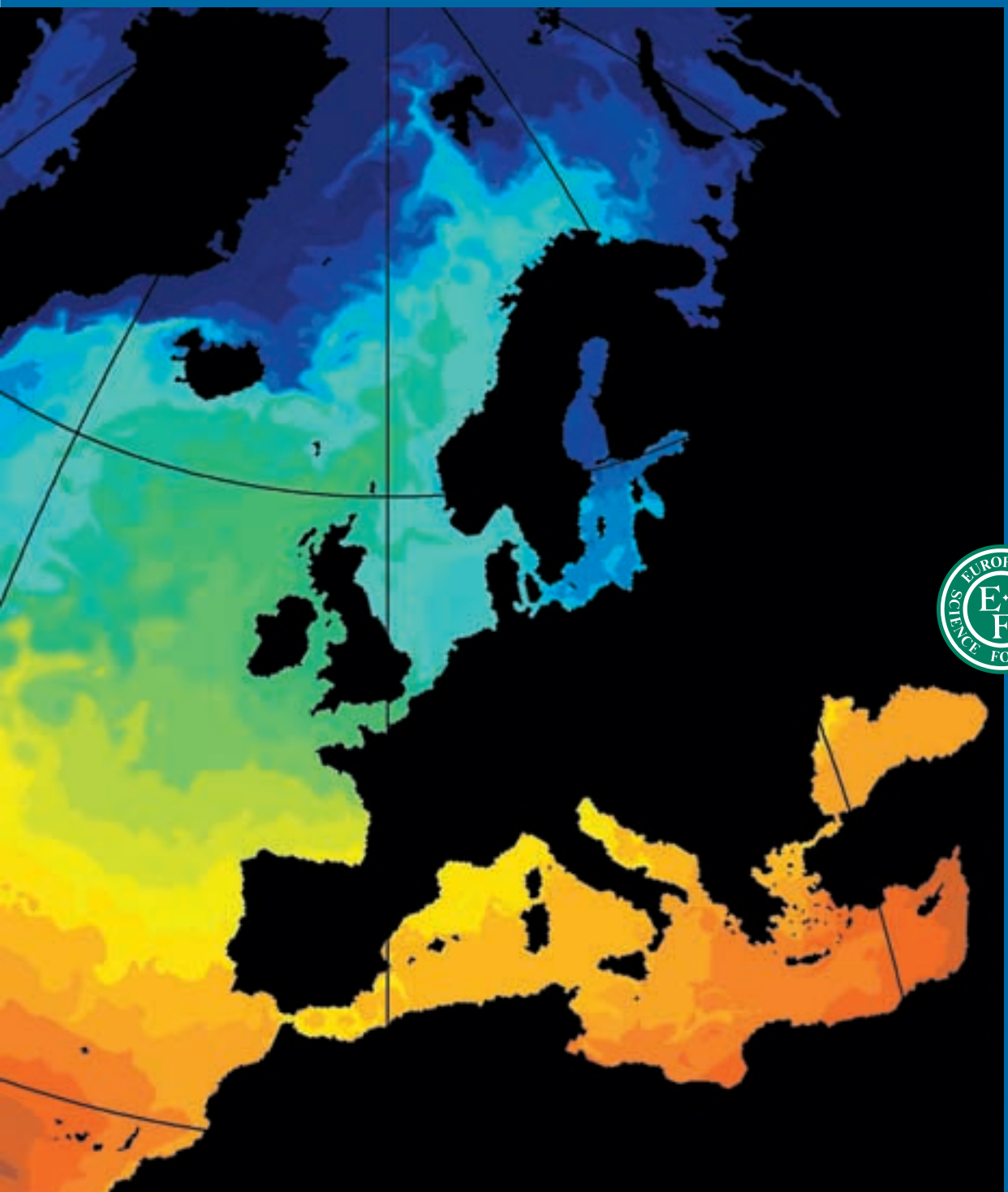
ESF Marine Board Position Paper 3

Navigating the future

Towards a *Marine* European Research Area



Marine Board

March 2001

The European Science Foundation (ESF) acts as a catalyst for the development of science by bringing together leading scientists and funding agencies to debate, plan and implement pan-European scientific and science policy initiatives.

