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7.1 International Council for Science (ICSU)

SCOR was the lead applicant on a proposal to support the development of the RGSO project, but the proposal was not funded (see p. 5-2). SCOR was a supporting applicant on an IGBP-led proposal and a SCOPE-led proposal, but they were not funded either. SCOR may consider ICSU grants as a means to develop cooperative activities with SCOPE, SCAR, and other ICSU organizations, although the grants are much harder to obtain now that the amount of funds available in the program have been reduced substantially.

The following is the section of the CSPR Assessment Panel on Environment and its Relation to Sustainable Development pertaining to SCOR. The full report can be obtained from the ICSU Web site (www.icsu.org).

Report of the CSPR Assessment Panel on Environment and its Relation to Sustainable Development

by

Robert Watson (Chairman), Anne Buttimer, Angela Cropper, Istvan Lang, Gordon McBean, James McCarthy, Uri Shamir, Crispin Tickell, Shem Wandiga

December 2003

(Excerpt from pages 24-25)

5.3 Thematic organizations

5.3.1 Scientific Committee on Oceanic Research (SCOR)

SCOR was founded in 1957 to further international scientific activity in all branches of oceanic research. It was one of the first IBs of ICSU, and every oceanographer is familiar with at least some of SCOR's impressive list of accomplishments. This organization has a rich history of successes with working groups that have vetted methods of sample collection and analysis, and brainstormed topics for future research. Well known is the reputation of SCOR for its extensive outreach to scientists, laboratories, and research organizations in the developing world. Over the last 45 years, many developed country oceanographers made their first contacts with developing country scientists through SCOR meetings and reports. Prior to its first major programmatic accomplishment - the Indian Ocean Expedition in the early 1960s - major oceanographic expeditions were largely the works of individual nations or individual laboratories. SCOR, more than any other organization, is responsible for the widespread international cooperation that is characteristic of modern ocean science. In view of the successes of the GEC programmes (e.g. IGBP and WCRP) in the 1990s, the advent of the Internet and virtual meetings, one could ask "does SCOR still have a role to play?" SCOR sponsorship remains still the best way to bring oceanographers of all disciplines to the table. The development of ocean projects within the GEC programmes was considerably facilitated by the work of SCOR. The roots of the international underpinnings of Tropical Ocean and Global Atmosphere (TOGA), World Ocean Circulation Experiment (WOCE), Joint Global Ocean Flux Study (JGOFS), and Global Ocean Ecosystem

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Dynamics (GLOBEC) can be traced to SCOR initiatives. Similarly, SCOR is currently a partner in the development of potential new projects like Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB), Surface Ocean Lower Atmosphere Study (SOLAS), and Integrated Marine Biogeochemistry and Ecosystem Research (IMBER). In conclusion, SCOR has demonstrated flexibility in its focus as ocean science has evolved, and the success of future ICSU projects and activities related to the ocean would be significantly diminished without the scientific integrity and experience of SCOR. Ocean science is inherently global, and SCOR is the instrument by which good local ideas in this field become global. Also in this regard, the Panel finds the successes of SCOR in capacity building to be highly meritorious. SCOR should continue in its efforts to enhance the development of international science within the oceanographic community, and to bring the strongest possible representation into ongoing and future projects of the GEC programmes. The Panel encourages SCOR to explore prospects for joint capacity building initiatives with START.

SCOR Input for ICSU Priority Area Assessment for Scientific Data and Information

SCOR Activities in Data and Information

As an organization that promotes research in the ocean sciences, SCOR has a significant interest in ocean data, particularly data from global-scale observations and research. SCOR projects are required to form data management policies and are encouraged to consider their data as legacies of the project. The best recent example is the Joint Global Ocean Flux Study (JGOFS), which sponsored a Data Management Task Team that compiled the majority of JGOFS data on a single DVD and is working with the World Data Center on Marine Environmental Sciences to ensure that the data are properly archived.

SCOR has taken the lead in at least three specific activities in recent years (two are ongoing) that are designed to help deal with specific types of ocean data:

1. SCOR/IGBP Meeting on Coordinated Data Management for International Marine Research Projects—SCOR and IGBP convened a meeting in December 2003 in Liverpool, UK to bring together scientists and data managers from major international ocean research projects to discuss the necessary content of data policies for currently forming ocean research projects. The meeting produced many recommendations to the projects to help them form effective data policies, but also some recommendations that should be useful to ICSU in its review (see below). Ferris Webster, chair of the ICSU Panel on World Data Centers, participated in the meeting and provided important information about the WDC system to meeting participants. The primary support for this activity was derived from a grant from the U.S. National Science Foundation to SCOR.

SCOR will consider several actions and additional activities to help implement the results of the meeting. First, SCOR will maintain a Web page to help provide information to projects about data policies and to stimulate continued interactions among project data managers (see www.jhu.edu/scor/DataMgmtActivity/htm). SCOR will also seek funds to make it possible for project data managers to convene joint meetings to promote common solutions to common problems among the projects and will approach key scientific societies about creating a peer-reviewed journal for data reports.

2. International Ocean Carbon Coordination Project—The Advisory Panel on Ocean Carbon Dioxide (a joint group of SCOR and the Intergovernmental Oceanographic Commission) and the Global Carbon Project (a partnership of IGBP, IHDP, and WCRP) formed the International Ocean Carbon Coordination Project (IOCCP). One of the purposes of IOCCP is to standardize formats of ocean carbon data so that it can be shared more easily among scientists involved in different projects.

IOCCP convened a meeting in Paris, France in January 2003 on “Ocean Observations from Ships of Opportunity and Repeat Hydrographic Sections” to coordinate ongoing plans and activities of the ocean carbon observation community. IOCCP has planned a meeting on “Ocean Surface pCO₂, Data Integration and Database Development in Japan in January 2004. The meeting will seek to reach agreements on best practices for metadata information and data formats for underway pCO₂ measurements and to publish a technical paper or best practices guide describing the proposed data format and

metadata structure and will discuss collaborations for regional and global data integration and database development for surface pCO₂ measurements. IOCCP will work with SCOR/IGBP projects to help ensure that ocean carbon data are collected and managed in such a way that they can be used across the projects. The primary support for IOCCP was derived from a grant from the U.S. National Science Foundation to SCOR.

3. SCOR Working Group 107 on Global Bathymetric Data—SCOR sponsored a working group on global bathymetric data, which published a report in 2002. SCOR continues to implement recommendations of the group, including a letter to national and world data centers that hold bathymetric data, suggesting ways to improve the access of the global scientific community to high-resolution bathymetric data and software to use such data.

Role for ICSU

The ongoing and recent activities of SCOR related to data and information have identified several issues that could be best addressed by ICSU and/or its Panel on World Data Centers and Committee on Data for Science and Technology (CODATA).

Publication of Data—A major factor that hinders scientists from submitting their data into project management databases and World Data Centers is the concern that they will not receive appropriate credit for their efforts in creating the data. The SCOR/IGBP meeting in Liverpool suggested that major geophysical societies should consider creating journals that would publish peer-reviewed data reports. In addition to stimulating the timely submission of data to appropriate databases, such data publications would also create the benefit of peer-review of data before it enters databases, which usually does not occur. SCOR will pursue this issue with the American Geophysical Union, the European Geophysical Society, and perhaps other societies. But, this issue is broader than ocean data; therefore, it might also be taken up by ICSU for global change data of all types.

Non-georeferenced Data and Socioeconomic Data in Global Databases—Most global databases are designed for data that can be referenced to a geospatial grid. Increasingly, however, some data important for global change studies cannot be associated with meaningful geospatial data coordinates. This will require new data structures and ways of handling such data. As part of this task, it would be useful for ICSU to determine whether important types of data are not being put into the existing World Data Centers because they cannot handle such data, and to promote new initiatives to remedy this situation.

Financial Resources Needed for Data Management—ICSU could provide an important service to the global community of scientists involved in large-scale research of all types, by estimating the resources that a project should devote to data management activities, providing this estimate to funding agencies, and making the case for national funding agencies to include support for data management in the grants for large Earth science projects. Projects represented at the SCOR/IGBP Liverpool meeting estimated that about 10% of a project's budget typically needs to be devoted to managing project data, but funds for data management activities are often not given appropriate attention when funding decisions are made.

Capacity Building—Participants at the SCOR/IGBP Liverpool meeting discussed the need for capacity building in ocean data management. (One meeting participant was the Director of the

Indian National Oceanographic Data Center.) Meeting discussions concluded that it would be difficult to downsize state-of-the-art data sets and data management software to mitigate the capacity problems in many developing nations. In many such nations, research institutions lack reliable Internet access and even the ability to read DVDs and CDs. (It is difficult to imagine implementing sophisticated data management and analysis software and having access to large data sets, if the only access device available is a 1.44 Mb disk drive.) The conclusion of meeting participants was that the primary need in many developing countries is to have the necessary equipment and telecommunication systems of adequate bandwidth.

Identify Lessons Learned From Various Fields and Then Generalize and Encourage Their Application—Many environmental fields have developed different approaches to manage their data. ICSU could help all the environmental sciences by synthesizing the lessons learned by each field. A key issue is how the various fields have ensured that data are used after archiving, not merely stored. For example, reanalysis activities can allow the generation of internally consistent data sets and promote applications for the data. Efforts to organize observational and model data in similar formats and structures has proved to be useful for providing a stronger basis for model evaluation, while also providing a richer set of variables that can be used to investigate why observed variations are occurring.

Priorities for Grants—SCOR's data activities have identified some major issues for marine environmental data, which could be important for other ICSU organizations. Grants to bring together ICSU organizations that sponsor large-scale research with those that deal with data (e.g., the Panel on World Data Centers and CODATA) could help answer specific questions of data management that are particularly important to SCOR, IGBP, and other ICSU organizations. ICSU grants could help fund activities to explore the data issues listed above that are common to projects from many disciplines, specifically new venues for publication of peer-reviewed data reports, handling of new data types in national and international global change databases, and strategies to overcome the limitations imposed by the "digital divide" between developing and developed countries.

ICSU Priority Area Assessment (PAA) on Data and Information Terms of Reference

1. Define an overarching "mission" and role for ICSU in the area of "Scientific Data and Information", taking into account relevant activities outside of ICSU;
2. Propose a strategic framework for ICSU to take this area forward for the next 5-10 years;
3. Examine current activities within the ICSU family; identify gaps, overlaps and synergies of existing activities, and; propose responsibilities for individual bodies;
4. Propose modalities for promoting collaboration and co-ordination within the ICSU family when necessary and propose potential partnerships with bodies outside ICSU;
5. Examine and propose, if appropriate, changes either in the future direction of individual bodies or the way they operate including relationships with other bodies/organisations. Two additional ToR for this specific review on "data and information" are also proposed as follows;
6. To consider the ethical issues related to scientific data and information and, where necessary, propose how ICSU might develop policies in response to these issues.
7. To identify policy issues of particular importance to science and society, which should be highlighted in the World Summit on the Information Society.

Work plan

A minimum of two physical (2-day) meetings of the Panel might be expected in addition to 'virtual' discussions via e-mail and telephone. In-put from the relevant members of the ICSU family will need to be solicited and analysed; it may be desirable to conduct 'face to face' interviews with representatives of key bodies. The first meeting might focus on future developments and priorities in the field as a whole. The second meeting could be more focussed on existing and future ICSU activities and structures. Additional meetings can be planned as necessary.

The Panel will be asked to prepare a report to the CSPR, which will include an overarching mission statement and strategic framework for ICSU and recommendations on roles of new and/or existing interdisciplinary bodies and joint initiatives in the area. This report will be published.

Members: Roberta Balstad Miller (USA, Chair), Jean Bonnin, Strasbourg (France), Marc Brodsky (USA), Graham Cameron (UK), Liu Chuang (China-Beijing), Carlos Correa (Argentina), Norihisha Doi (Japan), Ray Harris (UK), Andrew Kaniki (South Africa), Vitaly Nechitailenko (Russia), T B Rajashekar (India), and Pierre Ritchie (Canada).

ICSU Special Workshop on Comet/Asteroid Impacts and Human Society

Michael MacCracken was appointed by SCOR to serve as its representative to an ICSU project on Comet/Asteroid Impacts and Human Society, which will have as its major activity a workshop. The following is MacCracken's report and additional information about the ICSU meeting.

Liaison Report for 2003-2004 of SCOR/IAMAS Representative to Organizing Committee for the ICSU

In my role as a (ex officio) member of the SCOR Executive Committee (and cognizant of my research some years ago concerning the atmospheric effects of such impacts), I have been nominated by the SCOR EC to serve as their liaison to the organizing committee of the ICSU "Workshop on Comet/Asteroid Impacts and Human Society." I will be working with Laurent Labeyrie to ensure the involvement of appropriate members of the oceanographic community.

The organizing committee is led by Hans Rickman of the International Astronomical Union and Peter Bobrowsky of the International Union of Geological Sciences. In addition to myself representing SCOR (and IAMAS), the Advisory Committee on which I serve presently includes Harry Atkinson (UK NEO Task Force), Clark Chapman (a leading scientist in the area serving as a Member at Large), Viacheslav Gusiakov (IUGG), Wing-Huen Ip (COSPAR), and Stefan Michalowski (OECD). It would seem plausible that, based on the outcome of the workshop, this activity could develop into a SCOPE project.

Since the beginning of the year, an objective of the workshop has been adopted, a listing of topics has been generated, logistical plans for the workshop have been developed, speakers have been invited, and a limited number of invitations to the workshop have been distributed. The objective responds to the call for such an effort by ICSU, and is now stated as follows:

"The International Council of Sciences (ICSU) recently recognized that the societal implications (social, cultural, political and economic) of a comet/asteroid impact on Earth warrants an immediate consideration by all countries in the world. Given the paucity of information on this important issue, ICSU is sponsoring a multi-union effort to hold a specialized "think-tank" workshop on the various aspects associated with such an event. The aim of the workshop is to bring together individuals who represent different aspects concerning comet/asteroid impacts and human society. The goal of the workshop is to produce a timely state-of-the-art synthesis regarding the likelihood and implications of a comet/asteroid impact and its effect on human society in the form of a "white paper". This position statement should be an unbiased consensus of the various participants regarding this type of event and will be used by ICSU and others to positively influence governments at the highest level around the world to begin to take preparatory action to deal with a possible comet/asteroid impact in the next century."

The workshop has been scheduled for 27 November to 2 December 2004 in Santa Cruz de Tenerife, Canary Islands (the site being near an observatory, and near areas where impacts such as might be expected from impact of such an object can be viewed). Speakers have been invited

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to make overview presentations on the following major topics: the populations of potential impactors; the risks of impacts; the geological record of past impacts; the recent archaeological record; the consequences/extinctions to life; direct effects in the oceans such as tsunamis; direct effects from atmospheric influences such as energy, dust and fires; indirect effects: chemical and climatic consequences of impacts; economic implications to society; psychological consequences; sociological consequences; communicating impact risks to the public; disaster management and emergency response; political issues; and religious implications. Topics for discussion groups are currently under development. Attendance is invited, and is expected to total about 40-50.

Respectfully submitted: Michael MacCracken (12 June 2004)

Dear Colleague

Re: Specialist Participant Invitation
ICSU Workshop on Comet/Asteroid Impacts and Human Society

On behalf of the organizing committee for the ICSU Workshop on Comet/Asteroid Impacts and Human Society we cordially invite you to participate in this event as a representative specialist in your field of study. The workshop is scheduled for November 27-December 2, 2004 inclusive to be held at La Laguna, Santa Cruz de Tenerife.

We ask that you attend this workshop to discuss the implications of a potential catastrophic comet/asteroid impact and human society emphasizing those aspects related to your own field of study. You will NOT be giving a formal presentation to the group. Instead you are part of a larger team of 40 individuals participating in open but structured discussions. Discussions will follow a day of formal background presentations by other keynote speakers. For your information we attach a copy of the first announcement for the workshop. The audience of some 40 individuals at this venue will comprise astronomers, geologists, journalists, political scientists, social geographers, insurance specialists, etc.; all with a shared interest of addressing the potential threat and effects of a catastrophic comet/asteroid impact on human society. The success this workshop depends significantly on your level of preparation and discussion during the discussions. It is vital that you attend the event with as much information in hand as possible.

At this time we request that you confirm your interest in this workshop. Funding from ICSU allows us to provide you with a maximum of \$1000 USD towards your airfare. All other costs involved with local on site travel, hotel accommodation, food and other living expenses will also be fully covered by us. Proof of ticket purchase will be required.

Please note that all participants are required to submit a manuscript for publication on their topic of expertise before the workshop. These papers must be submitted to the organizers before 1 September 2004 to allow us to distribute them to all other participants. This will give all participants ample opportunity to familiarize themselves with the various fields of specialty before the actual workshop. Similarly, we plan to publish the manuscripts as a special book with an international publishing house. Funding and participation in the workshop is dependent on receipt of a finished manuscript before the deadline.

We look forward to your positive **reply to this invitation before April 23, 2004**. If you have any questions regarding this invitation or the workshop, please feel free to contact either organizer: Hans Rickman (Hans.Rickman@astro.uu.se) or Peter Bobrowsky (pbobrows@nrca.gc.ca) for further details.

Kind Regards, Hans Rickman and Peter Bobrowsky

**ICSU WORKSHOP:
COMET/ASTEROID IMPACTS AND HUMAN SOCIETY
First Notice 29 March 2004**

**November 27 – December 2, 2004
Santa Cruz de Tenerife**

Objective:

The International Council of Sciences (ICSU) recently recognized that the societal implications (social, cultural, political and economic) of a comet/asteroid impact on Earth warrants an immediate consideration by all countries in the world. Given the paucity of information on this important issue, ICSU is sponsoring a multi-union effort to hold a specialized “think-tank” workshop on the various aspects associated with such an event. The aim of the workshop is to bring together individuals who represent different aspects concerning comet/asteroid impacts and human society. The goal of the workshop is to produce a timely state-of-the-art synthesis regarding the likelihood and implications of a comet/asteroid impact and its effect on human society in the form of a “white paper”. This position statement should be an unbiased consensus of the various participants regarding this type of event and will be used by ICSU and others to positively influence governments at the highest level around the world to begin to take preparatory action to deal with a possible comet/asteroid impact in the next century.

Workshop:

To meet ICSU expectations a 5-day workshop will be held in late November 2004 in an isolated location to encourage continuous and after hour interaction on the theme of the meeting. Participation to the workshop is restricted to an “invitation only” policy. Confirmed participants will have their travel expenses (economy class only), local accommodation as well as board provided courtesy of ICSU. Eligibility to participate requires that the individual is first invited by the organizers and second agrees to submit a manuscript suitable for publication to the organizers before September 1, 2004. Upon receipt of the manuscript, participants will be granted financial support for the workshop. Invited participants who have not provided a manuscript for publication can contribute at their own expense and will not be reimbursed by the workshop organizers. Details regarding manuscript submission format and structure will be made available from the organizers in early July.

Workshop Organizers:

Hans Rickman
(International Astronomical Union)
Hans.Rickman@astro.uu.se

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Peter Bobrowsky
(International Union of Geological Sciences)
pbobrows@nrcan.gc.ca

Local Organizer:

Mark Kidger
(Inst. Astrofísica Canarias - IAC)
mrk@iac.es

Advisory Group:

Harry Atkinson (UK NEO Task Force), Clark Chapman (Member at Large), Viacheslav Gusiakov (IUGG), Wing-Huen Ip (COSPAR), Michael MacCracken (SCOR) and Stefan Michalowski (OECD)

Schedule:

Nov 27 -- participants arrive
Nov 28 -- local field trip plus tourism
Nov 29 -- technical presentations in the Museum auditorium
Nov 30 -- breakout group discussions in the Museum
Dec 1 -- summary discussions in the Museum auditorium
Dec 2 -- participants depart

Workshop Location:

Museo de las Ciencias y el Cosmos
Avenida de los Menceyes, 70
San Cristóbal de La Laguna
Santa Cruz de Tenerife
SPAIN
Email: mcc@museosdetenerife.org

November 29 - Invited Keynote Technical Presentations (optional speakers shown):

State of the art reviews prepared for a general audience on a particular theme. Power point presentations only (no slides or overheads), a maximum of 20 minutes in length (includes presentation and question period). Power point presentations must be approved by organizers before November 1, 2004. On-site submissions and revisions will not be accepted. Presentations should complement manuscripts submitted before September 1, 2004.

The purpose of the technical talks is to broaden the perspective and knowledge base of the various participants. Given the diversity of expertise, it is essential that colleagues from other disciplines fully understand and appreciate the key assumptions, implications and conclusions of the keynote speaker's thesis. Topics cover all aspects associated with asteroids, from the astronomical to the social.

