Strengthening the EU capacity to respond to disasters: Identification of the gaps in the capacity of the Community Civil Protection Mechanism to provide assistance in major disasters and options to fill the gaps – *A scenario-based approach*

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Community Civil Protection cooperation

Community co-operation in the field of civil protection aims to better protect people, their environment, property and cultural heritage in the event of major natural or manmade disasters occurring both inside and outside the EU. It is a long tradition for EU Member States to express their solidarity with EU Member States and third countries affected by major disasters by providing civil protection assistance. However, the coordination of the assistance has only really started a decade ago, increasing over time the reliance on co-operation and the pooling of resources in order to be as effective as possible on the disaster site. The EU has developed and continuously reinforced the *Community Civil Protection Mechanism (the Mechanism)* which facilitates these cooperation efforts.

Aim of study – a scenario approach

This study focused on building scenarios for various types of disasters as a tool to explore potential gaps in current civil response capacities as part of the Commission's efforts to develop a knowledge base for improving the overall European civil protection capacity.[1] For each selected disaster type (storm, flood, earthquake, tsunami, oil spill, forest fire, and industrial accident) one scenario was located within the EU and for some types an additional scenario was located in a third country (Chapter 3).

Registered and reported resources at European level

For determining the potential gap of current response capacities versus needed response resources for the various types of disasters an inventory[2] for comparison is determined: the current civil response capacity in Europe (Chapter 4). The inventory focused primarily on the so-called civil protection modules[3]. Whilst civil protection modules will increasingly become the basis for significant European civil protection assistance operations launched through the Mechanism, their action will often be complemented by the provision of other in-kind assistance such as for example low capacity equipments (e.g. pumps) and relief items (e.g. tents, blankets).

In January 2009, the European civil protection rapid response capacity included a total of 86 modules[4]. In addition, the Mechanism's capacity includes 8 technical assistance support teams providing support functions, such as kitchen, IT, logistics, etc. At this point in time no forest fire fighting module using helicopters has been registered, nor do any emergency temporary shelter modules currently exist. By the end of 2010, when taking into account planned modules, the capacity will likely increase by about 40 to 44% of its current capacity, and it will likely be more balanced across all types of modules.

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[1] COM (2008) 130 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0130:FIN:EN:PDF

[2] This inventory is based on the consolidated outcomes of a questionnaire completed by the Participating States combined with latest European Commission information.

[3] Civil protection response modules are task / needs driven pre-defined arrangements of resources of the Participating States.

[4] Modules include high capacity pumping, water purification, various types of urban search and rescue, forest fire fighting planes, mobile medical posts and field hospitals, medical aerial evacuation capacity, and chemical, biological, radiological and nuclear (CBRN) sampling and detection equipment as well as search and rescue specialised for CBRN situations.

Furthermore, the MIC has trained over 600 experts, some of which can be rapidly deployed to the place of crisis to perform assessment and coordination tasks.

Identification of potential gaps in the overall EU civil protection response capacity

Chapter 5 then identifies the potential qualitative and quantitative gaps in the overall EU civil protection response capacity; synthesised in five categories: (a) gaps hindering the degree of availability of existing resources; (b) lack of sufficient quantities of major categories of resources; (c) lack of sufficient quantities of specific equipment or expertise; (d) lack of information on specific categories of equipment or expertise; and (e) limited preparedness of major categories of response resources.
Chapter 6 analyses identified policy options for addressing each gap category as regards their potential economic, environmental and social impacts, and likely level of effectiveness. Options are compared to the status quo – 'no action'- situation.

Policy options for addressing major gaps

Category (a) gaps are the lack of capacity to guarantee deployment because of soft factors and limited access to transport solutions and represent a major obstacle to deployment. Currently we cannot guarantee European solidarity for these resources. Similarly, some major categories of resources are limited in their existence (category (b) gaps), which limits the capacity of European solidarity to address potential needs in these fields. These major types of gaps thus require an in depth reform of the Mechanism to move to a situation where European solidarity is guaranteed. All assessed policy options for inducing such a reform would significantly improve the level of burden sharing and thus offer improved means of deploying nationally available resources for external assistance. The main differences between options are (1) whether the centre of gravity of decision-making resides more with the Community or with the Member States, and (2) the extent of sharing of cost-burden of solidarity between all Participating States.

The slightly less extensive gaps listed under gap category (c) 'lack of specific equipment and expertise' can be addressed via similar policy options and require the same type of Mechanism reform and movement towards greater solidarity and burden sharing.

Need for further research and analysis

All gaps identified under category (d) 'lack of information on specific categories of equipment or expertise' require further in-depth analysis, including inventories, before being able to develop meaningful policy options. Such exercise of further information gathering and analysis will likely improve preparedness and may reveal further gaps.

Need for strengthened preparedness activities

All gaps falling under category (e) 'limited preparedness of major categories of response resources', could be significantly reduced or eliminated via new and strengthened preparedness activities offered by the Mechanism to address the identified gaps.

Conclusions

The key conclusion (Chapter 7) of this study is that the Community Civil Protection Mechanism currently facilitates assistance without guaranteeing European assistance; but that several options exist that have the potential to reform the Mechanism into a tool that guarantees European assistance. The main condition of this system to function is the sharing between all Member States of the cost burden of European assistance, and various policies to improve the availability of equipment and expertise for rapid deployment. Finally, the assessment of options for addressing current insufficiencies in coastal oil spill clean up resources has signalled a clear niche where improvements on the European level and thus a new role for the Mechanism would make sense.

Summary

Community Civil Protection cooperation

Community co-operation in the field of civil protection aims to better protect people, their environment, property and cultural heritage in the event of major natural or manmade disasters occurring both inside and outside the EU.

It is a long term tradition for EU Member States to express their solidarity with EU Member States and third countries affected by major disasters by providing civil protection assistance. However, the coordination of the assistance provided by the Member States has only really started a decade ago. This coordination has increased the international role that the European Community is playing in the provision of civil protection assistance. The European response provided in many major disasters such as the 2004 South Asia tsunami, the 2005 US hurricanes, the 2007 Greek forest fires, the 2008 earthquake in China and floods in Romania, Moldova and Ukraine, and the most recent 2009 Italy earthquake, bear witness to this.

EU institutions and EU Member States have over time increased their reliance on co-operation for the provision of civil protection assistance in order to be as effective as possible on the site of a disaster. There is clear added-value in working together. Such co-operation allows for the pooling of resources, maximising the collective European effort on site.

The role of the Mechanism

Based on this realisation, the EU has developed and continuously reinforced the *Community Civil Protection Mechanism (the Mechanism)* which facilitates these cooperation efforts for responding to major disasters that overwhelm national response capacities in EU Participating States as well as third countries.

The main role of the Community Mechanism for Civil Protection is to facilitate co-operation in civil protection assistance interventions in the event of major emergencies which may require urgent response actions. This applies also to situations where there may be an imminent threat of such major emergencies. It is therefore a tool that enhances community co-operation in civil protection matter. The Mechanism was established by the Council Decision of 23 October 2001. A Recast of this Council Decision was adopted on 8 November 2007.

In accordance with the principle of subsidiarity, it can provide added-value to European civil protection assistance by making support available on request of the affected country. By pooling the civil protection capabilities of the Participating States, the Community Mechanism can ensure even better protection primarily of people, but also of the natural and cultural environment as well as property.

So as to enable and ensure an effective delivery of assistance, teams working in emergencies need to be mobilised rapidly and to be capable of working effectively in an international environment with teams of other countries, international organisations, and non-governmental organisations. Moreover their work needs to be well co-ordinated while requiring flexibility. In order to achieve this, the Mechanism has its own tools that help to ensure this.

How to improve the overall European disaster response capacity

In its Communication on reinforcing the Union's disaster response capacity[5], the Commission committed to launching a series of activities to develop the necessary knowledge base for policy debate and decisions regarding the improvement of the overall European civil protection capacity available for responding to major disasters occurring in the EU or hitting third countries.

Aim of this study - a scenario approach

In this context, the Directorate General for Environment of the European Commission has contracted this study.

This study focused on building scenarios for various types of disasters as a tool to explore potential gaps in current civil response capacities – both quantitative and qualitative gaps. Scenarios were developed for the following disaster types and locations. For each type of disaster one scenario was located within the EU and for some types an additional scenario was located in a third country:

- EU winter storm scenario and international windstorm scenario
- EU and international flood scenarios
- EU and international earthquake scenarios
- EU and international tsunami scenarios
- EU oil spill scenario
- EU forest fire scenario
- EU chemical accident scenario

These future disaster scenarios have been constructed based on existing information on past disasters, which provided insight in the likely risk of the various hazards and impacts and civil protection response needs of similar disasters in the past using regional averages for the disaster site. This required a review of available information on past disasters which is summarised in chapter 3.

For each scenario a basic scenario description table has been developed including the following contents: characterisation of the hypothetical scenario (description of the initial event, disaster site, immediate impacts); needed response resources (and how much of it can be addressed by the national response capacity versus how much requires external assistance).

The concept of using scenarios proved useful during the workshop gathering experts from the Member States held on December 4, 2008, not only for analysing the type of response

[5] COM (2008) 130 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0130:FIN:EN:PDF

needed for the various scenarios and defining the niche for the Mechanism, but also to identify the potential obstacles to the provision of needed assistance through the Mechanism. The workshop concluded that the scenario approach could be further explored in future exercises, for contingency planning and for operationalising the functioning of the Mechanism in a broader context in order to highlight the added value of the Mechanism.

Inventorying current disaster rapid response capacities

In order to carry out the next step of determining the potential gap of response capacities versus needed response resources for the various types of disasters an inventory for comparison is determined: the current civil response capacity in Europe (Chapter 4). This inventory is based on the consolidated outcomes of a questionnaire completed by the Participating States combined with latest European Commission information. The inventory is focused primarily on the so-called civil protection modules. Civil protection response modules are task and needs driven pre-defined arrangements of resources of the Participating States. Thirteen different modules for heavy type of response resources have already been defined in a technical framework under the Mechanism and they aim to enhance European preparedness and response efforts. The modules are being developed since end 2007 to become the major components of the EU's rapid response capacity for natural and man-made disasters. Significant efforts of the Commission and the Participating States aim at enhancing the capacity of the modules to intervene in an international environment as well as their interoperability.

Whilst civil protection modules will increasingly become the basis for significant European civil protection assistance operations launched through the Mechanism, their action will often be complemented by the provision of other in-kind assistance such as for example low capacity equipments (e.g. pumps) and relief items (e.g. tents, blankets).

In view of the above and taking into account the type of information available from the European Commission as well as the type of information revealed in quantitative terms by Participating States, response capacity for the purpose of this study focuses mainly on civil protection modules.

Registered and reported resources at European level

In January 2009, the European civil protection rapid response capacity included a total of 86 modules (of which 82 have been registered at the Mechanism). Modules include high capacity pumping, water purification, various types of urban search and rescue, forest fire fighting planes, mobile medical posts and field hospitals, medical aerial evacuation capacity, and chemical, biological, radiological and nuclear (CBRN) sampling and detection equipment as well as search and rescue specialised for CBRN situations. In addition to these technical modules, the Mechanism’s capacity includes 8 technical assistance support teams providing support functions, such as kitchen, shelter, IT, logistics, etc. (of which 7 have been registered). At this point in time no forest fire fighting module using helicopters (FFFH) has been registered, nor do any emergency temporary shelter (ETS) modules currently exist. In the near future, by the end of 2010, when taking into account planned modules, this capacity will likely increase by about 40 to 44% of its current capacity, and the capacities will likely also be more balanced across all types of modules, including the two modules that are currently not covered yet (FFFH and ETS).

Type of Module	Registered modules	Planned modules	When?	Total number of modules likely registered by the end of 2010
High capacity pumping module (HCP)	19	5	tbd	19 - 24
Water purification module (WP)	4	5	2 early 2009; others tbd	7 - 9
Medium urban search and rescue module (MUSAR)	20	3	2010	23
Heavy urban search and rescue module (HUSAR)	8	2	One in 2010; other tbd	9 - 10
Aerial forest fire fighting module using helicopters module (FFFH)	0	2	tbd	0 - 2
Aerial forest fire fighting module using airplanes module (FFFP)	3	1	1 early 2009; others tbd	3 - 4
Advanced medical post module (AMP)	11	3	3 early 2009	14
Advanced medical post with surgery module (AMPS)	2	5	3 early 2009; others tbd	5 - 7
Field hospital module (FHOS)	2	3	2009	5
Medical aerial evacuation of disaster victims module (MEVAC)	2	1	2009	3
Emergency temporary shelters module (ETS)	0	4	2009	4
Chemical, biological, radiological and nuclear detection and sampling (CBRN) module (CBRNDET)	11	5	4 early 2009; others tbd	15 - 16
Search and rescue in CBRN conditions module (CBRNUSAR)	4	2	1 early 2009; others tbd	5 - 6
Technical assistance support team (TAST)	8	2	2009	10
Total quantity of modules	**86**	**41**		112 - 125
Total quantity of modules + TAST	**94**	**43**		**122 - 134**

Furthermore, the MIC has trained over 600 experts, some of which can be rapidly deployed to the place of crisis to perform assessment and coordination tasks.

In addition to the registered modules, national capacities of Participating States also include other types of response resources currently not standardised into modules. For some of these a qualitative inventory of reported additional types of resources has been established; for others it is unknown if and what quantities exist on national levels and their degree of preparedness for being made available and intervening in international civil protection operations.

Identification of potential gaps in the overall EU civil protection response capacity

Chapter 5 identifies the potential qualitative and quantitative gaps in the overall EU civil protection response capacity. It builds on the information gathered through the questionnaires filled by the Participating States, interviews of experts and latest information available at the European Commission. Potential gaps were identified on a general level in the questionnaires and on a more disaster-specific level during the expert workshop and interviews. As a next step, findings were synthesised in five categories of potential Mechanism response capacity gaps:

(a) gaps hindering the degree of availability of existing resources;
(b) lack of sufficient quantities of major categories of resources;
(c) lack of sufficient quantities of specific equipment or expertise;
(d) lack of information on specific categories of equipment or expertise;
(e) limited preparedness of major categories of response resources.

The following table provides an overview of the specific gaps per gap category and presents potential generic policy options (labelled ii to vii in the table below) for filling the Mechanism response capacity gap. Policy options are compared to the status quo – the 'no action' situation (option i).

Category of Mechanism response capacity gap	Gap #	Mechanism response capacity gaps	Potential generic options for filling the Mechanism response capacity gap
(a) Gaps limiting the availability of existing resources	1	Funding to cover the transportation and deployment of response resources	The qualitative issues related to logistics and operational issues may have major impacts on the effectiveness of the EU response to requests for assistance. Policy options for addressing these issues include: (ii) strengthening co-financing options for covering transportation/deployment costs for provided assistance (the Commission would cover 100% of the cost of transporting/deploying the assistance provided by Participating States); (iii) empowering the Commission to mandate the dispatch of national resources, with financing by the Commission. This option mirrors the system applied in the regulation establishing the FRONTEX agency. However, given the wide range of possible civil protection interventions and diversity of type of resources, this option would rely on a well defined pool of civil protection modules that would be maintained on high alert; (iv) Agreements between the Commission and the Participating States that guarantee the availability of specified resources during specified periods - with or without financing by the Commission; (v) strengthening the current responsibilities of the Commission to further improve the assessment of needs and the coordination of assistance: the role of the MIC in on-site disaster response coordination should be reinforced. This should be supported by highly available experts that the Commission is able to mobilise at very short notice, on the model applied by the UN to UNDAC experts, which requires simplified mobilisation procedures and direct access
	2	Capacity to transport the response resources to the site	
	3	Lack of EU capability to mandate the dispatch of response resources	
	4	Lack of EU capability to mandate the dispatching of experts	
	5	Although improving, still limited MIC capability in the areas of: • Assessment; • On-site coordination, including regarding local distribution, local transport, local procurement • Support to deployment (e.g. information on health and safety aspects)	
	6	Limited availability of aerial fire fighting resources, both fixed and rotary wing aircraft, if the whole EU forest fire prone region faces conditions of severe forest fires risks.	

			for the Commission to the experts.
(b) Lack of major categories of resources	7	Lack of mobile units of medium capacity pumping equipment.	Policy options for addressing this type of gap include: (vi) increasing national capacities in combination with promoting registration of modules/resources under the Mechanism; (vii) developing EU level capacities based on contractual agreements (e.g. framework agreement in public tender) with a third party (private or public) including human resources and equipment defining also terms of rapid deployment and transport.
	8	Water purification equipment – especially when large quantities of large scale water purification and/or small-scale more mobile units for small, remote villages are required.	
	9	High capacity emergency temporary shelter.	
	10	Lack of field hospital modules – this includes a need for larger field hospitals.	
	11	Emergency evacuation capacity to expatriate EU citizens.	
	12	Limited quantities of registered AMP (Advanced Medical Posts) modules.	
	13	Limited quantities of aerial fire fighting resources, both fixed and rotary wing aircraft.	
(c) Lack of specific equipment or expertise	14	Limited existence of equipment suitable for sub-zero operations, such as winterised tents and medical facilities.	Policy options for addressing these gaps are the same as for the above category. However option (vii) is probably only relevant for developing the MIC's damage assessment/surveillance capability.
	15	Lack of sufficient capacity in treatment of burnt victims.	
	16	Mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, schools.	
	17	Damage assessment / surveillance equipment, incl. planes and/or satellites for deployment by the MIC	
	18	Limited existence of temporary waste discharge and storage facilities for oil spill response	
(d) Lack of information on specific categories of equipment or expertise	19	Stock piling of medicine, antidotes and antibiotics: The stock piling of the antidotes is necessary to treat the large number of casualties.	These gaps require an inventory. In case quantitative gaps are discovered appropriate option will need to be considered for filling the identified gaps.
	20	Portable dryers, floating pumps, electric submersible pumps, and water filters.	
	21	Purification tablets / their degree of availability.	
	22	Availability of specialist companies to repair underwater cables.	
	23	Body bags and cooling equipment to collect bodies quickly to limit the spread of diseases and to centralise them for body ID process.	
	24	Portable communications equipment.	
(e) Limited preparedness of major categories of response resources	25	Terrestrial fire fighting resources.	This requires the Commission to launch new preparedness activities to address the identified gaps. This may take the form of the creation of new categories of civil protection modules, specific courses/exercises, etc.
	26	SAR in flooding conditions and in mountainous areas	
	27	Scientific back office for ensuring adequate support of CBRN teams and modules on site.	
	28	Shoreline clean-up, including availability of equipment, protective gear for volunteers.	
	29	Post-disaster psychological support with appropriate language skills and cultural awareness for external assistance deployment.	

Chapter 6 then analyses the identified policy options in more detail for each gap category as regards their potential cost implications, environmental and social impacts, likely level of effectiveness in terms of reducing the gap and in terms of the social and political feasibility of the option.

Policy options for addressing major gaps
The detailed major gaps in terms of (a) 'gaps hindering the degree of availability of existing resources' and (b) 'lack of sufficient quantities of major categories of resources' as listed in the table above essentially boil down to the following issues:

1. Limited availability of resources (gaps 1 to 6), i.e. the lack of capacity to guarantee deployment because of soft factors and access to transport solutions is a major obstacle to deployment. Currently we cannot guarantee European solidarity for these resources.
2. Some major categories of resources are limited in their existence: (resources listed as gaps 7 to 13). This insufficient quantity of existing amounts of the respective resources limits the capacity of European solidarity to address the potential needs in these fields.

These major gaps require an in depth reform of the Mechanism to move to a situation where European solidarity is guaranteed. Some of the most feasible policy options for inducing such a reform and improving the availability of resources (addressing gaps listed under category (a)) have been assessed in this study:

- (ii) Strengthening co-financing options for covering transportation/deployment costs for provided assistance (the Commission would cover 100% of the cost of transportation/deploying the assistance provided by Participating States);
- (iii) Empowering Commission to mandate the deployment of registered national resources (Frontex model of mandatory solidarity), provided that resources would be financed by Commission; and
- (iv) Agreements between the Commission and the Participating States that guarantee the availability of specified resources during specified periods, provided resources would then be financed by the Commission.

All options would significantly improve the level of burden sharing and thus offer improved means of deploying nationally available resources for external assistance. While option (ii) is complementary, options (iii) and (iv) present possible alternatives for the reform path: the main difference between them is the centre of gravity of decision-making would reside more with the Community under option (iii) and more with the Member States under option (iv).

Similarly, to reform the Mechanism towards improved quantities of currently limited or missing resources (addressing gaps listed under category (b)), two policy options have been assessed during this study:

- (vi) Increase national capacities; in combination with promoting registration of modules/resources under the Mechanism; and
- (vii) Develop centralised EU level capacities based on contractual agreements incl. both human resources and equipment defining also terms of rapid deployment and transport.

For most of the gaps in this category, the easiest option is (vi) increasing national capacities in combination with promoting registration of modules/resources under the

Mechanism. However, for some of the specific gaps, such as gap 13 'limited quantities of aerial fire fighting resources, both fixed and rotary wing aircraft' option (vii) may be a more cost-effective solution than building up parallel national capacities. Again, the major difference between options lies in (1) the centre of gravity of the decision-making power, and (2) the extent of sharing of cost-burden of solidarity between all Participating States.

To address gap #5 (MIC's limited capability in the areas of rapid assessment and on-site coordination, and support to deployment, the application of policy option (v) 'strengthening the current responsibilities of the Commission to further improve the assessment of needs and the coordination of assistance' represents a potential additional Mechanism capability development in order to better address civil protection response needs in the future. By expanding the support role and activities the Mechanism can play during the deployment phase and strengthening the MIC's capacity to rapidly and more accurately assess the real response needs, European assistance should become more relevant in terms of the type of response resource and the quantities provided, etc. Combined with a reinforced role of the MIC in on-site disaster response coordination, these niches for policy improvements have the potential to lead to significant increases in Mechanism capacity and cost-effectiveness.

Policy options for addressing other (less extensive) gaps

The slightly less extensive gaps listed under gap category (c) 'lack of specific equipment and expertise' can be addressed via similar policy options and require the same type of Mechanism reform and movement towards greater solidarity and burden sharing.

For gap #15 (lack of capacity for the treatment of burnt victims) a variant of policy options was drawn up: 'no action' (i), 'increased national capacity with availability through the Mechanism' (vi), or 'revised AMP module to include several beds for the treatment of severe burn victims' (viii). Overall, implementing one of the two policy variants is likely to have positive outcomes as compared to the 'no action' scenario. However, further detailed research would have to be carried out to determine whether it is more effective and efficient to evacuate the burn victims and fly them to specialised hospitals around Europe, or whether it would be advantageous to revise the AMP, AMPS or FHOS modules to request these units to include specialised beds and treatment for severe burn victims. First input from previous experience and experts suggests that it is more effective to fly severe burn victims to specialised hospitals rather than sending expert doctors and facilities to the disaster site.

Need for further research and analysis

All gaps identified under category (d) 'lack of information on specific categories of equipment or expertise' require further in-depth analysis, including inventories, before being able to develop meaningful policy options. Such exercise of further information gathering and analysis will likely improve preparedness and may reveal further gaps.

Need for strengthened preparedness activities

All gaps falling under category (e) 'limited preparedness of major categories of response resources', could likely be significantly reduced or eliminated via new and strengthened preparedness activities offered by the Mechanism to address the identified gaps. This may take the form of creating new categories of civil protection modules, specific courses, etc.

Conclusions

Chapter 7 presents the main findings that can be drawn from this study and whenever possible identifies the areas in which clear added value and reduced cost of shared resources has been determined.

The key conclusion of this study is that the Mechanism currently facilitates assistance without guaranteeing European assistance; but that several options exist that have the potential to reform the Mechanism into a tool that guarantees European assistance across a wide variety of disaster response resources. As this conclusions chapter highlights, the main condition of this system to function is the sharing between all Member States of the cost burden of European assistance, as well as various policies to improve the availability of equipment and expertise for rapid deployment.

The assessment of options for addressing current insufficiencies in coastal oil spill clean up resources has signalled a clear niche where improvements on the European level (option ix) and thus a new role for the Mechanism would make sense. Careful analysis shows that a centrally coordinated, standardised system of modules for shoreline oil spill response can guarantee the appropriate equipment, sufficient waste disposal / separation containers, trained teams and proper safety measures which significantly reduce overall costs, increase clean-up efficiency and effectiveness and consequently reduce health impacts and negative environmental effects.

1 Introduction

Community co-operation in the field of civil protection aims to better protect people, their environment, property and cultural heritage in the event of major natural or manmade disasters occurring both inside and outside the EU.

The international role that European countries are playing in the provision of civil protection assistance is increasing one emergency after the other. Both past, but especially recent disasters such as the 2004 South Asia tsunami, the 2005 US hurricanes and the 2005 Pakistan earthquake, bear witness to this.

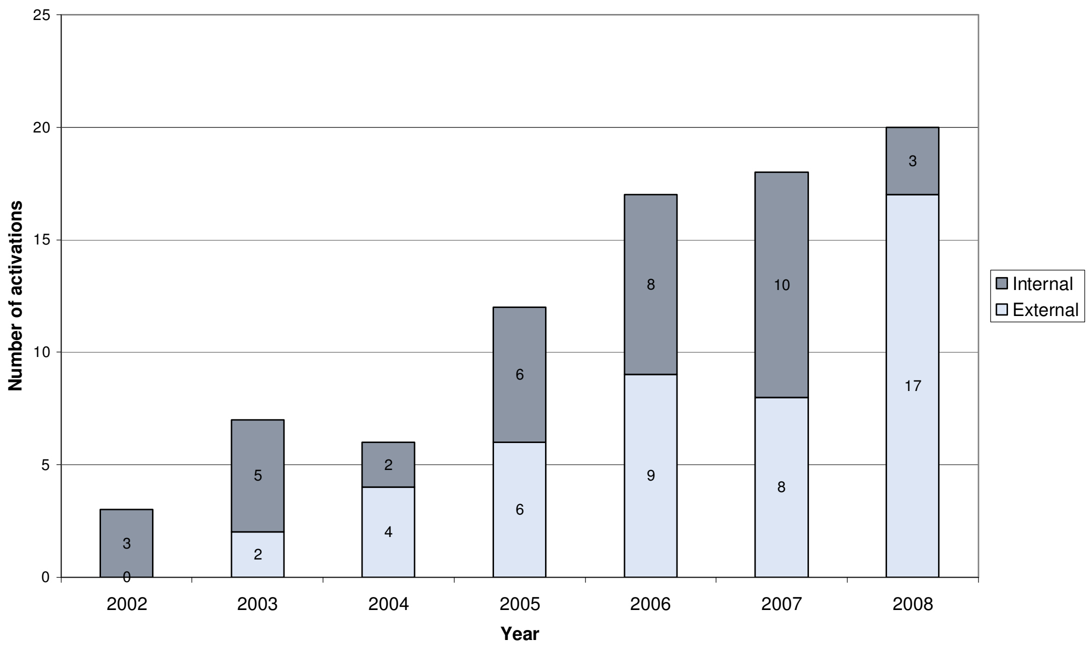
EU institutions and EU Member States have over time increased their reliance on co-operation for the provision of civil protection assistance in order to be as effective as possible on the site of a disaster. There is clear added-value in working together. Such co-operation allows for the pooling of resources, maximising the collective European effort on site.

Based on this realisation, the EU has developed a *Community Civil Protection Mechanism (the Mechanism)* which facilitates these cooperation efforts for responding to major disasters that overwhelm national response capacities in EU Participating States as well as third countries.

One of the primary objectives of the Mechanism is to contribute to the European preparedness for major disasters. Preparedness activities include training, real scale exercises, development of a network of contact points and IT tools, and the establishment of an operational crisis room. Additionally, the recent definition of a technical framework for civil protection modules aims to enhance European preparedness and response efforts.

After its establishment in 2001, the Mechanism was activated relatively few times the first three years of operation (3, 7 and 6 activations respectively). From 2005 (12 activations) onwards, however, the Mechanism booked a steady increase in the number of annual activations (Figure 1.1). From 2005 to 2007 roughly half of the activations were for events in the EU and half for disasters striking third countries. 2008 the Mechanism experienced a steep increase in the number of interventions for disasters occurring in third countries.

Figure 1.1 Mechanism activations inside EU and in Third Countries, 2002-2008



[Source: European Commission, DG Environment]

Recent experience in responding to major emergencies has highlighted several positive developments as well as important limitations currently hindering the success of interventions launched under the Mechanism.

Today, therefore, the question is arising whether or not further consolidation and strengthening of the Community Civil Protection Mechanism is needed in order to adequately prepare for and respond to major disasters in the future.

This effort, in turn, will require further insight on the type and likelihood of major disasters that could strike EU Participating States or third countries in the future. More information is also needed on the current national response resources as well as capacities required to respond to potential future disasters.

1.1 Purpose of the study

In its Communication on reinforcing the Union's disaster response capacity[6], the Commission committed to launching a series of activities to develop the necessary knowledge base for policy debate and decisions regarding the improvement of the overall European civil protection capacity available for responding to major disasters occurring in the EU or hitting third countries.

[6] COM (2008) 130 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0130:FIN:EN:PDF

On June 16, 2008 the Council of the European Union welcomed these activities and invited the Commission to fully involve the Participating States in this process.[7]

In this context, the Directorate General for Environment of the European Commission has contracted out a study that will:

1. Define a set of reference scenarios of potential disasters taking place in the EU or in third countries that would require the activation of the Community Civil Protection Mechanism;
2. Assess civil protection resources needed for a European response to the reference disasters;
3. Make an inventory of registered and reported resources using existing information, interviews and questionnaires, focussing on civil protection capacities;
4. Identify potential quantitative or qualitative gaps in the resources available versus the resources needed in the future.
5. Assess potential impacts of various policy options for addressing quantitative and qualitative gaps.

1.2 Definitions

1.2.1 Scope of the study

In this section we would like to reconfirm the proposed scope of the study. In terms of **geographic coverage**, this study will focus on the EU-27 countries as well as other Participating States of the Community's Civil Protection Mechanism, namely Iceland, Liechtenstein and Norway. Additionally, but to a lesser extent, this study will take into account disaster scenarios from major disaster-prone third countries or regions.

In terms of the disaster management cycle and the various activities promoted under the Mechanism, this study will mainly **focus on immediate response to disasters with a sudden onset** (i.e. this study does not include slow-onset disasters, such as drought or heat waves). Nevertheless, the study team will also consider how adequate preparedness and prevention influence the need for immediate response capacity. This analysis is done per disaster type in terms of discussing possible prevention options.

Linkages between disaster prevention, preparedness and response

Although this study focuses on the disaster response aspects of the disaster management cycle, linkages with other parts of the cycle are crucial and will be pointed out whenever deemed necessary. For all scenarios an appreciation of potential risk reduction via disaster prevention activities is discussed. Additionally, the disaster preparedness aspect

[7] Council Conclusions on Reinforcing the Union's Disaster Response Capacity – towards an integrated approach to managing disasters, paragraph 11: "WELCOMES the Commission's intention to develop a knowledge base comprising an overview of the competent structures, major disasters scenario staking into account prevention and preparedness measures, the resulting implications for resources, their availability, potential gaps in disaster response resources in the area of European civil protection taking into account lessons learnt, the links with the planned mapping of logistical capacity in the area of international humanitarian aid, and the impacts of options for filling any identified potential gaps, and INVITES the Commission fully to involve the Member States in this process.

plays an important role in potentially reducing the impacts and external response capacity needs for most scenarios. Local responders will generally be the first on the scene after the disaster, and their level of preparedness will be important in particular within the first 24 hours before any external assistance will be ready to be deployed. One of the primary goals of domestic preparedness capacities is therefore to increase the capacity of the local emergency response system.

1.2.2 Response capacity

In the context of this study, **response capacity** refers to resources existing at national level and deployable abroad to adequately respond to disasters. These resources include search and rescue equipment and personnel, medical assistance, fire fighting equipment and personnel, pollution control mechanisms, water pumping / purification material, sampling tools for identifying contamination, appropriate common emergency information system, etc. Thus, response capacity for the purpose of this study concerns only those national response resources that are available and readily deployable for disasters within Europe and / or in third countries.

Civil protection response modules are task and needs driven pre-defined arrangements of resources of the Participating States. The modules are being developed since end 2007 to become the major components of the EU's rapid response capacity for natural and man-made disasters. Significant efforts of the Commission and the Participating States aim at enhancing the capacity of the modules to intervene in an international environment as well as their interoperability.

Whilst civil protection modules will increasingly become the basis for significant European civil protection assistance operations launched through the Mechanism, their action will often be complemented by the provision of other in-kind assistance such as for example low capacity equipments (e.g. pumps) and relief items (e.g. tents, blankets).

In view of the above and taking into account the type of information available from the European Commission as well as the type of information revealed in quantitative terms by Participating States, response capacity for the purpose of this study focuses mainly on civil protection modules.

The European Commission and Participating States have worked closely together to develop the implementing rules for Civil Protection Modules. The implementing rules provide the technical framework for a total of 13 modules covering pumping and purification of water, aerial fire fighting (planes and helicopters), urban search and rescue (heavy and medium), medical assistance including medical evacuation (advanced medical posts, field hospital, aerial evacuation), emergency shelter, CBRN detection and sampling, and search and rescue in CBRN conditions. Tasks, capacities, main components and deployment times are defined and the provisions give more details about the notions of self-sufficiency and interoperability. The rules also provide for a Technical Assistance Support Team (TAST) that may support MIC assessment and/or coordination teams and may, under specified conditions, be incorporated in specific modules to fulfil support functions.

1.2.3 Costs of no action

'Costs of no action' refers to the decision NOT to strengthen current capacities of the Mechanism. Thus, the 'costs of no action' is the gap between the current capacities and the potentially required capacities in the future. This cost not only includes economic costs. It also includes social and environmental impacts that could occur due to inadequate response capacities. The 'cost of no action' option thus reflects a decision not to step-up cooperation toward building up a stronger European response mechanism.

The analysis of this option needs to also include any 'additional' costs incurred due to not having a harmonised EU response mechanism (i.e. non-efficient use of resources, lost opportunities, etc.). Here, it is crucial to determine what could be common EU equipment (e.g. planes to fight fires). Once such inventory has been established, it will be possible to determine the potential additional costs.

1.3 Outline of the report

This draft final report is organised as follows:

- Chapter 2 describes the various methodologies used;
- Chapter 3 focuses on the development of 11 future disaster scenarios providing background information for the disaster type and descriptions and analyses of the scenarios;
- Chapter 4 provides an inventory of currently registered and reported disaster response capacities in Europe;
- Chapter 5 analyses the potential gaps in response capacity by juxtaposing the current response capacities and the needed external response determined in the 11 scenarios;
- Chapter 6 includes an analysis of possible policy options for addressing various types of identified gaps; and
- Chapter 7 provides conclusions identifying potential response capacity niches for the Mechanism.

2 Methodology

This chapter includes a description of the various methodologies used to carry out this study.

2.1 Scenario approach

This study focused on building scenarios for various types of disasters as a tool to explore potential gaps in current civil response capacities – both quantitative and qualitative gaps. The usefulness of the scenario approach was confirmed during the expert workshop held on December 4, 2008. The workshop concluded on the usefulness of the scenario approach for investigating the questions posed by this study. Furthermore, participants concluded the added value of using scenarios for other purposes, including:

- Analysing the type of response needed for various scenarios and defining the niche for the Mechanism;
- Identifying potential obstacles to the provision of needed assistance through the Mechanism;
- Providing the basis for planning interventions of the Mechanism.

2.2 Scenario selection

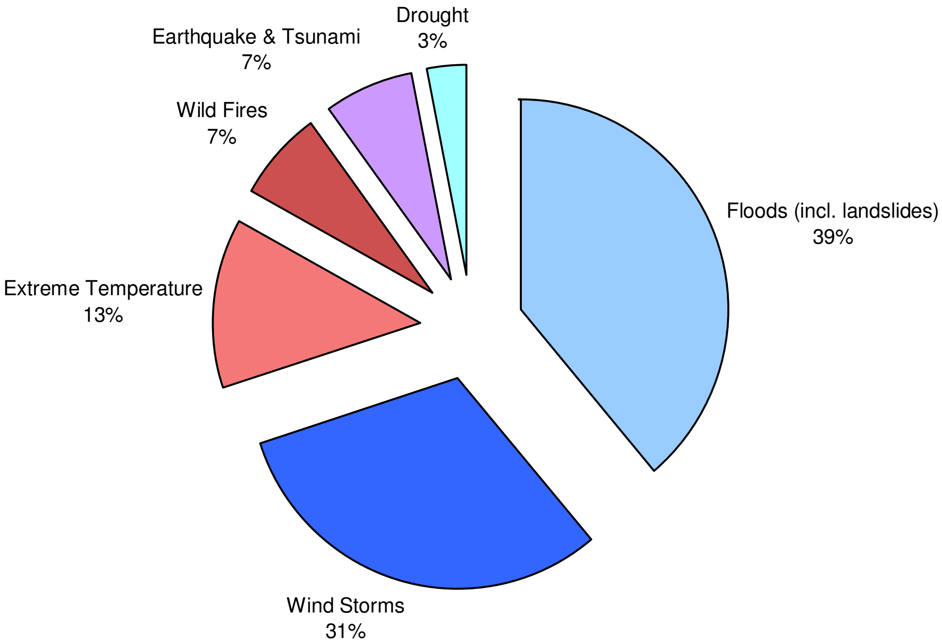
For the selection of the scenarios, a set of criteria was applied: they should cover various disaster types that are likely to strike EU Participating States in the future; they should cover various potential impact categories; and they should allow for an analysis of required response resources and capacities.

The scenarios were set up to be specific enough to be able to determine potential impacts and required response resources; yet they are not country-specific in order to focus solely on the required response needs and the national, regional and European response capacities. Nevertheless, the scenarios will define risks, cost figures, etc. as detailed as possible on an aggregated level.

Previous disaster occurrence by disaster type helped determine the selected reference scenarios (see Figure 2.1 and Figure 2.2). However, it should be highlighted here that the likelihood of future disaster types has also been accounted for. Finally, the focus on sudden onset disasters eliminated disasters, such as drought, heat waves and epidemics from the selection.

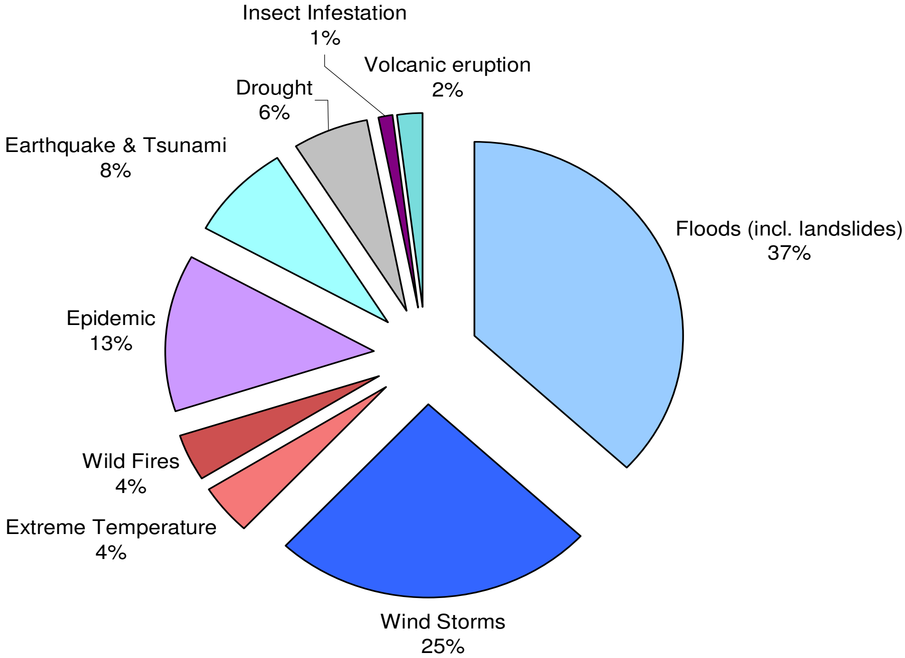
Additionally, there was also a concern to include disasters reflecting the geographical variety across Europe, but also to include disaster that are rarely to occur, but if they would occur would results in severe consequences, such as tsunami.

Figure 2.1 European disasters by type, 1989-2008



[Data source: CRED – UC Louvain, March 2009]
[Note: CRED-EMDAT data defines Europe as the EU-27 plus other countries on the European continent including Russia]

Figure 2.2 Worldwide distribution of disasters, 1989-2008



[Source: CRED – UC Louvain, 2009]

As a consequence the following types of disasters were selected:

- **Floods**, due to the fact that it is one of the most costly disasters, occurring on a regular basis and are likely to remain and even increase in frequency and severity due to climate change impact. Although there are many types of floods (e.g. coastal floods, flash floods, etc) river floods as was chosen for the specific scenario typically for Central Europe. The same is true for international floods.
- **Forest & wildfires**, is likewise a type of disaster that increasingly is causing considerable problems in Southern European counties on a frequent basis and of a severity where internal assistance has been required. Furthermore, the risks of forest fires are spreading to the north as the changing climate is causing dryer and hotter seasons. The high forest fire risk levels recorded in Germany during the spring of 2007 and the 2008 fires in Norway and Sweden were first signs of the increasing fire disaster risk across Europe.
- **Tsunami** was selected due to the both political and human impact the Indian Tsunami's have had. The likelihood of a Tsunami to strike in Europe, e.g. in the Mediterranean Sea is small, however should if happen, impact would be huge.
- **Industrial accident/**terrorist attacks are un-predictable and could in theory strike anytime and anywhere, hence the scenario is challenging.
- Northern Winter **Storms** and wind storms have been included as it is a frequent disaster causing large socioeconomic as well as environmental impact.
- **Oil spill**, likewise is a type of disaster occurring at a regular basis in European Seas with huge environmental consequences.

Other disasters which could have been interesting to include and should be considered for further investigation include: heat waves, coastal floods, nuclear accidents, etc.

2.3 Scenario development

The majority of the work for this study focussed on developing realistic potential future disaster scenarios for various types of disasters and sites. These scenarios have been developed in close cooperation with external experts (see section 2.4). Table 2.1 below provides an overview of the scenarios as well as the severity of the scenario and what the scenarios were expected to test.

Table 2.1 Overview of selected disaster scenarios in Europe and in Third Countries

#	Disaster Scenario - Subject	Specific characteristics/Comments
1	EU - Major Floods (including landslides)	Representing a worst case scenario
2	EU - Forest and wildfires	Representing a severe scenario affecting an entire region thus testing quantitative capacity of national fire-fighting resources
3	EU - Earthquake (seismic activity)	Representing a severe scenario
4	EU - Tsunami	Representing a severe scenario
5	EU - Industrial accident / terrorist attack	Representing a realistic scenario
6	EU – Northern winter storm	Representing a severe scenario
7	EU - Oil spill / marine pollution	Representing a severe scenario
8	INTL - Major Floods (including landslides)	Representing a realistic scenario
9	INTL - Wind Storms	Representing a severe to worst case scenario

#	Disaster Scenario - Subject	Specific characteristics/Comments
10	INTL - Earthquake (seismic activity)	Representing a severe but realistic scenario
11	INTL - Tsunami	Representing a worst case scenario which at the same time is realistic but only likely to occur on a very low frequency

These future disaster scenarios have been constructed based on existing information on the risk of the various hazards and impacts and civil response needs of similar disasters in the past using regional averages for the disaster site.

For each scenario a basic scenario description table has been developed including the following contents:

- Characterisation of the hypothetical scenario
  - Description of the initial event (place, time, intensity / size)
  - Disaster site (key geographic areas affected)
  - What are the direct and indirect impacts? (human toll, damage to infrastructure, ecological effects, immediate secondary impacts, overall economic impacts)

- Expected / required response resources
  - How much of the impact can be absorbed / addressed by the national response capacity?
  - What extent of the impacts cannot be addressed by national response resources and therefore requires external assistance and what type of external assistance is needed?

2.4 Expert consultation

The input of experts was an important component of this study in order to validate the scenario work as well as to collect information on perceived gaps between currently existing response resources and typical needs for external assistance. Two means of expert consultation were utilised: a questionnaire sent to all Participating States of the Mechanism and an expert workshop with representatives from Participating States, operational disaster response experts and representatives from the MIC and the civil protection unit of DG Environment.

Furthermore, the scenarios themselves were submitted to experts within the Participating States for written comments prior to the workshop. The scenarios were then discussed at the workshop on December 4th, 2008 followed by yet another round of written comments accompanied by bilateral interactions with experts for certain scenarios.

2.4.1 Questionnaire

One important method to gain the input of Participating States for information on national response capacities was a questionnaire. This written questionnaire aimed to solicit information on national capacities in order to gain a better overview of what currently exists on national levels that could potentially be available for external assistance deployment. 24 Participating States responded to the questionnaire (n=30).

Table 2.2 Overview of questionnaire respondents

Questionnaire Respondents (in alphabetical order)		
Austria	Greece	Norway
Bulgaria	Hungary	Poland
Czech Republic	Iceland	Portugal
Denmark	Italy	Romania
Estonia	Latvia	Slovakia
Finland	Liechtenstein	Slovenia
France	Lithuania	Sweden
Germany	Netherlands	UK

During our analysis, responses to this questionnaire were also compared to the latest update of the list of registered civil protection modules and TAST (DG ENV version as of 20 January, 2009).

The template for the questionnaire can be found in Annex A: Template of Questionnaire.

2.4.2 Expert Workshop

The workshop gathered experts from the Participating States to discuss in detail the specific future disaster scenarios and the potential future level of needs and capacities as well as critical gaps in the current system. The two main workshop goals were to:

(a) Refine and validate the scenarios;
(b) Gain more in-depth information on existing response capacity resources, as well as expected needs for external assistance, with a particular focus also on qualitative gaps.

The workshop agenda can be found in Annex B: Experts' Workshop .

Outcomes of the workshop were incorporated into findings throughout this report. Some general conclusions of the workshop included the following:

- Usefulness of scenario approach was confirmed.
- Multiple uses of scenarios (beyond this project) were identified, such as using similar scenarios for civil protection response exercises, for contingency planning, as well as for testing the operational performance of the MIC.
- Suggestion was made to also look at other types of disasters (e.g. nuclear accident, disease outbreak, etc.) or intensity levels of the existing disasters.
- Throughout the workshop the difficulty of striking a balance between how generic versus how specific a scenario should be was raised several times.
- Scenarios were built at an appropriate scale (i.e. one that overwhelms planned for national response resources).

- Scenarios should be strengthened in their linkage to prevention and risk assessment and better incorporate these aspects when estimating impacts and required response resources. In response each scenario now describes appropriate prevention measures to be considered or already in the process of being implemented (e.g. as for the case of the Flooding Directive).
- The external dimension (third country scenarios) needs a slightly different approach when estimating the required response needs and assistance compared to disasters occurring in Europe. The revised analysis approach for the assessment of response needs and assistance for the international scenarios now includes the following steps:
  a) Identify overall needs based on impacts;
  b) Develop planning assumptions (i.e. what the country can cover on its own);
  c) Assess planning assumptions on what could be requested in terms of external assistance;
  d) Evaluate what could possibly be channelled through the MIC given what is available locally, what others (including NGOs) are likely to contribute, and if additional measures are required to ensure that all disasters receive equal attention despite lack of media attention.

2.5 Creating an up-to-date inventory of current disaster response capacity

In order to determine whether there is a gap between the needed assistance described in the various future disaster scenarios and the current European disaster response capacity, the study had to first determine the current response capacity among Participating States. This inventory of the current capacity was then used as a basic starting point for the gap identification.

Determining the current response capacity among Participating States
In order to determine the current disaster response capacity in Europe, the study combined the latest available European Commission information (latest lists of registered modules) and the results from the above mentioned questionnaire among Participating States. Since both the quantitative responses to the questionnaire as well as European Commission information focus on civil protection response modules, the analysis of current disaster response capacity also centres on modules. Modules correspond to the heavy type of response resources inventoried based on the EU's module definitions. The advantage of focussing on an inventory of module capacities across Europe is the relatively easy comparison and description of the various capacities.

In addition, it should be mentioned, however, that Participating States do have additional response resources not grouped as modules; some of these have been reported to the MIC as additional response resources, others may exist on national levels but quantities are unknown (largely due to national security reasons). Furthermore, military resources can be requested for some response resources if a disaster is critically overwhelming non-military response capacities. These types of other national response resources have been taken into account on an ad hoc and more qualitative basis whenever possible.

Additionally, whenever available, extra information on more disaster-specific response tools, such as oil spill response tools, was also included in the inventory.

Current response capacity as approximation for scenarios
The current European resource level was then used as a rough approximation and starting point for determining the amount of possible assistance provided through the Mechanism.

For the individual disaster scenarios within Europe, the inventory has also been used to determine what amount of needed assistance can be handled by national resources. In order to not base the scenario in a specific country, however, the national level response resource estimations have been based on regional averages (to best available knowledge).

While this inventory is not exhaustive, it represents the best possible overview of capacities across Europe at the moment.

2.6 Gap identification and analysis

Once the inventory of current response resources among Participating States has been developed, a gap identification comparing these current inventoried resources to the needed assistance per scenario is carried out to determine gaps on a per scenario basis. This gap identification first looks at the European disaster scenarios and then lists – whenever relevant - any additional needs for disaster sites in third countries. Gaps are grouped into four types: (A) lack of sufficient number of registered modules; (B) limited number of reported other major types of response resources; (C) limited number of other specialised types of response resources (e.g. for oil spill response); and (D) more qualitative gaps hindering the degree of availability of existing resources, such as transportation issues or costs involved in operating the equipment.

As a next step the identified gaps are then analysed per gap type and a first set of recommendations on how to address them (next steps, possible policy options, etc.) is developed. For some of the gaps a more in-depth analysis of potential impacts of these policy options is then carried out in Chapter 6.

2.7 Analysis of policy options

Due to the lack of quantified data of potential impacts, the assessment of policy options and their potential impacts focuses mainly on a qualitative assessment of the costs and benefits. The European Commission's Impact Assessment Guidelines 2009 have been used as a general methodological guideline.

As a first step, a matrix with alternative policy options and assessment criteria was developed. Criteria focus on economic and environmental impacts, while taking into account some employment and health effects; criteria were quantified whenever possible.

Table 2.3 Overview of potential impact variables and associated cost indicators

Key Impact Categories and Variables	Indicator for Cost Analysis
Economic Costs	
Macroeconomic effects	GDP growth; loss of value added over given period
Sectoral impacts	GDP growth in specific sector (e.g. agriculture)
Emergency Services Costs	Necessary provision of equipment and people Incident specific costs (staffing, fuels, materials)
Cost of Clean-up	Estimated cost of labour and material for clean-up
Damage to Property and Infrastructure	Value of damaged private property / infrastructure Value of damaged public property / infrastructure Replacement costs Value of time spent for reconstruction
Reduction in economic activity	Estimated loss in earnings by comparison of forecast economic activity (without disaster), and actual economic activity in the event of the disaster
Loss of Life	Value of a Statistical Life (VOSL)
Ecological Effects / Impact on Natural Capital	
Damage to the environment (natural sites affected by the disaster)	Contingent Valuation Method, e.g. to estimate the recreational value of a coastal area
Social Consequences	
Injury and Illness	Medical expenses Loss in wages through time spent away from work
Displacement	Cost of lost income Medical costs for psychological damage Costs of emergency shelter Costs of returning people to their location
Loss of Household Possessions	Value of lost goods
Losses in Livelihood, for income and subsistence	Estimate losses in income by comparison with baseline data
[Based on DFID (2005) "Natural Disaster and Disaster Risk Reduction Measures: A Desk Review of Costs and Benefits"]	

Next, the policy alternatives were rated based on the assessment criteria with the following ranking scale: ++ = strong positive; + = positive; o = neutral; - = negative; -- = strong negative.

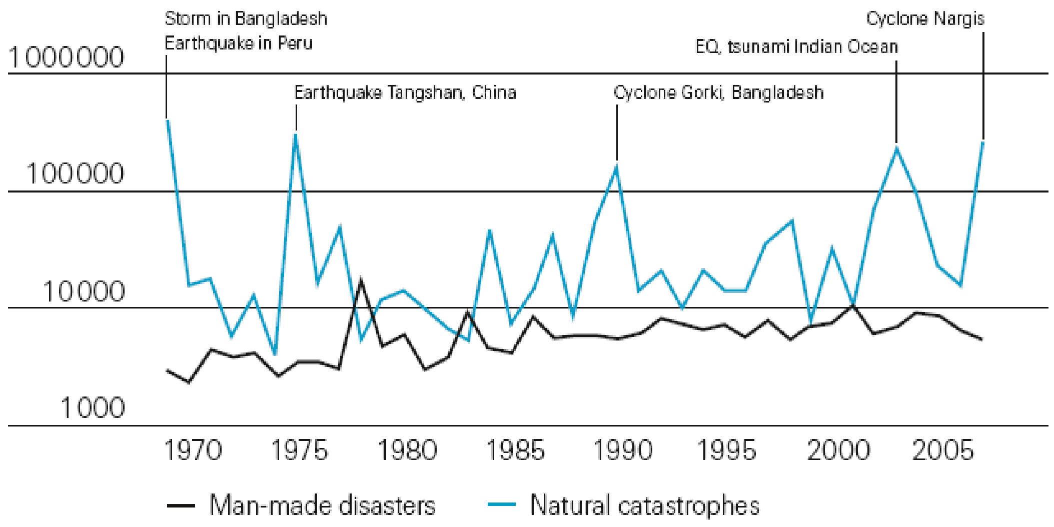
Finally, findings were synthesised to determine the most cost-effective and environmentally responsible policy options for tackling the gaps.

Cost indications

As an indication for the costs of disasters and the current trend, the following assessment provided by the insurance industry gives at least indication of the order of magnitude.

Natural catastrophes claimed 240.500 lives in 2008, in terms of victims the year 2008 was one of the worst since 1970 (see Figure 2.3).

Figure 2.3 Number of disaster victims, 1970-2008

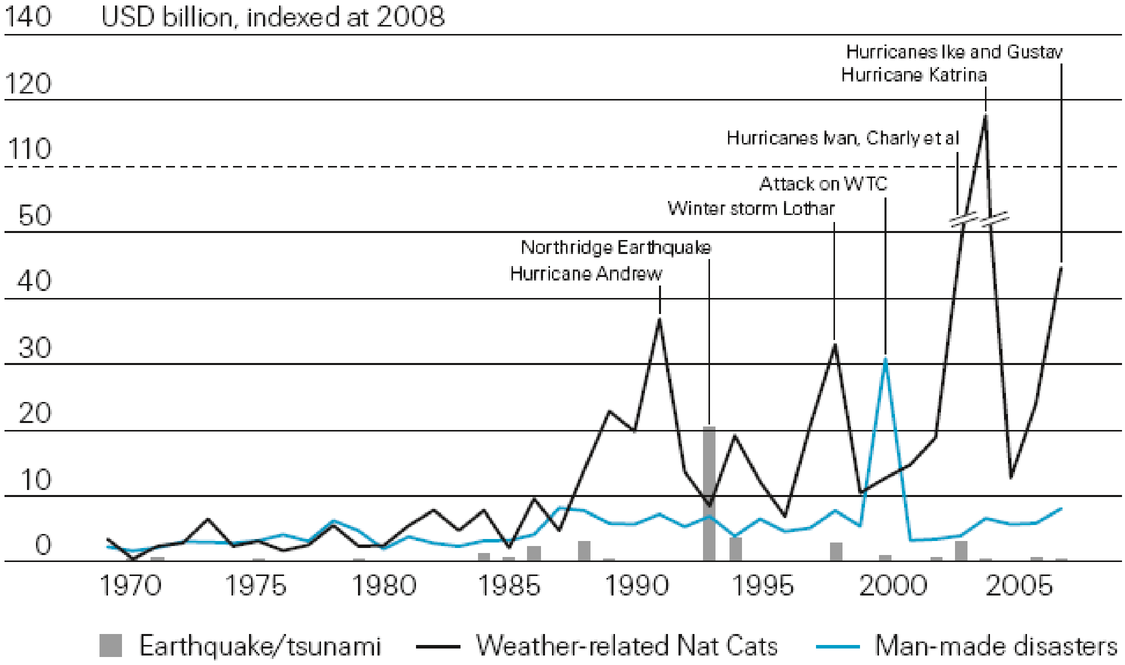


The scale is logarithmic – the number of victims increases tenfold per band.

[Source: Sigma2009 Swiss Re]

In terms of insured losses, Figure 2.4 below provides an overview of insured losses in the same period. The trend for costs of weather related disasters is clear: it has increased dramatically by a factor 10 since 1970.

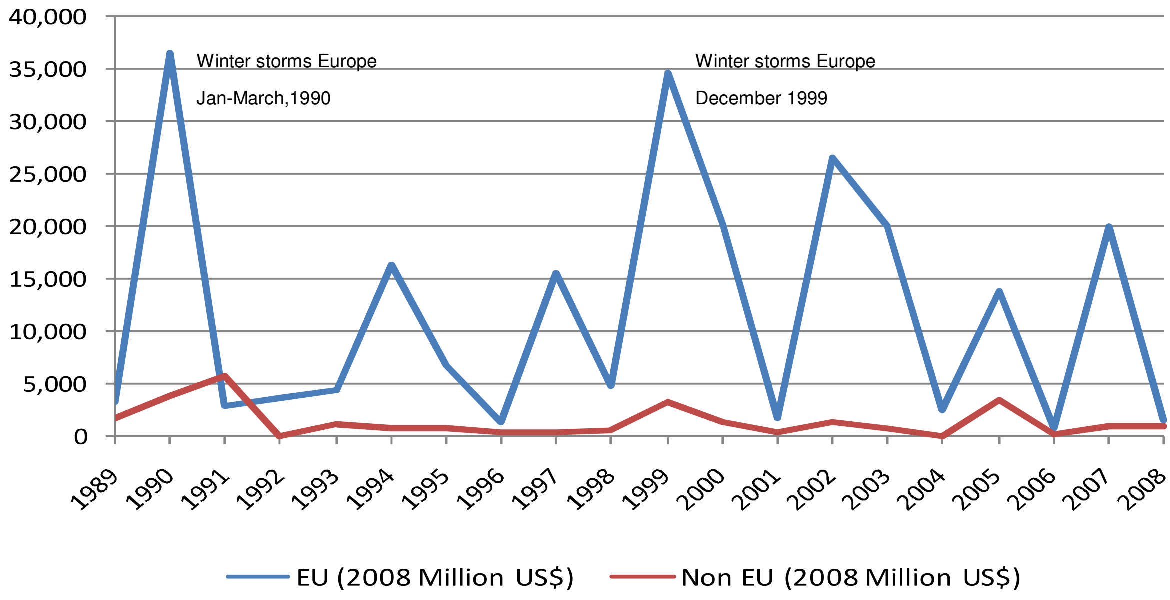
Figure 2.4 Insured losses due to disasters, 1970 – 2008



[Source: Sigma2009 Swiss Re]

Similar to these global insurance cost figures, a recent assessment by CRED EM-DAT compares economic costs incurred from disasters in Europe for EU-27 versus non-EU countries. In this analysis, EU-27 Member States account for the majority of reported damages. Further, a difference in vulnerability patterns can be determined: while the EU-27 is particularly vulnerable in terms of economic damages, the other European countries are more vulnerable in terms of human impacts. Total disaster-related costs between 1989 and 2008 amount to US$ 269,967 million Europe-wide, out of which US$ 240,386 were incurred within the EU-27 Member States.[8]

Figure 2.5 Economic costs from disasters in Europe: comparing EU-27 vs non EU



[Source: CRED-EMDAT, 2009]

[8] CRED EM-DAT, 2009.

3 Scenario Development

This chapter provides general background information per disaster type that was used for building the 11 future scenarios. Furthermore, all 11 scenario tables are provided, followed by a brief analysis on scenario choice, limitations and a sensitivity analysis regarding prevention and preparedness considerations.

This chapter is organised **per disaster type**.

3.1 General disaster trends

Prior to delving into the specific disaster types, a brief general overview of disaster trends worldwide and in Europe is provided.

