InterRidge -www.interridge.org

Chair: Colin Devey, Leibniz-Institut, Kiel, Germany

InterRidge (IR) is concerned with promoting all aspects of mid-ocean ridge research (their study, use and protection) which can only be achieved by international cooperation. At present IR is supported by 5 full-member nations (UK, France, Germany, Japan, USA, each paying US$20.000 p.a.) and 6 associate member nations (Canada, India, China, Korea, Norway, Portugal, each paying US$5.000), 17 other nations have corresponding nation status, 2700 individuals are on the mailing list.

IR has four main functions: (a) build and maintain an international ridge-research community; (b) identify, through its working groups and the workshops and conferences they organize, the important problems in ridge research and develop program plans for their solution; (c) act as a representative body for ridge scientists in policy discussions; (d) through education and outreach communicate the importance of ridge research to the general public and decision makers worldwide.

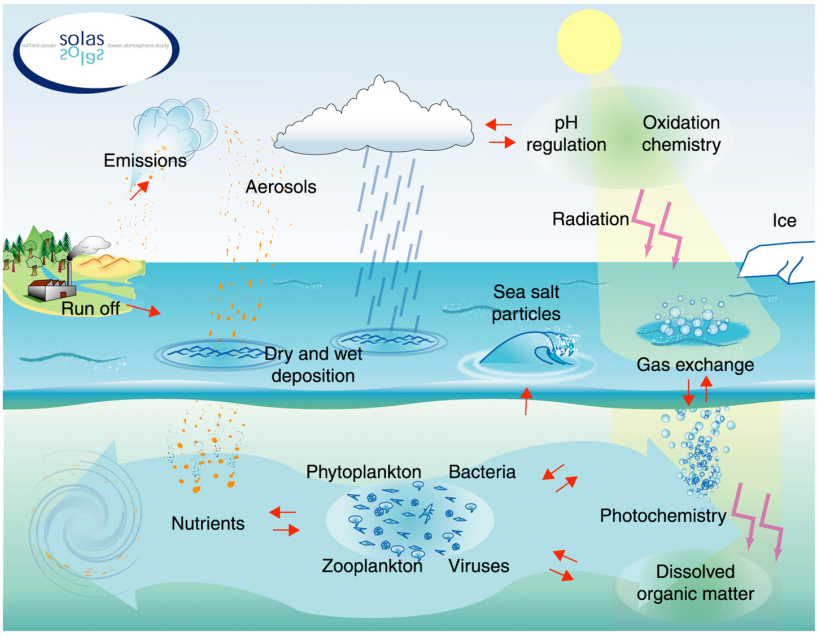
IR, in existence since 1993, has just begun its second decade. The science plan for this next decade identifies the themes (represented by working groups, the mainstay of InterRidge) that will constitute the core of research during this period:

Theme	Objective	Start	WG-Chair
Ultraslow-spreading ridges	concentrate on the particular scientific and coordination problems posed by ultra-slow ridges	2004	Jon Snow, Mainz
Ridge-hotspot interaction	better understand the physical and chemical interactions between mantle plumes and mid-ocean ridges and their effects on seafloor geological, hydrothermal, and biological processes	2000	Jian Lin, WHOI Jérôme Dyment, CNRS
Back-arc spreading systems	summarize past work on Back-Arc Basins and coordinate future studies	1995	Sang-Mook Lee, SNU, Korea
Mid-oceanic ridge ecosystems	increase international collaboration in hydrothermal biological studies and work on integrating ridge-crest biological and geological research	1994	Françoise Gaill, CNRS Nicole Dublier, Bremen
Monitoring and observatories	promote long term ocean bottom observatories. Establish a long-term observatory in the Atlantic	2002	Javier Escartin, IPG Paris Ricardo Santos, Azores
Deep earth sampling	strengthen the ties to, and use of, global deep earth sampling facilities such as IODP, ICDP etc.	2004	Benoit Ilsedefonse, Montpellier
Global exploration	address the need for more basic data about many of the world's spreading axes		*to be announced*
Biogeochemical interactions at deep-sea vents	address questions of biogeochemical interactions in different MOR and BAB environments and link scientists and their needs for technologies and sampling time	2004	Nadine le Bris, IFREMER

SOLAS

SOLAS (Surface Ocean - Lower Atmosphere Study) is a new international research initiative that has as its goal:

To achieve quantitative understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and the atmosphere, and of how this coupled system affects and is affected by climate and environmental change.



Achievement of this goal is important in order to understand and quantify the role that ocean-atmosphere interactions play in the regulation of climate and global change.

The domain of SOLAS is focussed on processes at the air-sea interface and includes a natural emphasis on the atmospheric and upper-ocean boundary layers, while recognising that some of the processes to be studied will, of necessity, be linked to significantly greater height and depth scales.

SOLAS research covers all ocean areas including coastal seas and ice-covered areas. A fundamental characteristic of SOLAS is that the research is not only interdisciplinary, but also involves closely coupled studies requiring marine and atmospheric scientists to work together. Such research will require a shift in attitude within the academic and funding communities, both of which are generally organised on a medium-by-medium basis in most countries.

SOLAS deals with 3 issues or foci, namely:

- Focus 1: Biogeochemical Interactions and Feedbacks Between Ocean and Atmosphere
- Focus 2: Exchange Processes at the Air-Sea Interface and the Role of Transport and Transformation in the Atmospheric and Oceanic Boundary Layers
- Focus 3: Air-Sea Flux of CO_2 and Other Long-Lived Radiatively Active Gases

More details on the science of SOLAS can be found in the Science Plan and Implementation Strategy, available at www.solas-int.org

SOLAS is based on national and trans-national research programmes and currently has activity in 23 countries around the world. It also runs educational and community-building events like the biennial summer schools and open science conferences. The work of SOLAS is led by a Scientific Steering Committee (Chaired by Professor Peter Liss) and is implemented by the SOLAS International Project Office, based at the University of East Anglia, Norwich, UK

CACGP GLOBAL IGBP CHANGE International Council for Science Scientific Committee on Oceanic Research WCRP Climate

International Antarctic Zone (iAnZone) focus areas and goals

iAnZone was conceived in the early 1990s as a sequence of informal biennial meetings of Southern Ocean researchers, primarily physical oceanographers, interested in understanding the Southern Ocean and its role in climate. Accorded status as a SCOR Affiliated Programme in early 1997, iAnZone's goal is to advance our understanding of climate-relevant processes within that region of the Southern Ocean poleward of the Antarctic Circumpolar Current. Additional affiliation to SCAR will be considered by SCAR's executive in autumn 2004. iAnZone (1) provides for exchange of ideas, plans, results and data; (2) identifies, develops and coordinates research projects consistent with our goal; (3) facilitates coordination among Antarctic and global climate programmes, and among other Southern Ocean programmes; and (4) advises on the development of appropriate observing systems, datasets and modelling strategies needed to assess the scales and mechanisms of climate variability in the Antarctic Zone.