- Introduction (Rickman and Bobrowsky)
- Identifying the problem of NEOs: why are we here? (Chapman)
- Populations of potential impactors: where are we from an astronomical perspective? (Morbidelli)
- Evaluating risks of impacts from a mathematical point of view (Milani)

- The geological record for past impacts (Grieve)
- The recent archaeological record (Masse)
- Consequences/extinctions to life (Schmitz)
- Direct effects: tsunamis (Bryant)
- Direct effects: energy, dust and fires (Melosh)
- Indirect effects: chemical and climatic consequences of impacts (Crutzen)
- Economic implications to society (Lave//McGuire)
- Psychological consequences (Hayashi)
- Sociological consequences (Adger//Hewitt)
- Communicating impact risks to the public (Hermellin)
- Disaster management and emergency response (Mileti)
- Political issues (Michalowski)
- Religious implications

POTENTIAL PARTICIPANTS

Neil Adger	Socio-economic Impacts	UNITED KINGDOM
Johannes Andersen	NEO research/politics	DENMARK
Harry Atkinson	Potentially Hazardous Near Earth Objects	UNITED KINGDOM
Peter Bobrowsky	Geological Survey of Canada	CANADA
Bill Bottke	Space studies	USA
Ted Bryant	Cosmogenic Tsunami	AUSTRALIA
Andrea Carusi	Space astrophysics and cosmic physics	ITALY
Clark R. Chapman	Space studies	USA
Curtis Covey	Climate Model Diagnosis & Intercompar.	USA
Paul J. Crutzen	Atmospheric Chemistry	GERMANY
Susan Cutter	Risk mapping, risk assessment	USA
Ian Davis	Natural hazards, risk assessment	UNITED KINGDOM
Mohammed Dore	Economic Impacts	CANADA
Sven Ehrichler	Insurance	GERMANY
Harry Foster	Hazard/risk management	CANADA
Richard Grieve	Geology	CANADA
Viacheslav Gusiakov	Tsunamis	RUSSIA
Haruo Hayashi	Psychological Impacts	JAPAN
Michel Hermelin	Public education and hazards	COLOMBIA
Kenneth Hewitt	Social response to catastrophic risk	CANADA
Leo Hickey	Geology	USA
Wing-Huen Ip	Astronomy	CHINA-TAIPEI
Boris A. Ivanov	Geoscience	RUSSIA
Robert W. Kates	Natural hazard impact models	USA
Mark Kidger	Astrophysics	SPAIN
Paul Kovacs	Insurance	CANADA
David A. Kring	Cosmochemistry and Planetary Geology	USA
Wolfgang Kundt	Tunguska	GERMANY
Howard Kunreuther	Catastrophic risk analysis and mitigation	USA
Lester B. Lave	Economics of risk management	USA
Meng Yang Lee	Toba eruption	CHINA-TAIPEI
Giuseppe Longo	Physics	ITALY
Michael MacCracken	Atmospheric Sciences	USA
Brian G. Marsden	Astronomy	USA
Jesus Martinez-Frias	Megacryometers	SPAIN
W. Bruce Masse	Myths, archaeology and Holocene records	USA
Bill McGuire	volcanic hazards, global geophysical events	UNITED KINGDOM
Jay Melosh	Theoretical geophysics, planetary surfaces	USA
Stefan Michalowski	Economics	FRANCE
Andrea Milani	Mathematics	ITALY
Dennis S. Mileti	Human adjustment to extreme risks	USA
Alessandro Morbidelli	Astronomy	FRANCE
Oliver Morton		
David Morrison	IAU WG on NEOs	USA
E.L. Quarantelli	Mass behaviour in disaster, disaster impacts	USA

Hans Rickman	Astronomy	SWEDEN
Birger Schmitz	Geology	SWEDEN
Roy C. Sidle	Hazard Assessment	JAPAN
Duncan Steel		AUSTRALIA
Owen Brian Toon	Atmospheric and Ocean Sciences	USA
Siim Veski	Kaali and ecology	ESTONIA
Derek Ward-Thompson	Physics and Astronomy	UNITED KINGDOM
Ben Wisner	Hazard Vulnerability Assess. & Planning	USA
Donald K. Yeomans	Astronomy	USA
Kevin Zahnle	Astronomy	USA
Donald J. Zeigler	Evacuation, coastal hazards	USA

Global Marine Assessment

ICSU requested that SCOR represent ICSU at a planning meeting in Nairobi, Kenya (at the Headquarters of the United Nations Environment Program, UNEP) for the development of a UNEP module for the Assessment of the Marine Environment. This meeting took place from 19-21 November 2003, and Robert Duce represented SCOR and ICSU at that meeting. This meeting was held in relation to a growing concern about the state of the marine environment and its living resources, particularly in coastal and shelf regions, and the role the United Nations in general, and UNEP in particular, might play in developing a regular assessment of the health of the ocean.

7.1.1 International Geosphere-Biosphere Programme

IGBP update for SCOR Meeting 2004

IGBP and SCOR have continued the valued collaboration on our jointly sponsored projects (JGOFS, GLOBEC, IMBER and SOLAS). In addition we have collaborated on a number of other projects such as the activities of LOICZ, activities of the Global Carbon Project and the Fast-Track Initiative on Iron.

The IGBP Secretariat has a new Executive Director, Kevin Noone, who starts his appointment on 1st September 2004. Kevin Noone is currently Professor at the Department of Meteorology, University of Stockholm and head of its Atmospheric Physics Division.

IGBP II

With the transition to its new phase now complete, IGBP officially launched its second decade of international research on global biogeochemistry in 2003. By December, the programme was operating fully within the new structure, and the last project planning activities were close to completion. Building on the successes of the now-completed GCTE and of LUCC (that will complete its work in 2005), the new Global Land Project held an open science conference in December 2003 to complete the planning phase and begin building a strong GLP community. Early in 2003 a similar conference was held to advance the new Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project towards implementation. In partnership with GLOBEC project, IMBER will contribute significantly to the ocean compartment of the new IGBP structure.

GAIM and PAGES evolved during 2003 further towards their central integration and synthesis roles in IGBP. One of the most important developments of the past decade was the explosion of new understanding of the Earth System from palaeo-studies, and during 2003 PAGES undertook an extensive self-analysis of how to better integrate palaeo-research with the more contemporary focus of other IGBP projects. GAIM is rapidly evolving from a primarily carbon-oriented project into a project that in collaboration with IGBP's ESSP partner programmes, will analyse, integrate and model the entire Earth System (AIMES). AIMES is also developing a network of institutions with expertise in Earth System analysis, integration and modelling.

The developments of 2003 have settled IGBP into its new structure and set the stage for more formal, systematic, programme-wide research integration. The challenges for the coming year or two are to maintain and support the focused research of the projects, whilst building innovative approaches to integration that enable understanding of the complex dynamics of the entire planetary life support system. Additionally, IGBP continued to enhance and extend its already strong communication effort, to focus its outreach activities on the further development of national committees, and to build its linkages to the observation community.

Synthesis Books

The IGBP Synthesis Book – *Global Change and the Earth System: A Planet Under Pressure* - was completed in late 2003 and published by Springer-Verlag in January 2004. With contributions from nearly 500 others from within and beyond the IGBP network, this 336-page book represents a comprehensive collation of the past decade of global change research. The

following synthesis books are now completed from the first phase of IGBP's synthesis: START, IGAC, JGOFS, PAGES and BAHC (see references). These new books are a major achievement of the IGBP Synthesis process, and testify to the breadth, depth and quality of IGBP science undertaken in the last ten years.

Earth System Science Partnership (ESSP)

The Earth System Science Partnership – a collaboration between IGBP, IHDP, DIVERSITAS and WCRP - continues to flourish. The fourth joint project on global sustainability – Global Environmental Change and Human Health - is developing rapidly, and is expected to complete its science plan and begin implementation this year. Under the leadership of START, the second Integrated Regional Study (on the Monsoon Asia region) was launched in 2003. In collaboration with SCOPE, a conceptual framework is being developed for the study, and a rapid assessment of the current state of understanding of regional and global change in Asia is being undertaken.

Global Carbon Project (GCP)

2003 was an exciting year for GCP, with the project formally launched by publication of its scientific framework document. More than 2000 copies were distributed to the community within a month of publication, attesting to the broad interest in and support for the project. Even in the first year of project implementation, the achievements are significant. GCP has sponsored or participated in 11 workshops, conferences and symposia, and has produced nine major publications in the international literature. In addition, the first networks around specific activities were established, for example, carbon management aspects of development strategies for cities in the Asia-Pacific region and the Americas. Partnerships have been built with the terrestrial component of the Integrated Global Carbon Observing (IGCO) theme of IGOS-P, and with the SCOR/IOC Advisory Panel on Ocean CO₂ to create the International Ocean Carbon Coordination Project. The development of the second GCP International Project Office, in Tsukuba, Japan, launched in early 2004, promises to further boost GCP.

Website: www.globalcarbonproject.org

Global Environmental Change and Food Systems (GECAFS)

GECAFS is developing and implementing an innovative research agenda that draws on both biophysical and socio-economic sciences. The development of this agenda is generating new concepts and establishing new paradigms in interdisciplinary research and in science-policy linkages. GECAFS is establishing novel collaborations between the international global change research community and research partners interested in the development agenda. During 2003, regionally based studies of food systems were established in the Indo-Gangetic plain, the Caribbean and Southern Africa. In addition to IGBP, IHDP and WCRP sponsorship, GECAFS formalised collaboration with CGIAR, FAO and WMO. Reviews of the project's future plans are ongoing, helping to refine criteria for GECAFS scenario studies, and helping to select priority geographic regions and topics. Drafting of a Science Plan and Implementation Strategy was initiated during 2003, for approval in 2004.

Website: www.gecafs.org

Global Water System Project (GWSP)

During 2003 much effort was put into the development and refinement of the scientific framework for the freshwater project GWSP. This was initially led by a project Scoping

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Committee co-ordinated by Holger Hoff. After review of the initial document a wider committee was established to refine the framework under the leadership of Joe Alcamo, with refinement focussed during and following the important open science conference held in October, in New Hampshire, USA, with around 100 delegates. During 2003 funding from the German Government enabled the establishment of an International Project Office at the University of Bonn. The appointment late in the year of Eric Craswell as the Executive Officer and staff to support him was a huge addition to the momentum of the GWSP. Project implementation will begin following the expected approval of the Scientific Framework in 2004.

Website: www.gwsp.org

Global Environmental Change and Human Health (GECHH)

Recognising the growing need to better understand the multi-faceted and complex linkages between global change (including climate change, land- and sea-use changes, global biodiversity loss and changes, global socio-economic changes) and human health, the ESSP established a new joint project during 2003. With its wide network global change scientists, the ESSP is well positioned to take up this challenge. Two primary and closely related goals have been defined: (i) to identify, and then reduce, the risks to human health posed by global environmental change; and (ii) to systematically collect evidence of these health risks that can inform policy for risk minimisation or avoidance. An initial Scoping meeting in Paris in March included representatives of organizations and institutes from 15 countries, including the World Health Organization (WHO). A planning team has begun the drafting of a Science Plan and Implementation Strategy for submission in 2004.

Website: www.diversitas-international.org

Regional Activities

Global Change SysTEM for Analysis, Research and Training (START)

START is sponsored by the ESSP. In late 2003 the START Strategy Plan for the coming decade was approved by the project SSC. The plan describes the START intentions to continue its highly successful efforts in areas such capacity building, regional cooperation, infrastructure establishment, scientific training and dialogue with policy makers. In addition, START has the challenge of implementing the Monsoon Asia Integrated Regional Study (see below). During 2003 GEF funding established 24 regional projects to assess impacts and adaptations to climate change. These regional projects involve 45 countries and 235 developing country researchers including 60 research students, and will contribute to the next IPCC assessment. A highlight of 2003 for START was the highly successful International Young Scientists' Global Change Conference in Italy in November. A rigorous peer-review of submitted abstracts led to a selection of 85 from over one thousand submissions. During the year over one thousand scholars from developing countries were involved in START activities, including regional workshops, collaborative networks, short-term fellowships, and visiting scientist/lecturer awards. START also conducted or participated in numerous workshops with core and joint ESSP projects. During 2003 START continued work on a major multi-authored book on Integrated Regional Assessments, and progressed plans for a synthesis volume of African global change research.

Website: www.start.org

Integrated Regional Studies

At the 3rd IGBP Congress in 2003 the proposal for a small number of Integrated Regional Studies (IRS) was presented and adopted. IRS will consider a region as a holistic entity in the context of the Earth System, will contribute sound scientific understanding in support of sustainable development of the region, and will contribute to a quantitative and qualitative understanding of regional-global linkages and the consequences of changes in these linkages.

A long-standing example of an IRS within IGBP is the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA). LBA comprises over 80 closely linked and coordinated research groups involving 600 scientists from South and North America, Europe and Japan. The second IRS to be established is the Monsoon Asia Integrated Regional Study (MAIRS). Under the leadership of START, several MAIRS Scoping meetings have been conducted and an interim steering group established. Funding from ICSU has been secured that will support three sub-regional rapid assessment exercises. The Chinese Academy of Sciences has offered to establish and support an IPO for MAIRS. Finally, there is interest within the ESSP of adopting AMMA (African Monsoon Multidisciplinary Analysis) as the third IRS.

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7.1.2 World Climate Research Programme (WCRP)

THE WORLD CLIMATE RESEARCH PROGRAMME STRATEGY 2005-2015
Coordinated Observation and Prediction of the Earth System
(COPEs)

A discussion document

Submitted by the Joint Scientific Committee for the WCRP
(12 May 2004)

PREFACE

The aim of this document is to provide a basis for discussion, development and eventual adoption of the strategy and goals to be pursued by the World Climate Research Programme (WCRP) for the period 2005-2015, following its successful first 25 years, 1980-2004. The plans outlined are intended to be developed and modified significantly throughout the course of further, open discussion by the scientific and related stakeholders at large. The articulation of the future strategy for the WCRP within the context of Coordinated Observation and Prediction of the Earth System (COPEs) is new. The opportunities and challenges that have led to the formulation of COPEs are presented, and proposals are made for its aims and some suggested specific objectives. This is followed by some implications for WCRP and its ways of working and a description of the initial steps that have been, or will be, taken. The WMO/ICSU/IOC Joint Scientific Committee for the WCRP invites comments that will help develop and refine COPEs to ensure that the WCRP becomes an even more effective, more coordinated and more relevant international research programme for the next decade. Comments and suggestions are particularly welcome on specific objectives for COPEs. The main text is complemented by Appendices summarizing WCRP's current activities and linkages, achievements so far, and significant steps in the development of COPEs to date.

Comments on any aspect of this document should be sent to Professor B. J. Hoskins, Co-Chair, COPEs Task Force, at b.j.hoskins@reading.ac.uk, with copy to Dr D. J. Carson, Director, WCRP, at dcarson@wmo.int.

1. INTRODUCTION

The World Climate Research Programme (WCRP) was established in 1980, under the joint sponsorship of the World Meteorological Organization (WMO) and the International Council for Science (ICSU), and has also been sponsored by the Intergovernmental Oceanographic Commission (IOC) of UNESCO since 1993. A WMO/ICSU/IOC Joint Scientific Committee (JSC) has the responsibility of formulating the overall scientific concepts and goals of the WCRP, as well as organizing the required international co-ordination of research efforts.

The two major objectives of the WCRP are to determine the extent to which climate can be predicted and the extent of human influence on climate. To achieve these objectives the WCRP promotes essential research into understanding the basic behaviour of the physical climate system, and its relation to the broader earth system and the needs of society, in particular:

- to observe and measure changes in the atmosphere, oceans, land and cryosphere;
- to improve our knowledge and understanding of global and regional climate variability and change, and of the mechanisms responsible;
- to assess the evidence of significant trends in global and regional climates;
- to develop and improve numerical models capable of simulating and assessing the predictability of the climate system over a wide range of space and time scales and suitable for operational predictions;
- to investigate the sensitivity of the climate system to natural and human-induced forcings and to estimate the changes resulting from specific disturbing influences.

These overriding objectives and research aims were reaffirmed at the Conference on the WCRP: Achievements, Benefits and Challenges, Geneva, August 1997 (WMO/TD-No.904, June 1998), with the immediate research priorities:

- to assess the nature and predictability of seasonal to interdecadal variations of the climate system at global and regional scales, in order to provide the scientific basis for operational predictions of these variations for use in climate services in support of sustainable development;
- to detect climate change and attribute causes, and project the magnitude and rate of human-induced climate change, its regional variations and related sea-level rise, as needed for input to the WMO/UNEP Intergovernmental Panel on Climate Change (IPCC), the United Nations Framework Convention on Climate Change (UNFCCC), and other such Conventions.

WCRP has a broad-based, multi-disciplinary science strategy offering the widest possible scope for investigation of all important physical, dynamical and other related aspects of climate, its variability and change. Note the emphasis on providing practical deliverables of global and regional relevance, importance and value, and the specific references to sustainable development, the IPCC, and the UNFCCC. The pursuit of these objectives to meet the needs of society for climate predictions and climate-change scenarios requires the development of understanding through diagnosis of data from observations and modeling experiments, process studies and the creation and analysis of special data sets. A brief description of the current projects and other activities of WCRP and some recent highlights in each area are given in Appendix A. During the 25 years of its existence, WCRP has enabled many achievements consistent with its aims, especially by advocating and coordinating research programmes among nations, and these are indicated in Appendix B.

As WCRP nears its 25th anniversary in 2005, it is appropriate to consider the progress that has been made towards achieving its main objectives and what should be its agenda and strategy for the future. The challenge to the JSC is to define the WCRP's specific objectives for the next decade or so and decide if changes in programme and structure are required to achieve them. What follows is an introduction to the new WCRP strategy, Coordinated Observation and Prediction of the Earth System (COPES), the outline of which was decided by the JSC at its 25th session (Moscow, March 2004). A summary of the development of this new strategy for WCRP is given in Appendix C.

2. THE STRATEGY

2.1 *The Challenge*

It is now particularly appropriate to consider the progress that has been made towards achieving the main objectives set for WCRP at its inception in 1980:

- **To determine the predictability of climate**
- **To determine the effect of human activities on climate**

and what should be its agenda and strategy for the future. This is partly because WCRP is now approaching its 25th anniversary, but mainly because of the new opportunities and challenges for its science:

a) *Address the seamless prediction problem: weeks-seasons-years-decades-centuries.*

Increasingly, century-long climate projection will become an initial-value problem requiring the current observed state of not only the atmosphere, but also the oceans, cryosphere, and land surface (including soil moisture, vegetation, etc.) to produce the best climate projections and also giving state-of-the-art decadal and interannual predictions. The shorter time-scales and weather are known to be important in their feedback on the longer-time-scale behaviour. In addition the regional manifestations of longer-time-scale changes will be felt by society mainly through the changes in the character of the shorter time-scales, including extremes. In the process of addressing this challenge, it will be necessary to build more accurate models of the climate system that replicate more faithfully the behaviour of the observed climate.

b) *Address prediction of the broader climate/Earth system.* The detailed physical prediction models of the coupled atmosphere, ocean and land developed and used within WCRP are increasingly being extended to include atmospheric chemistry, the carbon cycle, including dynamic vegetation, and interactive marine eco-systems.

c) *Demonstrate the use to society of WCRP-enabled predictions.* It is now realised that the usefulness of the predictions that are becoming possible depends on the details of the proposed application, and that for some purposes it is necessary to quantify the use that is made of the prediction. For example, models of specific applications such as crop-growth and malaria incidence are having model data fed directly to them or are even being added to the prediction models.

d) *Coordinate and implement new activities to exploit and show the benefit of:*

(i) *new and increasing data streams.* A huge quantity of data will be available from the environmental satellite missions already launched or planned. Also, the Argo system of operational ocean profiling floats, for example, is becoming a hugely important source of oceanographic data. These data must be used in process studies and turned into climate data sets. The latter will require continuing pressure for observational data of climate quality.

(ii) *the growth and availability of computing power.* The computing power becoming available gives the prospect of being able to run global models with resolution of a few kilometres, very large model ensembles, and Ice Age Cycle simulations with full coupled

global climate models.

(iii) *the increasing complexity of models*. Models with embedded cloud resolving models, and detailed models including many interactive parts of the Earth system, such as dynamic vegetation and atmospheric chemistry, are being developed.

(iv) *modern data assimilation techniques*. In the context of numerical weather prediction it has been shown that maximum value can be obtained from the various streams of data by analysing them together in the context of a prediction model that is sufficiently accurate. In the process, valuable information on model deficiencies can be obtained. Such data assimilation will increasingly be possible and will require new techniques for the components of the coupled climate system and for the wider Earth system.

e) *Interact strongly with other Earth System Science Partnership (ESSP) Programmes (see section A.10, Appendix A) and other activities*. In particular the broadening of the climate/Earth system interest of WCRP implies closer collaboration and synergy with the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP) and DIVERSITAS. Collaboration and coordination are also needed with both THORPEX (see section 2.7) and, in the immediate term, with the proposed International Polar Year 2007/08 (see section A.5, Appendix A).