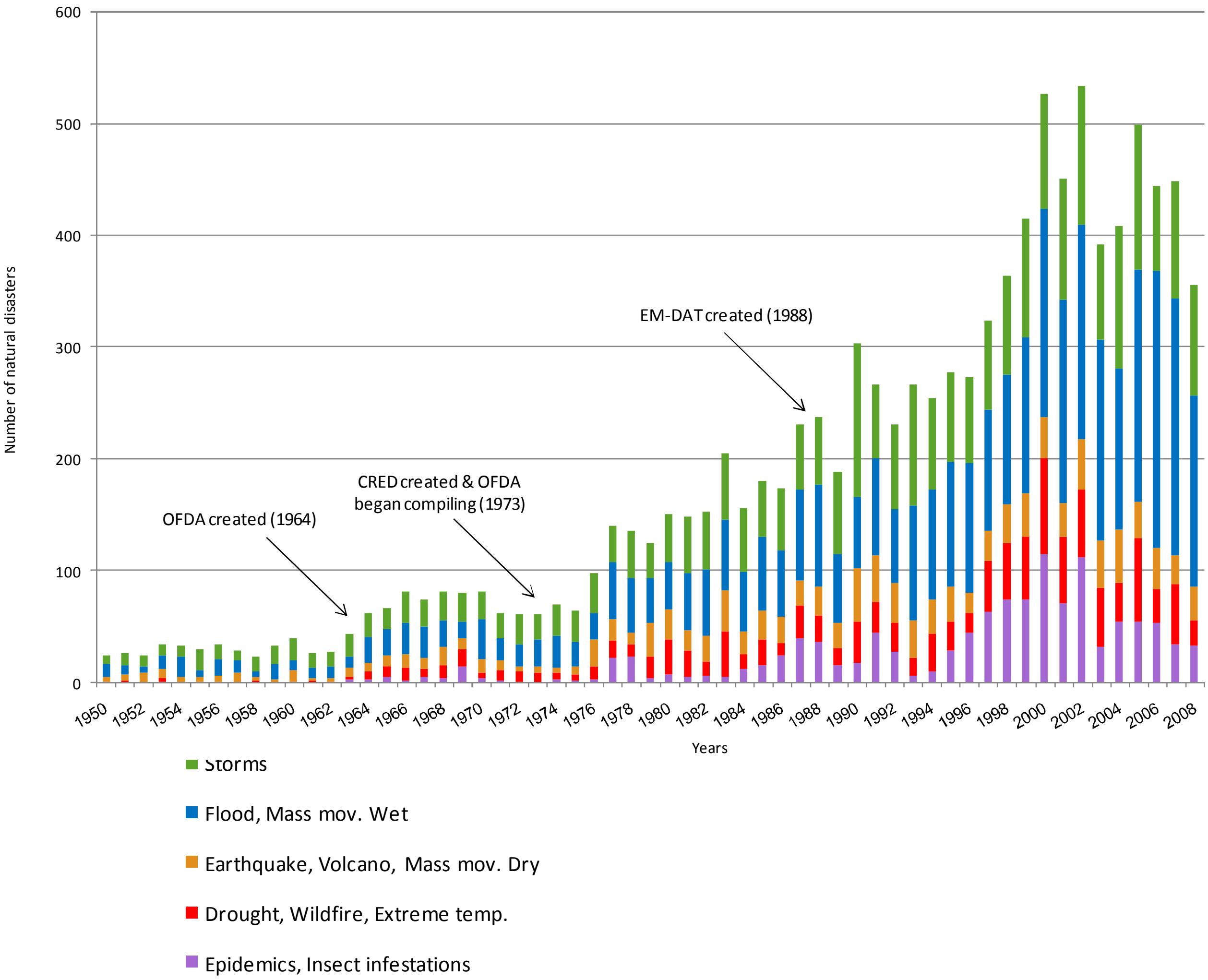
3.1.1 Global trends

In recent years, the importance of disaster management –risk reduction, prevention, preparedness and response - has increased immensely on the international agenda. The frequency and intensity of natural and man-made disasters, including floods, drought, storms, volcanic eruptions, cyclones, landslides, locust and grasshopper infestations, earthquakes and tsunamis have increased considerably over the past decade (Figure 3.1).

Over the past 20 years (1989-2008) 6248 disaster events have been registered worldwide, out of which 658 occurred in EU Member States.[9]

[9] CRED, "Are climate related disasters on the rise in Europe?", 2009.

Figure 3.1 Number of natural disasters, 1950-2008



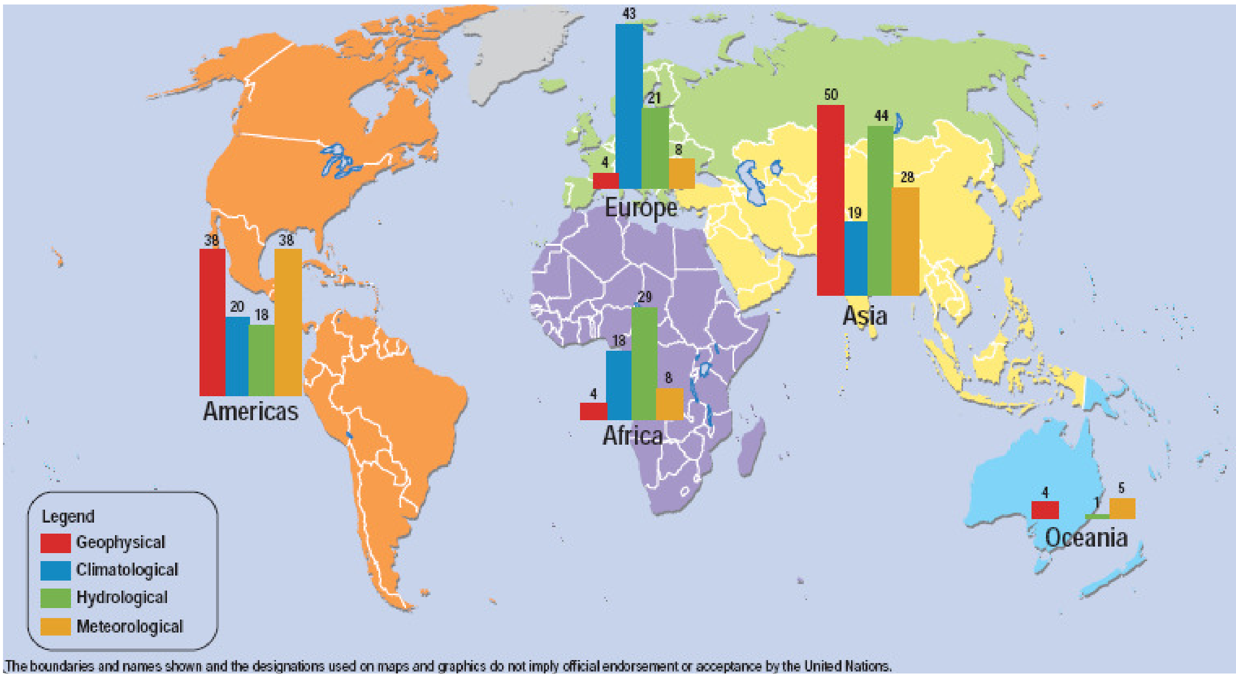
[Source: CRED EM-DAT, 2009]

Climate change is expected to further increase frequency and intensity of weather events in the future. These hazards are having an increasing impact on humans. The international community's and national governments' approach can no longer be business as usual.

The Indian Ocean tsunami in 2004 and Hurricane Katrina in the Gulf of Mexico in 2005 are but the latest mega-disasters involving massive destruction and loss of life. These extreme cases represent only the tip of the iceberg in an increasing accumulation of loss resulting from large, medium and small-scale events worldwide. Recent disasters including the earthquake in China, the Myanmar cyclone and the European winter storm Klaus in 2008 and floods in South and Central America as well as the Italian earthquake in 2009 demonstrate the continuing trend of intensifying natural disasters. Each disaster reminds not only the victims but also the international community of the desirability of taking action to reduce risks before disasters happen as well as to improve response capacities. All too often it is only after the fact that the required will and resources are mobilised.

This review of the latest disasters shows that all regions are affected by disasters. Risk levels for various disaster types (climatological[10], hydrological[11], meteorological[12] and geophysical[13] disasters) differ between regions. In 2007, for example, Europe experienced the highest share of climatological disasters, while both Asia and the Americas were faced with a high proportion of geophysical and meteorological types of disasters. Both the Asia and Africa experienced a high share of hydrological types of disasters in 2007.

Figure 3.2 2007 natural disasters: global proportion of occurrence by major disaster groups by region (in %)



[Source: CRED EM-DAT (2008), "Annual Disaster Statistical Review: The Numbers and Trends 2007"]

The following table (Table 3.1) provides an indication of the differences in vulnerability across regions. Human impact is essentially concentrated in Asia with 83% of the total amount of people killed and 91% of the people affected by disasters over the past 20 years.

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[10] Climatological disasters = events caused by longlived/ meso to macroscale processes (in the spectrum of intraseasonal to multidecadal climate variability) (CRED-EMDAT glossary).

[11] Hydrological disasters = events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up (CRED-EMDAT glossary).

[12] Meteorological disasters = events caused by shortlived/ small to mesoscale atmospheric processes (in the spectrum from minutes to days) (CRED-EMDAT glossary).

[13] Geophysical disasters= events originating from solid earth (CRED-EMDAT glossary).

Table 3.1 Disaster occurrence and impacts by region, 1989-2008 (in totals and in %)

	Occurrence	Killed	Affected (million)	Econ damage (US$ billion)
Africa	874	23,735	233	18
Americas	1,628	87,145	108	727
Asia	2,521	1,011,721	3,858	907
Europe	953	88,671	29	270
Oceania	272	3,560	18	23
Total	**6,248**	**1,214,832**	**4,247**	**1,946**
	Occurrence	**Killed**	**Affected (million)**	**Econ damage (US$ billion)**
Africa	14.0%	2.0%	5.5%	0.9%
Americas	26.1%	7.2%	2.5%	37.4%
Asia	40.3%	83.3%	90.9%	46.6%
Europe	15.3%	7.3%	0.7%	13.9%
Oceania	4.4%	0.3%	0.4%	1.2%
Total	**100%**	**100%**	**100%**	**100%**

[Source: CRED EM-DAT, 2009]

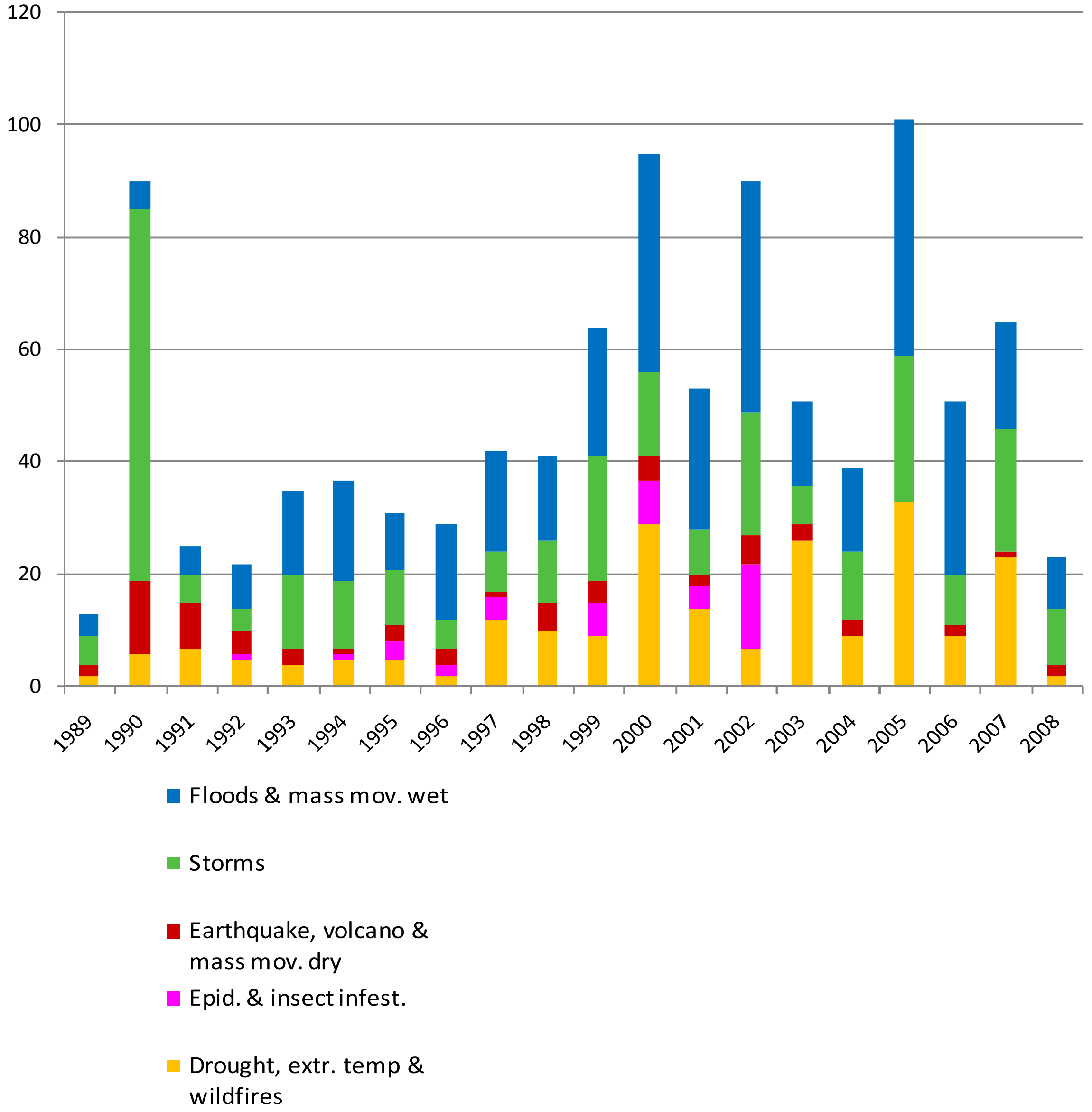
Annual economic loss associated with disasters is on the rise: US$ 75.5 billion in the 1960s, US$ 138.4 billion in the 1970s, US$ 213.9 billion in the 1980s and US$ 659.9 billion in the 1990s. In 2004 alone losses were estimated at US $103 billion, and these figures do not include small and medium scale disasters.[14] When comparing regions in terms of incurred economic damages over the past 20 years, Asia has estimated annual damage costs of US$ 225 per capita, whereas Europe has US$ 325.[15] Compared to the rest of the world, economic loss per capita is high in Europe partly because it is very densely populated.

3.1.2 Disasters in Europe

In the past 20 years, 953 disasters killed nearly 88,671 people in Europe (EU-27 plus neighbouring countries including the Russian Federation), affected more than 29 million others and caused a total of 269 US$ billion economic losses.

[14] Hermann, T.M., E. Ronneberg et al. (2004). Social and Economic Aspects of Disaster Reduction, Vulnerability and Risk Management in Small Island Developing States. Small Island Habitats: 231-233.
[15] CRED EM-DAT, 2009.

Figure 3.3 Disaster occurrence in Europe, 1989-2008



[Source: CRED EM-DAT, 2009]

Floods, droughts and storms are among the most frequent disasters in Europe and constitute major sources of economic damage. The following table provides a general overview of disaster types and where they most frequently occur within the EU-27.

Table 3.2 High risk regions by disaster type in the EU-27

Disaster Type	Most Frequently Affected Area
Floods	Eastern, and Northern Europe
Storms	Western, northern and central Europe and Baltic countries
Fires	Mediterranean countries
Droughts	Iberian peninsula and South Eastern Europe
Landslides	South and Eastern Europe
Avalanches	Alps region
Earthquakes	Italy and countries of the Aegean region

Disaster Type	Most Frequently Affected Area
Oil spills	Coastal areas, mainly Atlantic and Baltic coasts
Industrial accidents	Random / no clear tendency
Toxic spills from mining activities	Random / no clear tendency
Terrorist attacks	Random / no clear tendency

[Source: EEA, (2003). Mapping the impacts of recent natural disasters and technological accidents in Europe]

Over the last two decades, France experienced the highest number of disaster incidence, followed by Romania, Italy, the United Kingdom and Germany (Table 3.3). Spain, however, had the highest number of victims among all European countries. Italy and Germany have recorded major economic damages mainly due to floods and storms. [16]

Table 3.3 Ranking the EU-27 for disaster occurrence and impacts, 1989-2008

TOP 5 Countries 1989-2008		
Incidence	**Victims**	**Economic damage**
France	Spain	Italy
Romania	France	Germany
Italy	United Kingdom	United Kingdom
United Kingdom	Lithuania	France
Germany	Germany	Spain

[Source: CRED EM-DAT, 2009]

In line with global trends, Europe is also experiencing an increased frequency and magnitude of extreme weather events. In particular the influence of global climate change on the occurrence and intensity of these hazards will likely increase human vulnerability to disasters in Europe. The numbers of floods, storms, droughts and related disasters experienced in the new millennium already far exceed the averages of the 1980s and 1990s (Figure 3.3).[17] Thus, there is a clear need for improved measures of prevention, preparedness and response in all countries.

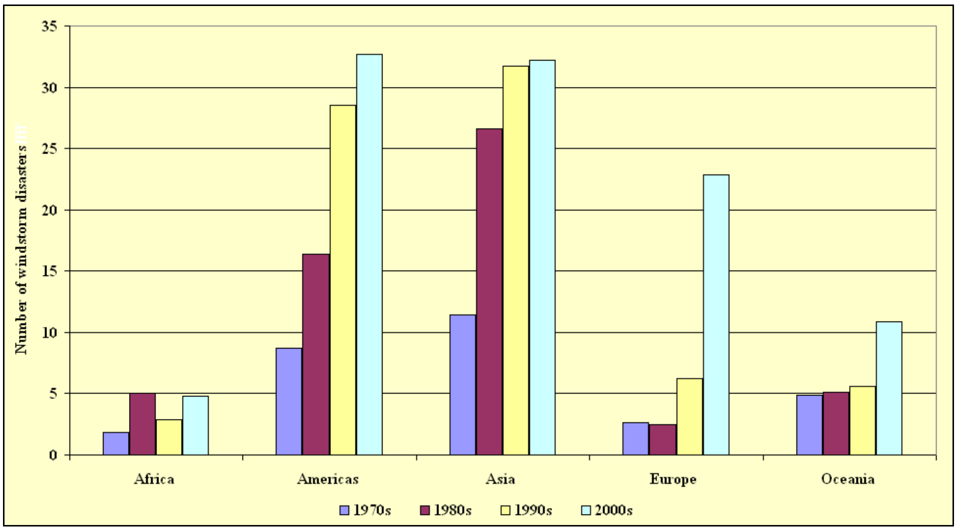
3.2 Storms

Storms accounted for 25% of all disasters worldwide in the period of 1999 to 2005 (UNEP/DEWA/GRID-Europe). Storms can be further broken down into hurricanes (14%), typhoons (20%), cyclones (16%), tropical storms (4%), winter storms (7%), tornadoes (7%) and storms (32%). In 2005 storms occurred in record levels: in the Atlantic basin alone, an unprecedented 26 tropical storms formed, 13 of which were of hurricane strength. Of these, seven became major hurricanes (category 3 or above) with 3 of these reaching category 5 intensities (Katrina, Rita and Wilma). Based on the records of the last 40 years, an average season would have seen 11 named storms, 6 hurricanes and 2 major hurricanes (CRED, EM-DAT).

[16] CRED, "Are climate related disasters on the rise in Europe?", 2009.
[17] CRED Annual Disaster Statistical Review: Numbers and Trends 2006.

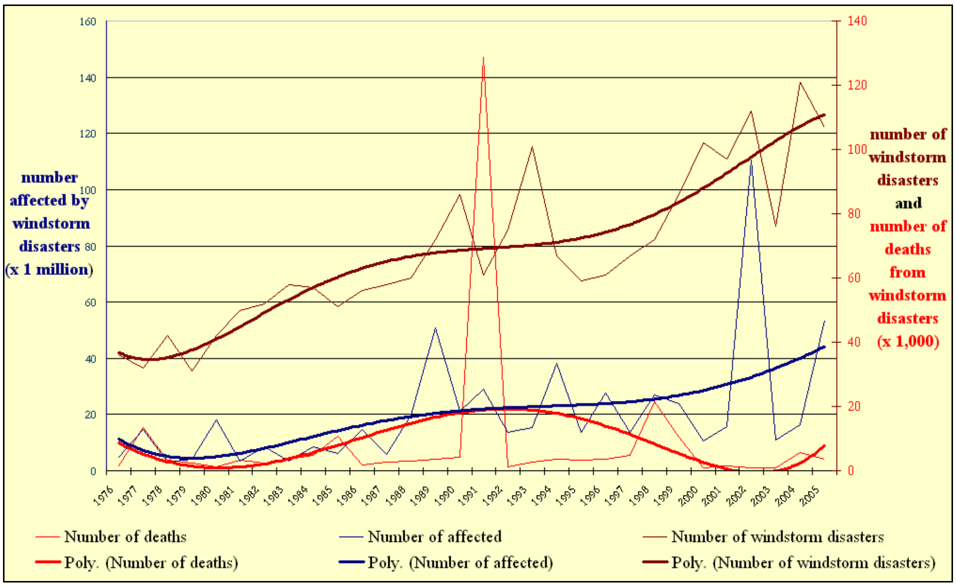
As can be seen from the figure below, the Americas and Asia have experienced many more storm events over the past 30 years than Africa, Europe and Oceania; although the stark increase in storm occurrence in Europe during the 21st century should be noted.

Figure 3.4 Trends in storm disaster occurrence by continent, 1970-2005



[Source: CRED, EM-DAT (2005)]

Figure 3.5 Polynomial trends in numbers of storm disasters, persons killed and persons affected, 1976-2005



[Source: CRED, EM-DAT (2005)]

In addition to the clear regional tendency of storm occurrence, the graph also highlights a clear increasing frequency of storm occurrence across all regions. As the next graph shows, this increased frequency of storm events in combination with exogenous developments, such as population growth, renders an ever increasing number of people vulnerable to storm events.

Though the majority (53%) of worldwide economic damages from storm disasters is due to hurricanes, the bulk of the global storm disaster mortality is due to cyclones (66%) and typhoons (25%). These typically occur in poor countries with fragile infrastructure and large populations exposed to the hazards. However, Hurricane Katrina (USA) is but one of the recent examples reminding us that countries may differ in their impact profiles – but vulnerabilities cut across both richer and poorer regions of the world.

The main factors leading to death due to storms are poor building quality, inadequate land-use patterns, non use of shelters, insufficient lead times for warning and evacuation, non-compliance with timely evacuation or inadequate evacuation, in particular for residents of hospitals and nursing homes. Although these factors have long been noted by disasters epidemiologists, Hurricane Katrina underlined the wide gap between knowledge and practice.

The direct losses experienced from storms are only one part of the total impact of storms in the world. Many storms are not in themselves major disasters but cause secondary catastrophes such as landslides, storm surges or severe flooding. Hurricane Stan (Mexico, El Salvador) in 2005 is a case in hand. Although a category 1 hurricane, it brought with it torrential rains, flash floods and mudslides, resulting in the highest storm-related mortality for the year (1,607 deaths). Similarly, 1998 Hurricane Mitch (Honduras) left a lasting impression in the global mind for Central America, one of the regions most significantly affected by secondary disasters associated with storms.

3.2.1 Typical Conditions (key risk factors)

Hazard frequency in the Caribbean

The Caribbean islands face one of the highest relative risks to disasters in the world. Two factors create this risk: human vulnerability and natural hazard occurrence.

- *Key natural hazards* in the Caribbean are meteorological hazards, including tropical cyclones, floods, droughts and landslides. Natural hazard occurrence rates are high: the Caribbean islands were affected by an average frequency of 0.4 disasters per year between 1965 and 2004.
- *Vulnerability* is determined by the conditions people live in prior to a natural hazard event. Vulnerability levels depend on "the human capacity to prepare for or mitigate and recover from (cope with) any negative impacts of disaster"; vulnerability is a product of access to economic, political, social, environmental and geographic assets.

The Caribbean island considered in this hypothetical scenario has the following disaster risk factors (based on regional averages):

0.4 disasters per year / 15 people killed per year / 4 million people exposed on a yearly basis / 8 people killed per one million exposed = relative vulnerability index

What factors contribute to the Caribbean island's high natural hazard frequency?

Geographic conditions make the island particularly prone to recurring natural hazards. As a small island bordering the Caribbean Sea and the Atlantic Ocean it lies within the hurricane belt. Its shape gives the island a disproportionately long coastline that makes the country vulnerable to flooding. The island is mountainous with slopes of a more than 20% grade covering more than half of the country; thus the likelihood of landslide occurrence is extremely high. The island's rivers often overflow during the rainy season, but are reduced to puddles during the dry season; this reinforces food insecurity, floods, and landslides.

Exposure/vulnerabilities in the Caribbean
What factors contribute to the island's high vulnerability? The principal causes of vulnerability can be divided into three essential aspects: (a) the country's current development status (economic / physical vulnerabilities), (b) the level of social infrastructure (social vulnerabilities), and (c) the shock absorbing capacity of the natural environment (environmental vulnerabilities).

(a) The current development status (economic and physical vulnerabilities) and thus the basic living conditions of a country have previously been neglected as key contributors to risk. Without a sense of security, economic opportunities and access to basic services, people's coping capacity is severely limited. The Caribbean countries share similar sustainable development challenges—small populations, human resource deficits, lack of access to central trading routes, susceptibility to natural disasters, lack of diversification, major dependence on commodities and tourism, and vulnerability to global developments. Over the past decade, the Caribbean region has made progress in the areas of poverty reduction and social development. However, recent history has underscored the vulnerability of Caribbean states. There has been a decline in the region's traditional economic base, which focuses strongly on tourism and exports such as bananas and sugar. Crime, instability, and violence are serious problems. There has also been an increase in the frequency of natural disasters and HIV/AIDS is a growing health problem. Two basic development challenges therefore contribute to the island's vulnerability:

- *Persistence of poverty* and extreme inequality intensifies all other factors. The Caribbean islands make up less than one-fifth of the total GDP of the LAC region. Data are very mixed across the Caribbean: three countries represent almost two-thirds of the islands' total GDP: Puerto Rico, Cuba and the Dominican Republic. Over half of the island's population depends on subsistence farming to sustain their livelihoods. Tourism is another major source of income. Inequality of income is very pronounced in the LAC region with a Gini coefficient of above 0.4. Continued poverty and income inequality render this island more vulnerable to natural hazard impacts.
- *Rapid population growth* and uncontrolled urbanization magnify poor people's vulnerability. The Caribbean islands are one of the most densely populated regions in the world today. Uncontrolled urbanization led to construction in areas vulnerable to natural hazards, poor quality of housing and other related land use issues.

(b) Sound social infrastructure (social vulnerabilities) is a key contributor to people's resilience. Access to basic services, including water and sanitation, transportation networks, and functioning and accessible social structures, such as health and education systems, provide social safety nets that buffer natural hazard impacts. Social infrastructure is not yet fully developed in the Caribbean.

(c) Environmental vulnerabilities: the islands environment is degraded and thus lacks absorptive capacity to buffer impacts of natural hazards. Healthy environments usually are quite resistant and can recover from shocks. Severely degraded ecosystems, however, will not even be able to respond to and absorb small-scale natural hazards, such as landslides. The relatively poor condition of the island's environment may very well be the main factor for its high vulnerability compared to some other Caribbean islands. The island's environment has been severely degraded as a result of mismanagement of natural resources and the lack of sound enforcement mechanisms for environmental policies.

- *Deforestation* is the most severe environmental issue the country is currently facing. Due to a lack of alternatives, the poor have no choice but to use firewood for energy. This has resulted in severe deforestation; a severe decline in forest cover has been observed across the LAC region. Deforestation in turn increases the impact of natural hazards and only widens the poverty trap. Research revealed an 89% correlation between the extent of deforestation and incidence of victims in case of landslides or cyclones.
- *Unsustainable agricultural practices* are another contributing factor leading to further degradation and extremely low yields which in turn result in more than 30 percent of the population being 'food insecure'. This food insecurity will only be amplified once a disaster hits. Soil erosion and low soil fertility are endemic due to centuries of harmful agricultural practices. Increasing population numbers have exacerbated the problem due to increased demand for food and fuelwood.
- *Insufficient waste water management* is yet another environmental problem that increases not only impacts the quality of life, but also furthers the degradation of the marine environment (e.g. coral reefs), which in turn weakens the island's natural defense mechanisms against storm surges, etc.

3.2.2 Types of prevention and preparedness measures

Currently, national development frameworks and disaster response plans are typically not addressed in a coordinated approach. Different ministries, development agencies, and civil society organizations work on sustainable development projects versus humanitarian relief or reconstruction. As a result, the two realms are unaware of how exactly they impact one another and how intricately their actions are linked. Many efforts overlap, while other areas of urgent need remain unaddressed.

While humanitarian action to rapidly respond to the impact of disasters will always be vitally important, it is also important to better anticipate — and then prevent, manage and reduce — disaster risk whenever possible. The key to achieving a sustainable reduction in disaster losses worldwide lies in factoring risk management considerations into all types of development interventions on a permanent basis. Urgent need thus exists to integrate disaster risk management and sustainable development approaches to better address the interrelated nature of these two realms. Both policy agendas can learn from and strengthen each other by mainstreaming efforts to prevent and reduce risks posed by natural hazards, which will in turn support the overall development process.

3.2.3 Types of impacts in the Caribbean

Cyclones in the past have accounted for approximately 65% to 70% of deaths caused by all types of disasters in the Caribbean. The main factors leading to death due to storms are poor building quality, inadequate land-use patterns, non use of shelters, insufficient lead times for warning and evacuation, non-compliance with timely evacuation or inadequate evacuation, in particular for residents of hospitals and nursing homes. The direct losses experienced from storms are only one part of the total impact of storms in the world. Many storms are not in themselves major disasters but cause secondary catastrophes such as landslides, storm surges or severe flooding. Hurricane Stan (Mexico, El Salvador) in 2005 is a case in hand. Although a category 1 hurricane, it brought with it torrential rains, flash floods and mudslides, resulting in the highest storm-related mortality for the year (1,607 deaths).

What types of impacts are likely to occur in the Caribbean? A careful review of disaster impacts in the Caribbean yielded four predominant types of effects (in addition to lives lost): (a) loss of shelter and decay of social infrastructures; (b) spread of diseases; (c) augmented food insecurity due to reduction of livelihood streams (agricultural/fishing productivity); and (d) further degradation of the environment. Cyclones, floods, storm surges, and land slides affect these impact dimensions to varying degrees, although their effects are not mutually exclusive and often intricately related to one another.

<u>(a) Loss of shelter and decay of social infrastructures</u> is a likely impact of any type of disaster in the Caribbean. Poor construction and the lack of zoning laws make the island's shelter highly vulnerable to damage.

- *Cyclones* – Severe windstorms tend to damage rooftops and break windows (where existent), but they do not completely destroy as many houses and community structures as floods do. Mountain communities face heightened threats because windspeed is often increased when it is funneled through narrow valleys, especially when there is no forest to act as a buffering shield. Urban slums are often completely destroyed by windstorms due to the poor quality of shelter construction. Also, people in densely populated cities often face the problem of having nowhere to flee to when a hurricane is imminent: island transportation networks are still limited, especially outside of cities.
- *Floods* - No matter where a flood hits in the country, it will destroy housing and infrastructure because most shelters, schools, health clinics and other infrastructure are simple and not built to resist major flooding. Floods tend to completely destroy shelter because wash away buildings from their foundation. Floods in mountainous areas render communities vulnerable because most towns are established in valleys, and thus entire towns can be washed away with severe floods.
- *Storm Surge* – the impact of storm surges on infrastructure is directly linked to the level of degradation of coastal zones and their protective features, including mangroves and coral reefs. The lack of protective boundaries allows flood waters to reach further inland than they otherwise would and thus they are likely to destroy more shelter and affect more people.

- *Land Slides* – Wherever land slides occur they are likely to burry all shelter and infrastructure that is located in their path. Additionally, slides can severely damage transport routes and thus cut off the community from outside aid.

(b) Disasters increase the likelihood for diseases to spread. The spread of diseases is more likely in cities and will occur at a much faster rate than in rural areas.

- *Floods and Storm Surge* - The threat of water-borne diseases as a post-flood effect is imminent throughout the country due to the inaccessibility of preventative healthcare and sanitation and hygiene measures while burying the dead and waiting for the flood to recede.

(c) Food insecurity is often intensified when disasters occur. Natural hazards tend to affect agricultural harvests and often wash away stored food supplies. Currently, most communities lack silos for storage of grain and emergency shelter to save animals from extreme weather events. Indirectly, the loss of agricultural outputs will impact food security and livelihood choices, thus severely decreasing economic and social assets within the affected community.

- *Floods* - Flooding often destroys harvests and livestock, thus washing away livelihood means of entire communities.
- *Storm Surge* - Floods are likely to carry large loads of solid wastes / hazardous materials into coastal waters; consequently the fishing industry can be severely harmed for several years to come.
- *Land Slides* – Similar to floods and storm surges, land slides tend to destroy agricultural products cultivated on the slopes and kill livestock if in its path.

(d) Disasters have indirect effects of further crippling the environment's resilience to act as a buffer. All natural hazards further degrade the natural environment. As a result, nature is even more inept to react to external shocks in the future.

- *Cyclones* – High windspeeds tend to destroy vegetation, uprooting trees and blowing away smaller plants and grains.
- *Floods* – Heavy rainfalls often lead to downwash of top soil and the sensitive vegetative layer. Also, floods will affect watershed balance.
- *Storm Surge* – Coastal mixing of salt and freshwater can cause severe fish kill, destroy mangroves and severely damage coral reefs along coastal zones due to debris and pollution run-off.
- *Land Slides* - Large amounts of soil being transported downhill will damage the local watershed system via sedimentation; this has potential adverse effects on water supply.

These four impact dimensions are the ones that really matter. Hence any immediate disaster response and subsequent reconstruction effort ought to address them (in addition to reducing lives lost due to natural hazards). All four impact dimensions severely increase the loss of lives, the overall economic impact of the disaster, and they further erode livelihood activities, governance capacity, and overall community resilience thus negating development achievements and challenging the prospects of future progress towards sustainable development and a better quality of life.

Overall economic impacts: On average, disasters reduce the economic output of developing nations by 13% and deprive them of resources needed to escape poverty.

These resources not only refer to economic means, but they also comprise a functioning social network and a healthy environment that are able to recover from shocks.

3.2.4 Past reference disasters

Winter storms in Northern Europe

The main reference scenarios to building the current scenario for Winter storms in Northern Europe derives the two most recent serious winter storms to hit Northern Europe, namely Gudrun and Kyrill.

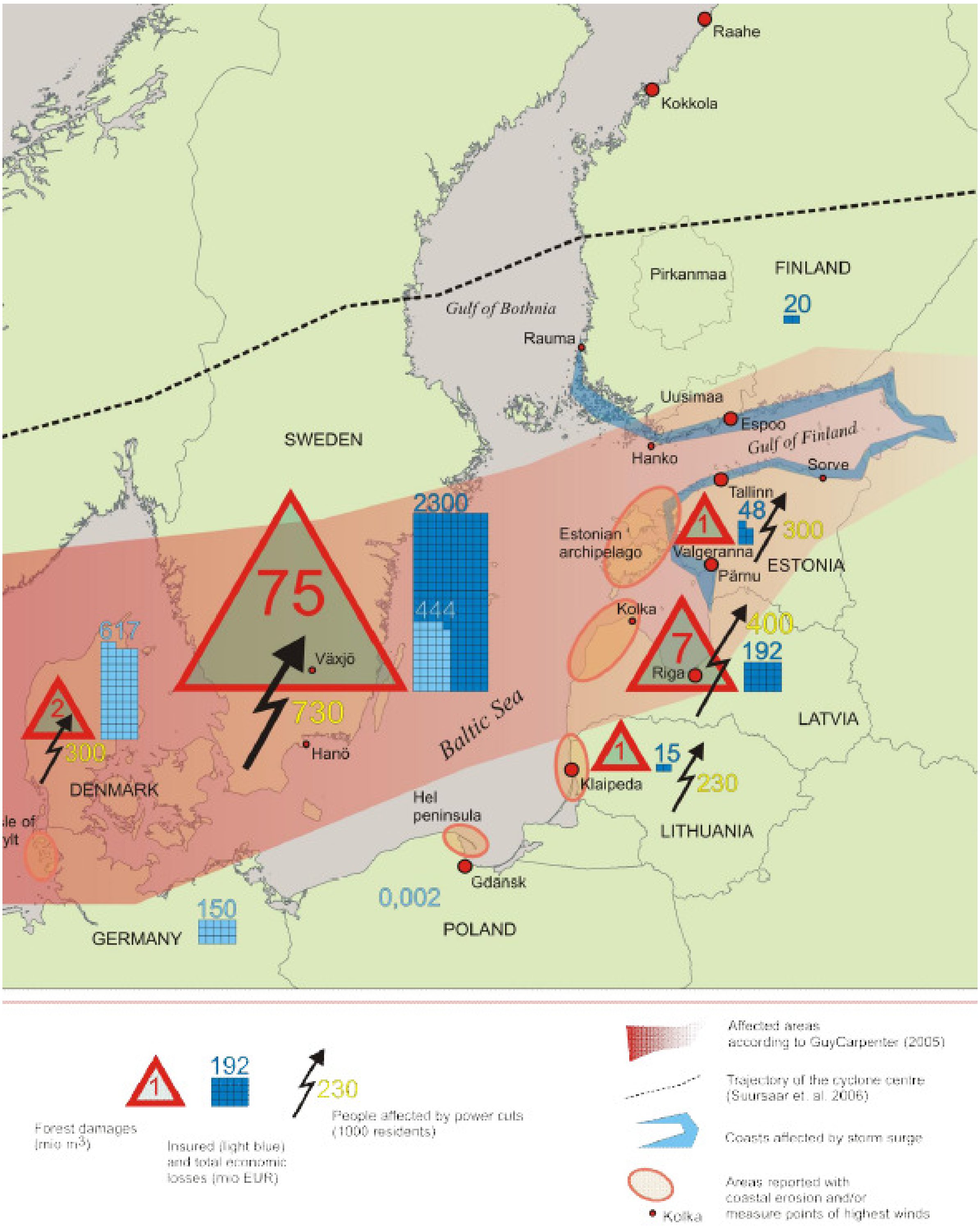
Gudrun (2005), Scandinavia[18]: Winter storm Gudrun (Erwin) battered northern Europe on January 79, 2005. 17 persons died in the storm. Social, economical and natural systems were severely affected. Total costs were estimated being close to € 2.5 billion. Gudrun exposed the lack of adaptation towards weather-borne hazards that already today pose a threat to the countries bordering the Baltic Sea. Climate change is expected to enhance extreme weather events that are thus likely to occur at a shorter interval in the future.

As an effect of the large number of fallen trees, at least seven persons were killed, mostly in traffic accidents with falling trees involved and an estimate of 410 000 households had no electricity after the storm. Even as long as a month after the storm, many households still lacked electricity.

For at least 200 000 households, the telephone network was out of order. Immediately after the storm, many roads where closed due to fallen trees. As the road authority was prepared, many of the major and middle sized roads where open within a couple of days after the storm. As the railroads were struck harder than the roads, rail traffic was affected for a month. In many watercourses, the water level rose but sank again shortly after the storm had abated.

[18] www.astra.org, French ministry of the Environment - DPPR / SEI / BARPI – Registered Installations Inspectorate (http://ec.europa.eu/environment/impel/pdf/lesson/fiche18.pdf)

Figure 3.6 Map of the Baltic region indicating the effects of Gudrun (2005)



[Source: www.astra-project.org]

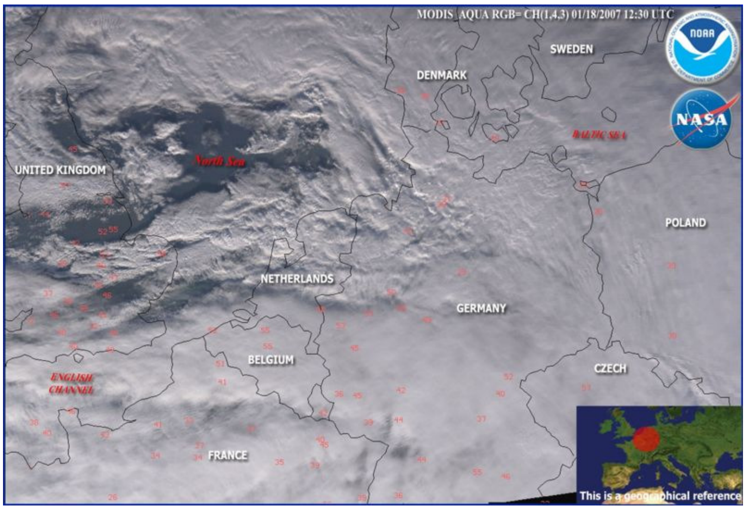
Kyrill (January 2005), UK, Holland and Germany[19]: After making landfall in Ireland and the UK in the late hours of January 17, the storm swept across Ireland and Great

[19] http://www.dw-world.de/dw/article/0,,2317752,00.html

Britain on the night of 17 to 18 January, with winds of 160 km/h at The Needles and 149 km/h recorded in Dublin.

The German Met Office had advised people to stay indoors and avoid unnecessary trips on 18 January, and wind strengths of up to 12 on the Beaufort scale were seen across the Netherlands and Germany as the storm made landfall. The storm moved across the Germany with Wind gusts as high as 202 km/h. The storm then moved eastwards towards the Baltic Sea, its cold front spawning several tornados in Germany. In the Czech Republic the highest wind speed was measured in the Krkonose Mountains, where wind gusts reached 212 km/h.

On the day of the landfall, an approximate 25,000 homes in southern England were without electricity after electricity pylons were damaged by the storm. Same day, the German states of Brandenburg, Saxony and Saxony-Anhalt were hit by a massive power cut. 52,000 homes were without energy. The German district Siegen-Wittgenstein had issued a state of emergency with schools remaining closed on Friday, January 19, and roads not to be cleared right away, but closed instead until the situation improved. By the second day of the storm, more than one million homes were left without power in the Czech republic with another million households without electricity in Germany and tens of thousands dark homes in Austria and Poland. In Poland, a flood alarm was issued in several localities due to large rainfalls and the storm damaged several houses in the region.



In the Netherlands, the storm flood warning system was activated, as the approaching storm was measured in excess of 10 Beufort. Alarms were issued to two northern regions. The water level peaked in the early hours of Friday, almost 4.5 m above the astronomical prediction level.

High winds in the Alps prompted the Austrian weather service to advise the skiers and snowboarders to seek shelter, and caused at least one major motorway tunnel closure.
Thousands of travelers were forced to spend the night in railway stations or seek emergency accommodation after train services across the country were cancelled.

Berlin's brand new central station, the biggest in Europe, was closed Thursday when high winds tore a steel girder from its high-tech facade. The two-ton girder fell 40 meters (130 feet) on to a stairway, police said. "No-one was hurt, thank God," said Volker Knauer, the Deutsche Bahn spokesman for the station.

More than 280 flights were cancelled at Heathrow airport, and 80 more flights were cancelled due to health and safety reasons at Manchester Airport. Overall, during January 18 and 19 Swiss Air announced the cancellation of at least 88 flights, British Airways canceled 180 flights and Lufthansa cut 329 flights and warned of more delays before the service began to return back to normal.

The cost of the damage across Europe to the insurance industry has been estimated by Swiss Re as € 3.5 billion.

At least 43 persons were killed, of which 13 in Germany, 11 in UK, 6 in Poland.

International storms

This section elaborates on similar / related disaster experiences in the past that were used as a reference for gauging likely future impacts, risks, etc. and their intensity.

Table 3.4 Overview of past reference disasters: Windstorms

Hurricane Katrina (2005)	
Intensity	Category 5 (280km/h wind speeds)
Areas affected	Bahamas, Cuba, USA
Human toll	1836 dead; 705 missing; 10 million affected; thousands emergency assistance
Physical damage	850.000 houses damaged/destroyed; 5000 public buildings destroyed; offshore rig damage; severe water contamination
Required response	1472 emergency shelters; 62.000 emergency personnel; 12 airlines for airlift rescue; helicopters to evacuate 4.000 from rooftops
Hurricane Stan (2005)	
Intensity	Category 1 (130km/h wind speeds)
Areas affected	Guatemala, El Salvador, Mexico, Nicaragua, Honduras, Costa Rica
Triggered secondary disasters	torrential rainfall, flash floods, mudslides
Human toll	~2.000 dead; millions affected
Tropical Storm Jeanne (2004)	
Intensity	Category 3 (195km/h wind speeds)
Areas affected	Puerto Rico, Dominican Republic, Haiti, Bahamas, Florida
Triggered secondary disasters	severe flooding; mudslides
Human toll	3.000+ dead; 25.000 need emergency assistance; 300.000 affected
Hurricane Mitch (1998)	
Intensity	Category 5 (285km/h wind speeds)
Areas affected	Central America, Yucatán Peninsula, South Florida
Triggered secondary disasters	floods, mudslides, etc.
Human toll	11.000 to 18.000 dead; millions affected
Physical damage in Honduras	50.000 houses damaged / 33.000 destroyed; 25 villages destroyed; 70-80% of transport infrastructure destroyed; 70% of crops lost; 50.000 cattle dead
Physical damage Caribbean	storm surges of 2-4m; damaged roads and harbours; beach erosion

3.2.5 Assumptions: international wind storm scenario

This section describes and justifies the assumptions made while building the international storm scenario. These assumptions directly or indirectly have an effect on vulnerability and exposure and thus on the intensity of impacts experienced from future disasters. Therefore, in order to assess and compare various disaster scenarios, it is important that assumptions are made explicit and are consistent.

Data assumptions: Since the reference scenario is hypothetical and takes place on an imaginary island, it is impossible gather specific data. Therefore, all data provided in this reference scenario has been built using regional averages to create an imaginary island that represents an average island in the Caribbean. Mostly, data from Antigua and Barbuda, Cuba, the Dominican Republic, Guadeloupe, Haiti, Saint Kitts and Nevis and Saint Lucia have been used. These islands present a geographic, economic, and demographic spread of Caribbean island states.

Assumptions on climate patterns and environmental change: There is a not yet fully confirmed North Atlantic trend toward more frequent and more extreme cyclones, that is to say toward increased storm activity itself. In regard to the connection between global warming and tropical cyclone activity, which could well become a question of survival for densely populated coastal regions, particularly in view of the expected rise in sea level, recent analyses reveal a significant upward trend at least of the number of the most powerful Atlantic hurricanes.[20]

In the Caribbean, the unavoidable rise in temperature of a further 0.6°C by around 2030 can be expected to give rise to an increase in extreme weather events, e.g. hurricanes.[21]

This risk of sea-level rise, in addition to the direct damages it is likely to cause due to storms and floods, also poses a risk of greater soil and coastal erosion as well as the salination of coastal areas in the wake of floods. This will have negative effects on groundwater and soil quality.[22]

Furthermore, the relatively high concentration of industrial facilities in the Caribbean gives rise to the risk of environmental destruction resulting, for example, from oil platforms toppled by storms. This constitutes an additional factor that could burden the marine ecosystem (e.g. fisheries) in the future.[23]

Water problems are expected to intensify– the number of people in the region experiencing water stress could rise from 22.2 million in 1995 to as many as 81 million in 2020.[24] This may further exacerbate national and international rural migration.[25]

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[20] Munich Re, 2006.
[21] WBGU 2007: 149.
[22] IPCC 2007b: 696 ff.
[23] WBGU 2007: 151
[24] IPCC 2007b: 597
[25] Simms/Reid 2006: 40

Assumptions on economic and political development: As a result of a heavy economic dependency on tourism, especially in the Caribbean, the climatic trends mentioned above will have substantial economic impacts in the LAC region. Additionally, the fact that ten per cent of South America's GDP continues to be generated in the agricultural sector adds to the likely economic impacts felt by storm events in the future.[26]

In addition, many countries are dependent for their electricity supply on hydroelectric power stations, whose productivity may decline in the wake of global warming.[27] These will likely further decrease productivity in the region.

Finally, non-sustainable management of natural resources has already led to local conflicts over resources in the past. In large parts of Latin America this constitutes an additional factor that amplifies the impacts of climate change.[28] Due to relative stability and a high level of development, however, 'Haitian conditions' are unlikely to prevail in the region in the short term.[29] On Haiti itself, it is unlikely that there will be any improvement in the environmental situation, however, which in the medium term could cause migration movements to spread to the Dominican side of Hispaniola.[30]

Assumptions on demographic change and social trends: The dual problem of extreme weather events and sea-level rise especially affects the large coastal cities of the LAC region, such as Rio de Janeiro, Buenos Aires and Lima. One key problem is that urbanisation currently eludes control and indeed in many cases already exceeds the capacity of cities to absorb the influx. By 2015 levels of urbanisation will probably have reached 80% in the region. Thus, alongside the expansion of slums, settlement is also taking place in areas at risk from mudslides or hurricanes.[31]

The expansion and improvement of necessary infrastructures of these and other coastal cities is barely keeping pace with their inadequately controlled growth. One example is the potential contamination of drinking water supplies as a result of overstretched wastewater systems. The combination of these effects may further the spread of disease.[32]

The increase in extreme events can also be expected both to steady and strengthen existing intraregional as well as extra-regional migratory movements, especially to the USA.[33] The border region between the USA and Mexico today is already both a social and an ecological hotspot.

Furthermore, climatic trends may further reinforce the tense social situation that exists in many places due to grave inequalities within the population. Extreme disparities currently prevail with regard to income and access to education, health care and other services in

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[26] IPCC 2007
[27] IPCC 2007
[28] IPCC 2007
[29] WBGU2007: 159
[30] Diamond 2005: 354
[31] IPCC 2007
[32] IPCC2007
[33] WBGU 2007: 150

Latin America. A further factor is that indigenous groups are increasingly challenging established elites.[34]

Assumptions on land cover / land use change: Existing competition over land use between smallholders and industry (agriculture and forestry, mining activity, energy crops) will further increase as a result of desertification and soil degradation caused by climate change and the increasing frequency of natural disasters.[35] Soil degradation and desertification in turn will increase vulnerability to future disasters and have adverse effects on the region's biodiversity.[36]

3.2.6 Scenario presentation: winter storm in Europe

		Disaster Scenario: Northern Winter Storms in Europe
Characterisation of the hypothetical scenario	Disaster event	▪ It is a Friday morning in January and the citizens of countries in Northern Europe including the Baltic Sea are warned that a serious storm will hit the region later in the day and during the evening. ▪ From Friday afternoon until Sunday morning the storm struck Northern Europe with hurricane force winds - up to 250 km per hour. ▪ The Northern European Member states affected by the winter storm cover an area of 1500km * 1000km, a total population of around 30 million people, 6 major cities (larger than 1million inhabitants), 50 smaller cities (less than 1 million inhabitants), large areas of forest, and thousands of kilometres of vulnerable coastal zones. ▪ Although the region (nature, inhabitants, infrastructure and buildings) are used to withstand harsh winter weather, extreme winds combined with coldness and heavy snowfall do cause trouble. ▪ Although temperatures across the region were relatively normal for the time of year, between 0-4 degrees Celsius, it felt freezing due to the wind factor. ▪ Many parts of coastal areas within the region affected also suffer from flooding due to the strong winds pressing water into the fjords and harbours and causing water to overrun the dykes. Many people drowned as evacuation efforts were impossible to undertake. ▪ Hundreds of kilometres of coastline, in particular along the eastern Baltic Sea are severely damaged causing high risk of land slides and further erosion.
	Disaster site	▪ In the central station of City X several hundred lives were lost when the wind toed away the glass ceiling causing big pieces of glass and metal to fall 50 meters down in the central hall of the station where thousand of passengers were held up due to cancelled trains. Others were killed due to falling trees hitting passing cars on both highways and country roads, roof tiles hitting pedestrians on the streets, parts of roofs or buildings falling on streets, etc. In the most northern parts of the region heavy snowfall, up to 80 cm, further added to the chaos and paralysed this region. 4 sports arenas are reported to have collapsed under the enormous heavy snow masses. ▪ The storm brought chaos to airports across the affected region. In one airport the wind caused aeroplanes to tilt resulting in massive material damages to the planes and to the terminal buildings. At least 20 planes are reported seriously damaged. ▪ Due to the warnings many people did stay at home from work Friday, however still hundreds of thousands of people were affected as they were travelling back from work Friday or aiming to go away for the weekend. ▪ Fortunately, coastal areas are not as build up and densely populated as is the case in other European coastal zones (such as the Mediterranean Sea). Likewise, strict building codes in most counties make houses and other constructions relatively robust as they are designed to be able to withstand heavy snow on the roof, etc. ▪ Furthermore, people in the region are used to harsh weather and should be aware of sensitive preventive measures and how to behave in extremely cold and windy situations. However, the extraordinarily strong winds did cause severe damages on roofs and caused windows to break, hence resulting in many homes to be temporarily unfit and unsafe for living.

[34] WBGU 2007: 154
[35] Carius et al. 2006: 42
[36] IPCC 2007.

Characterisation of the hypothetical scenario (continued)

Immediate direct and indirect impacts / types of damage

Human toll:
- Total population affected amounts to 30 million people.
- 2400 lives (approximately half due to the storm itself, the other half due to dangerous rescue situations)
- Several thousands injured
- Tens of Thousands of particularly elderly people suffering from coldness and lack of care as both heating, food delivery and nursing services were affected
- 1 million homeless as private homes and apartment buildings were damaged
- Several million homes without power supply for days and weeks
- Millions of people grounded as large parts of infrastructure are affected for several days

Infrastructure and Assets:
- Airports: 2 large airports and 5 smaller regional airports are severely damaged, clean up and reparations are expected to take 4-5 weeks
- Railways: tens of kilometres of tracks need clearance from fallen trees and power lines
- Railway stations: the Central station of City X will be affected for several months
- Many bridges and roads have been damaged.
- Power supply: at least 5 main power lines (due to damaged power pylons) are severely damaged across all 4 affected Member States causing the entire power grid to be extremely sensitive; the reparations will take several weeks
- Communication: mobile networks are down in most of the region, fixed land lines also severely damaged
- Private homes: in the order of 300 000 private homes (including some apartment buildings) are partly or completely damaged causing around 1 million people to be temporarily homeless
- Office buildings, schools, sports arenas: Approximately 10% of all buildings across the region are damaged and will need considerable reconstruction mainly due to damaged roofs, etc
- Historical buildings: in particular 2 old historic towns were hit hard by the storm due to the combination of very brutal winds and coastal floods
- Factories, warehouses: thousands of factories and warehouses across the region are damaged either due to flooding, or roofs collapsing due to heavy snow or wind
- Harbours, ferries, fishing boats, work ships: 2 large harbours along the Baltic Sea east coast are severely damaged and will affect ferry routes for some months. Large amounts of fishing boats as well as work ships were damaged in the harbour due to sea level rise as well as strong wind
- Windmill parks: 2 large off shore windmill parks suffered damages due to the strong jet winds combined with extreme waves. The wind mills need reinforcement in the fundamental construction and will be out of production for several months
- Flooding left enormous amounts of water inland, that cannot flow back to the rivers, fjords and sea by itself

Environmental effects:
- Large areas of forestry across all 4 affected Member States were heavily affected, the storm fell a total of 200 million M3 of trees equivalent to total harvesting in all 4 countries in one year. The economic impact as well as the ecological impact is enormous
- Coastal erosion: accelerating coastal erosion along the Baltic Sea east coast

Indirect effects:
- Health effects: most vulnerable citizens (e.g. elderly) suffer the most and might have died pre-mature due to coldness and lack of nursing in the aftermath of the storm
- Contamination: at least 5 smaller SEVESO type operations are reported affected situated in the 2 large harbour regions
- Social effects: the families who have lost their homes and are without insurance; this is in particular a problem in some of the poorest member states
- Economic effects: large economic costs to be felt on the GNP of the main affected countries, as well as insurance companies
- All flights, trains, buses, bridges, sports events etc were cancelled.

<table>
<tr>
<td>Expected / required response resources</td>
<td><u>0-24 hours:</u>
Managed by national capacities:
• Damage extension maps, e.g. satellite images to get an overview of extension of damages of forestry, coast, infrastructure, sea etc. and as mean for coordinate rescue operations.
• Special equipment and personnel to investigate and access damages to a total of 5 SEVESO type plants affected.
• Shelter, food, for half of the 1 million homeless
• Helicopters, buses for evacuation purposes, heavy equipment to clear roads and railway tracks.
• Need for alternative means of electricity to the 300 000 households without power spread across two countries (and perhaps heating).
• Equipment and experts to repair power lines across the region
• Equipment and experts to repair communication network

Need for external assistance:
• Shelter, food for half of the 1 million homeless (assuming that national capacities can cover the other half)
• Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, schools. Estimated 100-150 units.
• Search and rescue (S&R) e.g. urban search and rescue units of all kinds – heavy (2) and medium (6), in particular for member state x.
• Medical Coordination centres to register people and transfer to nearby hospitals with free capacity. One in each of the 4 countries.
• Management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors. One in each of the 4 Member States.
• High capacity pumping equipment. 15 high capacity pumps and 50 mobile units to drain flooded roads.
• Helicopters to get access to remote areas and rescue or evacuate people in the affected areas. 20-40 units.
• Ships, planes and trucks to provide food, aid, medical equipment, medicine, shelter to affected populations covering a large geographical area.

<u>Up to 2 weeks:</u>
Same as above PLUS:
Managed by national capacities:
• Post disaster stress experts
• Temporary housing for approximately 200.000
Need for external assistance:
• Doctors, medicine
• Technical assistance and support team
• High capacity pumping equipment and personnel
There is a considerable need for external assistance, throughout the emergency response period to the recovery period in particular for 3 out of the 4 main affected MS as these are relatively small countries (5-10 million inhabitants in total) and are relatively hard hit.</td>
</tr>
</table>

3.2.7 Scenario presentation: windstorm in the Caribbean scenario

<table>
<tr>
<th></th>
<th colspan="2">Disaster Scenario: Windstorms in the Caribbean</th>
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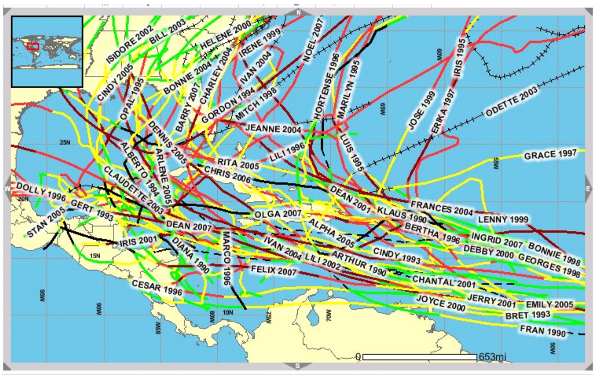
<tr>
<td>Characterisation of the hypothetical scenario</td>
<td>Disaster event</td>
<td>Hurricane Bert makes landfall in September on the south-eastern coast of the first Caribbean island state on a Wednesday morning at 8:35 am local time with sustained winds of approximately 200 km/h. The windstorm is of similar magnitude as Hurricane Katrina (category 5) and Hurricane Stan (triggered immense flooding, storm surges and landslides) in 2005. Hurricane level winds are recorded on a stretch of 180 km coastline. The magnitude of Hurricane Bert brings with it the additional burden of other disasters triggered by the storm event: major coastal zones are hit by storm surges, rivers swell above their limits due to heavy rainfall and the degraded hillsides cannot absorb the rain fast enough, thus many people and infrastructure are exposed to landslides.
▪ Storm surges of 6 m cause severe flooding several kilometres inland.
▪ 70% of the major coastal city is under water and likely to remain flooded for at least 20 days.
▪ Heavy rainfall of up to 30 cm is recorded.
▪ 2.000 landslides have been triggered as secondary effects of the Hurricane.

Hurricane Bert maintains most of its force as it continues its way through the Caribbean islands, hitting yet another two islands approximately 8-10 hours after it first made landfall previously.