Geographically, iAnZone projects have been undertaken in various locations in the Antarctic Zone (between the Southern Boundary of the Antarctic Circumpolar Current and the continent). Ice Station Weddell was in the southwest Weddell Sea studying processes of dense water formation and down-slope flows. AnzFlux was located in the region of Maud Rise and studied ocean-ice and ocean-atmosphere fluxes and upper ocean turbulent mixing processes. DOVETAIL (Deep Ocean Ventilation Through Antarctic Intermediate Layers) studied the region of the Weddell-Scotia Confluence in the northern Weddell and southern Scotia Seas to determine the processes involved in the outflow of Weddell Sea Deep Water. These three projects are now concluded. Two projects are currently ongoing. AnSlope is studying deep water formation and export in the Ross Sea. Ice Station Polarstern (ISPOL) will be a drift station in late 2004 from *Polarstern* in the western Weddell Sea. It will study spring ocean and sea ice conditions in the region of the continental slope.

Our future project, now in the planning phase, will be SASSI (Synoptic Antarctic Shelf-Slope Interactions). This will be undertaken in 2007-2008 and will be circumpolar. It is intended as the iAnZone contribution to International Polar Year (IPY). This centres around a series of 'hedgehog' sections radiating outward from Antarctica across the continental shelf and slope, to be occupied simultaneously during the period January-March 2008. It also includes moored arrays on these sections, where possible, to obtain winter data. The second primary part of SASSI is to deploy in the sea-ice zone around Antarctica under-ice floats (analogous to Argo floats) and the associated sound sources needed to track them.

Typically, iAnZone projects entail some or all of the following techniques: CTD sections, tracer surveys (e.g. CFCs, O18), shipborne and lowered ADCPs, moored current meter arrays, turbulence measurements, air-sea flux measurements, ocean-ice flux measurements, numerical model development and analysis. Geochemical and biological studies are often undertaken during the same cruises but are not coordinated by iAnZone.

The Steering Committee is currently chaired by Dr Karen J. Heywood (School of Environmental Sciences, University of East Anglia, UK). Steering committee members currently represent the UK, US, Germany, Italy, Russia, Japan, Finland, Brazil, New Zealand, China and Australia. However all iAnZone biennial meetings and project planning workshops are open to all, and anyone may sign up to the iAnZone mailing list. The next (9^{th}) biennial meeting will be held in October 2005 in Venice, in association with the IPAB meeting, ISPOL workshop and conference on the Oceanography of the Ross Sea. Further information can be found on the iAnZone website:
http://www.ldeo.columbia.edu/res/fac/physocean/ianzone/

Global Ocean Ecosystem Dynamics

GLOBEC (Global Ocean Ecosystem Dynamics) was initiated by SCOR and the IOC of UNESCO in 1991, to understand how global change will affect the abundance, diversity and productivity of marine populations comprising a major component of oceanic ecosystems. In 1995 GLOBEC was adopted by IGBP.

The aim of GLOBEC is to advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem to global change.

GLOBEC considers global change in the broad sense, encompassing the gradual processes of climate change and its impacts on marine systems, as well as those shorter-term changes resulting from anthropogenic pressures, such as population growth in coastal areas, increased pollution, overfishing, changing fishing practices and changing human use of the seas.

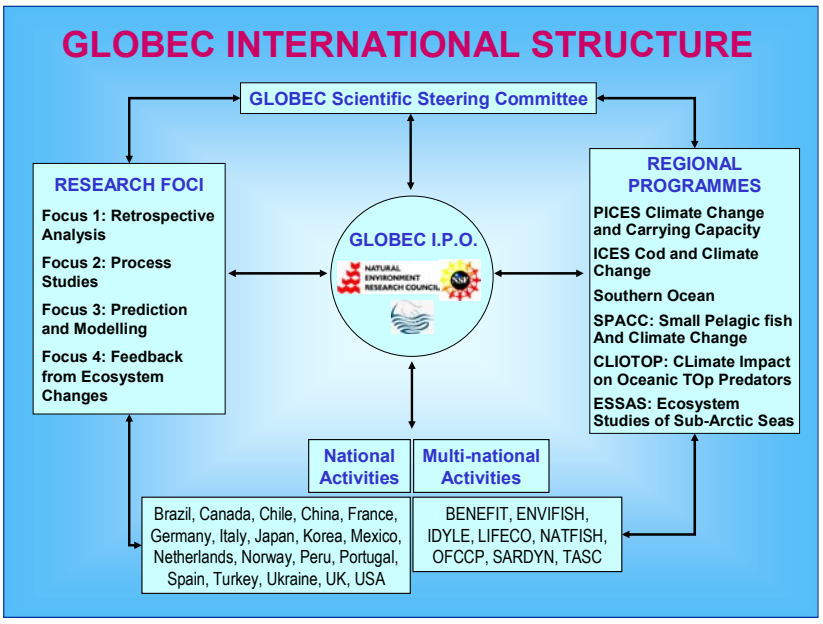
GLOBEC has four primary objectives:

Objective 1: To better understand how multiscale physical environmental processes force large-scale changes in marine ecosystems

Objective 2: To determine the relationships between structure and dynamics in a variety of oceanic systems which typify significant components of the global ocean ecosystem, with emphasis on trophodynamic pathways, their variability and the role of nutrition quality in the food web.

Objective 3: To determine the impacts of global change on stock dynamics using coupled physical, biological and chemical models linked to appropriate observation systems and to develop the capability to predict future impacts.

Objective 4: To determine how changing marine ecosystems will affect the global earth system by identifying and quantifying feedback mechanisms.



GLOBEC encompasses an integrated suite of research activities consisting of Regional Programmes, National Activities and cross-cutting research foci activities. The GLOBEC programme was developed by the Scientific Steering Committee (SSC) and is co-ordinated through the GLOBEC International Project Office (IPO).

