The economic impact of climate change and adaptation in the Outermost Regions

Supplementary Report:
Outermost Regions summary information for inclusion in CLIMATE-ADAPT

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This report has been prepared by AMEC Environment & Infrastructure UK Limited in partnership with Bio Intelligence Service, Milieu Limited and Cambridge Econometrics.

Purpose of this Report

This report has been produced for the purpose of providing material for the EU's Climate-ADAPT platform, summarising some of the findings of the Study on the Impact of Climate Change and Adaptation Measures in the Outermost Regions (under framework CLIMA.A.4/FRA/2011/0027). This report presents summary information taken from the main project report for each of the Outermost Regions (OR), presented in a format intended to be easily uploaded to the Climate-ADAPT website. This report is supplementary to the main project report and contains no new analysis or results. The information is presented within a structured format following that already in place on CLIMATE-ADAPT (see for example, http://climate-adapt.eea.europa.eu/countries/belgium). The exception to this is the introductory OR section which is intended to be presented on one webpage.

The findings of the study (presented here and in the main project report) are based upon resources available in the public domain supplemented by consultation with representatives of the OR (although no field trips have been undertaken for this study).

Third-Party Disclaimer

Document Revisions

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1	Draft Supplementary report	20 January 2014
2	Draft Supplementary report v2	31 January 2014
3	Draft Final Supplementary report	27 March 2014
4	Final Report 14170i1	May 2014

1 Outermost Regions

1.1 Legal Framework

The Outermost Regions (OR) of the EU are regions characterised by their remoteness, insularity, climate, terrain and richness of biodiversity as well as an economic dependence on a small number of products. They are important to the EU for the development of trade with third countries. Despite their remoteness, the OR are an integral part of the EU and are subject to the same regulations, policies and directives as the rest of the EU and the Member States which they are a part of.

The French Outermost Regions (Guadeloupe, Martinique, St Martin, French Guiana, la Réunion and (from early 2014) Mayotte were consulted during the development of the first French National Plan for Adaptation to Climate Change (2011-2015), in order to ensure that the recommendations developed correctly addressed the challenges faced by the OR (even though it does not address them specifically). The majority have recently adopted Regional Climate, Air and Energy Schemes (SRCAE) (St Martin and Mayotte being the exceptions). These are generally the first steps taken by the French Outermost Regions to assess the impacts of climate change and the potential for adaptation.

The only Spanish Outermost Region is the Canary Islands. Spain adopted its National Climate Change Adaptation Plan (PNACC) in 2006, and work has been ongoing since then. The Climate Change Strategy for the Canary Islands was adopted in 2009 and although this strategy focussed on mitigation measures, it included a mandate to develop an adaptation plan. The Adaptation Plan for the Canary Islands is expected in 2014.

Madeira and the Azores are both Outermost Regions and autonomous regions of Portugal. The National Strategy for Adaptation to Climate Change (ENAAC) was adopted by Portugal in 2010. The Azores approved its Regional Strategy on Climate Change (ERAC) in 2011, which will be implemented through the Regional Plan for Climate Change (PRAC), due in 2014. Madeira does not at present have a regional strategy on climate change, however there are plans to develop one in the near future. The preparation of the strategy will be led by the Regional Government of Madeira and the Department for Spatial Planning and the Environment.

1.2 Assessments

The European Union (EU) Adaptation Strategy[1], adopted in spring 2013, recognises that the Outermost Regions of the EU are particularly vulnerable to the impacts of climate change. Compounding this, there are significant challenges in understanding how climate may change over coming decades as, given their size, all of the Outermost Regions (with the exception of French Guiana) are typically unresolved by current global climate models.

The Intergovernmental Panel on Climate Change (IPCC) assessment reports provide a single source of consistent information, presenting what is known about climate science and uncertainties relevant to all of the Outermost Regions. This provides the best overall assessment of climate change for the Outermost Regions. For example, the she small islands assessment in the IPCC Fourth Assessment Report (2007) considered the Caribbean, Pacific and Indian Ocean islands with data (if not interpretation) provided for the Atlantic region as well.

[1] http://ec.europa.eu/clima/policies/adaptation/what/documentation_en.htm

To complement this there are some climate modelling data for specific OR, such as those developed within the SIAM II project (Santos, Forbes and Moita, 2002) for Madeira and Azores and Project ClimaImpacto for the Canary Islands.

1.3 Priority Sectors

A study commissioned by the European Commission considered the information available on climate impacts and adaptation for all of the Outermost Regions and synthesised this into a high level climate risk assessment based upon environmental, social and economic consequences of anticipated climate change impacts. As a result of the climate risk assessment, the study identified priority sectors for adaptation action in common across the Outermost Regions as being:

- **Tourism**. Tourism is a key contributor to the economy of many of the Outermost Regions, and is highly dependent on the quality of natural resources (e.g. quality of beaches and forests). It will therefore by threatened by potential climate change impacts. Protecting environmental resources and creating new tourist resources where possible will be key;
- **Transport**. There is a significant concentration of transport infrastructures along the coast, which are vulnerable to future climate change impacts such as flooding from sea-level rise;
- **Construction and buildings**. Outermost Regions all exhibit a strong concentration of buildings along the coast, which will be at risk from sea-level rise;
- **Coastal zone management**. Since infrastructure (domestic and commercial buildings, transport, other infrastructure, health and emergency services) is concentrated on the coastline, and at risk from climate change impacts, integrated coastal zone management and relocation of essential infrastructures away from at-risk areas will be key to climate change adaptation;
- **Biodiversity**. All the Outermost Regions exhibit high levels of biodiversity and high numbers of endemic species. Many of these species will be threatened by projected future climate impacts such as drought, and increases in average temperatures; and
- **Health**. Projected increases in temperatures and changes in precipitation will lead to an increase in vector-borne diseases (e.g. malaria), some of which already occur in some Outermost Regions.

1.4 Local Actions

To date the Outermost Regions have not undertaken any significant programme of actions to adapt to climate change. Those Outermost Regions which have developed Regional plans - such as the Regional Plans for Climate, Air and Energy of Guadeloupe, Martinique, French Guiana and Reunion, the Canary Islands Climate Change Strategy and the Azores Regional Strategy on Climate Change - have identified a number of overarching actions which need implementing in order to increase resilience to climate change. These include/focus around:

- Climate proofing key infrastructures (transport, housing, health and other infrastructures) which are located on the coast and at risk of future flooding;
- Protecting biodiversity and habitats from the impacts of climate change (linked in to their value to tourism in the Outermost Regions); and
- Developing knowledge of the impacts of climate change on health, and increasing resilience to these impacts.

Some of the Outermost Regions, for example Madeira, are mainly focussed on improving their knowledge base on impacts of climate change and adaptation.

Where adaptive actions have been taken, such as future-proofing transport infrastructure, they have generally been carried out during the course of infrastructure improvements, rather than formulated specifically as adaptation actions.

2 Guadeloupe

2.1 Legal Framework

Guadeloupe is one of the Caribbean's most popular tourist destinations. It is a diverse territory consisting of two islands separated by a very narrow strip of water. One part of the territory is characterised by a mountainous landscape and tropical forests, the other a flatter landscape with mangrove swamp to the southwest. Much of the coastline of Guadeloupe benefits from the protection of coral reefs. Guadeloupe is densely populated and there are settlements in sensitive areas, resulting in deforestation, pressure on natural resources and pollution. Guadeloupe, although an Outermost Region (OR), is a French overseas department (and has been since 1946) and is an integral part of the EU. Guadeloupe is therefore covered by all French and EU rights, regulations and obligations.

At the national level, in 2001 the French National Observatory for the Effects of Global Warming (ONERC) was set up, tasked specifically with adaptation to climate change. This was followed by the adoption of the French National Adaptation Strategy in 2006. These both marked the beginning of French government activity in the area of climate change adaptation.

Since then, the first French National Plan for adaptation to climate change (2011-2015) has been put in place. During the development of the Plan, the French Outermost Regions, including Guadeloupe, were consulted in order to ensure that the recommendations developed correctly addressed the challenges faced by the OR. As a result, the Plan responds to the needs of the French Outermost Regions even though it does not address them specifically.

Regional adaptation guidelines are defined in Regional Climate, Air and Energy Schemes (SRCAE) under the provisions of Law 2010-788 of 12 July 2010. The SRCAE Guadeloupe, published in December 2012, analysed the vulnerability of the island to climate change and identified priority actions for adaptation to be implemented by 2020-2050. The SRCAE aims to provide a reference framework to ensure consistency in the policies implemented in the field of sustainable development, energy and adaptation to climate change.

2.2 Assessments

The French National Plan for adaptation to climate change (2011-2015) carried out a consultation with the Outermost Regions, including Guadeloupe, during its development to ensure that the recommendations developed correctly addressed the challenges faced by Outermost Regions. Most of the national recommendations did correctly apply to the Outermost Regions. Some recommendations require adjusting to the local context during implementation however. In addition, nine complementary recommendations were developed to consider the specific needs of the French Outermost Regions.

The Regional Plan for Climate, Air and Energy for Guadeloupe (SRCAE Guadeloupe), published in December 2012, analysed the vulnerability of the island to climate change and identified priority actions for adaptation to be implemented by 2020-2050.The SRCAE Guadeloupe presents a state of knowledge on climate change in Guadeloupe, including an overview of both the contribution of Guadeloupe to global climate change and the impacts of climate change relevant to the island. It notes the challenges of identifying potential future impacts of climate change because of a lack of climate

models with a high enough resolution to provide information for Guadeloupe. The SRCAE considers the information which is available and concludes that future changes in climate are likely to include:

- An increase in average air temperatures of up to 5°C by 2100: the IPCC Fourth Assessment Report (IPCC AR4, 2007) suggests (based on the median A1B scenario) annual average temperatures may increase by 2°C in 2050 and up to 2.4°C in 2075 while the Climator project by INRA (2010) estimates average temperature is likely to increase by 1°C by the middle of this century and by approximately 2°C by the end of the century, during both summer and winter seasons;
- Uncertain change in precipitation but a likelihood of water shortages in lakes and rivers in the dry season, an impact already observed, and an increase in the frequency of drought;
- An intensification of tropical cyclones, with higher wind speeds and more rainfall; and
- Sea level rise of 0.8 metres.