Though immediate damages and impacts are not known, it is clear that the government of the Caribbean island calls for international assistance for disaster response within hours of the disaster event declaring an area of approximately 20.000 km^2 as disaster area. The intensity had been anticipated since the previous day when the tropical storm turned into a rapidly growing hurricane.</td>
</tr>
</table>

Disaster site (key geographic areas affected)



The Caribbean is an archipelago, 4,020 kilometres in length, and up to 257 kilometres wide. The region contains more than 7,000 islands, islets, reefs, and cays. The region's population is close to 40 million. The principal Caribbean hurricane belt arcs northwestwards of the island of Barbados in the Eastern Caribbean. The map clearly shows that windstorms typically move from the south-east towards the north-west of the Caribbean (1990-2007).

What geographic areas on the island suffer disaster impacts? The three key geographic regions of highest risk on a Caribbean island are (a) coastal areas, (b) inland mountainous regions, and (c) densely populated cities. Each of these areas faces different types and intensities of natural hazards and has to deal with diverse underlying vulnerabilities.

(a) Coastal communities are most likely to experience storm surges. Coastal populations are faced with degradation of natural protective structures - including mangroves, coral reefs, and natural beaches – which increases storm surge impacts.

- *Wind Damage* – windstorms are most powerful when they first make landfall. Thus, the most serious wind damage is likely to occur in coastal areas. The Caribbean island's coasts face high risks: more than 10,000 people are exposed to an average of 0.4 storm events per year; residents face a relatively high vulnerability to the impacts of windstorms (vulnerability proxy of 100 killed per one million exposed per year).
- *Storm Surge Impacts* – extreme wind events often trigger storm surges and flooding of coastal areas. Up to 10,000 people are exposed to an average of 0.3 storm surge events per year along southern beaches; residents face a relatively low vulnerability of being killed by the floodwaters, but the number of people affected by the aftermath can be enormous.

(b) Inland mountainous landscapes are the regions where the poorest and most marginalized populations tend to live. Deforestation and unsustainable agricultural practices affect erosion, watershed balance, and natural hazard risk. Wind storm events often trigger flooding and landslides that threaten mountain communities.

- *Wind Damage* – as many as 100,000 people are exposed to an average of 0.4 storm events per year; residents face a relatively high vulnerability (vulnerability proxy of 100 killed per one million exposed per year), especially due to the indirect impacts of cyclones.
- *Flooding Impacts* – Most windstorm and heavy rain events trigger flooding. About 1,000 people are exposed to an average of 0.3 flood events per year; residents face a relatively low vulnerability in terms of people killed per event, but the number of livelihoods affected by the aftermath can once again be very large.
- *Landslide Impacts* – Severe wind and rain events can cause land slides. Many (but as of yet unquantified numbers) of people in mountain communities are exposed to an average of 0.01 landslides per year. If affected, the vulnerability proxy is estimated to be high, especially because landslides have a very local impact and destroy not only lives, but also endanger livelihood sources of entire communities. Also, local landslide victims usually do not receive the amount of aid that typically pours into a country after a major national disaster occurs.

(c) Densely populated cities face particularly high risks because any type of disaster will have higher impacts due to the sheer number of people exposed as well as the dismal conditions under which people live in the quickly expanding urban slums. Most Caribbean island cities are located along the coastline and thus cities face particularly high risks from storm events and consequent storm surges. When natural hazards hit major cities this will have negative spillover effects throughout the country: survivors need to find shelter elsewhere until their city is reconstructed, markets for rural products will be dysfunctional, the loss of economic activities will depress growth rates across the nation, and violence is likely to spread out of the cities into the countryside.

Characterisation of the hypothetical scenario (continued)

Immediate direct and indirect impacts / types of damage (based on previous disasters Hurricanes Katrina, Stan, Jeanne and Mitch)

Human toll: Windstorms in the past have accounted for approximately 65% to 70% of deaths caused by all types of disasters in the Caribbean islands. The main factors leading to death due to windstorms are poor building quality, inadequate land-use patterns, non use of shelters, insufficient lead times for warning and evacuation, non-compliance with timely evacuation or inadequate evacuation, in particular for residents of hospitals and nursing homes. In summary, the human toll of Hurricane Bert is as follows:

- 3.000 killed (bodies need to be recovered in order to avoid diseases from spreading)
- 10.000 missing (search and rescue efforts needed in order to save lives of those trapped under rubble, injured, etc.)
- 4 million affected out of which
  - 125.000 need emergency assistance (approximately 75.000 in and around the two main cities of the island and another 50.000 in remote villages across the island)
  - 500.000+ displaced / homeless with immediate need for shelter, water, food and medical services

Damage to infrastructure: Poor construction and the lack of zoning laws make the island's shelter highly vulnerable to damage. Bert's damage to infrastructure is as follows:

- 70.000 buildings destroyed (mainly suburban and rural slum dwellings and wooden as well as metal huts across the island)
- 600.000 buildings damaged (public buildings, including schools, hospitals, townhall, etc. as well as brick / concrete residential housing in the main cities)
- 500.000 homes without power (mainly in the 2 major cities, plus 3 smaller cities) / most (80%) of phone and power lines damaged
- 85 health centers (across the island) and 4 hospitals (in 3 different cities) damaged / limited generator power available ; few operating rooms; severe shortage of beds and medicines
- 500 hotels badly damaged (therefore limited capacity to use as temporary shelter; indirect negative impact on the country's slowly developing tourism industry)
- 55% of businesses damaged or destroyed (mainly SMEs and small shops in cities as well as supermarkets, banks, etc. not functional for days)
- 85% of schools and nurseries damaged across the country in both urban and rural areas
- 160 km of highway destroyed and a total of 70% of the island's transportation infrastructure severely damaged (including small fishing vessel harbours) / more than 120 small bridges collapsed
- Fires breaking out in at least 20 locations (factories and houses caught on fire)

Ecological effects: Disasters have indirect effects of further crippling the environment's resilience to act as a buffer.

- Offshore rig and tanker damage spills approximately 40.000 metric tons of oil
- Millions of liters of water are contaminated due to sewage system breakdown, debris, oil, human bodies, animal cadavers, etc.
- 120 km^2 are converted from coastal wetlands / mangroves to open water after the hurricane
- 2/3 of the annual fish harvest is lost / 70% of crop is destroyed / extensive animal loss (cows, pigs, poultry). Indirectly, this will require food assistance for several years because most fish, crop and animal harvest on the island is subsistence agriculture.

Immediate secondary impacts: These include the spread of diseases, food insecurity, etc.

- Disasters increase the likelihood for <u>diseases</u> to spread. The spread of diseases is more likely in cities and will occur at a much faster rate than in rural areas. The threat of water-borne diseases as a post-flood effect is imminent throughout the country due to inaccessibility of preventative healthcare and sanitation and hygiene measures while burying the dead and waiting for the flood to recede.
- <u>Food insecurity</u> is intensified. The windstorm affected agricultural harvests and washed away stored food supplies. Currently, most communities lack silos for storage of grain and emergency shelter to save animals from extreme weather events. Indirectly, the loss of agricultural outputs will impact food security and livelihood choices, thus severely decreasing economic and social assets within the affected community. The storm surges carried large loads of solid wastes / hazardous materials into coastal waters; consequently the fishing industry can be severely harmed for several years to come.

Overall economic impacts: On average, disasters reduce the economic output of developing nations by 13% and deprive them of resources needed to escape poverty. These resources not only refer to economic means, but they also comprise a functioning social network and a healthy environment that are able to recover from shocks. Natural disasters further erode livelihood activities, governance capacity, and overall community resilience thus negating development achievements and challenging the prospects of future progress towards sustainable development.

Expected / required response resources	**How much of the impact can be absorbed / addressed by the national response capacity?** The Caribbean island's national capacity is weak. While national disaster plans exist on paper, national disaster management capacity is not fully developed. Currently, the government's role is limited to declaring a state of emergency once a disaster occurs and to soliciting international relief and reconstruction assistance. Regional response capacities are primarily coordinated through the Risk-Emergency-Disaster (RED) Platform for Latin America and the Caribbean. This regional coordination mechanism established in Panama in 2003 forms a task force to unite actions of various regional agencies and NGOs. Further, the platform serves as a forum for information exchange, reflection and analysis that allow for optimization of preparedness, response actions and risk reduction activities. However, hurricane Bert hit three Caribbean islands and affected another two. Therefore, the regional response capacity is also overwhelmed within hours of the event and national assistance capacities of other Latin American and Caribbean States will also be affected. Thus, additional international assistance must be requested. The following lists describe the required response managed by national/ regional capacities versus the needed amount and type of external assistance (which could be provided by humanitarian aid organizations, international organizations as well as via bilateral assistance or through the MIC): Up to 3 days: **Managed by national / regional capacities:** ▪ Mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, supermarkets and food storage houses. ▪ Need for communication equipment, sat com, etc. ▪ General registration of people, fatalities, wounded, missing, evacuated, unknown status also to be able to inform relatives. ▪ Damage maps, e.g. satellite images to get an overview of extension of damages of land, coast, infrastructure etc. and as mean for coordinate rescue operations. **Need for external assistance:** ▪ Ships, planes and trucks to provide food, aid, medical equipment, medicine, shelter to affected populations along the coast and remote areas. ▪ Medical Coordination centres to register people and transfer to nearby hospitals with free capacity. ▪ Body ID equipment. ▪ Food and water for a total of several of millions of people. ▪ Search and Rescue (S&R) equipment, e.g. helicopters, heavy equipment to remove rubble, surveillance equipment incl. planes, coast guard ship for S&R at sea (at least 3 MUSAR and 2 HUSAR modules or equivalent). ▪ Advanced medical post with surgery and field hospital, doctors, medicine (at least two in each of the two main cities). ▪ At least 6 planes for airlift rescue and several large boats for evacuation purposes (20.000 people need to be transported out of disaster zone). ▪ Water purification equipment – (4 large-scale units for 2 cities with approx. 400.000 inhabitants each) (300 small-scale units for small, remote villages with less than 500 inhabitants each) (500.000 water purification tablets). ▪ 1 technical damage assessment team (to assess damage to infrastructure and needs assessment for temporary bridges, road reconstruction, etc.). ▪ Testing equipment for environmental contamination, drinking water, soil, sewerage etc. ▪ Emergency temporary shelter in at least 4 locations for the 500.000+ homeless for a period of up to 3 weeks (approximately 150.000 are required from external assistance). ▪ High capacity pumping equipment (to drain the flooded areas of the two major cities as well as parts of the national transportation network) (at least 6 units: two for each city and two mobile ones for flooded roads, etc.). ▪ Oil pollution clean-up equipment to recover the 40.000 tons of oil (mainly at sea / some along the shores). ▪ At least 3 helicopters to get access to remote areas and rescue or evacuate people in the affected areas. ▪ 1 management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors (Technical assistance support team). Up to 2 weeks: **Managed by national / regional capacities:** ▪ Temporary medical emergency facilities to serve several thousands people in at least the two major cities (plus some mobile units). ▪ Food and water supplies for people in need (mainly in temporary shelters). **Need for external assistance:** ▪ Temporary shelter needed for approximately 350.000 people as well as temporary nursery, and school shelters. ▪ Removal of debris, coastal zone clean-up and repair of harbours. ▪ At least 7 temporary metallic bridges (200-300 metres length and 3.5 metres wide) to help get assistance to remote places. ▪ Water purification equipment – (4 large-scale units for 2 cities with approx. 400.000 inhabitants each) (300 small-scale units for small, remote villages with less than 500 inhabitants each). ▪ Bridge and transportation infrastructure reconstruction. ▪ Financial planning for reconstruction.

3.2.8 Analysis

Scenario Choice

The EU winter storm scenario was chosen due to several reasons:

- Storms due to Atlantic cyclones are the dominant cause of weather related deaths and economic losses in the north and west of Europe. Storms accounts for half of the weather related damages reported
- Winter storms on the other hand are more frequent. The Kyrill storm hitting northern Europe (mainly Germany) in January 2007 is the latest example killing 44 people and bringing trains, plains etc to a complete still for a few days and causing economic damages for a more than 1 BEUR. Other examples of severe winter storms: France 1999 (killing 19 people), March 2008 (mainly UK, France), etc.

The international windstorm scenario was chosen for various reasons.

- Windstorms account for 25% of all disasters worldwide; thus they are the second most common disaster type after floods.
- Over recent years, due to global warming, there has been an increased frequency and intensity of windstorm events.
- Latin America and the Caribbean is one of the most vulnerable and most frequently hit regions.
- The site location on the Caribbean islands can additionally test response resource transport / logistics capacity to remote locations / island situations.

Limitations

The current European winter storm scenario as described represents a severe case scenario, where the force of the wind is the most critical factor. The meteorological condition causing violent winter storms in Northern Europe are due to the cold polar air meeting southern air masses warmed by the ocean. The difference in temperatures between these two air masses becomes large enough to trigger a storm, as when cold polar air pushes southward it sets the air masses in an anti-clockwise spin surrounding a deepening centre of low pressure. If the difference in temperatures persists the storm from may grow to a diameter of 300km and possess wind speeds up to 200km/h.

What factors could be intensified in a worst case scenario?

- If weather forecast has not been precise enough and warnings not reaching the citizens.
- The timing of the event, for instance during a holiday period, e.g. Christmas where millions of people will be away from home, social workers and rescue teams on holiday leaving for instance elderly people even more fragile.

Sensitivity analysis: prevention and preparedness

How much can preventive measures reduce disaster impacts and consequently the need for response actions? Obviously, winter storms cannot be prevented. However the impact of a violent winter storm can be reduced by:

- stricter regulation concerning building codes for sports arenas, roofs, etc.;
- higher degree of ‘forced’ warnings to keep citizens at home in advance of a storm warning;

- higher degree of enforcement of contingency plans within the local communities in particular towards the elderly;
- improved local preparedness of towns and villages, e.g. awareness, training, equipment, etc.

The following seven key components of disaster risk reduction are particularly relevant preventive measures in the Caribbean: (1) early warning capabilities; (2) community preparedness; (3) awareness raising and knowledge development efforts; (4) infrastructure strengthening; (5) environmental management; (6) government disaster policies; and (7) stakeholder commitment.

If measures under these prevention and risk reduction topics are applied, the Caribbean islands can significantly reduce disaster impacts and limit the need for emergency response. When comparing two Caribbean islands, for example, it becomes clear that proper prevention measures can definitely reduce disaster impacts and risk factors and in turn reduce the needed emergency response and recovery capacity. One only has to look at one specific hurricane – Hurricane Jeanne – that hit Haiti in 2004, to realize how natural hazards strike differently, depending on how the ground "was prepared" for them depending on different levels of prevention and preparedness as well as the absorptive capacity of the natural environment. In Haiti, extreme deforestation left large slopes bare, allowing rain to run off directly to the settlements at the bottom of the hills; the lack of community preparedness as well as prevention measures left the population vulnerable and exposed to the natural hazard. In the neighbouring Dominican Republic which is facing the same exogenous climate conditions, Hurricane Jeanne only left 11 victims to mourn compared to over 3,000 in Haiti (Europaworld 2004). Part of the reason is that the Dominican hills are still covered by protecting forests and people there engage in more sustainable agricultural practices (Toepfer 2005). These prevention measures helped minimise disaster impacts and required emergency response as much as possible.

In summary, storm disasters tend to be both prevention and preparedness sensitive and impacts as well as response needs can be mitigated via proper preventive and preparedness measures.

3.3 Floods

There are several ways to classify floods. According to the definition provided by the European Commission "flood means temporary covering by water of land not normally covered by water".[37] That is to say that flooding happens when a river overtops its banks and inundates nearby low-lying areas. Floods are often classified by its spatial and temporal scale (a continuum from extensive long lasting floods to local sudden floods). Furthermore, floods are usually classified in three main types:

- *River floods* which are the result of intense and/or persistent rain for several days/weeks over large areas. River floods are usually the combination of several

[37] http://www.ewaonline.de/downloads/com_2006_15_en.pdf

factors in a give region i.e. weather and soils conditions, measures for flood protection , land use, etc.;

- *Flash floods* which are characterized by intense rainfall over a small area within a short period of time; and
- *Storm surge floods* which are characterised by water being pushed onto dry lands by onshore or offshore winds or storms.[38]

Floods often cause tangible damage on public and private property, economic activities (infrastructure, buildings, machines, disruption of production), agriculture etc. Furthermore, floods cause intangible damages such as causalities and negative effects on human health and well-being. Floods can also have important beneficial effects for river ecosystems, groundwater recharge and soil fertility.

3.3.1 Typical conditions (risk factors)

Hazard frequency in Europe

In Europe, floods are the most common natural disaster and in terms of economic damage, the most costly (source: EEA: Environmental Issue report No 21; part 3 Extreme hydrological events: floods and droughts). According to EM-DAT International disaster database[39] floods comprised 43% of all disaster events for the period 1998-2002. During this period, Europe suffered about 100 major damaging floods, causing some 700 fatalities, the displacement of about half a million people and at least 25 billion euro in insured economic losses. The number of people affected by flooding was around 1.5% of the European population (EEA: Environmental issue report no 35, mapping the impacts of recent natural disasters and technological accidents in Europe).

The map below indicates major flood disasters in Europe in the period from 1950-2005. Numbers from 1 to 23 are flash floods, 24 to 44 are river floods and 45 to 47 are storm surge floods (a triangle feature represents very large regional events). Major flood disasters hit all regions of Europe from time to time (a major flood is classified as the number of registered casualties being greater than 70 and/or the direct damage is larger than 0.005% of the EU GDP in the year of the disaster source.[40] 47 major flood disasters have been recorded in the 25 European Union Member States (plus Bulgaria and Romania) for the period 1950-2005. In total, 15 countries have suffered significant floods in the period 1950-2005. The most affected, considering the total number of major disasters are: Italy with 12 events, Spain 10 and France and Germany with 9 and 8 events, respectively. The 9 major flood disasters that Europe suffered between 2000 and 2005 caused 155 victims and economic losses of more than € 35 billion. Disaster impacts are likely to affect multiple countries.

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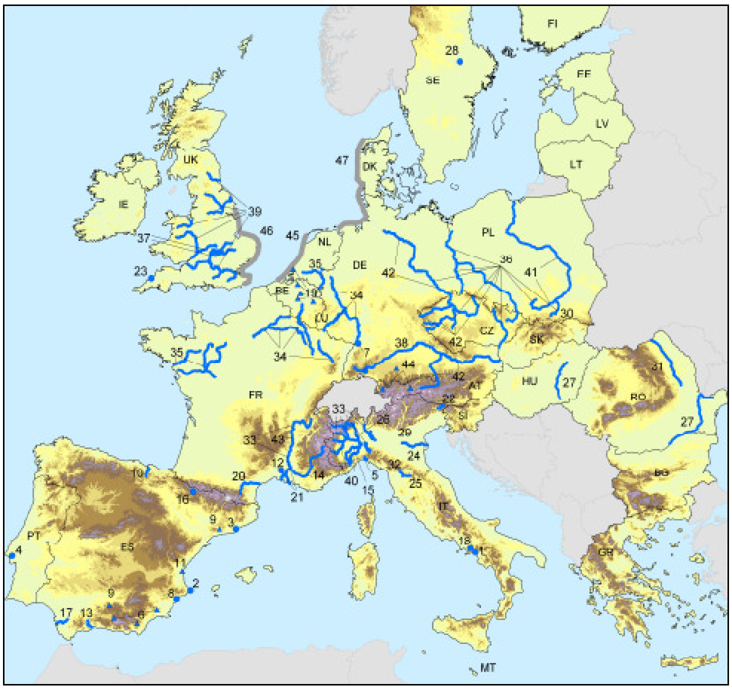
[38] http://www.springerlink.com/content/nl46740140626l81/fulltext.pdf
[39] http://www.cred.be/emdat
[40] http://www.springerlink.com/content/nl46740140626l81/fulltext.pdf

Central Europe (approximately 10 countries) has witnessed some of the largest regional floods in Europe. Around eight major rivers and their tributaries flow across this part of



Europe. The large river systems of Central Europe are vulnerable to flooding. Of the countries' most affected by floods between 1998 and 2002, eight are in central and eastern Europe. As almost all these countries are newly members of EU or candidate countries, flooding has become a greater challenge for EU 27. Projections under the IPCC Fourth Assessment report indicates a substantial increase in the intensity of daily precipitation events and the risk of floods throughout Europe are likely to increase (very high confidence). The increasing volume of floods and peak discharge would make it more difficult for reservoirs to store high runoff and prevent floods.

Hazard frequency worldwide

On a worldwide level, projections under the IPCC Fourth Assessment report indicates increased precipitation intensity and variability is projected to increase the risks of flooding in many areas (high confidence). Globally, flood magnitude and frequency are likely to increase in most regions, and even volumes of low flows are likely to decrease in many regions. Globally, the number of great inland flood catastrophes during the last 10 years (between 1996 and 2005) is twice as large, per decade, as between 1950 and 1980, while economic losses have increased by a factor of five. The dominant drivers of the upward trend in flood damage are socioeconomic factors, such as increased population and wealth in vulnerable areas, and land-use change. Floods have been the most reported natural disaster events in Africa, Asia and Europe, and have affected more people across the globe (140 million/yr on average) than all other natural disasters. For instance in Bangladesh, three extreme floods, due to river floods and sea level rises, have occurred in the last two decades, and in 1998 about 70% of the country's area was inundated. In developing countries flood-related water-borne diseases are expected to increase due to lack of maintenance of water and sanitation services.

3.3.2 Types of prevention and preparedness measures

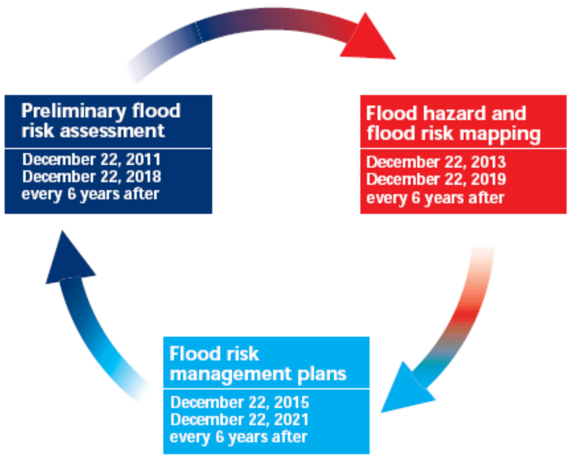
The socio-economic and environmental impact of flooding can to a large degree be prevented by improved land-use planning of vicinity of flood prone areas

The increasing volume of floods and peak discharge would make it more difficult for reservoirs to store high runoff and prevent floods. Preventive measures will to a high degree have a positive impact on reducing the intensity level of disasters but reducing risks may have substantial economic costs. The main structural measures to protect against floods are likely to remain reservoirs and dykes in highland and lowland areas respectively. However, other planned adaptation options are becoming more popular such as expanded floodplain areas, emergency flood reservoirs, preserved areas for flood water, and flood warning systems, especially for flash floods. Other strategies to lessen the risks of flooding include public flood warning systems, evacuations from lowlands, waterproof assembling of hospital equipment and the establishment of decision hierarchies between hospitals and administrative authorities.

Globally, flood magnitude and frequency are likely to increase in most regions of the world. Preventive measures will have a very positive impact on reducing the intensity level of disasters but reducing risks may have economic costs that might be difficult to finance by developing countries. The main structural measures to protect against floods are likely to remain reservoirs and dykes. Other adaptation options are expanded floodplain areas, emergency flood reservoirs and preserved areas for flood water. Among the non-structural measures one can mention early warning systems and flood management measures comprising, for example, real-time hydrological forecasting and the development of flood evacuation and management plans, the establishment of decision hierarchies between hospitals and administrative authorities. Furthermore, the following aspects are of high importance in the case of developing countries: incorporate risk management principles in water resources management; increase multidisciplinary approaches in flood management; improve information on integrated flood management approaches; integrating land and water management, alleviate poverty and reduce poor people’s vulnerability, enhance community participation and ensure international cooperation in trans-boundary basins.

3.3.3 EU Floods Directive

The Directive 2007/60/EC on the assessment and management of flood risks entered into force on 26 November 2007. This Directive now requires the Member States to assess all water courses and coastlines on whether or not they are prone to flooding. Further, it requires to map the flood extent, assets and humans at risk in these areas and to take adequate and coordinated measures to reduce flood risk. The Directive also reinforces the rights of the public to access this information and to have a say in the planning process. The Directive shall be carried out in coordination with the Water Framework Directive, notably by flood risk management



plans and river basin management plans being coordinated, and through coordination of the public participation procedures in the preparation of these plans. The Directive defines a 3-stage approach, which is to be repeated in a cyclic process as shown in the figure above.[41]

3.3.4 Past reference disasters

Three examples among the 47 major flood disasters recorded in Europe for the period 1950-2005 flood disasters are presented below.

Central European Flooding (2002)
The floods that hit Europe during August 2002 caused significant damage in the Czech Republic, Slovakia, Italy, Spain, Germany, Romania, Bulgaria, Croatia, Hungary, and Ukraine. Several rivers in the region, including the Vltava, Elbe and Danube reached record highs. The floods were caused by unusual but not exceptional meteorological conditions. Two rain-bearing depressions crossed Europe in close succession. The first depression resulted in minor flooding in northern England. The system reached southern Germany and Austria, where torrential rainfall resulted. The system then moved eastwards along the southern side of the Alps, resulting in further heavy rainfall in Romania the Czech Republic and the eastern coast of the Black Sea. The second rain-bearing storm caused heavy rain in northern Italy, before moving to the north-east and causing further heavy precipitation in Austria, the Czech Republic and southern parts of Germany. Exceptional rainfall also occurred in Spain. In the Czech Republic, water levels in the Elbe, Berounka and Vlatava reached heights corresponding to between a 500-yr (upstream) and 25-yr (further downstream) return period. Serious flooding also resulted on the Danube in Germany and Austria.

The floods caused more than 100 victims in central Europe and 93 in southern Russia. Tens of thousands fled their devastated homes. Economic loss estimates: Germany (€10-15 billion), Czech Republic (€3-6 billion), Austria (€+3 billion), Slovakia (€35 million), Hungary, Bulgaria, Romania, Ukraine were also damaged. Subsequently the European Union released funds to help countries recover from the devastating effects of floods.[42]

Floods in Italy (2000)
A flood occurred in the Piedmont region in October 2000 caused by heavy rainfall over the North-Western Alpine chain (up to 740 mm of rain in four days). This event was one of the most intense events of the last 200 years in the area. The majority of the basins suffered strong flood episodes; most of the mountainous portion of the basins and parts of the city of Turin were seriously damaged by the strong rainfalls. Thousands of people were forced from their homes where flooding and mudslides are known to have killed at least 29 people. Power was cut in several mountain communities, affecting an estimated 30,000 people. The floods brought Italy's industrial heartland to a virtual standstill. Some 30 factories were damaged by floods in the industrial zone. Car-maker Fiat closed down momentarily three of its largest factories because supplies could not be delivered and

[41] DHI, 2006.
[42] http://www.absconsulting.com/resources/Catastrophe_Reports/flood_rept.pdf

workers have been stranded. More than 173 roads were closed during floods and dozens of bridges destroyed. Some districts were without drinking water.[43]

Floods in Czech Republic, Poland and Germany (1997)

Floods were the result of three series of very intense rainfall. Areas affected were Oder Morava, Wisla and Elbe Rivers; Moravia and Bohemia regions (Czech Republic), Katowice, Opole, and Walbrzych provinces (Poland), Oder and Elbe Rivers (Germany). 55 Poles and 60 Czechoslovakians were killed in the floods. In Poland the floods inundated 665 000 ha of land. 162,000 thousand people were evacuated. Economic loss amounted to US$ 5.900 billion (Czech Republic), US$1.850 billion (Poland) and US$ 0.360 billion (Germany).[44]

Major flood disasters third countries

Indonesia (2007): Heavy rains in the first week of February 2007 caused massive flooding in the Indonesian capital of Jakarta, affecting more than 340,000 people, damaging public utilities and disrupting livelihoods affecting more than 80 regions. A malfunctioning floodgate in the east of the capital caused the main canal to burst its banks. All five districts of Jakarta were affected by the flooding as well as Tangerang and Bekasi, two cities close to Jakarta. Torrential rain caused rivers to burst their banks, sending muddy water up to 3m deep into homes and businesses. Rising floodwaters have cut water supplies, power and communications to parts of the city and forced medical teams to use boats and helicopters to reach many of those left stranded. Many of the homeless are sheltering in schools and mosques, while others are refusing to leave their partially flooded homes. The flood is considered the worst in the last three centuries, including the 1996 and 2002 Jakarta floods, which killed 10 and 25 people respectively.

Mozambique, Malawi (2001): Torrential rains hit Mozambique and Malawi; severe floods threatened the homes and lives of thousands of families. In Mozambique, flooding concentrated in several northern and central provinces. Nearly 400,000 people have been affected by the disaster. At least 41 people died and 86,300 homeless ´displaced from their homes. Large parts of port city Beira flooded. 80,000 hectares of crops flooded in Zambezi valley Flooding in Malawi began in mid-February. Similar to the situation in Mozambique, rivers and lakes are overflowing, destroying many of the homes that stood in low-lying areas. With about 60,000 people homeless, 6 dead, 13 of the country's 27 districts were declared disaster areas. A total of almost 200,000 people have been affected. The flooding has caused extensive damage to crops and livestock. More than 250 villages have lost all crop fields.

[43] http://dialnet.unirioja.es/servlet/fichero_articulo?codigo=258493&orden=74445
[44] http://www.absconsulting.com/resources/Catastrophe_Reports/flood_rept.pdf

3.3.5 Scenario presentation: floods in central Europe

<table>
<tr><th></th><th></th><th>Disaster scenario: Floods in Central Europe</th></tr>
<tr><td rowspan="2">Characterisation of the hypothetical scenario</td><td>Disaster event</td><td>After a dry late-summer heat, September starts with storms followed by weeks of heavy and intense rainfalls across Central Europe a river flood hits a water basin. This start a dynamic cascade of downstream events described below:
Day 1 & 2
▪ Two days of rain in the northern parts of Central Europe have swollen water levels in the upper part of the river basin located in the most northern country among the three countries. At this stage the main river reaches 10- to 20-, or even 100-year levels.
▪ Some localised flooding takes place but a series of reservoirs contain most of the water runoff. The event is, however, enough to raise water levels in the main river and its tributaries; water levels are reported to just centimetres below the tops of levees in upstream areas. Saturation levels in the soil of the upper parts of the river basin rise.
Day 3 & 4
▪ A second period of intense rain fall starts. Areas around cities are protected by removable flood defences as part of national emergency plans. A state of emergency is declared in six regions. Yet, in the most northern country, in the upper part of the river basin, the main river bursts its banks in several provinces. Many reservoirs in the tributary river areas are unable to absorb any of the extra precipitation and thus surrounding areas are flooded immediately.
▪ The walls of a dam collapse.
▪ A flood warning and a warning on the risk of landslides is sent to all regional defence agencies and communities in 8 regions. A landslide with a length of 1 km and a width of 100m with a volume of 600,000 m3 occurs in a sub-basin. The speed of the landslide is less than 1 m/s but destroys a hydropower plant located 800 meters downstream and a bridge about 200 meters further downstream.
Day 5
▪ Rainfall continues.
▪ The flood wave reaches the middle part of the catchment located in the second country.
▪ Rainfall in a mountainous area in the second country followed by runoff to a tributary river causes more severe flooding.

Day 6
▪ The flood wave continues through the second country and reaches the lower part of the catchment located in the third country.
▪ On reaching the northern parts of the third country the flood water inundates a major city and several smaller ones.
Day 7
▪ Water levels in the main river exceed all expectations and existing defences are simply not high enough to withstand water levels. An unfortunate combination of several factors including a quick increase of upstream water levels, failure of a dyke and bank material leave a railway submerged and substantially damaged.
▪ A very violent storm intensifies the pressure on the rivers. The highest water level is reached in the major city of the third country - 9.7.m, exceeding the previously recorded high of 8.43 m in 1833.
Day 8 & 9
▪ The flood wave continues to travel downstream and reaches the southern parts of Central Europe. Warning of the impending flood are issued, city officials in larger cities implement flood protection plans. Unfortunately some tributary rivers change their courses in unexpected ways, catching residents off guard and people die or get injured as a consequence.
Day 10
▪ The water starts to recede. In total, the flood wave took around 10 days to travel from the upper reaches to the lower parts of the river basin.</td></tr>
<tr><td>Disaster site</td><td>▪ The water basin covers a total of 160.000 km2 shared between three Central European countries. The basin has both a pronounced mountainous catchment with a high ridge of 1500-1800 meters as well as lowlands. The basin consists of an upper, middle and lower part and has three main tributary rivers. Structural measures to prevent floods and manage water resources are constructed and lakes and rivers regulated. This is done through the construction of flood embankments and flood walls, systems of drainage canals, pumping stations and designated flood detention reservoirs. A large reservoir (+500km2) and a number of smaller reservoirs are located along the main river. In the basin there are a large number of reservoirs, forests, wetlands and protected areas. Land in the basins is mainly used for agriculture, forestry, pastures, nature reserves, as well as urbanized areas. As a result of intensive agricultural development over the past decades, many natural ecosystems have been transformed into arable lands and pastures. In the mountainous area, deforestation is responsible for changes of the flow regime. The number of inhabitants in the basin is close to 38 million, of which two thirds live in flood prone areas.

▪ After 10 days civil protection can start stabilising and safe-guarding damaged buildings in the three countries. Disposal of sand bags and damaged property creates a problem. In addition, the clean-up of property and streets is required. In many areas, centimetres of mud, sometimes polluted, make streets impassable. Drains need to be unblocked before the water remaining in many basements can be pumped away. In many areas, more modern properties are especially badly affected since these have a higher tendency to be located on the flood plains. Considerable loss due to business interruption is inevitable. Follow-up on victim assistance and rescue includes psychological support to traumatised people. Fire brigades and military forces in the three countries describe the rescue effort as the biggest in peacetime.</td></tr>
</table>

<table>
<tr>
<td>Characterisation of the hypothetical scenario (continued)</td>
<td>Immediate direct and indirect impacts / types of damage</td>
<td>
Human toll:

Country 1: 12 fatalities, 400 injured, a total of 2.5 millions directly affected.
Country 2: 75 fatalities 735 injured, a total of 1.2 millions directly affected.
Country 3: 90 fatalities, 1250 injured, a total of 1.6 millions directly affected, 220,000 evacuated.

Damage to infrastructure:

Country 1: 10,000 houses are damaged or destroyed, 350,000 people without running water, 48,000 homes have power cut. 2 rescue centre, 1 flood announcement centre,1hydro power plant, 1 bridge, 5 hospitals, 260 schools and the national museum flooded. A number of nurseries, primary and secondary schools are damaged and a total of 30.000 children in school age are directly affected. Hundreds of public buildings are damaged. Damage to infrastructure: 1 dam collapsed, 5 small reservoirs collapsed, 1 electricity plant flooded. 25,000 km of roads severely damaged.
Country 2: The capital flooded, 50,000 houses flooded, 420,000 left without drinking water 32,000 homes evacuated. 145 towns and villages entirely flooded, 350 partially flooded. 1 major bridge and two smaller collapsed. Major business areas are closed down.4 hospitals and 88 schools are evacuated. Public buildings damaged.
Country 3: 50,000 houses flooded, 420,000 left without drinking water 32,000 homes evacuated. 8 hospitals evacuated. Underground train system flooded. 245 towns and villages entirely flooded, 100 partially flooded. 3 bridges collapsed. Tens of thousands of hectares of agricultural land damaged and 50,000 livestock lost. 450 km of railway damaged. Major business areas are closed down. Public buildings damaged.

Ecological effects:

In all three countries raw sewage spilled in flooded areas, vegetation was damaged and the destruction of buildings and chemical industrial complex /stores/petrol stations released toxic materials (paints, pesticides and gasoline) into the local environment. This resulted in a temporary negative impact on water quality in all three countries.
Indirect impacts included pollution such as the mobilisation of toxic substances in the soil that then infiltrated aquifers.
In the second and the third country leakages from flooded industrial areas caused severe local chemical pollution.

Immediate secondary impacts:

Country 1: Drinking water contamination and occurrence of landslides due to severe erosion of flood banks.
Country 2: Drinking water contamination and outbreak of water related diseases.
Country 3: Drinking water contamination.

Overall economic impacts: The total economic damage is estimated to exceed 2.3 billion Euros. It is estimated that in the worst damaged areas only 30% of the habitants will be able to return to their homes within the first three months after the floods. Insurers in the three countries dealt with some 230,000 claims for flooded homes, businesses and vehicles.
</td>
</tr>
</table>

Expected / required response resources	0-24 hours: **Managed by national capacities:** ▪ Establishment of recovery centres for 2 million people. ▪ Health and safety advice and information. ▪ Transportation for evacuation purposes (by road, rail, air or water as appropriate), heavy equipment to clean-up property and streets, unblocking of drains, etc. ▪ Facilities for registration of evacuees. ▪ Portable dryers, floating pumps, electric submersible pumps, hygiene kits and water filters. ▪ Removable flood protections and pumping equipment ▪ Temporary shelter and food for 1 million people **Need for external assistance:** ▪ High capacity pumping equipment. 4 units high capacity pumps for two cities and 25 mobile units to drain flooded roads. ▪ Provision of community/individual recovery services: food, clothing and temporary accommodation for 1 million people. ▪ Military and rescue services equipment for evacuation of 1.5 million people, including special requirements for evacuating 50 hospitals and about 200 nursing homes. ▪ Restoration of power supply (mobile power supplies) ▪ Water purification equipment for approximately 2 million people spread across various locations. ▪ Helicopters. ▪ Search and rescue (SAR) e.g. urban search and rescue units of all kinds – MUSAR (at least 5 units). Up to 3 days: **Managed by national capacities:** • Management of recovery centres including specialists on traumatised people, doctors, medicine. **Need for external assistance:** • Specialists on environmental pollution, contamination of drinking water facilities etc. (at least 2 teams). • Heavy equipment machinery for clean-up operations. • Water purification equipment – (6 large-scale units for 2 cities in each of the three countries) (600 small-scale units for villages throughout the three countries) (500.000+ water purification tablets). • High capacity pumping equipment. Minimum 15 units of high capacity pumping equipment to be used among the hardest hit cities / villages in two countries. Up to 2 weeks: **Managed by national capacities:** • Management of recovery centres including specialists on traumatised people, doctors, medicine. **Need for external assistance (beyond civil protection assistance):** ▪ Specialists on environmental pollution, contamination of drinking water facilities etc. (at least 1 team). ▪ Heavy equipment machinery for clean-up operations. ▪ Water purification equipment – (4 large-scale units for 2 cities in each of the three countries) (400 small-scale units for villages throughout the three countries) (200.000+ water purification tablets). ▪ High capacity pumping equipment. Minimum 8 units of high capacity pumping equipment to be used among the hardest hit cities / villages in two countries.

3.3.6 Scenario presentation: floods in southern Africa

<table>
<tr><th colspan="3">Disaster Scenario: Floods in Southern Africa</th></tr>
<tr><td rowspan="2">Characterisation of the hypothetical scenario</td><td>Disaster event</td><td>Heavy downpours are common in the region during the annual rainy season, which runs from November to April. It is only the beginning of the rainy season but this year the rainfall is believed to be the heaviest since records began a century ago.

Day 1 & 2: After two days of heavy rain in the central part of the river basin the main river is already well over six metres deep. Nourished by above average run-off from the upper part of the river basin, the river is rapidly approaching the 7.6 metre level that it reached during disastrous floods in 2000. The rain has flooded and destroyed fields and washed out roads and villages. The main city of the northern regions of the country is flooded as rivers across the regions burst their banks. In low-lying areas tens of thousands of homes, livestock and infrastructure are destroyed. Several regions experience power cuts.

Day 3 & 4: On the third day water from rivers in the north flow into the southern part of the country. The southern parts are already hard-hit areas where millions are struggling to feed themselves in the midst of an economic crisis. 1.5 million people are displaced by floods, road links are cut to many parts of the country. Crops and village granaries are washed away, destroying food supplies. The government is warning that tens of thousands of people face starvation because food distribution has been virtually impossible in some areas. Outbreaks of diarrhoea and cholera due to contaminated floodwater start spreading. 71 people die as a result of the severe flooding. Houses are damaged or destroyed. People across the country are left without running water because of the floods. The government is planning an emergency response with support from the UN, The Red Cross and NGOs.

Day 5: A second period of intense rainfall starts in the second country. At the same time the flood wave reaches the middle part of the catchment. Floods are forcing people to flee their homes, even as they try to recover from last year's floods. The walls of a dam collapse. Many remain trapped on islands in the river or have retreated to shrinking patches of higher ground near villages. Some 270,000 people face food shortages in the affected areas. Risk of waterborne diseases and diseases caused by poor sanitation rises. A rapid assessment of the disaster is carried out by several UN agencies and country government officials.

Day 6: The flood wave continues through the second country. A cyclone makes landfall, government and UN authorities declare a humanitarian emergency. The first autonomous mass displacement is registered by the International Red Cross. 78 lives are claimed and 12 people are missing in a landslide. The HIV/AIDS prevalence rate in the area is said to be 43 percent deepening the vulnerability of people to waterborne diseases and malaria. Shelter is not available and displaced people are temporarily settling in the open, underneath trees, with limited protection from the heavy rains. Thousands of hectares of agricultural land are damaged and large numbers of livestock lost. The few major businesses are forced to shut down. Towns and villages are entirely flooded. The main bridge connecting the eastern and western side of the capital collapses.

Day 7: Preventive measures are taken by emergency teams in the capital of the second country. People are evacuated.

Day 8: The water starts to recede slowly but huge areas remain inundated.</td></tr>
<tr><td>Disaster site (key geographic areas affected)</td><td>In the current scenario it is assumed that floods hit a water basin due to extraordinarily intense rainfall in the rainy season. The water basin covers a total of 1.170.000 km^2 shared between 5 Southern African countries. The flood scenario is imagined to hit the central part of the river basin shared by two countries. The central part with a total of 490.000 km^2 is a region with dense patches of forest and grass lands and is joined by sizeable tributaries flowing from highlands. It unfolds in a flat floodplain landscape, with the flood reaching a width of 25 kilometres in the rainy season. The annual flood cycle dominates the natural environment, human life, society and culture. Several smaller dams and a larger dam with a surface area of 4300 km^2 are found in this central part of the river basin. These provide hydropower to the two countries that own the dams. Before the dams were built, the upper part of the river basin experienced a small flood surge early in the dry season and much larger floods in the rainy season. The dams have changed that pattern. The dams have not removed flooding in the basin completely; they have just made medium-level floods less frequent but cannot control extreme floods. When heavy rains and strong run-off from the upper part hit the basin, massive floods still happen. Sewage effluent is a major cause of water pollution around urban areas, as inadequate water treatment facilities in all the major cities of the region force them to release untreated sewage into the river. This has resulted in eutrophication of the river water and has facilitated the spread of diseases of poor hygiene such as cholera, typhus and dysentery. The construction of the major dam regulating the flow of the river has had an effect on wildlife and human population in the area. The drastic reduction in the flow of the river led to a shrinking of wetland ecosystems. The basin is home to about 40 million people of which 25 million live in the central parts. The basin's population is growing rapidly. If the present growth rates of the population are sustained, the population will double within the next generation. In most of the countries, over 40 percent of the population is under 14 years of age, implying a high dependency ratio.</td></tr>
</table>

Immediate direct and indirect impacts

Human toll:
Country 1: 278 fatalities, approximately 8000 injured, a total of 3 million people directly affected. Autonomous mass displacement of 450,000 people.
Country 2: 1098 fatalities, approximately 15,000 injured, a total of 3.5 million people directly affected. Autonomous mass displacement of 630,000 people.

Damage to infrastructure:
Country 1: Hundreds of public buildings damaged and one major bridge collapsed. 5 regional hospitals, 320 health clinics and 1200 community schools flooded. 50,000 houses flooded, 1 electricity plant and 2000 km of roads severely damaged. Thousands of hectares of agricultural land damaged. 10,000 heads of cattle and goats and 200,000 poultry lost.
Country 2: Walls of a dam collapsed 1200 villages flooded. Main bridge in the capital collapsed. Thousands of hectares of agricultural land damaged. 12,000 heads of cattle and goats and 350,000 heads of poultry lost. Industries closed down. 2,200 km of roads severely damaged.

Ecological effects:
Damage to vegetation and raw sewage spilled in to the local environment in flooded areas.

Immediate secondary impacts:
Country 1 and 2: High risk of drinking water contamination, and high risk of outbreak of waterborne diseases and diseases caused by poor sanitation (diarrhea, typhus and cholera). Risk of landslides due to severe erosion.

Overall economic impacts:
The total economic damage is estimated 251 million Euros.

Expected / required response resources

Responses require international financial and technical emergency assistance (International NGOs and state agencies) throughout the disaster response.

<u>Up to 3 days:</u>
Managed by national capacities:
- Establishment of recovery centres for 2 million people.
- Health and safety advice and information.
- Transportation for evacuation purposes (by road, rail, air or water as appropriate), heavy equipment to clean-up of property and streets, unblocking of drains, etc.
- Facilities for registration of evacuees.
- Management of recovery centres including specialists on traumatised people, doctors, medicine.

Need for external assistance:
- Removable flood protections (at least 10 units for the city x where walls of the dam collapsed).
- High capacity pumping equipment. Minimum 20 units of high capacity pumping equipment to be used among the hardest hit villages in the area.
- Provision of community/individual recovery services including: personal support, food, clothing and temporary accommodation for 2 million people in various locations across the countries.
- Military and rescue services equipment for evacuation of 1.5 million people, including special requirements for the aged and infirm.
- Restoration of power supply (mobile power supplies).
- International disaster assistance - helicopter reconnaissance, portable dryers, floating pumps, electric submersible pumps, hygiene kits and water filters.
- Search and rescue (SAR) e.g. urban search and rescue units (at least 10 MUSAR units). Also units for flooded conditions are needed.
- Specialists on environmental pollution, contamination of drinking water facilities etc.
- Water purification equipment – (2 large-scale units for 2 cities with more than 200.000 inhabitants each) (400 small-scale units for small, remote villages with less than 500 inhabitants each) (1 million + water purification tablets).

<u>Up to 2 weeks:</u>
Managed by national capacities:
- Preparing water points, buckets and latrines
- Transportation for evacuation purposes (by road, rail, air or water as appropriate), heavy equipment to clean-up of property and streets, unblocking of drains, etc.

Need for external assistance:
- Operations of recovery centres for 2 million people.
- Removable flood protections (at least 10 units for the city x where walls of the dam collapsed).
- High capacity pumping equipment. Minimum 10 units of high capacity pumping equipment to be used among the hardest hit villages in the area.
- Specialists on environmental pollution, contamination of drinking water facilities etc.
- Water purification equipment – (2 large-scale units for 2 cities with more than 200.000 inhabitants each) (200 small-scale units for small, remote villages with less than 500 inhabitants each) (500.000+ water purification tablets).
- Restoration of essential services (management of public and environmental health issues, reconstruction and redevelopment of infrastructure) (external assistance required).
- Provision of economic recovery services (implementation of financial assistance schemes, management of public appeals and insurance).
- Provision of community/individual recovery services including: personal support, food, clothing and temporary accommodation for 2 million people.
- Insecticide treated mosquito nets, water purification products, education material on how to safely treat water, hygiene kits, food assistance (including baby food and instant meals), tents, sleeping mats, water containers, blankets, etc.

3.3.7 Analysis

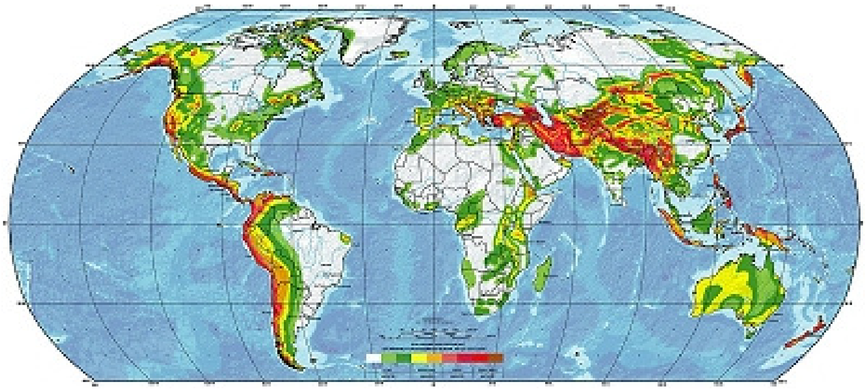
Scenario Choice
The last decades have shown an increasing frequency and impact of river floods in Europe and third countries. The present scenarios illustrate the wide impacts of major floods, and the needs for international coordination of response capacities both at national and trans-boundary scale in Europe and third countries.

Limitations
The current scenario as described is likely to represent a worst case scenario. However, there are many other types of floods disasters not covered within the current scenario. This includes flash floods, coastal floods, storm surge floods etc. Each type of disaster, however, is very different and would require individual scenario descriptions.

3.4 Earthquakes

Earthquakes are caused when the pressure built up by the friction of tectonic plates moving against each other is suddenly released, sending waves of seismic energy through the earth's crust. As such, earthquakes tend to be concentrated in those areas of the world which lie on or close to the boundaries of tectonic plates.

The effects of heavy earthquakes can be felt over long distances and may even transcend national borders. However, it is not well understood if earthquakes can trigger remote seismicity, causing similar events to occur in other countries. Earthquakes tend to occur in series, consider for example the major earthquakes in Turkey (August 17 and November 12) and Greece (September 7) in 1999, but whether there is a direct causality is far from certain.



Based on regional maps, the Global Seismic Hazard Assessment Program (GSHAP), a United Nations demonstration programme carried out during the International Decade for Natural Disaster Reduction (1990-2000), has put together a world map of seismic risks. The map shows that the following regions have a relatively high earthquake risk: Southeast Europe; Western, Southern, and Central Asia; and the countries located on the Pacific Ring of Fire.

In recent years, a number of destructive earthquakes have occurred in these areas, such as the 2001 Gujarat earthquake (India), the 2003 Bam earthquake (Iran), the 2005 Kashmir earthquake (India and Pakistan) and the 2008 Sichuan earthquake (China). While the majority of earthquake activity in the region takes place either at the fault line between the Indian and Eurasian or at the fault line between the Arabian and Eurasian plates, there are also instances of so-called intra-plate earthquakes, which occur in fault zones in the middle of a tectonic plate (e.g. the Gujarat earthquake). Though rare, such earthquakes can be extremely destructive if they are of a sufficient magnitude, not least because the affected areas tend to be less prepared for tremors than zones with a higher earthquake frequency (i.e. zones on or close to the boundaries of tectonic plates).

3.4.1 Typical conditions (key risk factors)

Hazard frequency

Despite the fact that some regions are clearly more earthquake-prone than others, it is very difficult to estimate the probability of future major earthquakes occurring or much less to predict the time and scale of impacts of an imminent earthquake. “Given the nature of the large geological processes causing earthquakes, we can expect that each earthquake zone will have a rate of earthquake occurrence associated with it. Broadly, this is true, but as the rocks adjacent to plate boundaries are in a constant state of change, a very regular pattern of seismic activity is rarely observed. In order to observe the pattern of earthquake recurrence in a particular zone, a long period of observation must be taken, longer in most cases than the time over which instrumental records of earthquakes have been systematically made.”[45]

Several areas are widely known for the regularity and intensity with which earthquakes have originated there. One example is the Vrancea region in the Eastern Carpathian Mountains of Romania, about 150 km northeast of Bucharest. In the last 65 years, 4 major earthquakes with moment-magnitudes between 6.9 and 7.7 have hit the Romanian capital.

Although areas of high seismic risk are fairly well identified, a low rate of instrumental seismicity is not a reliable indicator for judging seismic potential. Consider for instance the 1999 Athens earthquake, which was caused by a hitherto unknown fault (Fili) which could have been identified with a more thorough study of tectonic systems, historical seismicity, geodesy or gravimetry. Should such a research effort have been undertaken before 1999, “it certainly would have revealed that the neotectonic Fili fault is active, that at least one strong earthquake occurred on it in historical times and that strong shocks should be expected in the future.”[46]

According to the United States Geological Survey, the number of large earthquakes ($M_L <$ 7.0) has not increased over the past century, and may even be decreasing. Several factors, however, contribute to the widespread perception that the number of earthquakes has

[45] Coburn, A. and R. Spence (2002): ***Earthquake Protection***, 2nd ed., John Wiley and Sons Ltd., p. 18

[46] Papadopoulos, et al (2002): ***The problem of seismic potential assessment: Case study of the unexpected earthquake of 7 September 1999 in Athens, Greece***, in *Earth Planets Space*, **54**, 9–18, 2002

grown. First of all, technological development and large-scale deployment of sensors have allowed a much greater number of earthquakes to be identified. Second, modern communication systems allow reports of earthquakes in remote parts of the world to be disseminated across the globe. Third, population density in developing countries has been increasing; meaning that the number of casualties has risen even though the strength of earthquakes has not increased. Finally, earthquakes tend to occur in clusters, which human psychology tends to interpret as a threat, while periods of quiescence are hardly ever remarked upon.

Exposure/vulnerabilities

In most cases, earthquakes do not directly cause fatalities. However, when combined with high population density and poor quality housing and infrastructure earthquakes, fatalities are far more likely to occur. About 75% of deaths in an earthquake can be attributed to collapsing buildings, while the remaining fatalities are often caused by fires, accidents, post-earthquake epidemics, civil disorders, landslides, etc. Thus, from a technical point of view, a combination of adverse site conditions, poor building design, bad workmanship, and poor quality materials greatly increases the risk of buildings being affected by earthquakes. Vulnerability is greatly increased if there are a large number of residents living and working in these buildings and there are no systems in place to guarantee that emergency assistance can be sufficiently provided. Four types of vulnerabilities can be distinguished: social vulnerabilities, economic vulnerabilities, physical vulnerabilities and environmental vulnerabilities. These will be further discussed below.

Social vulnerabilities: Badly sited areas with high population density and low quality infrastructure and public services are usually inhabited by lower income segments of the population, who are most vulnerable to natural disasters such as earthquakes. In some cases, inadequate rebuilding after an earthquake in order to house large numbers of displaced people can itself be a source of risk.

Economic vulnerabilities: Large earthquakes can cause significant economic losses, as estimates of the GNP loss incurred by the 1977 Bucharest (3.0%), 1980 Friuli (6.8%) and 1999 Athens earthquakes (12.8%) show. If risk is considered "a convolution of seismic hazard, vulnerability and economic value exposed to the hazard"[47], then a place like the Athens region, which is of relatively low seismic hazard, is at high risk because of its very high economic value and vulnerability.

Physical vulnerabilities: Earthquakes affect critical infrastructure (e.g. industrial power plants, dams, bridges, etc.) as well as historic buildings and sites of cultural significance. For example, numerous archaeological sites in earthquake-prone zones can be damaged, leading to a practically irreplaceable loss of cultural goods. These cultural goods may also be an important source of income from tourism.

Environmental vulnerabilities: Apart from their high destruction potential, earthquakes can trigger secondary disasters, such as fires, landslides, tsunamis and floods. Additionally, as earthquakes displace large numbers of people from their homes forcing

[47] Papadopoulos, et al (2002): ***The problem of seismic potential assessment: Case study of the unexpected earthquake of 7 September 1999 in Athens, Greece***, in *Earth Planets Space*, **54**, 9–18, 2002

them to leave them unattended and in insalubrious conditions, they may provoke epidemics.

3.4.2 Types of prevention and preparedness measures

Several preventive measures have the potential to significantly reduce the number of casualties. The following types of prevention and preparedness measures have been considered in the earthquake scenarios:
- Stricter building codes and compliance with standards;
- More robust lifelines;
- Improved early warning systems; and
- Regular rehearsal of evacuation plans.

3.4.3 Types of impacts

According to the Nevada Seismological Laboratory, the impact of any earthquake depends on a number of different factors. These factors are either:
- *Intrinsic* to the earthquake (e.g. its magnitude, type, location, or depth);
- *Geologic* conditions where effects are felt (e.g. distance from the event, path of the seismic waves, types of soil, water saturation of soil, etc.); and
- *Societal* conditions reacting to the earthquake (e.g. quality of construction, preparedness of populace, or time of day).

The very same seismological laboratory distinguishes between two classes of earthquake effects: direct effects and secondary effects. Direct effects are defined as "solely those related to the deformation of the ground near the earthquake fault itself". It should be noted here that a large number of earthquake faults never break the surface and, consequently, never create direct effects. An example is provided in terms of the Kobe earthquake (will be further elaborated upon below), where the direct effects were observed only in a relatively small area. Secondary effects are defined as "those not directly caused by fault movement, but resulting instead from the propagation of seismic waves away from the fault rupture". Secondary effects actually cause most of the damage as they can occur over very large regions, having wide-spread consequences such as seismic shaking, landslides, liquefaction, fissuring; settlement; and the triggering of aftershocks and additional earthquakes.[48]

The EQE International report 'Earthquakes of 1999 - Issues for Catastrophe Risk Management' also confirms these findings. It is also stated there that "ground shaking caused 90% of building and equipment damage, with reinforced concrete frames being especially highly variable" and that "soil failures (liquefaction, landslides, and settlement) caused extensive damage". Furthermore, with respect to the actual financial impacts of a

[48] The Nevada Seismological Laboratory, *Earthquake effects*, at http://www.seismo.unr.edu/ftp/pub/louie/class/100/effects-kobe.html

shock, the very same publication points out that business interruption in areas after an earthquake can actually dominate the losses. [49]

3.4.4 Earthquake response options

As research in recent decades has shown, the period straight after any major earthquake is often characterized by a wide variety of initiatives from various societal actors. For example, Mileti, Drabek and Haas (1975) already pointed to differences in post-earthquake behaviour between individuals, groups, organizations, community, nation and international systems in the various post-impact phases.[50] However, in the lights of the post-impact chaos, one can see how the various initiatives by these various actors occurring in the various phases of behaviour are inevitably hard to coordinate. Consider for example the earlier mentioned EQE International report 'Earthquakes of 1999 - Issues for Catastrophe Risk Management' which found that in the 1999 Earthquakes response was poorly managed, and recovery particularly burdensome.[51] The post-impact problems of coordination might thus be able to explain some of the difficulty often confronted with in responding to earthquakes.

This is also recognized by the study 'Optimized resource allocation for emergency response after earthquake disasters'. The authors of this study note that: "One important difficulty arising in this period is to find the best assignment of available resources to operational areas". The authors of this report solve this problem by coming up with a dynamic optimization model with the potential to calculate the resource performance and efficiency for response tasks.[52]

In recent decades, the Commission has also recognised this problem of coordination. With respect to disaster response in the EU, earthquakes fall under the comprehensive approach to dealing with disasters outlined by EUR-OPA major hazards agreement. As Pia Bucella emphasized on the 11th ministerial meeting of the EUR-OPA major hazards agreement in 2006 in Marrakech (Morocco), the Community has strived to set up various disaster preparedness and response mechanisms to enable adequate coordination on an international level. A well-known example is the Community Mechanism to facilitate reinforced cooperation in civil protection assistance interventions. This Community Mechanism is continuously evaluated and various ongoing initiatives are undertaken to further develop and improve the mechanism.[53]

In drawing up a disaster response programme, a point primarily focused upon by the Commission is coming up with an integrated and comprehensive approach covering four major aspects: disaster prevention, disaster preparedness, disaster response and disaster

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[49] EQE International, *Earthquakes of 1999 - Issues for Catastrophe Risk Management*, **Issues for Global Catastrophe Risk Management (2000)**

[50] Mileti, D.S. and Drabek, T.E. and Haas, J.E., *Human systems in extreme environments: a sociological perspective*

[51] EQE International, *Earthquakes of 1999 - Issues for Catastrophe Risk Management*, **Issues for Global Catastrophe Risk Management (2000)**

[52] Fiedrich, F. and Gehbauer, F. and Rickers, U., *Optimized resource allocation for emergency response after earthquake disasters* , Safety Science 35 (2000) 41-57

[53] Bucella, P. *Disaster prevention, a political concern for Europe and the Mediterranean: priorities for the future*, Speaking points for the 11th ministerial meeting of the EUR-OPA major hazards agreement in 2006 in Marrakech (Morocco),

rehabilitation.[54] This is also a matter consider essential by various studies in the post-disaster response field. Consider for example, the authors of the earlier mentioned EQE publication who state that response effectiveness can be greatly improved by coming up with an integrated programme of earthquake risk identification, quantification and mitigation and linking this programme to national earthquake insurance schemes. It is noted that, at the time of writing, this was not the case, although New Zealand's EQC scheme comes close and the US NFIP and French CCR offer excellent flood-related analogies.[55]

3.4.5 Past reference disasters

This section elaborates on disaster experiences in the past that were used as a reference for gauging likely future intensity, impacts, risks, etc. Several major past earthquakes will be discussed in detail.