The opportunities afforded by (d) and (e) above are crucial to addressing successfully the challenges posed by (a)-(c). All are new and this gives an impetus and a necessity for this WCRP reassessment of its strategy.

2.2 Coordinated Observation and Prediction of the Earth System (COPES)

As a refocusing of its activities towards its original two aims and in response to the new opportunities and challenges, the JSC is proposing the new strategic framework for its activities in the period 2005-2015: COPES. This name is appropriate as ‘Coordination’ is an essential ingredient of what WCRP provides for its science. ‘Observations’ and enabling quantitative ‘Prediction’, along with the essential process understanding, are the pillars of WCRP science. ‘Earth System’ expresses the increasing breadth of our climate system interest.

Combining the two aims of WCRP, consistent with the seamless nature of the prediction problem, the aim of COPES is:

- To facilitate prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society.

COPES will provide the framework to oversee and draw on the whole range of WCRP’s projects and other activities to tackle the new challenges given in 2.1, and for the JSC to review and assess progress towards achieving the original WCRP aims, to set specific objectives in the context of those aims, to strengthen existing and stimulate new scientific activities within WCRP, and to gain increasing recognition for the scientific and societal relevance and importance of WCRP results.

COPES is a new overarching activity that builds on existing (and future) WCRP projects, and provides a context in which they and other activities and scientists will be able to perform their research, and that will help show the relevance of this research. Wherever possible, new experiments, studies, and observational activities will be carried out through the existing WCRP programme structure. However, the WCRP structure must continue to evolve, as it has in the past.

2.3 Specific WCRP objectives within the context of COPES

Under the framework of COPES, WCRP will set a number of specific objectives with clear rationale for their importance and relevance and also with associated time-scales for achieving them, and milestones and metrics to map out and measure their progress. At the end of the time-period for each objective, a publication synthesizing the scientific status and understanding of the topic should be produced. These specific objectives will be widely debated in the WCRP community and stakeholders are asked for their comments. Some examples of possible topics that have already been suggested are given in Appendix D, at this stage without rationale, time-scales, or metrics. Four of these are listed here to indicate the types of issues that could be selected:

- (i) determine the feasibility and expected skill of seasonal climate prediction in all regions of the globe with currently available models and data (this important exercise should be repeated periodically as observational systems and models evolve);
- (ii) further develop and test the techniques for ensemble prediction of climate variability and change;
- (iii) determine the scientific basis for, the best approaches to, and current skill of projections of regional climate change at several time-scales;
- (iv) develop well-tested, detailed chemistry-climate prediction and projection models and related procedures (with the International Global Atmospheric Chemistry (IGAC) project of IGBP).

The JSC for the WCRP specifically invites comments on the tentative specific objectives listed above and in Appendix D. It also welcomes further suggestions for such specific objectives appropriate to WCRP and, in particular, within the context of COPES. Some of these may be suitable for starting very soon whilst others may be suitable for later in the period, 2005-2015.

2.4 Observations required for COPES

The aims of COPES require WCRP to study how the observations of important climate variables contribute to the increased predictability of climate at various time- and space scales. The observational issues of COPES will require the coordinated collection and reanalysis of climate observations to describe the structure and variability of the climate system, and to generate dynamically-balanced and internally-consistent states of the coupled climate system for the numerical prediction of climate. Special efforts will be required to obtain and assimilate data from the new generation of environmental satellites to meet the scientific objectives embedded in COPES. An urgent task under COPES will be to define the *in-situ* and space observing systems for the next decade required to address the aims and objectives of WCRP, and for the implementation of the COPES strategy. In particular, consideration will need to be given to

identifying gaps and deficiencies in existing observing systems, which may have resulted in reduced predictability.

In addition to the longer-term data for climate monitoring and analysis of time-dependent variations, there will be a need to collect, analyze and archive high spatial and temporal resolution data of physical variables and chemical constituents using *in situ* as well as remote-sensing methods. Many such data will likely be obtained for short periods from observational campaigns designed for process studies. Data from these observational components will help formulate, evaluate, and parametrize processes that go into the global models and also help validate satellite data.

Under COPES, the new observational data, particularly those from the new generation of satellites, will be exploited to the maximum possible extent in pursuit of the aims and objectives of WCRP and in particular to determine what can be predicted and how it can be done. By doing so, WCRP will position itself to argue for the climate observational system that will be required in future. The Coordinated Enhanced Observing Period (CEOP) (see section A.3, Appendix A) led by the WCRP Global Energy and Water Cycle Experiment (GEWEX) should be viewed as an example of coordinated global observational activity in support of COPES.

Climate observations need to be tailored for specific purposes and set in a framework that will achieve best value. A commitment is needed to create a comprehensive, reliable, end-to-end, 'Global Climate Observational System', which will produce long-term, high-quality, temporally homogeneous data sets and products. Observations should adhere to the Global Climate Observing System (GCOS) observing principles, thereby ensuring that they are useful for multiple purposes, including climate change. A strategic plan is required for the progressive, coordinated, periodic analyses and reanalyses of observations, which are necessary to incorporate lessons from new measurements and research, and also for the stewardship, archival and access of data, as well as the support to enable institutions to do these tasks.

Increased resources are needed to achieve more effective exploitation of current and planned observations (especially for satellites) through increased international cooperation on developing integrated analyses and products. The transition from research to operational systems is also an important practical issue.

The Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC (GCOS-82, WMO/TD No.1143, April 2003) provides a platform for supporting operations and for the further development of the global observing systems (see section A.7, Appendix A; and also the draft GCOS Implementation Plan 2004). It will be a task within COPES to work closely with GCOS to build on this report and to specify with more precision the observations needed to improve the realisable predictability of climate at various temporal and spatial scales.

The Group on Earth Observations (GEO) exercise and the related Earth Observation Summits are potentially of great value to WCRP in the context of the observational needs and aspirations of COPES (see section A.7, Appendix A). It is important, therefore, that the opportunity is taken to provide informed and comprehensive WCRP input into the GEO process, which is scheduled to finish early in 2005, but with implementation of its plans to follow. In addition, many of the

observational issues of COPES will be addressed through the IGOS-Partnership and the Committee on Earth Observation Satellites (CEOS), especially through the IGOS Global Water Cycle Observations theme and, potentially, through a newly proposed cryospheric theme.

2.5 Modelling issues for COPES

The first aim of WCRP is to determine the extent to which climate (at all relevant temporal and spatial scales) can be predicted. Although major advances have been achieved in this context in WCRP's first 25 years, there remains a long way to go and, with the anticipated improvements in global observations, understanding, models and computers, there is every expectation of further significant potential gains to be won. The essence of WCRP science is observation, diagnosis and modelling of the physical climate system leading to a better understanding of the mechanisms that determine the mean climate and its variability. However, the ultimate objective is that WCRP will provide the soundest possible scientific basis for a predictive capability for the total climate system to meet society's needs, including an assessment of what is, and what is not, predictable on various time- and space-scales.

COPES will require that the roles of atmosphere, ocean, land and cryosphere be considered in comprehensive models of the climate system, which are also capable of assimilating weather and climate observations. This will require a sustained research effort in the validation and development of climate models and data assimilation techniques. This will also require the validation of climate models through their ability to simulate past climate variations including abrupt climate changes.

As indicated earlier, while WCRP has, and will continue to have, a firm foundation in the physical climate system, it will also increasingly consider quantitative modelling of the wider Earth system. This will be done in close collaboration, in particular, with IGBP. Similarly, in order that the science addressed in WCRP should be in support of the sustainable development of societies, WCRP will need to nurture closer collaborations with IHDP and other international projects relevant to the welfare of the global society. In the context of these collaborations, the JSC has drafted a 'modelling strategy' for consideration by the ESSP, which proposes the coordinated modelling efforts required to understand and predict the Earth System. This 'ESSP Modelling Strategy' is reflected in the rest of this section.

The current status of modelling the Earth system is characterized by sophisticated high resolution general circulation models (GCMs) for the physical climate system, with these complex models being expanded to encompass chemical and biological aspects of the Earth system. In particular, detailed models for the atmospheric chemistry and the carbon cycle, including dynamic vegetation modules and interactive marine ecosystems, are now being developed for GCMs. Earth system Models of Intermediate Complexity (EMICs) offer a complementary approach for long-term simulations, and more holistic, exploratory models are being developed for the investigation of the interaction of human societies with the other components of the Earth system. Improvement of the present modelling capability thus requires a co-ordinated hierarchical approach with a suite of different models. In particular, there is a need for:

1. Experimentation with current GCMs to:
 - a. provide the material for IPCC and other international assessments through sensitivity studies, climate hindcasts and projections of future change;
 - b. assimilate and predict the coupled system on intraseasonal to interannual (and eventually longer) time-scales.
2. Continued experimentation (including ‘retrospective predictions’ at various time-scales) and process studies with current GCMs and comparison with observations to improve and validate the models used in 1.
3. Development of the ability to perform more detailed global modelling of the carbon cycle, hydrology, dynamic vegetation, tropospheric and stratospheric chemistry, ocean biology, lateral transport of elements and a range of other biogeochemical processes (requiring observations, process studies and modelling of the individual systems).
4. Work on extending GCMs to include each of these additional components of the Earth system in turn, as a basis for the studies in 1.
5. Development of and work with more holistic models (including EMICs) to:
 - a. study the interactive aspects of the natural system;
 - b. simulate longer time-scales, e.g. Ice Age Cycles;
 - c. compare and validate with GCMs where possible.
6. Development of models of the interaction between the human and natural systems based on the more holistic models.
7. Use of simpler models to help in the design of the diagnosis of the more complex coupled models.

The effective development and implementation of such a modelling programme would require a range of separate but coordinated and collaborative activities. Including all of these in a single overarching ESSP activity would not be appropriate, at least at this stage. Instead, the coordination of the various modelling activities above could be achieved at least initially through presentation, discussion and agreement at the now-annual sessions of the ESSP Chairs and Directors. However, more dedicated mechanisms, procedures and fora will also be needed to make effective progress on the necessary cooperative efforts, and such issues should also be considered in the first instance and as a matter of high priority by the ESSP Chairs and Directors.

WCRP’s expertise with global data sets and in the coordination and implementation of major global modelling activities should be a major contribution to the ESSP and its joint activities. Based on experience and track-record to date, it would be most fitting for WCRP to continue to take the lead for activities 1 and 2 above, through its projects and Working Group on Coupled Modelling (WGCM), drawing on the expertise of IGBP projects as appropriate. In turn, IGBP should continue its lead, in partnership with WCRP, in activity 3, which builds on the work of the IGBP projects and draws, as appropriate on the expertise of WCRP projects. Item 4 is being

implemented through the existing partnership between WCRP's WGCM and IGBP's Global Analysis, Integration and Modelling (GAIM) activity (to be replaced in IGBP by Analysis, Integration and Modelling of the Earth System (AIMES)), with WCRP taking the lead. This productive partnership provides a common platform for a broad range of communities to collaborate as complex models of the physical climate evolve towards more complex and integrated Earth System models. IGBP should take the lead for activity 5, which must provide inputs to activities 2 and 3, linking closely with WGCM, WCRP Climate Variability and Predictability (CLIVAR) project and IGBP's Past Global Changes (PAGES) project. Activity 6 should be implemented in the first instance through a full and equal partnership between IGBP and IHDP, with WCRP being kept informed but with a view to playing an increasingly more active and direct role in the development, use and evaluation of such model components. Activity 7 is relevant for each of the ESSP programmes.

2.6 The essential synergy between observations and models

There are three fundamental ways in which WCRP approaches its aims, namely, through climate related observations and their analysis, through fundamental research on climate/Earth system processes, and through the development, evaluation and use of climate/Earth system models. The second of these is vital for the improvement of models and also in helping to provide a framework for model experimentation and for deciding what observations are required and how they should be analysed. In addition, as raised in the Challenges (section 2.1), more complete exploitation of observations and improvement of models require climate/Earth system data assimilation. This is already occurring in some operational centres as an extension of numerical weather prediction procedures. It requires the best climate/Earth system models and is an excellent test of them. Maximum possible value of observations is obtained by putting them together with other observations in the context of the model. The resulting products are essential for providing our best estimates of the current state of the climate and for many uses in the context of the development, use and evaluation of climate models. Independent observational data sets and analyses are also required to make an independent check of both models and analyses.

In order to meet the observational and modelling requirements of COPES, the WCRP will initiate field experiments to collect special observational data sets, will coordinate the development of global data sets for climate, and will organize coordinated modeling experiments to gain an understanding of the dynamical mechanisms of climate/Earth system variability, and assess the limits of predictability of climate/Earth system variations. COPES will provide a context in which the ongoing regional observational programmes and modeling experiments of WCRP will fit together synergistically. Thus, COPES will provide a strategic framework for developing WCRP's requirements for comprehensive, internationally coordinated sustained global observations of weather and climate and prediction of climate/Earth system variations and change.

An immediate opportunity is provided by the proposed International Polar Year 2007/08 (IPY 07/08). As requested at JSC-XXIV (March 2003), the WCRP involvement in the planning of IPY 07/08 is being led by the Scientific Steering Group of the Climate and Cryosphere (CliC) project, taking account of the interests of other relevant WCRP activities. A longer-term prospect for synergy and strong collaboration is afforded by THORPEX.

2.7 THORPEX

Within the framework of COPEs, WCRP should liaise closely with other related, large-scale, observationally based, activities. This applies in particular to THORPEX, which was established in May 2003 by the Fourteenth World Meteorological Congress as a 10-year international global atmospheric research and development programme under the auspices of the WMO Commission for Atmospheric Sciences (CAS). THORPEX is a component of the WMO World Weather Research Programme (WWRP), and is also sponsored by the JSC/CAS Working Group on Numerical Experimentation (WGNE). During the coming decade, THORPEX will focus on the possibility that targeting the observational system, both satellite and *in situ*, using prediction-model information may give enhanced ability to predict high-impact weather. It also wishes to determine how such ability depends on larger space-and time-scale phenomena such as the variability of the organisation of tropical convection in the intra-seasonal oscillation (i.e. Madden-Julian Oscillation (MJO)), and to investigate the ability to predict weather between one and two weeks ahead. THORPEX will culminate in a one year global weather experiment in the period 2010-15. Given the COPEs challenge of the seamless prediction problem, recognizing the importance in longer term predictions of the statistics of severe weather, the feedback of weather and phenomena, such as the MJO, onto the longer time-scale, and also given the complementary predictability time-scales it is clear that there is much common interest between WCRP-COPEs and THORPEX. The WCRP in COPEs should recognise and seek to cooperate fully with, and develop synergy with, THORPEX, and in particular its global weather experiment.

3. WCRP FUTURE STRUCTURE

3.1 Role of the JSC

It is the responsibility of the JSC to formulate the overall scientific concept and goals of the WCRP, to take account of the aims and objectives in guiding the development and implementation of COPEs, and to use them as the 'yardstick' by which the overall performance of WCRP is measured and assessed. In particular, the JSC will need to decide on the purpose, nature, content and goals of the COPEs strategic framework. This document is intended to facilitate this task and to reflect the current status of the articulation of COPEs. Such a responsibility implies that the JSC members will play an active role in the programme of WCRP, with specific members taking on roles and responsibilities for its projects and other activities, and with a view to paying particular attention to fulfilling the aims and objectives of WCRP through the implementation, monitoring and evaluation of COPEs.

It will be necessary to evaluate the progress of implementing COPEs and clear formulation of goals (short-, medium- and long-term), milestones, metrics and deliverables will be needed to enable this. One outcome of this will be a change in the nature of JSC sessions, especially with respect to reporting on each core project and other activities of the WCRP. JSC meetings will focus more on progress towards the main aims and objectives, with reduced emphasis on the verbal reporting of the wide range of research being performed in projects and activities, whilst discussing points that arise from the full written reports and recognizing that this research is necessary for the long-term development of climate science and contributes to future specific objectives for WCRP. In particular, there will be increasing focus on a few specific topics and issues each year where assessment and advice are needed from the JSC. In this context,

JSC-XXV (March 2004) decided that the first such cross-cutting topics to be presented and discussed, at JSC-XXVI (March 2005), should include: atmospheric chemistry and climate; sealevel rise; and, monsoons. Other initial suggestions have included ‘tropical convection’ and ‘global precipitation’, and further proposals are invited.

3.2 Core projects and other activities

The core projects and other activities of WCRP will remain central to its *modus operandi* and will continue to play an essential role in determining and pursuing the objectives of WCRP. Wherever possible, new experiments, studies, and observational activities will be carried out through the existing and evolving WCRP programme structure. Existing core projects and other activities will themselves develop and direct their scientific programmes and structures so as to enable them to make their full and proper contributions towards the adopted WCRPCOPES aims and objectives. With such a concentration, responsibilities among projects should become clearer and interactions stronger.

The JSC and the WCRP projects and other activities will need to work closely together to define more fully and implement COPEs. As part of the progress of WCRP towards its aims and the evolution of its programme, all projects are considering their end-dates in the period before 2015. WCRP already has a good record of concluding major core projects following their successful implementations (i.e. TOGA (1985-94), WOCE (1982-2002) and ACSYS (1994-2003)), and of initiating new follow-on projects (i.e. CLIVAR (2005) and CliC (2000)). See Appendices A and B for further details.

3.3 Modelling Panel

All the WCRP core projects have modelling working groups. The need for liaison between them, and also WGNE and WGCM, is sometimes tackled by cross-attendance or even meeting together. In recognition of the central role of modelling in COPEs, and the over-riding need for coordination of this activity, JSC-XXV (March 2004) approved the establishment of a WCRP Modelling Panel under the Chairmanship of Professor J. Shukla (JSC Member). Its prime role will be to coordinate and integrate modelling activities across WCRP with the purpose of meeting the WCRP objectives, especially in the context of COPEs. Its members will include specified JSC members, the Chairs of WGNE, WGCM, WGOA (see section 3.4) and the project modelling groups, and IGBP and IHDP will each be invited to provide a representative.

Draft terms of reference for the Modelling Panel are:

- a. to coordinate modelling activities across WCRP and facilitate collaborations where appropriate;
- b. to focus on the prediction and projection aspects of COPEs and effective use of coupled models for identification of climate system predictability;
- c. to liaise closely with the Working Group on Observations and Assimilation (WGOA, see section 3.4) on the requirements for and uses of observations in models (e.g. issues of data analysis, reanalysis, assimilation, model initialization, identifying observational gaps and deficiencies in relation to predictive skill and to understanding and parametrizing processes);

- d. to oversee data management in WCRP modelling activities;
- e. to liaise with the modelling activities of IGBP and IHDP.

The business of the Modelling Panel should be carried out by electronic means to the greatest extent possible, but it is expected that the Modelling Panel will meet, if required, about once per year, often co-located with another WCRP meeting. The Modelling Panel will report to the JSC.

3.4 Working Group on Observations and Assimilation (WGOA) of the Climate System

In recognition of the need as expressed in COPES to also provide a focus on and coordination of the observational aspect of WCRP's activities, JSC-XXV (March 2004) approved the establishment of a WCRP Working Group on Observations and Assimilation (WGOA) of the Climate System under the Chairmanship of Dr K. Trenberth (JSC Officer). The Atmospheric Observation Panel for Climate (AOPC), co-sponsored by WCRP and GCOS, and the Ocean Observations Panel for Climate (OOPC), co-sponsored by WCRP, GCOS and the Global Ocean Observing System (GOOS), are recognised as key parts of WCRP, especially in its essential close working relationships with both GCOS and GOOS. It is important to note therefore that the responsibilities and tasks of the WCRP WGOA should be fully complementary to, and closely interactive with, those of GCOS and GOOS, including especially the AOPC and OOPC, and also with the corresponding observational and assimilation groups and efforts within existing WCRP projects and other activities. Its members will include specified JSC members, representatives of project observational activities, the Chair of the WCRP Modelling Panel (see section 3.3), representatives from major reanalysis centres, and with the possible addition of other experts as necessary and appropriate.

Draft terms of reference for the WGOA are:

- a. to foster, promote and coordinate synthesis of global observations from the atmosphere, oceans, land and cryosphere, and for the fully-coupled system, through analysis, reanalysis and assimilation activities across WCRP, including the Modelling Panel (see section 3.3);
- b. to act as a focal point for WCRP interactions with other groups and programmes (e.g. WMO, IOC, GCOS, GOOS, GTOS, AOPC, OOPC, TOPC, JCOMM, IGBP, IGOS-P, CEOS, IPCC, etc) on observational requirements for WCRP and assist in optimization of observational strategies for sustained observations;
- c. to promote and coordinate WCRP information and data management activities, including development of web sites, in liaison with WCRP projects.

