



Building a pan-European observation system for geosciences

EU support for research infrastructures in environmental sciences



EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate B – European Research Area
Unit B.3 – Research Infrastructures

Contact: Agnès Robin (agnes.robin@ec.europa.eu)
Anna Maria Johansson (anna-maria.johansson@ec.europa.eu),
Janine Delahaut (Janine.delahaut@ec.europa.eu)

European Commission
B-1049 Brussels, Belgium

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Directorate-General for Research and Innovation
Research infrastructures

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Building a pan-European observation system for geosciences: needs and strategies

There is convincing evidence of the need to build a pan-European observation system for geosciences. From an EU perspective, the challenges are recognised and strategies are already in place and being further developed to achieve this aim¹.

Serving excellent research

"Distributed, long-term remote controlled observational networks applying state of the art technologies are of key importance to increase our understanding of processes to develop new predictive power in solid Earth systems and ecosystems, biodiversity, hydrology, climate change, etc.". In its Strategy Report and Roadmap update 2010, the European Strategy Forum on Research Infrastructures (ESFRI), highlighted the essential role that Earth observing systems (including more exploratory platforms) play in serving excellent environmental sciences and Earth system research².

Pooling resources

These research fields involve highly complex systems of very different time and spatial scales and require facilities ranging from (mobile or fixed) site specific multipurpose platforms to fully distributed facilities and related data centres. The scientific questions to be addressed (as well as the required level of investments) necessitate the pooling of resources at European level and, where relevant, at global level. Pooling resources is particularly important in the realisation of global initiatives such as GEOSS. However pooling resources is not straightforward³ and significant and continuous work on interoperability, standardisation and coordination with European and international initiatives is necessary.

Serving user communities beyond researchers

Most of the observing systems are developed for (and frequently operated by) the scientific community. They are however increasingly requested to serve a much broader community: policy makers and public authorities, especially in the context of risk management, or to stimulate industrial or social innovation. Research needs (e.g. in the context of climate change) and operational services for other users, have demonstrated the need for sustainable infrastructures aiming at permanent and long-term observations.

Diverse strategies and level of integration

To enhance integration in Europe, different complementary strategies are put in place (depending on the type of platforms, the scientific field and the history):

- integration of one class of observing platforms to optimise their operation, to benchmark and harmonise the quality of data and services provided, and to jointly develop innovative technologies, etc. (e.g. aircrafts, fleet of gliders)
- integration of complementary observing platforms in the same field or in close fields for the same objectives as above, aiming in particular at more integrated services to larger communities of users. (e.g. coastal observatories, carbon monitoring stations)

¹ The space component, already integrated at European level developed and managed by the European Space Agency is not considered although the complementary synergies are recognised.

² ESFRI Strategy Report on Research Infrastructures – Roadmap 2010.

³ Existing measuring and observing platforms have very diverse national backgrounds, sources of funding, ways of operating, data and access policies, strategy and governance.

- integration of different classes of observing platforms. This might cover platforms addressing more global scientific issues or with geographic constraints; it covers also most of the data and e-infrastructures. (e.g. Arctic Earth observing system, infrastructure for biodiversity and ecosystem research)

The level of integration ranges from networks developing joint services to a fully integrated infrastructure with a unique name and legal status. Whatever the (successive) strategies, key issues have to be addressed such as sustainability and financial engineering, governance (contribution to European and global monitoring initiatives such as GMES and GEOSS), and efficient management (including data).

EU support to relevant research infrastructures

For several years, the EU Framework programmes have supported the development of research infrastructures of pan-European interest⁴ leading to better integration and a more coherent and sustainable contribution to the existing overarching monitoring initiatives and related data and services.

Several of these infrastructures have been identified by ESFRI in its successive Roadmaps (2006, 2008 and 2010). The EU is supporting their preparatory phase which aims to bring the project to a level of legal and financial maturity necessary to implement it. While considered "new" research infrastructures, most of them are building on existing facilities and networks. However the final objectives of these ESFRI projects are the long term sustainability of these infrastructures and their joint governance at European level. The EU is also supporting conceptual design studies for new European research infrastructures. An example is the recently launched "GROOM" project (European glider capacity for research and sustained observations of the oceans).

Nevertheless, the major financial support which the EU's Framework programme provides is via the so-called "Integrating Activities" which bring together and integrate, on a European scale, key research infrastructures, in order to promote their coordinated use and development. Such projects combine *networking activities* (for coordination among the facilities but also with all relevant stakeholders), *transnational access activities* (for a wider access by the scientific community) and *joint research activities* (for improving the scientific services offered by the infrastructures).

Next steps

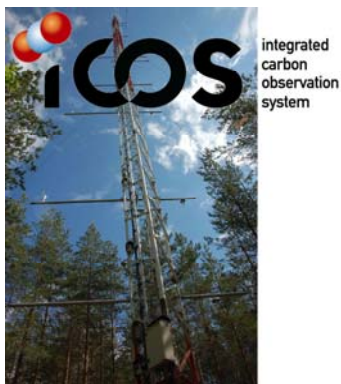
The EU will continue supporting the further integration of national and European facilities (example: on-going discussions on the need for an integrated European ocean observing System); the development of a consistent eco-system of research facilities (e.g. fostering links between RIs and GMES or GEOSS boards; increasing the interoperability of platforms, equipment and of course data); and the strengthening of international cooperation in this field.

⁴ FP7 "Capacities" specific programme, Research Infrastructures action. Additional support is offered under FP7 in particular under the "Cooperation" specific programme.

Atmospheric observation

ICOS - Integrated Carbon Observation System

ESFRI



The facility

ICOS will provide across Europe and adjacent regions a distributed infrastructure for standardised long-term high precision monitoring of atmospheric and oceanic greenhouse gas concentrations, ecosystem fluxes and essential carbon cycling variables. These measurements will allow daily determination of sources and sinks at scales down to about 100 km², and will be a basis for understanding the carbon exchange processes between the atmosphere, the terrestrial surface and the ocean.