Earthquakes in the EU region

Commencing with the tremors in the night of the 6th of May 1976, a sequence of 435 earthquake shocks occurred over a period of two years in Friuli in Northeast Italy. Statistics show that approximately 950 persons died while more than 2,500 persons were severely injured. Furthermore, approximately 12,000 houses were destroyed and 25,000 were damaged.[56]

On March 4, 1977, an earthquake hit the city centre of Bucharest (Romania), levelling 35 multi-story buildings and killing about 1,300 people. Additionally, 32,000 flats suffered heavy damage, leaving 34,000 families homeless. The tremors also inflicted structural damage on a great number of buildings.

The earthquake which occurred on November 23, 1980 in the lrpinia area of Southern Italy (northeast of Naples), is often said to be one of the most devastating to have occurred in Europe during this century. Damage to buildings is reported to have occurred over an area of 8100 square kilometres. In total, 480,000 buildings were damaged, of which 120,000 were reported unusable. Furthermore, approximately 3,000 lives were lost and almost 200,000 individuals became homeless.[57] [58]

The Athens earthquake of the 7th of September 1999, which mainly affected the northwest suburbs of the city, caused the complete collapse of 65 buildings. It killed 143 individuals, injured 7,000 and left 70,000 families homeless. In total, about 93,000 buildings suffered some degree of damage. While lifelines remained more or less intact, the entire telephone system (including mobile telephony) collapsed due to saturation of

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[54] Bucella, P. *Disaster prevention, a political concern for Europe and the Mediterranean: priorities for the future*, Speaking points for the 11th ministerial meeting of the EUR-OPA major hazards agreement in 2006 in Marrakech (Morocco),

[55] EQE International, *Earthquakes of 1999 - Issues for Catastrophe Risk Management*, **Issues for Global Catastrophe Risk Management (2000)**

[56] Cattarinussi, B. – *Victims, Primary Groups, and Communities after the Friuli Earthquake*

[57] Goretti, A. and G. Di Pasuale (2002): *An overview of post-earthquake damage assessment in Italy*, presentation at EERI Invitational Workshop, Pasadena, California (USA), 19-20 September 2002

[58] Spence, R. – *Some observations from a field survey of the Irpinia (Italy) earthquake of 23 November 1980*, Eng. Struct., 1982, Vol. 4, July

the phone lines. Rescue teams used hand radios to maintain communication with crisis centres, while helicopters were dispatched to examine affected sites. Search and rescue operations at 32 collapsed building sites included teams from 8 countries. Overall, given the extent and severity of the earthquake, government response in the hours and days after the event were deemed satisfactory. However, the lack of equipment to prop up severely damaged buildings and make them resistant to aftershocks was a major point of criticism. This shortcoming was most likely due to the inexperience of the municipal authorities, who had only recently been conferred the responsibility for emergency response.[59]

A little less than 9 years later, another major earthquake hit Greece. On June 8, 2008 the region of Peloponnese provided the setting for this disaster. Panicked residents were reported to have run into the streets when the earthquake struck 33 miles south of the western port city of Patras. In total, two individuals were killed and a further 125 were injured. Authorities reported dozens of damaged homes.[60]

On April 4, 2009 a 6.3 earthquake hit the Abruzzo region in central Italy with a quake depth of approximately 2 kilometres. The closest towns were S. Pizzoli (6km) with a population of 3.378 and L'Aquila (7km) with a population of 72.279. The earthquake caused close to 300 deaths and injured thousands. Approximately 30.000 have lost their homes and had to be placed in temporary shelter. Aftershocks continued days after the initial incident and hampered rescue efforts.

Preliminary assessments show that poor construction of modern buildings and a lack of early warning played a major role in the high death toll. Modern buildings that suffered partial or total collapse in the quake include a hospital, city buildings, the provincial seat and university buildings. About 1,000 damage assessors were deployed to check over 20.000 premises to evaluate which ones are safe.

Earthquakes in third countries

In 1995, the worst earthquake catastrophe in years occurred on western Honshu Island in Japan. In total, over 5,000 individuals died as a result of the earthquake; most of these in the city of Kobe, Japan's most important port city.[61]

Looking at the number of fatalities, an earthquake of even greater magnitude occurred four years later in Kocaeli (Turkey). On August 17 1999, the Izmit Earthquake tore through Kocaeli, resulting in a very large number of deaths and injuries. Various divergent estimates exist on the exact number of fatalities. The official death count was 18,373 but reports exist which estimate the actual number of fatalities to be about 2.5 times larger. Consider, for example, the publication 'On the death toll of the 1999 Izmit (Turkey) major earthquake' by Marza. Based on indirect data such as the number of plastic bags requested (by Turkish Government), the amount and severity of building

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[59] Dimitriu, P., C. Karakostas, and V. Ledikis (2000): *The Athens (Greece) earthquake of 7 September 1999: The event, its effects, and the response*, at http://www.iiasa.ac.at/Research/RMS/july2000/Papers/dimitriu2807.pdf

[60] The independent – *Two killed as earthquake strikes Peloponnese*, 9 June 2008, at http://www.independent.co.uk/news/world/europe/two-killed-as-earthquake-strikes-peloponnese-842881.html

[61] The Nevada Seismological Laboratory – Earthquake effects, at http://www.seismo.unr.edu/ftp/pub/louie/class/100/effects-kobe.html

damage and the life loss in other comparable size events hitting in resembling vulnerability environments, he comes up with an estimate of around 45,000 fatalities.[62]

Besides the fact that Iran provides a typical example of a country where earthquakes are common because it lies on major fault lines, the 2003 Bam (Iran) earthquake is a typical example of how adverse site conditions, poor building design, bad workmanship, and poor quality materials greatly increases the risk of buildings being affected by earthquakes and, consequently, the number of fatalities.. In reporting on the disaster, BBC News also notes this, saying: "It was the prevalence of poorly designed houses built with primitive materials and in disregard of building codes which meant that a tremor of similar strength killed as many as 50,000 in the Iranian city of Bam but only two in quake-prone California the previous week".[63] As a consequence, this article shows how incredibly important the earlier identified preventive measures are.

In 2005, the world was shocked by the extremely heavy earthquake in Kashmir (Pakistan). Officials estimate the disaster to have caused a total of over 79,000 fatalities.[64] The United States Agency for International Development (USAID) estimates 73,320 individuals dying, 69,392 becoming injured and another 2.8 million losing their homes as a result of this disaster. Furthermore, the very same organization estimates another 1,309 fatalities, 6,622 injured individuals, and 150,000 homeless individuals because of the effects of the earthquake in India.[65]

The nineteenth deadliest earthquake of all time, the 2008 Sichuan (China) earthquake, is estimated to have killed over 87,000 individuals. The earthquake occurred 90 kilometres from Chengdu, a large Chinese financial hub.[66] The last time more individuals died in a Chinese earthquake was in the 1976 Tangshan earthquake, which killed at least 240,000 people. In reporting on the Sichuan earthquake, the NY times indicates the importance of the earlier identified preventive measures: "Since the Tangshan earthquake in 1976, which killed over 240,000 people, China has required that new structures withstand major quakes. But the collapse of schools, hospitals and factories in several different areas around Sichuan may raise questions about how rigorously such codes have been enforced during China's recent, epic building boom."[67]

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[62] Marza, V.I. - *On the death toll of the 1999 Izmit (Turkey) major earthquake*,

[63] BBC News - ***Starting from scratch in Bam,* Friday, 2 January, 2004 at http://news.bbc.co.uk/2/hi/middle_east/3363125.stm**

[64] MSNBC - *New figures put quake toll at more than 79,000*, 19 October 2005 , at http://www.msnbc.msn.com/id/9626146/page/2/

[65] US Aid – *Fact sheet: South Asia Earthquake*, at http://www.reliefweb.int/rw/RWB.NSF/db900SID/KHII-6J93HT?OpenDocument

[66] US Geological Survey – *Earthquake centre*, at http://earthquake.usgs.gov/eqcenter/eqinthenews/2008/us2008ryan/#summary

[67] NY Times – Topics: Sichuan Earthquake, at http://topics.nytimes.com/top/news/science/topics/earthquakes/sichuan_province_china/index.html

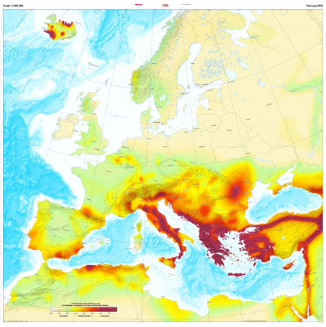
3.4.6 Scenario presentation: earthquake in Europe

<table>
<tr><th colspan="3">Disaster scenario: Earthquake in Europe</th></tr>
<tr><td rowspan="2">Characterisation of the hypothetical scenario</td><td>Disaster event</td><td>Shortly after 4:20 in the morning of a Sunday in August, a strong earthquake ($M_L = 7.5$) hits the mountainous area of a southeast European country. Originating approximately 25 km below the surface of the earth, its epicentre is only about 6 km from the nearest conurbation, a small town of 13,000 inhabitants. The tremor is felt over a long distance, including in the capital (120 km away), where most of the damage is inflicted. In total, damage and loss of human life is reported in 186 towns, villages, and hamlets across the total affected area, which is estimated at around 200,000 km². The population found within the total affected area is about 18 million, of which 4.5 million live in the core affected area of 40,000 km².

Within the core affected area, there is widespread power supply failure and telephone communication systems are interrupted. The local emergency infrastructure is quickly overwhelmed by the number of injured persons brought to medical facilities, while the lack of vehicles and helicopters seriously restricts the authorities' capacity to survey the damage and provide emergency assistance.

While older two- and three-story masonry houses built in the traditional style suffer only moderate damage, the larger and more modern structures mostly found in urban areas are more seriously affected. Due to the fact that a significant portion of the housing stock (particularly pre-1940s stock) in urban areas is of sub-standard quality, many multi-story reinforced concrete buildings have suffered serious damage, some to the point of partial or total collapse, trapping sleeping inhabitants in their beds. Some older residential buildings erected on the hilly outskirts of the capital have been also been affected due to minor landslides, while a newer settlement 12 km upriver from the capital was particularly affected by ground liquefaction. In the centre of the capital, the roof and terrace of a popular discotheque (a reconverted cinema) have collapsed.

The streets and squares of affected cities, towns, and villages quickly fill up with frightened people, some of whom are injured and in a state of shock. The situation threatens to get out of hand as people do not see help arriving immediately and being to dig for survivors with their bare hands, commandeering whatever vehicles they can find to ferry victims away from the worst hit zones. Passable streets and roads quickly clogged with vehicles, creating a formidable traffic jam and interfering with the rescue efforts. Public order is threatened and there are reports of looting.

Numerous fires break out and local water supply systems cannot cope with increased strain, leaving 50% of the core affected area with limited access to piped water.</td></tr>
<tr><td>Disaster site</td><td>
The European Seismological Commission has published a seismic hazards map based on the first unified seismic source model for Europe and the Mediterranean (ESC – SESAME). This map shows that seismic risk in the region is concentrated mainly in the eastern Mediterranean, particularly Italy, Cyprus, and the countries on the Adriatic and Aegean Seas, as well as central Romania, the southern Alps, and the southeast coast of Spain. Notable earthquake-prone zones also exist in Turkey, Iceland and Algeria.</td></tr>
</table>

Immediate direct and indirect impacts / types of damage

Human toll:

- The earthquake's toll in terms of human suffering amounts to 1282 deaths, 217 missing, and 9024 injured persons, of which 40% will have some sort of long-term disability. The fatalities were caused by the following: 1229 deaths from collapsed buildings (mainly blunt injuries; also asphyxia and myocardial infarction), of which 157 were due to the collapse of the roof and terrace of the discotheque and the ensuing panic; 13 deaths from a butane gas explosion in a hardware store and various post-earthquake fires; and 40 deaths from various causes.
- Most deaths (915) occurred in larger urban areas, mainly in the capital and in 6 towns with newer buildings. Villages and hamlets, which mostly have older buildings and relatively few new constructions (in recent years rural to urban migration has been notable, leading to a decreased need for new buildings), are much less affected, although the total number of deaths in the 42 conurbations nearest to the epicentre reaches a total of 199. 3 further deaths occur in other regions.
- Over 450,000 people are in need of assistance (shelter, food, medicines).

Damage to infrastructure:

- 34 blocks of residential flats and 3 office towers have completely collapsed, and a further 323 buildings of various types have been damaged beyond repair. 17,097 houses are uninhabitable, leaving 33,213 families homeless.
- Damage to buildings is distributed as follows (damaged but habitable housing has been ignored):

Location	Buildings collapsed	Damaged residential buildings(uninhabitable)
Capital	29 residential blocks, 3 office blocks, 244 other buildings	7721
6 larger towns and cities	5 residential blocks, 41 other buildings	647
Other urban areas	2 other buildings, 42 residential buildings	527
42 villages and hamlets close to epicentre	36 other buildings, 1,062 residential buildings	7140

In addition, the earthquake also caused significant damage to vital infrastructure, such as:

- Energy infrastructure: About 700 transmission towers are down and there is considerable damage to 18 substations, leaving 75% of the capital without power. Two local thermal power plants have been shut down as a precautionary measure while a damage assessment is carried out. Following the explosion of a gas storage tank, major supply lines have had to be shut down for safety reasons. This has left the capital without a piped gas supply, though bottled gas is available.
- Communication infrastructure: Moderate to heavy damage to telephone landlines. Mobile telephony is interrupted for days as some 40% of repeater stations are down.
- Transport infrastructure: Several main roads and bridges have become impassable by car, including the main artery connecting the capital to the principal port city, which will delay aid shipments arriving from the harbour. Landslides and fault lines have blocked and/or damaged about 50% of all trunk roads surrounding the capital. Inside the city, traffic flow is extremely restricted until rubble is cleared and transport systems are re-established. Rail tracks in the affected area are damaged in various places, making train transport impossible.
- Health infrastructure: 30% of clinics and hospitals are offline and there is reduced functionality (mainly due to shortages of personnel, energy, and medical supplies) in a further 60%. Thus, out of 3700 free hospital beds in the affected area, only 1200 are available for use. Out of ca. 600 local medicine dispensaries, only 200 are functional.
- Other infrastructure: 60 school buildings have been damaged, but some are still useable as temporary shelters (as it is the summer holidays, schools are empty). Banks have closed, as have most supermarkets, leaving people with few options to feed themselves once their stocks run out.

Ecological impacts:

- Various fires have affected a total area of 4 ha of forest and grasslands.
- Sewer pipe ruptures in various places have formed open cesspools in the street, increasing the danger of an epidemic due to waterborne pathogens. There has been some groundwater contamination as some wells have become infiltrated with grey water. Water shortages have affected some of the agricultural land. An archaeological site has also been heavily damaged.

Various indirect effects:

- Tourism income will be significantly lower in the short and medium run as tourists stay away.
- There is limited water supply for several months until the energy network is fully functional and water from underground wells must be pumped using diesel generators. Water shortages have affected some of the agricultural land.
- An archaeological site has also been heavily damaged.

Overall economic impact:

The economic consequences of the earthquake are considerable and can be described in the following categories:

Direct damage caused: Costs related to the repair, reconstruction or demolition of the housing stock and other infrastructure.

Expenditures related to indirect effects: Costs related to clean up, remediation of fire damage and decontamination of water wells.

Indirect losses: Lost tourism income, lost agricultural production, mainly due to the rationing of water supply, and lost employment due to the above two points.

Opportunity costs, resulting as a consequence of the aftermath of the disaster: Costs of building material rises as reconstruction efforts are scaled up all; several infrastructure projects must be cancelled or put on hold as reconstruction is a priority and existing infrastructure must be refurbished; the image of the area as a safe destination for tourism is affected in a negative way, leading to a decrease in the volume of visitors.

Expected / required response resources	
	Up to 3 days: **Managed by national capacities:** ▪ Shelter for 200,000 homeless ▪ Food for a total of 450,000 people ▪ Evacuation of 200-500 critically sick patients at the damaged hospitals to be transferred to other hospitals ▪ Damage extension maps, e.g. satellite images to get an overview of extension of damages of land, coast, infrastructure, sea etc. and as mean for coordinate rescue operations ▪ Medical Coordination centres to register people and transfer to nearby hospitals with free capacity ▪ Urban search and rescue teams ▪ Heavy equipment to remove rubble to get access to houses, roads etc ▪ Ground rescue vehicles e.g. buses for evacuation purposes ▪ General registration of people, fatalities, wounded, missing, evacuated, unknown status also to be able to inform relatives **Need for external assistance:** ▪ Shelter for 50,000 homeless ▪ Field hospital in the capital (600 beds needed). ▪ Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, supermarkets and food storage houses (approx. 400 sites) and energy for homes left without power (approx. 700,000). ▪ Need for communication equipment, sat com, etc (approx. 700 units). ▪ Management and coordination facility to provide overview of the situation and to act as interface to international bodies, incl. MIC and local actors. ▪ 3 helicopters for evacuation and transport able to operate at night. ▪ 4 MUSAR (medium urban search and rescue) teams, including specialists for structural engineering, heavy rigging, collapse rescue, logistics, hazardous materials, communications, canine and technical search. ▪ Water purification equipment for approximately 250,000 people in 5 major locations (30,000 persons each) and 10 smaller locations (up to 10,000 persons). ▪ Heavy equipment to prop up damaged critical infrastructure. ▪ Building and infrastructure stability evaluation assistance (at least 1 technical damage assessment team). Up to 2 weeks: **Managed by national capacities:** ▪ Shelter for 200,000 homeless ▪ Food for a total of 450,000 people ▪ Body ID equipment. ▪ Post disaster stress experts. ▪ Doctors, medicine (for approximately 20,000 people). ▪ Temporary housing (for at least 25,000 people for a period of up to 2 months). ▪ Temporary nursery and school shelters (for a period of up to 6 months). **Need for external assistance:** ▪ Shelter for 50,000 homeless ▪ Testing equipment and team for environmental contamination, drinking water, soil, sewage etc. (at least 2 units). ▪ 3 temporary medical / rehabilitation facilities to serve 1,000 people each. ▪ Heavy equipment to prop up damaged critical infrastructure. ▪ Building and infrastructure stability evaluation assistance (at least one team). ▪ Cleaning up process using heavy equipment machinery.

3.4.7 Scenario presentation: earthquake in central Asia

		Disaster Scenario: Earthquake in Central Asia
Characterisation of the hypothetical scenario	Disaster event	On a Tuesday morning in February, at 11:40 AM, a large shock ($M_L = 7.8$) hits a mountainous area in a Central Asian country. The epicentre is about 18 km from the nearest urban area, a city of approximately 75,000 inhabitants which is also the provincial capital. Shocks are felt over a wide area, with reports of tremors even several hundred kilometres from the disaster site. The location of the earthquake and the extent of the damage only become apparent some considerable time after the initial tremor, as reports take from a few hours to several days to come in. In Europe, news of the disaster quickly becomes headline news and major media channels begin moving correspondents to the affected area. Although the general plight of the local population is the main focus, there is much interest regarding the fate of a 21-member mountaineering expedition from several European countries, which was in the affected area at the time. At least 9 other tourist groups and their guides – some injured – must be transferred from lodges and camps in the mountains to more safe locations. Rescue efforts are begun almost immediately, but the harsh winter conditions and poor visibility make it difficult to get an accurate picture of the situation. Furthermore, the low temperatures are in themselves a serious threat to injured persons and those without adequate shelter. Already there are reports of death from exposure only hours after the event. Weather reports indicate heavy snowfall and fog for the next 72 hours, and the outlook for the next 7 days remains bleak. In the following days, numerous aftershocks are registered, one of which reaches ML = 6.5. By the early afternoon, national authorities send out calls for international assistance.

	Disaster site	The principal affected region is a relatively remote mountainous area, though loss of life and damage are also registered in the urban areas closest to the epicentre. Due to the location of the earthquake – a mountainous, low-density region populated mainly by herders and their families – most government services, such as health, education, and availability of disaster relief, are notably below the national average, Lack of local response capacity and communications equipment, as well as a poor network of transport infrastructure, mean that help to the victims does not arrive when it is needed, leading to an elevated number of preventable deaths. There are not many cities with a population of over 50,000 people, and most buildings in the region have been erected by local masons without recourse to a building code. This means that most homes and nearly all the health infrastructure collapse almost immediately in the event of an earthquake. Winter in the region is long and often harsh, and local inhabitants who live in the mountains survive by building small shelters, sometimes shared with their herd animals (e.g. goats). These shelters are barely adequate under normal circumstances and life-threatening in the event of a disaster, as they are not well built (i.e. prone to collapse) or insulated (i.e. unsuitable for sheltering injured persons). With regard to physical characteristics, about 70% of the affected region is above 1,500m over sea level, with some peaks above 5,000m. The road network is not well-developed (usually limited to two lanes) and there are only limited number of airstrips and helicopter landing sites. Power supply is limited to urban areas with more than 500 persons, and mobile phone coverage is poor due to the geography.
	Immediate direct and indirect impacts / types of damage	**Human toll:** The earthquake's toll in the region, including aftershocks, ascends to 62,670 dead, 193,103 wounded, and 16,459 missing persons. Additionally, some 700,000 people have been left homeless due to destruction or extensive damage inflicted on housing stock, and an additional 1,500,000 people are considered to be in need of urgent assistance (e.g. distribution of food rations, blankets and medicine, re-establishment of energy supply, psychological support, disease prevention, etc.). Rescue efforts are hampered by the lack of information about the location and number of victims (in part due to the non-existence of up-to-date maps, satellite images, and census data) as well as the shortage of adequate vehicles (both land and air) to scout the region and transport relief supplies. Large stocks of bulky supplies, such as tents and water purification equipment, cannot be brought to where they are needed, leading rescue workers to organize expeditions to stricken areas on foot. **Damage to infrastructure:** In the nearby town, some 90% of buildings have been destroyed or damaged beyond habitability. In the affected region, a total of 34,100 buildings have collapsed, with many more damaged. As a large proportion of houses is built from traditional materials such as adobe, casualties due to building collapse are considerably higher than if the buildings had been made of slabs of concrete, which tend to create air pockets when they collapse. Most buildings are self-built, leading to higher vulnerability in case of an earthquake. ▪ Energy infrastructure: The region's electricity transmission systems, which under normal conditions only provide partial coverage to the population living there, collapse completely as several high-power lines are interrupted. Several hydroelectric dams report damage, leading operators to open spillways in order to decrease reservoir pressure, which further decreases the amount of available power. ▪ Transport infrastructure: Most roads have been made impassable, either through direct earthquake damage or by landslides and avalanches. Major highways leading into the region have also been blocked by road slides, fallen trees, and fault lines. Bridges have collapsed, cutting off large numbers of people from rescue. Tremors have interrupted rail lines and derailed a train carrying chemical supplies, and several nearby airports have been temporarily shut down in order for engineers to carry out damage surveys. A cable car line has had to be stopped and passengers rescued from cabins. ▪ Health infrastructure: The rural health care system in the region is notably poor, even in comparison to the standard found in the urban capitals, and hospitals and clinics cannot cope with the scale of the disaster. In addition to a shortage in medical supplies, climactic conditions are too harsh to safely transport victims to where they can get medical attention. As a result, many injured victims must be cared for by surviving family members. ▪ Other infrastructure: Telephone lines are down, and half of the mobile telephone towers in the region are no longer operating. Damage to water wells and pipelines is also substantial, leaving many villages in the upper reaches without access to water. **Ecological impacts:** Several landslides have been triggered in nearby mountainous areas, causing further deaths and damage to infrastructure. The chemical spill is a minor disaster in its own right, leading authorities to devote considerable efforts to cordon off the area and begin confining the toxic material. **Various indirect effects:** Increased rural-to-urban migration pressure as many people have to leave their homes until reconstruction is completed. Additionally, as many victims receive medical attention and temporary housing near urban centers, there may be a reluctance to return to rural areas. **Overall economic impact:** The economic consequences of the earthquake are considerable and can be described in the following categories: 1. Direct damage caused: Costs related to the repair, reconstruction or demolition of the housing stock and other infrastructure. 2. Expenditures related to indirect effects: Costs related to clearing the road network from rubble (difficult due to lack of heavy equipment) and cleanup costs of chemical spill. 3. Indirect losses: A large number of farm animals has been killed, many others fled in panic. Agricultural land has been affected as terraced fields were hit by mud slides. 4. Opportunity costs, resulting as a consequence of the aftermath of the disaster: The sheer scale of the reconstruction effort is a significant drain on developing country resources, and will certainly affect other development priorities.

Expected / required response resources	Up to 3 days: **Managed by national capacities and humanitarian aid organizations:** ▪ General registration of people fatalities, wounded, missing, evacuated, unknown status also to be able to inform relatives. ▪ Evacuation of 300-600 critically sick patients at the damaged hospitals to be transferred to other hospitals. ▪ Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, supermarkets and food storage houses. ▪ Temporary emergency shelter, fuel and clothing for 700.000 homeless people. ▪ Medical Coordination centres to register people and transfer to nearby hospitals with free capacity. ▪ Food and water for a total of more than 1 million people. ▪ Damage extension maps, e.g. satellite images to get an overview of extension of damages of land, infrastructure, etc. and as mean for coordinate rescue operations. **Need for external assistance:** ▪ Winterized tents (to shelter 40,000 people for 4 months in at least 6 locations). ▪ 4 search and rescue (S&R) teams (2 MUSAR teams for urban areas and 2 Mountain Rescue teams). ▪ Management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors. ▪ 6 helicopters suitable for high-altitude operations in harsh winter weather, 2 of which should be cargo helicopters. ▪ Field hospitals with medical staff and supplies, able to operate in sub-zero temperatures (minimum 2 units), total 400 beds. Up to 2 weeks: **Managed by national capacities and humanitarian aid organizations:** ▪ Body ID equipment / Doctors, medicine. ▪ Temporary emergency shelter, fuel and clothing for 500,000 homeless people. ▪ Food and water for a total of more than 500,000 people. ▪ Cleaning up process using heavy equipment machinery. ▪ Temporary nursery and school shelters. **Need for external assistance:** ▪ Winterized tents (to shelter 40,000 people for 4 months in at least 6 locations). ▪ Testing equipment for environmental contamination, drinking water, soil, sewerage etc. ▪ Management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors. ▪ 4 helicopters suitable for high-altitude operations in harsh winter weather, 2 of which should be cargo helicopters. ▪ Field hospitals with medical staff and supplies, able to operate in sub-zero temperatures (minimum 1 unit), total 200 beds. ▪ Post disaster stress experts. ▪ Heavy equipment to prop up damaged vital buildings. ▪ Temporary assistance facilities to serve several thousands of people gathered at emergency camps (6 camps with between 2,000 and 25,000 people).

3.4.8 Analysis

Scenario Choice

The EU earthquake scenario was chosen for the following reasons:

- Earthquakes have been responsible for a larger number of human fatalities than any other type of natural disaster in Europe, and are second only to floods with regard to economic damage.
- Large sections of Europe are earthquake-prone, and although there is no notable increase in the number of earthquakes, the degree of vulnerability rises with increasing population density.
- The location of the earthquake is a region known for having elevated seismic activities.
- The disaster type was chosen to test whether current Module types sufficiently address the types of immediate response needs requested by Participating States.

Limitations

The present scenarios are based upon earthquakes in the recent past. While the European one is a close to worst case scenario, the international one is considered to be a realistic one for future occurrence.

To worsen the earthquake scenarios, simple steps could be taken, including increasing the quake intensity on the Richter scale, moving the epicentre closer to more populated areas, etc.

Sensitivity analysis: prevention and preparedness

Earthquake preparation in the region can generally be considered poor. Some of the most visible shortcomings are: the absence of a permanent national earthquake response centre in the affected country, no ministry-level agency for natural hazard preparedness/mitigation, very limited civil protection capabilities, no seismic risk assessments or maps, no sophisticated early-warning system, lack of communication between different bodies (e.g. emergency services, military, energy, communications and transportation), and little or no available knowledge about critical infrastructure (e.g. power lines, pipelines, telephone system, etc.). Measures to remediate these problems will undoubtedly increase preparedness and response capacity. Additionally, increased public awareness of the dangers posed by earthquakes would greatly reduce the number of casualties in such an event (e.g. better choice of materials and better workmanship with regard to housing construction, stockpiling of essential supplies, knowledge of hazard sources, shelters and escape routes).

3.5 Tsunamis

3.5.1 Typical conditions (risk factors)

Hazard frequency

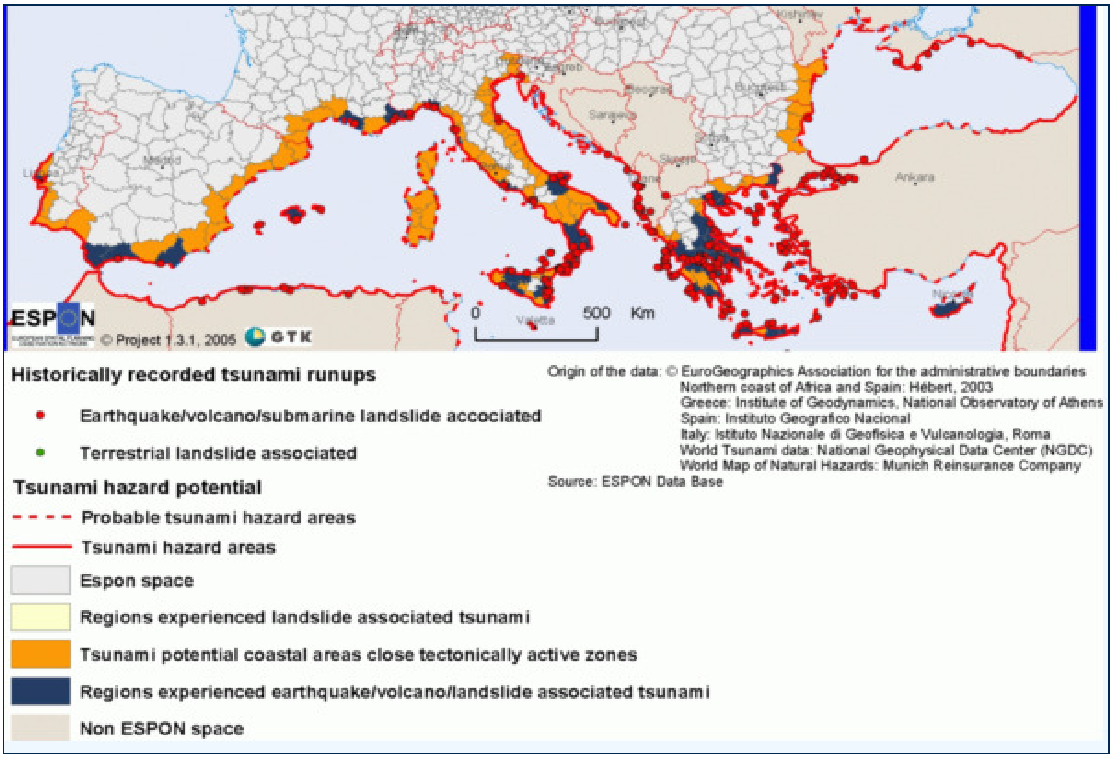
In Europe tsunamis can mainly occur in the Mediterranean Sea with short travel times and thus very short early warning possibilities. The most devastating tsunamis in Europe occurred in Sicily (1693), Lisbon (1755), Calabria (1783), and Messina (1908), all killing more than 50.000 people. These are only examples, as there have been many more tsunamis throughout the European history. One of the most recent tsunamis in Europe hit the Balearic Islands in 2003 after a submarine landslide caused by an earthquake in Algeria (Hébert, 2003). The run-ups of this tsunami were rather small, up to 2 metres and caused no injuries. Nevertheless, this incident and the short estimated travel time of the tsunami (20-30min) shows that tsunamis maintain to be a potential hazard all over the Mediterranean, also in areas not marked in the World Map of Natural Hazards (Munich Reinsurance Group, 1998).

Exposure / vulnerabilities

Tectonically induced tsunamis occur in Europe mainly in the Mediterranean and the Black Sea. There are several geological and historical records of tsunamis (see above). The most endangered zones lie in close vicinity to the main volcanoes or along seismically active zones. Tsunamis caused by (submarine) landslides have mainly occurred in Norway, but also in some other areas in Europe. Often it is difficult to distinguish if an earthquake caused a tsunami or if an earthquake triggered a (submarine) landslide that then caused a tsunami. In general it can be concluded that tsunamis are possible along all shorelines that lie in tectonically active zones and/or in areas where (submarine) landslides are possible. Even though no devastating tsunamis have occurred in Europe in the last 100 years, the potential hazard is still high. Smaller tsunami occurs at regular intervals (every 3-5 years). Serious tsunamis tend to occur every 100 years. The likely impact, e.g. vulnerability of any tsunami, however, tend to grow proportionally with socio-economic development. As these areas are densely populated, the social impacts are huge.

Mediterranean coastal zones are becoming more and more vulnerable due to population sprawl, build up areas and a high level of economic assets at risk. A total number of 130 million people across 22 countries are living permanently at the vicinity of the Mediterranean basin all around the 46.000 km coastline. This number doubles during summer time. (Earthocean, 2007)

Figure 3.7 Overview of tsunami hazard potential in Europe



[Source: ESPON (http://www.gsf.fi/projects/espon/Tsunamis.htm)]

3.5.2 Types of prevention and preparedness measures

Obviously, tsunamis cannot be prevented (at least not the ones derived from underwater earthquakes).

However the impact of a tsunami can be reduced by:

- implementing an early warning system in order to warn people, businesses, local authorities, etc to take precaution actions, e.g. to get people away from the beaches, for ferries, boats, ships etc to stay clear of the coast. The problem with an early warning system is, firstly, that the lead time is very short 20-30 minutes, and secondly, to get the warning out to the people who needs it, thirdly, that it is costly to implement and operate compared to the likely frequency of tsunami occurrence;

- stricter regulation concerning land use along the coastal areas, building codes, distance to the sea of constructions of building, infrastructure etc.;
- stronger harbour protection; and
- improved local preparedness of towns and villages, e.g. awareness, equipment, etc.

3.5.3 Past reference disasters

In Europe

Ancient Tsunami (8000 years ago). A massive tsunami smashed Mediterranean shores some 8,000 years ago when a giant chunk of volcano fell into the sea. Waves up to 50 meters high swept the eastern Mediterranean, triggered by a landslide on Mount Etna on the island of Sicily. The tsunami destroyed ancient communities, with a series of killer waves hitting the eastern Mediterranean coastline from Italy to Egypt. Researchers from the National Institute of Geophysics and Volcanology in Pisa estimated the tsunami's strength by modelling the impact of the landslide from Etna, the tallest active volcano in Europe. The research team's calculation, published in the journal Geophysical Research Letters, shows that 6 cubic miles (25 cubic kilometres) of mountainside collapsed into the sea, generating giant waves that reached coasts as far away as the Middle East and North Africa. The waves would have reached heights of about 165 feet (50 meters) off southern Italy, the team says, with a sea surge reaching 43 feet (13 meters) swamping parts of Greece and Libya. Smaller waves hitting coasts farther away would also have had devastating power. The research team estimates the tsunami would have hit a maximum speed of around 725 kilometres an hour, taking a little over three and a half hours to reach what are now Israel and Egypt.

Sicily (1693). The 1693 Catania earthquake caused 60,000 deaths in eastern Sicily and generated a 5–10 m high tsunami.

Lisbon (1755) a magnitude 8.5 earthquake was unleashed offshore about 20Okm to the southeast. The earthquake had generated a tidal wave, a tsunami that swept towards the Portuguese coast. The tsunami wave grew as it reached the shallow waters of the mouth of the River Tagus, and by the time it reached Lisbon it was over five metres high. The waters crashed over the seawall and extended 250m into the city. A total of 60,000 to 100,000 people died, most due to the earthquake itself.

Calabria (1783). In 1783 Calabria was hit by a violent and long seismic crisis that lasted about three years. In the first two months this region was struck by a sequence of five strong earthquakes, with MCS intensity greater than IX that occurred on different faults within a zone 100 km long in South and central Calabria. The crisis was started by a strong tsunami-genic earthquake on the 5th of February 1783 which was followed by a number of aftershocks. One of these occurred probably in the Messina Straits around midnight between the 5th and the 6th and was followed by a strong tsunami that was one of the most lethal in the Italian history. It killed more than 1500 people that were passing the night on the beach of Scilla and that had abandoned their houses to escape the persistently dangerous and scaring shocks. The tsunami was caused by the detachment of a mass of rocks from the Mount Campallà south-west of Scilla, facing the Messina Strait The tsunami generated waves exceeded 8 m at the Scilla beach, called Marina Grande, which was the most affected place, but the tsunami was also destructive at Punta Faro on the opposite coast of the Strait. This case shows the relevance of double tsunami-generation mechanisms (tectonic and mass failure) in coastal areas and poses the serious problem of how to handle combined tsunami-genic processes in the evaluation of tsunami potential and risk.[68]

Messina (1908). The 1908 Messina earthquake (M=7.2) is one of the strongest historical seismic events that ever occurred in Italy, with more than 60,000 casualties and extensive damage produced in Sicily and Calabria. It was felt in a radius of about 300 km, with maximum damage (XII MCS) occurring in the cities of Messina and Reggio Calabria. This earthquake was accompanied by the most destructive tsunami that hit the Italian coast. Several source models have been proposed in the literature, some of them also using tsunami data to add reliable information for the identification of the fault mechanism. The tsunami, starting with a relevant withdrawal along the Sicily coast which was followed by a large inundation, produced a measured maximum run-up exceeding 13 m and a maximum water penetration of 200 m.[69]

The following provides a brief summary of the main Tsunamis which have occurred in the region of the Indian Ocean over the past few years.

26 December 2004 Tsunami. Caused by an earthquake magnitude 9,3 with epicentre off the northwest coast of the Indonesian Island of Sumatra. The earthquake deformed the ocean floor, pushing the overlying water up into a tsunami wave. The earthquake triggered a series of devastating tsunamis along the coasts of most landmasses bordering the Indian Ocean, killing more than 225,000 people in eleven countries, and inundating coastal communities with waves up to 30 meters high. It was one of the deadliest natural disasters in history. Indonesia, Sri Lanka, India, and Thailand were hardest hit
Apart from the tragic cost in lives, the tsunami wiped out thousands of kilometres of coastal areas, including human settlements. More than one million people became homeless and the total housing, rebuilding of infrastructures and revival of economic activities costs will exceed € 10 billion to reconstruct.[70]

Indonesia, 18 July 2006. Triggered by a 7.7 Richter scale magnitude undersea earthquake off the resort of Pangandaran caused a 2 m high Tsunami hitting the coast of Java and killed more than 660 and with several hundreds missing. The wave smashed into a 200 km stretch of the Java's coastline.[71]

[68] http://www.cosis.net/abstracts/EGU2007/02768/EGU2007-J-02768.pdf
[69] http://www.cosis.net/abstracts/EGU2007/02592/EGU2007-J-02592.pdf
[70] EU, 2007.
[71] Maps of world, Unicef.

3.5.4 Scenario presentation: tsunami in Europe

<table>
<tr><th></th><th colspan="2">Disaster Scenario: Tsunami in Europe</th></tr>
<tr><td rowspan="3">Characterisation of the hypothetical scenario</td><td>Disaster event</td><td>

It is a sunny afternoon in the middle of August along the holiday resorts of the Mediterranean Sea. The beaches are packed with people and a regatta for sail boats has just been called for start.
Minutes after, the same people witness a giant wave approaching the shore lifting the sail boats up into the sky and seconds after hitting the beach with enormous power. As the wave withdraws from the shore it takes with it everything from people, deck chairs, trees, cars, etc.
The tsunami generated waves up to 30 meters high hitting the coastline of several Mediterranean Member States, causing fatalities, severe destruction of infrastructure (harbours, roads, train tracks) and coastline. The wave caused serious damages as far as 3 km inland.
A shoreline of approximately 800 km is directly affected across 3 Member States.
The wave was felt and caused serious damages within a radius of 400 km2 reaching as far as the northern coast of Africa including several hotel resorts.
The emergency station located in the next village inland is alarmed minutes after the wave smashes into the shore. After another 10 minutes the regional emergency centre has been informed followed by the National emergency response unit, the National Met office and the MIC. Neighbouring countries likely to be affected are informed within 20 minutes, which is too late, to be able to mobilise any meaningful mitigation measures. A request for international assistance is issued for all direct affected MS.

</td></tr>
<tr><td>Disaster site</td><td>

The main area affected has a permanent population of approximately 6 million people with additional 400.000 visitors at any point in time during high season, of which 100.000 are in hotel resorts and the rest on camp sites, youth hotels, or agro-tourism sites.
There are three airports situated in the vicinity of the affected shore.
Two of the harbours prove to be severely damaged. Two of the ferries, one approaching the harbour, were hit by the tsunami. As the first ferry was already in shallow waters, it was hit hard and capsized, all 400 passengers were either thrown into the sea or got trapped on-board. The other ferry managed to ride on the wave, the ferry got damaged and took on a lot of water and many passengers on board were injured or killed.
Besides the sail boats participating in the regatta which all capsized and the sailors were killed by the power of the wave as they were still close to shore, another estimated 100-200 leisure boats were in the area. So were a number of cargo vessels.
Hotels near the beach feel the blast of the wave as windows smash and water flushes in on the ground floor, flooding basements, parking lots, etc. 22 countries border the Mediterranean Sea and approximately 130 million people are living permanently along the 46000 km coastline. During high season additional tens of millions of people visit the Mediterranean Sea.

</td></tr>
<tr><td>Immediate direct and indirect impacts / types of damage</td><td>
<u>Human toll:</u>

Dead and the number of people affected: Approximately 50.000 fatalities (of which the majority are women and children) a total of 4 millions directly affected, 200.000 homeless

<u>Infrastructure and Assets:</u>

A number of nurseries, primary and secondary schools are damaged and a total of 30.000 children in school age are directly affected
2 major hospitals, a number of public buildings are damaged
Damage to infrastructure: 800km of coast line severely damaged, 2 large harbours including hundreds of fishing vessels, and thousands of leisure vessels and fishing boats
Between 10-20 Seveso type plants, e.g. oil refineries, chemical plants along the affected coast are damaged causing already contamination of both land and ground water
The power supply are damaged and a total of 1 million homes, industries, shops, supermarkets and businesses are without electricity,
Several underwater communication cables connecting many countries around the Mediterranean basin have been damaged affecting broadband connections and telephone lines in a very large area (tens of millions of users)
The majority of the affected population lives in 3 medium sized cities (population around 200-500 thousands) and a number of smaller communities along the 800 km long coastline

<u>Environmental effects:</u>

Pollution at sea due to oil slicks from oil refineries along the affected cost line and spillages from ships.
Likelihood of Chemical pollution, not confirmed
Agricultural areas along the 800 km coast line affected and many contaminated due to sea water.

<u>Indirect effects:</u>

There is a risk of drinking water contamination, and a severe risk of coastal land slides due to severe erosion and damages of coastal areas

</td></tr>
</table>

Expected / required response resources	<u>0-24 hours:</u> **Managed by national capacities:** ▪ Shelter for the 1 million homeless spread in approximately 12 location along the 800 km long coastline. ▪ Evacuation of 500-2000 critically sick patients at the damaged hospital to be transferred to other hospitals. ▪ Search and rescue (SAR), e.g. helicopters, buses for evacuation purposes, heavy equipment to remove rubbles to get access to houses, roads etc, capacity of surveillance of oil spill at sea (plane, satellite images). 50+ units. ▪ Damage extension maps, e.g. satellite images to get an overview of extension of damages of land, coast, infrastructure, sea etc. and as mean for coordinate rescue operations. ▪ Medical Coordination centres to register people and transfer to nearby hospitals with free capacity. One in each of the main 3 cities. ▪ General registration of people, fatalities, wounded, missing, evacuated, unknown status also to be able to inform relatives. ▪ Ships, planes and trucks to provide food, aid, medical equipment, medicine, shelter to affected populations along the coast. **Need for external assistance:** ▪ Water purification equipment for a total of 2 million people (half of the total affected population), 3 large-scale units for the 3 main cities affected, 100 small scale units for smaller towns and villages. ▪ Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, supermarkets and food storage houses. Estimated 25-50 units. ▪ Management and coordination facility to provide overview of the situation and to act as interface to international organisational bodies incl. MIC and local actors. One in each o f the 3 main cities ▪ High capacity pumping equipment. At least 3 high capacity units for the 3 large cities, plus 20 mobile units to drain flooded roads. ▪ Helicopters to get access to remote areas and rescue or evacuate people in the affected areas. Minimum 5-10 units. <u>Up to 3 days:</u> Same as above PLUS: **Managed by national capacities:** • Post disaster stress experts • Temporary nursery, and school shelters • Cleaning up process using heavy equipment machinery • Temporary housing **Need for external assistance:** • Body ID equipment – equipment as X-ray scanners etc., personnel as dentists, medical doctors etc. • Testing equipment for environmental contamination, drinking water, soil, sewerage etc • Temporary medical emergency facilities to serve several thousands people • Specialist companies to repair underwater cables • Oil spill cleaning vessels, coast guard vessels for SAR at sea <u>Up to 2 weeks:</u> **Need for external assistance:** ▪ Planning for reconstruction involving civil engineering companies and public agencies ▪ Financial planning for reconstruction including insurance agencies for assessing amount of insured assets There is a considerable need for international assistance, throughout the emergency response period to the recovery period in particular for 2 out of the 4 main affected MS as these are relatively small countries (5-10 million inhabitants in total) and they are relatively hard hit.

3.5.5 Scenario presentation: tsunami in the Indian Ocean

		Disaster Scenario: Tsunami in the Indian Ocean
Characterisation of the hypothetical scenario	Disaster event	• On early Monday in February an earthquake leading to an upward movement of the seafloor across a strip of 100 km generated a range of tsunamis speeding across the Indian Ocean. • The first and strongest earthquake occurred off the west coast of the main island in the North Indian Ocean at 10 a.m., magnitude 9.0 USG, followed by another one three later and a range of aftershocks. The earthquakes set off giant tsunami tidal waves travelling rapidly through the Indian Ocean. Within 45 minutes it has travelled 120 km and after 2 hours it has reached 1000 km away from the epicentre. • In the coastal zones of the nearby islands of the first earthquake, many people had rushed out of buildings after feeling the earthquake and are trying to help victims buried in the rubble. Minutes after, they are caught by the Tsunami as the wave is pouring through the streets. The 20-30 meter high wave destroys everything in its path and reaches 4 km inland. An hour later the wave reaches several tourist resorts on the mainland as well as holiday island. After another couple of hours the wave reaches the coast of India and Sri Lanka and even as far as the African continent the wave causes serious damages. • A Tsunami warning was issued immediately after the first earthquake was registered. Due to the short lead time the warning only reached a fraction of the tens of thousands of people living in the nearby coastal towns. For the location further away from the epicentre the Tsunami warning had a larger effect and more people had a chance to escape safely inland away from the deadly Tsunami.

Disaster site (key geographic areas affected)

The affected areas are the Northern Indian Ocean including 8 Asian countries but also the African west coast felt the Tsunami resulting in both fatalities and some damages. Tens of thousands kilometres of coastal areas are affected.

Millions of people are living permanently along the coastline directly affected by the Tsunami.

Most of the loss of life occurred in the near field of the epicentre. The tsunami destroyed virtually every village, town, road, and bridge built at below 10 m elevation along the islands' coastline. While inundation did not extend more than 1 km in most places, the waters reached up to 4 km inland in the flat and densely populated cities of the main island. It is estimated that on average 50% of the people in the coastal region died.

Although the earthquake tremors caused significant building damage on both the nearby island as well on the main land, the large majority of property damage was caused by the tsunami waves. Along coastlines of most of the affected countries, the majority of the buildings consisted of poorly constructed houses primarily made out of wood, masonry, and concrete, which make them more vulnerable to damage from a tsunami. Along the Indian Ocean western coastline, tourist resorts and hotels sustained heavy damage.

Immediate direct and indirect impacts

Human toll:

- Fatalities: 200 000 (of which majority are women, children and elderly people)
- Missing: 25 000
- Displaced: 1.2 millions
- Directly affected: 4 million people

The tsunami killed many local officials, including school teachers and military personnel.
It is estimated that at least 10.000 Europeans were in the area on holidays, business or living in the area on a permanent basis.

Infrastructure and Assets:

- The tsunami destroyed a large number of government offices, hospitals, and schools.
- The tsunami destroyed main roads running near the coast as well as key bridges and harbours along the coast.
- A number of airports were likewise unusable for some days due to flooding.
- Thousands of fishing vessels are destroyed providing the means of living of thousand of families
- When road and bridges were carried away by the water it took with underground cables. The mobile phone system was also hit either due destroyed sending masts or due to interrupted power supply or landline interconnections.

At least 2 European Cargo vessels are affected and an estimated 5-10 European owned factories.

Environmental effects:

- Damage of large amounts of agricultural areas and life stock along the affected coast either because crops, e.g. rice fields, are washed away by the water or due contamination from sea water
- Drinking water contamination
- Destruction of large amounts of coral reefs, wild life and ecosystems

Expected / required response resources

Uo to 3 days:
Managed by national capacities:
- Damage maps, e.g. satellite images to get an overview of extension of damages of land, coast, infrastructure etc. and as mean for coordinate rescue operations
- Medical Coordination centres to register people and transfer to nearby hospitals with free capacity
- General registration of people , fatalities, wounded, missing, evacuated, unknown status also to be able to inform relatives
- Post disaster stress experts
- Temporary nursery, and school shelters; temporary housing

Need for external assistance:
- Shelter for approximately half a million homeless, located in approximately 100 different locations across the affected area (rather dispersed)
- Food and water for a total of several millions of people (mainly to be distributed in the 100+ temporary camps)
- Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, supermarkets and food storage houses. 50-100 units
- Search and Rescue (S&R) equipment, e.g. helicopters to reach remote areas, minimum 15 units
- Heavy equipment to remove rubble, 5 units
- Surveillance equipment incl. planes (1-2 units)
- Coast guard ship for SAR at sea (2-3 units)
- Management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors. 1-2 units
- Water purification equipment, a mix of smaller type equipment for the smaller villages (50-75 units), and larger equipment for the major cities (10-15 units).
- High capacity pumping equipment (10-15 units)
- Ships (5 units) , planes (5 units) and trucks (10 units) to provide food, aid, medical equipment, medicine, shelter to affected populations along the coast and remote areas
- Body ID equipment – equipment as X-ray scanners etc., personnel as dentists, medical doctors etc. 3-5 units
- Testing equipment for environmental contamination, drinking water, soil, sewerage etc. (5-10 units)
- Temporary medical emergency facilities to serve several thousands people (10-15 units)
- Specialist companies to repair underwater cables (2-3 teams)
- Oil spill cleaning vessels, coast guard vessels for SAR at sea (2-4 units)

Up to 2 weeks:
Managed by national capacities:
- Post disaster stress experts
- Temporary nursery, and school shelters
- Cleaning up process using heavy equipment machinery
- Temporary housing

Need for external assistance:
- Shelter for approximately half a million homeless, located in approximately 100 different locations across the affected area (rather dispersed)
- Food and water for a total of several millions of people (mainly to be distributed in the 100+ temporary camps)
- Heavy equipment to remove rubble, 5 units
- Management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors.
- Water purification equipment, a mix of smaller type equipment for the smaller villages (50-75 units), and larger equipment for the major cities (10-15 units).
- High capacity pumping equipment (10-15 units)
- Ships (2 units) , planes (2 units) and trucks (7 units) to provide food, aid, medical equipment, medicine, shelter to affected populations along the coast and remote areas
- Body ID equipment – equipment as X-ray scanners etc., personnel as dentists, medical doctors etc. 3-5 units
- Testing equipment for environmental contamination, drinking water, soil, sewerage etc. (5 units)
- Temporary medical emergency facilities to serve several thousands people (10-15 units)

3.5.6 Analysis

Scenario Choice

This scenario was chosen due to several reasons:

- The risk of tsunami in the Med Sea is relatively low. Incident statistics show major tsunamis only occur every 100 years. However, following the recent Indian tsunamis in 2004, 2006 attention towards the risks of tsunamis to hit Europe has drawn political attention, as it would have devastating impacts. An early warning for the Med Sea is under development.
- A serious tsunami would result in national response capacity to be overwhelmed and due to the nature of the disaster it most often involves more than one country.

- The disaster type was chosen to test whether current Module types sufficiently address the types of immediate response needs requested by Participating States.
- A tsunami in the Med Sea is most likely also to affect the coastline of the Northern African countries, as discovered during the 4 December workshop.

Limitations

What factors could be intensified in worst case scenario? The current scenario is not likely to represent a worst case scenario. Due to the low frequency of serious tsunamis in the Mediterranean Sea, there is a lack of (recent) reference scenarios except for the Indian Tsunami 2004. However, experts at the December 4th workshop felt that, should a tsunami hit the Mediterranean Sea with a strengths similar to the one depicted in the current scenarios, impacts and consequences could be both twofold or threefold in comparison with the impacts predicted in the current scenario. The scenario could be intensified via a longer area along the Med Sea coast line likely to be affected involving more countries (both EU MS as well as African states); or via more side effects likely to be triggered, e.g. industrial accidents, oil spills, land slides, diseases, infrastructure damages (e.g. trains, roads, harbours).

Sensitivity analysis: prevention and preparedness

How much can preventive measures reduce disaster impacts and consequently the need for response actions? There is not yet an Early Warning system for the Med Sea – it is clearly a challenge to get the information in time to the concerned people. Regulation concerning land use along coastal zones could be stricter, e.g. regulation concerning distance to sea for construction of buildings, roads, train tracks, coastal protection, harbor protection, etc. Such measures would be similar and serve the purpose also to protect against higher sea levels as to be expected in the future in any case. The local (villages, towns) level of preparedness is very important.

3.6 Oil spill

Oil spills into the natural environment typically affect both terrestrial and marine environment. Since humans rely heavily on petroleum-related products such as fuel, plastics and lubricating oil, oil spills are an unfortunate by-product of our way of life. Various triggers ranging from plain carelessness to deliberate dumping have the potential to cause oil spills. Only a small percentage of global oil spills are related to tanker accidents. However, tanker accidents tend to be particularly harmful because of the sheer volume of oil released at once, posing a serious threat to marine animals and seabirds.

3.6.1 Typical Conditions (key risk factors)

Hazard frequency

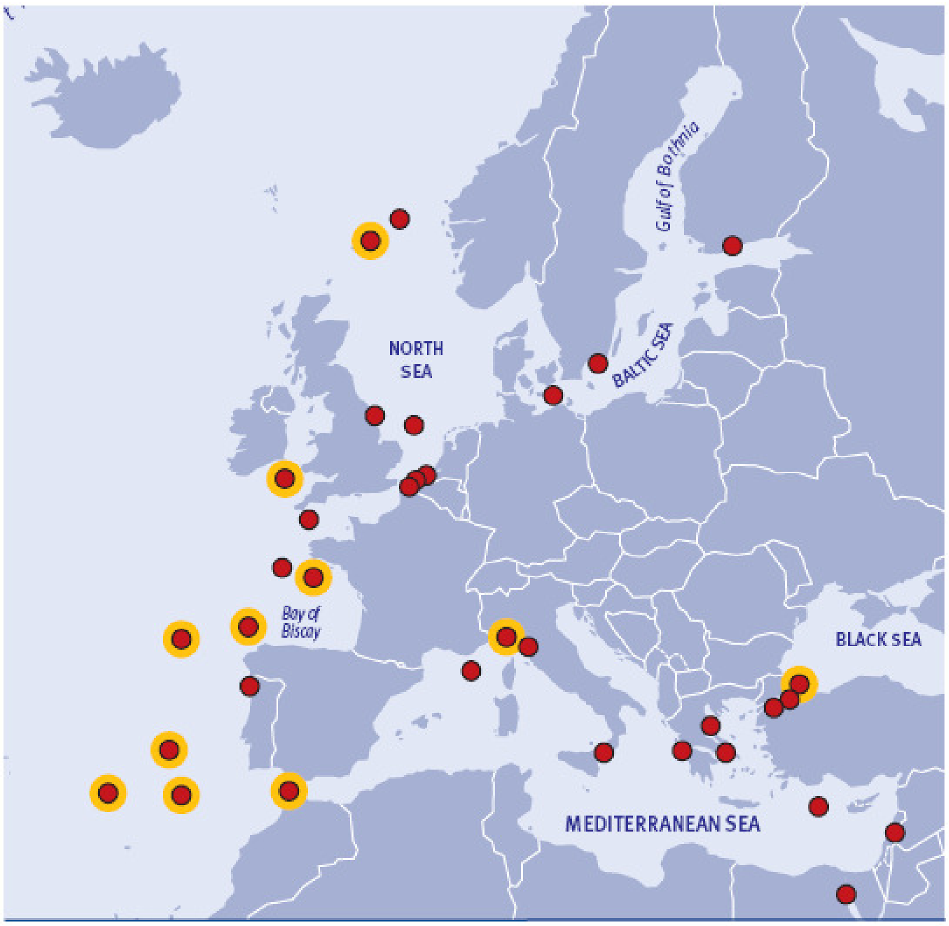
The frequency of large spills is relatively low and detailed statistical analysis is rarely possible. As a consequence, the emphasis is often placed on identifying trends. It is apparent that the number of large spills (>700 tonnes) has decreased significantly during the last twenty years. The average number of large spills per year during the 2000s was less than a third of the average yearly number of large spills witnessed during the 1990s.

In addition, it should be noted that a small number of particularly large spills are responsible for a large proportion of total oil spilled. Furthermore, an examination of average annual spill volumes in the period 1995-2004 showed that the volume split in the latter half of the 1990s was nearly 3 times the volume of the last 5 years.

The main causes of spills in the <7 tonnes category were operational, with 34% occurring during loading/discharging. Accidents were the major cause in the 7-700 tonne group, with collisions and groundings resulting in 51% and 24% of spills respectively. Groundings accounted for 62% of spills in the >700 tonnes category; operational factors played only a minor role in this category.

Nowadays, there are approximately 8,000 tankers transporting crude oil and oil-related products around the world, most of which operate without incident. However, major spillages due to tanker accidents, though infrequent, have had profound consequences for the image of the tanker industry. The map below (Figure 3.8) depicts all large tanker spills in European waters since 1984. As can be seen based on these past disasters, certain regions seem to be more vulnerable to large spills than others.

Figure 3.8 Large tanker spills since 1984



Spills > 700 tonnes   Spills > 10,000 tonnes

N.B. The most affected area over the last 35 years has been the Galician coasts in Spain with 7 tanker spills of more than 10,000 tonnes (DG Tren: Maritime Sector: Vademecum No. 6, 2004).

[Source: EMSA Action Plan]

Exposure / vulnerabilities

Input in decision making for both short and long-term response and recovery planning is often provided by identifications and assessments of the sensitivity and vulnerability of marine and coastal environments to oil spill damage.

Open waters are generally considered as less sensitive to oil spill damage, particularly if spills occur further offshore. This can mainly be attributed to the fact that there are sparser populations of sea birds and marine mammals in open waters and that these open waters are typically not used as habitats, spawning or breeding grounds. On the other hand, oil pollution is less detectable in vast open sea areas and, once the oil has disappeared from the water surface, it is far more difficult to detect. Moreover, oil compounds and pelagic biota are easily movable by ocean currents. Without baseline data and information the assessment of oil spill damage to environments and ecosystems is almost impossible and consequently the estimation of sensitivity and vulnerability is almost impossible.