JSC-XXV (March 2004) approved that any further activities of the *ad hoc* WCRP Satellite Working Group should be part of the remit of the WGOA, including the need to maintain and develop further close and strong working relationships with space agencies.

The business would again be carried out by electronic means to the greatest extent possible, but it is expected that the WGOA will meet, if required, about once per year, often co-located with another WCRP meeting. The WGOA will report to the JSC.

3.5 Data management

Data issues will be important to both the Modelling Panel and WGOA, which will need to interact closely and collaborate with each other, as well as with the WCRP projects and other activities, to develop a comprehensive and workable data policy for WCRP. This must include mechanisms and structures necessary for management, stewardship and access of data, climate system data assimilation, synthesis and reanalysis, and model initialisation. The need to get observations of the wider climate system analysed and reanalysed in the context of models of the system is absolutely central to the COPES strategy. Where appropriate, these data issues will be tackled via expert study groups, workshops and conferences involving experts in: *in-situ* and space observations of the Earth system; assimilation and modelling of the coupled climate system; continued reanalysis of climate observations; and, dynamical prediction of weather and climate as an initial-value problem.

3.6 Other modes of working and organisational comments

- a. Many objectives will be squarely in the area of an ongoing component of a single core project or other activity. However, Workshops and Task Forces (or Limited-life Working Groups) drawing from across WCRP will be appropriate for achieving, or helping to achieve, other objectives.

A recent example of a workshop aimed at one of the suggested objectives was the WGNE/WGCM Workshop on Regional Climate Modelling (Lund, Sweden, March 2004). Another was the Workshop on Climate Feedbacks (Atlanta, USA, November 2002), which was held jointly between the GEWEX Radiation Panel (GRP) and WGCM, in order to foster development of integrative data analysis methods. This was in direct response to the JSC's recognition that the complicated and unresolved issues of clouds and their interactions with radiation and therefore the climate should be examined afresh and jointly by the GRP and the WGCM as a matter of urgency.

A proposed seasonal-prediction objective has already been accepted by JSC, and acted on as detailed in section 4. A workshop is planned on ocean data reanalysis for November 2004.

Other possible topics for Workshops to be held in the near future are:

- systematic errors in models;
- desert and arid region climate processes;
- ensemble techniques;
- sea level rise.

In some cases, these might be organised by, or lead to the establishment of, limited-term Task Forces.

- b. In practice, there is and will continue to be an iterative interplay between model predictions, evaluation against observations, and focused studies leading to model improvement. Evaluation of predictions against observations and model intercomparison experiments usually identify gaps in scientific understanding, such as the example above of the lack of

complete understanding of clouds and their interactions with radiation. Early recognition and clear enunciation of these gaps can result in focused study groups and/or process studies to improve our understanding and the subsequent representation of these processes in climate prediction models. To facilitate this process there must be both linkages to the Modelling Panel and to the WGOA and ensuring by the JSC that this interplay and evaluation takes place on a continuing basis. To this end, the JSC has approved early prediction experiments on the seasonal timescale to initiate this iterative process of prediction, evaluation, focused study and model improvement (see section 4).

- c. The programme of WGCM is central to the aims and objectives of WCRP. It was decided at JSC-XXIV (March 2003) that WGCM should remain a joint JSC/CLIVAR Working Group, but with a Vice-Chair recommended by the CLIVAR Scientific Steering Group. Its terms of reference should include the development and evaluation of coupled climate models.
- d. Recognising that variability on time-scales of both weeks and decades is important for WCRP but not clearly expressed in the terms of reference of any modelling group, JSCXXIV (March 2003) also requested that the CLIVAR Working Group on Seasonal-to-Interannual Prediction (WGSIP) should consider a broadening of its time-scales of interest to cover the range from weeks to decades, possibly changing its name to make this clear.

4. COPEs FIRST STEPS: WCRP TASK FORCE FOR SEASONAL PREDICTION (TFSP)

Following a decision at JSC-XXIV (March 2003), which recognised the importance of seasonal prediction as a specific objective under COPEs, a limited-term WCRP Task Force on Seasonal Prediction (TFSP) was established in August 2003, and is scheduled to function until March 2005. Following the general philosophy that new activities promoted under the COPEs framework should, wherever possible and appropriate, be done in, or led from, existing WCRP structures and activities, this TFSP is led by the CLIVAR WGSIP and has sought to draw on the expertise in all WCRP activities. The TFSP is chaired by Dr B. Kirtman, a Co-Chair of WGSIP, and a progress report was presented to JSC-XXV (March 2004). The prime aim of the TFSP is to determine the extent to which seasonal prediction of the global climate system is possible and useful in all regions of the globe with currently available models and data. To this end, an expert workshop to help assess the extent to which seasonal prediction is possible and to help identify the challenges that need to be addressed within the international framework and research agenda of the WCRP, was organised by Dr Kirtman and held over two and a half days, preceding the annual session of WGSIP, during the week 3-7 November 2003, in Hawaii. Several members of the emerging TFSP were able to participate fully in the expert workshop.

Following receipt and discussion of the first report of the TFSP, JSC-XXV (March 2004) requested that the TFSP should continue to develop and refine its proposal for a 'Total Climate Prediction Experiment'. In particular, the TFSP should:

- seek to broaden and strengthen the involvement of the WCRP core projects and activities and regional panels in the TFSP;

- develop a timeline for the proposed prediction experiment that takes full account of the opportunities of benefiting from and contributing to any complementary modeling activities in support of the IPCC Fourth Assessment Report;
- perform a rigorous evaluation of current seasonal prediction capability and skill as part of the total climate system prediction experiment;
- seek to embrace appropriate existing or planned national and international predictability and prediction experiments, in particular, SMIP2, and the EU-funded DEMETER project and its successor, the ENSEMBLES project;
- consider extending the range of possible predictability experiments to optionally include annual timescales, in the spirit of the COPEs principle of ‘seamless prediction’;
- ensure that appropriate data are archived to enable diagnostic studies of processes and errors;
- include an element of model evaluation, diagnosis and development in the implementation plan for the experiment, which should link directly with the projects with respect to process studies.

5. COPEs NEXT STEPS

The JSC and the WCRP activities (CliC, CLIVAR, GEWEX, SPARC (Stratospheric Processes and their Role in Climate), WGNE and WGCM) will work closely together to define more fully and implement COPEs. When formed, the prime roles of the Modelling Panel and the Working Group on Observations and Assimilation (WGOA) will be to co-ordinate the respective activities across WCRP and facilitate collaborations where necessary and appropriate, especially so as to ensure the crucial synergy between observational and modelling activities.

JSC-XXV (March 2004) decided to establish a Task Force, Chaired by the Vice-Chair of the JSC, for the further development of the COPEs strategic framework for the WCRP for the period 2005-2015. As an immediate and interim measure, Professor B. Hoskins, the outgoing Vice-Chair, and Dr J. Church, the newly-elected Vice-Chair, with effect from 1 April 2004, will act as Co-Chairs of this Task Force until JSC-XXVI (March 2005). In practice, Professor Hoskins will act as the lead Co-Chair until then.

The ‘COPEs Task Force’ will report to the JSC. Its proposed membership includes: 2-3 further JSC members; representatives from each of the core WCRP projects and other relevant activities including, ex-officio, the Chairs of the Modelling Panel and the WGOA; and additional experts as necessary and appropriate (e.g. persons experienced in operational prediction, in satellite observation programmes, or the funding and management of large international programmes).

Draft terms of reference for the COPEs Task Force are:

- a. to propose the organization and initial objectives of COPEs so as to exploit to the full the expertise of the WCRP projects and other activities and their abilities to:
 - analyze and describe the structure, variability and changes of the climate system;
 - improve understanding of the mechanisms, processes, and the natural and anthropogenic forcings of the climate system, and encapsulate this new-found understanding in models;

- provide the basis for prediction of the climate system (including extreme events), on time-scales of weeks to centuries, and on global to regional scales; and,
 - apply models to projections of anthropogenic climate change on global and regional scales, thereby enabling more realistic assessments of the related impacts;
- b. to report progress to the next WCRP Officers, Chairs and Directors Meeting (in or around September 2004) and to JSC-XXVI (March 2005), and make recommendations on how COPES should be developed further and implemented, including the coordination and responsibilities inside WCRP, the involvement of IGBP and IHDP, satellite agencies and modelling centres, the establishment of milestones and metrics for assessing progress, and the nature and level of (additional) resources required. If a COPES Advisory or Steering Group is envisaged, then terms of reference and membership should also be proposed.

A major international conference should be held, as part of the celebration of WCRP's twenty-fifth anniversary within the next two years, to 'launch' COPES publicly and to receive input to its further development and implementation.

6. CONCLUDING REMARKS

The JSC is proposing the strategic framework, Coordinated Observations and Prediction of the Earth System (COPES), for WCRP activities for the period 2005-2015. The aim of COPES is:

To facilitate prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society.

The proposed response to the new challenges and opportunities for WCRP outlined in this document, with its renewed emphasis and focus on the original main objectives of WCRP, and setting them in the context of COPES, is intended to provide a stimulus for the science of the WCRP community, and to widen the recognition of its relevance for a sustainable future. All past and existing WCRP activities have been conceived and developed with the help of a wide community of climate scientists. Comments and suggestions on this document and the proposals in it are welcomed from that same community and other stakeholders, so helping the JSC determine the shape and agenda of the new COPES.

APPENDIX A

WCRP CURRENT ACTIVITIES

A.1 Programme organization

The range of studies involved in climate research requires input from many scientific disciplines, and co-operation among governmental and non-governmental organizations and the academic community. Such co-operation is therefore formally recognised and promoted by the Agreement among the World Meteorological Organization (WMO), the International Council for Science (ICSU) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, which makes

the WCRP a collaborative undertaking of the three organizations. A WMO/ICSU/IOC Joint Scientific Committee (JSC) has the responsibility of formulating the overall scientific concepts and goals of the WCRP, as well as organizing the required international co-ordination of research efforts. The latter responsibility is undertaken with the assistance of a small permanent Joint Planning Staff, located in WMO, Geneva, and a few (currently four) International Project Offices dedicated to the WCRP core projects.

WCRP pursues its objectives through a number of large-scale research, observational and modelling projects, and related activities, focused on aspects of the climate problem that require international commitment, co-ordination and collaboration. This *modus operandi* is reflected in the current main WCRP core projects, namely: the Climate Variability and Predictability (CLIVAR) project; the Global Energy and Water Cycle Experiment (GEWEX); the Stratospheric Processes and their Role in Climate (SPARC) project; and the Climate and Cryosphere (CliC) project. Also, jointly with the International Geosphere-Biosphere Programme (IGBP), the Scientific Committee on Oceanic Research (SCOR), and the Commission on Atmospheric Chemistry and Global Pollution (CACGP), the WCRP cosponsors the Surface Ocean-Lower Atmosphere Study (SOLAS). Additionally, the development and application of comprehensive computer models of the full global climate system is a major cross-cutting, unifying and integrating theme running through the WCRP, pulling together and building on the scientific and technical advances achieved in each of the individual projects. All these projects have been conceived and developed with the help of a worldwide community of climate scientists.

A.2 Climate Variability and Predictability (CLIVAR) Project

CLIVAR is concerned with the natural variability of the coupled climate system and the changes in response to natural processes and human influences. A particularly important CLIVAR focus is on the role of the ocean in climate. As noted earlier, CLIVAR is the planned natural successor to both TOGA (1985-94) and WOCE (1982-2002) (see sections B.1 and B.2, respectively, of Annex B). CLIVAR addresses these issues on all climate timescales from seasons (monsoons) to centuries (anthropogenic influence).

The specific objectives of CLIVAR are:

- to describe and understand the physical processes responsible for climate variability and predictability on seasonal, interannual, decadal, and centennial time-scales, through the collection and analysis of observations and the development and application of models of the coupled climate system, in cooperation with other relevant climate research and observing programmes;
- to extend the record of climate variability over the time-scales of interest through the assembly of quality-controlled palaeoclimatic and instrumental data sets;
- to extend the range and accuracy of seasonal to interannual climate prediction through the development of global coupled predictive models;
- to understand and predict the response of the climate system to increases of radiatively active gases and aerosols and to compare these prediction to the observed climate record in order to detect the anthropogenic modification of the natural climate signal.

CLIVAR will help to answer questions such as:

- Will there be an El Niño next year?
- What will next summer be like in Asia and will the next monsoon there cause droughts or floods?
- What will the next winter be like in northern Europe, ‘warm and wet’ or ‘cold and dry’?
- How is the planet warming from human influences?
- How much sea-level rise will there be in the 21st century?
- Will there be more extreme weather events because of global warming, and will these be more intense and widespread?
- Could climate make a sudden switch?

CLIVAR has a particular focus on the world’s monsoonal systems. Specific advances in the past year include: preparation of an atlas of African climatology; establishment of an Indian Ocean Panel, jointly with IOC, to help drive forward the implementation of ocean observations in the region; and, the successful execution of the SALLJEX (South American Low-Level Jet Experiment) field campaign, which was a major contribution to the Variability of the American Monsoon System (VAMOS) project. Major studies of the role of the oceans in climate are also being organized, in particular: variability of the thermohaline circulation in the Atlantic; dynamics and predictability of the Atlantic inter-tropical convergence zone and its regional influences on climate; atmospheric forcing and upper-ocean teleconnections and feedbacks involving tropical sea surface temperature; the Kuroshio extension; and, Pacific upwelling. Increased emphasis is being placed on ensuring the application of CLIVAR results. To this end, the CLIVAR Working Group on Seasonal to Interannual Prediction is leading a major preliminary initiative under the WCRP Coordinated Observation and Prediction of the Earth System (COPES) strategy (see section 4 of the main text) to determine the extent to which seasonal prediction is possible and useful in all regions of the globe with currently available models and data. The First International CLIVAR Science Conference, Baltimore, USA, June 2004, will assess progress to date and identify continuing and new challenges for CLIVAR. A major topic of the Conference is how best to deliver the knowledge, products and information achieved by CLIVAR research to end-users, decision and policy makers.

The CLIVAR agenda of maintaining or developing the necessary observational systems (together with the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS)), process studies and modelling is also advancing at a healthy pace. Recent advances include the global expansion of the Argo profiling float network, transition of the WOCE Data Assembly Centres into CLIVAR, launching of an unprecedented number of satellites with ocean observing missions, and two new missions with ocean relevance that have been selected for further development.

A.3 Global Energy and Water Cycle Experiment (GEWEX)

GEWEX provides the scientific focus in WCRP for studies of atmospheric and thermodynamic processes that determine the global hydrological cycle and energy budget and their adjustment to global changes such as the increase in greenhouse gases. A crucial issue is: ‘Can the Earth provide adequate water resources for human and other requirements in the future?’. Related principal scientific questions to guide the international research effort are:

- is the rate of cycling of water through the atmosphere changing as a result of climate change?
- to what extent are variations in local weather, precipitation, and water resources responses to global climate change (rather than climate variability)?
- how well can precipitation be predicted on temporal and spatial scales of interest for hydrological applications?
- how can the cumulative outcome of wet atmospheric processes be accurately taken into account (parametrized) in weather forecasting and climate models?

Significant improvements in modelling and predicting precipitation have been realized from GEWEX research into land-atmosphere interactions and subsequently improved model parametrizations. However, in general, weather and climate models cannot predict precipitation accurately enough at present (both in spatial and temporal resolution) to be effective in many applications of water resource management. GEWEX research is now focusing on the wet processes and precipitation mechanisms and their representations in models to improve such model predictions.

GEWEX has now begun a new major phase of its implementation, aimed at a fully global description of the Earth's water cycle and energy budget, at the development of improved capabilities for forecasting of precipitation and for predicting changes in the water cycle associated with climate variability and change, and at the development of tighter links with the water resource and applications communities. An excellent illustration of this evolution is the development and implementation of a major new component of GEWEX and the wider WCRP, the Coordinated Enhanced Observing Period (CEOP). CEOP aims to collect a comprehensive data set (from *in-situ*, satellite and modelling sources), in order to achieve a global description of the various components of the water cycle for the years 2002-2004, as a basis for simulation and prediction experiments.

In the past year, CEOP has continued its main observation and data collection period, which started in October 2002 and will finish at the end of 2004. CEOP, in conjunction with other components of the WCRP, aims to assess the influence of continental heat and moisture sources and sinks on the global climate system. Data from the first CEOP enhanced observation period, July-September 2001, have already been archived at the CEOP Data Centre at the University of Tokyo, and the first composite products are available on the Internet. CEOP has been endorsed by the Integrated Global Observing Strategy Partnership (IGOS-P) as a pilot study contributing to the IGOS Integrated Global Water Cycle Observations Theme, for which WCRP has played a leading role. It might also prove to be an instructive preliminary campaign in the context of the emerging COPES strategy (see section 2.4 of the main text). Another major activity, sponsored by both GEWEX and CLIVAR, is the African Monsoon Multidisciplinary Analysis (AMMA) being planned as a follow-up to, and extension of, the earlier CATCH (Coupling of the Tropical Atmosphere and Hydrological Cycle) project. The other GEWEX continental-scale experiments continue to be pursued with increased coordination.

Monsoons are a global phenomenon and monsoonal precipitation is significant not only for the Asian-Australian region, but also for North and South America and West Africa. Monsoon onset, intraseasonal variability, withdrawal and prediction have great societal implications. GEWEX

continental-scale experiments and the related CEOP are providing data and a research focus to address these issues, in collaboration with the corresponding and complementary monsoonal studies promoted under CLIVAR.

A.4 Stratospheric Processes and their Role in Climate (SPARC) Project

The WCRP SPARC project has the objectives of investigating the influence of the stratosphere on climate and the coupled chemical, dynamical and radiative processes that control changes in the stratospheric circulation and composition, including particularly ozone depletion and increased penetration of ultra-violet radiation into the troposphere. SPARC continues its significant efforts in the detection of stratospheric trends, which could indicate climate change or could affect climate. In particular, SPARC studies of long-term changes of temperature, water vapour and ozone in the stratosphere have underlined that trends in one variable are closely linked to those in others, and that an integrated approach is required to understand stratospheric changes. It is generally acknowledged that the first decade of SPARC research has generated significant and important results and the project has received wide international recognition.

SPARC has recently elaborated new strategic areas of research, namely: the detection, attribution and prediction of stratospheric changes; stratospheric chemistry-climate interactions; and, stratosphere-troposphere coupling. Recent SPARC activities have been concerned with stratospheric indicators of climate change and their interpretation, various assessments and development of stratospheric data assimilation. In addition, SPARC has led to international efforts to identify and remedy deficiencies in the representation of the stratosphere in climate models. Through the analysis of observations and modelling, evidence has been obtained of a significant impact of stratospheric processes on tropospheric predictability. It has been possible to use the new generation of models to reproduce the appearance of the ozone hole in the polar stratosphere. New techniques for blending data from different sources have generated a basis for new assessments of stratospheric trends including the so far unexplained positive water vapour trend in the lower stratosphere. An assessment of stratospheric aerosol is due to be completed in 2004. A further new SPARC initiative will be an assessment of polar stratospheric clouds.

A critical issue is the change of atmospheric composition and its impact on climate. This has not yet been addressed sufficiently but plans are in place to combine the effort, experience and expertise in both WCRP and IGBP to move towards a better description of the role of atmospheric chemistry in climate change and the development of full chemistry-climate models. Jointly with the International Global Atmospheric Chemistry (IGAC) Project of IGBP, SPARC is supporting the development of a new system for verification of global climate models that have a comprehensive atmospheric chemistry module. Chemistry-climate interactions is the central topic of the third General Assembly of SPARC, Victoria, Canada, 1-6 August 2004.

A.5 Climate and Cryosphere (CliC) Project

The cryosphere comprises those portions of the Earth's surface where water is in solid form (i.e. all kinds of ice and snow and frozen ground such as permafrost). It is strongly influenced by temperature, solar radiation and precipitation and, in turn, influences each of these properties. It also affects the exchange of heat and moisture between the Earth's surface (land or sea) and the atmosphere, the clouds, the river flow, and the atmospheric and oceanic circulations. Parts of the

cryosphere are strongly influenced by changes in climate and may therefore act as early indicators of both natural and human-induced climate changes.

The new WCRP core project, Climate and Cryosphere (CliC), is a sequel to ACSYS (see section B.3, Appendix B) and aims to systematically enhance monitoring, understanding and modelling of complex processes through which the cryosphere interacts with the global climate system. Studies have already indicated recent significant changes in the Earth's cryosphere including: record low multi-year sea-ice extent in the Arctic Ocean, with lowest levels in September 2002 and 2003; extensive melting of the Greenland ice sheet since satellite observations began in 1980; break-up of the Larsen B ice shelf in the West Antarctic peninsula in 2002; and, the accelerated melting of mountainous glaciers on all continents. CliC is expected to cover several important gaps in global climate research and observations including investigation of the possibility of additional releases to the atmosphere of greenhouse gases from frozen soils. The first CliC Science Conference will be held in Beijing, China, 11-15 April 2005.