A 2008 IUCN report, *Climate Change and Biodiversity in the European Union Overseas Entities*, (Petit J. & Prudent G.) assessed the impact of climate change on biodiversity in the European Union Overseas Entities, including Guadeloupe. The report highlighted the risk of coral die-off due to an increase in water temperatures off the coast of Guadeloupe. IFRECOR, the French Initiative on Coral Reefs, has estimated that around 80% of Guadeloupe's coral reefs are already dead as a result of changing sea water temperatures.
In addition there is a recent initiative supported by French Ministry of Environment which aims to develop knowledge on climate change impacts on hydrosystems and coastal environments in all of the French Outermost Regions. The research program EXPLORE 2070 (2010-2012) plans to build simulations of climate change.

A Study Commissioned by the European Commission considered the information available in climate impacts and adaptation for all of the Outermost Regions, including Guadeloupe.

2.3 Priority Sectors

Guadeloupe's economy is principally focused on agriculture, industry and tourism. Its traditional activities include the export of bananas, sugar, rum and melons. As climate changes, higher temperatures and changing patterns of rainfall have the potential to create challenges in these sectors.

Based on stakeholder consultation during development of the Regional Plan for Climate, Air and Energy of Guadeloupe (SRCAE Guadeloupe), the sectors most vulnerable to climate change identified are: **public health**, **resources** (including water and natural systems), **agriculture and fisheries**, and **land use development and planning**.

A study commissioned by the European Commission considered the information available on climate impacts and adaptation for all of the Outermost Regions, including Guadeloupe, and synthesised this information into a high level climate risk assessment based upon environmental, social and economic consequences of anticipated climate change impacts. As a result of the climate risk assessment, the study identified priority sectors for adaptation action for Guadeloupe as being:

- **Tourism.** Tourism is a key contributor to the economy of Guadeloupe, and tourism activities depend on the quality and accessibility of environmental resources (e.g. quality of beaches and forests), which are threatened by climate impacts. Protecting environmental resources and creating new tourist resources where possible will be key;
- **Construction & Buildings.** There is a significant concentration of infrastructure in and around the coast, which will be at risk from sea-level rise and any increase in the severity of coastal storms;
- **Transport.** As with buildings, the majority of transport infrastructure is located on or near the coast and is vulnerable to future climate change impacts, particularly flooding associated with storms (including cyclones) and sea-level rise;
- **Biodiversity.** Guadeloupe has a significant number of species endemic to the island, in addition to a wide variety of habitats. Some of these are threatened by projected future climate impacts such as drought, and increases in average temperatures; and
- **Coastal zone management.** Guadeloupe's infrastructure (domestic and commercial buildings, infrastructure, health and emergency services) are located predominantly on the coast, and are at risk from climate change impacts in the future. Coastal zones currently benefit from the protection of coral reefs but the potential loss of these coral reefs due to increasing sea temperatures and ocean acidification would expose the coast to higher risk of flooding from the sea. Integrated coastal zone management and relocation of essential infrastructures away from at-risk areas will be key to climate change adaptation.

2.4 Local Actions

The Regional Plan for Climate, Air and Energy of Guadeloupe (SRCAE Guadeloupe) developed recommendations for implementing actions to reduce the contribution of Guadeloupe to climate change. On the basis of the vulnerability diagnosis carried out for the SRCAE Guadeloupe, some priority areas for future potential actions to tackle the issues of climate change and adaptation were also identified.

In the field of **public health**, recommended actions are:

- Developing knowledge of the links between health and climate change;
- Supporting the implementation of a network of national experts and researchers on climate change and its impacts on human health; and
- Strengthening monitoring and early-warning alerts for environmental quality issues (e.g. air, water, and food) and vector-borne diseases, by strengthening the resources involved in the existing regional system. The latter works to develop suggestions to improve the process of health-related risk management and climate crisis.

Recommended adaptation actions for **land development and planning** include:

- Increasing the integration of energy and climate concerns in planning documents (to be implemented by 2020-2030); and
- Adapting the standards of building, construction and maintenance of the built environment to climate change challenges (to be implemented by 2020-2050).

Planned actions to adapt and protect **resources** include:

- Integrating the constraints of climate change into the Blueprint for water resources planning and management (to be implemented by 2020-2050);

- Reinforcing the protection and safeguarding of ecosystems and the natural environment (to be implemented by 2020-2050);
- Adapting, supporting and promoting local agricultural production (to be implemented by 2018-2020); and
- Supporting and adapting the fisheries sector (to be implemented by 2020-2050).

In the field of **governance**, the identified priority action is to ensure consistency in regional policies and adapting national policies (to be implemented by 2020-2030).

In the field of **knowledge development** and **dissemination**, planned adaptation actions include:

- Supporting innovation (to be implemented by 2020-2030); and
- Improving knowledge by observing the effects of climate change on the territory (to be implemented by 2020-2050).

In the field of **external cooperation**, the objective is to strengthen the exchange of information, knowledge, experiences and best practices with external partners (to be implemented by 2020-2030).

In the field of **communication**, targeted actions include:

- Increasing awareness amongst stakeholders (to be implemented by 2020-2030); and
- Strengthening information, awareness and training with regards to climate change (to be implemented by 2017).

The SRCAE Guadeloupe identified some potential sources of funding for some of the planned actions identified, however no specific budget allocations or plans were made. Potential sources of funding for adaptation actions included:

- The regional budget of Guadeloupe;
- National sources of funding such as ADEME (Agence de l'environnement et de la maitrise d'énergie) and FIDOM (Fonds d'investissement des départements d'outre mer);
- European sources of funding such as the European Regional Development Funds (ERDF) or the Programme d'Options Spécifiques à l'Éloignement et l'Insularité (POSEI); and
- Others such as the United Nations Environment Programme (UNEP).

2.5 Summary

Item	Status	Links
French National Adaptation Plan	Adopted in 2006	NAP (2006)
Regional Plan for Climate, Air and Energy for Guadeloupe (SRCAE Guadeloupe)	Adopted 2012	SRCAE Guadeloupe (2012)
Action Plans	National Plan for adaptation to climate change (2011-2015)	Ministère de l'Écologie, du Développement Durable et de l'Énergie

Item	Status	Links
Impacts, vulnerability and adaptation assessments	The SRCAE Guadeloupe analysed the vulnerability of the island to climate change and identified priority adaptation actions	SRCAE Guadeloupe
Research programmes	Adaptation to climate change was one of the strategic axes of the *Université des Antilles et de la Guyane* (UAG) research programme between 2010-2013.	Université des Antilles et de la Guyane
Climate services / Met Office	National level services established	Météo France Drias - les future du climat
Web portal	Online	ONERC
Monitoring, Indicators, Methodology	SRCAE Guadeloupe outlined indicators for each recommended action. At the National level, an evaluation of the implementation of the National Plan for adaptation to climate change was published in June 2013. A final evaluation is expected in 2015.	SRCAE Guadeloupe (2012)

2.6 Contacts

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3 Martinique

3.1 Legal Framework

Martinique is a popular tourist destination in the Caribbean. It is a volcanic island with northern parts of the island having a wetter, more mountainous and heavily wooded landscape than the south, the region which attracts the majority of tourists. Much of the coastline benefits from the protection of coral reefs, particularly the south and west of the island. Martinique, although an Outermost Region, is a French overseas department (and has been since 1946) and is an integral part of the EU. Martinique is therefore covered by all French and EU rights, regulations and obligations.

At the national level, in 2001 the French National Observatory for the Effects of Global Warming (ONERC) was set up, tasked specifically with adaptation to climate change. This was followed by the adoption of the French National Adaptation Strategy in 2006. These both marked the beginning of French government activity in the area of climate change adaptation.

Since then, the first French National Plan for adaptation to climate change (2011-2015) has been put in place. During the development of the Plan, the French Outermost Regions, including Martinique, were consulted in order to ensure that the recommendations developed correctly addressed the challenges faced by the OR. As a result, the Plan responds to the needs of the French Outermost regions, although it does not address them specifically.

Regional adaptation guidelines are defined in Regional Climate, Air and Energy Schemes (SRCAE) under the provisions of Law 2010-788 of 12 July 2010. The SRCAE Martinique, published in 2012, provided an overview of the contribution of Martinique to climate change, and the impacts of climate change to Martinique. The objective of the SRCAE is to consider regional priorities for the period 2020 to 2050, and to set guidelines to act as a framework for local authorities.

3.2 Assessments

The French National Plan for adaptation to climate change (2011-2015) carried out a consultation with the Outermost Regions, including Martinique, during its development to ensure that the recommendations developed correctly addressed the challenges faced by Outermost Regions. Most of the national recommendations did correctly apply to the Outermost Regions. Some recommendations require adjusting to the local context during implementation however. In addition, nine complementary recommendations were developed to consider the specific needs of the French Outermost Regions.

Martinique recently adopted its Regional Plan for Climate, Air and Energy (SRCAE Martinique 2012), which provided an overview of the contribution of Martinique to climate change, and the impacts of climate change to Martinique. The SRCAE also defined a strategy to address the challenges presented by climate change, organised along 3 thematic pillars:

- Energy savings;
- Energy efficiency; and
- Diversification of energy sources in a sustainable manner.

The SRCAE also sets out the need for 'eco-responsible' development and adaptation to climate change.

As is the case for Guadeloupe, there is a lack of climate model projections developed specifically for Martinique. However, some research has been carried out (SRCAE Martinique 2012) which estimated that between 1960 and 2000:

- Temperature has increased by approximately 1.5°C;
- The sea level has risen by approximately 3.5 mm per year; and
- Both hurricane and thunderstorm seasons have become more variable in their timing.

