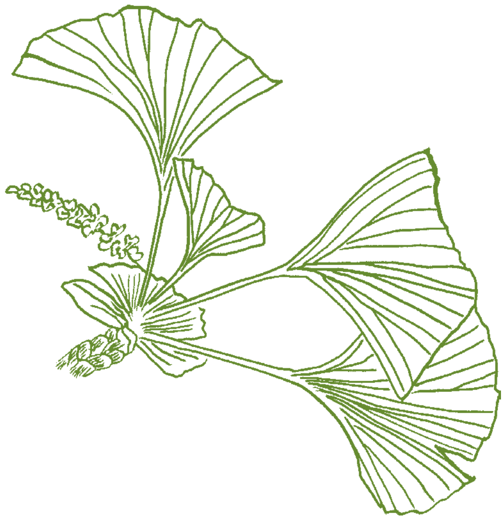
ESFRI European Strategy Forum on Research Infrastructures



Environmental Sciences

Thematic Working Group Report 2010

Contact:
ESFRI Secretariat
Postal address:
European Commission
SDME 01/128
B-1049 Brussels, Belgium
Tel: +00 32 2 299 25 39
Fax: +00 32 2 299 21 02
ESFRI@ec.europa.eu

www.ec.europa.eu/research/esfri

ESFRI European Strategy Forum on Research Infrastructures

Environmental Sciences Thematic Working Group Report 2010

FOREWORD

Eeva Ikonen

Environmental sciences cover a broad range of scientific fields and applications, such as biology, ecology, climate modelling, waste treatment, just to mention a few. Throughout this report environmental sciences are referred to in their broad sense. *Environmental RIs belong into flagships for EUROPE 2020, the European strategy for smart, sustainable and inclusive growth.*

In its "Strategy of 2020" the European Strategy Forum on Research Infrastructures (ESFRI) has given the Environmental Thematic Working Group (ENV TWG) a mandate to follow up on projects and initiatives in the field of environmental sciences, to support discussions within the environmental science community and to communicate a research infrastructure strategy for the environmental sciences.

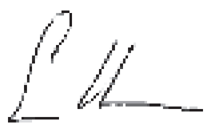
Strong dependence on fossil fuels, such as oil, inefficient use of raw materials combined with the expansion of the world population from 6 to 9 billion will intensify global competition for natural resources and put pressure on the environment. Europe must continue its outreach to other parts of the world in pursuit of global solutions to these problems and at the same time implement our agreed climate and energy strategy across Europe. The European environmental research infrastructures (ENV RIs) have a significant global role as knowledge providers for sustainable use of different ecosystems and of diminishing natural resources, as well as knowledge seeking on a more fundamental level in areas such as biology, biodiversity, oceanography, aerosols, climate, etc.

ENV RIs have an important role by implementing high quality environmental research and data sharing in scientific community (as well as other data users in society). It is therefore important to bring the existing RIs to work together, to cluster, and ensure that new RIs complete the existing ones in order to make efficient use of sparse resources.

Because of the global scale and complexity of environmental research, and due to high costs of environmental RIs, international collaboration is essential. The number of new users of ENV RIs in and outside Europe is expected to grow future years. Natural partners of pan-European RIs are global research and monitoring programmes of the planet Earth launched by international organisations. Some RIs, in particular SIOS, EISCAT_3D and EPOS, have participating organisations from outside Europe. Other, such as ICOS, EURO-ARGO and LifeWatch have activities with international research programmes to add value to ERA. This report sets out the opinion and recommendations of the Thematic Working Group. It cannot however prejudge the final decision of ESFRI with respect to the projects included on the ESFRI Roadmap and its updates.

This is the ENV TWG Report 2010 to ESFRI and is a record of the activities of ENV TWG. ENV TWG has reviewed the first ENV landscape, acquiring information from, and opinions developed within, the scientific communities. ENV TWG has given its opinion on two new proposals submitted to BMS and ENE TWGs. Finally it also reports on the follow-up of the ENV RI projects on the ESFRI Roadmap.

The chair would like to express her appreciation to all members of the group who have contributed their time and effort during the process in ensuring the quality of the opinion on two new proposals, and in providing valuable information and views on the landscape of environmental RIs.



Eeva Ikonen

Chair ENV TWG

CONTENT

FOREWORD 3

EXECUTIVE SUMMARY 6

1. ENV TWG recommendations to ESFRI 10

Sustainable funding 10

Management 10

Site selection 10

Dialogue with scientific and user communities of ENV RIs 11

Future Roadmaps 11

Follow up the RIs 12

Partnership and collaboration 12

Lessons learned 12

Roadmap 2010 13

New proposals to ESFRI 13

2. The Landscape of environmental sciences 14

Challenges and global dimension of environmental research 14

Research domains 15

Atmospheric research 16

Ocean including sea ice (dynamics, biology) 16

Land (hydrology, soils), water cycle ... 17

Climates and paleoclimates 18

Earth science 19

Environmental engineering and technology 20

Ecosystem services 20

3. Future needs 22

4. Implementation of the ESFRI Research Infrastructure Roadmap 2010 24

Implementation 24

Pan-European integration and structural aspects 25

Access policy 26

Data challenges of environmental sciences 26

5. ESFRI ENV Projects 2010 28

Annexes

1 Composition of the ENV TWG 43

2 Meetings held by ENV TWG 44

3 Update of ESFRI Roadmap 2010 .. 44

EXECUTIVE SUMMARY

Environmental issues will dominate the 21st century and access to natural resources is likely to continue to cause conflicts. International collaboration is essential for all the environmental Research Infrastructures (RI). Europe is particularly well-placed to make world-leading advances in addressing key environmental issues because of the strength of its scientific capability as well as a focus on particular geographical regions and ecosystems. Most environmental ESFRI projects have either a global dimension or the potential to assume a leading role in international environmental collaborations.

European Environmental RIs are fundamental for world-leading environmental research, education and training by clustering and networking existing and new facilities at European or global level. Environmental RIs are the flagships for EUROPE 2020, the European strategy for smart, sustainable and inclusive growth as well as answers to the grand challenges. The competitive and open access to high quality RIs supports and benchmarks the quality of the activities of European scientists, and attracts the best researchers from around the world.

Pan-European ENV RIs are keys to:

1. Addressing the most important challenges in environmental sciences.
2. Integrating capabilities on air, in rivers, lakes and seas, on land, fixed or mobile, new and existing facilities, together with models for the understanding of processes.
3. Taking advantage of Europe's diversity of landscapes, ecosystems and climates.
4. Pushing European capacities towards deeper integration and cooperation.
5. Providing nests for the Research – Education – Innovation triangle.
6. Developing and improving effective and efficient technologies for mitigation and adaptation, not only as a result of climate change but also of pollution, hazards, etc.

Long term challenges such as globalisation, ever increasing pressure on resources and climate changes will intensify in the next decades. Europe must take charge of its future and therefore look beyond the short term. The EU has launched *seven flagships* (initiatives to reach the goal of smart sustainable and inclusive growth). The flagship “the innovation Union” aims at improving framework conditions and access to finance for research and innovation, *the flagship “Resource efficient Europe” will help to decouple economic growth from the use of resources by an increase of the use of renewable energy sources, by supporting the shift towards low carbon economy.*

Environmental RIs will benefit from the flagship Innovation. At its turn, Europe will benefit from RIs as centres of frontier research in environmental sciences and human potential training.

- ENV RIs provide new knowledge and methodology in environmental sciences, for instance in areas of climate change mitigation and adaptation, integrative modelling in water resources, sustainable land use and food production.

- ENV RIs are centres for knowledge transfer to other sectors and political decision makers, for example: rescue and security, forecasting, engineering, and urban planning and rural land use.
- ENV RIs are centres for knowledge sharing and providing information to the general public, for example: early warning of natural hazards, better understanding of sustainable use of natural resources, basic understanding of ecosystems and biodiversity through scientific collections and different kind of activities.
- ENV RIs are training centres for students, young scientists and senior scientists.

Because of the global scale and complexity of environmental research, and due to high costs of environmental RIs, international collaboration is essential. Europe is particularly well-placed to make world leading advances in addressing key environmental issues, both because of the strength of its scientific capability and because of a focus on particular geographical model regions. The natural partners of pan-European RIs are global monitoring programmes of the planet Earth launched by international organisations.

Environmental sciences can be classified in many ways. Their expanded scope and depth break down the boundaries with physical, engineering and mathematical sciences, as well as with social sciences and humanities. Environmental sciences have an inherent systems approach. However, the research fields can be classified by the major needs for collaboration among disciplines (see Table below).

ENV RIs are supporting the grand challenges in:

- Science: high level scientific publications, research projects – *all ENV RIs.*
- Education: training facilities for students, doctoral students, jobs for Post docs – *all ENV RIs.*
- Society: security, public health in collaboration with GMES, GEOSS – *many ENV RIs.*
- Policy and Economy: sustainable use of natural resources such as water, energy - *many ENV RIs.*
- Innovation: technology development, new sensors, services, etc. – *many ENV RIs.*
- Monitoring: support environmental monitoring requirements assigned by EU Directives – *many ENV RIs.*

Research fields	**Facilities (examples)**
atmosphere	ground-based observing networks, planes and satellites
ocean including sea ice (dynamics, biology)	buoys, vessels, and other mobile systems, satellites, sea-floor and water column stations
land (hydrology, soils), water cycle	ground-based observing networks, satellites
climate and paleoclimates	models, data, high performance computing facilities, drilling facilities, collections
earth science	data bank, deep drilling, geophysical measurement systems, satellites
environmental engineering and technology	waste and waste water treatment research facilities, test facilities for new, sustainable industrial production and processing methods
ecosystem services	ecotrons, ground-based observing networks, models, data, high performance computing facilities, collections

Data about the natural environment are gathered from monitoring and observation networks, as well as from experimentation and modelling. Environmental time series data can never be recovered, thus secure archiving is important. Simulations using high performance computing facilities are increasingly providing a large fraction of data. There is a strong need to develop standards and software for interoperability and access for scientific and socio economic purposes.

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. Environmentally controlled rooms, research vessels and drilling capabilities, satellite Earth observation systems, airborne and sea-floor sensors, all need advanced technology and communication capacities, linked to computing power and data management resources.

The ESFRI Roadmap projects 2008 in environmental sciences

COPAL, COmmunity heavy-PAyload Long endurance Instrumented Aircraft for Tropospheric Research in Environmental and Geo-Sciences

EMSO, European Multidisciplinary Seafloor Observatory

ERICON–AB, European Research Icebreaker Consortium- Aurora Borealis

EURO-ARGO, Research infrastructure for ocean science and observations

IAGOS-ERI, In-service Aircraft for a Global Observing system

ICOS, Integrated Carbon Observation System

LIFEWATCH, Science and technology infrastructure for biodiversity data and observatories

EISCAT_ 3D, The next generation European incoherent scatter radar system

EPOS, European Plate Observing System

SIOS, Svalbard Integrated Arctic Earth Observing System

Environmental sciences need a wide range of RIs that involve complex systems and human interaction. Measurements and monitoring are required from fixed and mobile platforms and range across physics, chemistry, biology and geosciences. They are required for the terrestrial, marine, freshwater, atmospheric and cryospheric environments. Sophisticated large-scale analytical and informatics facilities from physical and biological sciences are likely to be used with increasing intensity by environmental scientists.