GLOBEC has a very broad scope from small scale National Activities to Regional Programmes covering ocean basins. Multinational programmes consist of several countries working together on a specific aim or area but do not cover sufficient geographical area to be considered Regional Programmes. There are 8 GLOBEC multi-national Activities, 2 of which have already been completed. The 6 Regional Programmes address research that could not be carried out by a single country. These Regional GLOBEC programmes are the mechanism for the practical implementation of many of the activities within the 4 research foci. The cross-cutting research foci are organised through Focus Working Groups that report to the Scientific Steering Committee.

More details can be found on the GLOBEC website: **www.globec.org**

The Global Ocean

The oceans share with the atmosphere the role of transporting heat around the Earth. Furthermore, the oceans' vastly greater heat capacity both exerts a moderating influence on seasonal and longer climate changes and provides a mechanism for sustained ocean influence on the atmosphere. This feature, sometimes referred to as the ocean's climate "memory" provides one of the main bases for our ability to predict climate. Hence CLIVAR devotes much of its energy to the study of the role of the oceans in climate. CLIVAR does this through intensive regional and process studies, through systematic sustained satellite and in-situ observations and through modelling.

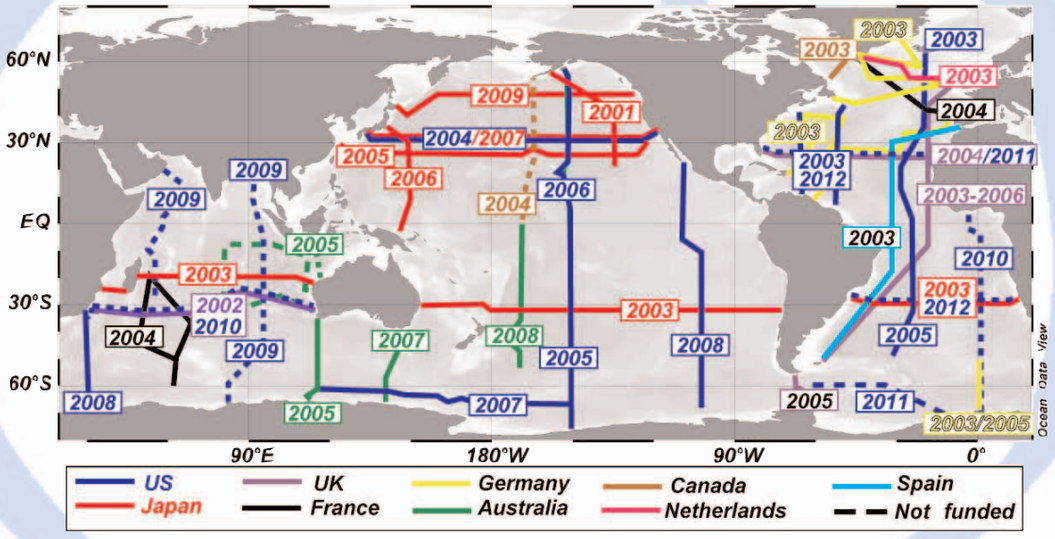
Activities

CLIVAR requires a wide range of ocean observations of adequate quality that can be combined to produce products needed for climate prediction experiments and research. Additionally, CLIVAR must develop consistent historical in-situ and satellite datasets to provide a context for current conditions as well as for exploring variability over longer time periods. CLIVAR builds on the considerable achievements of earlier World Climate Research Program initiatives: the 1990-1998 World Ocean Circulation Experiment (WOCE), that included an intensive ocean survey as well as the advent of several new remote-sensing capabilities and the 1985-1994 Tropical Ocean Global Atmosphere (TOGA) project, that established the ENSO observing system including the TAO/TRITON mooring array.

Regular maintenance trips are made to the TAO/TRITON array.

Ocean changes over decades, whether natural or human-induced, have been documented by comparing temperature/ salinity data from hydrographic sections. WOCE made a comprehensive global survey and CLIVAR, in partnership with the International Ocean Carbon Coordination Project, will repeat many of the WOCE sections so as to document change and create new ocean carbon inventories.

ENSO events cause major disruption and their early detection and forecasts of their development depend on observations from the TAO/TRITON array, from satellite observations of sea surface height, SST, and vector winds and from meteorological observations from merchant ships. Similar observing systems are now extending to the Atlantic and Indian Oceans. Additionaly satellite-derived ocean colour measurements are also known to provide early indications of ENSO events.

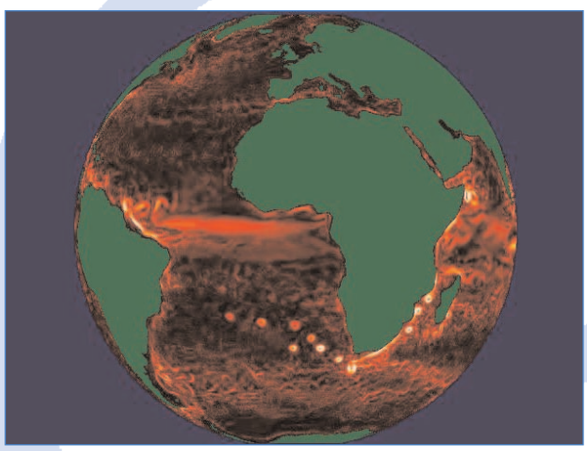


Planned and completed CLIVAR hydrography cruises with carbon measurements (www.ioc.unesco.org/ioccp).

The NASA-CNES Jason-1 and the Topex Poseidon Altimeter satellites that measure the distance between the satellite and the ocean.

CLIVAR also depends on the Argo project to provide temperature and salinity profiles in the upper ocean from autonomous profiling floats. Over 1100 of the planned 3000 floats now deliver 3300 profiles per month in real time. Argo data have already been used in a wide range of climate applications and (with satellite altimetry) are a key to documenting the state of the global ocean and its storage of heat and fresh water.

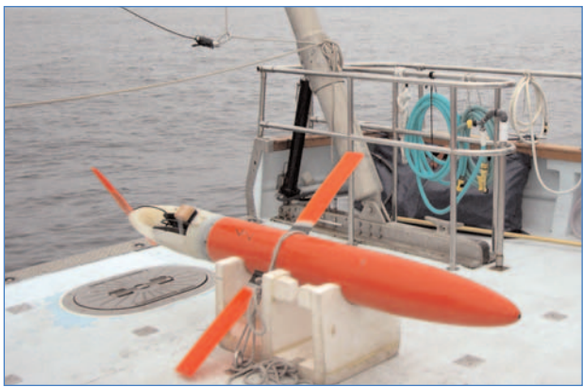
Since their introduction 30 years ago ocean observing satellites have provided global observations of ocean surface properties. In addition to robust historical records of these observations, CLIVAR particularly requires ongoing precise radar altimetry to monitor heat storage and currents, and (together with in-situ gauges) global variations in sea level. Vector winds from scatterometry and measurements of sea surface temperature are also essential. Proposed measurements of sea surface salinity from space and improved measurements of the geoid will provide new opportunities for CLIVAR.