Coastal waters and zones are the most biodiverse marine environments; this applies to the water column, the shoreline and the seabed. These are also the areas in which spilled oil naturally tends to accumulate[72]. Taking this into consideration, one can easily see why large and very visible damage occurs to coastal zones in case an oil spill reaches the shoreline. Seabirds breeding and feeding in coastal areas are faced with a high rate of mortality. The same applies to various mammal species although their mortality rates are usually lower. Benthic organisms are usually heavily damaged, as are fish spawning areas and coastal and seabed vegetation. Human assets, such as aquaculture installations, tourism and leisure facilities but also infrastructure and industrial installations are affected in the short and medium term. On a more general level, this might even lead to an interference of work and social life.

Polar regions - more specifically offshore sub-Arctic and Arctic areas temporarily or permanently covered with sea ice - are subject to an increasing amount of oil and gas exploration and sea transport activities. For this reason, oil spill damage and the mitigation thereof is essential in marine environmental protection. Due to the cold temperature and the consequently reduced chemical reaction, the capacity for evaporation, decomposition and degradation of the spilled oil is greatly reduced or delayed.

When oil is spilled in icy waters it diffuses into the various cracks and pockets, further spreading under the ice and between ice sheets. Thus, oil spilled in the polar regions is widely diffused and dispersed by means of ice drift and mechanical properties. Stranded or sunken oil compounds can easily be remobilised by ice action. For example, when oiled ice melts by drifting into warmer waters or by seasonal warming the enclosed oil is remobilised and released into the water surface and water column. Due to the slow growth and decay process typical for arctic environments, biodegradation as well as recovery and re-growth of oiled coastal areas is greatly delayed. In general, the long-term

[72] International Tanker Owners Pollution Federation – Oil spill scenario info (http://www.itopf.org)

damages to the environment and ecosystem are almost impossible to estimate as there is still relatively little knowledge on arctic lifecycles and ecosystems.

Increasing oil exploration and production activities along continental margins and in **deep water areas** have raised concerns on oil spill risks for these regions. Oil production in deep water brings along the risk of a new type of incident – an oil spill in great water depth. This type of spill may occur when a deep water oil well explodes or risers leak in great water depths. At present, very little is known on oil spill behaviour in great water depths and under high water pressure.

3.6.2 Types of prevention and preparedness measures

In order to limit impacts as much as possible, several prevention and preparedness measures should be in place.

An adequate response in open waters is essential in preventing oil from reaching the coastline. Timely removal of large quantities of contaminated water at sea may significantly reduce the quantity of oil reaching the shoreline. For this reason, three preventive measures are considered essential.

First, a preventive measure essential to ensure a timely and adequate clean-up can be found in pre-approved pollution preparedness and contingency plans, which ensure a fast mobilization/organization of the national response, including spill containment mechanisms, collection vessels; services contracting; surveillance, etc.

Second, timely requests for external assistance should be ensured through regional agreements as well as through EU mechanisms (EMSA) to send fleets of oil spill response vessels.[73]

Third, during the actual coordination of a timely removal process an adequate vessel traffic monitoring and reporting system for greater accuracy of location of vessels and potential first responders for search and rescue activities. Vessel traffic monitoring is also needed in order to monitor the traffic of passing ships around the area and control a safety area around the wreck.

Finally, more far-reaching emergency plans and information to the public on how to behave in case of emergencies is an essential preventive measure to limit the consequences of a potential oil spill.

3.6.3 Types of impacts

Reality shows that various ecological, social and economic effects are likely to occur from oil spills. According to ITOPF, the exact nature and duration of these impacts depend, among other factors, on the type and amount of oil spilled, on its behaviour once

[73] European Maritime Safety Agency – Action plan for oil pollution preparedness and response

spilled, on the characteristics of the area, on the weathering conditions and on the type and effectiveness of clean-up.[74] The EMSA mentions similar factors: type of oil; weather and sea conditions; effectiveness of clean-up operations; psychological, biological and economic characteristics of the spill location; amount and rate of spillage; and time of year[75]. In general, it should be noted that, although the short-term effects of oil spills on many marine species and communities are often reasonably predictable, very little is known about possible long-term effects.[76]

Typical environmental effects range from toxicity to smothering and impact various species and areas. Well known environmental effects include toxic and sub-lethal effects on plankton, seabird drowning or body heat loss following fouling of plumage by oil and the long-term tainting of commercial species caused by oil becoming incorporated into bed sediments.[77]

Besides having the potential to cause large environmental damage, oil spills typically also result in considerable economic damage. Contamination of coastal areas can significantly reduce tourists' desire for recreational activities. Temporary losses for the tourism sector are a very common consequence. Furthermore, an oil spill has the potential to damage boats and gear used by the fishery and mariculture sectors. The ITOPF specifically notes that one should always thoroughly investigate the status of fishery and the alleged effects of a spill to be able to determine the real economic and social impacts.[78]

3.6.4 Oil spill response

Institutional structure for oil spill response
In case of an oil spill emergency, various institutions and levels are responsible for the emergency response. First and foremost, oil spill response is a national responsibility. However, other resources and capabilities from industry (vessel owner) and P&I insurer typically would be involved from the outset to support the government-led response.

As a second level, when national response capacity is overwhelmed, regional frameworks for combating pollution spring into action. Four of these regional agreements are covering all major European waters: the Helsinki Convention, the Bonn Agreement, the Barcelona Convention and the Lisbon Agreement.

- The **Helsinki Convention** (HELCOM) was adopted in 1974 and entered into force in 1980. The HELCOM aims to protect the marine environment of the Baltic Sea from all sources of pollution. Under the HELCOM, each country has established its own response capabilities and maintains these in a state of constant readiness for oil spill response anywhere in the Baltic. Furthermore, the HELCOM strives to improve the collaboration between partakers in case of an oil spill.[79]

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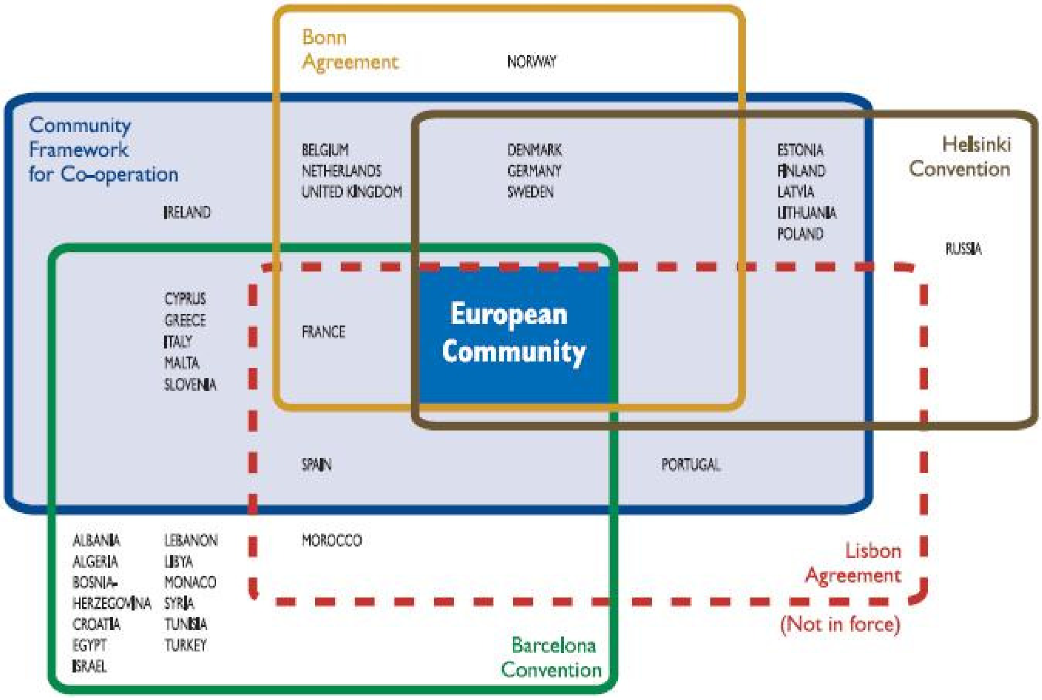
[74] International Tanker Owners Pollution Federation – Oil spill scenario info (http://www.itopf.org)
[75] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[76] International Tanker Owners Pollution Federation – Oil spill scenario info (http://www.itopf.org)
[77] International Tanker Owners Pollution Federation – Oil spill scenario info (http://www.itopf.org)
[78] International Tanker Owners Pollution Federation – Oil spill scenario info (http://www.itopf.org)
[79] European Maritime Safety Agency – Action plan for oil pollution preparedness and response

- The first **Bonn Agreement** was established in 1969 following a number of major oil spills. The current Bonn Agreement, however, was established in 1983 and focuses on combating marine oil pollution by encouraging the North Sea states to improve their response capacity through different types of exercises.[80]
- The **Barcelona Convention** entered into force in 1978. It is composed of a number of protocols, of which two relate to spills of oil and hazardous material. Out of these two, one focuses on co-operation for preparedness and response, whilst the other focuses on the prevention of pollution from ships.[81]
- The final regional agreement covering oil spills is the **Lisbon Agreement**. Established in 1990, this agreement aims to promote mutual assistance between France, Spain, Portugal and Morocco. It should be noted that this Agreement has not yet come into force. Under the agreement, the partaking states will establish their separate response organisations and contingency plans. Furthermore, they will assess pollution incidents and inform other parties accordingly as well as develop joint training activities at regular intervals.[82]

The following diagram depicts how the reach of these regional agreements partially overlap to ensure complete coverage of the European waters. Furthermore, the third emergency response level - international assistance - is shown. The third level consists of top-up capacities from the European Community as well as from international organisations that can complement the response resources already provided through the national and regional levels.[83]

Figure 3.9 International Framework for Co-operation in Combating Pollution



[Source: European Maritime Safety Agency: Action plan for oil pollution preparedness and response – October 2004]

[80] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[81] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[82] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[83] European Maritime Safety Agency – Action plan for oil pollution preparedness and response

An institution absolutely essential in minimizing key risk factors in case of maritime disaster scenarios in EU Member States is the **European Maritime Safety Agency** (EMSA). The EMSA was set up to ensure a high level of maritime safety and security, by providing operational support, co-operation/coordination abilities and information.

As of May 2004, with entering into force of Regulation 724/2004, the European Maritime Safety Agency (EMSA) has a legal obligation in the field of response to ship-sourced pollution within European Union waters. EMSA was tasked to provide a framework for developing pollution response actions at European level, and more specifically:

- "To provide Member States and the Commission with technical and scientific assistance in the field of ship-sourced pollution"
- "To strengthen and top-up the existing pollution response mechanisms of Member States in a cost efficient way".

Under Article 2 of the amended EMSA Regulation, the Agency's oil recovery capacity should be channelled to the requesting Member State through the existing **Community Mechanism in the field of civil protection**. Thus, a Member State will have to channel its request through the Commission's MIC.

For emergency response needs, the EMSA can be of assistance in a number of ways. First of all, the EMSA can make special at-sea oil recovery vessels available, enabling timely pollution response operations at sea. For this service, the Member State will pay a fixed rate except for the costs for bunker fuel for which the actual market prices apply. Second, as of 2007 the EMSA can provide a satellite imagery service to monitor oil spills. Finally, the EMSA can make pollution response experts available to assist national authorities.[84]

Oil spill response options

The main technical response strategies include mechanical recovery at sea, aerial application of dispersant chemicals, *in-situ* burning, monitor and evaluate, and shoreline clean-up. Each of these response options has its strengths and limitations also largely depending on the type of oils spilled, the volume spilled, and the weather conditions.

In general, removal of oil from the marine environment will directly and/or indirectly mitigate the impact of the oil on the coastline. **At sea oil recovery** is typically easier, less costly and less environmentally harmful than waiting until the oil slick reaches the shore and carrying out clean up operations on the shoreline. Mechanical recovery at sea involves booms, skimmers and grab systems that can be installed on regular vessels. Additionally, 'specialist' response vessels equipped with sweeping arm oil recovery systems can be deployed. Generally, the response equipment for non-specialised vessels can be deployed relatively quickly and can contain the oil spill relatively effectively as long as weather and sea conditions are relatively calm. In rough seas, specialist response vessels with sweeping arms are more effective. Furthermore, specialist response vessels incorporate onboard oil storage and ship-to-shore transfer pumps, making them considerably more efficient as they can collect the oil more effectively, they can stay at sea longer hours and they can transfer the collected oil at a much faster rate.

[84] European Maritime Safety Agency – Action plan for oil pollution preparedness and response

Aerial application of dispersant chemicals is applied to help accelerate the natural dispersion process of oil into the sea. Dispersants can be sprayed from various means, including planes, helicopters and boats. This type of response method is most successful to light crude oils and not applicable for heavy fuel oils. Prior to deploying this type of response mechanism, a rapid environmental appraisal has to be undertaken to assess the potential impact of the oil in the water column on environmental and socio-economic sensitivities because the dispersant chemicals spread the oil from the surface into the water column.

***In-situ* burning** is an alternative method of removing oil from the sea surface by containing the spill with special fireproof booms and deliberately igniting it. However, this type of response is not really an option in European waters due to the close proximity to the exposed population and economic resources.

Under certain circumstances when the type of oil involved, its persistence in the marine environment, the spill site, meteorological and oceanographic conditions are favourable, the most suitable response option may be to **monitor and evaluate** while the oil naturally disperses at sea without contaminating coastlines and/or heavily impacting on wildlife.

Finally, with large oil spills there is invariably a **shoreline clean-up** aspect to the response strategy because not all oil can be captured at sea before it reaches the coast. There are a range of techniques which can be used in combination to clean up the coastline and minimise the environmental and socio-economic impacts. Techniques include manual and mechanical oil slick removal, and flushing or washing with water at high or low temperatures and pressures. Generally, a net environmental benefit analysis approach is carried out during a rapid appraisal in order to choose the most appropriate onshore clean up method. The clean-up of coastal zones and shore areas is usually a difficult undertaking which requires large amounts of personnel and equipment. Sensitivity and vulnerability of coastal zones depends on the characteristics of the specific area but also on a series of hydrodynamic, ecosystem and socio-economic factors.

Limitations to removal

A number of factors are known to limit the containment and recovery of oil. A very good example outlined by the ITOPF is the natural tendency of oil to spread, fragment and disperse causing oil to be scattered over a large area within just a few hours. Combining this with the fact that oil recovery systems often have a small swath width and move at slow speeds, one can easily see how, even if the systems can be operational within a few hours, it will be difficult for them to come across more than a minor part of a widely spread slick[85]. Other common complexities in removal can be caused by weather conditions or by coordination/co-operation issues.

Final disposal of oiled waste

The Oil Spill Scenario Information published by the ITOPF emphasizes that, ideally, as much of the collected oil as possible should be reprocessed through and oil refinery or recycling plant. This is, however, often impossible as the oil may have weathered.

[85] International Tanker Owners Pollution Federation – Oil spill scenario info (http://www.itopf.org)

However, this oil can still be disposed to landfill sites, used for example in land reclamation or road building. The disposal method employed will eventually be dependent on the type of oil, the location of the spill, the costs involved and the environmental, legal and practical limitations[86].

The EMSA also notes this in their Action Plan by saying that waste segregation or, more specifically, the lack thereof, is a major issue in final disposal. Waste material should be separated into various waste streams to facilitate disposal. Furthermore, it is mentioned that shoreline waste material can be a mix of a wide range of substances (e.g. sand, beach debris, etc.). This waste needs to be disposed in an environmentally satisfactory manner. Traditional disposal routes, however, include incineration and landfill. The EMSA further notes that the lack of waste segregation often causes waste disposal operations to continue long after the clean-up phase is over.[87]

Keeping the considerate amount of effort and time required in the disposal phase in mind, it should be noted that for every tonne of oil recovered at sea, it is estimated that at least 10 tonnes of shoreline clean-up waste material is avoided.[88] This fact makes a well coordinated and timely response even more valuable.

3.6.5 Past reference disasters

The following past oil spill disasters serve as reference benchmarks for building the future oil spill disaster presented in section 3.6.6.

2002 Prestige accident
The 2002 Prestige incident occurred when the Bahamas registered tanker PRESTIGE began leaking oil some 30 nautical miles off Cabo Finisterra. The PRESTIGE was carrying a large amount of IFO 650 heavy fuel oil, of which 63,000 tonnes are estimated to have been spilled.

The initial response to this incident mainly consisted of Spanish vessels being dispatched to the casualty to assist. However, these Spanish vessels did not carry containment and recovery equipment. Nevertheless, a considerable amount of oil was recovered because of the large fleet of fishing boats and specialised vessels arriving on the scene. The fishing boats were able to move close to the shore to recover oil. Furthermore, they were able to recover plates of oil too small and too spread out for the larger specialised vessels. Even though it took them longer before they arrived on the site, the specialised vessels themselves also recovered a significant volume of oil.

A few points were notable in this response operation. First of all, a very large volume of oil was recovered in the first days after the accident because of the viscosity of the oil and the coherent nature of the slicks at the time. The quick response was considered essential here. Second, gradual emulsification, fragmentation and spreading of the oil over time led

[86] International Tanker Owners Pollution Federation – Oil spill scenario info (http://www.itopf.org)
[87] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[88] European Maritime Safety Agency – Action plan for oil pollution preparedness and response

to reduced recovery efficiencies of vessels. Third, many of the vessels involved had problems to recover the heavy fuel oil in the heavy sea and Atlantic winter conditions. Fourth, vessels with large storage capacities were able to remain at sea recovering oil for longer periods before discharge was required. Fifth, and as was mentioned before, a particularly large problem was the amount of time it took for the vessels to arrive on site. Sixth, only limited success was achieved by boom and skimmer systems.[89]

1999 Erika disaster

Another past disaster was the M.T. ERIKA which broke in two in 1999 in a severe storm about 60 nautical miles off the coast of Brittany in Northwest France. It carried 30,000 tonnes of heavy fuel, of which about 20,000 tonnes were estimated to be lost in sea. This incident also took place in very poor weather and sea conditions. The oil spent much of its time at sea being swamped by waves and therefore did not move as fast as predicted by computer models.

Two days after the incident, the French authorities decided to send their response vessels to the site as well as to call for assistance under the Bonn Agreement. The poor weather conditions caused delays in the arrival of the vessels. Similar to the Prestige incident, limited success was achieved by boom and skimmer systems[90].

2003 FU SHAN HAI DGYNIA collision

Another oil spill disaster was the collision of the FU SHAN HAI with the container-vessel GDYNIA off the southern coast of Sweden and the Danish island of Bornholm. While the latter was only lightly damaged, the former sank carrying 1,800 tonnes of heavy fuel oil, 110 tonnes of diesel/lubes and 66,000 tonnes of potash.

The response by the authorities was rapid and ensured that there were oil response capabilities on site from the start. The weather and sea conditions were favourable. In this incident, the important role of fully equipped multi-purpose vessels in providing an immediate response was particularly noteworthy. The close cooperation by Participating States contributed to this, reducing the time required for other response vessels to arrive.[91]

1993 grounding of the BRAER

Finally, the 1993 grounding of the BRAER, leaking 84,000 tonnes of relatively light crude and 1,500 tonnes of heavy bunker oil serves as yet another past reference disaster. The extreme weather conditions significantly limited response options (i.e. mechanical at-sea oil recovery techniques and aerial application of dispersant chemicals proved either inefficient or impossible). These very same weather conditions provided a peculiar situation, as they accelerated the natural dispersion of the oil (reducing the presence of sea surface slick) and agitated sediment particles in the water column and seabed that in turn absorbed the oil (making only a limited amount of conventional shoreline clean-up beneficial). In conclusion, the response options that can be used are heavily dependent on situational circumstances[92].

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[89] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[90] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[91] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[92] European Maritime Safety Agency – Action plan for oil pollution preparedness and response

3.6.6 Scenario presentation: oil spill in European waters

Characterisation of the hypothetical scenario		Disaster Scenario: Heavy fuel oil spill in Europe
	Disaster event	• On a Friday afternoon in February the SASA oil tanker (with a deadweight tonnage of 140.000) breaks in two and sinks 55 nautical miles (ca. 100km) off the coast of a European country. • Approximately 75.000 tons of heavy fuel oil spill into the sea. • After sinking the wreck continues to leak oil at a rate of approx. 250 tons of oil a day. • Weather and sea conditions are predicted to be stable over the coming days (typical winter conditions with relatively rough sea, sustained winds and temperatures around freezing point). These weather conditions will affect the choice of the response strategy. • Intensity of the oil spill is immediately deems it a major disaster overwhelming national response capacities (additional capacities from regional agreements are also overwhelmed). Therefore a request for international assistance is issued.
	Disaster site	• Sea surface, water column, sea bed as well as animal and plant species in the wreckage area suffer immediate impacts of the spill. • Approximately 1.000 kilometres of southern European shoreline are at risk of being contaminated from oil reaching shore. • 3 European countries are affected by the spill, where many people live in coastal areas and many depend on the sea for their livelihood. • Local business, infrastructure and the tourism industry (including fisheries, beach hotels, desalination and power plants, etc.) have to seize operations within days to limit impacts once the oil hits the coastline. • Water and air quality impacts also require immediate safety measures to spring into action (e.g. evacuation of several hundreds of people).
	Immediate direct and indirect impacts / types of damage	**Human toll**: • 140 people suffered injuries or severe health effects during clean-up operations (this can be partially attributed to the high number of inexperienced volunteers carrying out beach clean-up without appropriate protective gear). • An additional 400 people suffered minor health effects. Oil has a direct effect on people through direct contact or inhalation of oil fumes. Short term adverse effects can include nausea, headaches and dermatological problems in fishermen, residents living close to the affected areas and beach visitors. • 800 people were evacuated as a safety measure. **Damage to on-shore infrastructure and assets**: • 15 power stations and desalination plants were shut down as a protective measure causing shortages of electric power and fresh water supplies. • 5,000+ hotels, restaurants and cafes are affected. Many public and private beaches (200+) have been affected by the oil spill. Many private boats, ships or yachts, that were once used to transport tourists on water trips and to off land islands, currently idle in their ports. • Harbours, fishing gear, mari-culture facilities and other structures were contaminated across an extensive stretch of coastline. The activity of several harbours located in the contaminated area was held up suspending 85% of passenger and freight transport. **Ecological effects**: • Prolonged contamination of the sea bed at the wreckage site (even after emergency recovery of the remaining oil from the wreckage via remotely operated vehicles). • Almost 200.000 oiled birds, of which almost 100.000 are dead. A major cleaning operation was mounted for the 100.000 oiled survivors. • 5 coastal protected areas were also affected by oil slick. One of the areas was included in the Natura Network 2000. **Immediate secondary impacts**: • 80.000 jobs affected direct or indirectly (around 8.000 fishermen have to suspend offshore fishing for at least one year due to the marine pollution as well as damage to their equipment). • The main socio-economic impact is felt by local fishermen and coastal communities. **Economic cost:** • The estimated cost for the cleanup is between 300 million and 400 million Euros. • Indirect economic costs of this disaster in terms of lost business and damage claims amount to more than 400 million Euros.

Expected / required response resources

Primary objective of the immediate response activities is to recover as much oil as possible at sea to limit socio-economic and ecological damage at the shoreline. Due to oil type (heavy fuel oil) the only feasible method is mechanical recovery at sea (aerial application of dispersant chemicals is not effective for this oil type; in-situ burning not suitable for ship-sourced heavy fuel oil pollution and not really an option in European waters because of the exposed population and resources).

<u>0-48 hours:</u>

Managed by national capacities:

- First responder vessel to rescue crew.
- Aerial surveillance of disaster site via plane to conduct first assessment of damage extent and required response mechanisms.
- Activation of national and regional contingency plans for responding to oil spill.
- 2 multi-purpose vessels (plus support boats) for immediate containment activity with booms and skimmers. Due to the difficult weather conditions described in 7.1.1 it will not be easy to find this many vessels capable of working in rough seas. Most may have to be called but put on stand-by. Therefore, this national capacity can only be counted on if weather permitting.
- Power generators for high priority facilities (hospitals, etc.).
- Management facility to coordinate emergency response efforts.

Need for external assistance (from regional agreements, EU Mechanisms including MIC and EMSA, industry, insurers, etc.):

- Computer modelling of potential oil movement and pollution scenarios.
- 4 multi-purpose vessels (plus support boats) for immediate containment activity with booms and skimmers. Due to the difficult weather conditions described in 7.1.1 it will not be easy to find this many vessels capable of working in rough seas. Most may have to be called but put on stand-by. Furthermore, it will likely take more than 48 hours to mobilise this amount of vessels in most places around Europe.
- 1 aircraft with remote-sensing equipment and trained observers trained for the reconnaissance of oil spills.
- Request for specialised at sea oil spill response vessels and satellite surveillance support.
- Water purification / desalination equipment to supply approximately 50.000 households in a dispersed area (many small coastal towns).
- Power generators for approximately 20.000 households.

<u>Up to 3 days:</u>

All of the above mentioned response means and the following additional resources:

Managed by national capacities:

- Containers for temporary storage of waste material as foreseen in the national/local contingency plan (incl. transport and treatment of waste).
- Evacuation and temporary shelter for 800 people (incl. measures for ensuring the surveillance and protection of abandoned houses and facilities).

Need for external assistance (from regional agreements, EU Mechanisms including MIC and EMSA, industry, insurers, etc.):

- At least 3 specialised oil spill response vessels with sweeping arm recovery systems, large onboard storage capacity for greater efficiency in current sea conditions (to top up specialised resources already mobilised on national and regional levels).
- Ship to shore oil transfer systems to minimise time spent offloading collected oil.
- Collapsible tanks for temporary storage of recovered oil (plus transportation means to bring equipment to the site where it must be deployed; plus trained people who know how to deploy and use the equipment).
- 20 kilometres of containment boom, ranging from beach to heavy duty offshore boom (plus transportation means to bring equipment to the site where it must be deployed; plus trained people who know how to deploy and use the equipment).
- Satellite surveillance support (such as EMSA's CleanSeaNet) to aid the coordination of at sea oil recovery efforts.
- 8 trailer-mounted steam cleaning / pressure washing systems.
- Protective equipment and additional experts to help manage teams of shoreline clean-up volunteers.

<u>Up to 2 weeks:</u>

Managed by national capacities:

- On-shore oil cleaning equipment based on Net Environmental Benefit Analysis approach.
- Provision of socio-economic recovery services.
- At least one specialised oil spill response vessel remains in operation.
- Waste separation, transportation, etc.

Need for external assistance (from regional agreements, EU Mechanisms including MIC and EMSA, industry, insurers, etc.):

- Top up nationally available on-shore oil cleaning equipment ad trained staff.
- Top up national response capacity with one specialised oil spill response vessel as long as required.
- Technical assessment team and testing equipment for evaluating environmental contamination, drinking water, soil, etc. (at least 2 teams).
- Satellite surveillance support (such as EMSA's CleanSeaNet) to aid the coordination of at sea oil recovery efforts.

3.6.7 Analysis

Scenario Choice

As can be seen from the oil spill scenario background information, various factors such as the effect of weathering processes, the impact of an oil spill and the clean-up and removal process of an oil spill are largely dependent on the particular type of oil spill dealt with. The most straightforward classification is into oil spills concerning light refined products (e.g. gasoline and diesel) and light crude oils on the one hand and oil spills concerning heavy crude oil, emulsified oil and heavy fuel oils on the other hand.[93]

'Light' oils when spilled often do not persist on the surface of the sea for long due to the rapid evaporation process. These oils are more likely to diffuse and dissolve naturally. As such, these oils may taint edible fish, shellfish and other marine products. However, these effects will usually be limited to a small area and will be relatively short-term because the toxic components are also the ones that evaporate the most easily.[94]

'Heavy' oils are generally lower in toxicity but are considerably more persistent in the marine environment. They do not readily evaporate, disperse or dissipate naturally. Because of their highly persistent nature, they have the potential to cause a long-lasting threat to seabirds and other wildlife.[95]

The 'heavy fuel oil spill from a sunken tanker' scenario was chosen for this study due to several reasons:

- Heavy fuel oil disasters typically require more emergency response capacities and different types of resources than light oils. Therefore, a heavy fuel oil scenario was chosen to depict a worst case scenario requiring maximum response resources.
- The risk of oil spills in European waters is relatively high. Incident statistics show that large scale oil spills may occur every 2 to 3 years but the location of such an event cannot be predicted.
- The disaster type portrays an area in which national response capacities are easily overwhelmed and due to the nature of the disaster it most often involves more than one country.
- The disaster type was chosen to test whether current Module types sufficiently address the types of immediate response needs requested by Participating States.

The oil spill scenario is expected to be used for inter-agency discussions on the complementarities and synergies of marine pollution resources accessible through the Mechanism and managed by EMSA and civil protection resources that Participating States may make available through the Mechanism. Also, the scenario could be used for carrying out civil response exercises or marine pollution response trainings.

[93] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[94] European Maritime Safety Agency – Action plan for oil pollution preparedness and response
[95] European Maritime Safety Agency – Action plan for oil pollution preparedness and response

Limitations
The current scenario does not represent a worst case scenario. The scenario parameters have been built around past reference scenarios. To intensify this scenario, the original spill size (tonnage) can be increased, the type of oil can be modified, the sea and weather conditions can be worsened, and the location of the spill can be moved closer to shore.

These changes would significantly change the intensity as well as the types of impacts. In turn, also the required response and the requested external assistance will change (e.g. request for chemical oil dispersants).

It should also be mentioned here, that a different type of oil spill, for example a spill involving light oil, may lead to different gaps due to the different types of response resources required. Therefore the gap analysis in this study focuses on the chosen scenarios and may not provide an exhaustive list of gaps for all disaster sub-types.

Sensitivity analysis: prevention and preparedness
How much can prevention and preparedness measures reduce disaster impacts and consequently the need for response actions? For oil spills and marine pollution, in particular, preventative measures and preparedness can significantly reduce disaster impacts. Over the past decade, better prevention measures have shown a significant decrease in the amount of oil spilled during accidents (see section 3.6.1). Nevertheless, it is impossible to predict oil spill occurrence and frequency. For this reason, most countries have detailed contingency plans that stipulate response plans and ensure that the necessary response mechanisms are in place.

In the case of oil spills, the prevention dimension refers primarily to reducing the amount of oil that reaches the shoreline because 1 tonne of oil recovered at sea equates to a 10 tonne reduction in contaminated beach material, thus lessening socio-economic as well as environmental impacts, clean-up costs and waste disposal challenges. However, this type of prevention does not help prevent the actual incident; it helps to limit its negative consequences. Thus, these preventive measures could also simply be seen as the most effective emergency response option. These types of measures lessening the intensity level of disaster impacts and thus also the required response resources include:

- Emergency plans and information to the public about how to behave in case of emergencies limits the consequences if any accident occurs.
- Pre-approved pollution preparedness and contingency plans ensuring fast mobilization/organization of national response, including spill containment mechanisms, collection vessels; services contracting; surveillance, etc.
- Timely requests for external assistance through regional agreements as well as to the Community civil protection mechanism to access EMSA oil spill response vessels. Quick removal of large quantities of contaminated water at sea may significantly reduce the quantity of oil reaching the shoreline.
- Vessel traffic monitoring and reporting system for greater accuracy of location of vessels and potential first responders for search and rescue activities in case of disaster. Furthermore, this system can monitor the traffic around the disaster site and ensure the safety of passing vessels.

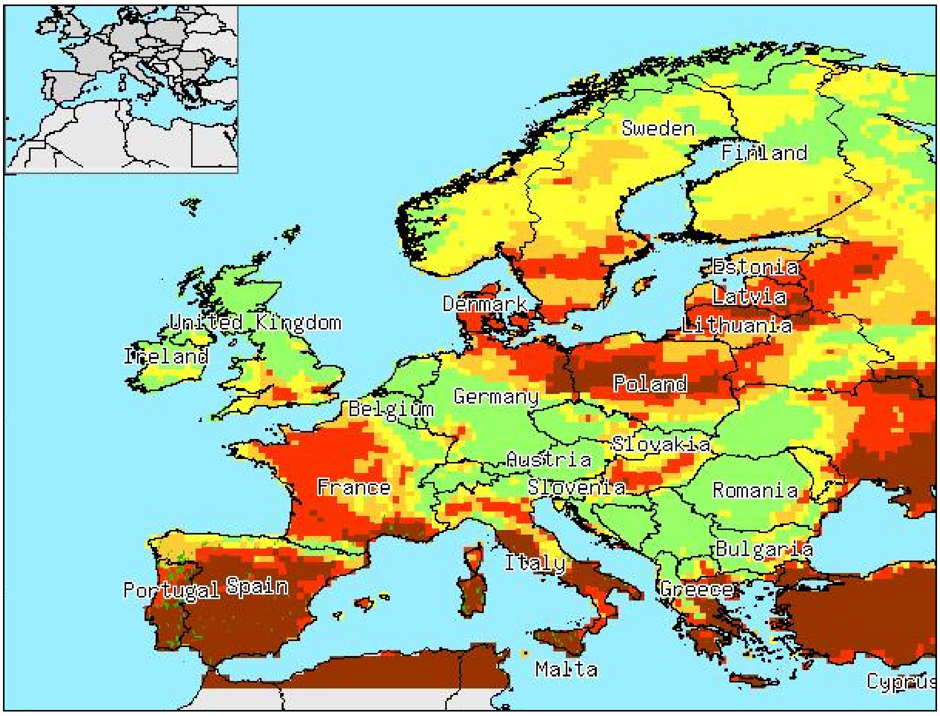
Given this sensitivity analysis, oil spill disasters are therefore primarily preparedness-sensitive scenarios. Good preparedness measures can help mitigate the negative impacts. Prevention measures (pre-incident), however, can still not prevent spills nor make them more predictable.

3.7 Forest Fire

Extremely high temperatures combined with below average rainfall lead to a high risk of wildfires across South East Europe every year. Wildfires are annual occurrences, and, consequently, the local ecosystems are fire-adapted. Nevertheless, the 2007 season was among the worst on record, according to national fire-fighting authorities and government officials.

Fire is the most significant natural hazard to the forests, wooded areas and bush land in the Mediterranean basin and the South East Europe. Forest fires can be caused by various agents including climatic conditions, such as extreme heatwaves and dry conditions, as well as via arson. The European Forest Fires Information System (EFFIS) map below indicates the relative risk of wild fire outbreaks in Europe.

Figure 3.10 Map indicating the relative risk of wildfire outbreaks across Europe



[Source: European Forest Fire Information System: Map viewer]

In terms of the types of forests, broad-leaved species predominate in southern Europe, especially in the eastern part of the sub-region. Broad-leaved dominated forests make up over 60% of the total southern European forest area, with a further 10% of mixed broad-leaved / coniferous forests. Due to the fact that in some southern European countries the average growing stock volume per hectare of coniferous stands is greater than that of broad-leaved stands, carnivorous forests account for more than half the growing stands in Bosnia and Herzegovina, Greece, Portugal, Slovenia and Spain.[96]

Oaks, both deciduous and evergreen species, are the most common broad-leaved species throughout southern Europe. Beech is also common at higher altitudes. Other species include chestnut, poplar and eucalyptus. Furthermore, extensive areas of broad-leaved coppice and coppice with standards can be found notably in Italy, Greece, Spain, Bulgaria and the Balkans.[97]

Pines are the most dominant coniferous species in the south of Europe, particularly Aleppo, Scots, maritime and radiate. Spruce, fir and larch can also be found in some locations.[98]

3.7.1 Typical Conditions (key risk factors)

Hazard frequency

In the past eight years, wildfires have accounted for 25 out of 196 natural disasters in Southern Europe.[99] These are 3,125 wildfire events per year. The average yearly number of individuals killed by wildfires is around 21, but the number of individuals affected is far greater. Research shows that the amount of individuals affected is approximately 18,085 per year. Although this number of casualties might seem relatively small in absolute numbers when compared to other disaster scenarios (e.g. extreme temperatures or earthquakes), wildfires occur rather frequently.

As can be seen in the figure below (Figure 3.11), the number of wildfires has been increasing significantly over the past decades. Nevertheless, due to improved fire-fighting equipment and techniques, the burnt area and average fire size has continuously decreased over the same period.

The most severe wildfire, looking at the number of deaths, took place in Greece from the 24th of August until the 30th of August 2007. This fire took the lives of 67 people and affected 5,392 Greek citizens.

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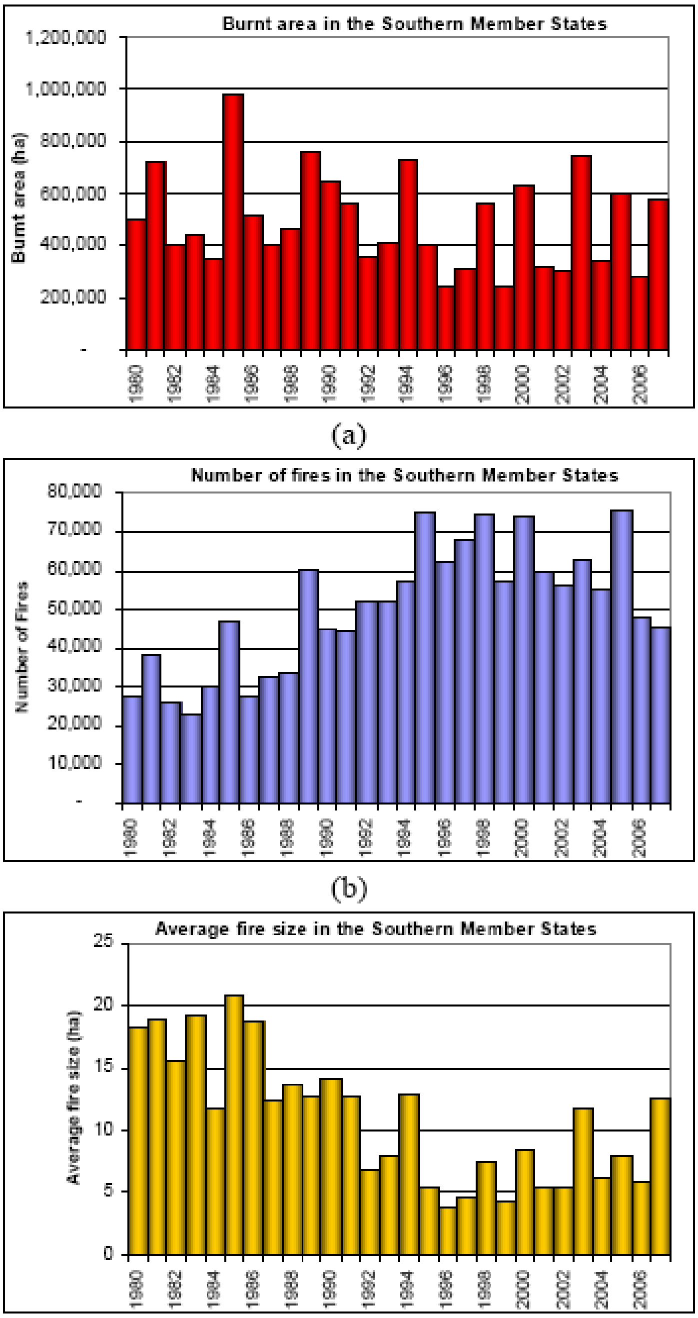
[96] FAO. Global Forest Resource Assessment 2000. Ch. 30 “Southern Europe”.
[97] FAO. Global Forest Resource Assessment 2000. Ch. 30 “Southern Europe”.
[98] FAO. Global Forest Resource Assessment 2000. Ch. 30 “Southern Europe”.

Figure 3.11 Summary overview of forest fire trends, 1980-2007



(c)

[Note: burnt area (a), number of fires (b), average fire size (c)]
[Source: EFFIS, “Forest Fires in Europe 2007”]

A factor often named to be of major influence in the occurrence of forest fires is the weather. Long time series of forest fire data available for 5 Southern European Countries show how much the occurrence of forest fires depends on seasonal meteorological conditions.[100]

[100] European Commission (DG Joint Research Centre, DG-Environment) - Forests fires in Europe in 2006

The average costs associated with fires revolve around US $986.7 million per year. Out of the 25 fires documented between 2000 and 2008, 16 caused casualties and 14 affected populations (not fully overlapping). This suggests that roughly every 1½ to 2 years a wildfire has direct disastrous effects in Southern Europe. Only nine fire records contain estimations of the costs associated with damages caused.

Forest fire risk has been increasing due to climate change, population growth and activity as well as urbanisation. Given the possible climatic changes driven by global warming, the number of future wildfires across Europe is likely to increase. This is mainly due to increasing temperatures combined with the low humidity levels.

Exposure/vulnerabilities
This disaster type is specifically hazardous concerning its potential to cause various environmental vulnerabilities. The loss of forests reduces biodiversity and causes various imbalance effects. Considering these imbalance effects are likely to be permanent or at least take centuries to recover, the structural changes in flora and fauna have considerable long term consequences.

Wildfires also have significant consequences for the agricultural sector. Without any exception, all parts of the agricultural value chain prior to long-distance transportation are exposed to the consequences of wildfires. In several Southern European countries, agricultural production is on a domestic/household rather than the industrial level. In these countries, wood is still a widely used material for tools, structures, etc. Consequently, particular exposure is faced here. In addition, the age of the population living in these areas is often above average, making them less mobile in the event of a forest fire.

The extent of economic and physical vulnerabilities is considerably lower than the extent of environmental vulnerabilities. Nevertheless, the costs of damages suffered in wildfires are substantial. The forest fire in Greece in August 2007 caused US $1,750 Million worth of damages. Typically, the majority of these costs relate to the human resources involved in extinguishing actions; often international forces and the army need to be involved, but also the loss of equipment (planes, cars, etc.) adds to these costs. In development terms, Southern European countries have a relatively lower GDP per capita and relatively lower technological standards than the Northern Member States. This further adds to the extensive level of exposure faced by Southern European countries.

Since the agricultural infrastructure (including breeding, production, irrigation, etc.) is highly exposed to this type of disaster, the level of social vulnerability can also be considered relatively high. Many local communities are located in mountainous areas, which are not easily accessible for the fire-fighters. This adds to the exposure and vulnerability. Finally, given the speed of the fires spreading through a region, even the mobile elements in agricultural or residential areas are at risk.

3.7.2 Types of prevention and preparedness measures

Several preventive measures are often named to have an impact on the intensity level of forest fire disasters and the required response resources. Preventive and preparedness measures for forest fires include both measures for avoiding an outbreak of fires in the first place as well as measures to limit the spreading of fires in case they do break out.

Prevention

- Awareness-raising campaigns (public education). Many times humans are responsible for the outbreak of forest fires in one way or another and thus one of the first steps of a prevention strategy typically is to inform, educate and mobilise citizens about the risks of forest fires as well as risky activities. Education and awareness-raising campaigns can occur at various levels, including schools, public seminars, information brochures, tv shows and commercial spots in the media.
- Clearing schedules for regular cleaning of road networks from fallen branches, vegetation and flammable materials.
- Strict legislation to discourage man-made fires caused through intentional arson. Countries without strict legislation have in the past faced forest fires via arson for reasons including building permits, etc.
- Creation of recreation areas. With the creation of camping grounds the danger of citizens accidentally starting a fire is decreased because campers are limited to controlled areas.
- Policies addressing the challenge of spatial dynamics (rural migration and urbanization), two processes which typically increase the fire risk, can help reduce fire risk.
- Forest fire information and monitoring system. Another important component of preventative measures are statistics that predict the probability of fire in certain areas helping in the immediate response. Strategically placed watchtowers and regular patrols for the purpose of detecting fires can also build part of the monitoring system in addition to satellite tools, etc.

Preparedness

- Preventive forestry measures (firebreaks, clear and felled areas, etc.). Their aim is to stop the course of the fire and they can be used for providing access to fire-fighting trucks.
- Road infrastructure with sufficient access routes to high risk areas.
- Sufficient water supply points and infrastructure. The installation and maintenance of water reservoirs and a good overview of whether sufficient natural and installed water supply points exist is a crucial part of the preparedness level for forest fires.
  Clearly indicated escape routes to allow for quick evacuation of endangered citizens, thus limiting the number of wounded or dead.
- Heliports built to help transport wounded people, personnel and supplies during a fire can reduce the search for appropriate landing sites and speed up the disaster response.

National and regional measures

To a large extent concepts for the prevention of forest fires are focused at the national level. However, large forest fire situations often exceed national response capabilities. Further, forest fires are often crossing national borders. Consequently, plans of action drawn up on a transnational and regional basis for risk management in areas threatened by disasters can often be even more effective than measures carried out on a national level. In addition to a more synchronised approach to the measures mentioned above, a more regional approach to fire prevention and preparedness can be facilitated by bilateral and transnational communication (harmonization of communication and information flow and procedural matters, such as incident command systems).

3.7.3 Typical impact types

A typical country in Southern Europe tends to have large parts of its surface area at risk to wild fires due to the climatic situation and the large amount of forest and grassland. Typically the high-risk countries are not landlocked and have, at least partially, a Mediterranean climate with low humidity. Rain tends to fall in short heavy downfalls with fewer overcast days than further North. The summers can be classified as either semiarid or subtropical dry.

In addition to vast forests and grasslands, the country has large sub-urban areas as well as 50% of its population living in rural areas. The population density is concentrated in the endangered areas. Infrastructure outside the metropolitan areas is relatively less developed. Not all areas are easily accessible. Suburban areas and larger cities are at risk due to their proximity to forests and bushland.

Agricultural communities and rural areas are at high risk of ignition during hot summers and drought. The wide areas allow for strong wind development which, in turn, facilitates further spreading of the wildfire. Some rural communities are not easily accessible due to missing infrastructure or steep locations. Due to significant migration waves of the younger population towards the cities, the man power for acute fire extinguishing reaction is limited. The agricultural sector has already suffered from these conditions and multiple livestock farms are located closely to the new fires. In addition to all the forest, bush- and farm land already burnt, one small town has already been completely destroyed by flames; several villages are engulfed by fires (2 km from fires).

Nature protection areas often have a large share of forests and lack permissions of construction. These two factors increase the probability of fires in these regions since (a) tourists are attracted, including fire making for various purposes, and (b) incentives to set a blaze in the hope of a building permit thereafter are induced. At this moment, one of the country's most popular nature protection areas has reported 3 fire locations that are quickly expanding in terms of the area burnt.

3.7.4 Forest fire response techniques

There is quite an array of different fire-fighting aircraft that can be used for fighting forest fires, each with its own advantages and drawbacks, dependent on the exact nature and situation of the fire. This section provides a brief overview of some of the aircraft and also examines the role there is to play for ground forces that can tackle blazes hands-on.

Quick-response is one of the key means to effective fire fighting policy. If one is dealing with fires of no more than a few hectares in size, they can be quickly be doused or impeded with water and fire-retardants from smaller aircraft while ground crews can then be transported to the site for “mop-up” operations. In case of larger blazes, various aircraft, including much higher-capacity aircraft can be used for dispersing water drops, as well as transporting manpower and equipment to sites, especially in more remote locations.

Current aerial fire-fighting methods can be broadly categorized into “fixed-wing” and “rotary-wing”. Of the fixed-wing type, there are two varieties: scoopers and tankers. Scoopers are amphibians or floatplanes capable of scooping water "on the fly" from a lake or river near the fire, injecting a foam concentrate into the water load and dropping it on the fire as a smothering foam. Scoopers can attack single or multiple fires for several hours at a time, scooping and dropping thousands of litres of water and foam as fast as they can shuttle to and from the nearest source of water. Others are land-based planes which carry fire-retardant chemicals to fires from mixing installations at strategically located airports. The major deciding factor as to whether a country uses or not scoopers is the availability of scoopable water.

Rotary-wing aircrafts, on the other hand, are very versatile aircraft. They are commonly used to transport men and equipment to and from forest fires and to drop water or foam directly on a fire perimeter to control and aid in extinguishing a fire. They can take off and land near the area, they can manoeuvre around obstacles, including irregular terrain, they can make shorter turns than fixed wing aircraft, and they can move slowly or hover over an area. Nevertheless, the use of helicopters generally remains limited to applications where their unique features are required, such as small fires, and they are not sent to assist fire fighting at long distances.

The current EU capacity for forest fire fighting consists primarily of national ground forces and aerial means. While aerial means can be transported relatively easily to fire sites across Europe, ground forces are typically limited to their proximity to the fire site (i.e. potential deployment to a neighbouring country). Partial information made available to the Commission on the fleet of medium to high capacity airplanes used in 2007 by the Member States includes 24 for France, 16 for Italy, 18 for Portugal, 27 for Spain and 21 for Greece. An ongoing project (EUFFTR – European Fire Fighting Tactical Reserve) is expected to provide an overview of the fleets of the Member States.

However, as mentioned before, these capacities are all managed on a national level and only some of them can potentially be deployed via requests for external assistance through the MIC. The European capacity currently does not include forest fire fighting resources held and managed on an EU level.

In other regions worldwide – the USA and the Russian Federation, in particular - the development of so-called "super tankers" is now aiding the fight against forest fires by significantly increasing the capacity of water that can be carried by aircraft. For example, the DC-10 has been converted into a fire-fighter and is now called "Tanker 910", having been certified in California by the California Department of Forestry (CDF) Aviation Management Unit in 2006. The tanks of the Tanker 910 can hold approximately 12,000 gallons of water, and it can dump the entire load in eight seconds or in various stages from any of the three tanks.

The Boeing 747 has also been adapted for fire-fighting purposes since 2009. The multi-role B747 Supertanker is the largest tanker aircraft existing today with a payload of more than 20,000 gallons and a response time of 600 mph.

Assessment techniques

As can also be seen in other disaster scenarios, computer models are increasingly used as assessment and monitoring techniques. In terms of forest fires, computer models can help assess fire behaviour taking into account extreme conditions, physical modelling, smoke dispersion, etc. These models can be used to provide various statistics such as the fuel moisture status of a fire or the fire danger rating. The EU continually strives to develop new technologies and methods to improve fire detection efficiency and early warning systems.[101]

Another technique essential in the assessment of forest fires is forest fire risk mapping. According to the DG Joint Research Centre publication 'Pan European Assessment of weather driven natural risks', two main indicators to be used have been proposed so far, namely fire density (i.e. fire frequency normalized upon time and space) and burned forest fraction (i.e. the forest burned areas normalized upon time and forest land areas). These two indicators have the potential to provide detailed maps on the spatial distribution of the risk for wild fires in the EU.[102]

A second tool commonly used for assessment when forest fires have already broken out is aircraft with sensors and image transmission in real time. These real time surveillance flights help experts plan and manage the response effort and – if used in combination with the above mentioned computer models – can help predict high risk areas for potential evacuation of citizens, etc.

Recent initiatives

With respect to forest fire intervention or suppression, various recent research initiatives exist. For example, substantial attention is focused upon the improvement of chemical products used in fire fighting with respect to both their performance and their cost/benefit ratio. Various types of new safety components are also tested.[103]

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[101] European Forest Fire Research Workshop – The burning issue of forest fire: how can research make the difference

[102] DG Joint Research Centre - Pan European Assessment of weather driven natural risks

[103] European Forest Fire Research Workshop – The burning issue of forest fire: how can research make the difference

The area of forest fire risk management is also characterized by a focus on innovation. New decision support systems, information and communication technology and fire fighting resources are employed to increase the effectiveness of risk management and coordination.[104]

Recently, simulation exercises serve as a major source of new knowledge on forest fire risk management and coordination. Building on the lessons learnt from the tragic events in 2007 (will be discussed below), the FIRE 5 exercise was ran on the Italian island of Sardinia in April 2008. Emergency response teams tackled simulated fires, while the European Commission's disaster Monitoring and Information Centre was active in supporting coordination efforts both in the field and at headquarters. The simulation provided useful training sessions for fire-fighting team leaders from Italy, France, Greece, Portugal and Spain, the five countries that sent aerial and ground fire-fighting resources to the exercise.[105] [106]

3.7.5 Past reference disasters

This section elaborates on disaster experiences in the past that were used as a reference for gauging likely future intensity, impacts, risks, etc. Several major 2003, 2006, 2007 and 2008 forest fires will be discussed in detail.

2003 forest fires in Portugal
In 2003, over 350,000 ha of Portuguese land were burned. This included both forest and agricultural land. The combination of high temperatures, wind and drought kept the potential for forest fires high throughout July and August. This disaster caused the loss of goods and employment for approximately 45,000 individuals. The Portuguese forestry industry, which accounts for 6.5% of the country’s exports, also suffered considerate damage. For these reasons, a € 31.6 million fund was established in August 2003 to help Portugal deal with the damages and cover emergency measures.[107]

2006 forest fires in Galicia
In July and August of 2006, Northeast winds drying out vegetation combined with high temperatures provided the setting for the appearance of hundreds of new fires every day. Considering these conditions, one can see why the initial extinguishing response proved insufficient. For each fire that was controlled, several new fires arose at other points. In the beginning of August, assistance from other ministerial departments, other autonomous communities and even from other countries was requested. More than 70,000 hectares were burned in Galicia and heavy material damages remained.[108]

2007 forest fires in Greece, Italy, Cyprus, Albania and Macedonia
2007 was a year of particularly heavy forest fires in multiple EU Member States. Wildfires in Greece, Italy, Cyprus, Albania and Macedonia will be discussed here.

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[104] European Forest Fire Research Workshop – The burning issue of forest fire: how can research make the difference
[105] EC MIC – Fire 5 Exercise map situation: 18 April
[106] EU Press release - Europe prepares for forest fires: major simulation exercise held in Sardinia
[107] Commission News. “Fire damage: Commission proposes 31.6 million euro for emergency measures”.
[108] European Commission (DG Joint Research Centre, DG-Environment) - Forests fires in Europe in 2006

According to Greek fire fighting authorities, the 2007 wildfire season was the worst ever recorded in Greece. 270,000 ha of land were burned, killing 76 individuals and injuring many others. Statistics show that during August, Greek authorities faced an average of up to 85 fire starts and 200 active blazes per day spread out across the country.[109] The meteorological conditions which provided the setting for these disastrous events included three long periods of extremely high temperatures, prolonged drought and strong winds. After three consecutive heat waves, fires broke out. A large ground force participated in fire fighting operations, including 9,500 permanent and 5,500 seasonally hired fire brigade employees, 3,000 soldiers, 200 volunteers of fire services, hundreds of other volunteers and hundreds of active citizens. Furthermore, various aerial means were also employed.[110] In total, around 20 European and non-European countries offered Greece their assistance for emergency response.[111]

In 2007, a total of 10,639 forest fires affected an area of 227,729 hectares in Italy. Once again, high temperatures and strong winds provided the setting for the greatest number of fires faced since 1997. All regions of Italy were seriously affected by the fires and a total of 23 lives were taken in the 2007 fires. Fires mostly occurred in July and August. On the basis of input provided by the Italian ministry, the publication 'Forests fires in Europe in 2007' further adds that the human factor also played a role in this disaster. In saying this, the publication does not only refer to the origin of the fires, but also to the limited emphasis on prevention work prior to the disaster. The Italian ministry indicates that this factor has caused high fire vulnerability to the whole district. With respect to the causes of the fires, relatively detailed information is available. The reason for this is that the Italian ministry carries out an investigation for every forest fire, attributing the event to one of five likely causes (natural, accidental, negligence, arson, doubtful). In 2007, the statistics were as follows: 65.5% was attributed to arson, 13.4% to negligence, 0.6% to natural events and 0.7% to accidents. The remaining 19.8% was not assigned. This means that 78.9% of large fires were man-made disasters. For this reason, the Italian ministry is now emphasising prevention and preparedness and started to carry out a large number of actions concerning forest fire risk management.[112]

2007 was also one of the worst fire seasons on record in Cyprus. A dry winter period was followed by a summer period with very high temperatures and strong winds. A total of 111 forest fires broke out, affecting an area of 4,483 ha. Various fire fighting means were employed in Cyprus. Among these were a campaign aimed at informing the public about forest fire prevention practices, the operation of 27 lookout stations, and a large number of fire engines, tractors, helicopters and aircrafts. Through the MIC, cross-border assistance was requested and provided.[113]

In mid-July, Albania was threatened by a large number of forest fires. An astonishing 150 forest fires burned across 21 Albanian districts, destroying 15 homes and 4 fire trucks and burning a total of 2,000 hectares of forest land. As a consequence of the widespread

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[109] US AID – Southeast Europe – Wildfires and Drought

[110] European Commission (DG Joint Research Centre, DG-Environment) - Forests fires in Europe in 2007

[111] MSNBC Fact file – Greece blazes

[112] European Commission (DG Joint Research Centre, DG-Environment) - Forests fires in Europe in 2007

[113] European Commission (DG Joint Research Centre, DG-Environment) - Forests fires in Europe in 2007

smoke, a number of individuals suffered health problems. Despite the fact that 1,300 military forces, 500 police forces and 800 fire-fighters were sent to respond to the forest fires, their ability to fight the blazes was seriously hampered by the rough terrain.[114]

Macedonia was also amongst the countries threatened by heavy wildfires in 2007. In July, wildfires consumed more than 3,000 hectares of forests in 32 municipalities. Despite causing only one death, the fires directly impacted approximately half of the Macedonian population. Luckily, in August rain and the lowering of temperatures brought an end to the wildfire emergency in Macedonia.[115]

2008 forest fires in Greece and Turkey

Although less detailed information is available on the 2008 forest fire season, several severe recent forest fires are included as a benchmark for building the future forest fire scenario presented in section 3.7.6.

After a particularly heavy 2007 forest fire season, several Greek districts suffered from forest fires again one year later. A well known example is the July forest fire which occurred on the island of Rhodes, a well known Greek holiday destination. Within days, over 5,000 hectares of forest and scrub were burned. Many local residents and tourists were forced to evacuate.[116] Fire fighting assistance was quickly arranged by other parts of Greece, as well as by France, Italy and Cyprus.[117]

Another popular holiday destination was the setting of heavy wildfire action in 2008. In Turkey's Antalya province, at least 4,000 ha of woodland were destroyed. Over 2,000 individuals backed up by more than a dozen aircrafts were reported to be involved in tackling the fires.[118]

2009 Forest Fires in Australia

To briefly provide a past reference disaster example with high human casualties, the recent Australian forest fires in Victoria and New South Wales serve as a tragic case study. In this disaster, more than 200 people lost their lives in the flames because fires managed to engulf the towns of Kingslake and Whittlesea. Many children have suffered burns and others are orphaned. Over 7,000 people have been left homeless and emergency shelter and food supplies had to be organised. Australian defence force personnel have been brought in to help police with searching and recovery of remains, which could take months. The impact on wildlife has been enormous, with more than 10,000 animals, including koalas and kangaroos, dying in the fires. The cost of the disaster has been estimated at Australian £880 million, and authorities warned that reconstruction would take years.[119]

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[114] US AID – Southeast Europe – Wildfires and Drought
[115] US AID – Southeast Europe – Wildfires and Drought
[116] BBC Weather Centre - Forest fires in Rhodes by Matt Taylor
[117] Deutsche Presse – Europe news - Italy, France, Cyprus to help fight Greek forest fire
[118] ITN World news - Turkish forest fires rage on
[119] The Guardian. News, 11 February 2009.