Based on the update information requested from the coordinators of the preparatory phase RI projects, ENV TWG concluded that all the projects have made satisfactory progress and that they should all remain on the Roadmap update 2010. However none of them has yet secured long-term commitments by partner countries. These projects are:

The ENV RIs on the ESFRI Roadmap fall in a range of places on the continuum between ‘site specific’ and ‘distributed’. For example, COPAL and ERICON_AB are mobile ‘site specific’ multipurpose platforms, while EISCAT_3D and SIOS are essentially site specific Arctic RIs though based at more than one site. Others, such as LifeWatch and EURO_ARGO, are fully distributed mostly building on existing facilities and networks. The selection of Headquarters and Distributed Nodes requires the same rigorous process as for site specific RIs. The standards and harmonized measurements in the agreement for an European RI do not restrict national stations and networks participating in cooperation programmes and campaigns in other fields or with other measurement techniques. It is easier for participants and users outside Europe to communicate with a central point in the RI rather than with several organisations.

Following table identifies 44 new (or major upgrade of) Research Infrastructures of pan-European interest
The EC funds 3 additional projects from the CERN Council strategic roadmap for particle physics*

Social Sc. & Hum. (5)	Life Sciences (10)		**Environmental Sciences (10)**		Material and Analytical Facilities (6)	Physics and Astronomy (11)		Energy (4)	e-Infra-structures (1)
SHARE	BBMRI	ELIXIR	ICOS	EURO-ARGO	EUROFEL	ELI	TIARA*	ECCSEL	PRACE
European Social Survey	ECRIN	INFRA FRONTIER	LIFEWATCH	IAGOS	EMFL	PRINS	CTA	JHR	
CESSDA	INSTRUCT	EATRIS	EMSO	EPOS	European XFEL	SPIRAL2	SKA	IFMIF	
CLARIN	EU-OPENSCREEN	EMBRC	SIAEOS	EISCAT_3D	ESRF Upgrade	E-ELT	FAIR	HiPER	
DARIAH	Euro BioImaging	ERINHA BSL4 Lab	COPAL	AURORA BOREALIS	NEUTRON ESS	KM3NeT	ILC-HIGRADE*		
					ILL20/20 Upgrade	SLHC-PP*			

Distributed research infrastructures

Single sited research infrastructures

Figure 1. Identifies 44 new (or major upgrade of) Research Infrastructures of pan-European interest in 2008, chart of different types of RIs (Source: EC 2010)

1. ENV TWG recommendations to ESFRI

Sustainable funding

Even though Europe is experiencing a severe economic crisis, we believe that support of new RIs is an important investment for the future.

Discussions are on-going within and between member states on commitments for construction and long term operations of the ESFRI roadmap projects in environmental sciences. Several countries have secured funds for participation in ESFRI environmental projects and activities at national level. Distributed RIs can progressively become operational over several years while, in contrast, platforms such as research vessels and aircraft require a high initial investment.

Through the thematic and targeted calls, the EU framework programmes are currently supporting many areas identified in the first ESFRI Report, as main challenges for the environmental sciences. Within the new framework programme, a specific European Fund for the operation of the new environmental RIs would be welcome. This would strengthen their integration in the European landscape.

It is important to stress that many regions in EU are eligible for funding through the structural funds. In particular, the ENV RIs construction phase can benefit from this funding source. Through the Risk Sharing Financial Facilities the EIB can provide loan finance as a complementary source of funding.

Commitment for funding goes hand in hand with political commitment to build the RI. Support to the different levels of construction may be easier with less formal set of agreements between research institutions. The difference in funding mechanisms (in many countries monitoring networks are the responsibility for Ministries/Agencies of environment, fisheries, agriculture, landscaping, as well as research) for different areas of research and different countries are another challenge to be looked into to secure a sustainable input of monitored data. If projects/RIs are financed on a Ministerial level or Agency level this does also affect the budget available as well as the long-term commitments.

Management

Distributed RIs are more complex than traditional large scale facilities and provide specific management challenges. This needs to be addressed by ESFRI and the EC.

RIs need qualified managers in order to ensure cost-effective exploitation of the available resources, as well as the science carried out of RIs. Successful operation requires training of key staff and users. Training provision should be planned from the very beginning of an RI to ensure that resource requirements are met in right time. Mobility of staff between countries and institutes is also an important element.

Site selection

ENV RIs are often distributed by nature, and usually require one headquarters and several specific centres. The process to decide on these sites is complicated and incorporates scientific, technical, social, economic, geographic and political considerations. ESFRI should encourage best practice for site selection based on scientific needs, transparency and competitiveness.

Dialogue with scientific and user communities of ENV RIs

ENV TWG would warmly recommend ESFRI to consider the following recommendations:

- ESFRI should, together with EC, organize Foresight Workshops on emerging RI fields and on specific issues such as instrumentation, modelling, standards, new technologies, etc. Essential part is to get the existing and potential new users actively to participate in workshops. ENV TWG welcomes the first steps taken with European Geosciences Union.
- ESFRI should, together with EC, organize Workshops on e-infrastructures, on collaboration and interaction with analytical RIs, ENE, ENV, BMS and SSH RIs.
- ESFRI should organize Workshops on global collaboration or with potential new partners outside Europe.
- ESFRI, together with EC, should inform Member States when they organize ECRI conferences topics and sessions on different disciplines or between disciplines.
- ESFRI should, together with EC and RIs, work on increasing visibility of European RIs to general public and political decision makers.
- ESFRI should together with the EC and RIs support regional cooperation and development of partner facilities.
- ESFRI should raise Member States awareness to the advantages of progressing with the establishment of National Roadmaps.

Future Roadmaps

In the environmental field, ESFRI is still work in progress and *the ENV scientific community must be confident that the process will continue*.

In the further development of the Roadmap process, guidelines for TWG technical work and cooperation between TWGs should be established. This would lead to higher quality work in the Roadmap updates. ENV TWG aims to apply the best practices so that the proposals with the highest potential can be submitted to the ESFRI Roadmap, and to further develop the evaluation of multidisciplinary proposals assessed in parallel by different TWGs. That a pan-European nature that is required to develop top priority ESFRI proposals is not yet communicated to the proposers well enough.

When a new project is to be accepted to the Roadmap, it must be shown to fit the landscape of existing RIs and to address a need identified in the thematic landscapes in order to get the most efficient use of European resources.

Guidelines to ESFRI TWGs should include common scoring schemes, criteria for evaluations, hearings, and forms for applications of new proposals, evaluation forms and consensus reports. All TWGs should follow same procedural guidelines. The process must be transparent and all applicants equally treated.

The first step of evaluation could be based on a plan of intents. At this stage three or more Member States must show official commitments to the project by letters of interest. Based on TWG's suggestions ESFRI would ask for full proposal for the next step. The proposals would then be evaluated by international scientific panels.

Follow up the RIs

Guidelines should explicitly instruct how to follow up the preparatory phase projects. These guidelines should also specify for how long the RI projects should be followed-up by the TWGs and at what point an RI is removed from the Roadmap. In the forthcoming ESFRI Landscape reviews, TWGs should review the implemented RIs. The methodology and procedure for the evaluation of RIs that need parallel assessment from two TWGs need to be clarified.

Partnership and collaboration

The ESFRI strategy should be developed for cooperation between the diverse array of agencies that work in the broad field of environmental sciences and technology.

A further issue, which must be more specifically addressed in an overall ESFRI policy plan, is the open access for research purposes to environmental data collected by non-research Agencies, and the interoperability of networks built for purposes other than environmental research.

In order to bring the existing and the new pan-European ENV RIs in closer cooperation, ESFRI should, together with the EC, develop a methodology for building a map of relevant existing RIs suitable for clustering. For example, some of the new RI initiatives may benefit from collaboration with the more advanced ESFRI projects and/or existing RI (or even networks). The future RI proposals which may strengthen some of the projects already in the preparatory phase should be combined.

There is a need to have effective coordination mechanisms with emerging scientific powers such as China and India, as well as with countries where strong collaboration already exists. ESFRI should make priorities on pan European RIs giving the best results in cooperation and value for ERA with countries outside Europe.

Lessons learned

Overall, the new pan European RI proposals should, at a very early stage in their plans and in addition to scientific and conceptual cases, address: the relationship of new observational RIs to operational networks, data management, interoperability, accessibility and standardization, and links to global programmes.

The concept of a research infrastructure initiative needs to be defined in a way that does not overlap with networking activities between European research organizations. Some of the networks may be seeking the ESFRI label to foster high-quality cooperation, although in some cases the ERA-NETs and Article 169 may be a more appropriate approach for the participating stakeholders.

In building the ERA, it is important to identify the best ways to support the strong research environments for different science disciplines. In addition ESFRI can benefit from strategic developments in joint program initiatives. When the ESFRI process is needed, or when are the other tools more relevant for a new initiative? To answer this, the environmental scientific community needs to continue, and evolve, its discussions on future RI needs. We are currently planning a forum for such discussions.

ESFRI should establish processes for better cooperation between different thematic working groups.

ESFRI should give special attention to facilitating cooperation between industry and academia, regarding RIs and policies.

ESFRI should establish a web-site for each of the TWGs to inform activities in each field. ENV TWG recommends to ESFRI to work on a clear visibility of existing and new RIs.

Roadmap 2010

ENV TWG recommends ESFRI to maintain the ENV projects on both the ESFRI 2008 and 2010 reports. We are closely following the progress of all these projects and recognise that some are more advanced than others and a few have particular problems.

The advice from ENV TWG to ESFRI is to find mechanisms to increase and improve interactions between existing Roadmap projects in order to gain added value for the environmental research community.

To develop a long term plan of new RIs in Europe, and to select projects to be added to the European Roadmaps, ESFRI needs to follow up the existing European RIs including ESFRI projects. This would include current networks to be part of ESFRI projects, merging of ESFRI projects or ESFRI projects to be part of existing (national or international) RI. A mapping of national RI could enhance this process.