Background

ICOS has a high scientific and societal pan-European and global relevance in the field of long term monitoring and research of greenhouse gases, their fluxes between atmosphere and continental biosphere and storage in the ecosystem. This distributed Research Infrastructure is both research and operational oriented (in the frame of GMES) and will enable European Member States and the EC to better respond to the obligations of the United Nations Framework Convention on Climate Change (UNFCCC). ICOS is the continuation of an ongoing preliminary project (through the Integrated Project CarboEurope) that demonstrates its feasibility and the maturity of the scientific and technical concepts. To secure the continuation of these observations a long term perspective should be guaranteed through the set up of an institutional concept (Research Infrastructure).

Steps for implementation

ICOS will soon move to its construction phase. Finland and France offered to host the headquarters of ICOS, and have submitted a joint application for the Atmospheric Thematic Centre. Italy, Belgium and France have submitted a joint application for the Ecosystem Thematic Centre.

The ICOS infrastructure is part of the **ESFRI roadmap**.

EU funding: €5 million in the ICOS Preparatory Phase project

Participation: 14 countries are participating in the ICOS preparatory phase project funded by the EU, under the coordination of France. The ICOS consortium consists of 18 partners (including ministries and funding organisations) from 13 countries.

First possible operation: 2013

More information: www.icos-infrastructure.eu

Note: the information relating to the infrastructures that are part of the ESFRI roadmap is mainly based on the document: *ESFRI Strategy report on research infrastructures, Roadmap 2010*.

EISCAT_3D - The next Generation European Incoherent Scatter Radar System

ESFRI



The facility

EISCAT_3D will be a three-dimensional imaging radar for atmospheric and geo-space research, which constitutes an upgrade to EISCAT, an existing international infrastructure based in Europe and devoted to the study of the upper atmosphere, ionosphere and geospace. This new large-scale European Research Infrastructure will have applications in a

wide range of European research areas including Earth environment monitoring and technology solutions supporting sustainable development, well beyond atmospheric and space sciences.

Background

EISCAT_3D represents a new concept in research radars for the upper atmosphere, based on multi-static phased arrays with state-of-the-art digital signal processing, which are intended to replace EISCAT's existing radars in northern Scandinavia. The new design will greatly extend EISCAT's data coverage and provide unique volumetric and small-scale imaging capabilities. It will also allow major improvements in temporal and spatial resolution, as well as producing new data products.

EISCAT_3D will contribute to Environmental sciences through studies of space weather and global change, as well as addressing atmospheric science and plasma physics. In addition to the EU-funded Preparatory Phase, a technology prototyping project has received 1M€ funding from regional development funds, to build a multi-beam test receiver at Kilpisjärvi in Northern Finland. The test station will use hardware concepts developed by the radio astronomy facility LOFAR. If successful, LOFAR hardware might provide the basis for the EISCAT_3D receiver sites.

Steps for implementation

EISCAT_3D is a development project of the EISCAT Scientific Association, whose headquarters are located in Kiruna, Sweden. The current EISCAT host countries (Sweden, Norway and Finland) should play a key role in EISCAT_3D, and it is expected that the other EISCAT members (UK, Germany, China and Japan) will participate at some level. Japan has invested strongly in Northern Scandinavia, financing one of EISCAT's two radar dishes on Svalbard, and has organized a national group discussing possible future participation in EISCAT_3D. There are also indications of interest by third countries, who are currently not members of EISCAT, such as Russia and US.

Picture caption: antenna array e3d artist impression

The EISCAT_3D infrastructure is part of the **ESFRI roadmap**.

EU funding: €4.5 million in the EISCAT_3D Preparatory Phase project

Participation: 5 countries are participating in the EISCAT_3D Preparatory Phase project under the coordination of Sweden. The consortium consists of 8 partner institutions from 5 countries. Three additional countries are participating in research activities. Several countries outside Europe have also expressed interest.

First possible operation: 2016

More information: www.eiscat.se



The facility

IAGOS will be established and operated as a distributed infrastructure for long term observations of atmospheric composition, aerosol and cloud particles on a global scale from a fleet of initially 10-20 long range in-service aircraft of internationally operating airlines. It will likely become a key component of a GMES service on air quality.

Background

IAGOS is an efficient and cost-effective approach to monitor the long-term variations of the atmospheric chemistry on the large scale, including many chemical species and aerosols. Data obtained by means of routine aircraft measurements have been widely used at the international level and notably within the Intergovernmental Panel on Climate Change (IPCC) process. Under full European leadership, IAGOS is important for long-term observations, given the scientific objectives of global climate change research. The first IAGOS aircraft was equipped in 2009 (deliverable of the Design Study IAGOS-ERI), while the CARIBIC aircraft is part of IAGOS since the start of Preparatory Phase. Three MOZAIK aircraft will be brought back to operation in 2010 as part of IAGOS.

Steps for implementation

At present the preparation and decision of an appropriate legal structure for IAGOS as distributed infrastructure, as well as a sustainable funding scheme; the integration of new partners (research institutions and airlines); the preparation of the operational basis (certification and maintenance) and new technical developments is discussed. Germany is currently negotiating to host the headquarters of IAGOS and many Member States have expressed their interest in the facility. The legal structure (International Association or ERIC) is under discussion between partners.

Picture caption: measuring instrument on Airbus A340

The IAGOS infrastructure is part of the **ESFRI roadmap**.

EU funding: €3.3 million in the IAGOS Preparatory Phase project

Participation: 4 countries are participating in the IAGOS Preparatory Phase project under the coordination of Germany. The consortium consists of 16 partners (including 2 ministries and funding organisations, 2 airlines and 2 industrial partners and manufacturers of instrumentation) and one associated organisation.