ESF is the European association of 67 major national funding agencies devoted to scientific research in 24 countries. It represents all scientific disciplines: physical and engineering sciences, life and environmental sciences, medical sciences, humanities and social sciences. The Foundation assists its Member Organisations in two main ways: by bringing scientists together in its scientific programmes, EUROCORES, forward looks, networks, exploratory workshops and European research conferences, to work on topics of common concern; and through the joint study of issues of strategic importance in European science policy.

It maintains close relations with other scientific institutions within and outside Europe. By its activities, the ESF adds value by cooperation and coordination across national frontiers and endeavours, offers expert scientific advice on strategic issues, and provides the European forum for science.

ESF Marine Board

The Marine Board operating within ESF is a non-governmental body created in October 1995. Its institutional membership is composed of organisations which are major national marine scientific institutes and funding organisations within their country in Europe. The ESF Marine Board was formed in order to improve co-ordination between European marine science organisation and to develop strategies for marine science in Europe.

Presently, with its membership of 23 marine research organisations from 16 European countries, the Marine Board has the appropriate representation to be a unique forum for marine science in Europe and world-wide.

In developing its activities, the Marine Board is addressing four main objectives: creating a forum for its member organisations; identifying scientific strategic issues; being the voice of European marine science; and promoting synergy among national programmes and research facilities.

This Position Paper is the summary of a report prepared by the ESF Marine Board and entitled *Towards a European Marine Research Area* which can be downloaded from the website: *http://www.esf.org/life/ac/Marine_Board/forum.htm*

Contact address:
European Science Foundation, ESF Marine Board – Secretariat
1 quai Lezay-Marnésia, 67080 Strasbourg Cedex, France
Tel: +33 (0)3 88 76 71 41 / Fax: +33 (0)3 88 25 19 54
E-mail: marineboard@esf.org

Cover picture: Map of Europe showing sea surface temperatures. © Southampton Oceanography Centre (SOC)

Navigating the future

Towards a *Marine* European Research Area

Contents

"More has been learned about the nature of the oceans in the past 25 years than during all preceding history…. However, what we know about the oceans is still far outweighed by what we do not know".

"The Ocean, Our Future", Report of the Independent World Commission on the Oceans (1998)

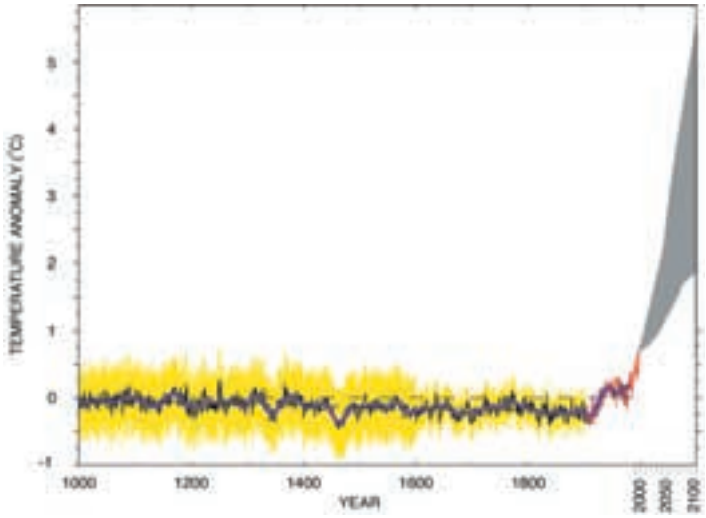
Oceans and seas represent a major component of the Earth System. They hold the key to climate. They support a significant proportion of the world's economic activities and a wide range of services and social benefits. And despite major scientific advances in recent years, they still offer exciting perspectives for frontier research on such fundamental issues as, for example, the origin and evolution of life.