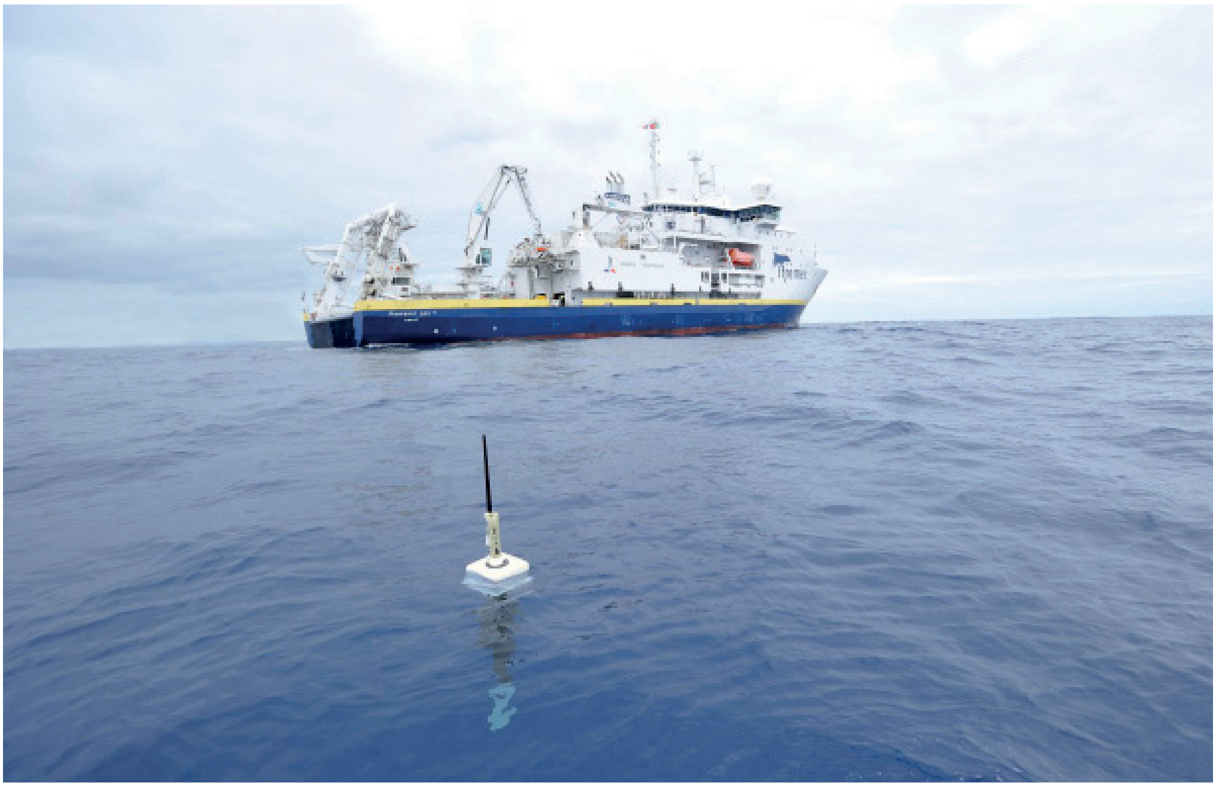
The development of impact indicators is vital for the assessment of existing pan-European ENV RIs.

New proposals to ESFRI

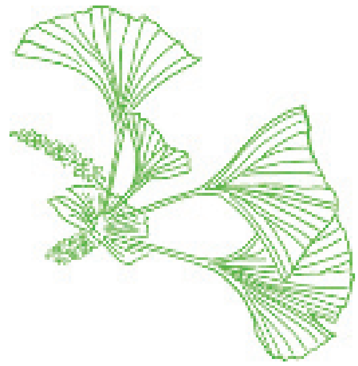
In 2009 it was not possible for the environmental research community to submit proposals to ESFRI. However, BMS and ENE TWGs received proposals on which the ESFRI EB sought the opinion of ENV TWG.

Infrastructure for analysis and experimentation on ecosystems - ANAEE- was evaluated by BMS. ENV TWG was asked to give an opinion of the project. ENV TWG supported it as an environmental project. ANAEE benefits from collaboration with the existing RIs. BMS and ENV could then monitor the progress of ANAEE.

Energy saving through green chemistry – ESTGC – has been evaluated by ENE and ENV TWGs. ENV TWG felt that the proposal does not fit well into the environmental RI landscape.



© Ifremer - 2009 - Mamaca/Dugornay



2. The landscape of environmental sciences

The aim of this chapter is to identify present needs for RIs in environmental sciences over the next 10 to 20 years.

At present, the greatest challenges for environmental research are sustainable use of natural resources, pollution prevention (litter, oil), the challenge of global change and the mitigation of natural hazards risks. By nature, most environmental research requires international collaboration and interoperability between different domain of research and new and existing RIs.

ENV TWG gives in this report initial views on the landscape of environmental sciences, which will be deepened by an in-depth, broad and sustained interaction with as well as discussions within the scientific community; these discussions will be part of the continuous work of the TWG's.

Systematic long-term measurements of meteorological variables since the 1800s have greatly improved our capability to forecast the weather. Continuous measurement since the 1950s of atmospheric CO_2 has greatly expanded our insights into global warming. These two examples show why modern environmental research utilizes spatially extended long-term observatories and monitoring systems for land, water and atmosphere. The environmental sciences need a wide range of RIs that address complex systems and human interaction. Measurements and monitoring are required from fixed (such as ground based radar) and mobile (such as research ships and aircraft, satellites, buoys) platforms and range across physics, chemistry, biology and the geosciences. They are required for the terrestrial, marine, freshwater, atmospheric and cryospheric environments. There is likely to be increasing use by environmental scientists of sophisticated large-scale analytical and informatics facilities from the physical and biological sciences.

Distributed, remote controlled, observational networks applying state of the art technologies are of key importance to new predictive power in earth - and ecosystem - science, biodiversity, hydrology, climate change etc. Environmentally controlled chambers, research vessels and drilling capabilities, satellite earth observation systems, airborne surveys and sensors all need advanced technology and communication capacity, linked to computing power and data management resources.

Frontiers in environmental research are associated with understanding complex environmental systems and their dynamics, and coupling of complex models. This requires combinations of advanced e-infrastructure such as facilities for high performance computing, mapping and data (processing, transfer and storage), and fast and effective e-science infrastructure and access.

Challenges and global dimension of environmental research

It is generally accepted that environmental issues will dominate the 21st century and that access to natural resources is likely to continue to cause conflicts. The expansion of the world population from 6 to 9 billion will intensify global competition for natural resources and put pressure on the environment. This scenario will not be altered after a possible stabilization of the human population, forecasted to occur between 2050 and 2100. Europe must continue reach out to other parts of the world in pursuit of a global solution to the many environmental problems as climate change and its related impacts.

A sustainable future means having a global long-term perspective. Society faces many challenges on planet Earth: food, energy, water and soil resources are getting scarce and have to be used efficiently, and natural hazards/disasters and global change are posing serious threats to human safety, security, well being and to economy. There is also an urgent need to reverse continuing trends of biodiversity loss and ecosystem degradation.

Because of the global scale and the complexity of environmental research, as well as the high costs for ENV RIs, international collaboration is essential. Europe is well-positioned to make world-leading advances in addressing key environmental issues both because of the strength of its scientific capability and because of a focus on particular geographical model regions (the Alps, the Mediterranean region, the Arctic, etc.).

The number of new users of ENV RIs both within and outside Europe is expected to grow and an increase of the range of scientific communities using distributed data through computing infrastructures (e-infrastructures) is anticipated.

The natural partners for pan-European ENV RIs are global monitoring programmes launched by international organisations. Global frameworks such as GEO (with its Global Earth Observation System of Systems 10-year plan), GOOS (The Global Ocean Observing System) and the European GMES (Global Monitoring of Environment and Security) emphasize the need for increasing the quality, distribution, long-term duration and accessibility of Earth observing systems. RIs for Earth observation and research in Europe face important structural and scientific challenges. RIs need to cover Earth processes spanning a large spectrum of time scales: the millions of years characterizing the evolution of continents, oceans and species; the hundreds of years typical of climate change; the annual variability of atmospheric and water cycles; and the seconds required for the generation of geo-hazards, such as landslides and earthquakes. To capture the time variability of Earth processes, data have to be collected (often in long time-series), archived, distributed and analyzed and infrastructures have to be planned to operate for decades and centuries in the future.

Environmental hazards (including earthquakes, volcanoes, flooding, drought, storms, tsunamis, coastal erosion, landslides and toxic wastes) destroy lives (more than a million since 1990) and damage economies world-wide (estimated at more than $1 trillion since 1990). Environmental science has a central role to play in understanding, forecasting and mitigating natural hazards. While many of these hazards will be exacerbated by climate change, environmental science will provide new approaches to environmental health, on issues such as the spread of disease, and air and water quality. Many of the ENV RIs will contribute to this area, with EPOS particularly relevant.

Research domains

Environmental research can be classified in many ways. Its expanded scope and depth break down the boundaries with physical, engineering and mathematical sciences, as well as with social sciences and humanities. Environmental research has an inherent systems approach. However, the research fields can be classified by the major needs of collaboration among disciplines:

Research fields	Facilities (examples)
atmosphere	ground-based observing networks, planes and satellites
ocean including sea ice (dynamics, biology)	buoys, vessels, and other mobile systems, satellites, sea-floor and water column stations
land (hydrology, soils), water cycle	ground-based observing networks, satellites
climate and paleoclimates	models, data, high performance computing facilities, drilling facilities, collections
earth science	data bank, deep drilling, geophysical measurement systems, satellites
environmental engineering and technology	Waste and waste water treatment research facilities, test facilities for new, sustainable industrial production and processing methods
ecosystem services	ecotrons, ground-based observing networks, models, data, high performance computing facilities, collections

Atmospheric research

The atmosphere is the central component of the Earth's climate system. It interacts with all the other components (the hydrosphere, biosphere, cryosphere, pedosphere and lithosphere) on time scales from hours to millennia. The atmospheric composition, water vapour, clouds, trace gases and aerosols play a key role in the Earth's energy budget which drives the climate. Weather stations and satellites provide continuous long-term monitoring of the atmosphere. They need to be complemented, for clouds and the atmospheric composition, by satellite observations when available, long-term observatories and in-situ field experiments. Such measurements are crucial for our understanding of processes as well as for societal issues such as hydrometeorological hazards, climate change and air pollution. Modelling complements observations and is required to understand the climate system as well as provide weather forecasts and climate projections.

In the atmospheric sciences and biogeochemistry, three infrastructure projects were selected in the first Roadmap. COPAL (Community heavy-Payload Long Endurance Instrumented Aircraft for Tropospheric Research in Environment and Geo-Sciences, previously named EUFAR) will improve our capacity to perform in situ measurements during field experiments. ICOS (Integrated Carbon Observation System) will improve our estimates of the carbon budget and how this later will evolve with human activities and mitigation policy. IAGOS- ERI, In-Service Aircraft research infrastructure for a Global Observing System, will monitor high tropospheric trace gases using regular airlines. EISCAT in the 2008 update allows monitoring the upper atmosphere and will be important to improve our monitoring of space weather.

The fourth assessment report of the IPCC (2007) has identified aerosols, clouds and precipitation as one of the largest uncertainties in our current understanding of the climate system. Setting a long-term European observing network for aerosols and clouds both at the surface and within the atmosphere would complement satellite data and improve our understanding of cloud-aerosols microphysics.

Ocean including sea ice (dynamics, biology)

Covering over two thirds of the Earth area, the seas and oceans are – even more than Space – the Final Frontier, still to be conquered by humans. Even though started centuries ago, the study of the Global Ocean, its physics, evolution mechanisms and laws, specific habitats, living creatures and resources is still at the beginning. The role of the seas and oceans in the global climate system is not fully understood – as nor is the human impact on the marine ecosystems. Phenomena occurring on the seafloor help us understand complex geological processes which control our very existence as society, while the resources are not yet fully evaluated and understood.

Marine research needs special and large facilities and resources often beyond the means of any single country and the restrictions of national boundaries. Developing concepts and implementation options for enhanced multi-lateral collaborative use of marine infrastructure requires a pan-European vision and mandate. ESFRI Roadmap projects EMSO and EMBRC represent examples of such opportunities.

Traditionally marine research has been carried out with ships and vessels, which can only observe snapshots of a small part of the ocean at reasonable cost. Automated observations such as from Argo floats and localized observatories, as well as new innovations in equipment offer promise for self-sustained observations over long-time. A related initiative is EMODNET[1] which primarily is intended to ensure that data once collected are made available free of charge to all users. FP7 and GMES currently run the My-Oceans initiative which includes operational use of observations assimilated in real time in prediction models. In the USA the Ocean observing initiative (OOI[2]) is also focussing on long-term observation, and in Australia IMOS[3] (Integrated Marine Observing System) has similar objectives. In Europe there is a need, as expressed by the Marine Board Forum in September 2010, for a long-term, stable and integrated network of strategic marine observatories, installed and operated through multi-national cooperation and support, providing consistent in situ data from the seas and oceans in support of the EU Integrated Maritime Policy[4] and as a driver for smart, sustainable and inclusive growth in Europe (Europe 2020[5]). This could probably only be achieved by a combination of Euro-Argo, EMSO and components of SIOS and other related initiatives.