First possible operation: 2012

More information: www.iagos.org

COPAL - Heavy Payload long Endurance Tropospheric Aircraft

ESFRI



The facility

COPAL aims at providing the European scientific community in the field of environmental and Geosciences, with a unique research aircraft platform, capable of reaching and operating in any remote area in the world. It will offer an unprecedented opportunity to countries that are not yet operating research aircraft to develop expertise in airborne

measurements and participate to international multidisciplinary experiments. With a payload of 10 tons or more and an endurance of 10 hours, a heavy-payload, long endurance (HPLE) aircraft will more than double the capabilities offered to European scientists. 15 to 20 research laboratories will contribute to the multidisciplinary instrumental setup.

Background

COPAL (ex EUFAR) is supported by the European consortium of research aircraft operators and users under the umbrella of the EUFAR (European Fleet for Airborne Research) Integrating Activity. National management of research aircraft in Europe has resulted in a diverse fleet of small to large size aircraft. Today more than 30 instrumented aircraft are available for research, with a sampling speed from 30 to 200 m/s, a payload from 80 to 4500 kg, and a ceiling from the boundary layer up to 21 km. All aircraft of the European fleet however are limited to a practical endurance of 5 hours. This situation has so far precluded European scientists from performing research over oceanic, polar and remote continental areas, which are especially crucial for climate studies. COPAL will fill this gap in the European research aircraft fleet by providing a research aircraft platform capable of reaching and operating in any remote area in the world and offering a heavy-payload for integration of a wide range of instruments for research in environmental and geo-sciences. The design and implementation of the COPAL research aircraft will be done in cooperation with the operator of community research aircraft in the USA, and with the other Preparatory Phase studies, especially those with points of similarity with COPAL, such as the research vessels.

Steps for implementation

The consortium today consists of 13 partners (including one funding organisation). France has offered to host the headquarters of COPAL and many Member States have expressed their interest in this Research Infrastructure.

Picture caption: with the permission of Lockheed Martin

The COPAL infrastructure is part of the **ESFRI roadmap**.

EU funding: €1 million in the COPAL Preparatory Phase project

Participation: 9 countries are participating in the COPAL preparatory phase project under the coordination of France. The consortium today consists of 13 partners.

First possible operation: not yet defined

More information: www.eufar.net/copala

ACTRIS - Aerosols, Clouds, and Trace Gases Research Infrastructure Network



Climate change is for a large part governed by atmospheric processes, in particular the interaction between radiation and atmospheric components (e.g. aerosols, clouds, greenhouse and trace gases). Some of these components are also those with adverse health effects influencing air quality. Strengthening the ground-based component of the Earth Observing System for these key atmospheric variables has unambiguously been asserted in the IPCC Fourth Assessment Report and Thematic Strategy on air pollution of the EU. However, a coordinated research infrastructure for these observations is presently lacking.

ACTRIS aims at filling this observational gap through the coordination of European ground-based network of stations equipped with advanced atmospheric probing instrumentation for aerosols, clouds and short-lived trace gases.

ACTRIS is a coordinated network that contributes to:

- providing long-term observational data relevant to climate and air quality research produced with standardized or comparable procedures;
- supporting transnational access to large infrastructures strengthening collaboration in and outside the EU and access to high quality information and services to the user communities;
- developing new integration tools to fully exploit the use of atmospheric techniques at ground-based stations, in particular for the calibration/validation/integration of satellite sensors and for the improvement of global and regional-scale climate and air quality models.

ACTRIS will have the essential role to support integrated research actions in Europe for building the scientific knowledge required to support policy issues on air quality and climate change.

Picture caption: Measuring tower in Cabauw, NL

EU funding: €7.8 million for the ACTRIS Integrating Activity project under FP7. ACTRIS is a follow-up project of the EARLINET-ASOS and EUSAAR projects on measurement of atmospheric aerosols from the ground that were supported by the EU under FP6 for a total of €7.9 million.

Partners: 28 organisations from 19 countries: Belarus, Belgium, Bulgaria, Czech Republic, Hungary, Italy, Finland, France, Germany, Greece, Ireland, Netherlands, Norway, Poland, Romania, Spain, Sweden, Switzerland, United Kingdom.

Start date: 01/04/2011 - **Duration:** 48 months

More information: <http://www.actris.net/>

EUFAR - European Facility for Airborne Research in Environmental and Geoscience



EUFAR coordinates the operation of instrumented aircraft and hyperspectral imaging sensors, exploiting the skills of experts in airborne measurements in the fields of environmental and geosciences, in order to provide researchers with the infrastructure best suited to their needs. EUFAR provides trans-national access to 26 installations.

The EUFAR consortium comprises 35 legal entities, out of which 15 are operators of airborne facilities, and 20 experts in airborne research. A Scientific Advisory Committee contributes to a better integration of the users with the operators to tackle new user driven developments. The project also aims at the joint development of airborne infrastructures in terms of capacity and performance. It will facilitate a wider sharing of knowledge and technologies across fields and contribute to better structure the way research infrastructures operate. The development of a central database for airborne activities improves the access to the data collected by the aircraft. All these activities rely on a unique web portal to airborne research in Europe.

Picture caption: ATR42-SAFIRE

EU funding: €8.0 million for the Integrating Activity under FP7 and €5 million for the Integrated Infrastructure initiative under FP6. EUFAR activities have also been funded under FP5.
Partners: 34 organisations from 13 countries: Belgium, Czech Republic, Finland, France, Germany, Hungary, Israel, Italy, Netherlands, Poland, Spain, Switzerland, United Kingdom
Start date: 01/10/2008 - **Duration:** 48 months
More information: <http://www.eufar.net/>

InGOS - Integrated non-CO₂ Greenhouse Gas Observation System



There is a big need to support and integrate the observing capacity of Europe on non-CO₂ greenhouse gases (NCGHG: CH₄, N₂O, SF₆, H₂ and halocarbons). The emissions of these gases are very uncertain and it is unknown how future climate change will feedback into these (mainly land use coupled) emissions. The InGOS project will work on standardizing the measurements, strengthen the existing observation sites into supersites, capacity building in new member states, and prepare for integration of the network with other networks already in place or currently being set up (e.g. ICOS).