Output from the global ECCO Consortium model.

High resolution global ocean models can now be used in coupled experiments and significant progress has been made in the the representation of physical processes in ocean climate models. CLIVAR is comparing state-of-the-art ocean models used in the IPCC class of climate models. Observations are essential for the validation of these model runs.

The ocean cannot be adequately described by observations alone. Rather, in-situ and satellite observations are assimilated into models to provide evolving estimates of the ocean state just as is done for the atmosphere by forecast centres. With the availability of sustained ocean observations, routine ocean state estimates and forecasts are now possible. Retrospectively the ocean state can now be reconstructed over the last 50 years in parallel with atmospheric reanalyses.



One of many autonomous Gliders currently under development.

Future Plans and Challenges

Our ability to observe and document the oceans' state has made enormous strides in the past 2 decades aided by satellites, autonomous instruments and a realisation of the importance of the oceans in climate. The observations identified here need to be sustained and their data managed effectively. As our ability to observe the ocean at global scales and our understanding of important climate processes improves, so the observing system can be made more effective.

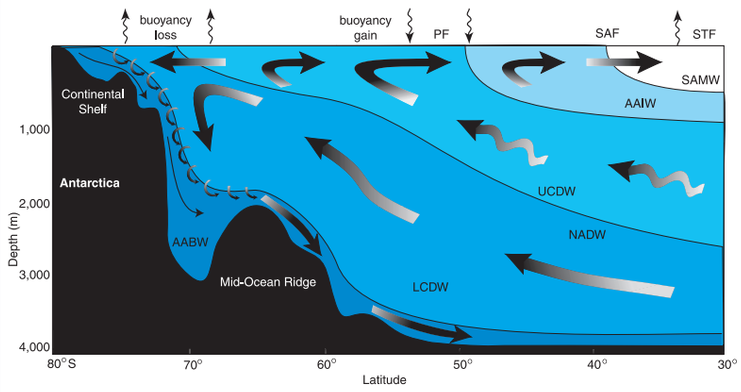
Improvements in technology, new autonomous sensors, new observing platforms such as moored profilers (for time series observations), gliders (ideal for observing near ocean boundaries), the ability to measure under ice and better data communications will enhance our capabilities.

These together with improvements in models and data assimilation allow CLIVAR to play a central role in developing our understanding of the oceans' role in the coupled climate system.

More information on CLIVAR's Global Synthesis and Observation Panel activities can be found at :
http://www.clivar.org/organization/gsop/ | http://www.clivar.org/data/
email : icpo@soc.soton.ac.uk.

Climate Variability in the Southern Ocean Region

The Southern Ocean region is of fundamental importance to the global climate system. It is also a remote and hostile environment, making it one of the least studied and understood areas in the world.



Schematic of the overturning circulation in the Southern Ocean. The "shallow" cell is primarily formed by northward Ekman (wind driven) transport and southward eddy transport in the Upper Circumpolar Deep Water (UCDW) layer. The "deep" cell is primarily driven by dense water formation (mainly AABW) near the Antarctic continent. (From Speer et al., Journal of Physical Oceanography, 2000).

Objectives

Through a joint Southern Ocean panel, CLIVAR and its WCRP companion project, CliC (the Climate and Cryosphere project), are endeavouring to:

- Design a strategy to assess climate variability and predictability of the coupled ocean-atmosphere-ice system
- Refine an implementation plan for the Southern Ocean region that defines the process studies, sustained observations and model experiments needed to meet the objectives of CLIVAR and CliC

Four themes of importance to the Southern Ocean and climate have been identified:

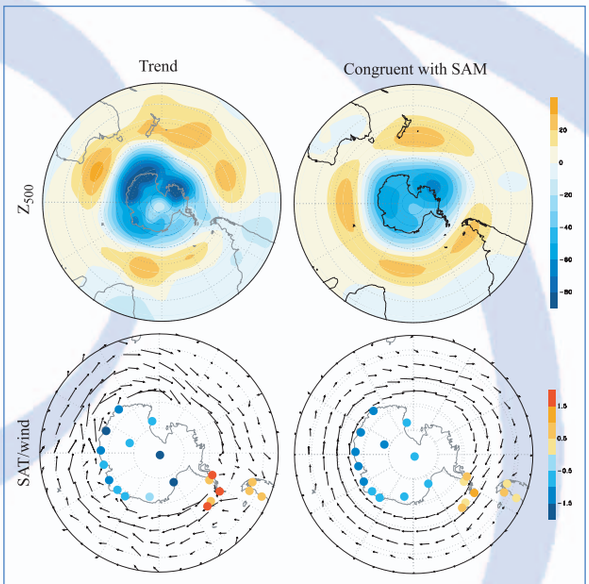
- The "shallow" overturning cell (e.g. formation and circulation of Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW); oceanic uptake of heat and anthropogenic CO_2)
- The "deep" overturning cell (e.g. stability of the deep overturning cell; rate of Antarctic Bottom Water (AABW) formation and sensitivity to change)
- Inter-basin exchange (e.g. propagation of anomalies between basins and their impact on regional climate)
- Teleconnections and low-frequency variability (e.g. interannual to centennial time-scales, including, for example, the Southern Annular Mode)

CLIVAR and CliC also work closely with other groups and projects with an interest in climate related studies in the Southern Ocean region.