International research projects like CliC (and ACSYS) not only improve our knowledge of local and global factors of global change but also cover a wide set of temporal scales. Ongoing changes in the Arctic are relatively rapid in climate terms. However, changes in Antarctic and Greenland ice sheets are happening on a timescale of thousands of years. Both short- and long-term predictions of climate change are impossible without at least adequate account of cryospheric processes. Prediction of sea-level rise is another factor of crucial relevance for the IPCC assessments. CliC has an important contribution to make here since a significant fraction of the sea-level rise is likely to be due to the melting of grounded ice. Other global issues of relevance to CliC include: thermohaline circulation (freshening of outflows into the North Atlantic); changes in the Southern Ocean circulation; snow and ice albedo feedbacks; accurate description and representation in models of climate for the regions with permafrost and snow cover; advances in measurement and analysis of solid precipitation.

Since 1995, WCRP has been supporting its International Programme for Antarctic Buoys (IPAB). This has proved its high value in filling gaps in surface meteorological observations in the Southern Ocean. Further, recent assessments have shown that IPAB buoys have helped to reduce uncertainties in the analysis of mean-sea-level pressure in that region and created a significant positive impact on the accuracy of satellite altimetry. All appropriate parties are encouraged to support this programme by co-ordinated deployment of drifting buoys, which report their observations through the WMO Global Telecommunication System.

Through the leadership of CliC, WCRP is also contributing significantly to the planning of the International Polar Year 2007/08 in which climate research and related observations are expected to form a major part.

A.6 Climate Modelling

The development of comprehensive global climate models, building on the scientific advances in the WCRP projects and other activities, is an essential unifying theme running through WCRP. Such models are the fundamental tools for understanding and predicting natural climate variations and for providing reliable estimates of anthropogenic climate change. WCRP activities in this area are centred on two main groups: the joint WMO Commission for Atmospheric Sciences/JSC Working Group on Numerical Experimentation (WGNE) and the JSC/CLIVAR

Working Group on Coupled Modelling (WGCM).

Efforts continue to be devoted to a wide range of internationally-coordinated model intercomparison exercises as a means of identifying errors in climate simulations and to find ways of reducing errors. In particular, coupled (ocean-atmosphere) model intercomparison projects have been organised, and standardised experiments with coupled models are being undertaken, which should help in reaching consensus on climate change. The results produced by these activities in WCRP have been a key input to all the IPCC Assessments. WCRP will continue to strive to further reduce the uncertainty of global change predictions and to broaden the scope of considered properties thus producing a sounder scientific basis for decision making in all areas where adequate management is dependent on the current and future state of the environment. In particular, the closer collaboration established with the Global Analysis, Integration and Modelling (GAIM) element of IGBP is working well, especially in respect to the organisation of the Coupled Carbon Cycle Climate Model Intercomparison Project (C4MIP). Also, the Second Coupled Model Intercomparison Project Workshop was held in Hamburg, Germany, in September 2003. Other studies include assessing the dependence of errors in atmospheric models on their basic dynamical cores.

A.7 Climate data

A prerequisite to designing and implementing a comprehensive, integrated and sustained global climate observing system is to identify the principal uses and users of the observations in order to justify such a costly, long-term, internationally collaborative operation. Such uses are:

- monitoring the climate in order to quantify natural climatic fluctuations on a range of temporal and spatial scales and to detect climate change;
- attribution of climate change to particular causes, in particular to human-related causes;
- detection (and attribution) of the environmental impacts of climate change;
- diagnostic studies to advance understanding of the behaviour of the climate system and its components, including the mechanisms of natural climate variability;
- development and testing of hypotheses relating to local and global climate variations and to the degree of predictability of climatic phenomena;
- process studies. Special data are needed for detailed research into a wide variety of complex dynamical, physical, chemical and biological processes, which help govern the state and evolution of the climate system. These often need to be highly resolved in time and space and therefore gathered for a limited period over a restricted area. Note, however, that continuous global data sets provide an excellent and often necessary context for the more focused process-study field campaigns;
- a wide range of uses for climate models, including boundary conditions, initialization, data assimilation, and validation, leading to their improvement, including for seasonal-to interannual climate predictions. A very wide array of observations of all elements of the climate system is needed for these highly-specialised and important purposes.

Since it began in 1980, the WCRP has been both a major user and provider of climate data and products and one of the main drivers in the planning and development of new Earth Observation instruments, surface-based experiments and satellite missions. Climate research requires not only exploratory and often short-lived observational field experiments and satellite missions to improve understanding of climate processes, but also long-term monitoring programmes

(including analysis, re-analysis cycles) essential to assess the characteristics of the present climate, for use in experimental climate prediction studies, and to detect natural and human-induced climate trends. Future satellite instrumentation will produce very large quantities of new, more detailed and better quality information on the usual meteorological and oceanographic state variables, aspects of the land surface and atmospheric composition. At the same time the *in situ* observational capability is increasing in its possibilities, but not necessarily in its execution. The Argo initiative, an outgrowth from the global array of WOCE subsurface floats, will routinely provide a large increase in the detailed information about the ocean outside the area of sea-ice cover.

An important context for the observational aspects of WCRP is the Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC (GCOS-82, WMO/TD No.1143, April 2003), which gives lists of specific and detailed requirements for essential climate observations for the atmosphere, oceans and land, and a corresponding list of variables that depend heavily on satellite observations. The report concludes that although there have been recent improvements in implementing the global observing systems for climate, especially in the use of satellite information and the provision of some ocean observations, nevertheless, serious deficiencies remain: e.g. atmospheric networks are not operating with the required global coverage and quality; ocean networks lack global coverage and commitment to sustained operation; global terrestrial networks are not fully implemented. Note that satellite data are still not being analyzed and therefore exploited to a sufficient degree. The report also prescribes twenty ***GCOS Climate Monitoring Principles***. The ‘ten basic principles’ were adopted by the UNFCCC in 1999. Ten further principles are aimed specifically at satellite systems. A widespread, disciplined adherence to these principles is necessary to achieve the homogeneous climate record needed for future use, especially for assessing climate change. The ‘Second Adequacy Report’ also concludes that internationally-coordinated reanalysis activities need to be enhanced and sustained by the involved Parties to meet the requirements for monitoring climate trends, to establish ocean reanalysis for the recent satellite era, and to include variables related to atmospheric composition and other aspects of climate forcing.

Observations from satellites require some special considerations. Since it began in 1980, WCRP has been a major user of satellite data and one of the main drivers in the planning and development of new Earth Observation (EO) instruments and space missions. In particular, a prime practical aim of WOCE was the development of improved ocean models for use in climate studies, but this was envisaged within the context of collecting global *in situ* and satellite data sets to validate and initialize these models. The required revolutionary satellites were launched in the early 1990s. ERS-1 was launched in 1991 and Topex-Poseidon was launched in 1992 and still operates successfully today. A WCRP *ad hoc* Satellite Working Group has produced an ‘Update of Space Mission Requirements for WCRP’ (January 2003, with further comments in October 2003), which highlights priorities for future space missions and related data management. In particular, the second report (October 2003) of this Working Group has emphasised the needs for a reanalysis of climate-related data sets making full use of all available satellite-borne sensors over the last 20-30 years.

The WCRP was represented at the first Earth Observation (EO) Summit, 31 July 2003, and at the inaugural session of the *Ad Hoc* Group on Earth Observations (GEO-1), 1-2 August 2003, both held in Washington D.C. In particular, an invited short paper ('The Need for a Comprehensive, Integrated and Sustained Climate Observational System') was submitted to the EO Summit. WCRP remains directly involved with the GEO process, especially through two of the five subgroups that GEO-1 initiated, namely, User Requirements and Outreach, and Data Utilization.

A.8 Surface fluxes

Quantitative analysis and understanding of the underlying physical mechanisms as well as intercomparison and validation of surface energy and mass fluxes are needed in a wide range of WCRP projects. In particular, in recent years a major study and workshop on air-sea fluxes was conducted by a joint WCRP/SCOR Working Group on Air-Sea Fluxes, which provided a comprehensive assessment of physical parametrizations and available flux products from different sources, including both *in situ* and remotely-sensed observations and from analyses produced by numerical weather prediction models. WCRP's continuing interests in surface fluxes are now being served by its co-sponsorship of SOLAS (see section B.1) with its focus on the physical and biogeochemical fluxes at the air-sea interface, and by the formation of a new WCRP Working Group on Surface Fluxes, which deals with WCRP's wider requirements and efforts on all relevant fluxes resulting from the interaction of the atmosphere with the underlying surface of whatever type.

A.9 Reanalyses

WCRP is a strong advocate of multi-year reanalyses of the atmospheric circulation with state-of-the-art assimilation/analysis schemes. Several operational and research centres are now conducting major reanalysis projects, in particular, ECMWF in Europe, NCEP, NCAR and DOE in the USA, and the Japan Meteorological Agency. Such reanalyses are essential for a wide range of climate diagnostic studies in support of not only WCRP-related research, but also many operational services and applications and are highly sought after and used by the international research and operational communities. The comprehensive, now 45-year (1957-2002), ECMWF reanalysis (ERA-40) was completed in April 2003 and a wide range of ERA-40 products are now available on the Internet. Also, the Japan Meteorological Agency's 25-year reanalysis (JRA-25 for 1979-2004) is progressing well.

In addition, there is a growing need and interest within WCRP to encourage, promote and coordinate other types of major reanalyses, specifically, for the oceans and for special regions such as the Arctic. In particular, a major ocean reanalysis would produce a potentially very effective long-term time series for studies of ocean climate variability worldwide.

A.10 Earth System Science Partnership (ESSP)

The essence of WCRP science is understanding, observation, quantification, prediction and projection of the climate system. Whilst WCRP research has a firm foundation in the physical system it is increasingly concerned with the more complete climate system that includes the two-way interactions with the chemical and biological systems and, more widely, with the effect of human activities upon the global climate and other global environmental changes. In this context,

significant progress is being made under the banner of the Earth System Science Partnership (ESSP), which was initiated by WCRP, IGBP, IHDP and DIVERSITAS (an international programme of biodiversity science) following the successful Global Change Open Science Conference, 'Challenges of a Changing Earth', Amsterdam, July 2001. The Proceedings of that conference, edited by W. Steffen, J. Jäger, D. J. Carson and C. Bradshaw, were published by Springer, 2002. The ESSP has been established to further the integrated study of the Earth system, the changes that are occurring to the system, and the implications of these changes for global sustainability. At this early stage of its development, the ESSP is undertaking three types of activity: joint projects; regional activities; and, global change open science conferences. The first four ESSP joint projects focus on: the global carbon cycle; food systems; the global water system; and, global environmental change and human health. In each case, the goal is to identify the challenges caused by global change, understand the implications of human-driven change, and build a research agenda of direct relevance for societies. A milestone in the evolution of the ESSP was the publication of the Science Framework and Implementation document of the Global Carbon Project (2003) as the first 'ESSP Report'.

A.11 WCRP support of the Intergovernmental Panel on Climate Change (IPCC)

The JSC intends to reinforce the WCRP's efforts in the research priority areas signalled in the IPCC Third Assessment Report (especially those listed under modelling and process studies), and is actively seeking improved and more direct involvement with IPCC to identify additional issues that might be taken up by the WCRP. It is a prime intention of the JSC to achieve better integration of the IPCC requirements with the research performed under the WCRP. In particular, the JSC is keen that relevant expertise and results from WCRP activities should be made available in the preparation of the IPCC's Fourth Assessment Report (AR4).

A.12 Development of climate research capabilities at regional level

The WCRP continues to promote the development of regional climate research capabilities through the active involvement of scientists worldwide in its activities in order to meet its scientific challenges and to deliver research results relevant to the entire global community. In particular, WCRP has achieved this through: the GEWEX continental-scale experiments being conducted in Africa, Asia, Australia, the Americas, and Europe; through the 40 plus active reference sites associated with the CEOP, which has extended the geographical distribution of experimental sites related to the continental-scale experiments; and through the major CLIVAR studies of monsoon systems in Africa, the Americas, Asia and Australia. Also, WCRP continues to co-sponsor the global change SysTem for Analysis, Research and Training (START), in partnership with IGBP and IHDP, and is seeking to strengthen its links with other organizations (e.g. the Asia-Pacific Network (APN) and the Inter-American Institute for Global Change Research (IAI)) involved directly with developing scientifically-relevant research networks in developing countries but within the limits of available resources and with due regard to the full range of WCRP priorities.

APPENDIX B

WCRP ACHIEVEMENTS

During the 25 years of its existence, WCRP has enabled many achievements consistent with its aims, especially by advocating and coordinating research programmes among nations.

B.1 Tropical Ocean and Global Atmosphere (TOGA) Project

The WCRP TOGA project (1985-94) established the physical basis for the understanding and predictions of El Niño temperature signals and associated changes in the global atmospheric circulation from a season to a year in advance. This was a major breakthrough in (operational) seasonal forecasting and the TOGA project is widely recognized as being the first major success of the WCRP. The substantial progress it achieved is reflected in the present skill levels in seasonal-to-interannual predictions. In particular, it provided:

- improved physical understanding of the climate system. A new depth of understanding of the El Niño Southern Oscillation (ENSO) phenomenon was achieved; theoretical models for the mechanism of ENSO were proposed, and the relationships between tropical sea surface temperature (SST) perturbations and the atmospheric response in middle latitudes began to be unravelled;
- a new capability to measure the upper ocean, using both enhanced *in situ* observations and remotely-sensed measurements, particularly for the previously poorly-sampled tropical Pacific;
- the development of increasingly realistic coupled ocean-atmosphere models particularly of the tropical Pacific Ocean, some of which now demonstrate skill in predicting tropical SSTs months to a year or so in advance; in particular, the predictability of El Niño (at least on some occasions) has been demonstrated;
- the availability of long (in many cases multi-decadal) data sets with stringent quality control, in particular for global SSTs and reanalyses for the atmosphere; and
- more-advanced techniques, not only for providing observations but also for their analysis and assimilation into atmospheric and ocean models.

In 1998, the American Geophysical Union published nine extensive review articles summarising the development of knowledge and capabilities during the TOGA project. These were reprinted from the *Journal of Geophysical Research*, in a special issue entitled, ‘The TOGA Decade: Reviewing the progress of El Niño research and prediction’, and edited by D. L. T. Anderson, E. S. Sarachik, P. J. Webster and L. M. Rothstein.

B.2 The World Ocean Circulation Experiment (WOCE)

A recent highlight of WCRP was the successful conclusion of the World Ocean Circulation Experiment (WOCE), the oldest of WCRP’s projects, which was formally completed at the end of 2002. Through its planning, observational and analysis phase, WOCE lasted two decades and was by far the biggest and most successful global ocean research programme to date. Its legacy includes: significantly improved ocean observational techniques (both *in situ* and satellite-borne); a first quantitative assessment of the ocean circulation’s role in climate; improved understanding

of physical processes in the ocean; and, improved ocean models for use in weather and ocean forecasting, and in climate studies. In particular, it is most commendable that within four years of the last data being collected, the WOCE data resource (about 20 Gbytes) had been quality-controlled and freely distributed on DVDs and via the Internet. WOCE results are documented in almost 1800 refereed publications, a highly-regarded 'WOCE book', 'Ocean Circulation and Climate: Observing and Modelling the Global Ocean', was published in 2001 (edited by G. Siedler, J. Church and J. Gould, Academic Press, 2001), and a four-volume WOCE Atlas is near to completion. Much remains to be done in the exploitation of WOCE observations and in the further development of schemes to assimilate data into ocean models. These aspects of ocean research and model development are now being incorporated, as planned, into the WCRP Climate Variability and Predictability (CLIVAR) project, which was designed as the successor to both the TOGA project (1985-94) and WOCE (1982-2002).

B.3 Arctic Climate System Study (ACSYS)

Another recent highlight was the successful completion of ACSYS, which was established in 1994 to better understand the role of the Arctic in the global climate system. It has examined the complex, interrelated pieces of the Arctic climate puzzle, to find out how delicately balanced the Arctic climate system is, and to ascertain its role in global climate change. It has addressed such questions as: what are the roles of Arctic Ocean water and sea-ice in driving the deep Atlantic Ocean circulation; what are the global consequences of natural or human-induced changes to Arctic climate; is the Arctic climate system as sensitive to increased greenhouse gas concentrations as climate models suggest? ACSYS finished with a final international science conference, 'The ACSYS decade and beyond', held in St. Petersburg, Russia in November 2003. The achievements of the 'ACSYS decade' include: creation of a basis for improved numerical simulations and reanalysis studies of the complex system involving polar atmosphere, oceans, sea-ice, and land; active deployment of sea-ice based drifting buoys by the International Arctic Buoy Programme, declassification of a large number of submarine sea-ice observations, deployment of moored sonars, intensification of ship-based studies generation of new satellite products, and collection and upgrading of circumpolar data sets; providing a rationale for maintaining meteorological observing networks in remote locations; stimulation of enhanced regional (Arctic) process studies; intercomparison projects which have led to advances in modelling of the polar environment and created a better basis for projections of amplified impact of the climate change in the polar region (an important aspect of the IPCC assessments).

B.4 Global Energy and Water Cycle Experiment (GEWEX)

The completion of the first phase of GEWEX was celebrated at its fourth International Scientific Conference, held in Paris in September 2001. GEWEX Phase I accomplishments include 10-25 year global datasets of clouds, precipitation, water vapour, surface radiation, and aerosols. These have served as a first global reference for such fields, indicating some regional variability. Also, implementation of improved land-surface and cloud parametrizations in most regional and global weather forecasting and climate models has led to improved representation and prediction (in operational models) of precipitation. Initial results from the first five major GEWEX continental-scale experiments have made progress towards the closure of the regional water and energy budgets and are helping determine the importance of 'recycling' and diurnal processes for regional predictions. The GEWEX global data sets, which now cover up to 20+ years make use

of both *in situ* as well as remotely-sensed data, with a major participation of environmental satellite agencies, and support the assessment of present climate and the validation of climate change models. The GEWEX continental-scale experiments have been extended in order to document most major climate patterns, and now include semi-arid regions in Australia and the Sahel. These continental-scale experiments enable the comprehensive modelling and evaluation of the components of the water cycle over large river basins. Throughout its Phase I, GEWEX scientific results have led to over 20 special issues of respected journals, a dozen or so review articles, over 5000 citations and the widespread distribution of over 5000 CD-Roms of GEWEX data.

B.5 Stratospheric Processes and their Role in Climate (SPARC) Project

SPARC was established as a WCRP project in 1992. Its major achievements to date include the careful assessments of trends in stratospheric temperature, vertical distribution of ozone, and upper tropospheric and stratospheric water vapour, and their inter-relationships. Of particular note in this context was the award of the Norbert Gerbier-MUMM International Award for 2003 to an international team of 17 SPARC scientists for their paper, 'Stratospheric temperature trends: observations and model simulations' (V. Ramaswamy et al., *Reviews of Geophysics*, 39, 71-122, 2001). SPARC has also provided much needed input to the WMO ozone and IPCC climate assessments and has fostered the expertise needed to do so. This type of basic information is necessary for any future scenarios and decisions, international and national assessments and strategy developments, especially in the light of the 'ozone hole' surprise.

B.6 Climate-change assessments and projections

Improved understanding of key climate processes has led to significantly improved climate models, and also operational weather and ocean forecasting models. Co-ordinated data analyses and climate model simulations provide the basis for our understanding of natural climate variability. In particular, improved modelling of the coupled physical climate system through systematic model diagnoses and intercomparisons has provided increasingly accurate simulations and predictions of natural climate variations, giving more confidence in models and their projections of human-induced climate change. Such results feed directly into the scientific assessments of the IPCC and contributed significantly to the conclusion in the IPCC Third Assessment Report that, '**there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities**'. In turn, the IPCC assessments provide the most authoritative, up-to-date scientific advice needed to inform the UNFCCC. In this way, WCRP has helped provide the direct scientific underpinning of the political process. WCRP will continue to play a most important role in helping to provide increasingly reliable climate-change scenarios and making them (and their likely consequences) immediately available (by various means) to decision makers, the media and the general public. These are critical contributions to deliberations on sustainable development.