Attribution of source categories by using advanced isotope techniques and data-assimilation methods using high resolution transport model will be an integral part of the network to allow design and evaluation of the measurements and will link the network to remote sensing data and bottom up inventory developments.

Picture caption: Jungfraujoch EMPA (CH)

EU funding: €8.0 million for the Ingos Integrating Activity project under FP7.
Partners: 34 organisations from 14 countries: Belgium, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Spain, Sweden, Switzerland, United Kingdom
Start date: 01/10/2011 - **Duration:** 48 months
More information: www.ingos-infrastructure.eu

IS-ENES - Infrastructure for the European Network for Earth System Modelling



ENES, through IS-ENES, promotes the development of a common distributed modelling research infrastructure in Europe in order to facilitate the development and exploitation of climate models and better fulfil the societal needs with regards to climate change issues. IS-ENES gathers 18 partners from 10

European countries and includes the 6 main European Global Climate Models. IS-ENES combines expertise in climate Earth system modelling (ESM), in computational science, and in studies of climate change impacts.

The IS-ENES project follows four main objectives:

- Fostering the integration of European climate & ESM community;
- Fostering the development of ESMs for the understanding of climate change;
- Fostering high-end simulations enabling better understanding & prediction of future climate change;
- Fostering the application of ESM simulations to better predict & understand future climate change impacts.

EU funding: €7.6 million for the Integrating Activity project under FP7

Partners: 18 partners from 10 countries: Germany, Greece, Finland, France, Italy, Netherlands, Romania, Spain, Sweden, United Kingdom

Start date: 01/03/2009 **Duration:** 48 months

More information: <https://is.enes.org/>

Ocean and marine observation

EMSO - European Multidisciplinary Seafloor Observatory

ESFRI



The facility

EMSO is the European Multidisciplinary Seafloor Observatory, a research infrastructure for long term permanent monitoring of the ocean margin environment around Europe. It is considered critical by the European Science Foundation marine board. EMSO is an essential tool for deep sea research including geosciences and geo-hazards, physical oceanography, biology and non-living resources.

Background

Cabled sea-floor observatories are needed to collect simultaneously long time series of data identifying temporal evolutions, cyclic changes and capturing episodic events related to oceanic circulation, deep-sea processes and ecosystems evolution. In addition, long-term monitoring will allow the capture of episodic events such as earthquakes, submarine slides, tsunamis, benthic storms, bio-diversity changes, pollution and other events that cannot be detected and monitored by conventional oceanographic sea-going campaigns.

A final detailed plan of involving the e-tools in EMSO is also needed. The plan should clearly state all connections with e-infrastructures for data gathering, processing, storage and transfer. A very good connection with other European projects has been developed by the EMSO Consortium, including not only projects from the field of environmental sciences but also with other domains (e.g. Km3NeT). Stronger links should nevertheless be forged with the Research Infrastructure Euro-Argo. EMSO has strong potential for international collaboration outside Europe.

Steps for implementation

Even though firmly on the way towards implementation, there are still several steps EMSO should take towards full operability. Thus, efforts should be taken towards achieving the ERIC (European Research Infrastructure Consortium) status for its consortium. EMSO will propose an ERIC in 2012. EMSO Secretariat is foreseen to be hosted in Italy.

The EMSO infrastructure is part of the **ESFRI roadmap**.

EU funding: €3.9 million in the EMSO Preparatory Phase project

Participation: 12 countries are participating in the EMSO preparatory phase project under the coordination of Italy. The consortium consists of 12 partners (including 8 with official mandate from ministries and funding organisations) from 12 countries

First possible operation: 2014

More information: www.emso-eu.org



The facility

Argo is a global ocean observing system with the primary goal to maintain the 3000 floats array over the next 10 to 20 years. This is extremely challenging and success in such a major undertaking can be achieved only through a very high degree of international cooperation and integration. Euro-Argo will develop and progressively consolidate the European component of the global

network. Specific European interests also require increased sampling in some regional seas. Overall, the Euro-Argo infrastructure should comprise 800 floats in operation at any given time. The maintenance of such an array would require Europe to deploy about 250 floats per year. Euro-Argo must be considered in its entirety: not only the instruments, but also the logistics necessary for their preparation and deployment, field operations, the associated data streams and data centres.

Background

Argo is endorsed by the Climate Research Programme of the World Meteorological Organisation (WMO), the Global Ocean Observing System (GOOS), and the Intergovernmental Oceanographic Commission (IOC). In November 2007, the international Argo programme reached its initial target of 3,000 profiling floats. These floats measure every 10 days temperature and salinity throughout the deep global oceans, down to 2,000 metres. Argo is now the major, and only systematic, source of information and data over the ocean's interior. Argo is widely recognized as a revolutionary achievement in ocean observation. The Argo array is an indispensable component of the Global Ocean Observing System required to understand and monitor the role of the ocean in the Earth's climate system. Satellite observations constitute a useful complement to the Argo observations. The Argo data are readily assimilated with those from satellites into ocean circulation and climate models, in support of research and operational applications. Argo is the single most important in-situ data set used today for the Global Monitoring for Environment and Security (GMES) Marine Core Service.

Steps for implementation

The Euro-Argo structure will include a central facility and distributed national facilities. The central facility will have a European legal structure (ERIC) to receive EC and Member states funding, to procure floats (including logistics and test facilities) and to provide funding to the international structure. The consortium submitted an application for the ERIC in August 2011.

Picture caption: an Arvor float at sea

The Euro-Argo infrastructure is part of the **ESFRI roadmap**.