A 2008 IUCN report, *Climate Change and Biodiversity in the European Union Overseas Entities* (Petit J. & Prudent G.) assessed the impact of climate change on biodiversity in the European Union Overseas Entities, including Martinique. The report highlighted risks from climate change impacts including:

- Risk of damage to mangrove habitats due to a potential increase in the intensity of tropical storms and rising sea levels; and
- Expected temperature variations – including an increase in average temperatures – which could threaten high-altitude forests in Martinican massifs.

Although there is relatively little research into the future impacts of climate change on Martinique, some assumptions can be made. For example, given proximity and common characteristics of Martinique and Guadeloupe, it is reasonable to assume that the likelihood and magnitude of climate change impacts will be similar in these two territories. On this basis, changes in climate are expected to include:

- An increase in average temperatures and the occurrence of periods of very hot weather;
- An increased variation in the occurrence of both the hurricane and thunderstorm season, as has already been observed on Martinique; and
- An increase in the frequency of summer droughts.

In addition there is a recent initiative supported by French Ministry of Environment which aims to develop knowledge on climate change impacts on hydrosystems and coastal environments in all of the French Outermost Regions. The research program EXPLORE 2070 (2010-2012) plans to build simulations of climate change.

A Study Commissioned by the European Commission considered the information available in climate impacts and adaptation for all of the Outermost Regions, including Guadeloupe.

3.3 Priority Sectors

As with Guadeloupe, Martinique's economy is principally focused on agriculture, industry and tourism. Its traditional activities include the export of bananas and sugar, now mainly made into rum. As climate changes, higher temperatures and changing patterns of rainfall have the potential to create challenges in these sectors.

A study commissioned by the European Commission considered the information available on climate impacts and adaptation for all of the Outermost Regions, including Guadeloupe, and synthesised this information into a high level climate risk assessment based upon environmental, social and economic consequences of anticipated climate

change impacts. As a result of the climate risk assessment, the study identified priority sectors for adaptation action for Guadeloupe as being:

- **Tourism.** Tourism is a key contributor to the economy of Martinique, and is highly dependent on the quality of natural resources (e.g. quality of beaches and forests). It will therefore by threatened by potential climate change impacts. Protecting environmental resources and creating new tourist resources where possible will be key;
- **Transport.** There is a significant concentration of transport infrastructures, including the airport, along the coast, which is vulnerable to future climate change impacts, particularly flooding associated with storms (including cyclones) and sea-level rise. Some adaptive actions have already been taken, however the sector is considered highly vulnerable;
- **Biodiversity.** Martinique has a significant number of species endemic to the island, in addition to a wide variety of habitats. Within the marine ecosystems three types of coral reefs are found: barrier, fringe and shallow coral reefs. Many of these species will be threatened by projected future climate impacts such as drought, and increases in average temperatures; and
- **Coastal zone management.** The infrastructure of Martinique (domestic and commercial buildings, transport, other infrastructure, health and emergency services) is located predominantly on the coast, and is at risk from climate change impacts in the future. Significant portions of Martinique's coastal zones currently benefit from the protection of coral reefs but the potential loss of these coral reefs due to increasing sea temperatures and ocean acidification would expose the coast to higher risk of flooding from the sea. Integrated coastal zone management and relocation of essential infrastructures away from at-risk areas will be key to climate change adaptation.

3.4 Local Actions

The Regional Plan for Climate, Air and Energy of Martinique (SRCAE Martinique 2012) developed specific actions to address the island's adaptation challenges. The main objective is to better integrate these challenges into planning and development policies. These planned actions are:

- Structuring existing knowledge in order to identify the gaps and the needs of research;
- Improving knowledge on the strongest vulnerabilities;
- Integrating climate change challenges in planning policies and documents in a structured way; and
- Strengthening the consideration of climate change-related risks in planning policies and development.

Although the SRCAE Martinique does not identify any specific budgets for the planned actions, nor identify potential sources of funding for these actions. It does estimate that the cost of inaction regarding climate change is around 250 million Euros by 2025 and 510 million Euros by 2050 for Martinique, if no action is taken to reduce Martinique's contribution to climate change. This takes into account damages from storms, and impacts on tourism, coastal infrastructures, marine coastal ecosystems and agricultural production.

In addition to work done for the SRCAE, a very small number of studies on the impacts of climate change in Martinique have been carried out to date. These include:

- The "LarGE" research laboratory of the University of Les Antilles and French Guiana, which is carrying out research on extreme events, natural risks and disasters; and
- Martinique cooperates with Guadeloupe, Martinique and La Réunion as part of the IFRECOR project related to the coral reefs which addresses climate change adaptation in its strategic action plan.

Martinique has the ambition to become a key observer of climate change impacts for the Caribbean region, metropolitan France and the European Union. Potential actions include cooperation and knowledge exchange on climate change best practices with neighbouring territories or the implementation of an observatory of the climate change impacts and actions to support the operational management of these impacts. For example, Martinique has recently answered a call for a preparatory action, namely BEST - Biodiversity Program in Outermost Regions. The submitted proposal deals with the implementation of an observatory on biodiversity which may be detrimentally impacted by climate change and natural risks. This action is in line with the targeted measures of the French National Plan for adaptation.
Some adaptation measures have already been put in place, including:

- Placing power cables underground in order to minimise future impact of cyclones on the electricity system;
- improvements to road and tramway lines near the airport;
- implementation of plans to prevent coastal risks in territories located near the shore; and
- ongoing effort to prepare and implement a strategy for disaster management.

3.5 Summary

Item	Status	Links
French National Adaptation Plan	Adopted in 2006	NAP (2006)
Regional Plan for Climate, Air and Energy for Martinique (SRCAE Martinique)	Approved in draft in 2012 (stakeholder consultation carried out in 2013)	SRCAE Martinique (2012)
Action Plans	National Plan for adaptation to climate change (2011-2015)	Ministère de l'Écologie, du Développement Durable et de l'Énergie
Impacts, vulnerability and adaptation assessments	The SRCAE Martinique analysed the vulnerability of the island to climate change and identified priority adaptation actions	SRCAE Martinique
Research programmes	Adaptation to climate change was one of the strategic axes of the *Université des Antilles et de la Guyane (*UAG) research programme between 2010-2013.	Université des Antilles et de la Guyane

Item	Status	Links
Climate services / Met Office	National level services established	Météo France Drias - les future du climat
Web portal	Online	ONERC
Monitoring, Indicators, Methodology	The SRCAE suggested indicators for each recommended action. At the National level, an evaluation of the implementation of the National Plan for adaptation to climate change was published in June 2013. A final evaluation is expected in 2015.	SRCAE Martinique

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4 St Martin

4.1 Legal Framework

St Martin is the larger half of volcanic and mountainous island in the Caribbean (the smaller half is Dutch). St Martin is an Outermost Region (since 2003) and a French overseas community (previously it formed part of the French administrative overseas department of Guadeloupe until it separated in 2007). It is an integral part of the EU, and is covered by all French and EU rights, regulations and obligations.

At the national level, in 2001 the French National Observatory for the Effects of Global Warming (ONERC) was set up, tasked specifically with adaptation to climate change. This was followed by the adoption of the French National Adaptation Strategy in 2006. These both marked the beginning of French government activity in the area of climate change adaptation.

Since then, the first French National Plan for adaptation to climate change (2011-2015) has been put in place. During the development of the Plan, the French Outermost Regions were consulted in order to ensure that the recommendations developed correctly addressed the challenges they face but St Martin did not have Outermost Region status at this time. Many of the climate challenges faced are however similar to those of its neighbours Martinique and Guadeloupe who were consulted. As a result, the Plan responds to the needs of the French Outermost regions, even though it does not address them specifically.

St Martin does not currently have a climate change strategy in place, or Regional Climate, Air and Energy Schemes (SRCAE) as Martinique and Guadeloupe.

4.2 Assessments

The French National Plan for adaptation to climate change (2011-2015) carried out a consultation with the Outermost Regions, during its development to ensure that the recommendations developed correctly addressed the challenges faced by Outermost Regions. Most of the national recommendations did correctly apply to the Outermost Regions. Some recommendations require adjusting to the local context during implementation however. In addition, nine complementary recommendations were developed to consider the specific needs of the French Outermost Regions.

There is currently very little specific information on climate change impacts with regards to St Martin and what does exist focuses mainly on the risk of flooding to coastal areas in relation to sea-level rise. Some information can be inferred from climate impacts in the region and hence assessment of climate impacts for Guadeloupe and Martinique can be taken as broadly indicative of the likely climate change impacts in St Martin, i.e. an increase in average temperatures and an increase in drought during the dry season.

The French National Observatory for the Effects of Global Warming (ONERC) estimated that St Martin is at high risk of coastal flooding from sea-level rise - St Martin has the highest ratio of buildings exposed to flooding as a result of sea level rise amongst all French Outermost Regions.

The exposure to hurricane risk and the vulnerability of the coastline to sea level rise appear to be amongst the most researched impact of climate change for St Martin, although still poorly documented. Due to its geographical situation and its natural features, the island is highly exposed to extreme weather events such as hurricanes.

The most recent hurricanes, which occurred in 1995 (Luis) and 1999 (Jose and Lenny), had a strong impact on tourism and since then St Martin has faced difficulties in boosting this activity. As for the other Caribbean French Outermost Regions, the intensity and frequency of hurricanes is expected to increase due to climate change.

4.3 Priority Sectors

There have been no assessments (to date) of climate vulnerability undertaken for St Martin but on the basis of the islands economy and the location of the majority of its infrastructure it is possible to identity two sectors are being areas of priority for action.

Tourism contributes up to 80% of the GDP of St Martin (including the impact on domestic demand and construction) and, given the small size of the island's economy, development of even a single project can have a significant impact on GDP.

Coastal zone management is important. Given the concentration of infrastructure and people along the coast of St Martin, taking adaptive actions to increase resilience to impacts of climate change such as sea-level rise and associated flooding will be key.