*An **Integrated Marine Science Plan for Europe** is due for completion in October 2001.* 'Navigating the future' *summarises the major benefits of this European plan, which must be given priority consideration under the Sixth Framework Programme and the European Research Area (ERA). The strategy will provide significant direction for national marine research plans, networking of national programmes and the integration of Europe in international programmes as well as maximising use of existing marine science and technology infrastructure.*

Drivers for a *Marine* European Research Area

1. **S**ustainable exploitation of the European seas' resources, protection of the marine environment, and provision of reliable marine-based services are vital to economic prosperity and the quality of life. Research, technology development and innovation are essential to address sensitive questions such as:
   - the finite nature of living resources;
   - increasing conflicts among competing uses (fisheries, aqua-culture, hydrocarbon exploitation, transport, sea-side recreation, etc.).

2. The Earth, the atmosphere and the ocean are in constant interaction. New research is urgently needed to understand the relationships between climate change and the marine environment. Variations of the pattern of ocean currents, especially in the North Atlantic, will dramatically affect the European climate and even the global one. Increased sea level



Mean annual temperature variations over the northern hemisphere (from Mann et al., 1999 Geophys. Res. Lett., 26, 759-762) compared to the estimated range of global temperature changes over the next century from a set of transient model experiments used in IPCC assessment excercises (from R.T. Watson, 11/13/2000 presentation at 6th Conference of Parties, U.N. Framework Convention on Climate Change).

rise, extreme events such as surges and storms, decline or regional shifts in aquaculture and fisheries productivity, are all potential outcomes of climate change. These will have significant socio-economic impacts on the coastal populations.

Breaking waves. © A. Gerdes, MARUM, Bremen, Germany

3. Oceans as a frontier in science and technology. In the last decade, new technology has tremendously extended the scope of research and has opened up a new era of discoveries. European seas have been the locus of exciting discoveries: thermal vents and cold seeps, huge accumulations of methane in the form of gas hydrates, and intriguing new ecosystems such as deep corals.

New research frontiers must include, for example:

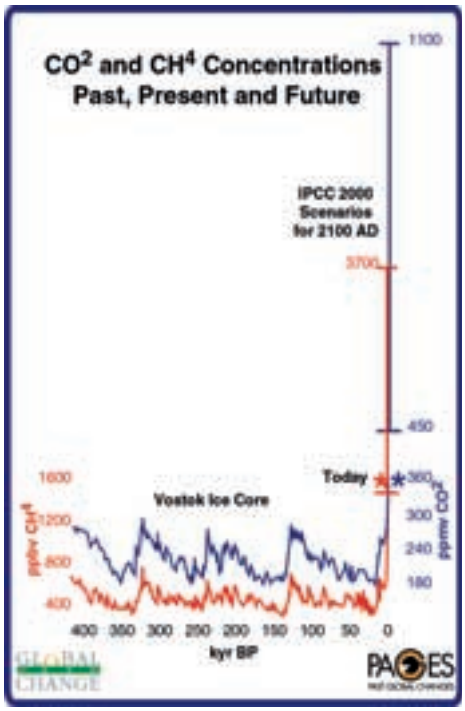
- the possible consequences of change in the marine environment for human activities and health;
- the ocean as the largest gene pool;
- stepping up the use of renewable energies;
- monitoring Earth processes and hazards by means of seafloor observatories;
- extending to 2500 m and beyond, access to a new range of targets for hydrocarbon exploration.

The scientific challenges

Five key themes have been identified to embrace challenges for future marine research.

1. Ocean – climate interaction

Climate-related research needs a better understanding of the processes governing ocean circulation and air-sea exchanges, their variability and predictability. Society demands improved forecasts of sea state and climate on all time scales, from short-term to very long-term, over hundreds of years. Forecasting ability is essential to realistically evaluate the various options to address the issue of climate change and its impact on society.



The ocean is a major source or sink of carbon and many other elements. This has critical implications for climate change and the debate on emission controls. The feasibility, sustainability and impact of deep-sea disposal of CO_2 and surface fertilisation must be investigated.