Land (hydrology, soils), water cycle

Research aiming to advance knowledge on all aspects of the water cycle, and in particular on catchments ecological management, water economy, water treatment, recycling and transport, are critically needed and should be encouraged. Important topics includes further advances (in pan-European networks, which could lead to ESFRI-proposals) in low energy demanding water desalinization technologies, considering both a reduction of the environmental impacts and a cost-efficient technology, would constitute an additional break through.

Freshwater availability is a critical issue needing urgent attention, since between 1.5 and 2 billion people currently survive under conditions of extreme water scarcity, while only about 15% of the world population enjoy water abundance. Within the coming decade, habitation of many regions in all continents may become unsustainable, triggering massive displacements of human populations, with major consequences for the global society, including Europe[6]. In Europe, according to the Intergovernmental Panel on Climate Change (IPCC) 2007 Report[7], nearly all regions are anticipated to suffer increased

1 http://ec.europa.eu/maritimeaffairs/consultation_emodnet_en.html

2 http://www.oceanleadership.org/programs-and-partnerships/ocean-observing/

3 http://www.imos.org.au/

4 An Integrated Maritime Policy for the European Union (http://ec.europa.eu/maritimeaffairs/policy_documents_en.html)

5 Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth (http://ec.europa.eu/eu2020/index_en.htm)

6 Cf "Climate refugees", by Collectif ARGO, ISBN-10:0-262-51439-7, ISBN-13: 978-0-262-51439-2

7 http://www.ipcc.ch/

risks of inland flash floods, more frequent coastal flooding and increased erosion. In consequence, increased water stress, risk of drought and heat waves will result, mainly in the Southern, Eastern and Central regions. Since the water cycle closely depends on the balanced functioning of ecosystems and on climate processes, trans-disciplinary research covering atmospheric, ecological, earth, social and economic sciences must be conducted at regional level and higher (at both high and detailed) spatial scales.

Due to the policy of the European Union, particularly the implementation of environmental directives such as the EU Water Framework Directive, the importance of adequate environmental data produced by environmental monitoring has been recognised. The environmental RIs provide key tools to support and enhance environmental monitoring. Thus the RIs provide tools for the relevant ministries to fulfill the increasing monitoring requirements.

In Europe, land that is potentially usable for agriculture is becoming scarcer, mainly due to conversion to artificial surfaces as well as to soil erosion. The maintenance of soil integrity is critical for food production by conventional farming. Farming intensification and consequent problems, such as increasing invasion of exotic species on farmland, require the use of increasingly higher quantities of agrochemicals that contribute to soil contamination. The importance of protected crops for food production is likely to accelerate, with consequent problems such as the environmental impacts of the construction and maintenance of structures housing the crops, the use of biocides to control pests and diseases, and high energy requirements.

The total area occupied by forests (including agro-pastoral-arboreal systems and short rotation tree crops) in Europe has increased over the last decade. Forests are not only a source of timber and fibre but an important source of food (mushrooms, nuts, fruits, honey, spices, and game). Forests are threatened by a range of human activities.

Many ENV RIs will contribute to this area of challenge, in particular LifeWatch and EMBRC. These infrastructures could help to integrate research in different disciplines and aspects of the food production chain (farming of aquatic, terrestrial habitats or other sources, genetic and biological resources, infectious diseases).

Climates and paleoclimates

Our knowledge of present-day climate relies on observational networks within the atmosphere, ocean and land combined with a large set of satellite observations. Observations are complemented both by a large development of climate models and by the investigation of past climate changes through different types of archives.

Climate and Earth system models are key tools for understanding climate change and its effects on society and are the basis of the International Panel on Climate Change (IPCC) projections and EU policy on climate change. Global climate models, complemented by regional climate models, provide information on possible future climate change projections to decision-makers and to a large range of users. Within Europe, the European Network for Earth System Modelling, ENES (http://is.enes.org) gathers the European climate/Earth system modelling community working on understanding and prediction of future climate change and develops the infrastructure constituted by climate models and simulated data (IS-ENES project). With the climate change, more and more information will be required by different sectors of society to prepare for adaptation. This transfer of information to society, known as “climate services”, is a challenge for climate research. It will require development of the link between climate research and end-users as well as development of the links with other disciplines to develop climate products more adapted to user needs. It will reinforce the need for a well structured infrastructure of climate models.

Understanding the mechanisms of climate change also requires study of past climate change. Ice cores, for example, have provided a record of past atmospheric composition and help emphasize the importance of greenhouse gases in past natural climatic variability. Sea sediments also provide information on past glacial cycles. Common to all paleoclimate investigations are the need for drilling facilities, in ice, sea sediments, peat bogs, lakes etc. They constitute an important infrastructure together with the collections of cores preserved for future analyses. Several European initiatives already exist, such as the European Consortium for Ocean Drilling (ECORD) and North Greenland Neemian ice-drilling (NEEM) but funding for long-time storage and data access needs to be secured.

Earth science

Infrastructures for monitoring and understanding the solid part of the Earth surface are important to manage risks associated to hazards as well as manage resources. The processes include the evolution and dynamics of the tectonic plates – uppermost part of our planet's internal structure, geo-hazards (such as earthquakes, landslides and their related effects), natural resources, water cycle, exploration and exploitation of energy resources, oceanography, climate change and the interactions between the natural and built environments. This vast panorama of scientific and societal challenges requires an integrated infrastructure for monitoring and research.

The large spectrum of scales does not apply only to time. RIs need to cover solid Earth processes spanning a large spectrum of spatial scales: the thousand- and hundred kilometre scale of tectonic plates as well as of large river catchments; the ten-kilometre scale of oil reservoirs; the kilometre scale of vertical elevation and the meter-scale granularity of debris-flows. Nested, multi-scale networks are required to monitor, model and understand the spatial variability and complexity of Earth processes.

Solid Earth science RIs vary in character, from single geochemical laboratories to satellites, to ocean-bottom installations and to distributed monitoring systems. Additionally, many observing systems are installed for national monitoring. A major, continuous effort of coordination and integration between infrastructures and data collection centres is required in order to build a single Solid Earth observing system of systems, breaking disciplinary as well as administrative and geographical barriers. A significant supplementary challenge is the data compatibility. In order to have data “in service” for decades and centuries, collection, analysis, interpretation and storage must be carried out in ways to enable use by future generations of scientists.

The large diversity of scientific priorities and societal and economic relevance areas complicates the definition of a harmonized strategy for investments for major RIs as well as for the accessibility to the collected data. For example, seismic instrumentation is used for research on the Earth interior, and also to assess hazards for building insurance, to locate oil reserves and to monitor nuclear explosions.

Early-warning and rapid assessment of processes, scenarios, damage and losses are crucial elements of any intervention policy for natural disasters, and pose additional challenges for RIs monitoring natural phenomena. Europe must face these challenges to create a network of RIs supporting the research needs as well as the requirements of societal sustainability.

EPOS, listed on the ESFRI roadmap addresses many, but not all, of these issues on a European Scale.

Environmental engineering and technology

Waste management /economy is an industrial sector accounting for 52.2 billion € per year, corresponding to 36% of the EU revenue generated by the green economy. In the previous decade, EU municipal solid waste increased at about 1.1% per year. Considering the unstoppable urbanization trend, this figure can be expected to grow, unless efficient policies are implemented. A new approach is needed, probably based upon the concept of precycling (Greyson 2007[8]).

Test facilities for industrial processes and sustainable production are in strong need to be developed; food industry, agriculture and energy are industrial sectors contributing to the increasing waste production. By developing new processes (closed) these industries could be part of the green economy and clean technology.

Additionally, fundamental research, and the related research infrastructures, in areas such as soil decontamination techniques and interdisciplinary studies between ecosystem contamination and ecological impacts studied at community level and including all trophic levels, is urgently needed.

Environmental and economic objectives are sometimes equivocally perceived as contradictory. However, Eco-Industries contribute 2.2% to the EU´s GDP and employ 1.7% of the paid work force (Facts and Figures - the links between EU´s economy and environment[9]).

The understanding and application of environmental economics principles is an indispensable tool for the achievement of ecological and social sustainability, and prevention of environmental degradation. Furthermore, forecasts point to a growing importance of economic links between European competitiveness and environmental economy.

The last decades have proven the high utility of environmental economics – as means of understanding the costs of environmental degradation, as opposed to the classical – monetary tools offered by the “traditional” economics. Concepts such as service, option and existence values have proved crucial when trying to understand the costs and benefits of protecting a specific environment.

Ecosystem services

Today's climate change and growing anthropogenic pressures have roots in changing societal demands including the exploitation of soil, habitat destruction and contamination, disruption of natural communities by invasive species, biodiversity loss and overexploitation of renewable natural resources. These impacts affect the structure and functioning of ecosystems and consequently their sustainability, on which the continuity of life on Earth depends.

Ecosystems sustainability can be guaranteed only if the main processes remain unaffected, that is functioning within the scales and thresholds tolerable by their populations and communities. To some extent, the supply of ecosystem products and services has already been jeopardized, and further threats are expected. Over the past decade, several initiatives have contributed to raising awareness among policy makers, researchers and stakeholders, pointing to the need for a profound understanding of the dynamics of natural systems. Among others, the Millennium Ecosystem Assessment (Hassan et

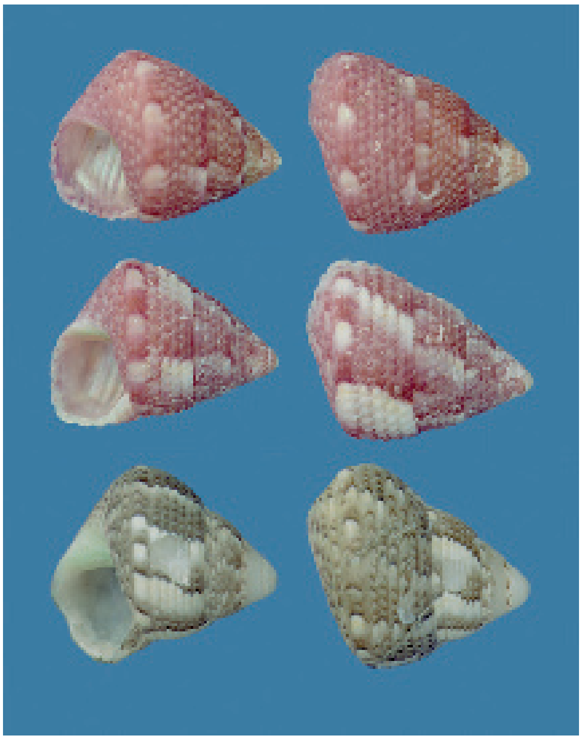
[8] Greyson, J. 2007. An economic instrument for zero waste, economic growth and sustainability. Journal of Cleaner Production, 15, 1382–1390 and amongst others: http://www.wiserearth.org/article/a87b462059040001e7b7509d1310b70f

[9] http://ec.europa.eu/environment/enveco/pdf/facts.pdf

al. 2005)[10] emphasized that biodiversity loss is inextricably linked to the degradation of ecosystem services, while the Stern Review Report (Stern 2006)[11] detailed the Economic Consequences of Climate Change.