B.7 Observations and global data sets

Comprehensive field measurements and the provision of essential global and regional climatological data sets are major components of all WCRP projects. Some of these have evolved into new operational climate observational and data collection systems. In particular: the

buoy array in the tropical Pacific is crucial for monitoring and for initialising model predictions of ENSO events; systematic observations of the ocean's three-dimensional structure, combined with satellite altimetry have provided the basis for establishing key elements of a Global Ocean Observing System (GOOS) and, in turn, also the Global Climate Observing System (GCOS). Indeed, the on-going Argo initiative for a worldwide network of operational ocean profiling floats is a direct outgrowth from the global array of subsurface floats that was established in WOCE.

B.8 Atmospheric reanalyses

WCRP has provided strong support for the initiation and execution of atmospheric reanalyses projects. Such activities are now well established, with the completion of the 45-year ECMWF reanalysis (ERA-40), the NCEP regional reanalysis covering the period 1979-2003 over the USA, and the commencement of the Japan Meteorological Agency's 25-year reanalysis for 1979-2004. Two major WCRP International Conferences on Reanalyses were held, which highlighted the value of reanalyses for an impressive range of studies and applications.

B.9 Public awareness

It was the international community of physical climate scientists that alerted the world to the reality of global warming, the prospect of anthropogenic climate change and its consequences. It is this same community that has determined the most likely causes of the recent global climate change and which has the capability to provide increasingly reliable climate-change scenarios, which are crucial for many aspects related to planning for sustainable development. WCRP has helped bring such climate-related issues to centre stage by carrying out policy-relevant science and raising the level of scientific, governmental and public appreciation of the importance of climate issues, through fostering much greater cooperation between hitherto distinct scientific disciplines in understanding the whole climate system.

B.10 Capacity building

WCRP has enabled scientists from countries with less developed scientific programmes to contribute to the global programme and to build up their research capability. The global change SysTem for Analysis, Research and Training (START) has been established by the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP), and WCRP, to foster capacity building activities in developing countries, and thereby help them to become partners in international global change research.

APPENDIX C

THE DEVELOPMENT OF A NEW STRATEGY FOR WCRP

C.1 The JSC Chair's address in 1997

In his address on 'The WCRP strategy and future challenges', to the Conference on the World Climate Research Programme: Achievements, Benefits and Challenges, Geneva, August 1997 (WMO/TD-No.904, June 1998), Professor W. L. Gates, then Chairman of the JSC for the WCRP, characterized the WCRP up to that point by its coordination of the acquisition of observational data, its contributions to short- and extended-range weather prediction through the improvement of atmospheric models, its development of coupled atmosphere-ocean and sea ice models, its determination of the feasibility of El Niño forecasts, and its coordination of a wide variety of climate change experiments. Further, he foresaw the thrusts of the WCRP over the following decade being focused on: fostering the development of increasingly complex coupled models of the interacting physical, chemical and biological components of the climate system; coordinating the development of a data and modelling infrastructure that would promote the construction, diagnosis and distribution of both global climate datasets and global climate models; promoting the development of the scientific basis for the prediction of regional climate anomalies on interannual to centennial timescales; and coordinating research on the detection and attribution of anthropogenic climate change. Achieving these goals would require cooperation across WCRP projects and of other international programmes, especially the International Geosphere-Biosphere Programme (IGBP).

In this 'long-range vision' for WCRP, Professor Gates also articulated the challenges lying beyond, say, 2010, involving the establishment of operational systems for the delivery and management of useful climate information in the broader context. In this time frame it was anticipated that comprehensive Earth system models would become available, and that operational climate observing and prediction systems would be established. It was also envisaged that these tools would permit the operational prediction of climate impacts and the integrated assessment of optimum societal responses. This would require the International Human Dimensions Programme on Global Environmental Change (IHDP) and other programmes to play increasingly important roles, while WCRP and IGBP would continue to refine the underlying scientific foundation.

It should be emphasised that WCRP research and results are already of direct relevance to many key aspects of sustainable development, including: food systems, water resources, natural disasters and extreme weather events, natural resources and biodiversity, desertification, health and diseases, sea-level fluctuations, and climate-change scenarios. However, in order to maintain, strengthen and broaden the application of WCRP results in the future, it is necessary to address new challenges and exploit new opportunities. In the process, to quote Professor Gates, the JSC needs to ensure that WCRP becomes 'a more effective, a more coordinated, and a more relevant programme'.

C.2 The discussion towards the strategic framework, COPEs

To this end, the JSC-XXIII (March 2002) began a major strategic and programme-wide review of the overall development and structure of WCRP scientific activities taking into account emerging new issues and challenges. Whilst acknowledging the tremendous progress made within the individual components of the WCRP in observing, diagnosing, understanding, modelling and predicting the components of the physical climate system, the JSC has recognised that, in order to accomplish the original objectives and the subsequent specific tasks of the WCRP, it is essential that all the components of the WCRP keep working jointly and more closely through a coordinated and comprehensive programme of observational, modelling and process research, which is clearly focused on stated overall goals.

In that context, a proposal was put forward at JSC-XXIII (March 2002) by Professor J. Shukla that WCRP should develop a comprehensive interdisciplinary project on predictability and prediction of seasonal-to-interdecadal variations at regional and global scales. The practical motivation was that society needed to know what was and was not predictable, and economists required quantitative information on predictability. At that same JSC session, Dr K. Trenberth gave a presentation on “the need for a climate observing system”. Stimulated by these presentations and extensive in-session discussion, the JSC formulated a proposal for a new “banner” for the WCRP entitled a Predictability Assessment of the Climate System, and whose aim would be to achieve major steps forward in climate prediction. It also established a Task Force composed of Professor B. Hoskins (Vice-Chair of the JSC), Professor Shukla and Dr J. Church to develop ideas and proposals for implementation of a WCRP predictability assessment, including consideration of the changes that might be needed in the organization of the WCRP. The Task Force reported to the next session of the JSC (JSC-XXIV, March 2003) at which considerable further time was dedicated to: discussion of this crucial prospective advance in WCRP; review of the status of relevant research and the contributions expected from existing WCRP projects and activities; formulating decisions on the future strategy; and outlining a vision for WCRP after 2010.

The proposal produced by the said Task Force for a new WCRP-wide Predictability Assessment of the Climate System was debated thoroughly at JSC-XXIV (March 2003), resulting in significant decisions for the future scientific direction and structure of WCRP. In particular, the two original major objectives of the WCRP were again re-affirmed, namely, to determine to what extent climate can be predicted and the extent of human influence on climate. Those remain the general mission statement for WCRP and are consistent with the longer-term vision of ‘seamless prediction’, from weeks through decades to the longer-term projection of climate change. Variability on all shorter times scales, including the weather, is important both for its impact on the longer time-scale behaviour and because its statistical behaviour is a crucial part of the longer time-scale prediction. Increasingly, climate projection also will become an initial-value problem. To meet these aspirations and needs and, in particular, in recognition of the renewed emphasis in WCRP on its prediction aims and the observational activities that are needed to fulfil them, JSC-XXIV (March 2003) decided to develop a major overarching and integrating framework, then tentatively called the ‘Climate system Observation and Prediction Experiment’, to be implemented over a decade up to about 2015. Substantive further deliberations took place within a limited sector of the WCRP community throughout 2003, in order to explore and develop the rationale and concept of the proposed activity, as perceived at JSC-XXIV (March 2003), in the

broader context of: WCRP objectives and research aims; WCRP's main achievements to date; current WCRP core projects and related activities; and, the JSC's responsibility to formulate the overall scientific concept and science goals of WCRP, with a particular requirement to look to the future. Further substantial discussions took place at, and immediately following, JSC-XXV (March 2004) and led to the JSC's decision to establish a Task Force for the further development of the re-focused and re-named strategic framework, Coordinated Observation and Prediction of the Earth System (COPES), which is posed in this document.

APPENDIX D

Tentative list of specific WCRP objectives within the strategic framework for COPES (with reference to section 2.3 of the main text)

1. Determine the feasibility and expected skill of seasonal climate prediction in all regions of the globe with currently available models and data (this should be repeated regularly).
2. Further develop and test the techniques for ensemble prediction of climate variability and change
3. Determine the scientific basis for, the best approaches to, and current skill of projections of regional climate change at several time-scales
4. Develop well-tested, detailed chemistry-climate prediction and projection models and related procedures (with the International Global Atmospheric Chemistry (IGAC) project of IGBP)
5. Produce realistic simulations of an Ice Age Cycle using general circulation models (in cooperation with the Past Global Changes (PAGES) project of IGBP)
6. Focus on reducing the range of uncertainty of climate sensitivity exhibited by models
7. Further the understanding of arid and desert climates and focus on the skill of climate predictions for them
8. Improve the understanding of monsoon climates worldwide and determine their predictability
9. Collaborate with IPCC Working Group 1 so as to enable the science that it will review in its Fourth Assessment Report (AR4)
10. Determine how, why and where modes of climate variability change in response to anthropogenic forcing and longer-term climate change caused by it
11. Assess the extent to which intraseasonal oscillations are predictable in coupled models
12. Determine the space-time scales on which the ocean temperature, salinity and circulation can be predicted
13. Increase the accuracy in projections of sea-level rise
14. Encourage and promote coordinated reanalyses of the components of the climate system, with regular, coordinated updates

7.1.3 Scientific Committee on Antarctic Research (SCAR)



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1 July 2004

Dear Bob,

Now that the annual SCOR meeting is approaching I thought it would be timely to bring you up to date on our thinking about how best to continue to develop the linkages between SCAR and SCOR. SCAR continues to be very keen to collaborate with SCOR in Southern Ocean activities, and I found it very useful to participate in the last SCOR Executive Committee meeting, in Moscow, and to explore possible joint activities with you there.

As you know, we now have our first Executive Director in place. Colin Summerhayes joined us from IOC at the beginning of April. I am appointing Colin to be the SCAR Liaison to SCOR. In that context he will represent me at the SCOR Executive Committee meeting, to take forward joint SCAR and SCOR initiatives.

Since the Moscow meeting, our two organisations have made a significant step forward in developing the concept of a Coordinating Group on Interdisciplinary Southern Ocean Science (ISOS) that would be jointly sponsored by SCAR and SCOR. We had hoped that the Intergovernmental Oceanographic Commission (IOC) might wish to join the group, but it seems from their recent Executive Council meeting that this will not be possible – at least not in the immediate future. Never mind, there is much work to do and SCAR and SCOR can begin right away by doing it together as partners. Indeed, we have a fine opportunity to do so through the meeting that SCOR has organised in Venice for a few days immediately preceding the SCOR Executive Committee session in September. I do hope that ISOS can be on the agenda for that meeting. Colin Summerhayes will represent SCAR in the ISOS group, and would be delighted to discuss ISOS on our behalf during that meeting. Given the absence of IOC from the equation, I would like to propose that Colin Summerhayes and Ed Urban re-work the text of the current ISOS document so that it focuses on the roles of SCAR and SCOR. The revised document could then form the basis for discussions in Venice.

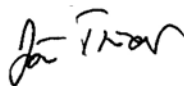
SCAR is happy to accept your suggestion that Julie Hall and Laurent Labeyrie be SCOR liaisons to SCAR, and that they be appointed as members of SCAR's Action Group on Oceanography. The Action Group's meeting last year, in Rome, was attended by Roberto Purini on behalf of SCOR. It was at that meeting that the concept of ISOS was fleshed out, and we are indebted to Roberto for his efforts. Within SCAR we are considering the possibility that the Action Group (which is a body dealing with short term needs) should be converted to an Expert Group (which is a body expected to deal with longer term requirements in the 6 to 10 year time frame). This question will be considered during the meetings of the SCAR Standing Scientific Groups, which meet in Bremen on July 29-30.

Those meetings are associated with the first SCAR Open Science Conference, which takes place in Bremen from the 26-28th of July. I do hope that you (and/or the SCOR liaisons to SCAR) can join us for the Conference – not least because the Southern Ocean will feature prominently on the programme (you can access the programme and abstracts on the Web at <http://www.scar28.org/SCAR/openScience.html>).

SCAR is focusing on the development of 5 major scientific research programmes as its flagships for the future. These are now in the final stages of development. The oceans are important in three of them: (i) Antarctic Climate and the Global System (ACGS); (ii) Cenozoic Antarctic Climate Evolution (CACE); and (iii) Evolutionary Biology of Antarctica (EBA). We hope that SCOR will be able to advise us on the development and implementation of these long-term programmes.

Let me conclude by wishing you a successful Executive Committee meeting, preceded by a successful oceanic research coordinating meeting, in Venice in September. I am sorry I cannot be with you on this occasion, but I can assure you that SCAR will be well represented.

With best wishes



Jorn Thiede

Ct: C.Summerhayes (SCAR), E.Urban (SCOR)

7.1.4 Scientific Committee on Problems of the Environment (SCOPE)

7.2 Affiliated Organizations

7.2.1 International Association for Biological Oceanography (IABO)

7.2.2 International Association for Meteorology and Atmospheric Sciences (IAMAS)

International Association of Meteorology and Atmospheric Sciences Report for the 2004 SCOR Executive Committee Meeting

Since the very successful IUGG2003 General Assembly in Sapporo, at which IAMAS was responsible for 43 symposia that drew about 1700 abstracts from over 800 IAMAS-affiliated scientists, the major association-wide activity has been making preparations for the IAMAS Scientific Assembly to be held in Beijing from 2-11 August 2005. The meeting will be held in coordination with the PAGES 2nd Open Science Meeting from 10-12 August, which we expect to broaden the participation in both meetings and more effectively relate the findings from paleoclimatic studies with the many studies of recent and future conditions. In recognition of this potential, the theme for the Assembly will be "The Fascinating Atmosphere: Changeable and Changing." The Beijing meeting will also incorporate a series of major symposia addressing the many aspects of precipitation and its controlling effects on climate.

The Local Organizing Committee (LOC) is off to a very strong start. The LOC is acting on behalf of the Chinese national committees for IAMAS and IUGG, and is in collaboration with a wide group of associations and government ministries. The first circular for the meeting was issued in late 2003 and is being widely distributed (and advertised on the Web), and the second circular is to be issued this summer. Working with the presidents of the 10 commissions and other IAMAS officers, Secretary General List, who visited Beijing in late 2003, is near completion of the calls and conveners for the proposed set of symposia. We are expecting that there will be approximately 45 scientific symposia (4 in collaboration with IAHS and ICSI of IAHS) along with two special symposia, one of which will provide an opportunity for the authors of the planned IPCC 2007 assessment to summarize the state of the science presented in the first draft of the chapters, and a second that will celebrate the 90th birthday of Prof Ye Duzheng (T. C. Yeh), who is Senior Academician of the Chinese Academy of Sciences and Honorary Director of the Institute of Atmospheric Physics. In addition, a number of featured talks are being planned, some by senior scientists and others by younger scientists. The LOC is also formulating an education and outreach program to take advantage of so many of the world's leading atmospheric scientists being in China for the meeting. The President of IAMAS is planning on visiting Beijing in October to meet with the LOC and the scientific organizers of the various symposia.

In addition to the full IAMAS scientific assembly in 2005, two IAMAS commissions are holding their quadrennial meetings this year: the Quadrennial Ozone Symposium (1-8 June 2004 in Kos, Greece) and the 14th International Conference on Clouds and Precipitation (18-23 July 2004 in Bologna, Italy). Both of these meetings attracted a solid set of papers, speakers, and participants.

Consideration is also being given to the scientific assembly in 2009. It has been tentatively agreed that it will be a joint assembly with IAPSO, and discussions are planned on possible locations and other matters during the IUGG EC meeting.

Secretary General Roland List, on behalf of IUGG, has guided the development of the assessment process on the Effects of Pollution on Precipitation, based on a resolution by the IUGG 2003 Assembly and a similar resolution approved by the WMO. An application was submitted by IUGG to ICSU for funding of these activities, including the creation of an IUGG/WMO International Aerosol-Precipitation Science Assessment Group, IAPSAG, under the leadership of Prof. Peter Hobbs, USA. While the funding proposal received high marks, the limitation on funding from ICSU has temporarily delayed the full establishment of the Panel, which will include as members leading scientists from a number of key scientific fields. It is presumed that funding will soon be found, and steps are already being discussed for the planning of follow-up programs.

SG List also attended WMO EC LVI in June. Of note are the discussions of the Global Earth Observing System of Systems, GEOSS, the International Polar Year, and THORPEX, the big forecasting effort that may reach the scale of GARP. The WCRP has also prepared a document describing COPEs (Coordinated Observation and Prediction of the Earth System), which is intended as their strategic plan for coordinating activities across the WCRP; comments on this draft description are being accepted prior to the next meeting of the Joint Scientific Committee in early 2005 [for further information, see <http://www.wmo.ch/web/wcrp/copets.html>].

The most visible outreach effort of IAMAS is its Web site (www.iamas.org), which is now being maintained by Deputy Secretary General John Turner, who is based at the British Antarctic Survey (BAS). Since IUGG 2003 the IAMAS web site has been completely re-designed and moved to the servers at BAS. The site now reflects the many activities of the Association and its Commissions, and includes lists of relevant conferences, contact details for officers of the Association, reports, news items and links to major sites providing atmospheric data. The site also contains planning information for the Beijing 2005 Assembly. It also reflects the activities sketched in this report.

While most support for scientists of developing countries to attend scientific meetings involves attendance at the general and scientific assemblies, IAMAS also provides funds to its commissions so that they can cover the expenses for developing country scientists to attend their meetings. In addition, IAMAS has provided support for developing country scientists to attend a few other scientific meetings, including the CLIVAR meeting in June in Baltimore, Maryland.

The IAMAS President has also pursued one follow-up item from the IAMAS meeting in Sapporo that was raised by the US national delegate. The delegate presented a recommendation from the U.S. national committee urging that all elections be contested (i.e., have at least two candidates). Based on discussion during and after the meeting, the President prepared a note enumerating several reasons why insisting on such an arrangement rather than allowing for it may actually tend to deplete the number of people willing and able to be candidates. Earlier this year, the President had a productive discussion about these reasons with the US national committee for IUGG, with both parties coming to a better appreciation of the issues involved and benefits and limitations of each perspective. Following the discussion, the US national

committee sent a note indicating that they would continue to “encourage you to persist in opening the election process and having contested elections to the greatest extent feasible.” They further indicate that their goal is an open process, and agree that this may not require contested elections.

IAMAS also has been active in its other liaison activities. The President has been active in his liaison roles to SCOR and the ICSU Workshop on Comet/Asteroid Impacts on Society. IAMAS former Secretary General Michael Kuhn continues with his leadership of efforts on IPY and liaison on other activities.

The IAMAS financial year 2003 ended with a loss of \$56379.74. This is as expected during an IUGG Assembly year considering the substantial support of needy country scientists from IAMAS funds [\$42000].

Respectfully submitted: Michael MacCracken, president, IAMAS
Date: 26 June 2004

7.2.3 International Association for the Physical Sciences of the Ocean (IAPSO)

REPORT OF IAPSO ACTIVITIES

JULY 2003 TO JUNE 2004

1. FUTURE PLANNING

The document, *Physical Sciences of the Oceans in the 21st Century - Science and Enabling Strategies for the International Association for the Physical Sciences of the Oceans (IAPSO)*, has been completed. This provides recommendations for a number of actions which will be considered for implementation in the future.

2. RESTRUCTURING OF THE IAPSO EXECUTIVE COMMITTEE

As part of the planning for the future, a revised set of Statutes and By-Laws was prepared and is now being distributed for a mail vote by member countries. One of the main items is the separation of the duties of the Secretary General by the creation of an IAPSO Treasurer. The position of Deputy Secretary General is eliminated, with the Executive Committee remaining the same size. The primary reason for this was to resolve a problem with the selection of Secretaries General, i.e., many potential candidates are in locations where it might be difficult to handle receipt and disbursement of funds. This change in the Executive Committee would take effect with the 2007 elections.

Other changes to the Statutes and By-Laws formally include the provisions for the Prince Albert I Medal and the Eugene LaFond Medal, and revise wording to bring the documents up to date according to present operations, e.g., including the requirement to provide financial reports to IUGG.

3. PLANNING FOR FUTURE MEETINGS

Using extensive e-mail discussion, planning has been completed for IAPSO's scientific program for the upcoming IAG/IAPSO/IABO Joint Assembly in Cairns, Australia, in August 2005. Separately, plans were completed for the IAPSO/SCOR Symposium on Ocean Mixing to be held in October 2004 in Victoria, Canada, and the International Workshop on Forecasting and Data Assimilation for the Benguela and Comparable Systems to be held in Cape Town, South Africa in November 2004.

4. COMMISSIONS AND SERVICES

Commissions and services are under continuing review. As part of this review, a decision was made by the IAPSO Executive Committee to discontinue the Commission on Groundwater/Seawater Interaction in 2005. While we realize that this has been a major outreach to developing countries, it was the feeling of the IAPSO Executive Committee that without participation by IAHS, this commission could not be continued by IAPSO. A possible

Working Group is being considered to continue the ongoing activities beyond 2005, but that would also require IAHS participation.