2. Sustainable exploitation of resources

Fisheries, aquaculture and associated processing industries employ more than 600 000 people in Europe and generate a turnover of 12 billion Euros.

Research is needed to ensure that both fisheries and aquaculture are sustained as viable businesses without having a negative effect on the marine environment.

Non-living resources include hydrocarbons, renewable energies and minerals. Research is essential to assess if the utilisation of these economically valuable resources poses a threat to the marine environment and how their exploitation is compatible with other usages of the sea. Investigations are required to discover if gas hydrates found in sediments of the European margin represent a future source of energy.

New research on renewable energies such as offshore wind and wave energy would greatly assist Europe's commitments to the Kyoto Agreement to reduce CO_2 levels.

Relation of CO_2 and CH_4 concentrations in the atmosphere over time.

Coastal erosion.
© Marine Institute, Ireland

3. Health of the coastal zone

A scientific background for effective *Integrated Coastal Zone Management* (ICZM) requires an approach to:

- promote water quality;
- forecast detrimental events such as pollution peaks and algal blooms;
- mitigate impacts of the discharge and dispersion of waste;
- protect the coastline against consequences of extreme events;
- preserve important parts of the European cultural heritage.

The issues at stake and the solutions science offers must incorporate the requirements of the decision-makers and the public.

Marine organisms play a crucial role in many processes that sustain the biosphere and provide a variety of products that are essential for human health.

Research is required to:

- provide an inventory of biodiversity in European seas;
- understand the role of biodiversity in the biosphere;
- preserve coastal marine biodiversity and ecosystem health;
- predict the ecological and economic consequences of loss of biodiversity as a result of environmental change.

4. New frontiers in marine life

The number and diversity of life forms in the sea is far greater than on land. The discovery of new life forms proceeds at an unrelenting pace. Applications of genetic engineering and biotechnology in medicine, the food industry and environmental sensors are expected to increase rapidly in coming years. Research is needed to discover novel compounds in organisms and habitats, establish new cultivation methods for organisms and cell lines, develop new products and processes, for application in biotechnology.

New perspectives on the origin of life and fundamental biological processes are just two potential benefits of "new frontier" research. In particular, up to 10% of the Earth's total living biomass may be contained in a sub-seafloor biosphere. Investigating these micro-organisms, in order to understand their

Living organisms associated with hydrothermal vents (HOT 96 Campaign). © IFREMER

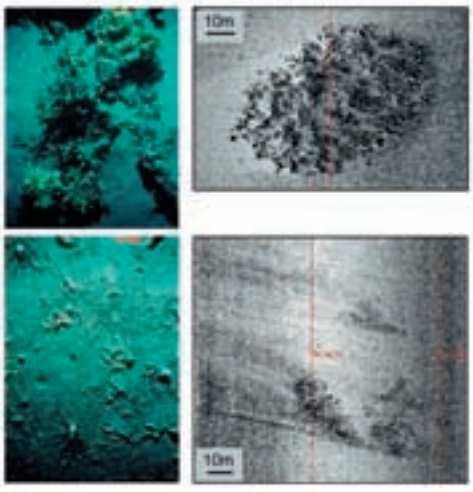
role in the formation of fossil fuels and possible use in biotechnology, is an important topic for future research. Also of great interest are special deep-sea ecosystems along the continental margins, in areas actively explored for hydrocarbons.

5. Margin seafloor studies and geo-hazards

This challenge addresses a number of geological, sedimentological and geochemical active processes that work on the sea floor. Petroleum exploration on the continental margin of Europe is confronted by several geo-hazards: slope failures and landslides, earthquakes, sudden releases of methane from hydrates.

Research is needed to:

- predict mass wasting which may induce tsunamis;
- monitor earthquakes (Eastern Mediterranean);
- mitigate impacts of offshore activities on the sea floor;
- assess the size, distribution and role of vents, seeps and deep ecosystems.