Activities

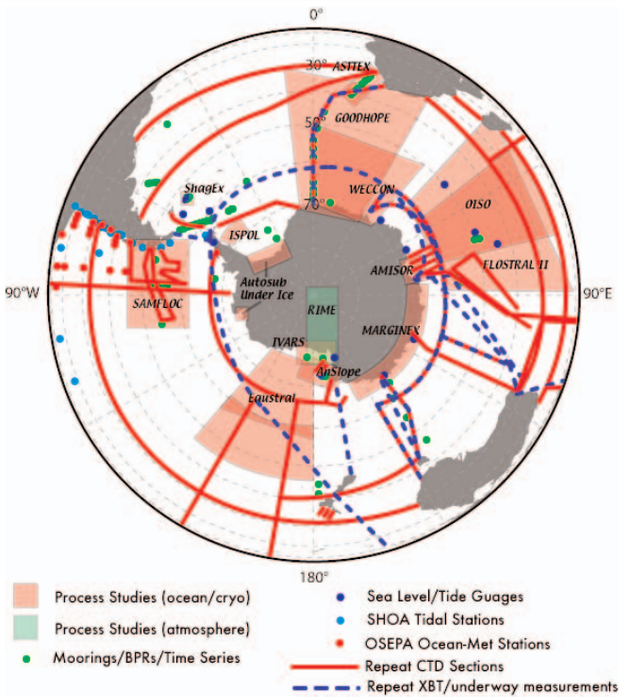
Since its formation in 2002, the Southern Ocean panel has:

- Strengthened our understanding of the Southern Ocean region's role in climate and the research carried out to address this
- Enhanced coordination with other programs (e.g. the International Antarctic Zone Programme, the Antarctic Sea-Ice Processes and Climate Project and the International Programme for Antarctic Buoys), other CLIVAR panels, and scientists with an interest in the Southern Ocean region



December-May trends (left) and the contribution of the Southern Annular Mode to the trends (right). Top, 22-year (1979-2000) linear trends in 500-hPa geopotential height. Bottom: 32-year (1969-2000) linear trends in surface temperature and 22-year (1979-2000) linear trends in 925-hPa winds. The longest vector corresponds to ~4 m/s. (From Thompson and Solomon, Science, 2002).

WCRP is sponsored by WMO, ICSU and IOC



Current and planned in-situ measurement systems and observational campaigns, as of April 2004. http://www.clivar.org/organization/southern/CLIVAR_CliC_Obs.html

- Played an important role in helping to fill gaps in the observing system (e.g. support of the GOODHOPE project to fill the important 'chokepoint' observational gap south of Africa)

- Been involved with strategic planning for the future (e.g. the proposal for an International Polar Year in 2007/8)

- Developed a Web site that includes an up-to-date overview of Southern Ocean region observational plans and activities, links, relevant publications and meetings etc.

Applications

Although remote from the population centres of the world, the Southern Ocean region can influence the climate of southern hemisphere nations through teleconnections and modes of variability such as the Southern Annular Mode and the Antarctic Circumpolar Wave (for example the Southern Annular Mode has been shown to influence rainfall patterns in southern hemisphere countries).

The Southern Ocean plays an important role in natural and anthropogenic climate variability through changes in albedo related to the sea ice cover; changes in heat and carbon storage (the Southern Ocean is thought to be the most important sink for anthropogenic carbon); and its contribution to rising sea levels.

The marine and terrestrial ecosystems in the Southern Ocean region are also particularly sensitive to climate change and variability.

Issues and Challenges

Commitments now exist for a large fraction of the proposed Southern Ocean observing system, but a number of significant gaps remain. These include: Argo in sea-ice covered water, air-sea flux measurements, Antarctic Circumpolar Current and Bottom Water monitoring, and a sea-ice thickness observations.

Global circulation and climate models show particular weaknesses in the Southern Ocean region. For instance, better parameterisation of sea ice and bottom water formation processes are required.

The CLIVAR/CliC Southern Ocean Panel acts as a focus for national and international collaboration in the Southern Ocean region.

More information on CLIVAR/CliC Southern Ocean Panel activities can be found at :
http://www.clivar.org/organization/southern/
email : icpo@soc.soton.ac.uk.

GEOTRACES – Marine Biogeochemical Cycles of Trace Elements and Isotopes

The GEOTRACES program will determine the global ocean distributions of selected trace elements and their isotopes, and generate a sufficient understanding of their biogeochemical cycles (sources, sinks, transport, transformations, chemical speciation, biological availability, fates, etc.) to apply that knowledge reliably to interdisciplinary problems.

GEOTRACES will be built around two themes:

- **Theme 1—Modern biogeochemical cycles of trace elements and isotopes (TEIs):**
  - Interface fluxes: atmosphere, freshwater, ocean margins, mid-ocean ridges
  - Internal cycling: biological uptake, chemical scavenging, transport by and regeneration from particulate matter, physical transport

- **Theme 2—Development of Paleoceanographic Proxies:**
  - Factors controlling the proxies in the water column today
  - Factors influencing the recording of proxies in geological substrates

The development of a full understanding of the distribution and biogeochemical behavior of trace elements and their isotopes (TEIs) in seawater has the potential to provide unique insights into a wide range of oceanic processes. It will provide, for instance, understanding of the role that limiting micronutrients play in regulating ecosystem structure and oceanic production, and it will elucidate the mechanisms controlling the fate of contaminants added to the ocean by human activities. Certain TEIs, particularly natural radionuclides, can also be exploited to constrain rates of key processes regulating the marine carbon cycle. Other TEIs provide valuable insight into the mean velocity field and mixing processes in the ocean on timescales that are not readily amenable to direct measurements by more conventional methods. Furthermore, TEI distributions in marine sediments and other geological archives yield vital clues about an array of environmental conditions in the past (e.g., ocean productivity, circulation patterns and rates, ecosystems structure, continental weathering, hydrothermal activity, ocean anoxia).

GEOTRACES will be conducted in close collaboration with other ocean research initiatives, such as CLIVAR (WCRP), IMBER, SOLAS, LOICZ, GLOBEC, IMAGES/PAGES (IGBP/SCOR), RIDGE, MARGINS, as well as various modeling programs to ensure synergy among the different initiatives and to avoid duplications of effort. To facilitate the planning, the Scientific Committee on Oceanic Research (SCOR) is providing support for a GEOTRACES planning group, co-chaired by Gideon Henderson (Oxford University) and Bob Anderson (Lamont-Doherty Earth Observatory), whose primary purpose is to develop a Science Plan. Following review and adoption of the Science Plan, the Planning Group will be replaced by a Steering Committee.

LOICZ Summary

The Land-Ocean Interactions in the Coastal Zone (LOICZ), a core project of the International Geosphere-Biosphere Programme (IGBP) and International Human Dimensions Programme (IHDP) on Global Environmental Change (GEC), has since 1993 studied the heterogeneous, relatively small but highly productive, dynamic and sensitive area of the earth's coastal zones. The science of LOICZ is focussed on the measurement of biogeochemical fluxes into and within the coastal zone. These fluxes are important because:

- Biogeochemical fluxes are the key variables for scaling up to global climate change.
- Biogeochemical variables are the key constituents for connections across coastal boundaries.
- Biogeochemical fluxes include primary production, which underpins ecosystems resources.
- Water and sediment quality determine distribution of key habitats and affect human use.
- They include key positive and negative feedbacks in coupled coastal systems.