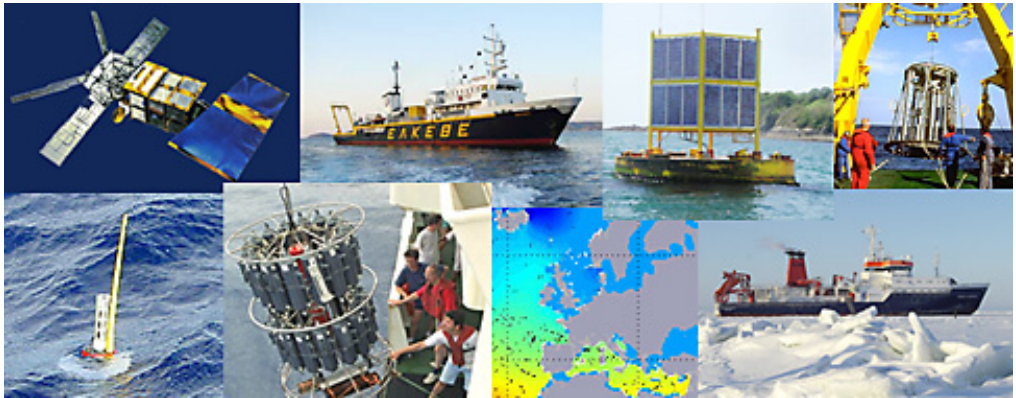
EU funding: €3 million in the Euro-Argo Preparatory Phase project. Euro-Argo is also supported with €0.9 million through the SIDERI project to strengthen its international dimension.

Participation: 12 countries are participating in the Euro-Argo preparatory phase project under the coordination of France. Eight European countries have indicated their interest in the construction phase, while 3 - 4 countries will likely have observer status.

First possible operation: 2011

More information: www.euro-argo.eu

SeaDataNet - Pan-European Infrastructure for Ocean and Marine Data Management



The overall objective of the SeaDataNet II project is to upgrade the SeaDataNet infrastructure into an operationally robust and state-of-the-art Pan-European infrastructure for providing up-to-date and high quality access to ocean and marine metadata, data and data products originating from data acquisition activities by all engaged coastal states. SeaDataNet is undertaken by the National Oceanographic Data Centres (NODCs) and marine information services of major research institutes from 30 coastal states bordering the European seas. It also includes Satellite Data Centres, expert modelling centres, and the international organisations IOC, ICES and EU-JRC in its network.

SeaDataNet II will undertake activities to achieve data access and data products services that meet requirements of end-users and intermediate user communities, such as GMES Marine Core Services (e.g. MyOcean), establishing SeaDataNet as the core data management component of the EMODNet infrastructure and contributing on behalf of Europe to global portal initiatives, such as the IOC/IODE – Ocean Data Portal (ODP), and GEOSS. Moreover it aims to achieve INSPIRE compliance and to contribute to the INSPIRE process for developing implementing rules for oceanography.

Picture source: <http://www.seadatanet.org/>

EU funding: €6.0 million for the Integrating Activity project under FP7 and €8.75 million for the SeaDataNet Integrated Infrastructure Initiative project under FP6.

Partners: 44 organisations from 30 countries: Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovenia, Sweden, Spain, Turkey, Ukraine, United Kingdom

Start date: 01/12/2011 - **Duration:** 48 months

More information: <http://www.seadatanet.org/>

UP-GRADE BS-Scene – Up-Grade Black Sea Scientific Network



The Black Sea SCENE project established a Black Sea Scientific Network of leading environmental and socio-economic research institutes, universities and NGO's from the countries around the Black Sea. It developed a distributed virtual data and information infrastructure populated and maintained by these organisations aiming at improving the identification, access, exchange, quality indication and use of data about the Black Sea.

The Up-Grade of Black Sea SCENE extended the existing research infrastructure with 19 marine environmental institutes/organizations from the 6 Black Sea countries. The consortium is now undertaken by more than 50 partners of which more than 40 are located in the Black Sea countries.

The Black Sea SCENE research infrastructure network provides improved data & information delivery services for the Black Sea region at a European level. It strengthens the regional capacity and performance of marine environmental data & information management and underpins the harmonization with European marine data quality control/assessment procedures as well as the adoption of international meta-data standards and data-management practices.

Picture source: <http://www.blackseascene.net/>

<p>EU funding: €3.4 million for the Integrating Activity project under FP7 and €2 million for the Integrated Infrastructure Initiative project under FP6.</p> <p>Partners: 49 partners from 12 countries: Belgium, Bulgaria, Cyprus, Greece, Georgia, Netherlands, Poland, Romania, Russia, Turkey, Ukraine, United Kingdom</p> <p>Start date: 01/01/2009 Duration: 36 months</p> <p>More information: http://www.blackseascene.net/</p>
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JERICO – Towards a Joint European Research Infrastructure Network for Coastal Observatories



Coastal observations are an important part of the marine research puzzle of activities and applications. However significant heterogeneity exists in Europe concerning technological design of observing systems, measured parameters, practices for maintenance and quality control, as well as quality standards for sensors and data exchange. Up to now, the expansion of “coastal observatories” has been driven by domestic interests and mainly undertaken through short-term research projects.

Therefore the main challenge for the research community is now to increase the coherence and the sustainability of these dispersed infrastructures by addressing their future within a shared pan-European framework. This is the main objective of JERICO, which proposes a Pan European approach for a European coastal marine observatory network, integrating infrastructure and technologies such as moorings, drifters, ferrybox and gliders.

Networking activities will lead to the definitions of best practices for design, implementation, maintenance and distribution of data of coastal observing systems, as well as the definition of a quality standard. Harmonisation and strengthening coastal observation systems within EuroGOOS regions will be sought. Unique twin transnational access experiments will be carried out in order to reveal the potential of datasets used in synergy. Central coastal infrastructure in Europe will be opened for international research. This will among other benefits GMES and European contribution to climate change research. New joint research will be conducted in order to identify new and strategic technologies to be implemented in the next generation European coastal observatories. Focus is given on emerging technologies and the biochemical compartment.

JERICO intends to contribute to the international and global effort on climate change research (GEOSS), to provide coastal data inputs for operational ocean observing and forecasting, and also to answer to some of the needs of the environmental research and societal communities.