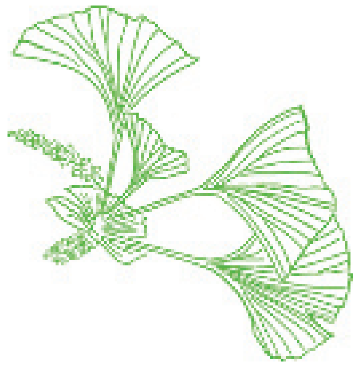
Over the past 50 years, ecosystem change due to anthropogenic causes has attained a magnitude never seen in history. During the same period, ecosystem research was initiated, but mainly addressing rather small-scale studies of isolated systems. Consequently, the data generated have made an important, yet limited contribution to our understanding of the principles driving ecosystems processes. There is wide agreement that multidisciplinary integrated studies, aiming at the extrapolation of general rules and theories, require the availability of long-term observations. These data are indispensable for the interpretation of ongoing processes, including those responsible for biodiversity erosion. Among other statistics, it is worth noting that in Europe between 10 and 30% of mammals, birds and amphibians are threatened with extinction. As it is not easy to reconcile short-term economic targets with medium– to long-term promotion of ecosystem sustainability, research will, in parallel, address the link between socio-economic issues and natural systems. The information generated could be used to forecast and model ecosystem dynamics and to develop appropriate management strategies, including the implementation of mitigation measures for ecological impacts and habitat restoration.

The ESFRI ENV TWG has recognized the importance of observational, experimental, analytical and modelling facilities in ecosystem science, such as ESFRI project LifeWatch, the new proposal ANAEE (see Annex 3), but also through existing initiatives such as the Long Term Ecological Research (LTER) network. These are mainly focused on mainland Europe, but there is a need to expand capabilities in the Arctic (where key anthropogenic changes are first detected) to be from initiatives such as the ESFRI project SIOS and the EC-supported INTERACT research station network.



10 http://www.millenniumassessment.org/documents/document.355.aspx.pdf

11 http://www.euractiv.com/en/sustainability/stern-review-climate-action-avoid-future-economic-chaos/article-159325



3. Future needs

This section addresses a number of particular issues, and identifies gaps in the landscape which are priorities for action. However, it should be mentioned that in all areas it is **important that long-term monitoring and observing systems are developed with a sustained funding mechanism** – only these can see the changes in climate and biodiversity allowing us to react fast. ENV TWG considered that observational, experimental, analytical and modelling facilities in ecosystem science, in mainland Europe and the Arctic, and the water/hydrological cycle are important parts of the landscape of the environmental RI but are still in the emerging phase and need to remain as a priority.

There are potential emerging projects in a wide area of geosciences related for example to water cycle or in marine research, such as aquaculture or research vessels. ENV TWG welcomes the first steps towards engaging a dialogue with European Geosciences Union to RI policy.

New potential may arise in the area of waste management and eco- industrial processes. A very important part of the environmental sciences RI is the knowledge-based resources such as scientific collections of various kinds (biological, geological, including soils, ice cores, fossils, animals, plants etc.). The LifeWatch initiative includes several scientific collections (museums) for biodiversity research. However, there is no coverage in the proposals proposed for the ESFRI Roadmap update, or in the first ESFRI Roadmap, for other types of scientific collections (e.g. geological). The global dimension of this issue is now dealt with by OECD in its GSF 'Progress Report on Activity on Policy Issues Related to Scientific Research Collections'. At a European level, an integrating body for the scientific collections would also be needed and the collections treated as a RI.

Basic data from the natural environment are gathered from monitoring and observation networks, and from experimentation and modelling. Interoperability between disciplines emphasizes the need for well designed and managed database systems, knowledge centres, shared expertise, services, dedicated training and communication, and *e*-infrastructure in environmental research.

PRACE is expected to provide the environmental community, in particular the climate modellers and solid Earth scientists, with access to world-class supercomputing systems that will complement national facilities and allow high-end simulations.

Data service and storage needs are increasing with resolution, model complexity and simulation length. For climate models, even a subset of the raw output will soon be 100TB. To fully utilize the simulation results, the data challenge has to be addressed simultaneously.

Software development and services have not kept pace with the development of hardware, and the challenges are increasing with the emergence of networking and new synergies associated with the new RIs. Technologies involved include workflows, web services, grids, portals, databases and analysis software. The importance of training users should be emphasised.

The environmental sector draws on a particularly wide range of science disciplines (ranging from mathematics, physics, to ecology and engineering) and interacts with an equally wide range of users (from energy to overseas aid to conservation). ENV TWG has recognised the importance of dialogue with our scientific and user communities to better understand the requirements of RIs and the opportunities for collaboration and synergies.

Needs attention in near future

- environmental engineering and technology
- water cycle
- scientific collections
- air pollution and aerosols
- e-infrastructure

4. Implementation of the ESFRI Research Infrastructure Roadmap 2010

Implementation

ENV TWG will continue the monitoring of the ESFRI projects. The focus for the next few years is the implementation of the first projects on ESFRI 2006 Roadmap, as well as following the development of the new entries to the 2008 roadmap.

Commitment for funding goes hand in hand with the political commitment to build the RI. Support to the different levels of construction may be easier with less formal set of agreements between research institutions. Securing the funding for the long term may need different approaches for different projects and even countries. Another point worth noticing is also the difference in funding mechanisms for different areas of research and different countries: in many countries monitoring networks are the responsibility of Ministries/Agencies for Environment, Fisheries, Agriculture, Landscaping, as well as Research. If projects /RIs are financed on a Ministerial or Agency level this affects the budget available as well as the long-term commitments.

Different types of ENV RI projects may require different legal structures. We are aware that good progress has been made and we recommend that ESFRI and EC continue to provide support for this important but time-consuming work.

Based on the update information from the coordinators of the preparatory phase RI projects, ENV TWG has concluded that all the projects have made satisfactory progress and that they should all remain on the Roadmap update 2010. However none of them has yet secured long-term commitments by partner countries. These projects are:

The ESFRI Roadmap projects 2008 in environmental sciences

COPAL, COmmunity heavy-PAyload Long endurance Instrumented Aircraft for Tropospheric Research in Environmental and Geo-Sciences

EMSO, European Multidisciplinary Seafloor Observatory

ERICON–AB, European Research Icebreaker Consortium- Aurora Borealis

EURO-ARGO, Research infrastructure for ocean science and observations

IAGOS-ERI, In-service Aircraft for a Global Observing system

ICOS, Integrated Carbon Observation System

LIFEWATCH, Science and technology infrastructure for biodiversity data and observatories

EISCAT_ 3D, The next generation European incoherent scatter radar system

EPOS, European Plate Observing System

SIOS, Svalbard Integrated Arctic Earth Observing System

Pan-European integration and structural aspects

Most of the ENV projects in the first ESFRI Roadmap are distributed facilities. Typically they have virtual access to data storage, processing and management.

To be recognized as a pan-European RI in environmental sciences, a distributed RI needs to have a clear hub, well-developed management, and structured links to partners, and clear roles and necessity of each partner facility. The involvement of new Member States (or new Associate or Candidate States) and integration in the development of the pan-European RI resources is an important issue.

Pan-European RI projects need a mechanism to bring in new partners under a joint management system. A trend towards integration of initiatives working around the same themes should be encouraged.

Due to the distributed nature of many ENV RI, they are providing excellent opportunities for partners from different regions of Europe (as well as from outside).

In Europe, environmental research, national monitoring and observation networks and systems are often driven and funded by Ministries other than Research Ministries (such as Ministries for Environment, Agriculture, Fisheries, land management, etc.), and funding organizations for basic research. There exist overlapping needs between the long-term observations made by the research community, and the observations made by governmental agencies. The relationship should be established in the RI proposals.

Operational monitoring is often best made by governmental agencies that are responsible for national, long-term measurement networks, have observatories etc., and obtain long-term measurement series. Some of the projects on the present Roadmap are benefiting from linkage with these long-term monitoring programmes. Bringing different types of measurements together for synergy is not always easy, but will be increasingly important for areas such as biodiversity and climate change research. This strategic issue needs further elaboration and could lead to a development of a new type of RI.

A strategy should be developed, aiming at the integration of the contributions and efforts of the heterogeneous array of agencies and stakeholders, working in the broad field of environmental sciences and technology, and leading to improved integration/ coordination of environmental research and exchange of knowledge. The national RIs are an important resource for researchers. Individual countries may agree between them to fund a project, without the perceived need to submit it for inclusion in the ESFRI Roadmap. Such regional or national RIs are often available to the outside user community via an access procedure and are thus part of the RI resources for the European researchers. These RIs could be recognised as existing RI resources in Europe either through a mapping exercise or as part of the ESFRI landscape analysis. The relative maturity of new RI proposals for ESFRI Roadmap update should take into account all relevant elements of existing structures, and fit well in the landscape of Environmental Science needs.

The implementation plan of the INSPIRE directive (Infrastructure for Spatial Information in the European Community, Directive 2007/2/EC[12]) and its implications should be taken into account. To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and trans-boundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting).

Access policy

RIs should be accompanied by a service unit in order to maintain efficient knowledge exchange, maximum accessibility and data interoperability, and to keep up with scientific and technical developments. Scientific service centres and hubs are integral parts of multidisciplinary and cross-sectoral environmental RIs. Distributed RIs in particular need to have a clear hub, together with well structured links and virtual connections to partners, who may be located far away from each other in Europe. The local partners may have different roles, responsibilities, and consequently different investment shares for the RI. The scientific service centre has a central role and challenge in coordinating the research activities, and in management, legal, and IPR issues. The *e*-services will be a critical part in distributed RIs. In addition to service centre and data archives, these centres and hubs can act as outreaches to the public, such as for education and popularizing science.

Environmental databases and hubs will have an economic and societal impact through providing data for application in, for instance, urban planning and construction, food production and plans for water services. The agreement on the rights and rules to access data is closely related to development of pan-European RIs and their associated service units. Typically in environmental research there is a need to integrate data from different sources to understand complex systems. Environmental sciences require harmonisation of methods and standards for data, common e-science tools and formal arrangements to promote a coherent management of on-line research data and access policy across Europe.

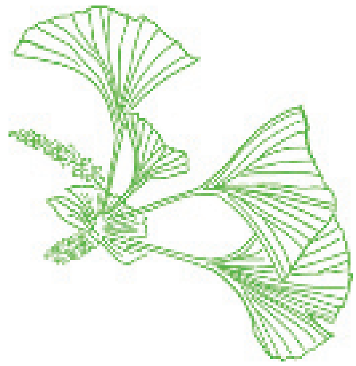
[12] http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML and http://www.inspire-geoportal.eu/index.cfm/pageid/241/documentid/468/doctype/0

Data challenges in environmental sciences

The datasets generated by both measurements and model simulations range in size from megabytes to tens of terabytes. Examples include raw measurements from satellite instruments, data from in situ observatories, and the output of three-dimensional global models. Data from all these sources are maintained by several international institutions with varying levels of accessibility and technological sophistication. The real challenge is in data life cycle management: curating, sharing and archiving the data. For the large datasets, it is a major challenge to store the data securely for a long term (tens of years), and simultaneously to serve the data to the user community. Sharing data is complicated, and protocols should include methods for open access, IPR-management, authorization and authentication. GEOSS and INSPIRE define interoperability standards, but these specifications are still evolving and rather complex, and require extensive effort for implementation. Although the models themselves have benefited from computing science research, the tools that scientists use for data analysis have received less attention and can barely cope with the current data volume. The increasing complexity of models and the development of satellite instrumentation will however overwhelm current capabilities and underscore the need for new technologies in data management and analysis. Interoperability and the development of e-infrastructures for the environmental ESFRI projects should still be tackled.