4.4 Local Actions

The Conservatoire du Littoral is a French public organisation in charge of the protection of natural coastal spaces. It is responsible for the preservation of protected areas, including coastlines of St Martin. The Conservatoire considers that coastlines are naturally affected by erosion and that climate change will increase their vulnerability. Taking into account the projected impacts of climate change on coastal erosion, the Conservatoire is currently working on assessing vulnerability of protected estate to erosion and integrating climate change into projects. For instance, in St Martin, the Conservatoire is working towards:

- Better protection of the mangrove and dry coastal forest (which acts as carbon sink); and
- Erosion control and shore restoration (e.g. the case of Pinel Island).

In addition, the natural protected area "Réserve Naturelle St Martin" has implemented an adaptation strategy. Actions carried out to date or in progress include:

- Improving scientific knowledge by:
  - Monitoring impacts on coral reefs;
  - Monitoring impacts on birds migratory routes; and
- Implementing the adaptation strategy through:
  - Controlling anthropogenic pressure on protected areas;
  - Restoring damaged populations and habitats; and
  - Developing tools for adaptation to climate change (e.g. modelling artificial reefs and coral reefs restoration).

In November 2013, a workshop on the resilience of marine protected areas to climate change took place in St Martin. The objective of the workshop was to share knowledge and best practices, contribute to local and regional capacity building and analyse adaptation options to reduce risk and build resilience. The work was focused not only on St Martin but the whole of the Caribbean.

4.5 Summary

Item	Status	Links
French National Adaptation Plan	Adopted in 2006	NAP (2006)
Regional Plan	None at present	
Action Plans	National Plan for adaptation to climate change (2011-2015)	Ministère de l'Écologie, du Développement Durable et de l'Énergie
Impacts, vulnerability and adaptation assessments	No impact assessment study specific to the island has been carried out	
Research programmes	With the exception of the work of the Conservatoire du Littoral, no research programmes have been established at present.	
Climate services / Met Office	National level services established	Météo France Drias - les future du climat
Web portal	Online	ONERC
Monitoring, Indicators, Methodology	Monitoring coral reef and bird migration	Réserve Naturelle St Martin

4.6 Contacts

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5 Mayotte

5.1 Legal Framework

Mayotte became an Outermost Region of the EU on 1st January 2014 having been a French overseas department since March 2011. Mayotte therefore an integral part of the EU and is covered by all French and EU rights, regulations and obligations.

At the national level, in 2001 the French National Observatory for the Effects of Global Warming (ONERC) was set up, tasked specifically with adaptation to climate change. This was followed by the adoption of the French National Adaptation Strategy in 2006. These both marked the beginning of French government activity in the area of climate change adaptation.

Since then the first French National Plan for adaptation to climate change (2011-2015) has been put in place. During the development of the Plan, the French Outermost Regions were consulted in order to ensure that the recommendations developed correctly addressed the challenges they face but Mayotte did not have Outermost Region status at this time. Many of the climate challenges faced are however similar to those of its neighbour La Réunion who were consulted. As a result, the Plan responds to the needs of all of the French Outermost regions, although it does not address them specifically.

To date, no regional or local climate change plan has been developed for Mayotte.

5.2 Assessments

At present, there has not been a climate change impact assessment undertaken which is specific to Mayotte. There are however some observations on changes in climate. Regarding projections, the only data available is taken from global models which are known to not fully accurately predict climate changes in small islands (see for example the IPPC Fourth Assessment Report sections on small islands).

Mayotte currently has very marked wet and dry seasons, with three quarters of annual precipitation occurring in the (Southern Hemisphere) summer. The wet season for Mayotte is from December to March when winds are predominantly from the west to northwest. The dry (and cool) season is from May to October when the southeast trade winds dominate. Although monsoons occur every year, and their patterns have been studied for many years, there remains significant uncertainty regarding their duration. The greatest challenge in this region is simulating the year on year variation associated with monsoon and the Madden Julian Oscillation (MJO), processes not well understood or well represented in climate models (IPCC, AR4).

The IPCC AR4 shows that models typically overestimate temperatures for the region (by an average of 0.6°C compared to climatology). All Indian Ocean islands are very likely to warm during this century, although the warming is likely to be smaller than the global annual mean across all seasons as the ocean will moderate the warming over land. Rainfall is likely to decrease in the southern hemisphere (SH) winter for both Mayotte and La Réunion. There is confidence in this projection as there is a high degree of correlation between climate models that this will be the case (IPCC AR4).

Sea levels are likely to continue to rise globally on average during this century however this is unlikely to be geographically uniform. There are large deviations among models on regional estimates of sea level rise so the degree of change for each island in the Indian Ocean is considered uncertain. Recorded data on sea levels

between 1993 and 2001 indicates that sea level has been falling in the western Indian Ocean (IPCC, AR4).

5.3 Priority Sectors

There is very limited information available on the impact of climate change on different sectors in Mayotte. Based on the current situation a number of key sectors can however be identified.

Biodiversity is very significant on Mayotte. There are a number of endemic species, in addition to key habitats such as wetlands and mangroves (a habitat that may be at risk due to changing sea levels. Other species and habitats may be at risk from changes in precipitation patterns. In addition, Mayotte has significant coral reefs, which may be at risk due to projected global increases in sea temperature.

Water is a key sector. The wetlands of Mayotte play an important role in the island's drinking supply, and any damage to them will have a knock-on effect on the island's water supply.

In common with all other islands in the Outermost Regions, the **transport** infrastructure of Mayotte is concentrated on the coast, and therefore will be at risk of flooding linked to potential sea-level rise.

5.4 Local Actions

To date, no specific adaptation actions have been taken. However, in order to study the changes in the coastline, a monitoring network has been established.

5.5 Summary

Item	Status	Links
French National Adaptation Plan	Adopted in 2006	NAP (2006)
Regional Plan	None at present	
Action Plans	National Plan for adaptation to climate change (2011-2015)	Ministère de l'Écologie, du Développement Durable et de l'Énergie
Impacts, vulnerability and adaptation assessments	No impact assessment study specific to the island has been carried out	
Research programmes	None at present	
Climate services / Met Office	National level services established	Météo France Drias - les future du climat

Item	Status	Links
Web portal	Online	ONERC
Monitoring, Indicators, Methodology	None at present	

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http://www.developpement-durable.gouv.fr/-Impacts-et-adaptation-ONERC-.html

6 French Guiana

6.1 Legal Framework

French Guiana is on the north Atlantic coast of South America. It borders Brazil to the east and south, and Suriname to the west. It has very low population density, and half of the population lives in the capital city area of Cayenne. It is the largest French overseas department (since 1946) and an Outermost Region of the EU. As such is it an integral part of the EU and is covered by all French and EU rights, regulations and obligations.

At the national level, in 2001 the French National Observatory for the Effects of Global Warming (ONERC) was set up, tasked specifically with adaptation to climate change. This was followed by the adoption of the French National Adaptation Strategy in 2006. These both marked the beginning of French government activity in the area of climate change adaptation.

Since then, the first French National Plan for adaptation to climate change (2011-2015) has been put in place. During the development of the Plan, the French Outermost Regions, including French Guiana, were consulted in order to ensure that the recommendations developed correctly addressed the challenges they face. As a result, the Plan responds to the needs of the French Outermost regions, even though it does not address them specifically.

Regional adaptation guidelines are defined in Regional Climate, Air and Energy Schemes (SRCAE) under the provisions of Law 2010-788 of 12 July 2010. The SRCAE Guyane (2012) provided an overview of the contribution of French Guiana to climate change and an assessment of the vulnerability to climate change of French Guiana. It also highlights the need for monitoring and evaluation of the climate variables in the territory. The objective of the SRCAE is to consider regional priorities for the period 2020 to 2050, and to set guidelines to act as a framework for local authorities.

6.2 Assessments

The French National Plan for adaptation to climate change (2011-2015) carried out a consultation with the Outermost Regions, including French Guiana, during its development to ensure that the recommendations developed correctly addressed the challenges faced by Outermost Regions. Most of the national recommendations did correctly apply to the Outermost Regions. Some recommendations require adjusting to the local context during implementation however. In addition, nine complementary recommendations were developed to consider the specific needs of the French Outermost Regions.

French Guiana recently adopted its Regional Plan for Climate, Air and Energy (SRCAE Guyane 2012), which provided an overview of the contribution of French Guiana to climate change, and the impacts of climate change upon it.
It highlights the need for developing monitoring and evaluation of the climate dynamics occurring in the territory. Furthermore, it emphasises the priority of defining adaptation actions and integrating adaptation challenges into planning and development documents and policies. Nonetheless, it does not define and specific adaptation actions.

A study by the French Geological Survey, the Bureau de Recherches Géologiques et Minières (BRGM), does however aim to identify the main actions to be implemented at local level to adapt to climate change.

A 2008 International Union for Conservation of Nature (IUCN) report, *Climate Change and Biodiversity in the European Union Overseas Entities*, (Petit J. & Prudent G.) assessed the impact of climate change on biodiversity in the European Union Overseas Entities, including French Guiana. The report highlighted risks from climate change impacts including:

- Risk to the Amazon forest due to higher temperatures and a drop in precipitation during the dry season – tropical forests could dry out; and
- Risks to the mangroves which line the coast of French Guiana due to sea-level rise.

There is relatively little research into the future impacts of climate change on French Guiana. The IUCN report refers to IPPC Fourth Assessment Report (2007) projections, which it summarises as:

- Between now and the end of the century, average annual temperatures in French Guiana could increase by 3.3°C, with the most marked increase of 3.5°C taking place in June to August; and
- Levels of precipitation are also likely to undergo a change, with an increase in rainfall of 4% during the months of December to February and a reduction of 3% in June to August, during the dryer months (IPCC, 2007).

In addition there is a recent initiative supported by French Ministry of Environment which aims to develop knowledge on climate change impacts on hydrosystems and coastal environments in all of the French Outermost Regions. The research program EXPLORE 2070 (2010-2012) plans to build simulations of climate change.

A study commissioned by the European Commission considered the information available in climate impacts and adaptation for all of the Outermost Regions, including French Guiana.