Side scan sonar images of a *Lophelia* coral mound at 1000 m before and after being damaged by a trawler. One can see the scuff marks left by the trawler. © Southampton Oceanography Centre (SOC)

Meeting the challenges

1. Human resources

Students unloading samples from the research ship Charles Darwin.
© Southampton Oceanography Centre (SOC)

A dynamic policy to promote human resources is an essential component of a European marine science plan. Key issues are:

- making a marine research career attractive;
- facilitating mobility of scientists within Europe and outside Europe including developing countries;
- providing networking opportunities for industry and academia with potential common interests.

2. Research infrastructures

Research infrastructure includes research vessels, sea-floor observatories, *in situ* buoys, satellite and aerial reconnaissance systems, data processing and management facilities, research centres. These are expensive to operate with specialist staff. Up to 50% of the overall budget for marine research is attributed to infrastructure and equipment.

Action must be taken to co-ordinate a European strategy for marine research infrastructure addressing:

- the use and co-ordination of existing facilities for national and international programmes;
- the identification of needs and building up of a European strategy for new facilities;
- the construction of dedicated new facilities.

The need to co-ordinate practice in data management and exchange is also vital. Longer-term funding mechanisms are crucial for ocean observing systems. In this respect co-operation with non-European agencies such as NSF and research institutions becomes essential. Greater co-operation with industry and

Research vessel in rough sea.
© A. Gerdes, MARUM, Bremen, Germany

the service sector can overcome some of these constraints and ensure the delivery of cost-effective and efficient services to science.

3. Forward looking technology

The rapid pace of technological development in recent years will provide a new generation of instruments and systems that will help to address these challenges by:

- monitoring ocean circulation for early warning of climate change;
- collecting long time series of environmental parameters;
- measuring and monitoring marine biodiversity;
- surveying the sea floor, monitoring geological hazards and pollution, and increasing the efficiency of ocean drilling.

Forecasting events and trends in the marine environment – for climate change, the occurrence of harmful blooms, coastal extremes, the onset and dispersal of pollution – requires complex computer simulations. More specifically, 3D models integrating all relevant parameters create a quantitative and complete picture of active processes in the sea. These models and their outputs should be incorporated in decision-making systems.

Research vessel Atalante handling the remotely operated vehicle (ROV) Victor. © IFREMER/ M. Gouillou

The main objectives for technology development in marine science should be to:

- integrate the most advanced progress in the domains of communication, computers, medicine, optics, biomolecular technology, new materials and nanotechnology;
- improve co-operation between research institutes and the commercial sector – involve SMEs in technological developments and stimulate European competitiveness in the international market for science and technology products and services;
- identify gaps in technology.

4. Long-term commitments for observing the marine environment

Marine research has moved away from the traditional exploratory mode. Climate-relevant research, ocean ecology, environmental impacts and all aspects of operational forecasting, require systematic data collection over long periods (ten years or more). This calls for networks of land, sea-based and satellite observatories.

In order to support this development, adequate commitments from policy makers and funding agencies are required. Co-ordination and long-term commitments must be addressed by a European marine science policy and will have to be built-up between ministries and agencies with responsibilities for marine affairs. The implementation of permanent observation systems has to be performed by collaborating large marine institutes.

5. Interdisciplinarity

This is mandatory in large targeted projects and is therefore a condition for implementing the European Research Area.

As marine science progresses, new research initiatives are being formulated, bringing together physicists, biologists and other natural scientists, and, especially on coastal seas research, social scientists and economists. Specialists in international maritime law and representatives from the shipping industry should be involved (for example in projects addressing risk prevention and pollution).

6. Implementation

Realising these scientific challenges requires:

- networking and co-operation within national programmes to make full use of the national and regional strengths;
- setting up large-scale targeted projects of a European dimension through:
  - clusters of regional projects;
  - integrated European research programmes;
  - focused research projects of multidisciplinary and regional dimensions;
  - networks of European scientists and laboratories from the public and private sectors;
- The EU (representing its Member States) should actively participate as a partner in international programmes, demonstrating European concern and increasing European visibility;
- Work with industry and SMEs to ensure active participation throughout the research project lifecycle.