5. OTHER ACTIVITIES

Abstract books for the IAPSO-led symposia at the IUGG 2003 General Assembly were posted on the IAPSO Web page. The Web page was slightly restructured and information is continually updated.

IAPSO co-sponsored the COSPAR meeting and provided some nominal funds for supporting an oceanography session.

IAPSO co-sponsored the AGU Ocean Sciences meeting and had an information booth at the meeting provided by AGU. Various display material was prepared for this and other meetings.

A mailing list was established for ocean scientists interested in periodic information (these scientists are considered non-paying members of IAPSO), and the Past President of IAPSO has been sending out periodic e-mail.

INTERNATIONAL WORKSHOP ON FORECASTING AND DATA ASSIMILATION IN THE BENGUELA AND COMPARABLE SYSTEMS

GSB Breakwater Lodge, Cape Town, 8 – 11 November 2004

International interest in regional ocean observing and forecasting is evident from the strategies of the Global Ocean Observing System (GOOS) of the Intergovernmental Oceanographic Commission, the International Association for the Physical Sciences of the Oceans (IAPSO) and other organisations. Permanent, continuously operating real-time regional ocean prediction systems are increasingly required to support a variety of critical activities in the ocean and coastal environments, including fisheries management, navigation and marine operations, response to oil and hazardous material spills, search and rescue, and prediction of harmful algal blooms and other ecosystem or water quality phenomena. Implementation of such systems requires advanced technologies in sensors and observing systems, and numerical models and data assimilation, as well as the infrastructure necessary to use them.

Hydrodynamic and ecological models for regional systems are beginning to show considerable skills. The crucial step allowing for real-time regional forecasting is the development of oceanographic data assimilation, which is now becoming a reality. This international thinking is reflected in the strategy of the GEF/UNDP sponsored Benguela Current Large Marine Ecosystem (BCLME) Programme, where a key policy action is the assessment of environmental variability, ecosystem impacts and improvement of predictability. Two cornerstones of this policy action are the development of an early warning system and the improvement of predictability of extreme events and their impacts in the BCLME.

The 2004 Benguela Forecasting Workshop, which is being sponsored by the BCLME Programme, IAPSO, IUGG, IOC/GOOS and ICSU's Scientific Committee for Oceanic Research (SCOR) *inter alia*, will be a crucial step in the development of a viable observing and forecasting system in support of integrated and sustainable management of the Benguela Current Large Marine Ecosystem, for fast-tracking GOOS-Africa, and for implementing a key strategy of IAPSO.

Objectives

- Assess variability in the BCLME and ascertain which aspects are amenable to forecasting of value
- Review present status and recent advances in forecasting and data assimilation in the BCLME
- Review advances in forecasting in comparable ecosystems (e.g. Humboldt, Canary, California)
- Specify minimum data, modelling and human capacity requirements for an early warning system (EWS), and a blueprint for implementation
- Transfer expertise and technology from leading overseas individuals and institutions to the BCLME region
- Promote collaboration between scientists engaged in research and operational oceanography in eastern boundary current systems

- Contribute to improving numerical literacy skills of marine scientists and decision makers
- Build human capacity in ocean observing and forecasting through creating awareness of needs and opportunities
- Improve and further develop linkages and networking amongst scientists and managers in the BCLME countries, internationally, and between the BCLME Programme and international and intergovernmental agencies
- Contribute to BCLME management by improving assessment of variability and developing a forecasting capability

Scope

The Workshop will address a broad range of subjects (ocean and atmosphere physics, chemistry, biology and resource-related) of importance for the development of a predictive capability for the greater Benguela Current region and comparable systems. Topics of relevance to forecasting on time scales ranging from hours to months, and possibly even years and decades, will be addressed *inter alia*:

- Wind forcing: the South-East Atlantic as a coupled ocean-atmosphere system
- Modes of ocean-atmosphere variability in the South Atlantic which impact on the shelf system
- Variability of the Angola (Cabinda) Front, Angola Current and Angola Dome
- Variability of the Angola-Benguela Front and implications thereof
- Benguela Niños and other events of tropical origin
- Frontal variability and generation of upwelling filaments
- Variability and alongshore and cross-shelf process associated with the principal upwelling cell (Lüderitz cell): impacts and predictability
- Intrusions (filaments, rings etc.) of the Agulhas Current
- Intrusions of Sub-Antarctic water into the Benguela
- Wind and waves and impacts on marine structures and maritime operations
- Generation and advection of hypoxia/anoxia
- Development and advection of harmful algal blooms, and their predictability
- Advection and dispersal of pollutants
- Sulphur “eruptions”: predictability and impacts
- Modelling food chain dynamics, including regime shifts
- Environmental impacts on fish resources
- Environmental constraints on the distribution of fish *vis-a-vis* modelling and forecasting
- Impacts of environmental variability on the ecosystem on inter-annual and decadal time scales
- Developments in observing and forecasting in comparable systems (Humboldt, Canary and California Current etc.)
- Models and the data requirements
- Ocean observing system appropriate for the BCLME region
- Key elements of an early warning system for the BCLME: Development of a sub-regional component of GOOS-Africa

Workshop Outputs

- Comprehensive assessment of environmental and resource variability in the Benguela and comparable systems and of latest developments and applications of modelling and data assimilation
- Evaluation of those aspects of variability which are amenable to forecasting of value
- Specification of minimum data, modelling and human capacity requirements for a viable early warning system, and its implementation
- Technology transfer and capacity building
- Establishment of closer links (and possible future partnerships) between the BCLME Programme and international and intergovernmental organisations
- Definitive peer-reviewed book and CD/DVD on observing systems and forecasting in the BCLME. (The provisional title of the book is “Development of a predictive capability for environmental and resource variability in the Benguela and comparable systems”)

Participation

The Workshop is aimed at quantitative scientists, engineers, economists and resource experts and managers. It will be a focussed high level meeting limited to a maximum of 80 persons with the requisite skills. Of these 60 will be by specific invitation, while 20 places will be reserved for non-invited experts

Scientific Programme Committee (SPC)

The overall planning and organisation of the scientific programme for the Workshop is being undertaken by the SPC, which has the following membership:

Vere Shannon (South Africa – SPC Chair)	Hashali Hamukuaya (Namibia)
Geoff Brundrit (South Africa)	Kwame Koranteng (Ghana)
Erlich Desa (India)	Mark Majodina (South Africa)
Wolfgang Fennel (Germany)	Coleen Moloney (South Africa)
Pierre Freon (France)	Paola Rizzoli (USA)
Johannes Guddal (Norway)	Claude Roy (France)
Dale Haidvogel (USA)	Frank Shillington (South Africa)
	John Woods (United Kingdom)

Local Organising Committee (LOC)

The LOC is responsible for all local and regional arrangements for the Workshop and will interact closely with the SPC. It is chaired by Lesley Staegemann (Director of the BCLME Programme’s Environmental Variability Activity Centre) and has a membership drawn from the main participating institutes in Angola, Namibia and South Africa.

Language

The official language of the Workshop will be English.

Contact Details

The BCLME Programme’s Environmental Variability Activity Centre (EVAC) will facilitate all arrangements for the Workshop. For more information contact Director: EVAC, bclmeevg@deat.gov.za (Tel +27 21 4023418/9)

INTERNATIONAL WORKSHOP ON FORECASTING AND DATA ASSIMILATION IN THE BENGUELA AND COMPARABLE SYSTEMS, CAPE TOWN, 8-11 NOVEMBER 2004: OUTLINE OF FORM AND STRUCTURE OF WORKSHOP PROGRAMME

This document should be read in conjunction with the WS Announcement (FORECASTREV.doc)

Theme

The general theme of the WS is to review and build on existing knowledge of variability in the Benguela Ecosystem and to advance understanding thereof in order to develop a viable regional predictive capability. More specifically the first four bullets of the WS Outputs as stated in the Announcement will guide the planning and execution of ALL WS sessions. As such they provide common cross-cutting sub-themes and overall cohesion of the WS. For ease of reference these four outputs are:

- Comprehensive assessment of environmental and resource variability in the Benguela and comparable systems and of latest developments and applications of modelling and data assimilation
- Evaluation of those aspects of variability which are amenable to forecasting of value
- Specification of minimum data, modelling and human capacity requirements for a viable early warning system, and its implementation
- Technology transfer and capacity building

Form of WS

In view of the broad scope of the WS, there will be both plenary and parallel sessions. The first and last days will be devoted to plenary sessions, while the two intermediate days will be set aside for (parallel) focussed specialist sessions. Invited oral presentations will mainly be in PowerPoint, and facilities will be available for invited and contributed poster papers. Day 1 will comprise an opening ceremony followed by six invited overviews (keynote papers and broad discussion). The overviews – augmented by posters - will cover the full scope of the WS and are intended to provide a sound foundation for the specialist sessions on Days 2 & 3. Integration of the outputs from the specialist sessions etc will take place on day 4.

Overview presentations and posters on Day 1

The following six topics have been identified:

- Ecosystem and resource variability, including regime shifts
- Variability in the physical environment
- Variability in the biological environment
- Hypoxia, anoxia and hydrogen sulphide
- HABs and pollutants
- Variability and change in comparable systems

Invited speakers will receive guidance from the SPC on the approach they should take.

Specialist (parallel) sessions on Days 2 & 3

The specialist sessions may comprise oral and poster presentations, model runs/displays, but will have a substantial amount of time set aside for discussion and “work shopping” proper. Three broad categories/groups are envisaged here, viz:

- A. Predictive capability for environmental variability (This will address *inter alia* improving the performance of regional environmental and ecological services by exploiting the information generated by GOOS i.e. How can the GOOS approach help Benguela prediction?)
- B. Generation and evolution of HABs, hypoxia and hydrogen sulphide events, their impacts and predictability
- C. Food chain dynamics, processes, and predicting the impacts on the ecosystem and resources

There will obviously be some overlap between the above categories/groups, so they should not be seen as watertight. Flexibility will be built into the programme to enable participants to maximise their inputs, and a plenary “information exchange” session, where session leaders can report progress, will conclude discussions on Days 2 & 3. It is also inevitable that the above three broad categories A, B and C may need further subdivision, and this will be catered for as the WS programme evolves. It is accepted that it will be difficult for participants both to focus and cover the full scope of the WS, so it is essential that the session leaders should be guided by the requirements of the WS Objectives, in particular Objectives 1 - 4 listed in the Announcement, and provide suggestions on each of these as outputs from their sessions.

Group (category) A will focus primarily, but not exclusively, on the physics. Scope bullets #1-10 apply here (Refer to the WS Announcement). Groups B and C will require inputs from the physics, chemistry and biology – scope bullets #11-14 are relevant for Group B and #15-18 for Group C. Interchange of some participants between groups will probably be required. Scope bullets #19-22 are cross-cutting and apply to all groups.

Within these groupings, or as an alternative approach perhaps, it might be helpful to classify marine prediction under “Nowcasting” (up to the limits of prediction of the atmosphere), “Forecasting” (beyond the limits of weather forecasting - includes inter-annual and intra-annual variability) and “What-if? Prediction”.

It is proposed to establish three small teams to help plan and structure the parallel sessions – one for each identified Group. Suggested names in alphabetic order are as follows:

Group A: Geoff Brundrit, Paola Rizzoli and Frank Shillington (with input from Erlich Desa, Johannes Guddal, Dale Haidvogel, Mark Majodina, Claude Roy, John Woods etc)

Group B: Wolfgang Fennel, Pedro Monteiro and Grant Pitcher

Group C: Pierre Freon, Larry Hutchings, Coleen Moloney and John Woods (with input from Robert Crawford, John Field, Hashali Hamukuaya, Kwame Korangteng, Carl van

der Lingen, Michael O'Toole, Claude Roy, Lynne Shannon and others)

Integration on Day 4

The approach which will be taken to bring everything together on the final day will depend on how the detailed planning of the various sessions develops over the next few months. Here the session leaders, keynote speakers and SPC members will play a crucial role – perhaps they could identify a small group to drive the process?

WS Output 6 (definitive peer-reviewed book)

A revised title (Benguela: Predicting a Large Marine Ecosystem) has been proposed for the envisaged book. The six invited overview papers will in all probability serve as the first set of chapters, with the remaining chapters being the products of the specialist sessions and final plenary. (What is essential that the collective wisdom of the participants in the WS is captured rather than regurgitation of what is already known.)

Venue

The WS will take place at the University of Cape Town GSB Breakwater Lodge, which is situated in the Victoria and Alfred Waterfront. The following meeting rooms have been reserved:

7.3 Affiliated Programs

SCOR-Affiliated Programs

From time to time, SCOR Working Groups propose activities that will extend beyond the normal life of the group and for which continuing SCOR sponsorship or oversight is appropriate. Unlike existing large-scale programs of SCOR, such as JGOFS and GLOBEC, funding for these programs is in place and the type of relationship proposed would not involve SCOR, or its Secretariat, in heavy commitments of funds or staff support. In 1995, SCOR developed the option of formal affiliation of relevant programs with SCOR.

SCOR's role in relation to Affiliated Programs is one of advice and occasional review. SCOR expects to be involved in membership decisions, ensuring that the steering committees include appropriate international and disciplinary balance. SCOR's national contacts could be used to find new members in regions where there is a need, or to entrain new countries into projects. SCOR can also provide an independent mechanism for the review of planning documents such as science and implementation plans.

Application for SCOR Affiliation

Application to SCOR for program affiliation should be initiated with a proposal of 2 to 5 pages, sent to SCOR at least three months before an annual SCOR meeting. The proposal should include an outline of the program's science plan, the terms of reference, and current membership of the steering committee. The proposal for SCOR affiliation should also address the following criteria, accepted at the 1995 SCOR Executive Committee meeting (*1995 SCOR Proceedings*). The Executive Committee agreed that in order to become a SCOR-affiliated Program, an activity must:

- be truly international, with a membership that rotates periodically
- show evidence of existing financial and/or organizational support
- demonstrate a need for SCOR affiliation
- have a scientifically well-integrated theme
- show that it is in SCOR's interests to establish this affiliation
- be of broad scale and global importance
- show, as appropriate, that any scheme of membership dues includes some nominal level so as to encourage the widest possible international participation by all countries
- be willing to adhere to the SCOR Publication Policy

Once a program is affiliated with SCOR, annual reports are required. At each biennial SCOR General Meeting, these reports should be somewhat more substantial (and scientific lectures may be requested) as a basis for the decision on continuing the relationship between SCOR and each program. The Chair of each Affiliated Program serves as an ex-officio member of SCOR as a Scientific Rapporteur (see SCOR Constitution, paragraph 4). SCOR will not usually sponsor an Affiliated Program for more than ten years.

7.3.1 Census of Marine Life (CoML) (affiliated in 2002)

Goal and Objectives:

The Census of Marine Life (CoML) is conceived as a decade-long program to promote and fund research assessing and explaining the diversity, distribution, and abundance of species throughout the world's oceans. Related activities integral to this research include the design and implementation of standard databases for marine species in collaboration with other international efforts launched recently, and the design and implementation of innovative biological sampling techniques for the marine environment. Outreach and education efforts will help inform the public about the CoML's potential and actual contributions to knowledge, and help tune the program to the concerns and priorities of governments, commercial and recreational fishers, environmental groups, the research community, and other stakeholders in the oceans.

The initial primary goal of the international Steering Committee is to foster the development of coherent goals and a scientific plan for the CoML. The Steering Committee will carry out this task through workshops, working groups, and other appropriate processes and means. The Steering Committee will also oversee the development of the education and outreach plan and its implementation.

Chair:

J. Frederick Grassle
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Membership:

Vera Alexander	USA
D James Baker	USA
Donald Boesch	USA
David Farmer	USA
Victor Ariel Gallardo	CHILE
Carlo Heip	NETHERLANDS
Poul Holm	DENMARK
Ian Poiner	AUSTRALIA
Yoshihisa Shirayama	JAPAN
Meryl Williams	AUSTRALIA

Ex-Officio Members:

Patricio Bernal	IOC
Serge Garcia	FAO

CoML Staff: Ron O'Dor and Kristen Yarincik
Executive Committee Reporter: Akira Taniguchi

What's New with CoML?
May/June/July 2004

- **All Program Meeting.** The Second CoML All Program Meeting will be held in conjunction with the 2005 International Senckenberg Conference on marine biodiversity, organized by CeDAMar project manager, Pedro Martinez. The Senckenberg Conference is scheduled for 30 October – 4 November 2005 in Frankfurt, Germany. The All Program Meeting will be held 5-6 November 2005 in Frankfurt. The goals of the All Program Meeting will likely be a mid-term synthesis of the research and identification of needs for the latter half of the program. The meeting will focus on integration of projects and working groups based on the *ocean realms* (of the Research Plan). More information on the meeting will be available in late December 2004... Please mark your calendars!

- **Scientific Steering Committee (SSC).** The SSC would like to welcome two new members, Dr. Michael Sinclair, Director of the Bedford Institute of Oceanography in Nova Scotia, Canada, and Dr. D. Chandramohan, Deputy Director of the National Institute of Oceanography, India.

The SSC met 1-2 July 2004 in Horta, Açores, Portugal, hosted by the Departamento de Oceanografia e Pescas, Universidade dos Açores and the Centro do Mar. The management subcommittee of the SSC reported on their preliminary recommendations about the reciprocal roles and responsibilities of the CoML National and Regional Committees (N/RICs) and the SSC, which will be discussed further with the N/RICs at the Paris SSC meeting. SSC members were assigned as liaisons to the various N/RICs to better communication between the central and distributed managements of the program. The SSC also endorsed proposals to initiate two new Ocean Realm Field Projects on zooplankton and marine microbes.

The next SSC meeting will take place on 1-3 December 2004 in Paris, France, hosted by Patricio Bernal and the IOC. Representatives from the CoML N/RICs (both formed and under organization) are requested to attend this meeting.

- **Secretariat.** CORE has just received renewed funding to support the SSC and serve as the international Secretariat for CoML. CORE Research Director Reggie Beach will take an active role as Program Manager of CoML at CORE to clarify the internal management of the Secretariat and improve tracking and reporting capacity.

The Secretariat would like to say farewell to Giselle Firme, who has ended her research fellowship at CORE. We've appreciated her work over the past year and will miss her. Giselle will be moving back to Brazil later this summer to take on a new role in her family's architectural and construction firm. She also hopes to remain active in marine science in Brazil.

- **Education and Outreach.** The Education and Outreach team at URI is currently developing the first CoML Annual Highlights report, due out in October. It will highlight the exciting scientific discoveries of the CoML projects over the past year.

The Outreach Liaison Network will hold its next meeting in Paris, France on 2-3 December 2004.

- **Ocean Biogeographic Information System (OBIS).** As of 28 July 2004, total data holding in the OBIS network is 2,929,761 records, 38,754 scientific names, and 30,543 species.

OBIS has received renewed funding from the Sloan Foundation to serve as OBIS Secretariat, support the International Committee, and establish and support a network of Regional OBIS Nodes (RONs). This network of Regional Nodes is developing in conjunction with national organizations such as: Fisheries and Oceans Canada and the Centre for Marine Biodiversity (Canada); NaGISA and Japan GTI (Japan); CSIRO and the National Oceans Office (Australia); National Institute of Water and Atmospheric Research (New Zealand); the National Oceanic and Atmospheric Administration's National Ocean Data Center, National Marine Fisheries Service, and the National Biodiversity Information Infrastructure (USA); and, in Europe, through cooperation among national data centers and EU projects (MARBEF/EurOBIS, EuroCAT/Species 2000 Europa, BioCASE, BIOMARE, MarLIN, SAHFOS, and the Flanders Marine Data and Information Centre). OBIS Regional Nodes are also proposed for South America, Southern Africa, the Caribbean and the Indian Ocean. The next meeting of the OBIS regional nodes is scheduled for 16-18 September 2004 at the Bedford Institute of Oceanography in Nova Scotia, Canada, hosted by Bob Branton.

The OBIS-SEAMAP (Spatial Ecological Analysis of Megavertebrate Populations) team held a Data Providers Meeting at Duke University in Durham, North Carolina, on 10-11 May. The first day focused on new web tools, particularly mapping and tracking applications compatible with Tracking of Pacific Pelagics project data. The second day reviewed the wide range of data types being brought together in SEAMAP from all oceans except the Arctic. A high point was a report from the British Antarctic Survey on the recent BirdLife Global Procellariiform Satellite Tracking Workshop, which illustrated the incredible new insights possible from data sharing by albatross trackers in the Southern Ocean. Other bird data providers included Wake Forest University, and University of Washington; turtle data from Duke University, Blue Ocean Institute and SeaTurtle.org; mammal data from New England Aquarium, University of Southern Maine and the National Marine Mammal Laboratory. NOAA Northeast, Southeast and Southwest Fisheries Science Centers all provided an impressive array of data from all taxa from surveys and cruises, both in the US EEZ and internationally. For further information see: <http://seamap.env.duke.edu>.