6.3 Priority Sectors

A study commissioned by the European Commission considered the information available on climate impacts and adaptation for all of the Outermost Regions, including French Guiana, and synthesised this information into a high level climate risk assessment based upon environmental, social and economic consequences of anticipated climate change impacts. As a result of the climate risk assessment, the study identified priority sectors for adaptation action for French Guiana as being:

- **Energy**. Hydropower accounts for a significant proportion of electricity generation – 56% of production in 2010. This will be at risk due to projected decreases in precipitation during the dry season;
- **Construction and buildings**. There is a concentration of buildings along the coast, which will be at risk from sea-level rise. In addition, there is a significant amount of illegal construction development within French Guiana, which makes risk management more difficult;
- **Health**. Health infrastructure, located predominantly along the coast, will be at risk from sea-level rise. Malaria is currently recorded in French Guiana, and projected increases in temperature during the rainy season could contribute to an increase in malaria cases, as it would favour the mosquito, vector of the disease;

- **Biodiversity**. There are a high number of endemic species, and high levels of biodiversity both on land and in the sea. Predicted changes in precipitation (reduced rainfall in the dry season) will threaten the Amazon forest; and
- **Disaster and risk**. 70% of the population is estimated to be at risk of flooding, landslide or coastal risk (BRGM, 2011). In addition, the high level of illegal construction makes it harder to plan for disaster and risk management.

6.4 Local Actions

A study *About the impact of climate change in French Guiana* was developed in 2011 by the French Geological Society, Bureau de Recherches Géologiques et Minières (BRGM). It provided a first overview of the impacts, the vulnerabilities and potential adaptation actions for French Guiana. Another, ongoing study by BRGM is carrying out further analysis on the impacts of climate change and attempting to define potential options to adapt.

The Regional Plan for Climate, Air and Energy (SRCAE) of French Guiana was released in December 2012. It highlights the importance of adaptation but does not yet define adaptation actions. The ongoing BRGM project aims to identify the main actions to be implemented at local level to adapt to climate change.

Increasing awareness and sharing knowledge are recognised as priority actions to tackle climate change challenges. In April 2013, a workshop was organised in French Guiana to consider the issues of climate change, share knowledge and develop capacity building.

6.5 Summary

Item	Status	Links
French National Adaptation Plan	Adopted in 2006	NAP (2006)
Regional Plan for Climate, Air and Energy for Guyane (SRCAE Guyane)	Approved in draft in 2012 (stakeholder consultation carried out in 2013)	SRCAE Guyane (2012)
Action Plans	National Plan for adaptation to climate change (2011-2015)	Ministère de l'Écologie, du Développement Durable et de l'Énergie
Impacts, vulnerability and adaptation assessments	The SRCAE Guyane analysed the vulnerability of the island to climate change. It does not identify specific adaptation actions	SRCAE Guyane
Research programmes	Adaptation to climate change was one of the strategic axes of the *Université des Antilles et de la Guyane* (UAG) research programme between 2010-2013.	Université des Antilles et de la Guyane

Item	Status	Links
Climate services / Met Office	National level services established	Météo France Drias - les future du climat
Web portal	Online	ONERC
Monitoring, Indicators, Methodology	The SRCAE suggested indicators for each recommended action. At the National level, an evaluation of the implementation of the National Plan for adaptation to climate change was published in June 2013. A final evaluation is expected in 2015.	SRCAE Guyane

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7 La Réunion

7.1 Legal Framework

La Réunion, although an Outermost Region, is a French overseas department (and has been since 1946) and is an integral part of the EU. La Réunion is therefore covered by all French and EU rights, regulations and obligations.

At the national level, in 2001 the French National Observatory for the Effects of Global Warming (ONERC) was set up, tasked specifically with adaptation to climate change. This was followed by the adoption of the French National Adaptation Strategy in 2006. These both marked the beginning of French government activity in the area of climate change adaptation.

Since then the first French National Plan for adaptation to climate change (2011-2015) has been put in place. During the development of the Plan, the French Outermost Regions, including La Réunion, were consulted in order to ensure that the recommendations developed correctly addressed the challenges they face. As a result, the Plan responds to the needs of the French Outermost regions, although it does not address them specifically. During the development of the plan, the French Outermost regions, including La Réunion, were consulted in order to ensure that the recommendations developed correctly addressed the challenges faced by the OR.

Regional adaptation guidelines are defined in Regional Climate, Air and Energy Schemes (SRCAE) under the provisions of Law 2010-788 of 12 July 2010. The objective of the SRCAE is to consider regional priorities for the period 2020 to 2050, and to set guidelines to act as a framework for local authorities. The SRCAE La Réunion, adopted in 2013, provided state of the art knowledge on climate change impacts to La Réunion and identified key its vulnerabilities.

7.2 Assessments

The French National Plan for adaptation to climate change (2011-2015) carried out a consultation with the Outermost Regions, including La Réunion, during its development to ensure that the recommendations developed correctly addressed the challenges faced by Outermost Regions. Most of the national recommendations did correctly apply to the Outermost Regions. Some recommendations require adjusting to the local context during implementation. In addition, nine complementary recommendations were developed to consider the specific needs of the French Outermost Regions.

In 2008, Météo France released the findings of a study on expected climate change impacts in La Réunion. The main findings were:

- The change in annual mean precipitation is estimated between -2 and +20% in the Indian Ocean compared to long term averages. In La Réunion, winters are likely to become drier and extreme weather events more severe;
- Sea level is expected to rise between 0.2 and 0.6m by 2100
- Trade winds are expected to increase in strength; and
- A decrease in the frequency of cyclones is likely over the longer term, but with an increase in their magnitude.

The Regional Plan for Climate, Air and Energy of La Réunion (SRCAE La Réunion 2013) summarised current knowledge on climate change impacts to the island and identified the main vulnerabilities. It highlights the lack of specific data and climate models for this area of the Indian Ocean. However, some changes which may be related to climate change have already been observed and are noted in the SRCAE. These include:

- Winters are becoming drier and there has been an increase in the number of extreme weather events (IOC, 2011);
- There is a trend towards increasing rainfall in the eastern part of the island and decreasing rainfall in the west. Western parts of the island are already the driest and so this is expected to further decrease water availability, especially for irrigation;
- There are, on average, around 20 fire outbreaks a year in La Réunion. The most exposed areas are forests in the highlands (western part of the island). Further reduction in rainfall could exacerbate this risk;
- Coastal flooding is one of the main risks faced by La Réunion (French Ministry of Environment, 2011a) although changes in future frequency of coastal flooding and in sea level rise are not clear; and
- Several incidents of coral bleaching have been recorded in the past decade: 2001, 2003, 2004 and 2005 (IUCN, 2010).

La Réunion was also involved in the Indian Ocean Commission[2]'s **Project Acclimate**, which focused on developing the knowledge-base for adaptation to climate change in the region. Following on from the project, a regional strategy for adaptation was adopted by the Indian Ocean Commission (IOC) in January 2013. The regional strategy aims to help the region become more resilient and acquire the necessary tools and resources to meet climate change challenges. It focuses on four sectors: food security, water, health and the environment.

In addition there is a recent initiative supported by French Ministry of Environment which aims to develop knowledge on climate change impacts on hydrosystems and coastal environments in all of the French Outermost Regions. The research program EXPLORE 2070 (2010-2012) plans to build simulations of climate change.

A Study Commissioned by the European Commission considered the information available in climate impacts and adaptation for all of the Outermost Regions, including La Réunion.

7.3 Priority Sectors

La Réunion is a popular tourist destination in the Indian Ocean, and tourism is a significant contributor to the economy of the island. Agriculture also contributes to the economy although to a lesser extent.

A study commissioned by the European Commission considered the information available on climate impacts and adaptation for all of the Outermost Regions, including La Réunion, and synthesised this information into a high level climate risk assessment based upon environmental, social and economic consequences of anticipated climate

[2] The Indian Ocean Commission (IOC) is an intergovernmental organisation created in 1982 at Port Louis, Mauritius and institutionalized in 1984 by the Victoria Agreement in Seychelles. The IOC is composed of five African Indian Ocean nations: Comoros, La Réunion, Madagascar, Mauritius and Seychelles.

change impacts. As a result of the climate risk assessment, the study identified priority sectors for adaptation action for La Réunion as being:

- **Energy.** Hydropower is a significant contributor to the island's electricity generation, and will be threatened by projected changes in precipitation. Additionally, more than 50% of the electricity distribution network is aerial (the remainder is buried underground), and will be at risk from an increase in the frequency and/or strength of storms and wind. Finally, in order to future-proof wind generation it will be necessary to install wind turbines which can withstand strong winds, since future projections are for increased storminess; and
- **Biodiversity.** La Réunion is home to a great variety of habitats (in part due to its rugged landscape and extreme climatic variations), and home to a number of endemic species. Projected climate impacts such as drought and higher temperatures will put a number of these at risk.

7.4 Local Actions

The Regional Plan for Climate, Air and Energy of La Réunion (SRCAE La Réunion 2013) provided state of the art knowledge on climate change impacts to La Réunion and identified key its vulnerabilities. Regarding adaptation to climate change, the Plan emphasised the need to develop an adaptation strategy at local level. It also defined future potential adaptation measures for the region. Priority actions planned for the future are:

- Predicting the effects of climate change by developing knowledge on climate change impacts on the territory, in particular in relation to natural risks; and
- Managing urban planning in order to integrate population increase by 2030, savings in energy consumption, and preservation of natural and agricultural ecosystems in the context of climate change.

According to the SRCAE La Réunion, the climate change impacts most likely to affect natural and human systems in La Réunion are:

- Disturbances to existing ecosystems, an increase in the prevalence of invasive species and potential loss of biodiversity;
- Changes in agricultural yields (although this could be positive or negative depending upon the crop) and in land use;
- Negative impacts on human health as a consequence of heat waves and an increase in vector-borne diseases;
- Change in geographical distribution of water resources; and
- Economic and social impacts related to the redistribution of the tourist flows and the impacts of extreme weather events on transport infrastructures.

Actions taken to date mainly focus around the development of new transport infrastructures (e.g. the new coastline road), future-proofing them by taking into account climate change.