7. European and societal dimensions

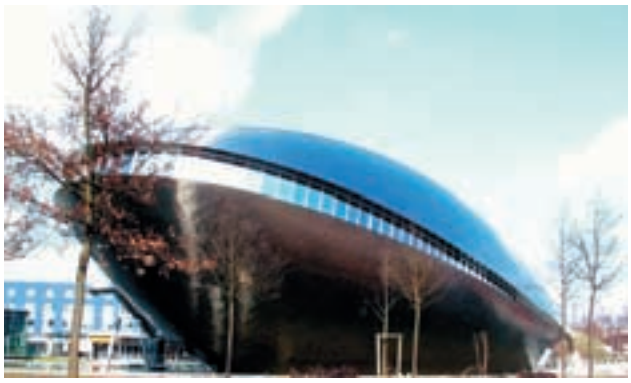
Science, society and citizens

Public appreciation of the oceans, their importance to mankind and the complex issues raised by their sustainable

development is of increasing concern at the European level.

The Marine Science Plan will promote:

- public awareness, appreciation and education on the scientific challenges of the ocean;



Universum Science Centre in Bremen © Universum, Bremen, Germany

- ethics for the governance of the ocean and adoption of codes of conduct in professional practices;
- the development of a marine science information system, including quantitative indicators, socio-economic data and syntheses required for policy development and marine science management.

Regional dimension

The seas around Europe display great diversity in their geographical setting, environmental drivers and pertinent environmental issues. The Marine Science Plan must take these regional differences into account, benefit from them and establish appropriate mechanisms to address them through the "*regionalisation of global issues*".

Co-operation with developing countries

Co-operation in marine science with developing countries must be engaged through mutually beneficial partnership programmes. These must be relevant to the development of the host country and strengthen its marine science capacity.

Joint projects should include training in research. Building strong regional centres of excellence and establishing internet networks are also important elements for co-operation.

EU enlargement

The Marine Science Plan will help EU candidate countries, especially those with a marine coastline, to assess their strengths and weaknesses. It will create opportunities to integrate their priorities and their scientists into the European marine science scene.

The European Research Area

The European Commission recently proposed the establishment of a European Research Area (ERA) to strengthen the coherence of research activities and policies in Europe. The ERA will require the full application of the principles of European added value between the research activities of the EU and its Member States.

Marine research stands out as an area where a truly European research partnership is needed.

ESF Marine Board membership

Austria

- Fonds zur Förderung der wissenschaftlichen Forschung
- Österreichische Akademie der Wissenschaften

Belgium

- Fonds National de la Recherche Scientifique
- Fonds voor Wetenschappelijk Onderzoek - Vlaanderen

Finland

- Suomen Akatemia / Finlands Akademi

France

- Centre National de la Recherche Scientifique
- Institut Français de Recherche pour l'Exploitation de la Mer

Germany

- Deutsche Forschungsgemeinschaft
- Hermann-von-Helmholtz-Gemeinschaft Deutscher Forschungszentren

Greece

- National Centre for Marine Research

Ireland

- Marine Institute

Italy

- Consiglio Nazionale delle Ricerche
- Ente per le Nuove Tecnologie, l'Energia e l'Ambiente

Netherlands

- Koninklijke Nederlandse Akademie van Wetenschappen
- Nederlandse Organisatie voor Wetenschappelijk Onderzoek

Norway

- Havforskningsinstituttet
- Norges Forskningsråd

Poland

- Polska Akademia Nauk

Portugal

- Instituto de Cooperação Científica e Tecnológica Internacional

Spain

- Consejo Superior de Investigaciones Científicas

Sweden

- Vetenskapsrådet

Turkey

- Türkiye Bilimsel ve Teknik Araştıma Kurumu (TÜBITAK)

United Kingdom

- Natural Environment Research Council

IREG Strasbourg – Dépôt légal: Mars 2001 - N° d'ordre: 010957