A very important part of the environmental sciences RI is the scientific collections of various kinds (biological, geological, ice cores, fossils, animals, plants etc.). At the European level an integrating body for the scientific collections would be needed, and the collections treated as a RI.

5. ESFRI ENV Projects 2010



The next generation European incoherent scatter radar system (EISCAT_3D)

Timeline:
Start of preparatory phase: 2010–2014
Start of construction: (2012) 2014–2016
Start of operation: 2016–2046

Estimated Costs:
Preparatory Phase: 4.5 M€
Construction Phase: 60 M€ (up to 250 M€)
Operation Phase: 4–10 M€/year
Decommissioning Costs: 10–15% of construction costs

Number of Partners: 8
Web Site: *www.eiscat3d.se*

The facility:

The preparatory phase of EISCAT_3D is funded by the European Commission with 4,5 M€. Started 1st of October 2010, the consortium today consists of 8 partner institutions (including 1 with official mandate from funding organization) from 5 countries. However there are additional 3 countries participating in research activities. Several countries outside Europe have expressed interest to EISCAT_3D.

Background:

EISCAT_3D is an existing international infrastructure based in Europe and devoted to the study of the upper atmosphere, ionosphere and geospace. EISCAT_3D proposes the replacement of EISCAT's radars in northern Scandinavia with a new system, based on multistatic phased arrays, which will greatly extend the data coverage and provide volumetric imaging capability. In addition, the new design will provide major improvements in temporal and spatial resolution, as well as new data products such as small-scale imaging. This upgrade has been prepared in a design study funded under the 6th Framework Programme. The Preparatory Phase will clarify the remaining design issues, and explore the logistical, organisational and financial questions which need to be resolved before construction can begin. EISCAT_3D addresses physical studies, such as atmospheric science and plasma physics, but is also fully relevant to Environmental science through issues such as space weather and global change. This new large-scale European research infrastructure has 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.

Steps for implementation:

Sweden hosts the headquarters of EISCAT_3D and many Member States of EISCAT Association have officially expressed their interest in supporting this development. Non-committed partners, who support the idea of the EISCAT_3D facility and indicate their intention to use the new data produced by the facility, have sent support letters for the Preparatory Phase action. These institutes are listed as Associate Partners in the Preparatory Phase. The associate partners at the time are too many to be listed here. The list can be found on the webpage http://www.eiscat3d.se/

The task of the Preparatory Phase Work Package for consortium building is to have firm commitments. It would be very naturally envisaged that at least the current host countries of EISCAT facilities, Sweden, Norway and Finland would play a key role, as well as it would be expected that the current other EISCAT member countries UK, Germany, China and Japan would participate at some level. Japan has strongly nationally invested in Northern Scandinavia at the current radar site for the next 10 years (a 10 MEUR multi-beam laser facility starts operations in the end of this year) and has organized a national group discussing possible future participation in EISCAT_3D. There are some indications of interest by third countries, who are currently not members of EISCAT, such as Russia and US for example. Russia placed a3-year contract with EISCAT for experiment time and wishes to have a similar agreement for the next 3 years, as well as discuss on how to participate in EISCAT_3D in the future. French institutes have expressed their wish to participate in preparatory phase action, which will be organized through the Work Package concerning the further development of Science plan of EISCAT_3D during the Preparatory Phase.

As the Preparatory Phase just started, no actual implementation steps are taken yet. However, in Finland there is technology prototyping project funded nationally in 2010 at a level of 1 M€, in order to construct a multi-beam capable test receiver station during 2011 in Northern Finland at Kilpisjärvi. Funding is coming for Regional development funds and University of Oulu.

The outcome of this project supports strategy planning in the preparatory phase. Since the test station is based on an industrialized concept of phased array receiver antennas and hardware in the radioastronomy project LOFAR, it is possible that adaptations of the technology concepts prototyped with LOFAR hardware would lead to an opportunity of feasible steps to fund actions towards implementation of EISCAT_3D receiver sites in the near future. Industrialization of LOFAR hardware has already covered the development costs of LOFAR hardware, so if adaptable in EISCAT_3D receivers, this technology might prove to be very attractive as the core for the receiver sites.

European Plate Observing System (EPOS)

Timeline:
Preparatory phase: 2010–2014
Construction: 2015–2020
Operation: 2020–2040+

Estimated Costs:
Preparation costs: 12 M€
Construction Phase: 500 M€
Operation Phase: 80 M€/year
Decommissioning Costs: not applicable

Number of Partners in preparatory phase: 18 + 5 associate partners
Web Site: *www.epos-eu.org*

The facility:

The following 18 countries officially participated to the EPOS proposal: Italy, France, Germany, The Netherlands, Romania, Iceland, Switzerland, United Kingdom, Norway, Turkey, Ireland, Portugal, Spain, Greece, Sweden, Poland, Denmark and Czech Republic. The preparatory phase of EPOS receives a 4.5 M€ funding from the European Union and started in November 2010. The consortium today consists of 20 partner institutes (including 1 non-governmental organization) and 6 associated organizations[13] from 23 countries.

Background:

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. EPOS 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. EPOS is actively networking the existing European facilities on seismological and geodetic monitoring as well as solid Earth observations.

Steps for implementation:

The EPOS preparatory phase started on November 1st 2010. All the 18 countries participating to the EPOS PP have expressed a support letter to maintain the existing RIs that will be integrated in the EPOS long-term integration plan. Because these RIs exist and are operational, such a commitment implies the financial support to maintain at least in the short term (that is the PP) these monitoring networks and experimental facilities. The site to host the EPOS Headquarter will be decided during the PP, which has the main goal to provide the long-term sustainability of integrated RIs.

The first step for implementation will concern the integration of existing national research infrastructures through the novel EPOS Data Centres representing a network of community service providers for distributed data storage and processing.

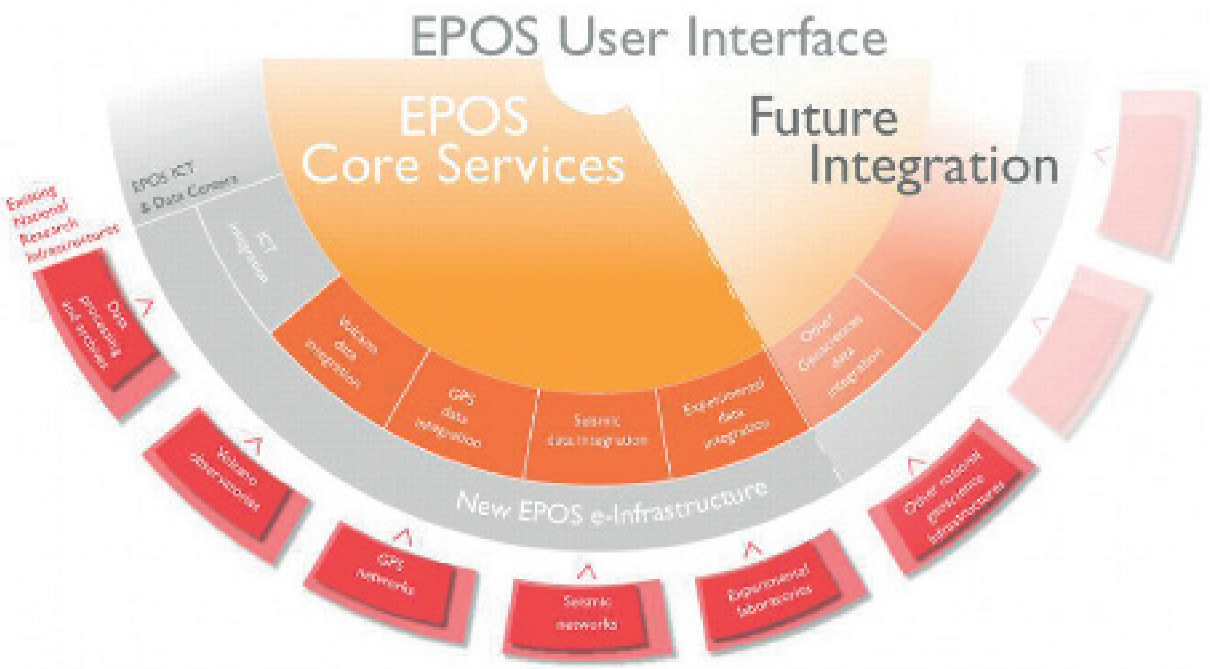
The second step will be dedicated to develop an innovative and coherent e-infrastructure architecture, which will form the platform and data service infrastructure (not community specific) by means of the EPOS Core Services, for interdisciplinary data and metadata

[13] Five representing the following countries: Slovak Republik, Finland, Slovenia, Austria, Israel; and one international organization EMSC (European Mediterranean Seismological Centre, www.emsc-csem.org)

exchange, processing tools and computational simulations through the EPOS user interface.

For seismology, the first step described above is quite advanced since ORFEUS (beneficiary of the PP as a non-governmental organization) is already integrating seismic monitoring infrastructures and has developed a first ICT infrastructure for data archiving and mining.

It does not exist an official expression of interest to host the headquarters of EPOS. It is likely that Italy and perhaps Turkey will work in this direction, but it is too early to express such an interest.



Svalbard Integrated Arctic Earth Observing System (SIOS)

Timeline:
Start of preparatory phase: 2010
Start of construction: 2011–2013
Start of operation: 2013

Estimated Costs:
Preparation costs: 2–5 M€
Construction Phase: 50 M€
Operation Phase: 10 M€/year
Decommissioning Costs: not applicable

Number of Partners: 26

Web Site: *www.unis.no/SIOS*, *www.forskningsradet.no/sios*

The facility:

The preparatory phase of SIOS started in October 2010 and is supported by the European Union with a 4.0 M€ funding. The consortium consists of 26 partners (including 3 with official mandate from ministries and funding organizations).

Background:

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 RI 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. It has a high level of maturity regarding all aspects (technical concept, timetable, availability of trained personal, budget).

Steps for implementation:

Norway has offered to host the headquarters of SIOS and many Member States and Associate States have expressed their interest in SIOS. SIOS has already a strong international character. There are 14 countries having activities on Svalbard that are partners in SIOS (such as Germany, Poland, Italy, UK, Russia, Denmark, Finland, The Netherlands, China, France, The Republic of Korea, Sweden and Japan).

The preparatory phase project started in October 2010.

European Research Icebreaker Consortium Aurora Borealis (ERICON-AB)

Timeline:
Start of preparatory phase: 2008
Start of construction: 2014–2017
Start of operation: 2018

Estimated Costs:
Preparation costs: 9.7 M€
Construction Phase: 790 M€
Operation Phase: 40 M€/year
Decommissioning Costs:

Number of Partners: 17
Web Site: *www.eri-aurora-borealis.eu*

The facility:

The preparatory phase of ERICON AB started in March 2008 and is supported by the European Union with a 4.5 M€ funding. The consortium consists of 17 partners from 11 countries.