7.5 Summary

Item	Status	Links
French National Adaptation Plan	Adopted in 2006	NAP (2006)
Regional Plan for Climate, Air and Energy for La Réunion (SRCAE La Réunion)	Adopted 2013	SRCAE La Reunion
Action Plans	National Plan for adaptation to climate change (2011-2015)	Ministère de l'Écologie, du Développement Durable et de l'Énergie
Impacts, vulnerability and adaptation assessments	The SRCAE La Réunion identified key vulnerabilities of the island	SRCAE La Reunion
Research programmes	Project Acclimate focussed on strengthening climate change adaptation capacity in the Indian Ocean	Acclimate
Climate services / Met Office	National level services established	Météo France Drias - les future du climat
Web portal	Online	ONERC
Monitoring, Indicators, Methodology	The SRCAE suggested indicators for each recommended action. At the National level, an evaluation of the implementation of the National Plan for adaptation to climate change was published in June 2013. A final evaluation is expected in 2015.	SRCAE Reunion

7.6 Contacts

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8 Canary Islands

8.1 Legal Framework

The Canaries archipelago is situated 100 km off the coast of Africa and comprises seven islands of volcanic origin: the Eastern group (Gran Canaria, Fuerteventura and Lanzarote) and the Western group (Tenerife, La Gomera, El Hierro and La Palma). The Canary Islands is an Outermost Region but is also an integral part of Spain (and thus the EU), being one of its Autonomous Communities. It is therefore covered by all Spanish and EU rights, regulations and obligations.

At the national level, Spain adopted its adaptation strategy, the National Climate Change Adaptation Plan (PNACC in Spanish), in 2006. The PNACC is the reference framework for the coordination of the Public Administrations' efforts in dealing with the assessment of impacts, vulnerability, and adaptation options to address the impacts of climate change in a series of sectors and natural resources acknowledged as potentially affected. It is developed through a series of specific Work Programmes.

To date, two PNACC Work Programmes have been adopted:

- First Work Programme (WP1, 2006) focused on developing a national programme on regionalised climate change scenarios and on the assessment of climate change impacts and vulnerability in sectors considered key and horizontal to others: water resources, biodiversity and coastal areas; and
- Second Work Programme (WP2, 2009) continued WPI activities and set additional and ambitious goals to address climate change adaptation in Spain. It is structured in four axes for action: (i) sectoral impacts and vulnerability assessments, (ii) mainstreaming climate change adaptation into sectoral regulations and planning tools, (iii) mobilising sectoral stakeholders, and (iv) setting up an indicator system on climate change impacts and adaptation. Additionally, the WP2 builds on two basic pillars: (1) promoting research and development activities, and (2) strengthening coordination between all the administrative levels with responsibility for adaptation to climate change.

At the regional level, the Canary Islands adopted their **Climate Change Strategy for the Canary Islands** in 2009. The strategy focussed on mitigation and education measures, but it included a mandate to develop an adaptation plan. An Adaptation Plan for the Canary Islands is expected to follow in 2014.

8.2 Assessments

Following the mandate established by the Climate Change Strategy for the Canary Islands to develop an adaptation plan, the Department of the Environment is assessing the vulnerability of the Canaries to climate change as a step towards developing the Adaptation Plan. The Plan, expected in 2014, will include short, medium and long term measures. In the short term, the most relevant measures (still under evaluation) will possibly be in the fields of water resources (groundwater recharge), biodiversity (exotic/native species extinctions, changes in forest), agriculture (crops, pests, and irrigation) and health (heat waves, new diseases).

Project ClimaImpacto, a European initiative supported by the "Transnational Cooperation Programme Madeira-Açores-Canarias (MAC) 2007-2013", generated climate scenarios and sought to quantify the impacts of climate change on the

archipelago. Initial measurements taken at a regional level have confirmed an increase in temperatures since 1940 (almost one tenth per decade) and suggested a slight decrease in average rainfall (Martin et al., 2012).

A 2008 International Union for the Conservation of Nature (IUCN) report, *Climate Change and Biodiversity in the European Union Overseas Entities*, (Petit J. & Prudent G.) assessed the impact of climate change on biodiversity in the European Union Overseas Entities, including the Canary Islands. The report highlighted the risk to both land-based and marine biodiversity in the Canary Islands (which has high biodiversity and a high number of endemic species). The report also highlighted the potential risk to the fishing industry if fish stocks decline due to an increase in sea temperatures. Finally, the report pointed out that the largest potential economic impact to the Canary Islands arises from impacts to tourism if e.g. an increase in the number of heatwaves, or desertification of natural landscapes make the islands less attractive to tourists.

Potential effects of climate change are already being observed in the Canary Islands. Available data from the ClimaImpacto project indicate that:

- There is a high level of confidence that temperatures have increased (almost 0.1°C per decade, from 1944 to the present);
- Average precipitation levels show a decreasing trend, with a significant decline in autumn rainfall;
- An increase in the number and intensity of heat waves during 1944-2007 has been documented.
- Average precipitation: an overall decline trend has been observed, especially in the windward slopes (-25 to -39 mm/ decade since 40's) of Gran Canaria and Tenerife; and
- Extreme heat and rainfall events have become more frequent and intense (Martín Esquivel, 2012).

ClimaImpacto also identifies potential indirect consequences of these variations as being:

- Increased risk of fire;
- Increased frequency and severity of heat waves;
- More persistent periods of drought; and
- More frequent events of Saharan dust invasion.

ClimImpacto identify likely future changes in climate to be:

- An increase in average temperatures: Annual temperatures are expected to increase by 1.9-2.4ºC according to IPPC AR4 (IPPC 2007);
- The effects of nearby tropical storms (e.g. Delta storm in 2005) could reach the Canaries more frequently;
- Floods/landslides are expected to occur more frequently as a result of extreme rainfall or storms. Coastal flooding is likely to be magnified by sea-level rise and a projected increase of sea storms; and
- Wildfires are likely to be more frequent with increased dryer conditions.

8.3 Priority Sectors

The economy of the Canary Islands is very heavily dependent on tourism, and any impacts on the tourist industry (e.g. if an increase in the number of heatwaves, or

desertification of natural landscapes make the islands less attractive to tourism) would be significant for the economy.

Agriculture in the islands may also be impacted by projected climate impacts, however agriculture proportionally only contributes to a very small proportion of economic activity.

A study commissioned by the European Commission considered the information available on climate impacts and adaptation for all of the Outermost Regions, including the Canary Islands, and synthesised this information into a high level climate risk assessment based upon environmental, social and economic consequences of anticipated climate change impacts. As a result of a climate risk assessment, the study identified priority sectors for adaptation action for the Canary Islands as including:

- **Tourism** is the primary contributor to the region's economy for approximately 80% of the region's GVA in 2011 tertiary sector. Due to its direct connection to the environment and climate, tourism is considered a sensitive sector to changes in climate. Tourism is also vulnerable to climate impacts related to the availability of water and energy resources. Additionally most of the tourism infrastructure is located along the coastline which will be vulnerable to climate impacts such as flooding linked to sea level rise. Conversely, climate change impacts may lead to opportunities in the sector e.g. spring and autumn tourism could be increased as temperatures increase;
- **Construction and buildings.** The Canary Islands are the most populated OR (IUCN, 2008). Due to steep mountainous landscapes, urban areas with high population densities are predominantly coastal. They are therefore at risk of flooding from sea-level rise in future;
- **Transport** is a crucial sector in the Canary Islands, due to its dual insularity (archipelago) and its remoteness from the European mainland. Transport infrastructures, particularly near the coast, are likely to be affected by climate change impacts such as increased frequency of extreme rainfall and significant wind events;
- **Biodiversity**. The Canary Islands have been designated as a biodiversity hot-spot; and have a high number of endemic species. In particular the Canary Islands are home to the Laurel forest, a forest unique to the Macaronesian region which has been identified as a conservation priority. Biodiversity will be vulnerable to climate change impacts including increased temperatures, reduced precipitation, and potential changes in trade wind patterns. Habitats such as the Laurel forest will be at risk as an increase in temperatures / reduction in precipitation will force them to retreat uphill, but there may be nowhere for them to retreat to;
- **Coastal zone management**. The concentration of infrastructure along the coast (transport, housing, commercial, health and tourism infrastructure) has already been documented. This will be at risk from rising sea levels and associated flooding; and
- **Energy.** The islands are strongly dependent on imports for electricity production (e.g. oil). Additionally the electricity network is not connected to the mainland European grid, and islands are not interconnected with each other (with the exception of Fuerteventura and Lanzarote). These characteristics all make the sector vulnerable to impacts from climate change, e.g. increased storms.

8.4 Local Actions

The Climate Change Strategy for the Canary Islands (approved in 2009), focused on mitigation and education measures, although it included a mandate to develop an adaptation plan. A preliminary assessment of the potential impacts of climate change was developed in 2010.

The Department of the Environment is now assessing the vulnerability of the Canaries to climate change as a step towards developing the Adaptation Plan, expected in 2014. This will include short, medium and long term measures. In the short term, the most relevant proposed measures (still under evaluation) will possibly be in the fields of water resources (groundwater recharge), biodiversity (exotic/ native species extinctions, changes in forest), agriculture (crops, pests, and irrigation) and health (heat waves, new diseases). No budget information in relation to possible projects is available at present.

At present, there are relevant adaptation measures underway in the areas of:

- **Energy** (i.e. development of renewable energies to enhance energy security in the context of the Energy Plan for the Canary Islands (Canary Islands Government 2006)); and
- **Risk management** through monitoring and prevention measures such as the Plan against extreme adverse weather events (PEFMA).

Significant efforts are being focused on research activities aimed at the development of a solid knowledge base. A number of research programmes are being supported by the European "Transnational Cooperation Programme Madeira-Açores-Canarias (MAC) 2007-2013".