Picture caption: glider, autonomous underwater vehicle, Source: <http://cobs.pol.ac.uk/>

EU funding: €6.5 million for the Integrating Activity project under FP7

Partners: 27 partners from 17 countries: Belgium, Bulgaria, Denmark, Germany, Greece, Finland, France, Ireland, Italy, Malta, Netherlands, Norway, Poland, Portugal, Spain, Sweden, United Kingdom

Start date: 01/05/2011 **Duration:** 48 months

More information: <http://www.jerico-fp7.eu/>

EUROFLEETS - Towards an Alliance of European Research Fleets



The quality of the infrastructures available for marine research affects directly Europe research performance. As marine research infrastructures are considered as key elements of the European Strategy for Marine Research under development, a coherent pan-European approach with enhanced partnership in investment, development and usage of fleets, will have a significant impact to better

meet the diverse needs of European marine research.

The EUROFLEETS process is based on the recent recommendations from the Marine Board of the ESF. It aims at bringing together the European research fleets owners to enhance their coordination and promote the cost-effective use of their facilities. It supports research services for the monitoring and the sustainable management of the Regional Seas and the Oceans, and organises a common access to all European scientists on sole condition of scientific excellence.

EUROFLEETS provides all European researchers with access to 19 high performing research vessels from 15 different countries. This would enable the EU to reach its ambitious goals about maintaining the ocean biodiversity or understanding climate change.

Picture caption: Mare Nigrum, operator: GeoEcoMar, Romania, Copyright: GeoEcoMar

EU funding: €7.2 million for the Integrating Activity project under FP7

Partners: 24 partners from 16 countries: Belgium, Bulgaria, Germany, Estonia, Greece, France, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Romania, Spain, Turkey, United-Kingdom

Start date: 01/09/2009 **Duration:** 48 months

More information: <http://www.eurofleets.eu/>

Arctic observation

SIOS – Svalbard Integrated Arctic Earth Observing System

ESFRI



The facility

The goal of SIOS is to establish an observational Research Infrastructure for the Arctic Earth System, integrating studies of geophysical, chemical and biological processes from the research and monitoring platforms. It corresponds to a need concerning climate change monitoring. The Research Infrastructure is mainly European with a strong international component, with the presence of a

large number of research institutes from all over the world (EU Member States and associated states, and other countries such as Russia, China, Japan, Korea, USA and India). It is of use for a very broad and interdisciplinary user community and offers opportunities for education and training of young scientists - also in a broad international context.

Background

Svalbard's geographical location and extensive Research Infrastructure provides excellent opportunities for studies of ecosystem changes and its effects on the food chain, oceanic and atmospheric transport patterns which prevail in the Arctic region, integrating observations and analysis of the changing Arctic ice cover, unique studies of the energy balance between layers of the atmosphere, from the borders of space to the surface of Earth and for dense satellite monitoring. The impact of climate change, pollution and other pressures on the environment appear sooner and with more severe consequences in the High Arctic compared to regions at lower latitudes. The High Arctic can therefore be seen as an early warning region.

Towards a common polar research strategy

Most countries involved in SIOS have national polar research stations in the Svalbard area, and virtually all countries have national polar research plans. The SIOS project is a unique opportunity to harmonize existing and develop a future common polar research strategy with minimized redundancies. SIOS will provide a "one-stop shop" for arctic system data and a common information base for European Arctic topics.

Picture copyright: Terje Tellefsen

The SIOS infrastructure is part of the **ESFRI roadmap**

EU funding: €4 million in the SIOS Preparatory Phase project

Participation: 14 countries are participating in the SIOS preparatory phase project funded by the EU, under the coordination of Norway. Moreover, major international programmes, organizations and core stakeholders are represented in the SIOS Advisory Board.

More information: <http://www.sios-svalbard.org>

INTERACT - International Network for Terrestrial Research and Monitoring in the Arctic



Environmental change and particularly amplified global climate change are accelerating in the Arctic. These changes already affect local residents and feedback from the Arctic's land surface to the climate system, will have global implications. However, climate change and its impacts are variable throughout the wide environmental and land use envelopes of the Arctic.

The Arctic is generally remote, sparsely populated and research and monitoring activities are more restricted in time and space than elsewhere. This limitation comes when there is a rapidly expanding need for knowledge as well as increasing technological opportunities to make data collection in the field and accessibility more efficient.

INTERACT is a network under the auspices of SCANNET, a circumarctic network of terrestrial field bases. INTERACT specifically seeks to build capacity for research and monitoring in the European Arctic and beyond. Partnerships will be established between Station Managers and researchers within joint research activities that will develop more efficient networks of sensors to measure changing environmental conditions and make data storage and accessibility more efficient through a single portal. New communities of researchers will be offered access to Arctic terrestrial infrastructures while local stakeholders as well as major international organisations will be involved in interactions with the infrastructures.

This will lead to increased public awareness of environmental change and methods to adapt to them, increased access to information for education at all levels, and input to major international research and assessment programmes. The whole consortium will form a coherent and integrated unit working within a concept of a wide environmental and land use envelopes in which local conditions determine the directions and magnitudes of environmental change whereas the balance and synergies of processes integrated across the whole region have global impacts.

Picture: Carsten Egevang, Greenland Institute of Natural Resources

EU funding: €7.3 million for the Integrating Activity project under FP7

Partners: 32 partners from 14 countries: Canada, Denmark, Germany, Greece, Finland, Faroe Islands, Greenland, Iceland, Italy, Norway, Russia, Sweden, United Kingdom, United States

Start date: 01/01/2011 **Duration:** 48 months

More information: [http:// www.eu-interact.org](http://www.eu-interact.org)

Solid Earth observation

EPOS - European Plate Observing System

ESFRI



The facility

EPOS will create a single sustainable, permanent observational infrastructure, integrating existing geophysical monitoring networks (e.g. seismic and geodetic networks), local observatories (e.g. volcano observatories) and experimental laboratories (e.g., experimental and analytic lab for rock

physics and tectonic analogue modeling) in Europe and adjacent regions. It will coordinate the currently scattered, but highly advanced, European facilities into one distributed, coherent multidisciplinary Research Infrastructure.