3.7.6 Scenario presentation: forest fires in Europe

		Disaster Scenario: Forest Fires in Europe
Characterisation of the hypothetical scenario	Disaster event	• Southern Europe (at least 3 countries) has experienced a prolonged heat period and drought without rainfall. Several forest fires have been breaking out throughout the region's forested areas over the past 3 weeks. Over the previous three weeks, a total area of 80.000 ha has already been burnt. The whole region EU forest fire region is facing either forest fires or high risk situations. • All national civil protection aerial means and ground forces in the 3 countries are employed in the ongoing fire fighting activities. • On the morning of a Sunday in August the situation was reported to be still critical with several fires still active despite ongoing national forest fire response activities within the region. • The situation then worsened over night due to unfavourable winds, extremely low humidity and temperatures of over 25 degrees Celsius even during night time and by Monday morning large areas are affected by fires. • 457 new fire reports follow within the first 24 hours. • The fires are fed by strong south-westerly winds, with a fire front extending over several hundreds of hectares in the most critical location. The total forest area burnt is rapidly multiplying. • Forecasts for the next three days predict strong winds, continued heat and low humidity, thus increasing the threat of fast spreading and potential spillovers to neighbouring countries. Due to the fact that forest fires are highly dynamic situations with regard to wind direction and force, the meteorological situation has to be monitored continuously in order to adjust the emergency response whenever necessary. • Though fires have broken out in 9 different locations throughout the region, in 3 of these (two in the South and one in the West) the situation is most critical. Currently, 2 major cities (100.000+ inhabitants) are under severe threat (5 and 10 km from fires). • Though immediate damages and impacts of the new ignitions are not known, it is clear that the governments of the South European countries call for international assistance for disaster response within 24 hours of the worsened situation because all national civil protection aerial means and ground forces are already employed in the fire fighting activities.
	Disaster site (key geographic areas affected)	• Large parts of the region's surface area at risk to wild fires due to large amount of forest and grassland. • In addition to vast forests and grasslands, the region has large sub-urban areas as well as 50% of its population living in rural areas. The population density is concentrated in the endangered areas. Infrastructure outside the metropolitan areas is relatively less developed. Not all areas are easily accessible. Suburban areas and larger cities are at risk due to their proximity to forests and bushland. • Agricultural communities and rural areas are at high risk. The wide areas allow for strong wind development which, in turn, facilitates further spreading of the wildfire. Some rural communities are not easily accessible due to missing infrastructure or steep locations. Due to significant migration waves of the younger population towards the cities, the man power for acute fire extinguishing reaction is limited. • The agricultural sector has already suffered from these conditions and multiple livestock farms are located closely to the new fires. In addition to all the forest, bush- and farm land already burnt, one small town has already been completely destroyed by flames; several villages are engulfed by fires (2 km from fires). • In one of the countries, a popular nature protection area has reported 3 fire locations that are quickly expanding in terms of the area burnt. • Two relatively large lakes are located in proximity to one of the two major fire locations. However, the dry summer has severely depleted water resources in lakes and rivers. For the fire location close to the border, additional refilling stations in the neighbouring country can be used. For one relatively smaller forest fire area, no large local facilities are available for quick aircraft refilling. Only one of the three countries is bordering the ocean. • Physical characteristics of the forest: mixed forest (predominantly broad-leaved, some coniferous); very dry soil due to extreme weather conditions.

Immediate direct and indirect impacts / types of damage (based on Portugal 2003, Galicia 2006, Greece, Italy, Cyprus, Albania 2007)

Human toll:
- 71 civilians killed; 6 fire-fighters killed
- Several thousands facing approaching fires (need to be evacuated by air and some by road)
- 450 injured (the majority have severe burn and smoke inhalation injuries; others have suffered various injuries from falling debris and during evacuation)
- 50 missing (search and rescue efforts needed in order to save these persons from fires)
- 15.000 need emergency assistance (approximately 10.000 have gathered in the 4 main cities around the affected area; another 5.000 are spread across the rural agricultural areas)
- 50.000 temporarily displaced (evacuated) / homeless
- 1 million affected

Damage to infrastructure:
- 340 buildings destroyed (mainly farms and rural residential housing / 4 community medical centres / 1 fire station / 1 school / approximately 10 SME businesses)
- 570 badly damaged (usually no reconstruction possible due to damaged foundations after severe fires)
- 250.000 homes without power / 1 power distribution station destroyed
- 155 km of highway temporarily closed / numerous smaller roads not useable, therefore limiting accessibility of disaster site via roads

Ecological impacts:
- Total land area of 295.000 ha burned, of which 120.000 ha trees, 95.000 ha bush and scrubland, 60.000 ha agricultural land, and 20.000 ha other
- Additional 250.000 ha under immediate threat
- At least 10.000 livestock killed (mainly cows, pigs, sheep)
- Severe impact on wildlife in natural reserve
- Severe air pollution throughout the disaster area

Overall economic costs: Costs include, among others, the opportunity costs of forgone tourism in the aftermath of the wildfire. This is particularly important for Southern European countries which display relatively large shares of GDP from the tourism industry. Furthermore, these effects might be long-lasting given that whole areas within nature protection reservoirs (large tourist attractions) are burnt down. In addition, Southern European countries have relatively large agricultural sectors which are negatively affected.

<table>
<tr>
<td>Expected / required response resources</td>
<td>
How much of the impact can be absorbed / addressed by the national response capacity? The national ground forces in the three countries include approximately 26.000 fire-fighters (of which 11.000 are seasonal employees dedicated to just forest fires) supported by 5.000 soldiers and more than 1000 volunteers performing emergency tasks other than fire-fighting. The national civil response resources include ca. 1.300 engines which can be involved in both structural and forest fire suppression efforts. Additionally, the national aerial means involve 26 fire fighting aircraft, 7 search and rescue helicopters and 13 fire fighting helicopters.
This national fire-fighting capacity has been fully occupied for three weeks already trying to fight the continued outbreaks of new fires. The new events have overwhelmed national response capacities in all three countries and considering the ongoing situation, the prime ministers declared a state of national emergency and issued a request for assistance in the framework of the European Mechanism for Civil Protection. The following lists describe the required response managed by national capacities versus the needed amount and type of external assistance:
<u>Up to 3 days:</u>
Managed by national capacities in the region:

National ground forces (all capacity has been mobilised and is present at all 9 fire locations).
Aerial forest fire fighting using helicopters (13) and planes (26).
Emergency temporary shelter for 50.000 displaced people in 4 main locations.
Food and water for at least 50.000 people.
Evacuation of people from endangered areas (7 helicopters, buses and trains used).
Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, supermarkets and food storage houses.
Need for communication equipment, sat com, etc.
Damage extension maps, e.g. satellite images to get an overview of extension of damages of land, infrastructure, etc. and as mean for coordinating rescue operations.
General registration of people, fatalities, wounded, missing, evacuated, unknown status also to be able to inform relatives.
Medical assistance in hospitals and deployment of two advanced medical posts (one south, one west).
Psychological support.

Need for external assistance:

Terrestrial means for fire fighting support (at least 9 teams of a minimum of 15 members each) plus a minimum of 15 fire trucks / vehicles.
Aerial forest fire fighting support using helicopters (at least 6 fire fighting helicopters with crew) and planes (at least 12 fire fighting planes with crew).
Assistance for possible evacuation of people surrounded from endangered areas (2 helicopters) and one module for medical aerial evacuation of burn victims.
At least 3 teams and equipment for search and rescue to locate and transport people out of fire zones.
3 advanced medical post with specialists for burn victims - one for each critical localities.
1 management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors.

<u>Up to 2 weeks:</u>
Managed by national capacities:

Ground and aerial fire fighting teams to keep remaining hazard zones under control (entire national fire fighting capacity).
Body ID equipment.
Post disaster stress experts.
Temporary medical emergency facilities to serve several thousands people.
Temporary housing for approximately 10.000 people, mainly in small rural towns.
Food and water for displaced and other people in need.

Need for external assistance:

Technical assistance team to assess ecological impact and damage to infrastructure (at least 2 teams).

</td>
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3.7.7 Analysis

Scenario Choice

The described scenario allows for an overview of a potential future forest fire disaster in Southern Europe well as a determination of the potentially needed external assistance. In particular, this scenario tests ground fire fighting and aerial fire fighting capacities as not all areas are easily accessible by road, yet planes also cannot easily refill at all fire locations. A southern European scenario has been chosen because wildfire occurrence risk is highest in this region.

Limitations

This forest fire scenario represents a severe, yet realistic case of a future forest fire disaster in Southern Europe. Given the climatic trends of recent years, risks across the region are likely to increase and a scenario with simultaneous outbreaks in several countries will be likely and should be analysed for response capacities. This regional scenario allows for testing the limits of current European capacities since national capacities throughout the region have been stretched and cannot be deployed for response assistance within the other neighbouring countries.

A different set up for a fire scenario naturally could also lead to different types of gaps identified. However, some of the forest fire specific gaps (e.g. lack of treatment facilities for severely burnt victims) generated will likely remain valid no matter how many countries and what type of forest is affected.

Sensitivity analysis: prevention and preparedness
For this disaster type, in particular, appropriate prevention measures may actually be able to reduce the frequency of forest fire occurrence because most of the major fires are man-made due to arson or carelessness. Thus, if Member States invest in awareness campaigns and other preventive forestry measures (firebreaks, clear felled areas, etc.), they may well be able to decrease the number of outbreaks even during extremely hot summers. Preparedness measures can also help contain and control fires more rapidly (e.g. sufficient water supply points and infrastructure; well maintained access roads, etc.), limit human casualties (via clearly indicated escape routes) and therefore reduce overall impacts in case forest fires do break out. Taken as a whole, therefore, this scenario is both prevention and preparedness sensitive.

3.8 Chemical accident

The disaster scenario is an industrial disaster where a plant unintended and uncontrolled over a period of time releases a mix of chemicals and gasses. The consequence is a contaminated gas cloud that contaminates the surrounding people, animals and vegetation in the areas in the wind direction.

3.8.1 Typical Conditions (key risk factors)

Hazard frequency
The Major Accident Hazards Bureau of the European Commission's Joint Research Centre (JRC) has registered and analysed the past accidents in process industries e.g. the chemical industry. According to events reported as major accidents occurred in EU 15 countries during the period 1994-2004 a performed analysis shows that there is a cyclical oscillation in the number of accidents reported to the MARS database since the implementation of the Seveso II Directive in 1996. Since that date, there appear to be periods of 3 years in which there is a progressive decrease in the number of accidents, with an abrupt increase of reported events at the end of each cycle. The present analysis also proves that accidents involving explosions are the ones that generate the most severe consequences, even though for certain types of industries, fires are of greater concern. On the other hand, accidents creating disturbances for the external population are usually related to toxic releases of general chemical products such as ammonia or hydrogen chloride.

Including all types of major disasters a total of 301 major accidents were reported by EU 15 countries for the period 1994-2004. A total of 63 accidents had one or more fatalities, whereas 153 people died as a consequence of those accidents.

There is a tendency which indicates that the number of major accidents has been decreasing over the last decade. Moreover, there seems to be a trend starting from the year 1996. According to that trend, accidents could be grouped in periods of three years. In each group, the number of accidents decreases, but at the beginning of the next cycle (1999, 2002) there is an abrupt increase in the number of accidents. However, an overall decrease in the number of accidents seems to be hinted comparing the first (1996-1999-2002), second (1997-2000-2003) and third (1998-2001-2004) respective years of each cycle. The only exception is found in the year 2004, in which there was one more major accident reported compared to the year 2001. This trend suggests that the evolution of safety in process industries is cyclical, probably related to variations in risk perception or awareness. This can be due to an increase in risk awareness after a relevant accident (like those occurred at Toulouse, France in 2001 or Enschede, the Netherlands in 2000) or to recent legislation for each period (like the implementation of Seveso II Directive).
The general chemicals manufacture industry has had an oscillating tendency, constantly increasing the number of accidents for the period 1995-1998, and then decreasing constantly during 1998-2002, with a slight worsening of the situation in 2003 and reducing the number of accidents again in 2004. General chemicals manufacture is the type of industry with the highest number of accidents (100), but only 15 (15%) of those generated a fatality. It is however the type of industry with higher number of fatalities (53), mainly due to the fact that the Toulouse accident, which had 30 fatalities, was reported under this category.

The frequency of a chemical disaster of the scale as described in the scenario has been very low since only the accidents in Bhopal and Seveso have similar level of impacts. On the other hand, conscious man-made accidents including terrorist attacks not only on factories and plants but also on chemicals under transport makes the scenario or similar events relevant.

Exposure / vulnerabilities

The chemicals industry is producing an unknown number of toxic substances, fluids and gases that represent an intermediary product in the manufacture of e.g. artificial fertilisers, insecticides, herbicides, cleansing materials and pharmaceuticals. An accident in which such substances leak out may have serious human health consequences. The risk of release is not only localised to the proximity of the factory but also exists along railways, roads, pipelines and on board ships.

Social vulnerabilities: Industrial chemical accidents in developed countries are less severe than those occurring in other geographic areas. The absence of major accidents and relatively rare 'smaller' accidents in recent years is not least because of the implementation of the SEVESO-directives and the priority and focus the initiatives has led to in the Member States. The extra vulnerability of industrializing countries to environmental problems and industrial accidents cannot be understood or solved by a 'normal' scientific analysis. Aspects of the social and institutional context must be included. In the relatively rare accidents with catastrophic potential the deaths per accident in India, Mexico and Brazil are much greater than in the industrialized countries. This discrepancy arises partly from location of such plants near residential communities for marginalized workers and their families. Other socio-political factors are relevant, as the role of these countries in the global production system, the enforcement of safety and planning laws, quality of housing, and lifestyle of residents.

Economic and physical vulnerabilities: Developing countries are particularly vulnerable to industrial crises. However, industrial accidents such as Bhopal are not just an Indian or even a Third World problem but are industrial disasters waiting to happen, whether they are in the form of "mini-Bhopals", smaller industrial accidents that occur with disturbing frequency in chemical plants in both developed and developing countries, and "slow-motion Bhopals", unseen chronic poisoning from industrial pollution that causes irreversible pain, suffering, and death. These are the key issues in a world of today where toxins are used and developed without fully knowing the harm that can come from their use or abuse.

Industry: Ammonia, chlorine, sulphur dioxide and petroleum products are produced, stored and transported in large quantities in the chemicals industry. There are stocks of these substances all over the region. Should an accident occur involving a storage system or a reactor tank, the effect on the environment and health could be very great. As a rule, the chemicals industry’s knowledge of how to act in different situations is great, for which reason the risk of serious accident must be assessed as relatively moderate.

Transport: Hazardous substances are transported chiefly by rail, road and sea. Only a modest proportion is transported by air. Road transport is largely over the total road system, together with other road users and vehicles. Through control of routing, attempts are made in many places to limit the transport of hazardous substances on roads where the risk of accident is great or where an accident would have serious consequences. This possibility is limited as regards railway transport.

Chemical substances are used not only in industry, but in many other places in the community. Thus for example ammonia is used in skating rinks, swimming pools and refrigeration plants. But since these purposes are not industrial they are not in focus of this scenario.

Environmental vulnerabilities: From a similar accident (Bhopal) researchers have reported on damage to crops, vegetables, animals, and fish from the accidents, but these offer few conclusive findings since they were reported in the early stages after the disaster. This report however, did indicate that the impact of whatever toxic substances emerged from the accident at the plant were highly lethal on exposed animals. Large numbers of cattle (estimates range as high as 4.000) as well as dogs, cats, and birds were killed. Plant life was also severely damaged by exposure to the gas. There was also widespread defoliation of trees, especially in low lying areas.

3.8.2 Types of prevention and preparedness measures

In order to limit impacts as much as possible, several prevention and preparedness measures should be in place.

- Basically the implementation of Seveso directives reduces the risk of accidents and limits the potential consequences of an accident. The aim of the Seveso II Directive is two-fold: First, the Directive aims at the prevention of major-accident hazards involving dangerous substances. Second, as accidents do continue to occur, the Directive aims at the limitation of the consequences of such accidents not only for man (safety and health aspects) but also for the environment (environmental aspect).
- Emergency plans and information to the public about how to behave in case of emergencies limits the consequences if an accident occurs.
- Early warning systems and public warning sirens raise awareness about a concrete accident and danger and thereby increase opportunities for citizens to take precautions in time.

3.8.3 Industrial disaster response

In any event of chemical disaster whether resulting from terrorism or industrial accident, a multidisciplinary approach will be necessary. Co-ordination among all the involved personnel including first responders (from fire- and rescue services, police, military etc., law enforcement agencies, emergency physician, toxicologist, environmental specialist, and security personnel will be required.

Local responders will generally be the first on the scene after the chemical disaster, but their capabilities and resources to respond to this incidence are severely limited. The primary goal of domestic preparedness capacities is therefore to increase the capacity of the local emergency response system. Larger incidents as described in this scenario will require assistance from neighbouring cities, national and external resources.

3.8.4 Past reference disasters

In **Seveso**, Italy, there was in 1976 an uncontrolled release of dioxins from a factory. Kilogramme quantities of the substance (a mixture of trichlorophenol, sodium hydroxide and tetrachloride bensodioxin) lethal to man even in microgramme doses was widely dispersed which resulted in an immediate contamination of an area of approximately 4–5 km2. No immediate injuries were noted in people or animals but after two to four days, small animals such as birds, chickens and rabbits died. After three to seven days chemical burn injuries were noted in children who had been playing outside in the affected areas. After two weeks to two months, persons exposed to the gas cloud suffered skin changes, termed chlorine acne, and slight effects on the liver. This accident shows that it may be some days to weeks after exposure to a toxic substance before symptoms develop.

The **Bophal** accident in essence: About 41 metric tons of methyl isocyanate was released from the Union Carbide India Limited (UCIL) pesticide plant in Bhopal just after midnight on December 3, 1984. This gas spread slowly southward from the plant site during the early morning hours with very stable weather conditions. Of the 900.000 population within the city, over 200.000 people were exposed to methyl isocyanate tainted air. Documented death counts are listed at 3.787. The number of undocumented deaths will never be known, but estimates are over 10.000. Chaos surrounded the city afterwards. Thousands panicked.

3.8.5 Scenario presentation: chemical industrial accident / terrorist attack in Europe

		Disaster Scenario: Industrial accident / terrorist attack in Europe
Characterisation of the hypothetical scenario	. Disaster event	• In the early hours of a Tuesday morning in January an explosion takes place on a plant in Europe producing chemical pesticides and leads to a release of a cocktail of chemicals. • The explosion initiates a heavy fire in the plant buildings that goes on for several hours/days. • The heavy fire spreads to three other chemical plants in the neighbourhood that leads to further releases of different cocktails of chemicals. • The population in the nearby surroundings are warned by sirens and through radio and television supplementary message is given to stay inside buildings. • Approximately 40 tonnes of various and mixed chemicals are instantly released as airborne contamination. • Because of the ongoing fire a continuously leak of a substance of mixed chemicals goes on for several hours since it is impossible to stop the leaks because of the heavy and ongoing fires.. • The toxic gas cloud spreads from the plant to the nearby city with approximately 900.000 citizens as airborne contamination. • Weather conditions are predicted to be stable over the coming hours/days (sustained winds, cloudy and temperatures around freezing point) • Though an exact overview of immediate damages and impacts is not established, it is clear that there is a need for supplementary assessment and detection teams as well as medical teams • Therefore a request for international assistance is issued within hours after the disaster event.
	Disaster site	• On-site the plant some people died instantly others are injured but not able to evacuate themselves, buildings are blown up by the explosion and the whole area is contaminated by the initial leek of mixed chemicals and the continuously leaking gas. • The surrounding geographic areas affected are those in several hundred meters of the wind direction. Factors which had contributed to both human and physical exposure in general were atmospheric (low wind speed), distance of residential buildings from the plant, duration of exposure, activity during exposure. Acute irritant effects of the gas cloud creates panic, great anxiety and disorientation, resulting in physical activity such as running which in turn increased the dose of chemical contamination delivered to the respiratory system. • The impact is for the major part on human beings, animals, open water (rivers and lakes), the soil and in areas with farmland on different kinds of crops and requires immediate safety measures to spring into action. • The plant was located in the middle of and close to densely populated areas with approximately 900.000 citizens and in wind direction there are several densely populated suburbs contaminated. • There does not seem to be cross border contamination effects.

	Immediate direct and indirect impacts / types of damage	**Human toll:** • Around 500,000 people were affected by the leaking gas cloud. • In the first couple of hours after the accident 2,000 persons have died, within the first 24 hours 4,000 people are expected to die and up to 20,000 are expected to die within the first week. • Approximately 4.000 are missing, and 8.500 persons are injured severely and show signs of contamination. • Over 120,000 suffer the effects of the disaster, such as breathing difficulties and other related problems and need to be hospitalised or receive other kinds of medical treatment and care. Some of the contaminated victims will have symptoms immediately after contamination others will arise weeks, months or even years after the accident. **Damage to infrastructure:** • The production facilities and the buildings on site the plant is totally destroyed and at the moment contaminated. • Though the infrastructure in the wind direction is temporarily not functioning - since it is contaminated - there is only limited permanent damage to infrastructure such as buildings, bridges, roads. The impact on infrastructure is limited to the period of contamination that depending on the fire on the plant is expected to last days. **Ecological effects:** • A large number of cattle (estimates range as high as 4,000), as well as dogs, cats, and birds were killed or contaminated. Fish and plant life - including crops and vegetables - was also severely damaged by exposure to the gas. There was also widespread defoliation of trees, especially in low lying areas. **Immediate secondary impacts:** • 500 jobs affected direct or indirectly. Several plants will be involved in the accident indirectly and won't be able to be active quickly after the event. • The main socio-economic impact is felt by those working on the plant and the shareholders. **Overall economic impact:** Overall economic impacts are mainly related to the treatment of dead and injured victims and their families. In comparison, only a minor part is related to re-establishing the damaged plant and equipment. The private financial burden to address impacts and their consequences is a major part of the total financial burden due to the fact that the owner(s) of the plant is held responsible for the damages/losses related to the accident. But there is also a national burden depending on the structure of the health system and regulation of payments for health care. **Economic cost:** The estimated cost for the cleanup is between 100 million and 200 million Euros. Indirect economic costs of this disaster in terms of lost business and damage claims amount to more than 300 million Euros. Another economic impact will be about the houses around the spot were more or less destroyed by the explosion of the plant and the following heavy fire.

Expected / required response resources

In any event of chemical disaster whether resulting from terrorism or industrial accident, a multidisciplinary approach will be necessary. Co-ordination among all the involved personnel including first responders (from fire- and rescue services, police, military etc., law enforcement agencies, emergency physician, toxicologist, environmental specialist, and security personnel will be required. Local responders will generally be the first on the scene after the chemical disaster, but their capabilities and resources to respond to this incidence are severely limited. The primary goal of domestic preparedness capacities is therefore to increase the capacity of the local emergency response system. Larger incidents as described in this scenario will require assistance from neighboring cities, national and external resources.

0-24 hours:

Managed by national capacities:

- Shelter for 50.000 evacuees. Food and water for evacuees.
- Evacuation of 500.000 citizens.
- Transport of critically sick patients to hospitals with capacity to deal with specific injuries caused by the gas cloud.
- Damage assessment maps, e.g. satellite images to get an overview of the extent of damage to land, coast, infrastructure, sea etc. and as means for coordination of rescue operations.
- Medical Coordination centres to register people and transfer to nearby hospitals with free capacity.
- We assume that in case of crisis, the Member State have solved the toxic cloud problem before the arrival of the international assistance.

Need for external assistance:

- Advanced medical posts - including equipment and personnel for 50.000 persons disposed at 5 locations.
- Additional medical (field) hospitals - including equipment and personnel for 2.000 injured and contaminated persons disposed in 4 cities.
- Personnel and equipment for general registration of people, fatalities, wounded, evacuated, unknown status also to be able to inform relatives for approximately 100.000 persons.
- Management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors.
- Water purification equipment for 50 villages with approx. 10.000 inhabitants each – incl. instruction.
- Capacities for decontamination of citizens, personnel and equipment - including equipment and personnel for approximately 200.000 persons as soon as possible.
- Chemical detection/sampling including equipment and personnel for an area of several 100 square kilometres.
- Search & rescue in chemical contaminated areas incl. equipment & personnel for 4 cities each of approximately 50.000 inhabitants and 10 major villages each of approximately 10.000 inhabitants. Expected need: 14 teams for chemical gas detection on ground with personnel & equipment to be operational for more than 24 hours.
- Hazmat teams to try to solve the contamination on the area of the plants. Maybe it will be necessary to send CBNR MUSAR or HUSAR on the spot.

Up to 3 days:

Managed by national capacities:

- Temporary housing.
- Temporary nursery and school shelters.

Need for external assistance:

- Body ID equipment for identifying 4,000 people,
- Post disaster stress experts for 10.000 people.
- Medical doctors and nurses (as many as possible).
- Stock piling of medicine, antidotes and antibiotics: The stock piling of the antidotes are necessary to treat the large number of casualties. There are several problems associated with appropriate quantities of the drugs and rapid distribution of antidotes to the victims.
- Testing equipment for environmental contamination, drinking water, soil, sewerage etc - including equipment and personnel for 4 cities each of approximately 50.000 inhabitants and 10 major villages each of 10.000 inhabitants.
- Temporary medical emergency facilities – incl. equipment and personnel - to serve 50.000 at 5 locations.
- Specialist to test facilities etc. to ensure that affected areas (approximately 10 square kilometres) are decontaminated before re-entering them.

Up to 2 weeks:

Managed by national capacities:

- Body ID equipment.
- Post disaster stress experts for 10.000 people.
- Surveillance and monitoring development of injuries and follow up on slow developing injuries.
- Removal of contaminated water and soil and in some areas also removal of contaminated crops and animals.

3.8.6 Analysis

Scenario Choice

This scenario was chosen to focus on a CBRN incident – specifically a chemical accident - that potentially could be but not necessarily is initiated as a result of a terrorist attack.

The scenario is supposed to test chemical preparedness capacities and capacities in general that are brought into use in case of mass casualties.

Limitations

The current scenario does represent a worst case scenario. The scenario parameters have been built around past reference scenarios and made even worse because in this scenario several accidents are happening simultaneously. It is possible to intensify this scenario even more e.g., the original size of leak can be increased, the type and mix of chemicals can be modified, the number of simultaneously accidents can be increased, the weather conditions can be worsened, and the location of the release can be moved closer to areas where the density of the population is higher.

The current scenario does not represent a worst case scenario. The scenario parameters have been built around past reference scenarios. To intensify this scenario, the original size of leak can be increased, the type and mix of chemicals can be modified, the weather conditions can be worsened, and the location of the release can be moved closer to areas where the density of the population is higher.

These changes would significantly change the intensity as well as the types of impacts. In turn, also the required response and the requested external assistance will change.

It should also be mentioned here, that a different type of chemical release, for example a continually leak or all at one time leak, may lead to different gaps due to the different types of response resources required. Therefore the gap analysis in this study focuses on the chosen scenarios and may not provide an exhaustive list of gaps for all disaster sub-types.

Theoretically cross border contaminations could happen in cases where a plant is located close to a national border and the airborne contamination depending on wind speed, wind direction, temperature and other meteorological parameters could reach a neighbouring country. Cross border contamination effect is in a similar a theoretical possibility where chemical accidental leaks flues into lakes or rivers that downstream are connected to rivers that cross borders. The scenario does not include cross boarder effects.

Since it seems impossible to evacuate 500,000 people during the first 24 hours, there are two possibilities:

- A sudden break of a tank due to an explosion - the contaminated cloud will be released immediately. It will take the cloud few minutes to cross the city area and then such a massive evacuation won't be necessary.
- We just have a simple hole into the tank but due to the fact that there is an heavy ongoing fire then the rescue services would not be able to control the leaks. An evacuation of population will be necessary, but not necessarily in such huge numbers of people.

Sensitivity analysis: prevention and preparedness

To what degree could preventive and preparedness measures have an impact on the intensity level of disasters and the required response resources?

The following seven key components of disaster risk reduction are particularly relevant preventive measures in case of chemical accidents: (1) early warning capabilities; (2) community preparedness; (3) awareness raising and knowledge development efforts; (4) infrastructure strengthening; (5) environmental management; (6) government disaster policies; and (7) stakeholder commitment:

- (1) Early warning systems raise awareness about a concrete accident and danger and thereby increase opportunities for citizens to take precautions in time.
- (2) Establishment of risk based set up of preparedness capabilities that correspond to worst case scenarios -including equipment for chemical accidents, educated and trained personnel and structures for cooperation between involved actors.
- (3) Emergency plans and information beforehand to the public about how to behave in case of emergencies limits the consequences if an accident occurs.
- (4+5) Proper land use planning and design of industrial areas.
- (6) Planning for national assistance across local and regional level and for receiving assistance from foreign countries/other Member States.
- (7) Information campaigns about preventive measures in the chemical industry and involvement through cooperation between public preparedness specialists and the individual plant.

While industry should pay close attention to implementing as many prevention measures as possible to prevent industrial accidents from happening in the first place, it should be noted that the occurrence of this disaster type remains unpredictable, especially with today's increased threat of terrorist attacks. Therefore, the scenario is also preparedness sensitive since sound preparedness measures can significantly limit disaster impacts.

3.9 Conclusions

The following conclusions can be drawn from the scenario approach:

- The scenario approach served the purpose as a tool to facilitate discussion and dialogue with Participating States concerning disaster response capacity and potential gaps.
- It should be noted that whilst the scenario approach has proved useful to provide insight into the types of gaps and their degree of importance and magnitude, the need for assistance expressed in numbers of modules and other resources are to be seen as rough estimates only.
- It should also be noted that for the European scenarios a 24 hours needs and response profile has been elaborated, whilst for the international scenarios a 'up to 3 days needs' was applied to reflect the reality that response takes longer when dealing with international disasters due to increased complexity of coordination, etc. This is true with the exception of the flooding scenario, where a day by day needs analysis has been necessary in order to reflect the response needs as the flood develops downstream, e.g. hitting new geographical areas.
- The scenarios studied represent a selection of the most typical or problematic disasters for Europe. They also vary somewhat in severity as indicated in the table hereafter and represent overall severe but not worst case events. Therefore:

  (1) gaps identified on the basis of these scenarios are minimum gaps which could be larger in case of events worse than the studied scenarios;

(2) further work on other types of disaster scenarios could usefully complement this study, including scenarios regarding coastal floods, a nuclear accident and a multiple CBRN accident.

- Finally, during consultations with experts it was recommended to further develop the scenario approach to serve as basis for contingency planning by the MIC, for practical exercises, and for further addressing capacity gaps.

#	Disaster Scenario - Subject	Level of severity	Comments
1	EU - Major Floods (including landslides)	Representing a worst case scenario	Other type of flood scenarios could be useful, e.g. coastal floods
2	EU - Forest and wildfires	Representing a severe scenario affecting an entire region thus testing quantitative capacity of national fire-fighting resources	
3	EU - Earthquake (seismic activity)	Representing a severe scenario	Could be developed to represent a worst case scenario impacting major cities
4	EU - Tsunami	Representing a severe scenario	Could be developed to represent a worst case scenario impacting also the Northern African coastline
5	EU - Industrial accident / terrorist attack	Representing a moderate seriousness scenario	More complex scenarios such as a nuclear event or a multiple accident event should be studies in the future
6	EU – Northern winter storm	Representing a severe scenario	A worst case scenario would include other elements such as severe snow fall combined with extreme low temperatures for a given period
7	EU - Oil spill / marine pollution	Representing a severe scenario	An oil spill in the Arctic would have caused environmental damages of a severe magnitude
8	INTL - Major Floods (including landslides)	Representing a realistic scenario	
9	INTL - Wind Storms	Representing a severe to worst case scenario	
10	INTL - Earthquake (seismic activity)	Representing a severe but moderate seriousness scenario	
11	INTL - Tsunami	Representing a worst case scenario which at the same time is realistic but only likely to occur on a very low frequency	

4 Inventory of current civil response capacity

In order to carry out the next step of determining the potential gap of current response capacities versus needed response resources for the various types of disasters described in the previous chapter, it is necessary to first develop an up-to-date inventory of the current civil response capacity in Europe. This chapter reports the consolidated outcomes of the questionnaire among Participating States combined with latest information available to the European Commission.

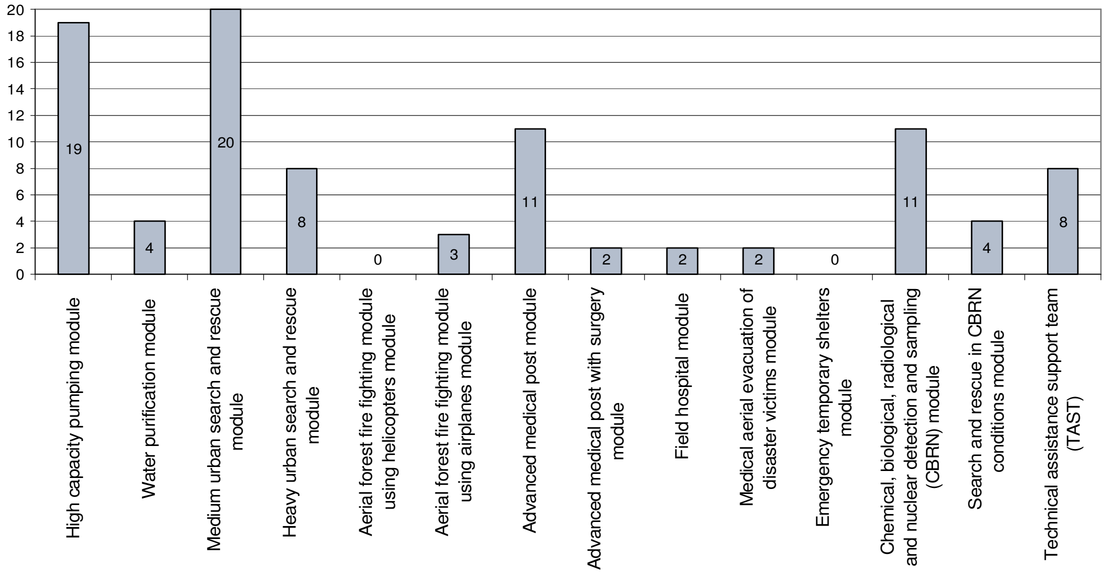
It is important to note that the inventory established in this chapter focuses on modules. Other additional types of response resources are mentioned throughout the analysis, but are not quantified. The focus on modules is due to the fact that modules have been designed as the essential components of a potential direct response to a major disaster; their content and capacity is pre-defined and can thus easily be compared across Participating States. The modules are being developed since end 2007 to become the major components of the EU's rapid response capacity for natural and man-made disasters. Significant efforts of the Commission and the Participating States aim at enhancing the capacity of the modules to intervene in an international environment as well as their interoperability. They are typically the type of complex and large resource that would be mobilised for major disasters. Whilst civil protection modules will increasingly become the basis for significant European civil protection assistance operations launched through the Mechanism, their action will often be complemented by the provision of other in-kind assistance such as for example low capacity equipments (e.g. pumps) and relief items (e.g. tents, blankets).

Participating States have thus concentrated their replies to the questionnaire on their capacity related to these pre-defined modules although the questionnaire also covered additional other types of resources. This other, smaller type of equipment is often offered on an ad hoc basis and not necessarily registered in the Commission database, which also suffers from irregular updating.

4.1 Registered module capacities

The following diagram shows the registered quantities of the various types of civil protection modules existing within the Participating States. This diagram is based on the consolidated quantities registered at the MIC (as of January 20, 2009) and listed in the questionnaire among Participating States carried out for this project.

Figure 4.1 Registered civil protection modules (in total quantities)



[Source: Participating States survey results and latest EC information (January 2009)]

The diagram shows that currently most European capacity is concentrated in medium urban search and rescue, high capacity pumping, followed by chemical, biological, radiological and nuclear (CBRN) detection and sampling as well as advanced medical posts. Some modules are also registered for heavy urban search and rescue, technical assistance support team, water purification, forest fire fighting with planes, search and rescue in CBRN conditions, advanced medical post with surgery, medical aerial evacuation, and field hospitals. The Mechanism is still lacking modules for forest fire fighting with helicopters and emergency temporary shelter. The table of registered quantities below (Table 4.1) shows this spread of civil protection response capacity across the various module types in table format.

Table 4.1 Registered quantities of different types of modules

Type of Module	**Registered quantities** (Consolidated capacity based on survey results and quantities registered at MIC)
High capacity pumping module (HCP)	19
Water purification module (WP)	4
Medium urban search and rescue module (MUSAR)	20
Heavy urban search and rescue module (HUSAR)	8
Aerial forest fire fighting module using helicopters module (FFFH)	0
Aerial forest fire fighting module using airplanes module (FFFP)	3
Advanced medical post module (AMP)	11
Advanced medical post with surgery module (AMPS)	2
Field hospital module (FHOS)	2
Medical aerial evacuation of disaster victims module (MEVAC)	2
Emergency temporary shelters module (ETS)	0
Chemical, biological, radiological and nuclear detection and sampling (CBRN) module (CBRNDET)	11

Type of Module	Registered quantities (Consolidated capacity based on survey results and quantities registered at MIC)
Search and rescue in CBRN conditions module (CBRNUSAR)	4
Technical assistance support team (TAST)	8
Total quantity of modules	**86**
Total quantity of modules + TAST	**94**

[Source: Participating States survey results and latest EC data (January 2009)]

This table (Table 4.1) shall be used throughout the remainder of this report as representing the best possible reflection of current registered and thus quantified civil response capacities and therefore serve as the minimum capacity starting point for the gap identification and the analysis of possible policy options to address identified gaps.

It should be noted, however, that the figures in this table (Table 4.1) represent only an instant snapshot as the registration of modules is a continuous process that could result inter alia of the Participating States developing additional capacities or up-scaling existing capacities in such a way to meet the modules' standards at any moment in time. Thus, the analysis in this report – to the extent possible - also takes into account modules that the Participating States plan to register by the end of 2010 (Table 4.2) as well as other additional types of response resources (even though they are not listed in a standardised way) (Table 4.4).

4.1.1 Likely quantities of registered modules by the end of 2010

From the questionnaire among Participating States we received useful information on resources planned to be registered for European interventions and interventions in third countries in the near future. Most of these planned resources will be registered as additional modules between now and the end of 2010. In total, 39 new modules are currently planned; this additional capacity would represent approximately a 47% increase in terms of the total number of modules registered. Furthermore, two new TAST are also planned for 2009.

Table 4.2 Survey result: planned civil protection modules to be registered in the near future

Type of Module	Planned modules	When?
High capacity pumping module	5	to be determined (tbd)
Water purification module	5	2 early 2009; others tbd
Medium urban search and rescue module	3	2010
Heavy urban search and rescue module	2	One in 2010; other tbd
Aerial forest fire fighting module using helicopters module	2	tbd
Aerial forest fire fighting module using airplanes module	1	1 early 2009; others tbd
Advanced medical post module	3	3 early 2009
Advanced medical post with surgery module	5	3 early 2009; others tbd
Field hospital module	3	2009

Type of Module	Planned modules	When?
Medical aerial evacuation of disaster victims module	1	2009
Emergency temporary shelters module	4	2009
Chemical, biological, radiological and nuclear detection and sampling (CBRN) module	5	4 early 2009; others tbd
Search and rescue in CBRN conditions module	2	1 early 2009; others tbd
Technical assistance support team (TAST)	2	2009
Total quantity of planned modules	**41**	
Total quantity of planned modules + TAST	**43**	

[Source: based on survey results and currently registered quantities from Table 4.1]

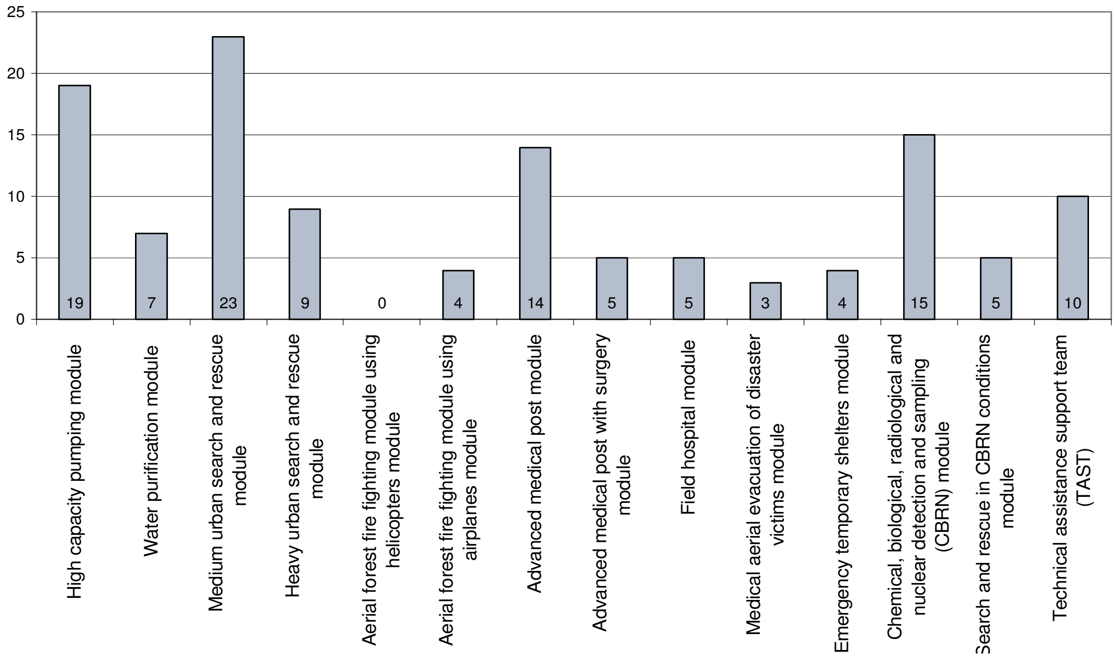
When comparing already registered module quantities (Table 4.1) and planned module quantities (Table 4.2), it becomes clear that with these additional modules, the capacity of the Mechanism would not only be increased by about 40 to 44% of its current capacity, but the capacities would also be more balanced across all types of modules, including the two modules that are currently not covered yet (FFFH and ETS) (Table 4.3).

Table 4.3 Total number of modules likely registered by the end of 2010

Type of Module	Total number of modules likely registered by the end of 2010
High capacity pumping module	19 - 24
Water purification module	7 - 9
Medium urban search and rescue module	23
Heavy urban search and rescue module	9 - 10
Aerial forest fire fighting module using helicopters module	0 - 2
Aerial forest fire fighting module using airplanes module	3 - 4
Advanced medical post module	14
Advanced medical post with surgery module	5 - 7
Field hospital module	5
Medical aerial evacuation of disaster victims module	3
Emergency temporary shelters module	4
Chemical, biological, radiological and nuclear detection and sampling (CBRN) module	15 - 16
Search and rescue in CBRN conditions module	5 - 6
Technical assistance support team (TAST)	10
Total quantity of planned modules	112 - 125
Total quantity of planned modules + TAST	**122 - 134**

[Source: survey results and current registered quantities from Table 4.1]

Figure 4.2 Total number of modules likely registered by the end of 2010



[Source: Participating States survey results and latest EC information (January 2009)]

4.2 Reported additional other general types of national response resources

In addition to the national response resources complying with the official definitions of civil protection modules, countries also reported in their replies to the questionnaire on other response resources existing on a national level that can be deployed for external assistance on an ad hoc basis. Due to the fact that these are not standardised, reporting varied in terms of the descriptions provided as well as the quantification (if provided at all). Therefore, this list does not include any quantification of these additional types of response resources because a meaningful attempt to quantify is not possible with the currently available information. The Participating States have again concentrated their replies on major resources rather than on resources such as tents, blankets, sandbags, etc., which are however also likely to be offered in large or medium size emergencies.

Table 4.4 Survey result: additional reported response resource types (other than modules)

Other reported types of response resources	
First aid / medical care related resources	First aid and emergency care (including psychological and psychosocial support)
	Emergency mobile hospital
Logistics / transport related response resources	Transport, logistics and storage
Maritime response related resources	Marine Pollution team
	Marine SAR team
	Technical Diving Team
	Diving rescue team
	EMSA capacities (see description below)
Search and rescue related resources	Canine search and rescue team

Other reported types of response resources	
	Detection and handling of explosive material
Sampling and detection related resources	Decontamination in case of a biological and or chemical attack
	Sample collection teams with equipment (Chemical)
	Decontamination in case of a radiological or nuclear attack
	Detection teams with equipment (Radioactivity)
	Ecological laboratory with mobile unit
Fire fighting related resources	Fleet of medium to high capacity aircraft used in 2007 by the Member States includes 24 for France, 16 for Italy, 18 for Portugal, 27 for Spain and 21 for Greece
Assistance / support related resources	Expert pool
	Coordination/assessment experts
	Water purification
	Container kitchens / Emergency food supplies
	Emergency shelter

[Source: Participating States survey results]

4.3 Reported additional specific types of response resources

In addition to the more general types of additional national response resources listed above, some information on current capacities for the more disaster type specific response tools can also be obtained, namely for oil spill response and forest fires.

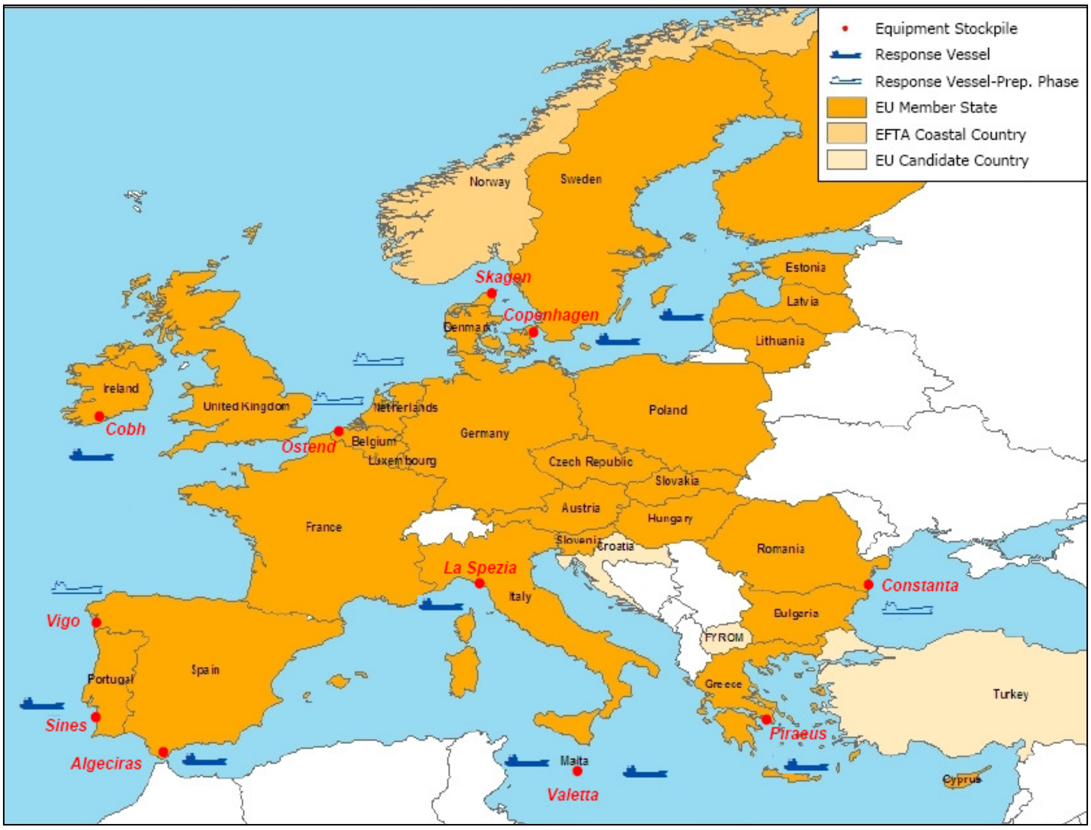
4.3.1 EMSA oil spill response capacities

As mentioned before, EMSA response capacities can be channelled through the MIC to meet civil protection response needs. The figure (Figure 4.3) and table (Table 4.5) below indicate the current contracted EMSA specialised oil spill response vessels. EMSA contracted specialised response vessels have ship-to-shore transfer systems on board. Furthermore EMSA equips them with containers full of oil spill response equipment that can be installed on specialised and non-specialised vessels, including several hundreds of meters of boom.

While EMSA's overall capacities are rather extensive, the resources available for immediate response in the region of concern for the scenario developed for this study are limited. Currently (as of February 2009) only three specialised vessels are stationed in the area: 1 in the southern Atlantic region (GALP MARINE in Sines, Portugal); 1 in the Mediterranean Sea, bordering with the Atlantic Sea (BAHIA TRES in Algeciras, Spain); and 2 in the Bay of Biscay (Rio de Vigo contracted since the beginning of 2009). All three can be deployed within the first 24 hours.

In addition, EMSA's CleanSeaNet system should be able to cover most of the satellite surveillance needs. The current caveat of this system is that the time lag between request for assistance and deployment for this satellite service is currently about 48 hours.

Figure 4.3 EMSA network of contracted specialised oil spill response vessels



[Source: EMSA response vessel map, February 2009]

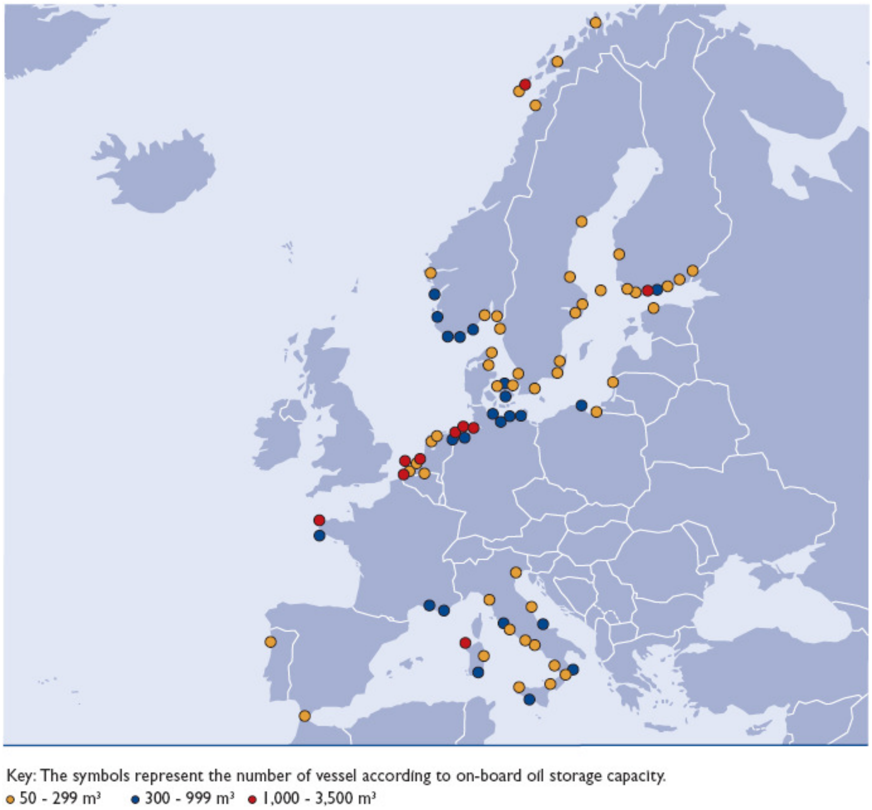
Table 4.5 EMSA Stand-by Vessel Oil Recovery Service response capacity

EMSA Stand-by Vessel Oil Recovery Service			
Quantity	**Type**	**Operational Area**	**Oil spill recovery equipment**
2	Dredgers (specialised response vessel)	North Sea (Belgium)	2 Sets of Rigid Sweeping Arms 2 Sets of Weir Skimmer 2 Sets of Oil Booms (500m) 2 Sets of Oil Detection Radar System
2	Bunker Vessels (specialised response vessel)	Baltic Sea (Denmark)	2 Sets of Flexible Sweeping Arms 2 Sets of Brush Skimmer 2 Sets of Arctic Skimmer 2 Sets of Oil Booms (400m + 500m) 2 Sets of Oil Detection Radar System
1	Product Tankers (specialised response vessel)	Atlantic Coast (Ireland)	1 Set of Rigid Sweeping Arms 2 Sets of Weir Skimmer 2 Sets of Oil Booms (250m each) 2 Sets of Oil Detection Radar System
2	Product Tankers	Atlantic Coast (Ireland)	Support vessels for specialised response vessel
1	Bunker Vessel (specialised response	Atlantic Coast (Portugal)	1 Set of Rigid Sweeping Arms 1 Set of Brush Skimmer

	vessel)		1 Set of Oil Booms (500m) 1 Set of Oil Detection Radar System
2	Bunker Vessels (specialised response vessels)	Mediterranean Sea (Malta)	2 Sets of Rigid Sweeping Arms 2 Sets of Weir Skimmers 2 Sets of Oil Booms (500m) 2 Sets of Oil Detection Radar System 2 Set of Weir/Brush Skimmer
1	Bunker Vessel (specialised response vessel)	Mediterranean Sea (Italy)	1 Set of Rigid Sweeping Arms 1 Set of Weir Skimmer 1 Set of Oil Booms (500m) 1 Set of Oil Detection Radar System
1	Bunker Vessel (specialised response vessel)	Mediterranean Sea (Spain)	1 Set of Rigid Sweeping Arms 1 Set of Weir/Brush Skimmer 1 Set of Oil Booms (500m) 1 Set of Oil Detection Radar System
1	Bunker Vessel	Mediterranean Sea (Spain)	Support Vessel for specialised response vessel
1	Supply Vessel (specialised response vessel)	Bay of Biscay (Spain)	1 Set of Rigid Sweeping Arms 1 Set of Weir Skimmer 1 Set of Oil Booms (500m) 1 Set of Oil Detection Radar System
1	Oil Tanker (specialised response vessel)	Aegean Sea (Greece)	1 Set of Rigid Sweeping Arms 1 Set of Weir Skimmer 1 Set of Oil Booms (500m) 1 Set of Oil Detection Radar System
1	Supply Vessel (specialised response vessel)	Black Sea (Romania)	1 Set of Rigid Sweeping Arms 1 Set of Weir/Brush Skimmer 1 Set of Oil Booms (500m) 1 Set of Oil Detection Radar System

In addition to these EMSA capacities, national governments have also reported various levels of marine pollution preparedness. The figure (Figure 4.4) below provides an indication of national response capacities in 2004.

Figure 4.4 Indication of additional national capacities for at-sea oil recovery (2004)



[Source: EMSA Action Plan]

Additionally, EMSA has identified four priority areas for developing additional marine pollution response capacity (see Figure 4.5: the Baltic Sea, the Mediterranean Sea, the Southern Atlantic (along Portugal) and the Northern Atlantic (Great Britain and France).

Figure 4.5 EMSA priority areas for developing additional marine pollution response capacities

[Source: EMSA Action Plan]

4.3.2 Other types of reported forest fire response resources

In terms of other resources for fire fighting, partial information made available to the Commission on the fleet of medium to high capacity airplanes used in 2007 by the Member States includes 24 for France, 16 for Italy, 18 for Portugal, 27 for Spain and 21 for Greece. An ongoing project (EUFFTR – European Fire Fighting Tactical Reserve) is expected to provide an overview of the fleets of the Member States.

4.4 Additional MIC/Mechanism capacities

In addition to channelling national civil protection response resources available for interventions launched under the Mechanism, the MIC also has additional capacities aiding the overall process of providing civil protection assistance via a common mechanism. Of these additional capacities, the ‘pool of experts’ is one of the cornerstones of the MIC.

Pool of Experts: key functions
1. The objective of the Pool of Experts (POE) is to ensure the **rapid deployment** of **highly qualified** experts for the Mechanism Assessment and Coordination teams.
2. The POE consists of those Mechanism-trained experts of the Participating States, who are declared "in principle available" to take part in the Mechanism teams. Entry of the experts´ data into CECIS is considered as the declaration of "in principle available." POE members need to dispose of the required Mechanism training (OPM level or higher), as well as personal qualifications and professional expertise.
3. The Commission establishes and maintains a POE database within CECIS. The database stores the experts´ coordinates and other data relevant for the Mechanism missions. The database entries should be visible only to the Commission and the Participating States providing the experts; other Participating States should only be able to see names. The protection of personal data, including personal data and bank details, shall be ensured. Access to data is limited to authorised personnel.
4. As an essential element within this database, the notice within which each expert can be deployed is specified: availability within 12 hrs, between 12hrs and 48 hrs, and longer than 48 hrs notice.
5. The Assessment and Coordination Teams are drawn from the POE. When composing teams, the Commission gives due consideration to rapid availability, wherever appropriate, experience, level of training and to experts´ specific competences required for the mission (e.g., language); non-POE experts may be used where specific expertise is required.
6. The Participating States designate the experts for the POE by entering the required data into CECIS, starting with the experts of highest availability. The experts should be designated by 1 August 2009; from 2010 onwards annual updates of the data should be executed by Participating States each year before 1 February.
7. The national or other appropriate Points of Contact (POCs) review the POE database's entries on their national experts based *inter alia* on information provided by the experts themselves, the National Training Coordinators and the MIC.

8. The experts listed in the POE database immediately notify the Training Coordinators and their POCs on any changes in their situation, particularly regarding changes in availability. POCs will update CECIS accordingly. POCs immediately remove experts no longer available from the POE. He/she can be re-introduced.

9. In order to foster effective team-building, more rapid deployment and networking amongst the POE and the MIC, experts are held to participate in Mechanism refresher training every two years in order to maintain their status as POE member. The Commission arranges additional refresher-courses for POE members focusing in the first stage on those experts with a rapid deployability.

10. The Participating States express their consent before the deployment of their experts as a part of a Mechanism Assessment and Coordination Team.

These Terms of Reference are subject to review by the end of 2009.

Since the launch of the training programme in 2002, approximately 600 experts attended the basic CMI training course. Some 400 of these experts are OPM-trained.
This does not mean that the MIC can draw from a list of 400 trained experts during emergencies. Some experts never intended to be part of EU assessment and coordination teams, but attended the training courses for other reasons (e.g. ambassadors, policy officials, desk officers or external EU partners). Others no longer work for the organisations that have nominated them or are unavailable for the MIC teams for other reasons.

The MIC must be able to select the best candidates for the job, prepare them for their specific mission and ensure their immediate deployment. In emergencies other than slow-onset disasters it is essential for the Commission to be able to appoint a coordination and assessment team and dispatch to the team to the site within hours. Existing arrangements where the Commission has no direct access to the pool of experts slows the process down considerably.

5 Identification of the qualitative and quantitative gaps in the overall EU civil protection response capacity

This chapter aims at identifying the qualitative and quantitative gaps in the overall EU civil protection response capacity. It builds on the information gathered through the questionnaires filled by the Participating States and the interviews of experts.

Prior to delving into the analysis of potential gaps, it is crucial to briefly define what is meant by the *degree of availability of resources*. This covers the existence of certain hindrances limiting the likelihood that a given resource would be mobilised in a specific emergency. This definition will allow for a better understanding of the gap identification since some resources will show quantitative gaps, meaning that the currently existing quantities of the resource are not sufficient, while others may demonstrate a more qualitative gap in terms of degree of availability.

This gap identification and analysis, in turn, will enable the formulation and assessment of policy options for addressing the identified issues. Thus, as a second step these identified gaps are then analysed and further action and or policy options for addressing the gaps are recommended. Options addressing different types of qualitative and /or quantitative gaps will vary.

5.1 Identification of qualitative gaps

Contrary to the more quantitative gaps in the physical existence of various disaster response resources, the more qualitative gaps boil down to the limited degree of availability of certain resources caused by various hindrances. This includes *inter alia* access to transport solutions, financing of transport and deployment,, national needs of the resource, political profile of the disaster; etc.

The resources registered by the Participating States under the Mechanism, such as civil protection modules are assumed to have a high degree of preparedness and a very limited time lag between request for assistance and actual deployment. However, as these resources are the main component of the EU rapid response capability and are designed for providing the bulk of assistance through the Mechanism, their limited availability would have a major impact on the possibility to deploy and the overall effectiveness of EU assistance in major disasters.

The issue of limited degree of availability of existing resources has been experienced time and time again throughout the 7 years of Mechanism operations. This covers a range of situations from the 2003 and 2007 South European forest fires where all countries having response resources were also in distress, floods (Bolivia, Somalia, Ecuador, Honduras, Turks and Caicos Islands, Yemen, Guatemala), and hurricanes (Haiti). In a number of cases there was a significant potential EU response which was however reduced because of the unavailability of transport solutions.

Furthermore, in many emergencies the response provided through the Mechanism relies on the same small group of Participating States. This raises the issues regarding the sustainability of the system and the potential need to ensure a better sharing of burden that would enable more Participating States to provide assistance during major and medium size emergencies.

Aware of this qualitative issue potentially hindering an efficient response, the study's questionnaire included a question on the issues Participating States are facing in deciding to deploy national civil protection capacities in the context of interventions launched under the Community Civil Protection Mechanism. The following table provides a summary overview of the most commonly mentioned issues.