8.5 Summary

Item	Status	Links
Spanish National Climate Change Plan	Adopted in 2006	PNACC (2006)
Climate Change Strategy for the Canary Islands	Adopted 2009	Plan de Adaptacion de Canarias al Cambio Climatico *(In Spanish only)*
Action Plans	An Adaptation Plan for the Canary Islands is expected in 2014	
Impacts, vulnerability and adaptation assessments	Nationally available from PNACC, Regionally still in development	A Preliminary General Assessment of climate change impacts in Spain including a focus on Specific sectors
Research programmes	Ongoing	The Spanish Meteorological Agency (AEMET)

Item	Status	Links
Climate services / Met Office	National level services established	The Spanish Climate Change Office (AEMET)
Web portal	Online	The Spanish Climate Change Office
Monitoring, Indicators, Methodology	Nationally: contained within the PNACC's 2nd work programme. Regionally none have been set out to date	2 Monitoring reports of the PNACC (2008 and 2011)

8.6 Contacts

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9 Azores

9.1 Legal Framework

The Azores comprises nine islands: the Eastern group (Sao Miguel and Santa Maria islands), Central group (Terceira, Graciosa, Sao Jorge, Pico and Faial islands) and Eastern group (Flores and Corvo islands). Current climate in the Azores is generally moist with a strong ocean influence. The archipelago is characterised by a very rich natural landscape and biodiversity, and challenging topography (there are high altitude regions inland). The Azores is an Outermost Region but is also an integral part of Portugal, being one of its two autonomous regions. As an Outermost Region, the Azores are also an integral part of the EU. The Azores are therefore covered by all Portuguese and EU rights, regulations and obligations.

At the National Level, the National Strategy for Adaptation to Climate Change (ENAAC) was adopted by the Portuguese Government in 2010. The ENAAC established the need for adaptation, through a synthesis of the main observed changes in climate over the 20th century and a summary of the conclusions of climate scenarios and projections for Portugal.

The ENAAC identified nine priority sectors: territory and urban development; water resources; safety of people and goods; human health; energy and industry; tourism; agriculture, forests and fisheries; coastal areas; and biodiversity. The creation of an inter-ministerial coordination group aimed to address all cross-cutting issues and provided a forum for discussing issues that are, by nature, cross-sectoral. The coordination group includes representatives of the Ministry of Foreign Affairs, the Autonomous Regions of Azores and Madeira and of the National Association of Portuguese Municipalities.

The Azores approved their Regional Strategy on Climate Change (ERAC) in 2011. The ERAC will be put into action through the Regional Plan for Climate Change (PRAC), which is due in 2014. The PRAC will cover: coastal zone management, water management, energy, biodiversity, fisheries, agriculture and forestry, tourism, transport, health, industry and communication infrastructure.

9.2 Assessments

The "Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures" (SIAM) project is the most comprehensive and integrated assessment to date on the impacts and vulnerability associated with climate change in Portugal. It was also the first one to be undertaken in southern Europe (started in 1999). The second phase of the SIAM project (SIAM II), funded by the Portuguese Environmental Agency, started in 2002 and broadened the scope of the analysis to include the autonomous regions of the Azores and Madeira.

Climate scenarios for the region of the Azores project a 1.9°C to 2.4°C increase in annual temperatures by the end of the century (IPCC Fourth Assessment Report, 2007). According to studies, there is a trend towards an increasing number of "summer days" (when temperatures exceed 25°C) and "tropical nights" (when temperatures exceed 20°C) (reported by the Autonomous Region of the Azores in 2011). Despite the likely increase in summer days and tropical nights, it is expected that due to oceanic thermoregulatory effect, the Azores are unlikely to suffer from increased frequency of excessively hot and/or excessively cold days.

While the annual level of precipitation is not expected to rise, the Azores will see changes in the annual pattern of rainfall, with expected wetter summers and drier remaining seasons (IPCC AR4, 2007). Changes in seasonal precipitation are expected to have a major impact on water management in the island, mainly on availability of freshwater resources. Saltwater intrusion in the groundwater of the Azores is a concern as observed in many of the wells that have been drilled to the basal aquifer (Jones & Phillips, 2011). Changes in the annual patterns of precipitation may require intensified exploitation of groundwater aquifers during the "drier" seasons, further augmenting the problem of saltwater intrusion.

SIAM II estimated temperature increases of between and 2ºC to 3ºC in Madeira, broadly consistent with the IPCC regional assessment. SIAM II also projected little change in annual rainfall is suggested for the Azores.

Given that the majority of infrastructure is located on the coast; coastal hazards associated with changing climate are of key concern in the Azores. While the Regional Climate Change Strategy states that there are insufficient sea-level measurements over significant timeframes to conclude whether local sea level rise is a long-term trend or just a seasonal variation, sea level rise has been cited as a serious threat to resources, infrastructure, coastal ecosystems and the population of the islands. In addition, with expected increase in ocean temperature, it is believed that tropical storms will reach the Azores more frequently and with greater strength (reported by the Autonomous Region of the Azores, 2011), increasing the risk of floods and coastal flooding.

With more frequent severe rainfall events, it is expected that the Azores may experience an increase in landslides, which are already the most common natural hazard in the archipelago, especially on the coast. The coastal areas of the Azores are more vulnerable to landslides due to the greater exposure to intense erosion processes and the presence of urban development (Quaternaire Portugal, 2011).

In 2008, the International Union for the Conservation of Nature (IUCN) reported that deep, cold-water corals, unique habitats of Macaronesia, are particularly sensitive to climate change. Damage to the corals caused by increasing water temperatures and ocean acidification may lead to biodiversity loss and reduction in commercial fish stocks. Pests and diseases are likely to be of particular concern with regards to the biodiversity, fisheries and agriculture of the Azores. Another major concern for the Azores and other regions within Macaronesia is the impact invasive exotic species invasions may have on the unique habitats of laurel forests and coastal vegetation (Quaternaire Portugal, 2011).

9.3 Priority Sectors

A study commissioned by the European Commission considered the information available on climate impacts and adaptation for all of the Outermost Regions, including the Azores, and synthesised this information into a high level climate risk assessment based upon environmental, social and economic consequences of anticipated climate change impacts. As a result of the climate risk assessment, the study identified priority sectors for adaptation action for the Azores as being:

- **Agriculture.** Agriculture contributes around 11-12% of total GVA to the economy of the Azores. Agricultural land is limited to the lowlands and coastal

areas, as the high altitudes are typical much wetter. Therefore agricultural land at risk from projected climate impacts may be irreplaceable;

- **Energy**. The energy infrastructure in the Azores consists of nine isolated energy systems. Similarly, there is no connection with mainland Africa or Europe. This makes the system vulnerable to climate change impacts such as greater risks of natural disasters/storms. Additionally the islands are highly dependents on imports of oil which may be disrupted by adverse climate conditions making harbours inaccessible;
- **Tourism** is a significant contributor to the economy in the Azores. It emerged as a new sector in the mid 1990s and therefore is a more recent development than in other Outermost Regions. The tourism sector is considered still fragile. Tourism may be adversely impacted by climate change if extreme weather events such as storms and associated flooding increase in frequency;
- **Transport.** Due to its island nature the Azores are reliant on air and maritime transport for many imports. Additionally much of the transport infrastructure is located on the coast, making it vulnerable to climate change impacts such as sea-level rise and associated flooding;
- **Biodiversity**. The Azores are home to a significant number of endemic species and have a rich biodiversity throughout. The archipelago is also home to Laurel forests, a rare habitat found only in Macaronesia. Biodiversity will be at risk from projected changes in the pattern of precipitation – Laurel forests in particular are vulnerable as they are unlikely to be able to move to high altitudes in response to climate change;
- **Coastal Zone Management**. There is a concentration of infrastructure along the coast (transport, residential and commercial, health and emergency services and other infrastructure), which makes coastal zone management very important for the Azores. In addition, the adaptive capacity of the coastal infrastructure to climate change is thought to be low, given that opportunity of moving it further inland will be limited due to the steep geography, high altitudes and unfavourable weather; and
- **Water.** Freshwater availability in the Azores is highly dependent on weather conditions. Changes in the patterns of precipitation may threaten the availability of sufficient freshwater.

9.4 Local Actions

There has been limited action on climate change adaptation in the Azores to date. The Regional Strategy on Climate Change (ERAC) was approved 2011. It will be implemented through the Regional Plan for Climate Change (PRAC) which will cover the following sectors: coastal zone management, water management, energy, biodiversity, fisheries, agriculture and forestry, tourism, transport, health, industry and communication infrastructure. The RAC is due to be completed in 2014.

Adaptation to climate change in the Azores is expected to bring new opportunities for the region, mainly through development of new infrastructure and technological innovation.

To date the Government of the Azores has already developed some plans with regards to existing problems which may be increased by climate change. These may have an added adaptation benefit. Examples include:

- In **biodiversity**: the Regional Plan for the Eradication and Control of Invasive Plant Species in Sensitive Areas (PREFICIAS), defining methodologies and

strategies for the eradication and control of invasive species. This will have an impact in protecting biodiversity;

- In the **energy sector:** the Azores are researching energy storage systems, such as flywheels and batteries, to increase the resilience of the electricity system (which is not interconnected either between islands or with any mainland system). By 2018, the Azores intends to increase the share of renewables within total electricity production to 75%, and in total primary energy consumption to 40%; and
- In the **Water** sector: the Azores are particularly sensitive to climatic mechanisms that determine the hydrology of the islands. Availability of freshwater is highly dependent on weather conditions. Water scarcity has been identified as the key concern for the Azores with regards to climate impacts (Autonomous Region of the Azores, 2011). An Integrated Management Plan for Water Resources has been developed at both an island and regional level (Governo da Região Autónoma dos Açores, 2012). No information on measures which would increase adaptive capacity of the water sector in the Azores, such as for example desalination plants, have been identified suggesting a high degree of vulnerability to the climatic changes.