Background:

The ERICON-AB project aims at the construction of AURORA BOREALIS (AB), a novel research icebreaker with drilling capability, and which shall serve as multidisciplinary research platform for European and international polar and marine research as well as for the deep-sea drilling community. The largest impact of climate change is expected to be in the Polar Regions, encompassing the Arctic and Subarctic regions as well as the Southern Ocean. The research vessel and the organisation that will be created around it will provide a good platform for co-ordinated European polar research in a multi-disciplinary environment.

Steps for implementation:

The Germany Research Council (Wissenschaftsrat) has recommended in 2006 to build the vessel, and many Member States have expressed their interest. According to the project's timeline the necessary documents for decision making on the vessel's construction will be in place in 2011.

Research infrastructure for ocean science and observations (EURO-ARGO)

Timeline:
Start of construction:2001
Start of operation: 2011

Estimated Costs:
Preparation costs: 3.0 M€
Construction Phase: not applicable
Operation Phase: 8.4 M€/year
Decommissioning Costs: not applicable

Number of Partners: 15
Web Site: www.euro-argo.eu

The facility:

The preparatory phase of Euro-Argo started in January 2008 and is supported by the European Union with a 3.0 M€ funding. The consortium consists of 15 partners. There is a general support from the ministries for all future members but no official letters were received except from Bulgaria and Greece. Indication of interest to Euro-Argo in construction phase has expressed by 8 European countries and 3 to 4 countries as an observer country.

Background:

Argo is a global ocean observing system endorsed by the Climate Research Programme of the World Meteorological Organization (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. Argo is strongly complementary to satellite 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 GMES Marine Core Service.

Argo's primary goal is to maintain the 3000 float 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.

Steps for implementation:

The first step is to send the official application for the Euro-Argo ERIC (to be done by the French ministry of research).

January 2011: set up an interim structure (consortium agreement) for one year or less depending on time needed to set up the Euro-Argo ERIC.

Mid 2011 – end of 2011: official start of the Euro-Argo ERIC.

2011–2013: phase 1 of the Euro-Argo ERIC. Budget from member states only. 250 K€ will be used to run the central research infrastructure (Euro-Argo ERIC) (members and observers subscription fees) and about 5 M€ will be used to run the national distributed research infrastructures.

2014–2020: phase 2 of the Euro-Argo ERIC. Budget from member states (5 M€) and from the European Commission (GMES) (3.4 M€).

The minimum contributions to the E-A ERIC required from Members and Observers are initially:

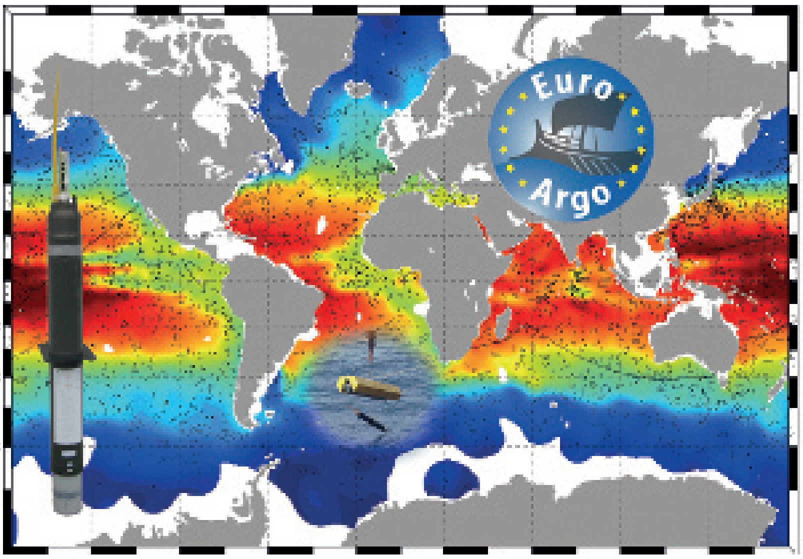
- For members: a subscription fee of 30 k€ and the minimum deployment of 3 Argo floats
- For observers: a subscription fee of 10 k€

Meeting the Euro-Argo objectives depends on larger contributions from the members as part of their national programmes. The initial national contributions are identified and given in the technical annex of the Euro-Argo ERIC application.

There is a need of additional direct EU funding (through GMES) of about 3.4 M€/year to complement funding from member states (about 5 M€/year).

Euro-Argo PP partners have defined and agreed on a long term organization (i.e. governance and legal issues) for Euro-Argo. The future long-term structure for Euro-Argo will allow Euro-Argo partners:

- To coordinate and supervise float deployment to ensure that Argo and Euro-Argo objectives are fulfilled (e.g. contribution to Argo global array, filling gaps, improve regional coverage, open data access, etc.).
- To decide on the evolution of the Euro-Argo infrastructure (e.g. data system, products, technology and new sensors, number or floats deployed per year).
- To share expertise on all scientific/ technological developments and use of Argo.
- To monitor the operation of the infrastructure (e.g. array performance monitoring) and to maintain the links with research and operational (GMES) user communities.
- To organize float procurement at European level (e.g. in case of direct EC funding and for small participating countries).
- To fund and link with the international Argo structure.



The Euro-Argo structure will include a central facility (Central RI) and distributed national facilities. The central RI will have a European legal structure (ERIC) to receive EC and national (member states) funding, to procure floats (includes logistics and test facilities) and to provide funding to the international structure. The governance model for the structure has been defined (council, board, scientific and technical advisory group) and its main characteristics have been agreed by all partners.

The decision to set up an ERIC has been reached in the course of the Preparatory Phase project and is being endorsed by the Members. However, since the very concept of an ERIC is a new one, it will undoubtedly take some time to reach the full capacity and organization. We can anticipate three stages from the end of the Preparatory Phase (December 2010): a transition phase of a few months during 2011, pending formal signature and approval from all the Members; a ramping up period 2011 to 2013) of consolidation with funding mostly from the Members, and a full operation beyond 2013 when funding from the EC (GMES) will bring operations to the expected level of some 250 floats deployed every year.

The plan to form an ERIC in 2011 is clear. Conditions are clearly expressed for all countries which may become full members or observatory members. These conditions include also financial aspects and responsibilities. The 12 national funding agencies / national partners have expressed the commitment towards EURO ARGO. An overall conclusion is that the EURO ARGO PP is going well on the right track – as the topics discussed were all very clear. There is a general level of understanding regarding what must be done, how and a clear assignments of responsibilities between partners.

Heavy Payload Long endurance Tropospheric Aircraft (COPAL)

Timeline:
Start of preparatory phase: 2007–2011
Start of construction: not defined yet
Start of operation: not defined yet

Estimated Costs:
Preparation costs: 1 M€
Construction Phase: 50 to 60 M€
Operation Phase: 3 M€/year
Decommissioning Costs: not applicable

Number of Partners: 13
Web Site: *www.eufar.net/copal*

The facility:

The preparatory phase of COPAL started in November 2007 and is supported by the European Union with a 1.0 M€ funding, the consortium today consists of 13 partners (including one funding organization).

Background:

COPAL (ex EUFAR) has the objective of providing the European scientific community with a research aircraft platform, capable of reaching and operating in any remote area in the world and offering a heavy-payload for integration of large panoply of instruments for research in environmental and Geo-sciences. It will also offer an opportunity to countries that are not yet operating research aircraft to develop expertise in airborne measurements and participate to international multidisciplinary experiments. The COPAL aircraft will fill a gap in the European research aircraft fleet. 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. They will supply with technical and logistic solutions the research institutions which will develop a new organizational model for COPAL.

Steps for implementation:

During the preparatory phase, COPAL has evolved towards the development of an integrated platform of several European aircrafts, embedding the new heavy-payload facility in a more extensive platform. This evolution benefits from EUFAR which already manages trans-national access to existing European aircrafts and will allow to develop a pan-European aircraft fleet for research.

France has offered to host the headquarters of COPAL and many Member States have expressed their interest in this RI.

European Multidisciplinary Seafloor Observatory (EMSO)

Timeline: 2009–2014
Start of construction:
Start of operation:

Estimated Costs:
Preparation costs: 80 M€
Construction Phase: ca.160 M€
Operation Phase: 32 M€/year
Decommissioning Costs: to be estimated

Number of Partners: 12
Web Site: *www.emso-eu.org*

The facility and background:

The preparatory phase of EMSO started in April 2008 and is supported by the European Union with a 3.9 M€ funding. The consortium consists of 12 partners (including 8 with official mandate from ministries and funding organizations) from 12 countries. Until now 6 countries have expressed an official interest to EMSO.

EMSO is the 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. 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.

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 status for its consortium. Efforts should also be focused towards the definition of a perfectly coherent policy related to the open access to and use of scientific data, which may give no possibility for further misunderstandings either from Consortium members or Third Parties.

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 are nevertheless recommended to be made with Euro-Argo RI Project. EMSO has strong potential for international collaboration outside Europe.

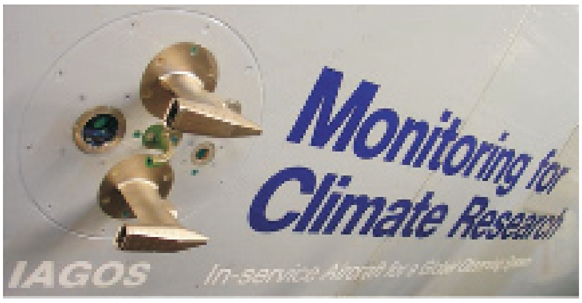
EMSO will propose an ERIC in 2011. No leading country for construction phase.

In-service aircraft for a global observing system (IAGOS)

Timeline:
Start of preparatory phase: 2008–2011
Start of construction: 2011–2016
Start of operation: 2012–2035

Estimated Costs:
Preparation costs: 5–7 M€
Construction Phase: 15 M€
Operation Phase: 5–10 M€/year
Decommissioning Costs: 0.5M€

Number of Partners: 16
Web Site: *www.iagos.org/*



The facility:

The preparatory phase of IAGOS started in September 2008 and is supported by the European Union with a 3.3 M€ funding. The consortium consists of 16 partners (including 2 ministries and funding organizations, 2 airlines and 2 industrial partners and manufacturers of instrumentation) and one associated organization.

The preparatory phase of IAGOS is funded by the European Commission with 3.3 M€. It started in September 2011, the consortium today consists of 16 partners (including 2 ministries and funding organizations, 2 airlines, and 2 industrial partners and manufacturers of instrumentation) and one associated organization.

Background:

IAGOS will establish and operate as an 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. 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 IPCC process. IAGOS is important (under full European leadership) for long-term observations, given the scientific objectives of global climate change research).

Steps for implementation:

Germany is negotiating to host the headquarters of IAGOS and many Member States have expressed their interest in. The Design Study of IAGOS-ERI was running from 04/2004 until 01/2010. Currently, IAGOS-ERI is in the Preparatory Phase, which is going to run until 08/2012. Steps of implementation during the Preparatory Phase are the following: Preparation and decision of an appropriate legal structure for IAGOS-ERI as distributed infrastructure, as well as a sustainable funding scheme. Integration of new partners (research institutions and airlines). Preparation of the operational basis (certification and maintenance) and new technical developments. Support by BMBF on the agenda for 2011. First IAGOS aircraft was equipped in 2009 (Deliverable of Design Study), CARIBIC aircraft is part of IAGOS since the start of preparatory phase. Three MOZAIC aircraft will be brought back to operation in 2010 as part of IAGOS, Implementation of three additional IAGOS aircraft in 2011/12.