Table 5.1 Survey result and scenario analysis: summary overview of common issues limiting the degree of availability

Funding Issues	Logistical Issues	Operational Issues	Political Reasons	Limited MIC capacity
- Lack of funds. - The lack of funds is primarily transport related (no funding for airlift, etc.). However, some also mentioned funding issues for maintenance and development of externally deployable capacities. - In case more than one country is asking for assistance funding may not be sufficient. - Difficult, long or too complex procedure to make available funding resources. - Cost of means of transportation.	- Transport issues arise in case more than 1 or 2 modules or assistance from several Participating States have to be deployed at the same time; or in case more than 1 country is asking for assistance. **- Distance to disaster area**. **- No or only limited access to air transport capacity**. - Dependency on private companies or military planes for air transport.	**- National need of the module/resource**. - Health issues (e.g. potential problems with providing needed vaccination for members of the teams in advance). - Relatively low level of foreign language abilities. - Visas / customs can pose a problem when dealing with third countries.	- Deployment is dependent on political situation in affected country (decision of the Ministry of Foreign affairs). **- Safety/security for dispatched personnel**. (If the minimum security conditions are not guaranteed, the decision may be not to deploy.)	- Need for improved management and coordination facility to provide overview of the situation and to act as interface to international bodies, incl. MIC and local actors - The MIC does not have the capacity to support local procurement where this is a rapid, feasible and cost-effective option. - Need for more rapid deployment of experts who could enter the operational scene in the very initial phase and contribute substantially to the first response as well as coordination and assessment.

[Source: Participating States' survey results]

The issues depicted in bold are the ones that were most frequently listed as one of the key issues hindering or challenging the deployment of existing resources within Europe and/or to third countries.

In addition to these survey outcomes, the expert workshop on December 4, 2008 provided fruitful feedback regarding common deployment issues. The workshop outcomes showed that often a combination of the following crucial factors leads to complications in actual deployment:

- Adequacy and accuracy of **rapid appraisal/assessment** of both impacts and needs in order to send the right types and quantities of assistance;

- Issues concerning **logistics** of assistance
  a) Mobilisation of assets (e.g. coordinated effort with centralised call for assistance; appropriate preparatory activities for quick deployment);
  b) Transportation to the disaster location (e.g. availability of air transport options);
  c) Local distribution of the asset within the disaster area.(if local coordination of assistance is overwhelmed, provided resources may not be deployed in the most efficient or effective way); and
  d) Operation of equipment at disaster site.

- **Coordination** of assistance from Participating States and from other countries and institutions at disaster location.

5.2 Identification of quantitative gaps

The previous chapter analysed the level of currently existing civil response resources throughout Europe. This section now links the quantitative response needs identified in the scenarios and the current civil response resources capacity described in the inventory in order to allow for an identification of potential quantitative shortcomings in physical existence of certain resources as well.

The needs for external assistance are juxtaposed to the relevant existing resources for each individual scenario. Whilst the needs expressed in the scenarios should not be considered as definitive and absolute quantities, they provide a reference estimation of the needs to address the particular scenarios in the conditions defined in the scenarios.

This section analyses potential gaps per disaster type. Potential differences between disasters occurring in Europe versus disasters in third countries are highlighted when relevant.

5.2.1 Storms

The first step juxtaposes the needs for external assistance identified in the EU winter storm scenario to the inventory of what the Mechanism can already contribute.

Needs for External Assistance – EU scenario (needs not covered by national response capacities)	**Possible contribution through the Mechanism** (including modules and other types of response resources) for filling the gap
Search and rescue (S&R) e.g. urban search and rescue units of all kinds – heavy (2), medium (6) for conditions of destroyed buildings and partially also for flooded conditions (in particular for Member State X).	• 19 MUSAR (Medium urban search and rescue). The envisaged future registration of 4 additional MUSAR modules should further strengthen this Mechanism capacity. • 8 HUSAR (Heavy urban search and rescue). The envisaged increased capacity of 1-2 additional modules by 2010 should further contribute to covering such a future need. HUSAR are however unlikely to travel over long distances. • Currently the Mechanism does not, however, have a formalised module for USAR type of activities specialised for flooded conditions.
Medical Coordination centres to register people and transfer to nearby hospitals with free capacity. One in each of the 4 countries.	• 11 AMP (Advanced medical post). Advanced medical posts should be sufficient to carry out this function in combination with the 2 MEVAC modules.
Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, schools. Estimated 100-150 units.	• Power supply equipment is offered on an ad hoc basis. No quantified inventory available.
Management and coordination facility to provide overview of the situation and to act as interface to relevant bodies and structures. One in each of the 4 Member States.	• The MIC can send assessment and coordination teams on the basis of the trained experts. • 7 TAST teams are available to support the assessment and coordination teams.
High capacity pumping equipment. 15 high capacity pumps and 50 mobile units to drain flooded roads.	• 19 HCP (High capacity pumping). This may cover the 15 required units as well as part of the mobile units to drain flooded roads. The envisaged increase in registered HCP modules should further contribute to covering such a future need.
Additional needs identified in the INTERNATIONAL windstorm scenario	**Possible response resources through the Mechanism** (including modules and other types of response resources) **for an appropriate Mechanism contribution to the response**
Advanced medical post with surgery and field hospital, doctors, medicine (at least two in each of the two main cities).	• 11 AMP (Advanced medical post) modules. • 2 AMPS (Advanced medical post with surgery) modules.
At least 6 planes for airlift rescue and several large boats for evacuation purposes (20.000 people need to be transported out of disaster zone).	• 2 MEVAC (Medical aerial evacuation of disaster victims) modules.
Water purification equipment – (4 large-scale units for 2 cities with approx. 400.000 inhabitants each) (300 small-scale units for small, remote villages with less than 500 inhabitants each) (500.000 water purification tablets).	• 4 WP modules currently registered (they can each purify a minimum of 225.000 litres per day). • Small-scale units and tablets may be provided as other resources from EU Member States.
1 technical damage assessment team (to assess damage to infrastructure and needs assessment for temporary bridges, road reconstruction, etc.). Testing equipment for environmental contamination, drinking water, soil, sewerage etc.	• Pool of experts can potentially provide quicker access to the needed experts.
Emergency temporary shelter in at least 4 locations for the 500.000+ homeless for a period of up to 3 weeks (approximately 150.000 are required from external assistance).	• No high capacity emergency temporary shelter capacity prepared under the Mechanism..
Oil pollution clean-up equipment to recover the 40.000 tons of oil (mainly at sea / some along the shores).	• No modules registered at the Mechanism. • EMSA would not send equipment (distance), but could potentially send oil spill response assessment and coordination experts.

At least 3 helicopters to get access to remote areas and rescue or evacuate people in the affected areas.	• No specific modules. • Unlikely to be provided as other resources from Member States due to large distance to disaster site.
Emergency evacuation capacity to expatriate 200-400 EU citizens.	• 2 MEVAC modules could potentially assist in this task. • Also previous Mechanism activation shows that resource pooling for this task provides added value and can be more efficient.
At least 7 temporary metallic bridges (200-300 metres length and 3.5 metres wide) to help get assistance to remote places.	• No specific module registered for this type of assistance, but recent Mechanism activation in Haiti showed that this type of support could be provided through the MIC.

[Source: ECORYS]

Based on the analysis of required external assistance versus current Mechanism capacities, the following potential gaps have been identified:

Identified potential gaps - storms
Potential lack of water purification equipment – especially small-scale units for small, remote villages with less than 500 inhabitants each and large amounts of water purification tablets.
No high capacity emergency temporary shelter prepared under the Mechanism.
Emergency evacuation capacity to expatriate EU citizens.
Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, schools.
Limited availability of helicopters to get access to remote areas and rescue or evacuate people in the affected areas.

[Source: ECORYS]

5.2.2 Floods

This first step juxtaposes the needs for external assistance identified in the scenario to the inventory of what the Mechanism can already contribute.

Needs for External Assistance - EU scenario(needs not covered by national response capacities)	**Possible contribution through the Mechanism** (including modules and other types of response resources) for filling the gap
High capacity pumping equipment. 4 units high capacity pumps for two cities and 25 mobile units to drain flooded roads.	• 19 HCP (High capacity pumping). This may cover the 4 units and part of the mobile units to drain flooded roads. The envisaged increase in registered HCP modules should further contribute to covering such a need. • Other small or medium sized equipment offered on an ad hoc basis. No quantified inventory available.
Rescue services equipment for evacuation of 1.5 million people, including special requirements for evacuating 50 hospitals and about 200 nursing homes.	• 1 FHOS (Field hospital), 11 AMP (Advanced medical post), 2 AMPS (Advanced medical post with surgery). Even taking into account the envisaged increase in registered modules, this may cover only a fraction of the needs in terms of emergency housing and medical care.
Restoration of power supply (mobile power supplies for approximately 2 million people spread across various locations).	• Power supply equipment is offered on an ad hoc basis. No quantified inventory available.
Search and rescue (SAR) e.g.	• Helicopters and boats may be offered on ad hoc basis, most

Helicopters and boats.	probably from close neighbouring countries. • This requires a type of SAR that is not defined in existing types of modules. Urban search and rescue is for specific for destroyed buildings.
Specialists on environmental pollution, contamination of drinking water facilities etc. (at least 2 teams).	• The MIC can set up two teams on the basis of trained assessment experts and additional identification of specialised experts.
Water purification equipment – (6 large-scale purification units for 2 cities in each of the three countries) (600 small-scale pumps, for villages throughout the three countries) (500.000+ water purification tablets).	• 4 WP (Water purification) modules. The 2-5 planned additional modules should help cover the large scale requirements in the future. • Other small or medium water purification equipment as well as water purification tablets are provided on an ad hoc basis. No quantified inventory is available.
Additional needs identified in the INTERNATIONAL flood scenario	**Possible response resources through the Mechanism** (including modules and other types of response resources) **for an appropriate Mechanism contribution to the response**
Portable dryers, floating pumps, electric submersible pumps, hygiene kits and water filters.	• Smaller types of flood response equipment have been made available on a bilateral basis in the past on an ad hoc basis. No quantified inventory is available.
Management and coordination facility to provide overview of the situation and to act as interface to international bodies incl. MIC and local actors.	• The MIC can send assessment and coordination teams on the basis of trained experts. • 7 TAST teams are registered to support the assessment and coordination teams.

[Source: ECORYS]

Based on the analysis of required external assistance versus current Mechanism capacities, the following potential gaps have been identified:

Identified potential gaps - floods
No large scale emergency temporary shelter capacity organised under the Mechanism.
Lack of sufficient quantities of registered FHOS (Field Hospital) modules.
Lack of sufficient amounts of mobile units of high capacity pumping equipment. Module is currently based on larger scale, less mobile specifications.
Lack of reported capacities for search and rescue in flooded conditions using helicopters and boats.
Portable dryers, floating pumps, electric submersible pumps, hygiene kits and water filters.
Insufficient knowledge on existing capacities of purification tablets and their degree of availability.

[Source: ECORYS]

5.2.3 Earthquakes

This first step juxtaposes the needs for external assistance identified in the scenario to the inventory of what the Mechanism can already contribute in terms of current capacity.

Needs for External Assistance – EU scenario (needs not covered by national response capacities)	**Possible contribution through the Mechanism** (including modules and other types of response resources) for filling the gap
Emergency temporary shelter for 50,000 people	• The ETS module (capacity: 250 people) is too small to make any significant contribution to covering this need.
Field hospital (600 beds needed)	• 1 registered FHOS (Field Hospital module) and additional 4 FHOS modules planned to be registered by the end of 2010 cover

	minimum 50 beds.
Mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, supermarkets and food storage houses (approx. 400 sites) and energy for homes left without power (approx. 700,000).	• Previous Mechanism activations shows that stock exist to supply power generators – whether this is sufficient for major emergencies is to be checked as no inventory exists.
Communication equipment, sat com, etc (approx. 700 units)	• No reported resources currently exist, but such equipment is similar to that used by e.g. police and emergency services and should be available on an ad hoc basis. No quantified inventory is available.
Management and coordination facility to provide overview of the situation and to act as interface to relevant bodies and structures.	• The MIC can send assessment and coordination teams on the basis of trained experts. • 7 TAST teams are registered to support the assessment and coordination teams.
3 helicopters for evacuation and transport able to operate at night	• No transport helicopter resources are currently reported. Resources likely exist on national level but transportation issues may play a key role in the degree of availability for external assistance. No quantified inventory is available.
4 MUSAR (medium urban search and rescue) teams, including specialists for structural engineering, heavy rigging, collapse rescue, logistics, hazardous materials, communications, canine and technical search.	• 19 MUSAR (Medium urban search and rescue). The envisaged future registration of 4 additional MUSAR modules should further strengthen this Mechanism capacity.
Water purification equipment for approximately 250,000 people in 5 major locations (30,000 persons each) and 10 smaller locations (up to 10,000 persons)	• 4 WP (Water purification) modules. The 2-5 planned additional modules should improve capacity at least for the large scale requirements in the future.
Heavy equipment to prop up damaged critical infrastructure	• 8 HUSAR (Heavy urban search and rescue) will have some of the needed equipment. However, no resources specifically geared towards stabilising critical infrastructure have been reported. They may exist on national levels but quantities and specifications are currently unknown. HUSAR are unlikely to travel over long distances.
Building and infrastructure stability evaluation assistance (at least 1 technical damage assessment team)	• The MIC can set up two teams on the basis of trained assessment experts and additional identification of specialised experts.
Testing equipment and team for environmental contamination, drinking water, soil, sewage etc. (at least 2 units)	• The MIC can set up two teams on the basis of trained assessment experts and additional identification of specialised experts.
3 temporary medical / rehabilitation facilities to serve 1,000 people each	• As there are no ETS (Emergency Temporary Shelter) registered in the Mechanism, 11 AMP (advanced medical post) and 2 AMPS (advanced medical post with surgery) can partly cover this requirement. • Planned future capacities should provide better coverage of this type of need from 2010 onwards: 4 ETS modules should then be registered as well as additional AMP and AMPS modules.
Additional needs identified in the INTERNATIONAL earthquake scenario	**Possible response resources through the Mechanism** (including modules and other types of response resources) **for an appropriate Mechanism contribution to the response**
Winterised tents (to shelter 40,000 people for 4 months in at least 6 locations).	• This type of capacity has not been reported under the Mechanism. However, it may be available on a national level on an ad hoc basis. No quantified inventory is available.
4 search and rescue teams (2 MUSAR teams for urban areas and 2 Mountain Rescue teams)	• While the current MUSAR modules registered under the Mechanism are able to cover the urban search and rescue needs, currently no specialised module exists for mountain rescue. • Capacity may be available in some mountainous Participating States, but no capacities have been reported. No quantified inventory is available.

Field hospitals with medical staff and supplies, able to operate in sub-zero temperatures (minimum 2 units), total 400 beds	• 1 registered FHOS (Field Hospital) module. The additional 4 FHOS modules planned to be registered by the end of 2010 should help to cover this need in the future. However, the FHOS modules are unable to operate in sub-zero temperatures.
6 helicopters suitable for high-altitude operations in harsh winter weather, 2 of which should be cargo helicopters	• This type of capacity has not been reported under the Mechanism. Even if available on a national basis, it is highly unlikely that the Mechanism would try to contribute to this need given the difficulty in transporting such equipment over long distances.
Post disaster stress experts	• This type of specialised medical expertise currently has not been formally reported under the Mechanism. However, national capacities are likely to include this type of expertise. No quantified inventory is available.

[Source: ECORYS]

Based on the analysis of required external assistance versus current Mechanism capacities, the following potential gaps can be identified:

Identified potential gaps - earthquakes
No preparation for large scale emergency temporary shelter
Lack of field hospitals.
Limited existence of equipment suitable for sub-zero operations, such as winterised tents and medical facilities.
Limited degree of availability of heavy equipment (e.g. for HUSAR teams), which is mostly needed in the early stages of a disaster but whose transport is the most complicated. Often it is easier to obtain local equipment, or to send trainers which supervise local teams.
Potential shortcoming of portable communications equipment. Unknown quantities exist on national levels.
Limited degree of availability of helicopters for transportation, both in EU and in third countries. However, as helicopters are unlikely to travel over very long distances the provision of such assistance to third countries would have to rely on Participating States assets positioned in the affected region.

[Source: ECORYS]

5.2.4 Tsunamis

This first step juxtaposes the needs for external assistance identified in the scenario to the inventory of what the Mechanism can already contribute in terms of current capacity.

Needs for External Assistance - EU scenario (needs not covered by national response capacities)	**Possible contribution through the Mechanism** (including modules and other types of response resources) for filling the gap
Water purification equipment for a total of 2 million people (half of the total affected population); 3 large-scale units for the 3 main cities affected; 100 small scale units for smaller towns and villages.	• 4 WP (Water purification) modules. The 2-5 planned additional modules should improve capacity at least for the large scale requirements in the future. A total of 9 modules would provide purified water for some 135 thousand people (15 litres per day per capita)
Management and coordination facility to provide overview of the situation and to act as interface to relevant bodies and structures. One in each o f the 3 main cities.	• The MIC can send assessment and coordination teams on the basis of trained experts. • 7 TAST teams are registered to support the assessment and coordination teams.
High capacity pumping equipment. At least 3 high capacity units for the 3 large	• 19 HCP (High capacity pumping). This may cover the 4 units and part of the mobile units to drain flooded roads. The envisaged

cities, plus 20 mobile units to drain flooded roads.	increase in registered HCP modules should further contribute to covering such a need. • Other small or medium sized equipment offered on an ad hoc basis. No quantified inventory available. Furthermore modules comprising several small pumps might be able to contribute to covering this need.
Helicopters to get access to remote areas and rescue or evacuate people in the affected areas. Minimum 5-10 units.	• Resources likely exist on national level but transportation issues may play a key role in the degree of availability for external assistance. No quantified inventory is available.
Temporary medical emergency facilities to serve several thousand people	• 1 FHOS (Field hospital) modules with 4 more planned to be registered by the end of 2010; 11 AMP (advanced medical post) modules with 3 more planned ones; 2 AMPS (Advanced medical post with surgery) modules with at least 3 more planned ones. • 2 MEVAC (Medical aerial evacuation of disaster victims), with one additional module planned to be registered by the end of 2010. • This capacity will likely be able to cover the medical needs identified in this scenario.
Body ID equipment and body bags.	• This type of smaller equipment exists on national levels but has not been reported in terms of quantities and degree of availability to the Mechanism. No quantified inventory is available.
Testing equipment and experts for environmental contamination of drinking water, soil, sewage, etc.	• The MIC can set up two teams on the basis of trained assessment experts and additional identification of specialised experts.
Specialist companies to repair underwater cables	• This type of specialised response capacity is typically offered by private companies. No quantified inventory is available.
Oil spill cleaning vessels	• EMSA's network of specialised oil spill response vessels should be sufficient to cover this need. However, this does not apply to the international disaster scenario.
Coast guard vessel for SAR at sea	• SAR capacities at sea are currently not reported under the Mechanism but likely exist in all Participating States bordering the ocean. However, it is unclear how available these resources could be for external emergency response. No quantified inventory is available.
Additional needs identified in the INTERNATIONAL tsunami scenario	**Possible response resources through the Mechanism** (including modules and other types of response resources) **for an appropriate Mechanism contribution to the response**
Shelter (and supplies) for approximately half a million homeless, located in approximately 100 different locations.	• The ETS module (capacity: 250 people) is too small to make any significant contribution to covering this need.
Heavy equipment to remove rubble and prop up critical infrastructure	• 8 HUSAR (Heavy urban search and rescue) will have some of the needed equipment. However, no resources specifically geared towards stabilising critical infrastructure have been reported. They may exist on national levels but quantities and specifications are currently unknown.
Damage assessment / surveillance equipment, incl. planes and/or satellites	• The Mechanism currently has no module dedicated to this type of need. Some relevant other resources have been reported to the Mechanism, but no quantitative inventory is available.

[Source: ECORYS]

Based on the analysis of required external assistance versus current Mechanism capacities, the following potential gaps have been identified:

Identified potential gaps - tsunamis
Shortcoming of registered WP (Water Purification equipment) modules, especially more mobile units.
Potential shortcoming of registered AMP (Advanced Medical Posts) modules.
Insufficient quantities of registered FHOS (Field Hospitals) modules.
Large scale emergency temporary shelter.
Limited degree of availability of heavy equipment (e.g. for HUSAR teams), which is mostly needed in the early stages of a disaster but whose transport is the most complicated. Often it is easier to obtain local equipment, or to send trainers which supervise local teams.
Need for mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, supermarkets and food storage houses.
Limited degree of availability of helicopters for transportation, particularly in third countries.
Unknown quantities and degree of availability of body ID equipment – equipment as X-ray scanners etc., personnel as dentists, medical doctors etc.
Potential lack of sufficient quantities and/or degree of availability of damage assessment / surveillance equipment, incl. planes and/or satellites.
Need for specialist companies to repair underwater cables.

[Source: ECORYS]

5.2.5 Oil spill

This first step juxtaposes the needs for external assistance identified in the scenario to the inventory of what the Mechanism can already contribute. This does not cover an analysis of potential gaps the pollution control at sea capacity that is outside of the scope of this study.

Needs for External Assistance (needs not covered by national response capacities or regional cooperation agreements)	**Possible contribution through the Mechanism** (including modules and other types of response resources as well as EMSA resources) for filling the gap
Water purification / desalination equipment to supply approximately 50.000 households in a dispersed area (many small coastal towns).	• Previous Mechanism activation shows sufficient supply of water purification / desalination equipment to cover this need. • 4 WP modules currently registered (they can each purify a minimum of 225.000 litres per day). Planned future capacities should further improve response capacity for this type of resource.
Power generators for approximately 20.000 households.	• Previous Mechanism activation shows sufficient supply of power generators to cover this need. However, no quantitative inventory is available.
Collapsible tanks for temporary storage of recovered oil.	• No quantified inventory available for this on Mechanism or EMSA level.
8 trailer-mounted steam cleaning / pressure washing systems.	• No shoreline clean-up capacity reported or prepared through the Mechanism.
Protective equipment for shoreline clean-up volunteers.	• Nationally available equipment is quickly exhausted. • Difficulties of mobilising external assistance.
Assistance with waste separation	• Waste separation and disposal remains a problem. National capacities are easily overwhelmed.

[Source: ECORYS]

Based on the analysis of required external assistance versus current Mechanism (plus EMSA) capacities, the following potential scenario specific gaps can be identified:

Identified potential gaps – oil spills
Appropriate shoreline response mechanisms also need to be ensured. The scenario indicated insufficient existence of ***shoreline clean-up technologies*** (e.g. vacuum units, steam cleaning / pressure washing systems).
Limited existence of ***protective gear for shoreline clean up volunteers***.
Limited existence of ***temporary waste discharge and storage facilities*** (for waste collected on shore and at sea). The clean-up process can be more efficient and less costly with appropriate temporary waste discharge and storage facilities. Immediate waste separation during clean-up operations ensures more appropriate disposal. Current capacities do not guarantee sufficient and timely supply of these temporary storage arrangements.

[Source: ECORYS]

5.2.6 Forest fires

This first step juxtaposes the needs for external assistance identified in the scenario to the inventory of what the Mechanism can already contribute.

Needs for External Assistance (needs not covered by national/regional response capacities)	**Possible contribution through the Mechanism** (including modules and other types of response resources) for filling the gap
Terrestrial means for fire fighting support (at least 6 teams of a minimum of 15 members each) plus a minimum of 8 fire trucks / vehicles.	• Previous Mechanism activation shows that terrestrial fire fighting equipment and teams can be made available through the Mechanism if the assisting country is in relative proximity to the disaster site. • However, no specific module or inventory currently exists regarding this type of resource.
Aerial forest fire fighting support using helicopters (at least 4 fire fighting helicopters with crew) and planes (at least 8 fire fighting planes with crew).	• 3 FFFP (Aerial forest fire fighting module using planes) registered • Previous Mechanism activation shows that: 1. In situations where not all Participating States having such capacities are affected by forest fires or high risk of forest fires sufficient supply of additional planes, helicopters and crew are likely to be made available through the Mechanism. 2. Aerial fire-fighting assistance is limited if severe forest fires break out in more than one country at the same time and the whole EU forest fire prone region faces conditions of high forest fire risks. In case 2. there is a gap in the existing capacity.
At least 3 teams and equipment for search and rescue to locate and transport people out of fire zones. Assistance for possible evacuation of people surrounded from endangered areas (2 helicopters). Two modules for medical aerial evacuation of burnt victims.	• Previous Mechanism activation for similar disasters shows that other resources than modules can be made available for search and rescue (especially helicopters). However, no inventory exists of how much capacity exists on national levels and how much of these quantities could be made available via the Mechanism. • Registered MUSAR and HUSAR modules typically not used in this configuration for search and rescue of large areas threatened by forest fires. • 2 MEVAC (Medical aerial evacuation of disaster victims) modules registered. But limited specialised hospital capacity for amount of injured and burnt victims that need to be taken care of.

2 advanced medical posts with specialists for burnt victims - one for each of the critical localities.	• 11 AMP (advanced medical posts) and 2 AMPS (advanced medical posts with surgery) registered. However, limited capacity and specialised equipment to treat severe burns. • 2 MEVAC (Medical aerial evacuation of disaster victims) modules registered. These can fly severely burnt victims to specialised hospitals throughout Europe.
Management and coordination facility to provide overview of the situation and to act as interface to relevant bodies and structures. One in each o f the 3 main cities.	• The MIC can send assessment and coordination teams on the basis of trained experts. • 7 TAST teams are registered to support the assessment and coordination teams.
Technical assistance team to assess ecological impact and damage to infrastructure (at least 2 teams).	• The MIC can set up two teams on the basis of trained assessment experts and additional identification of specialised experts.

[Source: ECORYS]

Based on the analysis of required external assistance versus current Mechanism capacities, the following potential scenario specific gaps can be identified:

Identified potential gaps – forest fires
There is a lack of organisation and preparedness of terrestrial resources for providing ground fire fighting assistance for forest fires.
Helicopters are typically not deployed if disaster site is far away from home base and the EU Mechanism does not have FFFH (Aerial forest fire fighting module using helicopters) registered.
Furthermore, aerial fire-fighting capacity is limited if severe forest fires break out in more than one country at the same time and the whole EU forest fire prone region faces conditions of high forest fire risks. Therefore, a **gap in the quantities (and degree of availability) of both aerial and terrestrial forest fire fighting** resource deployment possibilities exist.
Another gap particularly relevant during forest fire disasters is the **lack of sufficient capacity in emergency care and treatment of burnt victims**. Aerial evacuation capability is especially crucial as advanced medical posts are not (well) equipped to treat burn victims, and these persons might therefore have to be transported from the fire site directly to hospitals. Hospitals, however, also have limited capacity to handle burn victims (e.g. Germany has a total of 20 specialised beds to treat severely burnt people). Care and treatment is especially urgent in cases of burns to the face and hands, but not all burn victims are in critical, life-threatening danger. While 2 MEVAC modules can be activated for evacuation of severe burn victims, the overall European capacity for treating severely burnt disaster victims may easily be overwhelmed in case of simultaneous fires in more than one Member State.
Limited degree of availability of helicopters for transportation of terrestrial crews and fire fighting equipment to fire locations as well as for evacuating citizens out of danger zones.

[Source: ECORYS]

5.2.7 Chemical spill

This first step juxtaposes the needs for external assistance identified in the scenario to the inventory of what the Mechanism can already contribute.

Needs for External Assistance (needs not covered by national response capacities)	**Possible contribution through the Mechanism** (including modules and other types of response resources) for filling the gap
Advanced medical posts - including equipment and personnel for 50.000 persons disposed at 5 locations.	• 11 AMP (Advanced medical post) modules and 2 AMPS (Advanced medical post with surgery) are already registered. Future capacities will further strengthen the response capacity for this type of resource.
Additional medical (field) hospitals - including equipment and personnel for 2.000 injured and contaminated persons disposed in 4 cities.	• Currently only 1 FHOS (Field hospital) is registered. A planned amount of 4 additional modules by the end of 2010 should strengthen the civil protection capacity for this aspect.
Post disaster stress experts.	• No quantities have been reported to the Mechanism. No inventory is available for what exists on national levels and to what degree these resources could be made available for external assistance.
Management and coordination facility to provide overview of the situation and to act as interface to relevant bodies and structures. One in each o f the 3 main cities.	• The MIC can send assessment and coordination teams on the basis of trained experts. 7 TAST teams are registered to support the assessment and coordination teams.
Water purification equipment for 50 villages with approximately 10.000 inhabitants each - including instruction and equipment.	• Previous Mechanism activation shows sufficient supply of water purification equipment to cover this need. • 4 WP modules currently registered (they can each purify a minimum of 225.000 litres per day).
Rapid deployment of medical and technical experts: capacities for decontamination of citizens, personnel and equipment - including equipment and personnel for approximately 200.000 persons as soon as possible.	• Currently no quantified capacities for addressing this need have been reported. No quantified inventory available.
Chemical detection and sampling including equipment and personnel for an area of several 100 square kilometres. Expected need: 14 teams for chemical gas detection on ground with personnel and equipment to be operational for more than 24 hours. Specialist to test facilities etc. to ensure that affected areas (approximately 10 square kilometres) are decontaminated before re-entering them. Testing equipment for environmental contamination, drinking water, soil, sewerage etc - including equipment and personnel for 4 cities each of approximately 50.000 inhabitants and 10 major villages each of 10.000 inhabitants.	• 11 CBRNDET (CBRN detection and sampling) are currently registered. 4-5 additional planned modules should help strengthen the response capacity for this type of external assistance need in the future. • Such team need to be supported by scientific backup networks for expert advise and specialist analytical capacities which as not necessarily available within one country.
Search and rescue in chemical contaminated areas - including equipment and personnel for 4 cities each of approximately 50.000 inhabitants and 10 major villages each of approximately 10.000 inhabitants.	• 2 USARCBRN (Urban search and rescue in CBRN conditions) are already registered; 3-4 additional modules should be registered by the end of 2010.

[Source: ECORYS]

In any event of chemical disaster whether resulting from terrorism or industrial accident, a multidisciplinary approach will be necessary. Coordination among all the involved personnel including first responders (from fire- and rescue services, police, military etc., law enforcement agencies, emergency physician, toxicologist, environmental specialist, and security personnel will be required.

Based on the analysis of required external assistance versus current Mechanism capacities, the following gaps can be identified:

Identified potential gaps – chemical spills
Scientific backup networks for expert advise and specialist analytical capacities supporting the CBRN teams and modules on site
The scenario showed the need for post disaster stress experts for approximately 10.000 people. Here languages skills and knowledge about cultural characteristic is of major importance and makes it even more difficult to provide international assistance.
Unknown quantities and degree of availability of body bags, cooling facilities and ID equipment – equipment as X-ray scanners etc., personnel as dentists, medical doctors etc.
Stock piling of medicine, antidotes and antibiotics: The stock piling of the antidotes are necessary to treat the large number of casualties. There are several problems associated with appropriate quantities of the drugs and rapid distribution of antidotes to the victims. One of them is the logistic issue in bringing them to the area where needed another is the appropriate amount of skilled personnel (doctors and nurses) to make needed medical judgement and to give the medicine etc. to the patients.

[Source: ECORYS]

5.3 Analysis of the identified gaps

The previous sections identified all potential general qualitative gaps and all quantitative gaps per disaster scenario. Five categories of potential Mechanism response capacity gaps can now be distinguished:

(a) gaps hindering the degree of availability of existing resources;
(b) lack of sufficient quantities of major categories of resources;
(c) lack of sufficient quantities of specific equipment or expertise;
(d) lack of information on specific categories of equipment or expertise;
(e) limited preparedness of major categories of response resources.

The identified gaps are summarised in Table 5.2. Each of these types of gaps, in turn, will require a different type of policy response (numbered in the following table ii to vii). The status quo to compare policy options against in this analysis is the ‘no action’ situation (option i).

Table 5.2 Summary overview of the identified gaps and corresponding generic policy options

<table>
<thead>
<tr><th>Category of Mechanism response capacity gap</th><th>Gap #</th><th>Mechanism response capacity gaps</th><th>Potential generic options for filling the Mechanism response capacity gap</th></tr>
</thead>
<tbody>
<tr><td rowspan="6">(a) Gaps limiting the availability of existing resources</td><td>1</td><td>Funding to cover the transportation and deployment of response resources</td><td rowspan="6">The qualitative issues related to logistics and operational issues may have major impacts on the effectiveness of the EU response to requests for assistance. Policy options for addressing these issues include:

(ii) strengthening co-financing options for covering transportation/deployment costs for provided assistance (the Commission would cover 100% of the cost of transporting/deploying the assistance provided by Participating States);

(iii) empowering the Commission to mandate the dispatch of national resources, with financing by the Commission. This option mirrors the system applied in the regulation establishing the FRONTEX agency. However, given the wide range of possible civil protection interventions and diversity of type of resources, this option would rely on a well defined pool of civil protection modules that would be maintained on high alert;

(iv) Agreements between the Commission and the Participating States that guarantee the availability of specified resources during specified periods - with or without financing by the Commission;

(v) strengthening the current responsibilities of the Commission to further improve the assessment of needs and the coordination of assistance: the role of the MIC in on-site disaster response coordination should be reinforced. This should be supported by highly available experts that the Commission is able to mobilise at very short notice, on the model applied by the UN to UNDAC experts, which requires simplified mobilisation procedures and direct access for the Commission to the experts.</td></tr>
<tr><td>2</td><td>Capacity to transport the response resources to the site</td></tr>
<tr><td>3</td><td>Lack of EU capability to mandate the dispatch of response resources</td></tr>
<tr><td>4</td><td>Lack of EU capability to mandate the dispatching of experts</td></tr>
<tr><td>5</td><td>Although improving, still limited MIC capability in the areas of:
• Assessment;
• On-site coordination, including regarding local distribution, local transport, local procurement
• Support to deployment (e.g. information on health and safety aspects)</td></tr>
<tr><td>6</td><td>Limited availability of aerial fire fighting resources, both fixed and rotary wing aircraft, if the whole EU forest fire prone region faces conditions of severe forest fires risks.</td></tr>
<tr><td rowspan="7">(b) Lack of major categories of resources</td><td>7</td><td>Lack of mobile units of medium capacity pumping equipment.</td><td rowspan="7">Policy options for addressing this type of gap include:

(vi) increasing national capacities in combination with promoting registration of modules/resources under the Mechanism;

(vii) developing EU level capacities based on contractual agreements (e.g. framework agreement in public tender) with a third party (private or public) including human resources and equipment defining also terms of rapid deployment and transport.</td></tr>
<tr><td>8</td><td>Water purification equipment – especially when large quantities of large scale water purification and/or small-scale more mobile units for small, remote villages are required.</td></tr>
<tr><td>9</td><td>High capacity emergency temporary shelter.</td></tr>
<tr><td>10</td><td>Lack of field hospital modules – this includes a need for larger field hospitals.</td></tr>
<tr><td>11</td><td>Emergency evacuation capacity to expatriate EU citizens.</td></tr>
<tr><td>12</td><td>Limited quantities of registered AMP (Advanced Medical Posts) modules.</td></tr>
<tr><td>13</td><td>Limited quantities of aerial fire fighting resources, both fixed and rotary wing aircraft.</td></tr>
</tbody>
</table>

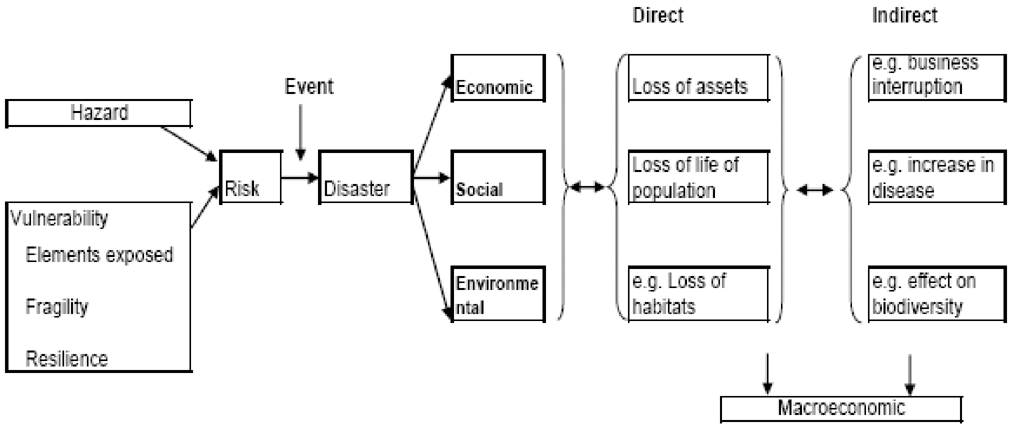
(c) Lack of specific equipment or expertise	14	Limited existence of equipment suitable for sub-zero operations, such as winterised tents and medical facilities.	Policy options for addressing these gaps are the same as for the above category. However option (vii) is probably only relevant for developing the MIC's damage assessment/surveillance capability.
	15	Lack of sufficient capacity in treatment of burnt victims.	
	16	Mobile power supply to a number of critical operations, e.g. hospitals, emergency centres, police, military, schools.	
	17	Damage assessment / surveillance equipment, incl. planes and/or satellites for deployment by the MIC	
	18	Limited existence of temporary waste discharge and storage facilities for oil spill response	
(d) Lack of information on specific categories of equipment or expertise	19	Stock piling of medicine, antidotes and antibiotics: The stock piling of the antidotes is necessary to treat the large number of casualties.	These gaps require an inventory. In case quantitative gaps are discovered appropriate option will need to be considered for filling the identified gaps.
	20	Portable dryers, floating pumps, electric submersible pumps, and water filters.	
	21	Purification tablets / their degree of availability.	
	22	Availability of specialist companies to repair underwater cables.	
	23	Body bags and cooling equipment to collect bodies quickly to limit the spread of diseases and to centralise them for body ID process.	
	24	Portable communications equipment.	
(e) Limited preparedness of major categories of response resources	25	Terrestrial fire fighting resources.	This requires the Commission to launch new preparedness activities to address the identified gaps. This may take the form of the creation of new categories of civil protection modules, specific courses/exercises, etc.
	26	SAR in flooding conditions and in mountainous areas	
	27	Scientific back office for ensuring adequate support of CBRN teams and modules on site.	
	28	Shoreline clean-up, including availability of equipment, protective gear for volunteers.	
	29	Post-disaster psychological support with appropriate language skills and cultural awareness for external assistance deployment.	

[Source: ECORYS]

6 Analysis of policy options

The qualitative impact assessments carried out in this chapter assess the likely environmental, economic and social impacts of various policy options for addressing selected gaps identified in Chapter 5. As much as possible, the assessment takes into account costs of implementing the new policy measure versus costs associated with various disaster impacts which may be avoided or limited if the measure were in place. The following figure provides a general overview of typical disaster impacts and their associated direct and indirect costs.

Figure 6.1 Overview of disaster impacts and associated cost categories



[Adapted from Mechler (2005) "Cost-benefit Analysis of Natural Disaster Risk Management in Developing Countries"]

In line with the previous chapter, impacts are assessed per gap type identified in Table 5.2. It should be noted, however, that gaps related to the lack of information on specific categories of equipment or expertise (gaps # 19, 20, 21, 22, 23, 24) and gaps related to the limited preparedness of major categories of resources (gaps # 25, 26, 27, 28, 29) are excluded from this policy option analysis. The former gaps first require a detailed inventory; the latter simply require new preparedness activities.

In addition, a specific assessment has been provided for developing the action of the Mechanism in the area of coastline pollution control following oil spills.

6.1 Analysis of policy options addressing gaps limiting the degree of availability of existing response resources

The policy options identified in Table 5.2 may address either one or more of the identified gaps. This impact assessment is therefore developed in three different sections addressing different gap types related to the degree of availability.

All the defined policy options on reducing general qualitative gaps can considerably improve the overall functioning and effectiveness of the Mechanism and of civil response resources provided by Participating States in disaster situations. To assess and measure the impact of these complex options, not only direct costs and benefits need to be assessed, but also indirect benefits should be taken into account. The preliminary impact analysis carried out in this chapter takes both direct and indirect costs and benefits into account to the extent possible. In the future, once a certain policy direction will be analysed in more detail, these direct and indirect costs and benefits should be explored in more detail.

6.1.1 Transport related policy options (addressing gaps #1 and #2)

Qualitative gaps related to logistics and the cost of transport have been mentioned throughout questionnaire responses as well as the experts' workshop as one of the major soft factors hindering adequate deployment of emergency response resources for external assistance. Therefore, potential policy options need to help address this qualitative gap in current response mechanisms. The following policy options are evaluated for their economic impacts:

- (i) No Action.
- (ii) Strengthen co-financing options for covering transportation costs for provided assistance. The Commission would cover up to 100% of the cost of transporting the assistance provided by the Participating States.

Summary of potential impacts	i. No Action	ii. Strengthen co-financing options for covering transportation costs for provided modules	Remarks and/or assumptions
Economic impacts			
Initial investment costs (low costs = positive)	o	- for Community + for Participating States	These are costs pertaining to the respective institutions. Rather than a net increase of costs this represents a sharing of the cost burden of European solidarity by the transfer of costs of individual Participating States to the Community. This equitable burden sharing of the costs of solidarity may also result in more Participating States being able to provide national resources for disaster

Summary of potential impacts	i. No Action	ii. Strengthen co-financing options for covering transportation costs for provided modules	Remarks and/or assumptions
			response.
Operational costs (reduced costs = positive)	--	o/-	Operational costs are assumed to still be high (too high) under the No Action scenario because individual Participating States choose not to send some resources due to transportation limitations.
Timing of deployment (reduced time of deployment=positive)	o	+	Immediate access to transport solutions made available by the Commission will reduce the time (1) needed for the Participating States to decide the mobilisation and to dispatch their resources, and (2) on the identification of transport solutions.
Environmental impacts			
Pollution / environmental contamination (reduced amount = positive)	o	+	Assumption: better availability of transport options allows more response resources to be deployed and thus indirectly environmental impacts should be able to be minimized.
Social impacts			
Loss of life (reduced loss of life = positive)	o	+	Assumption: better transport financing allows more response resources to be deployed immediately after the disaster and thus can indirectly lead to saved lives.
Number of people suffering health effects (reduced number = positive)	o	+	Assumption: better transport financing allows more response resources (particularly medical response units, which can be very expensive to transport) to be deployed immediately after the disaster and thus can indirectly lead to better treatment of patients.
++ = strong positive + = positive o = neutral - = negative -- = strong negative			

From the above table, it becomes clear that option ii seems to be able to address the current qualitative gap and increase the efficiency and cost-effectiveness of operations launched under the Mechanism. This type of policy option could significantly improve the overall response capacity of the Mechanism because one of its major limitations could be overcome: transportation to and from the disaster site. By addressing this qualitative gap, most of the existing response resources would become more widely available for external assistance deployment

6.1.2 Policy options for general lack of availability of response resources (addressing gaps #3, 4 and 6)

Both the expert workshop as well as the scenario assessment showed that the current lack of capacity of the Mechanism to guarantee the deployment of existing resources represents a major soft factor limiting the degree of availability of some response resources. Some options exist to potentially improve this situation and to reduce some of the political barriers to response provision. The following policy options are evaluated for their economic impacts:

- (i) No Action.
- (iii) Empowering the Commission to mandate the deployment of registered national resources (Frontex model of mandatory solidarity); provided resources would then be financed by the Commission;
- (iv) Agreements between the Commission and the Participating States that guarantee the availability of specified resources during specified periods, provided resources would then be financed by the Commission.

Summary of potential impacts	i. No Action	iii. Empower the Commission to mandate deployment of registered national resources (Frontex model)	iv. Establish gentlemen agreements with Participating States based on a rotation system	Remarks and/or assumptions
Economic impacts				
Initial investment costs (low costs = positive)	o	o/-	o/-	
Operational costs (reduced costs = positive)	--	- for EU + for Participating States	- for EU + for Participating States	These are costs pertaining to the respective institutions. Rather than a net increase of costs this represents a sharing of the cost burden of European solidarity by the transfer of costs of individual Participating States to the Community. This burden sharing may result in more Participating States being able to provide national resources for disaster response. Option 4 could potentially lead to some cost savings as Participating States' have defined periods of responsibility.
Timing of deployment (reduced time of deployment=positive)	o	+	+	General assumption: due to more formalised deployment arrangements, deployment time should be significantly shortened (no decision time necessary anymore on political level, nor financial commitment level). Furthermore, both options could potentially improve the time lag between request and deployment since the respective pool of modules (option III) or countries on rotation (option iv) will be on high alert for the period they are assigned to.

Summary of potential impacts	i. No Action	iii. Empower the Commission to mandate deployment of registered national resources (Frontex model)	iv. Establish gentlemen agreements with Participating States based on a rotation system	Remarks and/or assumptions
Environmental impacts				
Total area affected (reduced area = positive)	o	o/+	o/+	Assumption: greater availability of various response resources and quicker deployment process could indirectly help limit the extent of environmental impacts.
Pollution / environmental contamination (reduced amount = positive)	o	o/+	o/+	Assumption: greater availability of various response resources and quicker deployment process could indirectly help limit the extent of environmental impacts.
Social impacts				
Loss of life (reduced loss of life = positive)	o	o/+	o/+	Assumption: greater availability of various response resources (especially search & rescue and medical resources) and quicker deployment process could indirectly help reduce the loss of life.
Number of people suffering health effects (reduced number = positive)	o	o/+	o/+	Assumption: greater availability of various response resources (especially search & rescue and medical resources) and quicker deployment process could indirectly improve health care in an emergency situation.
++ = strong positive + = positive o = neutral - = negative -- = strong negative				

Both options iii and iv show clear advantages and European added value as compared to the no action option. Their main advantage is to ensure the sharing of the cost burden of European solidarity.

For option iii, a closer look at the Frontex model (the European Agency for the Management of Operational Cooperation at the External Borders) shows that the objectives and tasks carried out by this European agency are similar in nature to those of the Mechanism (e.g. Frontex coordinates the operational cooperation between Member States in the field of border security; activities of Frontex are intelligence driven and include trainings for experts, facilitation, information sharing, etc.; Frontex complements and provides particular added value to the national border management systems of the Member States). However, the Frontex approach for participation is different: this system opted for so-called "mandatory solidarity". This concept, if applied to the Community Civil Response Mechanism as indicated in Option iii, could overcome most of the current issues regarding the gap between resource availability versus actual deployment. By financing the deployment on an EU level and mandating Participating States to deploy the requested resource (in case not sufficient quantities are made available via voluntary offers), sufficient deployment could be guaranteed for all resources (given they exist in sufficient quantities). However, such a system would have a well defined scope addressing the principal resources that might be needed to respond to major disasters.

Thus, this option would rely on a well defined pool of civil protection modules that would be maintained on high alert.

Option iv, on the other hand, seems politically more acceptable as it is a system of gentlemen agreement and might be perceived as more fair and adequate for the purpose of ensuring sufficient deployment of European civil protection resources. However, policy discussion during 2008 has not achieved an agreement on such a system that was proposed by the French Presidency under the concept of "European Mutual Assistance", which however did not include the notion of Community financing for transport and deployment. Projects running under the Preparatory Action on a EU rapid response capacity is currently exploring the feasibility of such a system with a high level of co-financing of transport and deployment of modules (80%) being ensured by the Commission.

Although in practice both options would be similar and have similar impacts, the main differences between these two options appear to be (1) the perceived role of the concerned levels of government - the centre of gravity of the decision making is more with the Community Institutions in option iii and more with the Participating States with option iv – and (2) whether or not the cost burden of solidarity is shared between the Participating States.

6.1.3 Policy options for assessment and coordination (addressing gap #5)

As identified in the previous chapter, the degree of availability of existing resources is sometimes still influenced by the MIC's capability in the areas of rapid assessment and on-site coordination (including regarding local distribution, local transport and local procurement), and support to deployment (e.g. information on health and safety conditions, etc.). Experts and stakeholders identified this gap across all disaster scenarios. To further improve these qualitative aspects and reduce this limiting factor, the no action scenario is compared to the most feasible policy option:

- (i) No Action;
- (v) Strengthening the current responsibilities of the Commission to further improve the assessment of needs and the provision of support to the deployment of assistance; additionally the role of the MIC in on-site disaster response coordination should be reinforced. This should be supported by experts that the Commission is able to mobilise at very short notice, on the model applied in the UN to UNDAC members, which requires simplified mobilisation procedures and direct access for the Commission to the experts.

The impact assessment focuses on direct economic, cost-effectiveness considerations.

Summary of potential impacts	i. No Action	v. Strengthen current MIC responsibilities in assessment and coordination (improve availability of core pool of experts in parallel)	Remarks and/or assumptions
Economic impacts			
Initial investment costs (low costs = positive)	o	o/-	Investment costs for expanding the MIC role in assessment, support and coordination are expected to be relatively low. Additional liaison officers may need to be trained; other response agencies need to be informed about this MIC capacity. Better deployment support structures could be explored.
Operational costs (reduced costs = positive)	o	+	Assumption: MIC assessment, support and coordination would allow for a more efficient deployment of the right type and amount of resources as well as a more effective utilization of provided assistance and therefore reduce overall operational costs and improve cost-effectiveness.
Timing of deployment (reduced time of deployment=positive)	o	++	Better rapid assessment of needs for assistance combined with improved deployment support should facilitate and speed up the deployment process and make it more efficient. For improved coordination at the disaster site, the timing of deployment refers to the duration of deployment of the resource. It is assumed that better local facilitation and coordination can shorten the required deployment period at least for certain types of assistance.
Environmental impacts			
Pollution / environmental contamination (reduced amount = positive)	o	o/+	Assumption: improved coordination and assessment should lead to a more effective deployment and usage of resources and thus indirectly limit environmental impacts.
Social impacts			
Loss of life (reduced loss of life = positive)			Assumption: improved coordination and assessment should lead to a more effective deployment and usage of resources and thus indirectly limit social impacts.
Number of people suffering health effects (reduced number = positive)			
++ = strong positive + = positive o = neutral - = negative -- = strong negative			

The application of policy option (v) can clearly lead to cost-effectiveness advantages as compared to the 'no action' scenario. Improved rapid assessment of needs for external assistance combined with better deployment support should help overcome some of the current qualitative limiting factors and improve the overall effectiveness of the response provided through the Mechanism. It is expected that local logistics (distribution and utilisation of the provided assistance) could be improved and therefore disaster response can be more effective in terms of limiting negative impacts. At the same time better coordination should also reduce overall costs and improve cost effectiveness of the emergency assistance provided.

As a next step, various possibilities for improving MIC assessment and coordination capabilities have to be explored. Furthermore, linkages with other international and national coordination teams have to be explored. MIC liaison officers need in-depth knowledge about the role, structure and activities of the main emergency operational partners, such as UN, NGOs, etc, and at the same time all external partners (UN, NGOs, Ministries of Foreign Affairs, etc.) need to be well informed about the Mechanism's role and capabilities in this area.

6.2 Analysis of policy options addressing the lack of major categories of resources and the lack of specific equipment and expertise

This section evaluates the various generic types of policy options that could potentially be applied to address gaps # 7, 8, 9, 10, 11, 12, 13, 14, 16, 17 and 18. The following policy options have been identified that possibly could reduce or close the potential future gap between needed and existing quantities of response resources:

- (i) No action.
- (vi) Increase national capacities; in combination with promoting registration of modules/resources under the Mechanism.
- (vii) Develop centralised EU level capacities based on contractual agreements (e.g. framework agreement in public tender) with a third party (private or public) including both human resources and equipment defining also terms of rapid deployment and transport.

The policy options are evaluated in terms costs of operations and the likely impacts in terms of economic, social and environmental impacts.

- The No action policy option represents the status quo where there is a constant lack of sufficient quantities of the respective response resource.
- Policy option vi would encourage Participating States to increase their own capacity and resources adding to improved preparedness. Additional registration of modules/resources and better EU financing mechanisms would further improve the availability of the additional capacity on a European level.
- Policy option vii would develop a centralised capacity on an EU level, not necessarily acquiring assets but potentially contracting both equipment and corresponding human resource capacities from parties other than the Participating States.

Summary of potential impacts	i. No Action	vi. Increase national capacity	vii. Develop centralised capacity on EU level	Remarks and/or assumptions
Economic impacts				
Initial investment costs (low costs = positive)	o	--	-	These are costs pertaining to the respective institutions. Furthermore, it could be analyzed in how far burden sharing of investment costs could increase / decrease the likelihood of investment. Costs for option vii should be less than for option vi because investment would focus on resources available to all Participating States and the costs would be shared between the Participating States through Community financing.
Operational costs (reduced costs = positive)	o	o	+	Operational costs are assumed to be less for option vii because resources are shared. Furthermore, efficiency gains are expected for some resources that could be contracted in larger sizes
Financing assistance in case of emergency (improved options = positive)	n/a	o	+	
Environmental impacts				
Area affected by disaster (reduced area = positive)	-	+	+	Assumption (example of forest fires): if sufficient number of aerial and terrestrial fire fighting equipment and crew are available, the fires can be controlled quicker.
Social impacts				
Loss of life (reduced loss of life = positive)	-	++	++	Assumption: greater availability of various response resources (especially search & rescue and medical resources) and quicker deployment process could indirectly help reduce the loss of life.
Number of people injured / suffering health effects (reduced number = positive)	-	++	++	Assumption: greater availability of various response resources (especially search & rescue and medical resources) and quicker deployment process could indirectly improve health care in an emergency situation.
Number of people evacuated (reduced number = positive)	-	+	+	Assumption: greater availability of evacuation resources would increase the number of people evacuated.
++ = strong positive + = positive o = neutral - = negative -- = strong negative				

The assessment shows that both policy options (vi and vii) have similar positive effects towards reducing the gap as compared to the status quo (no action). For option vi the Mechanism can encourage Participating States to improve their national capacities and to register resources. The major advantage of building capacity on the European level (option vii) is that the resources can be more readily available Europe-wide, whereas increased national capacities may not necessarily benefit other countries if they cannot easily be made available (e.g. due to lack of registration under the Mechanism or due to other qualitative issues hindering the degree of availability). Furthermore, under option vii initial investment costs as well as operating costs should be less than for option vi because investment would focus on resources available to all Participating States and the costs would be shared between the Participating States through Community financing, which would significantly reduce the individual contribution per country. The advantage of such a shared, centrally coordinated capacity increase would be a quick deployment time as well as a more efficient use of resources.

Based on this preliminary assessment, both policy options for increasing the quantities of registered response resources should be further investigated for all types of resources under these 2 quantitative gap types (lack of sufficient quantities of major categories of resources and specific equipment or expertise) with a general impact assessment to determine their costs and benefits.

Gap # 15

The option analysis for addressing the lack of capacity for the treatment of burnt victims requires a slightly different set of policy variants: ‘no action’ (i), ‘increased national capacity with availability through the Mechanism’ (vi), or ‘revised AMP module to include several beds for the treatment of severe burn victims’ (viii).

Summary of potential impacts	i. No Action	vi. increased national capacity with availability for external deployment through the Mechanism	viii. revised AMP module to include several beds for treatment of burn victims	Remarks and/or assumptions
Economic impacts				
Initial investment costs (low costs = positive)	++	-	-	These are costs pertaining to the respective institutions. Furthermore, it could be analyzed in how far burden sharing of investment costs could increase / decrease the likelihood of investment.
Financing assistance in case of emergency (improved options = positive)	n/a	+	+	
Social impacts				
Number of severely burned victims saved (increased number = positive)	-	+	+	
++ = strong positive + = positive o = neutral - = negative -- = strong negative				

Overall, implementing one of the two policy variants is likely to have positive outcomes as compared to the ‘no action’ scenario. However, further detailed research would have to be carried out to determine whether it is more effective and efficient to evacuate the burnt victims and fly them to specialised hospitals around Europe, or whether it would be advantageous to revise the AMP, AMPS or FHOS modules to request these units to include specialised beds and treatment for severe burn victims. First input from previous experience and experts suggests that it is more effective to fly severe burn victims to specialised hospitals rather than sending expert doctors and facilities to the disaster site.

Furthermore, for option vi sufficient MEVAC capacity needs to be ensured in order to fly severe burn victims to the relevant countries with increased national burn treatment capacity; without this MEVAC capacity, option vi cannot work sufficiently.

For option viii, the Mechanism would have to promote the advantages of the revised module among Participating States in order to convince them to update their emergency medical units.

6.3 Analysis of policy options addressing shoreline pollution control in case of oil spill

This assessment analyses the potential costs and benefits of developing a Module for professional shoreline clean up (including equipment and team) – option ix. The alternative to address the identified gap is to improve the current local volunteer system via trainings and the supply of appropriate protective gear and clean up equipment (combination of options x and xi).

Summary of potential impacts	i. No Action	ix. New Module under the Mechanism	x. Improved protective gear and equipment for local volunteers	xi. Specialized trainers during disaster response	Remarks and/or assumptions
Economic impacts					
Initial investment costs (low costs = positive)	++	-	--	o	
Operational costs (reduced costs = positive)	-	+	o	o	Operational costs are assumed to not only include the direct costs of clean up, but also the additional or reduced costs through time saving, etc.
Direct economic impact of spill (reduced costs = positive)	--	++	+	o	Direct economic impact is assumed to not only include the direct costs of clean up response, but also time savings, prevented costs, etc.
Damage to on-shore and harbour infrastructure / assets (reduced damage = positive)	-	+	o	o	This does not only include immediate damage, but also long term damage and required recovery time based on effectiveness of clean up operations.
Number of hotels / beaches affected (reduced number = positive)	-	+	o	o	This does not only include immediate damage, but also long term damage and required recovery time based on effectiveness of clean up operations.

Summary of potential impacts	i. No Action	ix. New Module under the Mechanism	x. Improved protective gear and equipment for local volunteers	xi. Specialized trainers during disaster response	Remarks and/or assumptions
Environmental impacts					
Number of oiled mammals/ birds (reduced number = positive)	-	++	+	o	
Area affected by shoreline oil slick (reduced area = positive)	-	+	+	o	
Area affected by oil residues that cannot be removed (reduced area = positive)	-	+	o	o	
Amount of sand / soil contaminated by oil residues during clean up (reduced amount = positive)	n/a	++	o/-	o/+	
Appropriate waste management (reduced waste = positive) (improved separation and storage capacity = positive)	-	++	+	o/+	
Social impacts					
Lost employment (reduced loss of employment = positive)	-	+/o	+/o	o	
Number of people injured / suffering health effects (reduced number = positive)	--	++	+/o	+/o	
Number of people evacuated (reduced number = positive)	--	+	+	o	
++ = strong positive + = positive o = neutral - = negative -- = strong negative					

The assessment of this option signals a clear niche where improvements on the European level (option ix) would make sense. Careful analysis shows that a centrally coordinated, standardised system of modules for shoreline oil spill response can guarantee the appropriate equipment, sufficient waste disposal / separation containers, trained teams and proper safety measures which significantly reduce overall costs, increase clean-up efficiency and effectiveness and consequently reduce health impacts and negative environmental effects. For this policy option to succeed, in addition to developing the appropriate module characteristics, national governments have to be encouraged to improve their respective capacities and register this new type of module.

Alternatively, a combination of option x and xi can also significantly improve the response capacity as compared to the no action scenario. While the combination of these two policy options would increase the equipment capacity as well as reduce negative health impacts on volunteers, it remains unclear whether this combination could achieve the same cost savings, efficiency gains and reduced environmental impacts as a professional Module under policy option ix could.

7 Conclusions

This chapter reviews the outcomes of the study and whenever possible identifies the areas in which clear added value and reduced cost of shared resources has been determined.