LOICZ aims to overcome traditional disciplinary fragmentation, in particular between natural and human dimension sciences, to focus on the primary issues of sustainable human use of coastal systems in respect to vulnerability of coasts and risks for human uses through the following objective:

'to develop capacity to assess, model and predict change in the global coastal zone under multiple forcing, including the contribution of human activity and consequences for human welfare'

Science Themes

Confronting and managing the consequences of global environmental change whilst securing a sustainable future requires a more integrated approach that inculcates human aspects within traditional analytical methods of disciplinary studies LOICZ II will focus on how humans are supported by, and impact, the coastal system, and what policies and practices will be required to ensure the sustainability of this system. The LOICZ II strategy is designed to provide improved understanding that integrates coupled biogeochemical, physical and human dimensions of coastal change through 5 themes that form the backbone of its scientific activities. Because much of the change originates from outside the coastal zone, but is borne to it via river systems, this requires catchments and coasts to be considered as a single interrelated system – the water continuum.

Theme 1: Vulnerability of coastal systems and hazards to human societies sets the stage for the subsequent themes that address the wider coastal domain. It addresses the hazards to humans from coupled human and ecological system change, carrying capacities and vulnerability issues.

Theme 2: Implications of global change for coastal ecosystems and sustainable development focuses on conflicting spatial, temporal, and organisational issues of coastal change, and land and sea use, and how they influence natural resources availability and natural systems sustainability.

Theme 3: Anthropogenic influences on the river basin and coastal zone interactions address river catchment–based drivers/pressures that influence and change the coastal domain. The whole water cascade (source to sea) is considered as a single system.

Theme 4: Fate and transformation of materials in coastal and shelf waters focuses on budgeting methodologies to describe the cycling of carbon, nutrients and sediments in coastal and shelf waters and their exchange with the ocean.

Theme 5: Towards coastal system sustainability by managing land-ocean interactions provides an overarching integration cutting across the four other themes addressing the development and management of coastal zone resources in the context of strong and weak sustainability options.

Products

The outcomes of LOICZ are focussed upon a better understanding of (i) the temporal and spatial relationship between the flow of land-based materials and impacts on the coast, (ii) the complexity of the coastal sea environment in determining critical levels and thresholds, and (iii) the multiple interests of stakeholders from local to global scales which determine the net trajectories of drivers and pressures of change. LOICZ aims to produce a suite of deliverables that can scientifically underpin management. A key product line in this context will be integrated coastal system change models and scenarios of change and management options.

In preparation of the SCOR Coordination Meeting, Venice, 23-24 September 2004

IMAGES (International Marine Global Change Study)
Marine program of IGBP-PAGES, affiliated to SCOR in 1995)

IMAGES (International Marine Global Change Study) is a core program of Past Global Changes (PAGES), a core project of the International Geosphere-Biosphere Programme (IGBP), and is affiliated with SCOR. IMAGES was initiated to respond to the challenge of understanding the mechanisms and consequences of climatic changes using oceanic sedimentary records. The overriding IMAGES science issue is to quantify climate and chemical variability of the ocean on time scales of oceanic and cryospheric processes; to determine its sensitivity to identified internal and external forcings, and to determine its role in controlling atmospheric CO_2. In order to achieve these scientific objectives, IMAGES proposes to coordinate a global program to collect and study marine sediment records to address three fundamental questions:

1. How have changes in surface ocean properties controlled the evolution of global heat transfer through the deep and surface ocean and thereby modified climate?
2. How have changes in ocean circulation, ocean chemistry, and biological activity interacted to generate the observed record of atmospheric pCO_2 over the past 300 kyr?
3. How closely has continental climate linked to ocean surface and deep-water properties?

IMAGES accomplishes these objectives through (1) the planning and coordination of oceanic cruises to retrieve and exploit in international collaboration giant sediment cores from long, continuous time series in high sedimentation rate areas of the ocean, and (2) the support of symposia, working groups and their workshops.

IMAGES Administration
The program has a permanent office hosted at the University of Bremen in Germany. Our budget covers, in addition to the day to day expenses of the office:

- Full-time salary for a data manager.
- Six months of salary per year for an Assistant Director
- Funding or co-funding (with SCOR and PAGES, mainly) of working group meetings and symposia
- Support for training of young scientists (participation to symposia and oceanic cruises)

Chair
William B. Curry
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
USA

IMAGES Office
Ralph Schneider, Executive Director
Fachbereich Geowissenschaften
Universitaet Bremen
28359 Bremen, Germany

Membership
26 countries with national consortia of university or governmental research institutes as well as represented by a single institute only are members and 23 of them contribute to the budget

F. Abrantes	PORTUGAL	H. Kawahata	JAPAN
J. Backman	SWEDEN	K.L. Knudsen	DENMARK
H. Neil	NEW ZEALAND	D. Kroon	NETHERLANDS
M.T. Chen	TAIWAN	J. Lee-Thorp	SOUTH AFRICA
J. Eriksson	ICELAND	C. Lange	CHILE
J.A. Flores	SPAIN	M.L. Machain-Castillo	MEXICO
F. Florindo	ITALY	A. Mackensen	GERMANY
B. Flower	USA	B. Manighetti	NEW ZEALAND
J. Grimalt	SPAIN	B. Opdyke	AUSTRALIA
F. Grousset	FRANCE	V. Ramaswamy	INDIA
W. Hantoro	INDONESIA	E. Rohling	UK
J.C. Herguera	MEXICO	J. Rogers	SOUTH AFRICA
C. Hillarie-Marcel	CANADA	A. Mackensen	GERMANY
E. Ivanova	RUSSIA	J. Sopaheluwakan	INDONESIA
E. Jansen	NORWAY	T. Stocker	SWITZERLAND
N. Kallel	TUNISIA	Z. Jian	CHINA

Data Archiving and Synthesis

Archiving of IMAGES data, including shipboard and laboratory data has been continued effectively. A new bibliography has been installed on the IMAGES website, which is in service with all recent information concerning our activities (workshops, past and future cruises, database).