Background

A tectonic plate is a single dynamic system requiring a unique integrated multidisciplinary and long-term sustainable observing system. Presently, different European countries own a mosaic of hundreds of impressive, but separated networks, observatories, temporary deployments and facilities for solid earth studies. Combining a wide variety of data and modelling tools are prerequisites to innovative research and for better understanding of the physical processes controlling earthquakes, volcanic eruptions and other catastrophic events, such as landslides and tsunamis. Europe's most active areas are also those where population density is high. Even moderate-size earthquakes may turn catastrophic when they strike large urban agglomerations with poor building construction practice. Advances in understanding of the behaviour of faults or volcanoes as well as quantifying hazards largely rely on strategic investments in Research Infrastructure in this field. EPOS is already actively networking the existing European facilities on seismological and geodetic monitoring as well as solid Earth observations. It will promote innovative approaches for a better understanding of the physical processes controlling earthquakes, volcanic eruptions and tsunamis, as well as those driving tectonics and Earth surface dynamics.

Steps for implementation

In a first step, existing national Research Infrastructures will be integrated through the EPOS Data Centres, a network of community service providers for distributed data storage and processing. For seismology in particular, ORFEUS already integrates seismic monitoring infrastructures and has developed a first ICT infrastructure for data archiving and mining. In a second step, innovative and coherent e-infrastructure architecture will be developed, which will form the platform and data service infrastructure. By means of the EPOS Core Services, it will provide interdisciplinary data exchange, processing tools and computational simulations.

Picture source: www.epos-eu.org

The EPOS infrastructure is part of the **ESFRI roadmap**.

EU funding: €4.5 million in the EPOS Preparatory Phase project

Participation: 18 countries are participating in the EPOS preparatory phase project funded by the EU, under the coordination of Italy. The EPOS consortium today consists of 20 partners and 6 associated organisations from 23 countries.

First possible operation: 2020

More information: www.epos-eu.org

The EU also provides support (€9.0 million) to a Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation. The **NERA** project (2010-2014) integrates key research infrastructures in Europe for monitoring earthquakes and assessing their hazard and risk. The overall aim of NERA is to achieve a measurable improvement and a long-term impact in the assessment and reduction of the vulnerability of constructions and citizens to earthquakes. The NERA consortium consists of 28 partners (universities and research centres) from 15 countries.

More information: <http://nera-eu.org/>



The facility

LifeWatch is an e-science and technology infrastructure for biodiversity and ecosystem research to support the scientific community and other users. It is putting in place the infrastructure and information systems necessary to provide an analytical platform for the modelling and simulation of both existing and new data on biodiversity to enhance the knowledge of biodiversity

functioning and management.

Background

While we are exploring other planets, it is surprising how little we still know about our own planet Earth. This is especially true for our understanding of the living world, the biological diversity of species, their genes and the ecosystems in which they occur. We also need novel approaches to understand and sustainably manage our environment so that human activities and the natural environment are balanced. EU projects and the Global Biodiversity Information Facility have made much progress in providing access to interoperable biodiversity databases, but data integration and large-scale analytical and modelling facilities have to provide the research community with a new methodological approach to understand the biodiversity system. The LifeWatch Research Infrastructure will contribute as a European component to the Global Earth Observation System of Systems (GEOSS) 10-year implementation plan, particularly in relation to enabling global, multi-system capabilities for research, ecosystem management and biodiversity conservation; and improving the coverage, quality, and availability of essential information from a variety of data resources, including in situ observatories and the integration of in situ and satellite data.

Steps for implementation

Eight countries signed a Memorandum of Intent. These countries did enter the final negotiations towards submitting the ERIC Statutes for approval, and will establish a start-up organisation as a transition to the construction phase. The ERIC application is expected to be submitted to the European Commission in 2012. Three countries (Italy, the Netherlands and Spain) offered to take lead with advance funding to allow for continuity. The statutory seat of LifeWatch will be hosted in Spain.

Picture copyright: Phernambucq

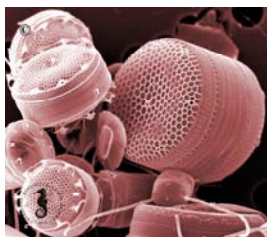
The LIFEWATCH infrastructure is part of the **ESFRI roadmap**.

EU funding: €5.0 million in the LIFEWATCH Preparatory Phase project. The EU is also providing €0.7 million to the project CReATIVE-B to support the interaction between LifeWatch and research infrastructures on biodiversity research in other parts of the world.

Participation: 20 countries are participating in the LIFEWATCH preparatory phase project funded by the EU, under the coordination of The Netherlands.

First possible operation: 2012

More information: www.lifewatch.eu



The Facility

The European Marine Biological Resource Centre will comprise a consortium of key European marine biological and molecular biology laboratories, together providing: (1) access to a wide range of European coastal marine biota and their ecosystems; (2) an integrated supply of marine organisms for interdisciplinary research, including existing and new models; (3) coordinated services including state-of-the-art bio-banks and dedicated platforms for genomics, structural and functional biology, microscopy and bioinformatics; (4) interdisciplinary training in marine biological sciences and genomics; and (5) outreach to stakeholders, users and the public at large.

Background

Marine biodiversity is essential in ecosystem functioning and for our quality of life. This has stimulated construction of marine biological research institutes around the European coastline over the last 125 years. Over time, these have developed, largely independently, into world renowned facilities. Taken together, the European marine biological stations represent a critical mass of infrastructure and human resources that has had a significant influence on the history of worldwide marine research.

Marine biology is currently experiencing ground-breaking technological and theoretical advances, notably associated with the introduction of state-of-the-art '-omics' approaches. This is facilitating rapid progress in existing disciplines, integration of this field into a range of other research domains, and creation of major new avenues of research. The need for integrated study in marine biology is becoming increasingly compelling as global warming and ocean acidification start to affect whole ecosystems. In parallel, the pressure on stocks of commercial marine bio-resources is rapidly escalating, resulting in increasing focus on mariculture alternatives, and biotechnological interest in the extremely diverse pool of materials, molecules and genes from marine organisms is booming.