Recalling the purpose of this study, it builds part of the Commission's efforts for launching a series of activities to develop the necessary knowledge base for policy debate and decisions regarding the improvement of the overall European civil protection capacity available for responding to major disasters occurring in the EU or hitting third countries. This study has consequently focused on building scenarios[120] for various types of disasters[121] as a tool to explore potential gaps in current civil response capacities – both quantitative and qualitative gaps. The main conclusions from the scenario building exercise (Chapter 3) were that this approach worked well as a methodology for determining the minimum impacts and needed response capacities for these types of future disasters[122] and that it was a valuable exercise also for the Participating States and experts to be involved in. This was also emphasised during the workshop gathering experts from the Member States held on December 4, 2008, where the scenario approach proved useful not only for analysing the type of response needed for the various scenarios and defining the niche for the Mechanism, but also to identify the potential obstacles to the provision of needed assistance through the Mechanism. The workshop concluded that the scenario approach could be further explored in future exercises, for contingency planning and for operationalising the functioning of the Mechanism in a broader context in order to highlight the added value of the Mechanism.

In order to carry out the next step of determining the potential gap of response capacities versus needed response resources for the various types of disasters an inventory for comparison is determined: the current civil response capacity in Europe (Chapter 4). This inventory was based on the consolidated outcomes of a questionnaire completed by the Participating States combined with latest European Commission information and focussed primarily on Modules. Civil protection response modules are task and needs driven pre-defined arrangements of resources of the Participating States. The modules are being developed since end 2007 to become the major components of the EU's rapid response capacity for natural and man-made disasters. Significant efforts of the

[120] These future disaster scenarios have been constructed based on existing information on past disasters, which provided insight in the likely risk of the various hazards and impacts and civil protection response needs of similar disasters in the past using regional averages for the disaster site.

[121] For each type of disaster one scenario was located within the EU and for some types an additional scenario was located in a third country: EU winter storm scenario and international windstorm scenario; EU and international flood scenarios; EU and international earthquake scenarios; EU and international tsunami scenarios; EU oil spill scenario; EU forest fire scenario; and EU chemical accident scenario.

[122] It should be mentioned here that not all of these scenarios were set up as worst case scenarios and that this type of exercise could be expanded to other types of disasters.

Commission and the Participating States aim at enhancing the capacity of the modules to intervene in an international environment as well as their interoperability. Whilst civil protection modules will increasingly become the basis for significant European civil protection assistance operations launched through the Mechanism, their action will often be complemented by the provision of other in-kind assistance such as for example low capacity equipments (e.g. pumps) and relief items (e.g. tents, blankets).

The findings of the inventory thus show the following reported capacities: In January 2009, the European civil protection rapid response capacity included a total of 86 modules. Modules include high capacity pumping, water purification, various types of urban search and rescue, forest fire fighting planes, mobile medical posts and field hospitals, medical aerial evacuation capacity, and chemical, biological, radiological and nuclear (CBRN) sampling and detection equipment as well as search and rescue specialised for CBRN situations. In addition to these technical modules, the Mechanism's capacity includes 8 technical assistance support teams providing support functions, such as kitchen, shelter, IT, logistics, etc. At this point in time no forest fire fighting module using helicopters (FFFH) has been registered, nor do any emergency temporary shelter (ETS) modules currently exist. In the near future, by the end of 2010, when taking into account planned modules, this capacity will likely increase by about 40 to 44% of its current capacity, and the capacities will likely also be more balanced across all types of modules, including the two modules that are currently not covered yet (FFFH and ETS). In addition, the MIC has trained over 600 experts, some of which can be rapidly deployed to the place of crisis to perform assessment and coordination tasks.

Chapter 5 then identified the potential qualitative and quantitative gaps in the overall EU civil protection response capacity and the findings were synthesised in five categories of potential Mechanism response capacity gaps:

(a) gaps hindering the degree of availability of existing resources;
(b) lack of sufficient quantities of major categories of resources;
(c) lack of sufficient quantities of specific equipment or expertise;
(d) lack of information on specific categories of equipment or expertise;
(e) limited preparedness of major categories of response resources.

Finally, Chapter 6 provided an analysis of the defined policy options in terms of their potential economic, environmental and social impacts. The key message based on the outcome of this chapter is that at the moment the Mechanism facilitates assistance without guaranteeing European assistance; but that several options exist to reform the Mechanism into a tool that guarantees European assistance. As the results of the option analysis show, the main condition of this system to function is the sharing between all Member States of the cost burden of European assistance. Burden sharing implies that all Member States finance and all Member States are able to participate in the system.

Based on this overall conclusion, more detailed findings can be synthesised for the various types of gaps. The following table provides a summary overview of the various gaps identified, their estimated significance, the corresponding potential policy option for addressing the gap, as well as the likely level of cost-effectiveness and the degree of political acceptability of the policy option.

Table 7.1 Summary overview of identified gaps, their relative importance and corresponding policy options

Gap category	Gap number	Relative importance	Potential policy option to address gap	Level of cost-effectiveness	Degree of political feasibility
(**a**) Gaps limiting the availability of existing resources	(**1**) funding to cover transport & deployment of resources (**2**) capacity to transport response resources to site	Major gap	(**ii**) Strengthen co-financing options for covering transport costs for provided assistance	High	Medium
	(**3**) Lack of EU capability to mandate the dispatch of response resources (**4**) Lack of EU capability to mandate dispatching of experts (**6**) Limited availability of aerial fire fighting resources (both fixed and rotary wing aircraft)	Major gap	(**iii**) Empowering Commission to mandate the deployment of registered national resources (Frontex model of mandatory solidarity), provided that resources would be financed by Commission (**iv**) Agreements between Commission and Participating States that guarantee availability of specified resources during specified periods, provided that resources would be financed by Commission	High High	Low High
	(**5**) Still limited MIC capability in the areas of assessment, on-site coordination and support to deployment	Major gap	(**v**) Strengthening current responsibilities of Commission to further improve assessment of needs and provision of deployment support of assistance; additionally role of MIC in on-sire disaster response coordination should be reinforced	High	Medium
(**b**) Lack of major categories of resources	(**7**) Lack of mobile units of medium capacity equipment (**8**) Water purification equipment – especially when large quantities of large scale water purification and/or small-scale more mobile units (**9**) High capacity emergency temporary shelter (**10**) Lack of field hospital modules – this includes need for larger field hospitals (**11**) Emergency evacuation capacity to expatriate EU citizens (**12**) Limited quantities of registered Advanced Medical Posts modules	Major gap	(**vi**) Increase national capacities; in combination with promoting registration of modules/resources under the Mechanism	Medium	High
	(**13**) Limited quantities of aerial fire fighting resources, both fixed and rotary wing aircraft	Major gap	(**vi**) Increase national capacities; in combination with promoting registration of modules under the Mechanism (**vii**) Develop centralised EU level capacities based on contractual agreements incl. both human resources and equipment defining also terms of rapid deployment and transport	Medium High	High Medium / low

(**c**) Lack of specific equipment or expertise	(**14**) Limited existence of equipment suitable for sub-zero operations, such as winterised tents and medical facilities (**16**) Mobile power supply to a number of critical operations	Less extensive gap	(**vi**) Increase national capacities; in combination with promoting registration of modules/resources under the Mechanism	Medium	High
	(**15**) Lack of sufficient capacity in treatment of burnt victims	Less extensive gap	(**vi**) Increase national capacities; in combination with promoting registration of modules/resources under the Mechanism (**viii**) Revised AMP module to include several beds for treatment of burnt victims	Medium Medium	High Medium
	(**17**) Damage assessment / surveillance equipment, incl. planes and satellites for deployment by MIC	Less extensive gap	(**vii**) Develop centralised EU level capacities based on contractual agreements incl. both human resources and equipment defining also terms of rapid deployment and transport	High	Medium
	(**18**) Limited existence of temporary waste discharge and storage facilities for oil spill response	Less extensive gap	(**ix**) New module under the Mechanism	Medium	Medium
(**d**) Lack of information on specific categories of equipment or expertise	(**19**) Stock piling of medicine, antidotes and antibiotics (**20**) Portable dryers, floating pumps, electric submersible pumps and water filters (**21**) Purification tables / their degree of availability (**22**) Availability of specialist companies to repair underwater cables (**23**) Body bags and cooling equipment to collect bodies quickly to limit spread of diseases and centralise body ID process (**24**) Portable communication equipment	Need for further research	n/a	n/a	n/a
(**e**) Limited preparedness of major categories of response resources	(**25**) Terrestrial fire fighting resources (**26**) SAR in flooding conditions and in mountainous areas (**27**) Scientific back office for ensuring adequate support of CBRN teams and modules on site (**29**) Post-disaster psychological support with appropriate language skills and cultural awareness for external assistance deployment	Need for strengthened preparedness activities	n/a	High	High
	(**28**) Shoreline clean-up, including availability of equipment, protective gear for volunteers	Potential new niche for Mechanism	(**ix**) New module under the Mechanism (**x**) Improved protective gear and equipment for local volunteers (**xi**) Specialised trainers during disaster response	Medium Medium Medium	High High High

Addressing major gaps

The detailed major gaps listed in the table above essentially boil down to the following issues:

1. Limited availability of resources (gaps 1 to 6), i.e. the lack of capacity to guarantee deployment because of soft factors and access to transport solutions is a major obstacle to deployment. Currently the Mechanism cannot guarantee European solidarity for these resources.
2. Some major categories of resources are limited in their existence: (resources listed as gaps 7 to 13). This insufficient quantity of existing amounts of the respective resources limits the capacity of European solidarity to address the potential needs in these fields.

These major gaps require an in depth reform of the Mechanism to move to a situation where European solidarity is guaranteed. Some of the most feasible policy options for inducing such a reform and improving the availability of resources (addressing gaps listed under category (a)) have been assessed in this study:

- (ii) Strengthening co-financing options for covering transportation/deployment costs for provided assistance (the Commission would cover 100% of the cost of transportation/deploying the assistance provided by Participating States);
- (iii) Empowering the Commission to mandate the deployment of registered national resources (Frontex model of mandatory solidarity), provided that resources would be financed by the Commission; and
- (iv) Agreements between the Commission and the Participating States that guarantee the availability of specified resources during specified periods, provided resources would then be financed by the Commission.

All options would significantly improve the level of burden sharing and thus offer improved means of deploying nationally available resources for external assistance. While option (ii) is complementary, options (iii) and (iv) present possible alternatives for the reform path: the main differences between them are (1) the centre of gravity of decision-making would reside more with the Community under option (iii) and more with the Member States under option (iv), and (2) the extent of sharing of cost-burden of solidarity between all Participating States.

Similarly, to reform the Mechanism towards improved quantities of currently limited or missing resources (addressing gaps listed under category (b)) two policy options have been assessed during this study:

- (vi) Increase national capacities; in combination with promoting registration of modules/resources under the Mechanism; and
- (vii) Develop centralised EU level capacities based on contractual agreements incl. human resources and equipment, defining also terms of rapid deployment / transport.

For most of the gaps in this category, the easiest option is (vi) increasing national capacities in combination with promoting registration of modules/resources under the Mechanism. However, for some of the specific gaps, such as gap 13 'limited quantities of aerial fire fighting resources, both fixed and rotary wing aircraft' option (vii) may be a more cost-effective solution than building up parallel national capacities. Again, the major difference between options lies in the centre of gravity of the decision-making power and degree of sharing of the cost burden of solidarity.

Policy option (v) ‘strengthening the current responsibilities of the Commission to further improve the assessment of needs and the coordination of assistance’ represents a potential additional Mechanism capability development in order to better address civil protection response needs in the future. By expanding the support role and activities the Mechanism can play during the deployment phase and strengthening the MIC’s capacity to rapidly and more accurately assess the real response needs, European assistance should become more relevant in terms of the type of response resource and the quantities provided, etc. Combined with a reinforced role of the MIC in on-site disaster response coordination, these niches for policy improvements have the potential to lead to significant increases in Mechanism capacity and cost-effectiveness.

Other (less extensive) gaps
The slightly less extensive gaps listed under gap category (c) ‘lack of specific equipment and expertise’ can be addressed via similar policy options and require the same type of Mechanism reform and movement towards greater solidarity and burden sharing.

Need for further research and analysis
All gaps identified under category (d) ‘lack of information on specific categories of equipment or expertise’ require further in-depth analysis, including inventories, before being able to develop meaningful policy options. Such exercise of further information gathering and analysis will likely improve preparedness and may reveal further gaps.

Need for strengthened preparedness activities
All gaps falling under category (e) ‘limited preparedness of major categories of response resources’, could likely be significantly reduced or eliminated via new and strengthened preparedness activities offered by the Mechanism to address the identified gaps. This may take the form of creating new categories of civil protection modules, specific courses, etc.

Coastal oil spill clean-up is a potential new response capacity niche for the Mechanism
The assessment of options for addressing current insufficiencies in coastal oil spill clean up resources has signalled a clear niche where improvements on the European level (option ix) would make sense. Careful analysis shows that a centrally coordinated, standardised system of modules for shoreline oil spill response can guarantee the appropriate equipment, sufficient waste disposal / separation containers, trained teams and proper safety measures which significantly reduce overall costs, increase clean-up efficiency and effectiveness and consequently reduce health impacts and negative environmental effects. For this policy option to succeed, in addition to developing the appropriate module characteristics, national governments have to be encouraged to improve their respective capacities and register this new type of module.

Closing remark
When looking at the larger picture without analysing the individual gaps identified, the major conclusion of this study is that the Mechanism currently facilitates assistance without guaranteeing European assistance; but that several options exist that have the potential to reform the Mechanism into a tool that guarantees European assistance across

a wide variety of disaster response resources. As this conclusions chapter has highlighted, the main condition of this system to function is the sharing between all Member States of the cost burden of European assistance, as well as various policies to improve the availability of equipment and expertise for rapid deployment.

Annex A: Template of Questionnaire

Questionnaire addressed to the Civil Protection Committee representatives of the Countries participating in the Community Civil Protection Mechanism on the availability of national civil protection resources for participation in interventions launched under the Community Civil Protection Mechanism

In its Communication on reinforcing the Union's disaster response capacity[123], the Commission committed to launching a series of activities to develop the necessary knowledge base for policy debate and decisions regarding the improvement of the overall European civil protection capacity available for responding to major disasters occurring in the EU or hitting third countries.

On June 16, 2008 the Council of the European Union welcomed these activities and invited the Commission to fully involve the Member States in this process.[124]

[123] COM (2008) 130 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0130:FIN:EN:PDF

[124] Council Conclusions on Reinforcing the Union's Disaster Response Capacity – towards an integrated approach to managing disasters, paragraph 11: "WELCOMES the Commission's intention to develop a knowledge base comprising an overview of the competent structures, major disasters scenario staking into account prevention and preparedness measures, the resulting implications for resources, their availability, potential gaps in disaster response resources in the area of European civil protection taking into account lessons learnt, the links with the planned mapping of logistical capacity in the area of international humanitarian aid, and the impacts of options for filling any identified potential gaps, and INVITES the Commission fully to involve the Member States in this process.

In this context, the Directorate General for Environment of the European Commission has contracted out a study that will:

1. Define a set of reference scenarios of potential disasters taking place in the EU or in third countries that would require the activation of the Community Civil Protection Mechanism;
2. Assess civil protection resources needed for a European response to the reference disasters;
3. Make an inventory of available civil protection resources using existing information, interviews and questionnaires;
4. Identify potential quantitative or qualitative gaps in the resources available versus the resources needed in the future.

This questionnaire forms part of the overall study. It focuses on gathering the necessary information regarding:

- The quantitative inventory of national response capacities of the Participating Countries that may be made available for civil protection interventions launched under the Community Civil Protection Mechanism;
- The conditions that may influence the availability of those national response capacities for deployment in such interventions.

Your input will be essential for this project and we would like to thank you in advance for taking the time to answer this questionnaire. Once you completed the questionnaire, we may contact you by telephone or email to clarify any questions and to gain more in-depth information during a telephone interview.

Furthermore, a workshop will be organised that will gather the experts of the Participating Countries and discuss the interim report of the study, i.e. the reference scenarios including the assessment of civil protection assistance needs and the results of the inventory of available availability of national civil protection resources for participation in interventions launched under the Community Civil Protection Mechanism.

Please return your questionnaire by 19 September, 2008.

Return address:

- By e-mail (lisa.eichler@ecorys.com)
- By fax to +31 10 452 3660 for the attention of Lisa Eichler
- By mail: ECORYS, attn. Lisa Eichler, P.O. Box 4175, 3006 AD Rotterdam, The Netherlands

Questions?
In case of questions, please contact Lisa Eichler (T: +31 10 453 85 84, E: lisa.eichler@ecorys.com).

Statement on the use of Information

(1) The Commission does not intend to publish information specifying the resources made available by individual Member States. The reports made available by the Commission will only give aggregated information on the resources available for European interventions.

(2) The Commission will refuse public access to information disclosed by the Member States / Participating States to the Commission where this would undermine public interests as regards public security or defence and military matters, in accordance with Article 4(1)(a) of Regulation EC No. 1049/2001.

(3) In accordance with Article 4(5) the Member States / Participating States may request that the Commission does not disclose the filled questionnaire received from the Member States / Participating States. Please specify below if you want this provision to apply.

*** Please tick the appropriate box if your Participating Country requests that provisions in Article 4(5) are applied in order for the Commission to not disclose part of or the entire filled questionnaire:

☐ It is requested that the Commission does not disclose the following parts of this filled questionnaire:
Please specify the relevant parts: ……………………………………………………………………………………………………
……………………………………………………………………………………………………

☐ It is requested that the Commission does not disclose this entire filled questionnaire***

For easy reference Regulation EC No. 1049/2001 is available on http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:145:0043:0048:EN:PDF

Definitions

Please take the following definitions into account when responding to this questionnaire:
'Disaster response' for the purpose of this study is defined in a narrow civil protection response sense: it concerns only the immediate response after a disaster has struck. Immediate response typically includes equipment and teams. It does not focus on relief items such as food, covers, etc. In terms of disaster type, disaster response does not include response to slow-onset disasters, such as droughts or heat waves.

'Response capacity' and 'preparedness' means a state of readiness and capability of human and material means enabling them to ensure an effective rapid response to an emergency, obtained as a result of action taken in advance. It is not only a function of a national resource inventory, but also about the ability to deploy these resources to a disaster site outside the country that is providing its immediate response - modules to a disaster that overwhelms national capacities elsewhere in the EU or worldwide.

'Response resources' cover civil protection response capacities such as civil protection modules or other relevant CP equipment and tools that either do not comply with or are not covered by the existing technical framework of civil protection modules. Examples include inflatable dykes, ground fire fighting teams and equipment, water pumping and purification material, IDP logistics team, mobile water storage tanks, helicopter for aerial surveillance, maritime pollution cleansing equipment and team, etc.

The implementing measures of the Community's Civil Protection Mechanism specify thirteen types of civil protection response modules and one type of Technical Assistance Support Team (TAST). This technical framework specifies the capacity and main components of the relevant capacities. For easy reference you can access this document in all Community languages at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008D0073:EN:NOT .

Overview of European Civil Protection Modules and TAST		
1. High capacity pumping	6. Aerial forest fire fighting module using airplanes	11. Emergency temporary shelters
2. Water purification	7. Advanced medical post	12. Chemical, biological, radiological and nuclear detection and sampling (CBRN)
3. Medium urban search and rescue	8. Advanced medical post with surgery	13. Search and rescue in CBRN conditions
4. Heavy urban search and rescue	9. Field hospital	14. Technical Assistance Support Team (TAST)
5. Aerial forest fire fighting module using helicopters	10. Medical aerial evacuation of disaster victims	

'Types of Disasters considered during this Study' include only those requiring immediate response due to their sudden on-set characteristic or rapid build-up and their intensity scale. For guidance purposes, the following table provides an overview of the types of disasters that will be considered during this study.

Disaster Scenario (EU)	Disaster Scenario (International)
Major Floods (including landslides)	Major Floods (including landslides)
Forest and wildfires	Wind Storms
Earthquake (seismic activity)	Earthquake (seismic activity)
Tsunami[125]	Tsunami
Industrial accident / terrorist attack[126]	
Ice storm	
Oil spill / marine pollution	

[125] The scenario will be built as a tsunami striking the Mediterranean coast on a nice summer afternoon.
[126] This scenario involves a high degree of airborne contamination that could either be triggered via a terrorist attack or an industrial accident.

The Questionnaire

Basic Information

Please provide us with your personal details:

Organisation:	
Country:	
Name contact person:	
Function/Position:	
Telephone number:	
E-mail address:	

National civil protection response resources available for interventions launched under the Community Civil Protection Mechanism

Please provide as much information as possible on the resources that can be made available for European interventions versus interventions in third countries at the moment. Please quantify whenever possible. **Note: please only list modules if all the technical requirements set by the technical framework are met. Otherwise please list them as other resources. If needed, please expand this table or add details on a separate page.**

National Response Resource	**Quantity available for deploymen t**	**Relevant qualitative characteristics of resource** (for modules: please specify if it has a capacity higher than the capacity fixed in the technical framework)	**Situation / type of disaster the resource is likely to be made available for**	**Situation / type of disaster the resource is likely NOT to be made available for**	**Any obstacles that hinder making the resources available / deployable within the EU** (e.g. transport costs, political situation in country, etc.)	**Any obstacles that hinder making the resources available / deployable INTERNATIONALLY** (here it is particularly interesting to point out any differences between deployability within the EU versus to third countries)
High capacity pumping module						
Water purification module						
Medium urban search and rescue module						
Heavy urban search and rescue module						
Aerial forest fire fighting module using helicopters						

module						
Aerial forest fire fighting module using airplanes module						
Advanced medical post module						
Advanced medical post with surgery module						
Field hospital module						
Medical aerial evacuation of disaster victims module						
Emergenc y temporary shelters module						

Chemical, biological, radiological and nuclear detection and sampling (CBRN) module						
Search and rescue in CBRN conditions module						
Technical assistance support team (TAST)						
Other resources (please specify)						

Additional national civil protection response resources planned to be made available in the near future

Please provide as much information as possible on the resources that are planned to be made available for European interventions versus interventions in third countries in the near future. Please quantify whenever possible. **If needed, please expand this table or add details on a separate page.**

National Response Resource	When will this new resource be available	Quantity likely to be available for future deployment	Relevant qualitative characteristics of resource (for modules: please specify if it has a capacity higher than the capacity fixed in the technical framework)	Situation / type of disaster the resource is likely to be made available for	Situation / type of disaster the resource is likely NOT to be made available for	Any obstacles that hinder making the resources available / deployable within the EU (e.g. transport costs, political situation in country, etc.)	Any obstacles that hinder making the resources available / deployable INTERNATIONALLY (here it is particularly interesting to point out any differences between deployability within the EU versus to third countries)
High capacity pumping module							
Water purification module							
Medium urban search and rescue module							
Heavy urban search and rescue module							
Aerial forest fire fighting module using							

helicopters module							
Aerial forest fire fighting module using airplanes module							
Advanced medical post module							
Advanced medical post with surgery module							
Field hospital module							
Medical aerial evacuation of disaster victims module							
Emergency temporary shelters module							

Chemical, biological, radiological and nuclear detection and sampling (CBRN) module							
Search and rescue in CBRN conditions module							
Technical assistance support team (TAST)							
Other resources (please specify)							

National response capacity versus actual deployment

In order to provide the Commission with a good understanding of the issues your Participating Country faces in deciding to deploy national civil protection capacities in the context of interventions launched under the Community Civil Protection Mechanism, please respond to the following questions with as much detail as possible. If needed please expand the table or continue on separate pages.

a. What are the conditions that may restrict the actual deployment of resources?

☐	Transport	(please explain)
☐	Funding issues	(please explain)
☐	Operational issues	(please explain)
☐	Political reasons	(please explain)
☐	Other conditions	(please explain)

If as a matter of principle your country would not deploy at a given time all the available capacities of a specific type reported in the tables under sections 1 and 2, please reply to the following questions i and ii:

i. What would be the maximum fraction of the individual types of resources reported in tables 1 and 2 that your country would deploy at a given time in interventions launched under the Mechanism? Please specify to which type of resources this applies.

ii. Does this differ for disasters in the EU versus worldwide disasters?

THANK YOU FOR YOUR PARTICIPATION !

Annex B: Experts' Workshop Documents

Experts Workshop

"Future Disaster Scenarios and the Need for Civil Protection Response Resources"

4 December 2008

European Commission, DG Environment
Avenue de Beaulieu, Room C
Brussels, Belgium

Revised Workshop Programme – 25 November 2008

1. Agenda Overview

Time	Session Type	Content
9:00 – 10:30	Opening Plenary	Welcome & overview of workshop (European Commission) Keynote speech (European Commission) Presentation of the current study (COWI/ECORYS) Brief discussion on remaining issues regarding scenarios (Chair & Floor)
10:30 – 11:00	*Break*	*Coffee break / brief individual interviews with Experts*
11:00 – 12:30	Break-out Session I	Discussions on first set of scenarios: ▪ Work Group 1: Major Floods (Scenarios 1 and 8) ▪ Work Group 2: Forest Fires (Scenario 2) ▪ Work Group 3: Tsunamis (Scenarios 4 and 11)
12:30 – 13:30	*Break*	*Lunch / / brief individual interviews with Experts*
13:30 – 15:00	Break-out Session II	Discussions on second set of scenarios: ▪ Work Group 4: Wind storms (Scenarios 6 and 9) ▪ Work Group 5: Earthquakes (Scenarios 3 and 10) ▪ Work Group 6: Industrial accident and oil spill (Scenarios 5 and 7)
15:00 – 15:30	*Break*	*Coffee break / brief individual interviews with Experts*
15:30 – 17:00	Closing Plenary	Presentation of findings from working groups (COWI/ECORYS) Discussion of common issues (Chair & Floor) Closing remarks (Chair)

2. Introduction

In its Communication on reinforcing the Union's disaster response capacity[127], the Commission committed to launching a series of activities to develop the necessary knowledge base for policy debate and decisions regarding the improvement of the overall European civil protection capacity available for responding to major disasters occurring in the EU or hitting third countries.

On June 16, 2008 the Council of the European Union welcomed these activities and invited the Commission to fully involve the Member States in this process.[128]

In this context, the Directorate General for Environment of the European Commission has contracted out a study that will:

5. Define a set of reference scenarios of potential disasters taking place in the EU or in third countries that would require the activation of the Community Civil Protection Mechanism;

[127] COM (2008) 130 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0130:FIN:EN:PDF

[128] Council Conclusions on Reinforcing the Union's Disaster Response Capacity – towards an integrated approach to managing disasters, paragraph 11: "WELCOMES the Commission's intention to develop a knowledge base comprising an overview of the competent structures, major disasters scenario staking into account prevention and preparedness measures, the resulting implications for resources, their availability, potential gaps in disaster response resources in the area of European civil protection taking into account lessons learnt, the links with the planned mapping of logistical capacity in the area of international humanitarian aid, and the impacts of options for filling any identified potential gaps, and INVITES the Commission fully to involve the Member States in this process.

6. Assess civil protection resources needed for a European response to the reference disasters;
7. Make an inventory of available civil protection resources using existing information, interviews and questionnaires;
8. Identify potential quantitative or qualitative gaps in the resources available versus the resources needed in the future.

Most Participating States have already filled out the questionnaire on current national civil response resources that was sent to all Participating States in the context of this study during August / September 2008.

This workshop now aims to validate the disaster scenarios and provide a forum for discussing – in more detail – the level of needs and capacities as well as critical bottlenecks in the current system.

3. Background

Work carried out to date on this project has focused on developing realistic potential future disaster scenarios for various types of disasters and sites. The following disaster scenarios have been developed and are distributed together with this agenda for comment prior to the workshop:

#	Disaster Scenario	#	Disaster Scenario
1	EU - Major Floods (including landslides)	7	EU - Oil spill / marine pollution
2	EU - Forest and wildfires	8	INTL - Major Floods (including landslides)
3	EU - Earthquake (seismic activity)	9	INTL - Wind Storms
4	EU - Tsunami	10	INTL - Earthquake (seismic activity)
5	EU - Industrial accident / terrorist attack	11	INTL - Tsunami
6	EU – Northern winter storm		

These future disaster scenarios have been constructed based on existing information on the risk of the various hazards and impacts and civil response needs of similar disasters in the past using regional averages for the disaster site.

For each scenario an outline has been developed including the following contents:

- Characterisation of the hypothetical scenario
  - Description of the initial event (place, time, intensity / size)
  - Disaster site (key geographic areas affected)
  - What are the direct and indirect impacts? (human toll, damage to infrastructure, ecological effects, immediate secondary impacts, overall economic impacts)

- Prevention dimension
  - To what degree could preventive measures have an impact on the intensity level of disasters and the required response resources?

- Expected / required response resources
  - How much of the impact can be absorbed / addressed by the national response capacity?
  - What extent of the impacts cannot be addressed by national response resources and therefore requires external assistance and what type of external assistance is needed?

4. Participants

Up to 60 experts from the Participating States are expected to participate in the workshop, i.e. maximum two per State.

The workshop will be chaired by the European Commission and facilitated by ECORYS/COWI consultants responsible for this project.

5. Process

The workshop will be a tool to use the specific future disaster scenarios as concrete example for Member States to discuss – in more detail – the potential future level of needs and capacities as well as critical bottlenecks in the current system.

Workshop Goals:

a) Refine and validate the scenarios (prior to workshop day)

b) Gain more in-depth information on available response capacity resources, as well as expected needs for external assistance, with a particular focus also on qualitative bottlenecks.

Pre-workshop preparation:
Prior to the actual workshop, each participant is asked to provide written feedback on draft disaster scenarios in order to refine and validate the scenarios and identify the key remaining questions before the workshop. This will allow us to have more fruitful discussions during the workshop with a predetermined starting point of accepted scenarios.

Once the experts from the Participating States have provided their feedback on the scenarios, the consultants will incorporate these and circulate the revised final versions of the scenarios, together with a final workshop programme and key discussion questions.

The timeline of events is shown below:

Output	Deadline
Deadline for returning comments on scenarios	November 26
Workshop participants receive revised scenarios, final workshop programme and discussion questions	November 28
Workshop	December 4

Workshop sessions:
The workshop itself will be a one-day event held in Brussels on December 4, 2008.
The opening plenary serves as a platform to introduce the purpose of the workshop, its content and procedure. The two break-out sessions are designed to engage operational experts from Member States in an active discussion on specific scenarios in order to gain more in-depth conclusions on:

- future needs
- existing civil response capacity
- potential gaps and quantitative or qualitative bottlenecks.

Finally, the closing plenary will wrap up the lessons learned during the workshop and explore how to integrate the workshop outcomes into the ongoing study commissioned by DG Environment.

6. Annotated Agenda for the Workshop

Session 1: Opening Plenary
Following the welcoming of the participants, the opening plenary session will be used to reiterate the objectives of the workshop and introduce the proposed methodology and organisation of the working groups.

A keynote speaker will be asked to set the stage for the discussions by placing the challenge before the participants in its broad context, presenting questions for discussion and inviting everyone to consider what might be the key bottlenecks in the current system of European civil response.

Furthermore, a brief presentation of survey results will serve as the baseline for national response capacity and needs for assistance. This baseline is then to be further elaborated during the remainder of the workshop.

Finally, a brief discussion on any remaining issues regarding the scenarios (based on prior pre-workshop written input) will allow everyone to validate the credibility of the scenarios and to comment further on whether or not the needs described are the right ones. This discussion will establish a common ground for the following more detailed discussion in the working groups on how to best address these needs.

Break: Coffee break / brief individual interviews with Member States
On the basis of the preferences expressed by the experts when registering to the workshop and taking into account the need to have balanced groups,, the organisation team will provide lists with the various group members for the break-out groups.

Additionally, during the two coffee breaks as well as during the lunch break, the organisation team will schedule brief individual interviews between the experts and the consultants. These interviews serve the purpose of further clarifying some of the questionnaire responses and / or to discuss other remaining questions.

Session 2: Break-out Session I

This session will be divided into three working groups discussing the first set of scenarios.

The following scenarios will be discussed during this first break-out session:

Work Group	Type of Disaster	Scenarios to be discussed
1	Major Floods	Scenarios 1 and 8
2	Forest Fires	Scenario 2
3	Tsunamis	Scenarios 4 and 11

All work groups should discuss the key questions posed in the plenary. These include, but are not limited to, the following topics:

- How do we address needs presented in scenario? Taking the inventory (survey results) as a basis, what might be mobilised in case of the specific scenario?
- How can we improve European civil response to address gaps?
- Is there a difference in EU external assistance capacity for European versus international disaster occurrence?
- What are quantitative/qualitative bottlenecks that need to be overcome?

Lunch: Lunch buffet / brief individual interviews with Member States

Session 3: Break-out Session II
This session will be divided into three working groups discussing the second set of scenarios. Participants will be divided into these groups by the organisation team (different composition than in morning session).

The following scenarios will be discussed during this first break-out session:

Work Group	Type of Disaster	Scenarios to be discussed
4	Wind Storms	Scenarios 6 and 9
5	Earthquakes	Scenarios 3 and 10
6	Industrial accident and oil spill	Scenarios 5 and 7

All work groups should discuss the key questions posed in the plenary. These include, but are not limited to, the following topics:

- How do we address needs presented in scenario? Taking the inventory (survey results) as a basis, what might be mobilised in case of the specific scenario?
- How can we improve European civil response to address gaps?
- Is there a difference in EU external assistance capacity for European versus international disaster occurrence?
- What are quantitative/qualitative bottlenecks that need to be overcome?

Break: Coffee break / brief individual interviews with Member States
[For more information, see above.]

Session 4: Closing Plenary
During this last session, the rapporteurs of the working groups will present their findings (5 minutes per working group). This will be followed by a discussion of common issues and remaining questions resulting from these brief presentations.

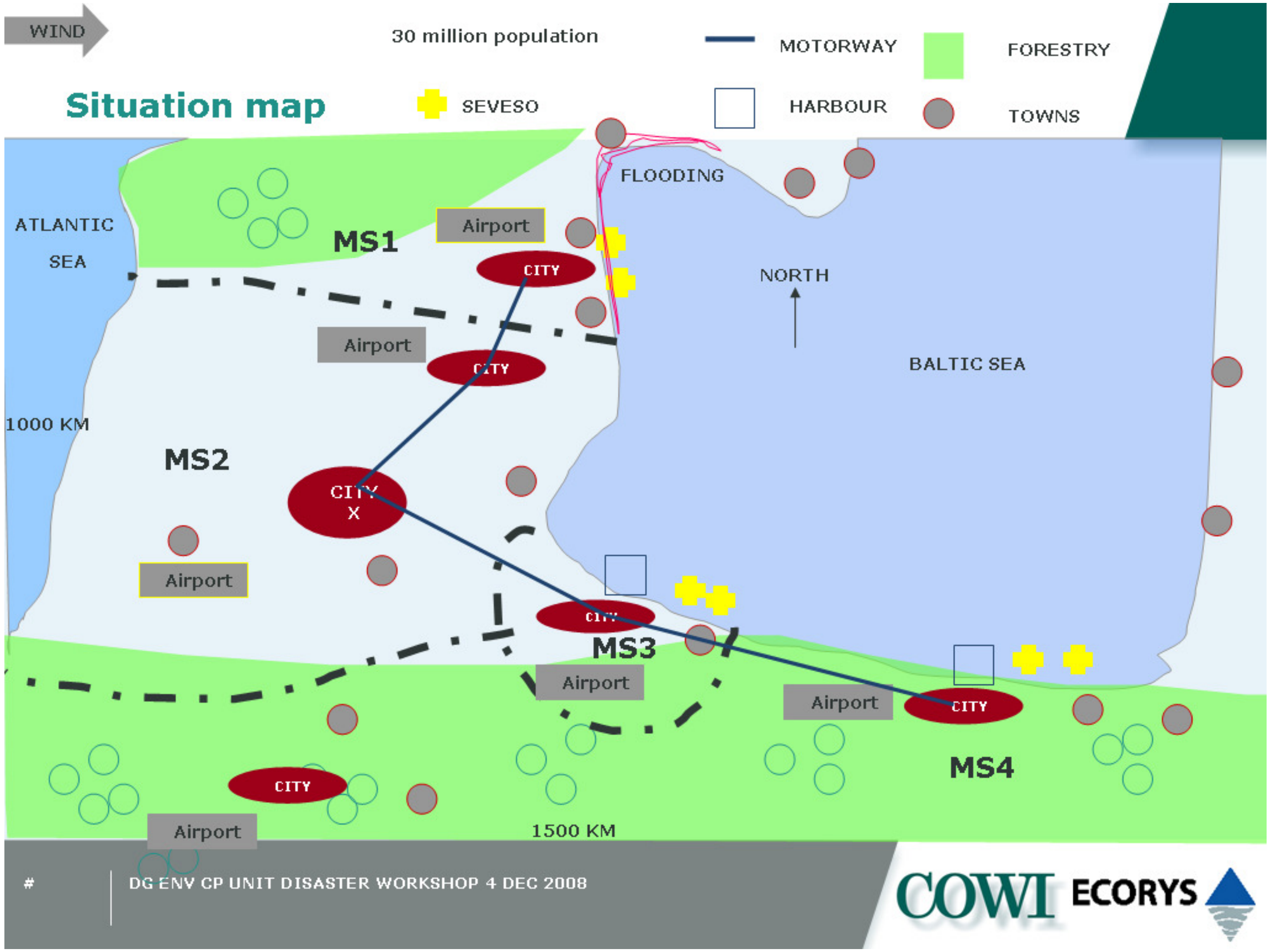
The workshop will conclude with closing remarks from the European Commission, DG Environment.
Conclusions will be drawn and key qualitative and quantitative bottlenecks in current European civil response will be determined.

7. Logistic Information

Venue
Meeting room C
European Commission
DG Environment
5, avenue de Beaulieu
1160 Brussels

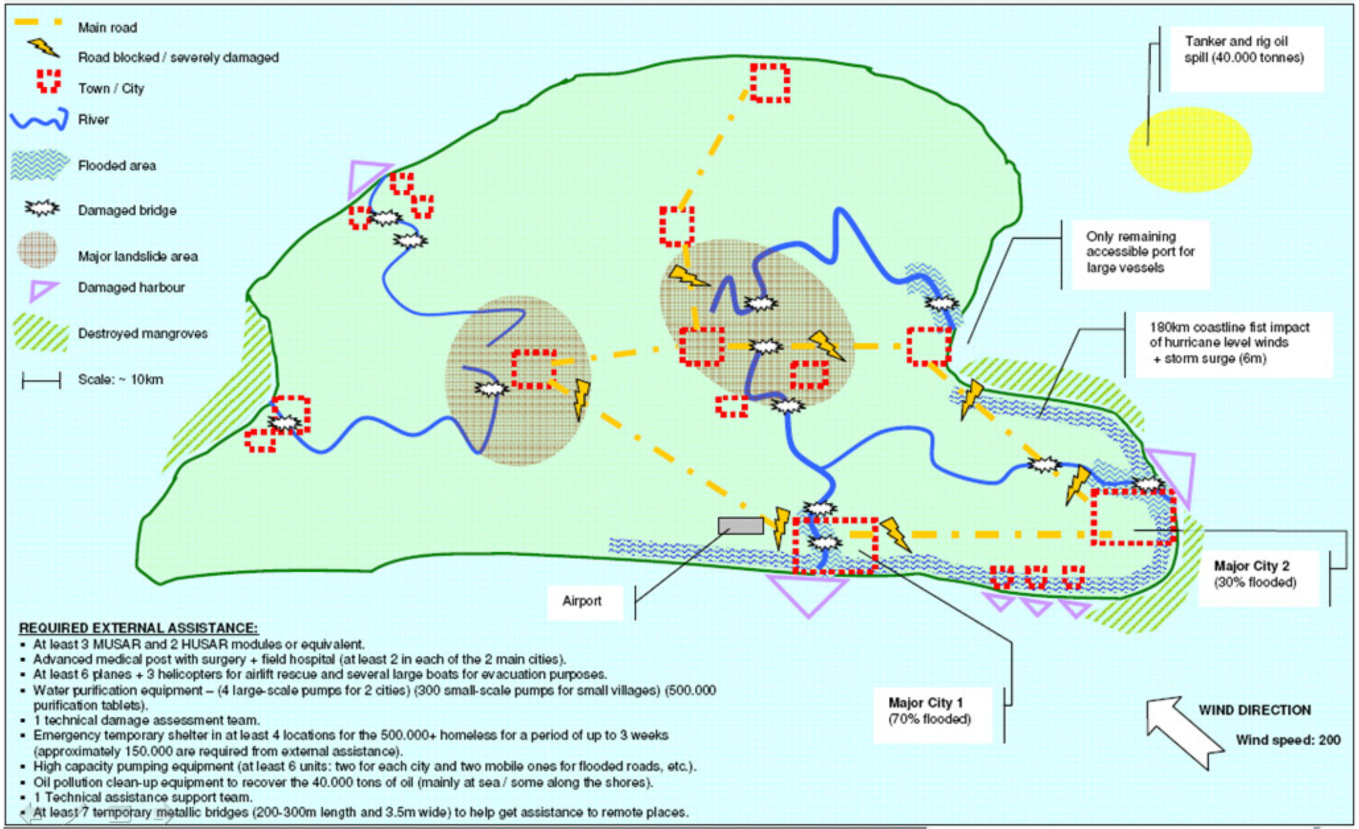
Annex C: Situation Maps

Storms

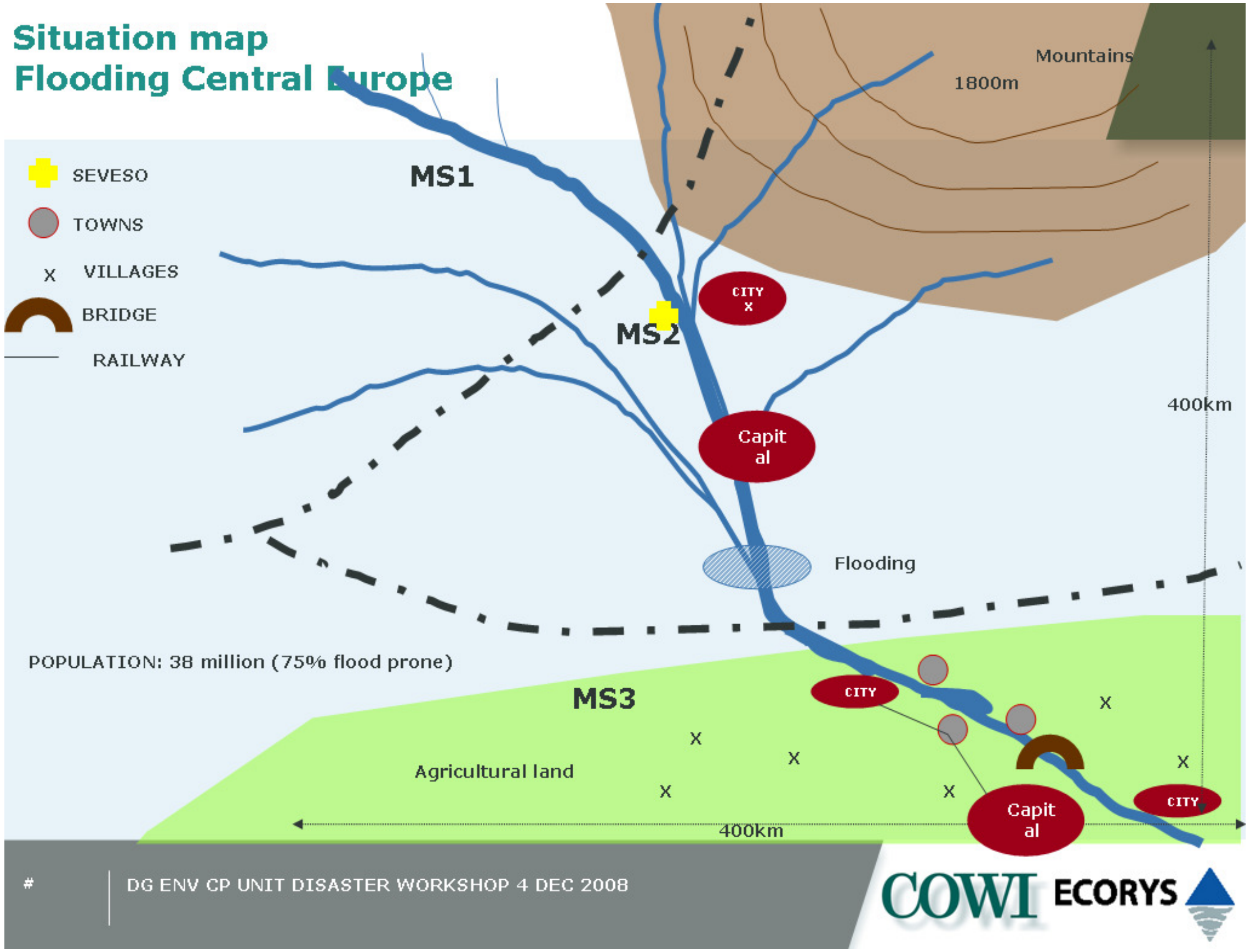


WIND
30 million population
MOTORWAY
FORESTRY
Situation map
SEVESO
HARBOUR
TOWNS
FLOODING
ATLANTIC SEA
MS1
Airport
CITY
NORTH
Airport
CITY
BALTIC SEA
1000 KM
MS2
CITY X
Airport
MS3
Airport
Airport
CITY
MS4
CITY
Airport
1500 KM
#
DG ENV CP UNIT DISASTER WORKSHOP 4 DEC 2008

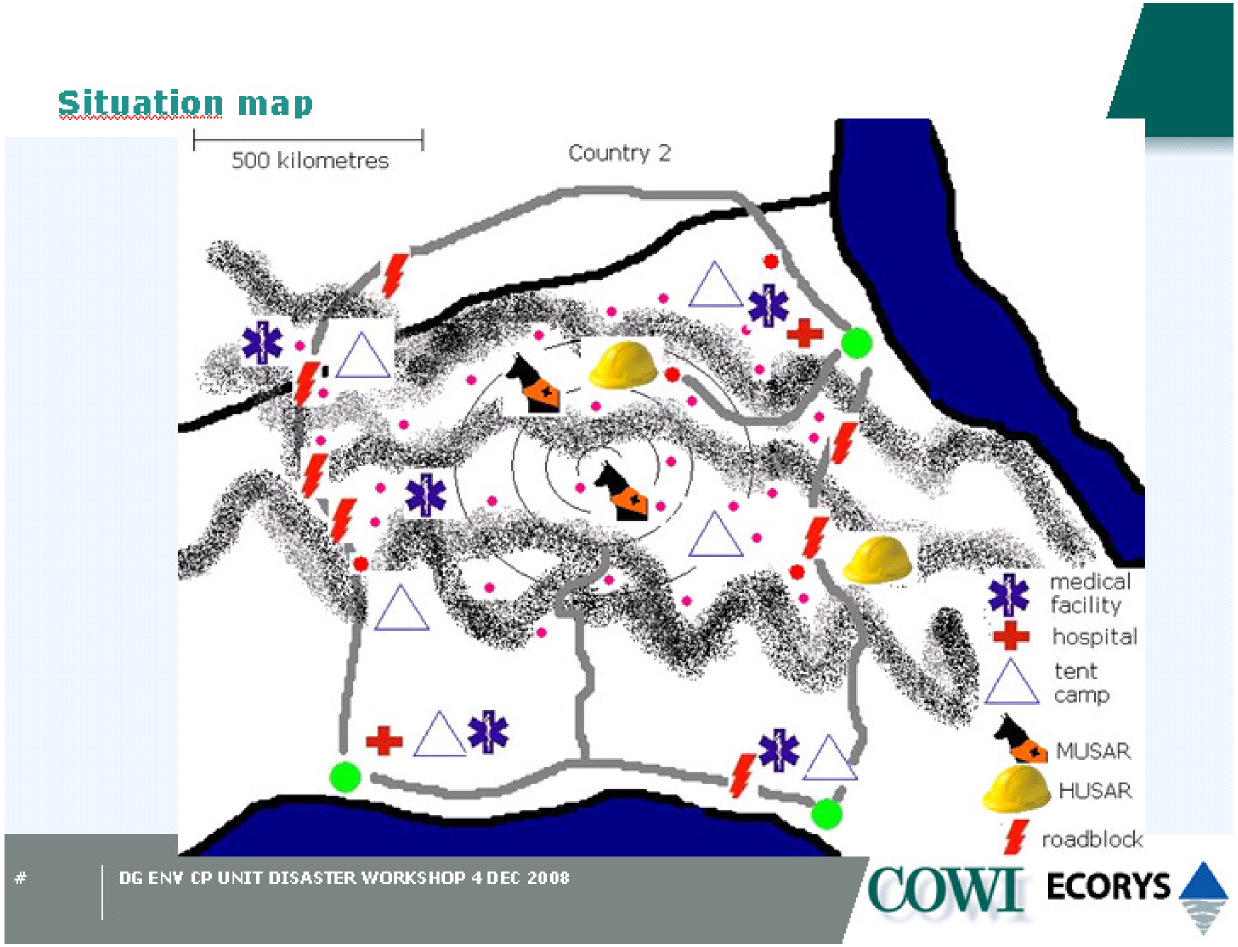
Situation Map



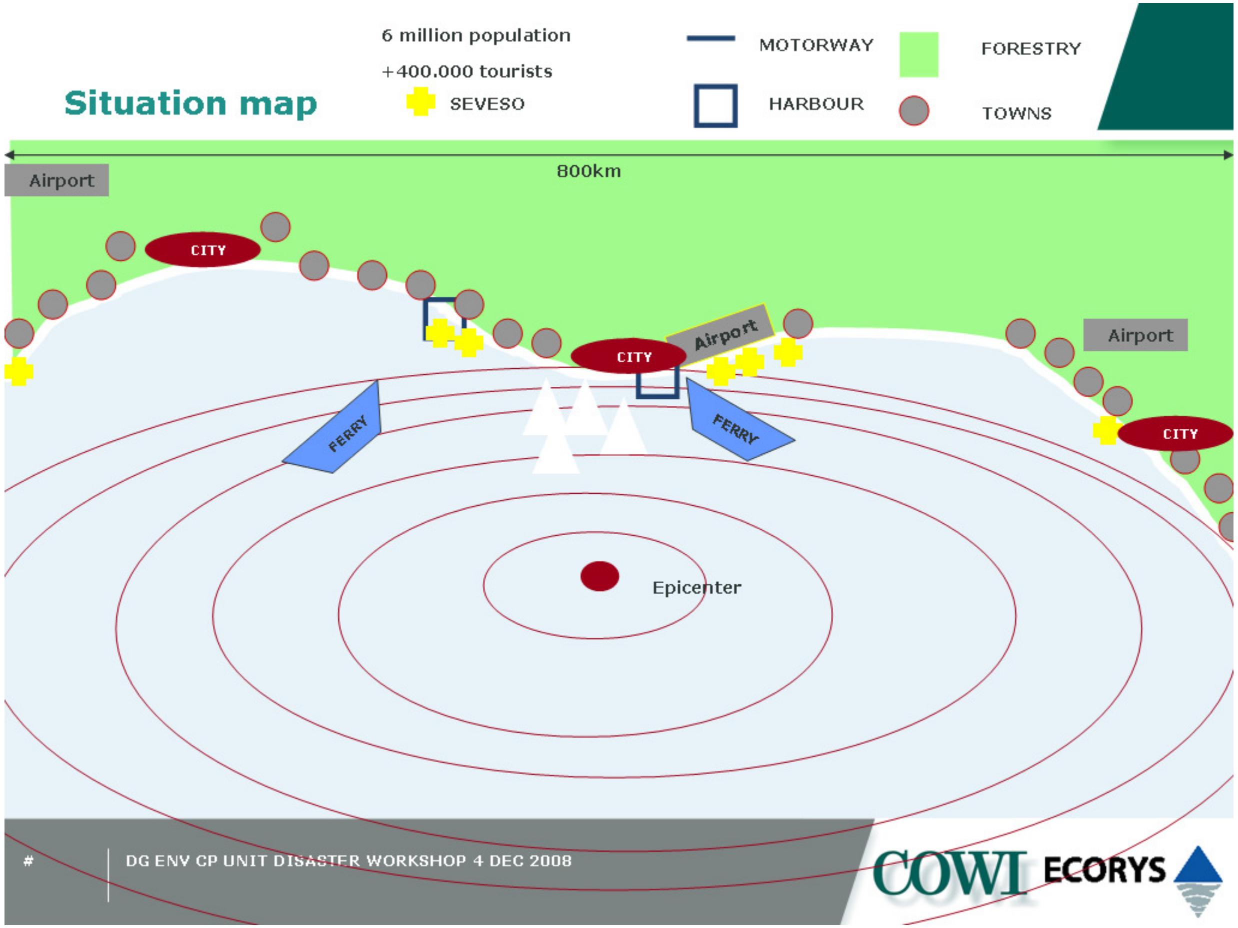
Floods


Situation map
Flooding Central Europe
SEVESO
TOWNS
X VILLAGES
BRIDGE
RAILWAY
MS1
MS2
MS3
Mountains
1800m
CITY X
Capit al
Flooding
400km
POPULATION: 38 million (75% flood prone)
CITY
X
Agricultural land
400km
Capit al
CITY
#
DG ENV CP UNIT DISASTER WORKSHOP 4 DEC 2008
COWI
ECORYS

Earthquake

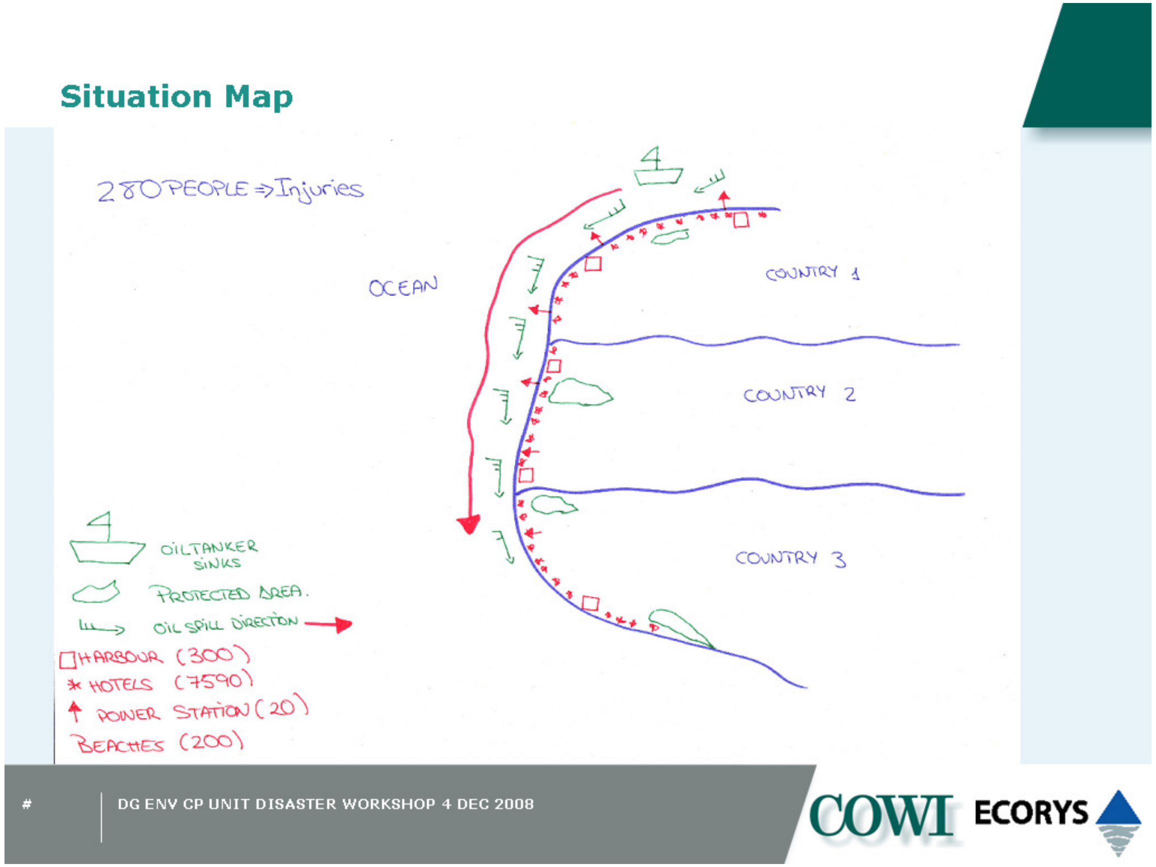

Situation map
500 kilometres
Country 2
medical facility
hospital
tent camp
MUSAR
HUSAR
roadblock
#
DG ENV CP UNIT DISASTER WORKSHOP 4 DEC 2008
COWI
ECORYS

Tsunamis

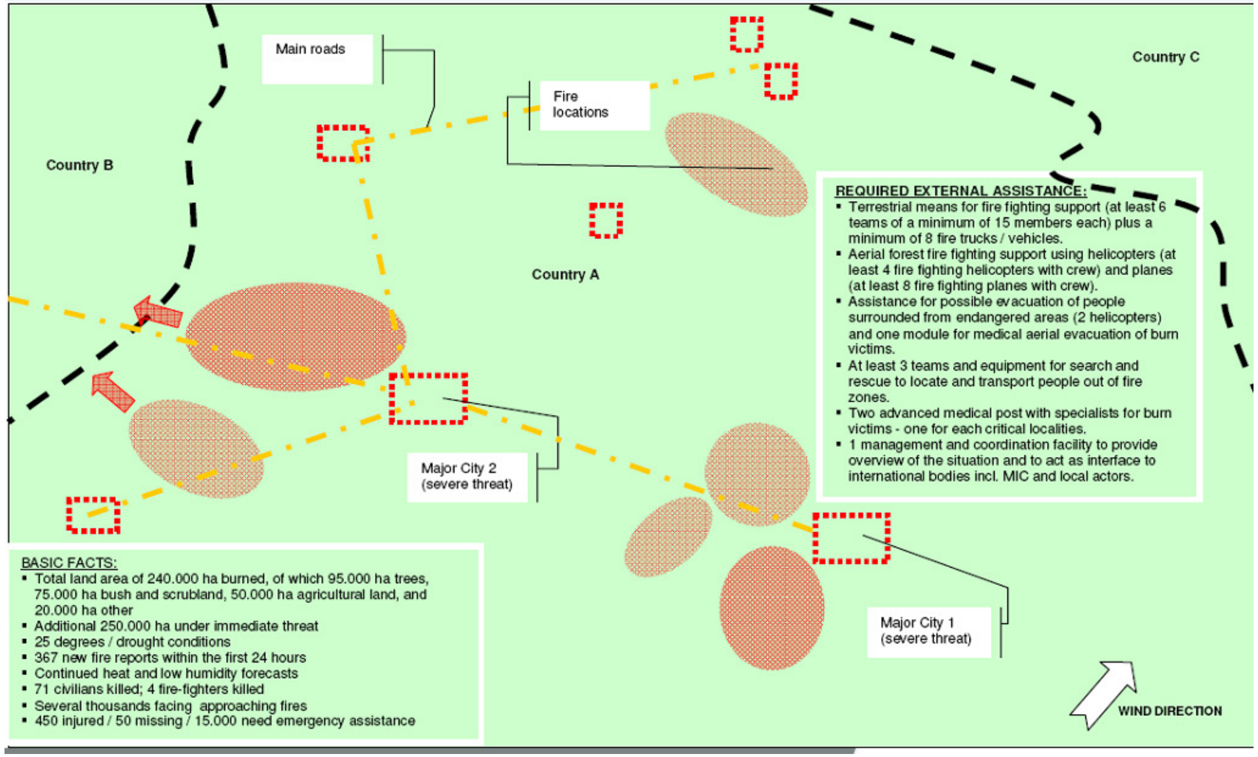


Situation map
6 million population
+400.000 tourists
SEVESO
MOTORWAY
HARBOUR
FORESTRY
TOWNS
800km
Airport
CITY
Airport
CITY
Airport
CITY
FERRY
FERRY
Epicenter
DG ENV CP UNIT DISASTER WORKSHOP 4 DEC 2008
COWI ECORYS

Oil spill


Situation Map
280 PEOPLE ⇒ Injuries
OCEAN
COUNTRY 1
COUNTRY 2
COUNTRY 3
OILTANKER SINKS
PROTECTED AREA.
OIL SPILL DIRECTION
HARBOUR (300)
HOTELS (7590)
POWER STATION (20)
BEACHES (200)
#
DG ENV CP UNIT DISASTER WORKSHOP 4 DEC 2008
COWI
ECORYS

Situation Map



Chemical spill