Working Groups

IMAGES supports the activity of several IMAGES and SCOR-IMAGES There are currently seven active Working Groups, whose main task is to coordinate the acquisition of cores and laboratory data in key areas. Two new SCOR/IMAGES WG on the ***"Reconstruction of Past Ocean Circulation (PACE)"*** (SCOR 123) and on the ***"Present Oceanic Processes and Paleorecords (LINKS)"*** (SCOR 124) were installed in 2004. IMAGES has financially supported the first meetings of the new WG's in 2004. The other active working groups comprise:

- *EPILOG: Re-evaluation of the LGM conditions*
- *Southern Ocean*
- *Icesheet-Ocean Interaction*
- *Holocene Climate Variability*
- *PEPD: Past Equatorial Pacific Dynamics*

A complete list of all former and still active working groups and their workshop reports can be found on the IMAGES website.

SCOR/IOC Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Programme

GEOHAB was created by SCOR and IOC to promote international research to study the ecological and oceanographic mechanisms underlying the population dynamics of harmful algal blooms (HABs) in comparable ecosystems worldwide. Such knowledge will be used to develop predictive models of HABs. GEOHAB published its *Science Plan* in 2001 and its *Implementation Plan* in 2003.

For the purposes of implementation, the GEOHAB SSC adopted a three-category system for defining and endorsing GEOHAB research:

1. Core Research is comparative, interdisciplinary, international, and directly addresses the overall goals of GEOHAB as outlined in the GEOHAB *Science Plan*. Core Research will involve scientific co-ordination by the SSC and comprises oceanographic field studies conducted in, and application of models to, comparable ecosystems, supported by identification of relevant organisms; and measurements of the physical, chemical, and biological processes that control their population dynamics.

2. Targeted Research addresses specific objectives outlined in the GEOHAB *Science Plan*. Targeted Research may be solicited by the SSC as the need arises from Core Research Projects.

3. Regional/National Research is coordinated at a regional or national level rather than by the SSC, but may be endorsed by GEOHAB. For endorsement by GEOHAB, Regional/National Research activities must share objectives with GEOHAB in furthering the understanding of the ecological and oceanographic mechanisms underlying HAB population dynamics, but may have other overall objectives. Parts of Chinese GEOHAB (CEOHAB) have been endorsed by the GEOHAB SSC.

The present focus of GEOHAB is the development of detailed plans for Core Research in four ecosystem types:

1. Upwelling Systems
2. Fjords and Coastal Embayments
3. Eutrophied Systems
4. Stratified Systems

Small open science meetings have been held for the first two topics and the other two will be held in 2005. These meetings will provide the basic information for the Core Research Project plans for each ecosystem type.

Included in the *Implementation Plan* are Framework Activities that are not research, but will facilitate the implementation of GEOHAB. They serve to enhance the value of research by ensuring consistency, collaboration, and communication among researchers, and include scientific networking and co-ordination of resources, data management, specification of protocols and quality control, capacity building, interaction with other programmes and projects, and resources and funding.

The next meeting of the GEOHAB SSC will be held in Cape Town, South Africa in November 2004. The focus of this meeting will be on the Core Research Projects and their implementation and future management, the development of targeted research projects (specifically those related to modelling and observation systems), the development of standard measurement protocols within GEOHAB, and the formulation of a GEOHAB data committee.

Integrated Marine Biogeochemistry and Ecosystem Research (IMBER)

Planning for the IMBER (Integrated Marine Biogeochemical and Ecosystem Research) project was initiated by SCOR and IGBP in 2001, to address the gaps that exist in the available knowledge of the ocean system. The IMBER project will identify the key interactions between marine biogeochemical cycles and ecosystems, and how these interactions may respond to complex, natural and anthropogenic forcing in the ocean (Figure 1). Important forcings include large-scale climatic variations, changing physical and biological dynamics, changes in carbon system chemistry, and changing nutrient fluxes. Anticipated changes in marine biogeochemical cycles and ecosystems also have consequences for the broader Earth System, with negative feedbacks, for example, on oceanic storage of anthropogenic CO_2. Dramatic reductions in the top marine predators (fish stocks such as tuna) will impact the dynamics of lower trophic levels, thus impacting marine biogeochemistry and associated global feedbacks. Advancing our knowledge and quantification of these interactions and feedbacks are central to the goal of IMBER.

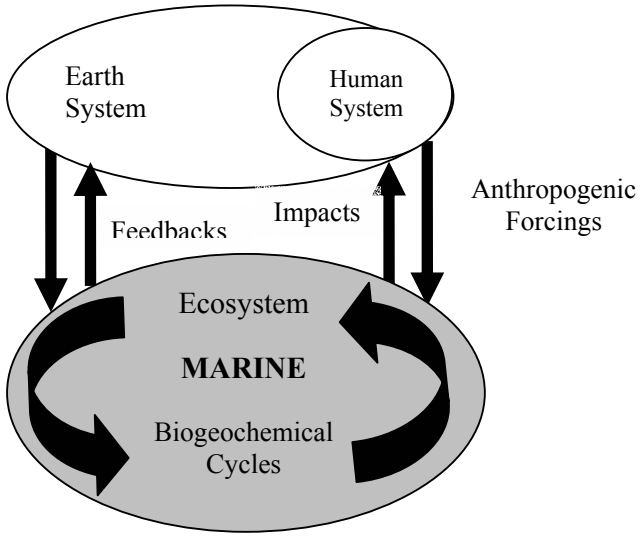


Figure 1. Schematic depiction of the essential features of the IMBER project. These include impacts of natural climatic and anthropogenic influences on marine biogeochemical cycles and ecosystems, their interactions, and feedbacks to the Human and Earth Systems.

The IMBER Science Plan has been developed around four major themes. Theme 1 focuses on identifying and characterizing interactions of the key biogeochemical and ecosystem processes that will be impacted by global change. Theme 2 considers the sensitivity of these key processes and interactions to global change, with an emphasis on prediction and quantification. Theme 3 investigates the role of ocean biogeochemistry and ecosystems in impacting the larger earth system through direct and indirect feedbacks. Finally, Theme 4 draws findings from the previous three themes to investigate key interactions with the human system and the policies that must be developed to mitigate or adapt to the impacts of global change on marine biogeochemical cycles and ecosystems. Each theme identifies a series of priority issues to be considered.

The IMBER themes and issues are:

Theme 1: Interactions between biogeochemical cycles and marine food webs: What are the key marine biogeochemical cycles, ecosystem processes, and their interactions, that will be impacted by global change?