Steps for implementation

The Preparatory Phase started in February 2011. The aim is to develop a coherent pan-European strategy for interconnecting, harmonising and upgrading the actual infrastructures and the common services they provide in light of common analysis and projection of Europe-wide user requirements.

Picture caption: A phytoplankton sample featuring *Thalassiosira* species, for one of which the genome has been sequenced. Copyright: SZN

The EMBRC infrastructure is part of the **ESFRI roadmap**.

EU funding: €7.5 million in the EMBRC Preparatory Phase project

Participation: 9 countries are participating in the EMBRC preparatory phase project funded by the EU, under the coordination of Italy.

First possible operation: 2014

More information: www.embrc.eu

ASSEMBLE - Association of European Marine Biological Laboratories



Europe has a very long and distinguished history in marine biology and its coastal marine biological stations are the oldest in the world. For example, Stazione

Zoologica in Naples (SZN), Station Biologique in Roscoff (SBR) and Kristineberg Marine Research Station in Fiskebäckskil (KMRS) were all established in the late 19th Century. They began an enviable tradition as marine biological research stations that acted, even at that time, as international infrastructure sites to serve, enhance and develop collaborative marine research worldwide.

Now, however, they have become a new breed of marine research station, developing and applying new technologies and facilities that allow a higher quality of service, not only to the marine biologist community but also to the increasing numbers of scientists that are turning to marine organisms as models with which to investigate fundamental questions in biology. Building upon this enviable tradition ASSEMBLE seeks to create a network of key marine biological research stations around the European coastline including the sub-tropical station at Eilat (IUI). Uniquely, ASSEMBLE also include a Pacific site in Chile (PUC) that provides access to one of the most important upwelling sites in the world.

The aim is to develop an integrated infrastructure that will make possible for biologists in Europe to study a range of unique coastal ecosystems and a wide variety of marine organisms using the most advanced approaches in modern biology. It will be based on the existing hosting capacities, sea-going facilities and research background of these marine stations, which, as noted above, already have a long experience in hosting students and visiting scientists. This infrastructure will focus on key marine ecosystems and biological models, making possible both the enhancement of existing infrastructures and the introduction and development of new technologies. These include, for example, indoor and outdoor equipment for the cultivation/raising/stud.

Picture caption: IUI - research vessels, M Cock. Source: <http://www.assemblemarine.org/>

EU funding: €8.7 million for the Integrating Activity project under FP7

Partners: 8 partners from 8 countries: Chile, Germany, France, Israel, Italy, Portugal, Sweden, United Kingdom

Start date: 01/03/2009 **Duration:** 48 months

More information: <http://www.assemblemarine.org/>

EXPEER - Distributed Infrastructure for Experimentation in Ecosystem Research



EXPEER brings together, major observational, experimental, analytical and modelling facilities in ecosystem science in Europe. By uniting these highly instrumented ecosystem research facilities under the same umbrella and with a common vision, EXPEER has the multidisciplinary expertise and critical mass to integrate and structure the European long-term ecosystem research facilities.

EXPEER builds on an ambitious plan for networking research groups and facilities. The joint research activities will provide a common framework and roadmap for improving the quality, interaction and individual as well as joint performance of these infrastructures in a durable and sustainable manner. EXPEER provides a framework for increased use and exploitation of the unique facilities through a strong and coordinated programme for transnational access to the infrastructures.

The establishment of the EXPEER Integrated Infrastructure enables integrated studies of the impacts of climate change, land use change and loss of biodiversity in terrestrial ecosystems through two major steps:

- Bringing together the EXPEER Infrastructures to enable collaboration and integration of observational, experimental and modelling approaches in ecosystem research (in line with the concept developed in ANAEE);
- Structuring existing network of ecosystem observational, monitoring and experimental sites across Europe (LTER-Europe).

Picture source: <http://www.expeer.fr/>

EU funding: €7.4 million for the Integrating Activity project under FP7

Partners: 37 partners from 19 countries: Austria, Belgium, Denmark, Germany, Finland, France, Hungary, Israel, Italy, The Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, United Kingdom

Start date: 01/12/2010 **Duration:** 48 months

More information: <http://www.expeer.fr/>

Support to common operations of research infrastructures

ENVRI - Common Operations of Environmental Research Infrastructures

The EU supports the Implementation phase of the ESFRI research infrastructures through cluster projects in a given scientific field. In environmental sciences, support is provided to the ENVRI project gathering seven ESFRI Environment projects (the others are represented in the advisory board) to develop, with the support from ICT experts, common data and software components and services for their facilities.

The results will speed up the construction of these infrastructures and will allow interoperability among them. Common challenges faced by the ENVRI infrastructures include data capture from distributed sensors, metadata standardisation, handling of high volume data, workflow execution and data visualisation. The common standards, deployable services and tools developed by ENVRI will be adopted by each infrastructure as it progresses through its construction phase. The project will be based on a common reference model created by capturing the semantic resources of the ESFRI infrastructures.

EU funding: €3.7 million

Partners: 16 partners from 8 countries: Austria, Germany, Finland, France, Italy, The Netherlands, Sweden, United Kingdom

Start date: 01/11/2011

Duration: 36 months



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A major step took place in the European Research Area since 2006 with the inclusion into the ESFRI Roadmap of about ten pan-European distributed infrastructures aimed at atmospheric and ocean as well as the Arctic and plate observation. Two of them are more specifically orientated to the monitoring and research on biodiversity and marine ecosystems.

The present document is a European Commission working document, intended to be further developed for publication in 2012 and prepared in view of presenting the contribution of EU research infrastructures to the development of a pan-European earth observation system, in the framework of the GEO VIII Meeting, held on 16-17 November 2011 in Istanbul.

Further information on the European policy regarding research infrastructures:

www.ec.europa.eu/research/infrastructures

Further information on the ESFRI Roadmap:

www.ec.europa.eu/research/esfri