Legal structure (International Association or ERIC) under discussion between partners.

Integrated carbon observation system (ICOS)

Timeline:
Start of preparatory phase: 2008–2011
Start of construction: 2010–2015
Start of operation: 2013–

Estimated Costs:
Preparation costs: 6.7 M€
Construction Phase: 130 M€
Operation Phase: 36 M€/year
Decommissioning Costs: not applicable

Number of Partners: 18
Web Site: *www.icos-infrastructure.eu/*

The facility:

The preparatory phase of ICOS started in October 2008 and is supported by the European Union with 5.0 M€ funding. The consortium consists of 18 partners (including ministries and funding organizations) from 13 countries. Until now 6 countries have expressed an official interest to ICOS.

Background:

The objective of ICOS is to initiate across Europe and adjacent regions a network for standardized long-term high precision monitoring of atmospheric and oceanic greenhouse gas concentrations and ecosystem fluxes and essential carbon cycling variables. These measurements will allow daily determination of sources and sinks at scales down to about 100 km^2, and will be a basis for understanding the carbon exchange processes between the atmosphere, the terrestrial surface and the ocean. ICOS has a high scientific and societal pan-European and even 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 facility is both research and operational (in the frame of GMES) oriented and will enable European member States and the EC to better respond to the obligations of the UNFCCC. ICOS is in continuity of an ongoing preliminary project (through IP 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 is in transmission from preparatory phase to construction phase. Finland and France offered to host the headquarters of ICOS. France and Finland have submitted a joint application for the Atmospheric Thematic Centre, Italy, Belgium and France have submitted a joint application for the Ecosystem Thematic Centre.

© Jussi Paatero

Science and Technology Infrastructure for Research on Biodiversity and Ecosystems (LifeWatch)

Timeline:
Start of preparatory phase: 2008–2011
Start of construction: 2011–2016
Start of operation: 2012 (first release) – 2016 (full operation)

Estimated Costs:
Preparation costs: 5 M€
Construction Phase: 255 M€
Operation Phase: 35.5 M€/year
Decommissioning Costs: not applicable

Number of official partner countries in preparatory phase: 33
Web Site: *www.lifewatch.eu*

The facility:

The preparatory phase of LifeWatch started in February 2008 and is supported by the European Union with a 5.0 M€ funding. The consortium consists of 33 partner institutions from 19 different countries. Recently Albania and Georgia formally requested to become involved in the preparatory phase. Germany did not yet sign the letter of interest, but various German institutes are involved in the preparatory phase.

Background:

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 an 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. The LifeWatch research infrastructure will contribute as a European component to the 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:

The Preparatory Phase is ending on 31 January 2011. At this stage (October 2010) already eight countries signed a Memorandum to Intent, implying that 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. These countries are Finland, Greece, Hungary, Italy, the Netherlands, Romania, Spain and Sweden. There are clear indications that more countries will follow in the year 2011. Three countries (Italy, the Netherlands and Spain) offered to take lead with advance funding to allow for continuity. The transition activities include efforts with respect to detailed financial and financial rules, the process of recruitment of senior executives, processing of the first year construction logistics, and orchestrating the distributed construction work.

Annex 1. Composition of the ENV TWG

Chair

Eeva Ikonen, Academy of Finland, Finland

Vice Chair

Elisabeth Koch, Central Institute for Meteorology and Geodynamics, Austria

Members

Miklòs Bulla, Széchnyi István University of Applied Sciences, Hungary

Magnus Friberg (1.1.2010-), Vetenskapsrådet, Sweden

Domenico Giardini, Swiss Seismological Service, Switzerland

Peter M. Haugan (1.2.2010-), University of Bergen, Norway

Rudy Herman, Flanders Authority, Belgium

Anna Maria Johansson, European Commission, Belgium

Sylvie Joussaume, National Center for Scientific Research, France

Michal V. Marek, Institute of System Biology and Ecology, Czech Republic

Frans Martens (1.4.2010-), National Research Council, The Netherlands

Frank McGovern, Environmental Protection Agency, Ireland

Antonio Navarra, Centro Euromediterraneo per i Cambiamenti Clinmatici, Italy

Laura Höijer (1.1.2010-), Ministry of Environment, Finland

Maria Rosa Paiva, Universidade Nova de Lisboa, Portugal

Michael Schultz, Natural Environment Research Council, UK

Adrian Stanica, Romanian National Institute for Marine Geology and Geoecology, Romania

Svetlana Thaller-Honold, Zukuenftige Technologien Consulting, Germany, replaced in Autumn 2010 by Saskia Vielgraf from the same organisation.

Rein Vaikmäe, Tallin University of Technology, Estonia

Maciej Zalewski, University of Lodz, Poland

Experts

David Dodd, Environmental Protection Agency, Ireland

Secretariat

Saara Lilja-Rothsten (1.10-31.12.2009), University of Helsinki, Finland

Timo Sareneva, (1.1.2010-), Academy of Finland, Finland

Annex 2. Meetings held by ENV TWG

ENV TWG used CIRCA site as a working platform of the group. All members received a username and password to the site. The Secretariat of ENV TWG and EC Secretariat for the group took care of the documents on the site. All documents were available for the whole group on the CIRCA site with the understanding that the minutes and discussions in the meeting are confidential. No conflict of interest was documented.

1. November 12, 2009 in Brussels, Belgium
2. December 15-16, 2009 in Helsinki, Finland
3. January 26, 2010 in Brussels, Belgium
4. March 17, 2010 in Brussels, Belgium
5. June 7-8, 2010 in Vienna (Drafting Group meeting), Austria
6. September 22, 2010 in Brussels, Belgium

Annex 3. Update of ESFRI Roadmap 2010

Consensus opinions:

ANAEE – Infrastructure for analysis and experimentation on ecosystems

Background: This is the second time that ANAEE has been submitted for inclusion on the ESFRI Roadmap. The RI proposal has improved since evaluation 2008. The community has organized itself. The main difference is the addition of a fourth element (analytical platforms) to add to the original three (ecotrons, long-term *in situ* experimental platforms and *in silico* platforms).

Conclusions: ANAEE infrastructure aims at developing a coordinated set of experimental platforms for terrestrial ecosystems. ANAEE is essential to help improve our understanding of the response of ecosystems to environmental changes (such as climate change and other stresses on the environment). ANAEE will also be very important to test management techniques to prepare for adaptation as well as mitigation.

The need for this type of infrastructure is urgent and consensual. Ecosystem research in Europe must be strengthened, thus requiring the integration of inputs from a broad and interdisciplinary base. ANAEE is important RI for research on terrestrial ecosystem functioning and relevant for ecological engineering and land-use management special in frame of climate change adaptation.

It is relevant to Europe. Links with USA have also begun through developments of methodologies and could provide the basis for a larger RI.

The proposal has overlaps with the objectives, tasks and infrastructures established by the LTER-Europe network, an initiative that in part, has entered the operation phase over one decade ago. Although some countries are still going through the implementation stage (site establishment), for several other sites, important data series have been collected (http://www.lter-europe.net/sites). Other expected socio-economic impacts – Interactions with other EU programmes, it is referred that strong collaborations with the ESFRI projects LifeWatch and ICOS are envisaged. Both ANAEE and LifeWatch are ambitious and broadly-based, and need to find a way to work together. The RI will be a very distributed infrastructure; it would be good to have a better idea of the proposed location of the individual infrastructures, and at least a list of the infrastructures which already exist and the one which are proposed.

To be clarified: ANAEE proposes to network a large number of platforms and other infrastructures across Europe. The first proposal listed support from France (2 institutions), UK (2), Italy (2), Germany (1) and Spain (1). The current proposal shows a far wider regional involvement across Europe (37 institutions in 19 countries) with coverage in particular of Scandinavia and Eastern Europe which was missing from the original proposal. Verification the stage of commitments of partners informed in the application must be done.

- Is ANAEE a project that fits to the 'Food, Agriculture and Fisheries, Biotechnology' topic?
- How the access will be enabled for researchers outside the participating institutions?
- What are the plans for the administration and the legal structure for this kind of very distributed RI?

Recommendations to BMS: ENV TWG would support the evaluation of ANAEE proceeding further with an interview. This should be done by BMS TWG with ENV TWG representation.

Additional comments to ESFRI:

Both ANAEE and LifeWarch are ambitious and broadly-based, and need to find a way to work together.

The RI will be a very distributed infrastructure; it would be good to have a better idea of the proposed location of the individual infrastructures, and at least a list of the infrastructures which already exist and the one which are proposed."

So far no agreement for collaboration and or coordination has been made, regarding the common use/ rentabilization of sites / infrastructures.

Consensus assessment:

ESTGC – Energy saving through green chemistry

Conclusion: ENV TWG is unclear as to whether the proposal fulfils the criteria to be chosen to the ESFRI Roadmap. ENV TWG suggests that it could have a representative on an interview panel or at a meeting when the proposal is considered at ENERGY TWG.

A new path must be followed in order to save resources and to achieve the reduction of CO_2 emission. Establishment of renewable resources as supplier of resources and energy could be a significant contribution. Substantial efforts in research will be necessary to accomplish this. Even with significant financial investment this will be difficult to implement on a national level. With transnational pooling and full-scale cooperation among research facilities, ESTGC is aiming in the right direction.

However, the approach and scientific objectives of the proposal remain unclear. The described scope seems vague. Concrete references to which kind of CO_2-based chemistry is envisioned to replace the mentioned chlorine containing reagents are missing. Likewise, the objectives of research in the area of CO_2 to fuel conversion are unclear. It seems clear that green chemistry will have a crucial role for the future of our society; it is much less clear that the proposed RI would contribute to the required development.

The proposal is very unclear of what infrastructure is actually proposed. Two Italian partners, INCA, a national consortium, and ENEA, an Italian governmental agency is presented. No indication is given of what infrastructures already exist and what new infrastructures are proposed. The proposal seems to describe the future focus of R&D at existing infrastructures (and more generally of the whole chemistry in Europe), without giving a clue of the size/sustainability/budget/long-term future of these existing infrastructures. Although several European institutions are indicated as interested partners, commitment has not been expressed.

Links to other ESFRI projects such as ECCSEL (Energy) and ICOS (ENV) should have been considered and forms of interaction suggested.

The question of open access to infrastructures and data is not addressed.

The budget is very unclear. The reference cost of each Center (unclear what these centers should be) is given in the range of 100 M€, while the detailed costs listed for the preparation, construction, operation and decommissioning of the RI are unrealistically low.

In general, the proposal should present more details concerning planning and implementation procedures of the RI and the involvement of the potential partners mentioned should be documented. The ESTGC proposal does not propose an ESFRI-class RI and should not be evaluated further in the present form. The consortium should be invited to present a much clearer proposal for a RI fitting within the ESFRI framework. Despite the obvious environmental relevance of CO_2 utilization, the proposed infrastructure does not in fact have a significant environmental content.

Environmental Sciences

Thematic Working Group Report 2010

Contact:
ESFRI Secretariat
Postal address:
European Commission
SDME 01/128
B-1049 Brussels, Belgium
Tel: +00 32 2 299 25 39
Fax: +00 32 2 299 21 02
ESFRI@ec.europa.eu

www.ec.europa.eu/research/esfri

ESFRI European Strategy Forum on Research Infrastructures