9.5 Summary

Item	Status	Links
Portuguese Strategy for Adaptation to Climate Change (ENAAC)	Adopted in 2010	ENAAC 2010 *(in Portuguese only)*
Azores Regional Strategy on Climate Change (ERAC)	Adopted 2011	ERAC 2011
Azores Regional Plan for Climate Change (PRAC)	Expected in 2014	
Action Plans	Not considered at this stage	
Impacts, vulnerability and adaptation assessments	Available primarily at the National level	Project SIAM *(site in Portuguese only, publications in Portuguese and English)* ImpactE *(site and publications in Portuguese and English)* 2-FUN - Past, Present and Future Health Impacts of Extreme Events in Portugal *(site and publications in English)* Clitop Project - Climate Change & Tourism In Portugal: Potential Impacts & Adaptation Measures *(site and publications in English)* Project SIAM - Municipality of Sintra *(site in Portuguese only)* Project SIAM - Municipality of Cascais *(site in Portuguese only)*

Item	Status	Links
Research programmes	Not currently available	
Climate services / Met Office	National level services established	IPMA
Web portal	Online	Climate Change Adaptation Portal *(in Portuguese only)*
Monitoring, Indicators, Methodology	Regular monitoring of a range of indicators	Monthly climate monitoring *(in Portuguese and English)* Daily fire risk weather index *(in Portuguese and English)* Daily biometeorology and human bioclimatology indices *(in Portuguese and English)* Temperature extremes from climate records *(in Portuguese and English)* Climate normals (temperature and precipitation) *(in Portuguese and English)* *Drought monitoring (in Portuguese only)* Daily water storage levels in river dams *(in Portuguese only)* Monthly water storage levels in aquifers

9.6 Contacts

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10 Madeira

10.1 Legal Framework

The archipelago of Madeira consists of two inhabited islands (Madeira Island and Porto Santo Island) and two groups of uninhabited islands (Desertas and Selvagens). The island of Madeira is characterised by challenging topography with high altitudes; while the island of Porto Santo has a gentler terrain. Madeira is an Outermost Region but is also an integral part of Portugal, being one of its two autonomous regions. Madeira is also an integral part of the EU and is therefore covered by all Portuguese and EU rights, regulations and obligations.

At the National Level, the **National Strategy for Adaptation to Climate Change** (ENAAC) was adopted by the Portuguese Government in 2010. The ENAAC established the need for adaptation, through a synthesis of the main observed changes in the climate over the 20th century and a summary of the conclusions of climate scenarios and projections for Portugal.

The ENAAC identified nine priority sectors: territory and urban development; water resources; safety of people and goods; human health; energy and industry; tourism; agriculture, forests and fisheries; coastal areas; and biodiversity. The creation of an inter-ministerial coordination group aimed to address all cross-cutting issues and provided a forum for discussing issues that are, by nature, cross-sectoral. The coordination group includes representatives of the Ministry of Foreign Affairs, the Autonomous Regions of Azores and Madeira and of the National Association of Portuguese Municipalities.

Madeira does not at present have a regional strategy on climate change, however it intends to develop one in the near future. The preparation of the strategy will be led by the Regional Government of Madeira and the Department for Spatial Planning and the Environment. It is thought that the strategy is likely to cover mitigation action, potential impacts of climate change on the islands, assess vulnerability of different sectors to these impacts and include some adaptation measures noting that more studies will need to be conducted to better understand potential impacts and map vulnerability of the Autonomous Region of Madeira to climate change.

10.2 Assessments

The "Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures" (SIAM) project is the most comprehensive and integrated assessment to date on the impacts and vulnerability associated with climate change in Portugal. It was also the first one to be undertaken in southern Europe (started in 1999). The second phase of the SIAM project (SIAM II), funded by the Portuguese Environmental Agency, started in 2002 and broadened the scope of the analysis to include the autonomous regions of the Azores and Madeira.

Expected climate impacts include:

- An increase in average temperatures – the IPCC AR4 (2007) climate scenarios predict a 1.9°C to 2.4°C increase in annual temperatures by the end of the century. The SIAM II project (Santos, Forbes and Moita, 2002) estimated a temperature increase of between 2ºC to 3ºC in Madeira, broadly consistent with the IPCC regional assessment; and
- A reduction in precipitation - a decrease in overall annual precipitation, characterised by a lower level of rainfall throughout autumn, winter and spring months, and a small increase in precipitation in the summer (Santos & Aguiar,

2006). It is estimated that the volume of water available annually for recharge of water resources will halve by the end of the century. The SIAM II project also projected a significant reduction (about 30%) in annual precipitation for Madeira. This is likely to have severe implications across the majority of economic sectors as well as human and environmental systems. In particular, it is likely to aggravate the problem of salt water intrusion already observed in wells located along the coast.

Madeira has also been part of CLIMAAT II, a research project carried out by institutions from the Azores, the Canary Islands and Madeira, carrying out an assessment of the impacts of climate change on the island. The study assessed the impacts of climate change for the Madeira archipelago in the following sectors: water resources, forests, agriculture, biodiversity, human health, tourism and energy. The assessment was based on the characterisation of the recent climate of the Madeira islands, including the ocean, and on future climate scenarios obtained from global climate models, through downscaling techniques adopted in the SIAM Project.

10.3 Priority Sectors

A study commissioned by the European Commission considered the information available on climate impacts and adaptation for all of the Outermost Regions, including Madeira, and synthesised this information into a high level climate risk assessment based upon environmental, social and economic consequences of anticipated climate change impacts. As a result of the climate risk assessment, the study identified priority sectors for adaptation action for Madeira as being:

- **Energy.** The energy sector in Madeira relies highly on imports for electricity generation. The electricity network is not connected to the mainland and therefore has to be self-contained. This makes the islands' energy sector highly vulnerable to potential impacts of climate change, e.g. storm damage affecting the ability to import fuel such as oil;
- **Tourism**. Tourism is the dominant economic sector in Madeira, with the island being one of the oldest tourist destinations in the world. 70% of tourism in Madeira depends on international tourists, therefore it is dependant on good transport links with mainland Europe, which may be affected by an increase in extreme weather events. Projected climate impacts such as changes in the precipitation regime will also impact tourism – either through drought or flooding;
- **Construction and buildings**. There is a significant concentration of buildings and infrastructure along the coast of Madeira, which will be at risk from flooding due to projected sea-level rise. Infrastructure more generally is at risk of flooding due to an increase in extreme weather events – linked to changes in the precipitation patterns. In February 2010 Madeira suffered severe flooding, leading to significant damage to infrastructure;
- **Transport.** Transport has a key role for Madeira - there is no alternative to air transportation, which plays a major role in international tourism. Transport between the islands relies on either aviation or ferries; extreme weather events and increased frequency of storms is therefore likely to have a major impact on the transport infrastructure in the Madeira, potentially causing severe economic losses;
- **Health.** Climate change has already been identified as an element affecting the incidence of vector organisms capable of transmitting vector-borne diseases in the archipelago of Madeira. Mosquito vectors transmitting yellow fever and dengue have been recorded in Madeira (first in 2004). Despite all the vector

control management initiatives, the mosquito population has found favourable climatic conditions to proliferate, and as a result, the region is at high risk of vector-borne diseases due to increased temperatures (an outbreak of dengue was recorded in November 2012). Projected warmer temperatures will favour the proliferation of mosquitoes and will therefore increase the risks to human health on the island;

- **Biodiversity.** Madeira is a biodiversity 'hot-spot', with a high number of endemic and rare species. In particular, the island of Madeira is home to the world's largest and best-preserved Laurel Forest, declared in 1999 a UNESCO World Heritage Site. Species which thrive at altitude may be threatened by changes in climate – e.g. warmer temperatures – as they may not be able to move uphill in search of cooler temperatures, as they are already on the mountain tops. However some species may benefit from warmer temperatures and expand their territories; and
- **Coastal zone management**. Given the concentration of infrastructure along the coast (residential and commercial, transport, tourism, health and emergency services infrastructure), and the risks posed by sea-level rise and associated flooding, coastal zone management is a key sector for Madeira.

10.4 Local Actions

Madeira does not at present have a regional strategy on climate change, however it intends to develop one in the near future. The preparation of the strategy will be led by the Regional Government of Madeira and the Department for Spatial Planning and the Environment. The strategy is likely to cover potential impacts of climate change on the islands, assess vulnerability of different sectors to these impacts and include some adaptation measures noting that more studies will need to be conducted to better understand potential impacts and map vulnerability of the Autonomous Region of Madeira to climate change.

Current efforts are focused on research activities aimed at the development of a knowledge base. A number of research programmes are being supported by the European "Transnational Cooperation Programme Madeira-Açores-Canarias (MAC) 2007-2013".

Some actions are being taken within Madeira which while not taken directly for climate change adaptation reasons, have the effect of improving climate resilience. For example, the port facilities at Funchal, Caniçal and Porto Novo on the island of Madeira have been recently improved.

10.5 Summary

Item	Status	Links
Portuguese Strategy for Adaptation to Climate Change (ENAAC)	Adopted in 2010	ENAAC 2010 *(in Portuguese only)*
Regional Strategy	None at present	
Action Plans	Not considered at this stage	
Impacts, vulnerability and adaptation assessments	Available primarily at the National Level	Project SIAM *(site in Portuguese only, publications in Portuguese and English)* ImpactE *(site and publications in Portuguese and English)* 2-FUN - Past, Present and Future Health Impacts of Extreme Events in Portugal *(site and publications in English)* Clitop Project - Climate Change & Tourism In Portugal: Potential Impacts & Adaptation Measures *(site and publications in English)* Project SIAM - Municipality of Sintra *(site in Portuguese only)* Project SIAM - Municipality of Cascais *(site in Portuguese only)*
Research programmes	Not currently available	
Climate services / Met Office	National level services established	IPMA
Web portal	Online	Climate Change Adaptation Portal *(in Portuguese only)*
Monitoring, Indicators, Methodology		Monthly climate monitoring *(in Portuguese and English)* Daily fire risk weather index *(in Portuguese and English)* Daily biometeorology and human bioclimatology indices *(in Portuguese and English)* Temperature extremes from climate records *(in Portuguese and English)* Climate normals (temperature and precipitation) *(in Portuguese and English)* *Drought monitoring (in Portuguese only)*

Item	Status	Links
		Daily water storage levels in river dams *(in Portuguese only)* Monthly water storage levels in aquifers *(in Portuguese only)*

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