- Issue 1. Transformation of organic matter in marine food webs
- Issue 2. Transfers of matter across ocean interfaces
- Issue 3. End-to-end food webs and material flows

Theme 2: Sensitivity to Global Change: What are the responses of key marine biogeochemical cycles, ecosystems and their interactions to global change?

- Issue 1. Impacts of climate-induced changes through physical forcing and variability.
- Issue 2. Effects of increasing CO_2 and changing *p*H.
- Issue 3. Effects of changing supplies of macro- and micronutrients.
- Issue 4. Impacts of harvesting.

Theme 3: Feedbacks to the Earth System: What is the role of ocean biogeochemistry and ecosystems in regulating climate?

- Issue 1 : Change in global oceanic storage of carbon
- Issue 2: Ecosystem feedbacks on ocean physics and climate

Theme 4: Responses to Society: What are the relationships between marine biogeochemical cycles, ecosystems, and the human system?

- Issue 1: Human lifestyle effects on the state of the ocean
- Issue 2: Mitigation or adaptive policies that could reduce the impact of global change on society

Goal: The Census of Marine Life (CoML) is an international program to assess and explain the diversity, distribution and abundance of life in the oceans. It is a global program, recognizing that climate effects on local ecosystems reflect global changes.

Objective: To increase understanding about our marine planet and to improve management of ocean resources. The oceans contain the majority of our planet's new resources – energy, food, pharmaceuticals – and demands will increase with population. To achieve these objectives, a global census is urgently required to establish a marine biodiversity baseline, relate it to historic changes and to predict, monitor and mitigate, as necessary, future changes.

History: The ocean is vast, encompassing 95% of the living volume of the planet. At present, less than 0.1% of the oceans volume has been scientifically sampled. Even this small sampling has made it clear that intense fishing, pollution and altered climate are changing the oceans physically, chemically and biologically.

In June 1999, an international Scientific Steering Committee (SSC) was formed to define the goals of the CoML. In 2000, the SSC met with the United Nations Intergovernmental Oceanographic Commission (IOC) and agreed that environmental change and increasing human access to the oceans made a census of present marine life crucial to monitor future changes. The IOC encouraged this census and its four initiatives to meet its goal:

- Assemble existing data in an internet-accessible information system.
- Use emerging technologies to discover species-level, geo-referenced ocean data.
- Develop analytic tools to use with the data to generate and test hypotheses.
- Establish a public education and outreach network.

Strategy: CoML projects will address: **what did live in the oceans, what does live in the oceans and what will live in the oceans, with all data accessible on-line**. National and regional implementation committees will ensure compliance with local requirements and integration within the overall CoML. The Ocean Biogeographic Information System (OBIS) is the portal to geo-referenced, species-level datasets,. To meet the United Nations objective of a Global Marine Assessment (GMA), it has been estimated that the CoML will require $1 billion dollars, globally.

Milestones:

-2007, OBIS operational for all known marine species
-2010, Baseline data and tested sampling protocols published for all ocean realms to facilitate the UN Global Marine Assessment

For additional information: Visit websites; **www.coml.org, www.COREocean.org**

DIVERSITAS

What is DIVERSITAS?

DIVERSITAS is an international global environmental change programme dedicated to the science of biodiversity. It is placed under the auspices of ICSU, IUBS, IUMS, SCOPE and UNESCO.

Its overall goals are:

- to promote an integrative biodiversity science, linking biological, ecological and social disciplines in an effort to produce socially relevant new knowledge; and
- to provide the scientific bases for the conservation and sustainable use of biodiversity.

DIVERSITAS recognises that many of the questions addressed in biodiversity science need collaborative research. DIVERSITAS contributes to producing new knowledge by synthesising existing scientific knowledge, identifying gaps and emerging issues of global importance, promoting new research initiatives, building bridges across countries and disciplines, investigating policy implications of biodiversity science, and communicating these to policy makers and international conventions.

There are 3 core projects within the overall science plan. These link biodiversity to ecosystem functioning and service provision and thereby on to conservation and management.

- Core Project 1, *bioDiscovery*, “Discovering biodiversity and predicting its changes”,
- Core Project 2, *ecoServices*, “Assessing impacts of biodiversity changes on ecosystem functioning and services”,
- Core Project 3, *bioSustainability*, “Developing the science of conservation and sustainable use of biodiversity”.

Each core project has two co-chairs, each from a different discipline (e.g. ecology and economics), and an international office. There is also a main DIVERSITAS secretariat office in Paris. The core project offices are charged with enacting the science plan for their core project by arranging workshops that may have one-off deliverables, provide a springboard for a major funding application to national and international agencies and foundations or apply for funds on behalf of the DIVERSITAS community to such agencies and foundations. The core project offices and the main Paris secretariat thus work to ensure that the science plan is delivered.

DIVERSITAS and Marine issues

The level of activities on marine biodiversity in DIVERSITAS is presently low. There is no obvious reason for this and it must appear odd to the wider community. Most of the planet is blue, most people live in coastal areas and the oceans largely control the world's climate. There is a need therefore to raise the profile of marine biodiversity research within DIVERSITAS. Carlo Heip, Dave Raffaelli and Meryl Williams were asked by DIVERSITAS as to how this might best be achieved and they recommended that an effective way would be to link up with existing marine initiatives. There is no point in re-inventing wheels or competing for limited funds, and the inter-disciplinary research community assembled by DIVERSITAS has much to offer such initiatives. The three core programmes of DIVERSITAS (see above) have major points of contact with such initiatives.

EcoSERVICES strives to expand the science of biodiversity and ecosystem functioning to larger scales and over a greater breadth of the biological hierarchy, to develop an effective means for linking changes in ecosystem structure and functioning to changes in ecosystem services, to assess human response to ecosystem services changes, and feedbacks onto ecological systems; and to examine the impacts of biodiversity change on human health. Of the ecological goods and services provided by the marine environment, two stand out as key elements: the provision of food (fish and shellfish), and global-scale climate regulation by the oceans.

BioSUSTAINABILITY aims to develop new knowledge to guide policy and decision making. Its main objectives are to evaluate the effectiveness of current measures for the conservation and sustainable use of biodiversity; to formally analyse the social, political and economic drivers of biodiversity loss; to investigate social choice and decision making, and to understand the interactions between humans and biodiversity in ecosystems. Collectively, these activities comprise a cycle of discovery, analysis and information sharing that supports the application of socially relevant knowledge.

Dave Raffaelli, August 2004

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