OBIS – in partnership with the IOC International Oceanographic Data and Information Exchange, the International Association for Biological Oceanography (IABO), and the Flanders Marine Institute – will hold a major international workshop on Ocean Biodiversity Informatics in Hamburg, Germany, 29 November – 1 December 2004. For more information, visit <http://www.vliz.be/obi/>. The OBIS International Committee plans to meet in conjunction with this conference on 26-27 November in Hamburg.

The OBIS international Secretariat at Rutgers University (USA) is currently seeking a Program Manager to oversee day-to-day operations and planning for a federation of OBIS-affiliated data systems throughout the world. The Program Manager will have full responsibility for managing activities related to the OBIS Portal at Rutgers University and its partners, including a number of independent marine biological databases, Census of Marine Life Field Projects, and Regional OBIS Nodes in eight countries. For more information, please contact Fred Grassle (grassle@imcs.rutgers.edu) or visit <http://www.coreocean.org/Dev2Go.web?id=260273>.

- **History of Marine Animal Populations (HMAP).** The first HMAP Modeling workshop took place in Esbjerg, Denmark on 21-23 April with 19 participants from Denmark, US, UK, Russia, South Africa, Belgium. For the agenda, abstracts and a list of participants, visit the workshop page at <http://www.hmapcoml.org/Default.asp?ID=190>.

The fifth annual HMAP workshop, *Testing the HMAP Hypotheses: known, unknown and unknowable*, will take place on 11-13 August 2004 at the University of Southern Denmark in Esbjerg. Marine scientists, historians, archaeologists and ecologists working on the HMAP case studies around the world will attend the meeting with the aim to assess the progress and future development of the project. A number of presentations will be heard, including a final installment of Neil Klaer's work on the SE Australian shelf. The workshop will comprise delegates from the US, UK, Russia, Estonia, Latvia, Germany, Belgium, Australia, New Zealand, Sweden as well as from Denmark.

The book "Learning from Environmental History in the Baltic Countries," which includes a chapter written by Poul Holm, has been produced within the framework of "The Baltic Sea Project" as a part of the UNESCO Associated Schools Project.

A workshop has been funded under the auspices of EuroCoML to develop an HMAP case study in the Mediterranean Sea. It will be held 20-23 September 2004 in Barcelona, Spain. Dr. Isabel Palomera of the Institut de Ciències del Mar is hosting.

The HMAP Open Science Conference, *Oceans Past - Multidisciplinary Perspectives on the History of Marine Animal Populations*, will take place from 24-27 October 2005 at Hotel Comwell in Kolding, Denmark. Oceans Past is a global conference dedicated to the history of the oceans and marine life. The conference format will be an open science forum where researchers from all relevant disciplines are welcome, both from the natural sciences and the humanities. The conference will present a large number of scientific papers in addition to discussions in open sessions about what we know, do not know, and may never know about past oceans, and how we can improve marine historical research on a global scale. A call for papers will be issued in late 2004. For more information, visit the conference website at <http://www.hmapcoml.org/Default.asp?ID=194>.

- **Future of Marine Animal Populations (FMAP).** FMAP has assigned full-time Ph.D. student Derek Tittensor to work with the developing Seamount project and to develop methods for biodiversity modeling to be used for other projects. There is a meeting planned for 15 September 2004 at Woods Hole Oceanographic Institution (WHOI) to examine the field survey data issues associated with the Seamount project.

Another modeling meeting is planned with Zooplankton group (Ann Bucklin) for 16 September at WHOI. The goal of this meeting is also to help design an efficient sampling program.

FMAP expects to hold its next steering group meeting this coming (northern) winter in Japan (dates TBD). Some members may also meet in conjunction with the Known, Unknown, Unknowable workshop on Future Biodiversity scheduled for 22-25 April 2004 in La Jolla, CA.

Ocean Realm Field Projects

- **Gulf of Maine Area Program: GoMA.** A team of explorers completed its second “Mountains in the Sea” cruise to the Manning, Kelvin, and Bear seamounts. Objectives of the May 2004 cruise included documenting the occurrences of corals with respect to current flow, and seeing what the relationships are of the benthic fishes, not only to corals distributions but also to other aspects of the seamount landscape. The cruise was assisted by NOAA’s Office of Ocean Exploration. See <http://oceanexplorer.noaa.gov/explorations/04mountains/welcome.html>

Cruises also were made in late spring by Michael Vecchione to Bear Seamount and by Michael Fogarty to the Slope Sea.

The Gulf of Maine Census is participating with Tom Trott of Suffolk University on his project to sample “critical marine invertebrate areas” in coastal Maine regions. This work is funded by Maine Sea Grant. One objective, in addition to documenting change in these areas, is to demonstrate that diversity and distribution data collected in small areas can be integrated into GMBIS.

As a result of the initiative of DFO-Canada, the development of a Discovery Corridor is underway. The Discovery Corridor, which will extend from the intertidal area to deep basins and the seamounts, will serve as an organizing tool for amassing what is known about the diversity and distribution of life in the Gulf of Maine across a variety of habitats. The effort is chaired by Peter Lawson.

The Gulf of Maine Ocean Data Partnership is up and running. It was launched at a meeting at the Northeast Fisheries Science Center in Woods Hole in late April. At present the Partnership consists of 14 members, including some of the largest data generators in the region, coordinators of databases, and holders of small area databases. The Partnership’s goal is to create a truly dynamic system of sharing and integrating data—physical, biological, geological, and cultural. For the Census, this will greatly advance the opportunity to understand the workings of the Gulf of Maine ecosystems. David Mountain of the NEFSC is chair, and GoMOOS is hosting the Partnership. The Gulf of Maine Census has coordinated its organization.

- **Mid-Atlantic Ridge: MAR-ECO.** The long-awaited MAR-ECO cruise on the R/V *G.O. Sars* set sail from Bergen, Norway, 5 June 2004 for a 2-month voyage. On 3-4 July, the ship docked in Horta, Azores, flying the banners of MAR-ECO and CoML, to change research teams for the second leg. The CoML Secretariat and Scientific Steering Committee were there to greet them and learn of the discoveries of Leg 1, which travelled south along the mid-Atlantic Ridge from south of Iceland to the Azores. During its stay in Horta, the ship was open to interested members of the public. Leg 2 is travelling north along the same route, but focusing in two sub-areas north of the Azores (approx 43°N) and near the Charlie-Gibbs Fracture Zone (approx 52°N). The exciting two-months will end in Bergen on 4 August, followed by an international press release on 5 August. You can follow the *G.O. Sars* journey on MAR-ECO's website: <http://www.mar-eco.no/>.

On 21 July, the Royal Norwegian Airforce 333 Squadron airdropped to the *Sars* much-needed parts for the ROV Bathysaurus. The Bathysaurus has the capability to dive to 5000m. Now back in operation, it will allow the crew to study the very deep life on the Mid-Atlantic Ridge. We

extend our deepest thanks to Lieutenant Colonel Asak and the 333 Squadron for their willingness to perform this unusual mission.

- **Chemosynthetic Ecosystems: ChEss.** ChEss welcomes Prof. Yoshihiro FUJIWARA from Japan to the ChEss SSC. He represents the Japan Agency for Marine-Earth Science and Technology (JAMSTEC).

The development of the ChEss database (ChEssBase) has been progressing well. The team expects to have a user-friendly web presence and interoperability through OBIS before the end of the year.

Eva Ramirez-Llodra of ChEss is participating on the InterRidge Global Exploration Working Group.

ChEss will be involved in the Organising Committees for the 3rd Hydrothermal Vent Symposium (Scripps, 2005) and 11th Deep-Sea Symposium (SOC, 2006).

- **Tagging of Pacific Pelagics: TOPP.** Since our last “What’s New?,” the TOPP field programs have moved into full swing, with lots of tags going out and data coming in.

- **FISHES.** Recovery of archival tagged bluefin and yellowfin are exceeding expectations. In June, Japan returned 3 archival tags from bluefin released off Baja, California. A bluefin tuna, tagged with a Lotek archival tag in August 2002 was captured off Japan in the spring of 2004. After spending 8 months off California and Mexico this remarkable tuna traveled to Japan and back to Baja and then to Japan once again a journey of over 18,000 nm in 677 days. The tuna teams have recovered over 7000 days of data on yellowfin, bluefin and albacore tuna.
- **SHARKS.** The shark team has had incredible success with satellite tagging salmon sharks. Migrations as long as two years have been recorded. TOPP researchers will be in Alaska in July testing a new UK tag that will provide the first real-time speed and depth temperature profiles. The shark team is staying busy and two teams are currently in the field tagging blue, mako and great white sharks in the Southern California Bight. Later this year additional tags will be deployed off Mexico and Northern California.
- **SEABIRDS.** The first tracks from Laysan albatrosses for the non-breeding season show extraordinary movement across the north Pacific with birds concentrating in the Aleutian Islands and Alaska Gyre. In Chile, 2 archival tags were recovered from pink-footed shearwaters after 7-8 month. This is the smallest seabirds (~800 g) ever tracked for this duration. One bird was headed north along the coast of Central America before its tag stopped functioning.
- **ELEPHANT SEALS.** The development of the new conductivity, temperature, depth (CTD) tag is progressing nicely. This spring CTD tags were deployed on 9 elephant seals for the 2-5 day trip across Monterey Bay. After correction for near field effects the data collected was virtually indistinguishable from that obtained using a Seabird CTD cast at the time of release. Even this small number of deployments provided over 3,000 individual oceanographic profiles for Monterey Bay. This spring 4 satellite linked CTD tags were deployed on elephant seals for the 8-month, post-molt migration. These tags are currently providing real-time salinity data.

- **EDUCATION AND OUTREACH.** The TOPP education and outreach team is currently recruiting two full-time staff to support the ongoing E&O effort. One will provide oversight of the TOPP web programs, and the other will be responsible for developing content for web, print and media.
- **Salmon/Coastal Tracking: POST.** All 2004 milestones initially planned for POST have been met. The completion of all lines forming the 2004 acoustic array was officially achieved on 8 June 2004, when the acoustic line north of Icy Strait, Alaska, was deployed. In addition, all tagging targets have been met with the exception of one wild stock from the Nimpkish River (NE coast of Vancouver Island), which has not yet begun to migrate to sea. They wait to see if the run is simply late. To date, a total of 1,955 tagged animals have been released with POST tags in 2004. Equipment recovery, initial data download, and redeployment of the acoustic array will now begin.
- **Latitudinal/Longitudinal Gradients in Near-Shore Biodiversity: NaGISA.** The NaGISA Protocols are available as a PowerPoint presentation online at the NaGISA website: <http://220.111.242.120/>.
- **Abysal Sediments: CeDAMar.** CeDAMar PI's Joelle Galleron (IFREMER), Craig Smith (University of Hawaii) and Pedro Martínez (German Centre for Marine Biodiversity Research) participated in the French NODINAUT cruise on the *R/V L'Atalante*, which departed Manzanillo (Mexico) on 17 May and ended successfully in Noumea (New Caledonia) on 27 June 27. Chief scientist Joelle Galeron led a group of 20 scientists from 8 different countries (France, England, Spain, Italy, Korea, Japan, USA and Canada) to obtain data on the sediment geochemistry and the microbiology and diversity of abyssal communities at two sites in the Pacific nodule province, an area of about 3 million square km at a depth of about 5000m. The cruise sought to answer question, such as: (1) is there a specific fauna associated with the nodules? (2) Does the presence of nodules influence the diversity and abundance of benthic communities? (3) What consequences will large-scale exploitation of the nodules in this area have for abyssal life? (4) How does the diversity of the Pacific nodule province compare to abyssal basins in other Oceans? (5) How is the gene flow between organisms in the Pacific region? The cruise employed the French manned submersible *Nautile*, which itself had a crew of 8. The *Nautile* was used to perform 14 dives of about 9 hours duration each to about 5000m depth. The dives recorded 70 hours of video and hundreds of photographs of the seafloor and of the abyssal fauna, which will be analyzed at IFREMER to identify the megafauna and to calculate its densities and community structure. The most abundant organisms recorded were holothurians of different species, as well as sponges, cnidarians, sea stars, deep sea fishes and squids. Spurs of bioturbation like burrows, tracks and mounds were also recorded. Other instruments used included multi-corer and box-corer grabs and Landers to measure of oxygen consumption and colonization of artificial substrate experiments.

Only a year after the expedition ANDEEP I and II, a first set of publications is about to be published as a special volume of *Deep Sea Research*.

The CeDAMar SSC will meet in Wilhelmshaven on August 6th. CeDAMar welcomes Brigitte Hilbig, co-PI of ANDEEP, who, since June, serves as CeDAMar scientific project manager in charge of the Outreach activities and the CeDAMar secretariat.

- **Arctic.** Russ Hopcroft, Rolf Gradinger, and Bodil Bluhm of the University of Alaska have received funding from the Sloan Foundation to launch and organize an Arctic Ocean Census of

Marine Life (ArcCoML). An international steering group, comprised of representatives from Canada, Russia, Norway, Denmark, Germany and the U.S., guides the project. For more information, visit the project website: <http://www.sfos.uaf.edu/research/arcdiv/>.

The announcement of ArcCoML was met with much international media attention on 24 June 2004. Read the press release at

<http://www.coreocean.org/iDuneDownload.dll?GetFile?AppId=141&FileID=260332&Anchor=&ext=.pdf>. Several of the articles spurred by this release can be found at the news section of the CoML portal: <http://www.coml.org/medres/medres1.htm>.

The full proceedings of the Arctic biodiversity workshop that initiated development of this project in April 2003 are now available as a PDF through the Alaska Sea Grant bookstore website: http://www.uaf.edu/seagrant/Pubs_Videos/pubs/M-26.html.

National and Regional Activities

- **Australia.** The Australian Committee is making plans to hold a Known, Unknown, Unknowable workshop on the Western Pacific. They will collaborate with New Zealand and the South Pacific island nations. They also plan to hold a major national education and outreach event in 2005.
- **Canada.** The Census of Marine Life Canada will hold a workshop 19-31 October in Ottawa to create a unified, research agenda to advance knowledge of biodiversity in Canadian waters, the variables that regulate biodiversity pattern, and how to use this knowledge to manage and conserve marine biodiversity. The workshop will focus on processes that regulate biodiversity from populations to ecosystems. A major objective is to determine how interaction with international initiatives can make the most of Canadian resources that are small relative to the country's extensive ocean borders. Dr. Paul Snelgrove, Memorial University of Newfoundland and Dr. Mike Sinclair, Bedford Institute of Oceanography, will chair the meeting.
- **Caribbean.** A CoML-sponsored regional workshop on Caribbean marine biodiversity took place 15-17 June 2004 in Isla de Margarita, Venezuela, organized by Patricia Miloslavich and Eduardo Klein of Universidad Simón Bolívar. The workshop included approximately 20-25 participants from around the Caribbean including Belize, Bermuda, Columbia, Costa Rica, Cuba, Dominican Republic, Grand Cayman, Jamaica, Guatemala, Mexico, Panama, Puerto Rico, Tobago, and Venezuela. The group identified 4 primary areas of interest for a CoML Caribbean initiative: OBIS, NaGISA, Coral Reefs, and HMAP (Megamollusks). The background papers will serve as the proceedings of the workshop. The next challenge is the establishment of a formal CoML-Caribbean committee, which will be chaired by Patricia Miloslavich.
- **Europe.** EuroCoML attended the EurOcean Conference in Galway, Ireland on 10-13 May 2004. CoML received a lot of positive attention and was featured on the Irish radio program "Seascapes."

The next meeting of the full EuroCoML Committee will be held 4-5 October 2004 (location TBD).

- **Indian Ocean.** The IO-CoML Committee has been formally established. Members include: Mohideen Wafar (Chair – India), John Keesing (Australia), Charles Griffiths (South Africa and Chair of the Sub-Saharan African CoML Committee), Jan Sopaheluwakan (Indonesia), Mazlan Ghaffar (Malaysia), Yoshihisa Shirayama (Japan and member of the CoML international SSC), Mitra Bhikajee (Mauritius) and Vishwas Chavan (India). The Secretariat for the Indian Ocean Regional Committee is located at the National Institute of Oceanography in Goa, headed by NIO Deputy Director P.A. Lokabharathi.

The report of the Indian Ocean biodiversity workshop held December 2003 will be published as a special issue of the Indian Journal of Marine Sciences. Mohideen Wafar and Shubha Sathyendranath are hard at work editing the volume.

- **South America.** CoML South America has a new website. Please visit it at <http://www.coml-sa.org>.

The proceedings of the November 2002 South American biodiversity workshop are published as a special issue of *Revista Gayana 67(2):2003*. Victor Ariel Gallardo, workshop organizer and Vice Chair of the CoML international SSC edited the volume. Please contact the Secretariat at CORE for a copy.

- **Southeast Asia.** The Research Center for Oceanography, Indonesian Institute of Sciences (LIPI) has recently established an Indonesia Census of Marine Life Program entitled Marine Life in Indonesia (MarLIIn). They plan to hold a National Workshop on Marine and Coastal Biodiversity on 30 August - 1 September 2004 in Jakarta.

- **USA.** The U.S. National Committee met 3-4 June 2004 in Long Beach, CA. They are currently preparing for targeted visits to federal agencies to present the components of the U.S. program plan as they support specific recommendations of the final report of the U.S. Commission on Ocean Policy. The agency visits will take place in September and October.

An Ocean Research Coordination and Advancement Act (S.2648) was introduced to the U.S. Senate on July 13th by Senators Hollings, Stevens and Inouye. The Act calls for a 10-year interagency Marine Ecosystem Research Program to be established and maintained by a National Ocean Science Committee (the National Oceanic and Atmospheric Administration, the National Science Foundation, the United States Geological Survey, the Office of Naval Research, and others). The proposed program includes elements addressed by and important to the Census of Marine Life, such as: dynamic access to biological and other data through an integrated ocean biogeographic information system; integrated national and regional studies and products that focus on appropriate scales to support ecosystem-based management; improved biological sensors for ocean and coastal observing systems; investment in exploration and taxonomy to study little known areas and describe new species; studies of earlier changes in marine populations to trace information on biological abundance and diversity to the earliest historical periods of minimum human impact; and improved predictive capability. The program is to include competitive research grants to the scientific community. The proposed authorization for development and implementation of the research program is \$50M for each of fiscal years 2005 through 2010, to be appropriated to the National Oceanic and Atmospheric Administration.

A CoML session for the 6th International Aquarium Congress (5-10 December 2004, Monterey, CA) has been accepted. Jerry Schubel, chair of the USNC education and outreach subcommittee, is organizing this session.

Cross-cutting and Other Related Activities

- **SCOR Panel on New Technologies.** The SCOR Panel is developing a new website on technologies for observing marine life. The website will draw international attention to the potential benefits of emerging technologies in the detection and enumeration of marine life, explore the relative merits of different technologies and identify those that deserve further research, reflect the Panel's thinking on emerging technologies, serve as an archive of technical articles, links, references, etc., and enable both general-purpose.
- **Microbes.** The SSC has endorsed an International Census of Marine Microbes (ICOMM), a new CoML global field project proposed by Mitch Sogin (Marine Biological Laboratory, USA) and Jan de Leeuw (The Royal Netherlands Institute for Sea Research). The project would catalogue all known diversity of single-cell organisms inclusive of the Bacteria, Archaea, Protista and associated viruses, explore and discover unknown microbial diversity, and place that knowledge into appropriate ecological and evolutionary contexts. ICOMM will also serve as a crosscutting effort across CoML field projects with existing or potential microbial components. The proposal awaits formal review.
- **Zooplankton.** The SSC has endorsed a proposal for a Census of Marine Zooplankton (CMarZ), a new global field project to make a taxonomically comprehensive assessment of biodiversity of animal plankton throughout the world ocean. Ann Bucklin (University of New Hampshire, USA), Shuhei Nishida (University of Tokyo, Japan) and Sigrid Schiel (Alfred Wegener Institute for Polar and Marine Research, Germany) are the Principal Investigators. The proposal awaits formal review. In the meantime, the group is working with FMAP to examine sampling design issues. This will be done through a small meeting scheduled for 16 September in Woods Hole, MA.

The CMarZ Science Plan is available for review. You can find it linked from the News column at www.comlsecretariat.org. Please send comments, corrections, suggestions, and additional information to Ann Bucklin (ann.bucklin@unh.edu).

- **Coral Reefs.** The CoML U.S. National Committee is sponsoring a workshop to identify the appropriate goals and scope of a census of marine life on coral reefs, which would be the U.S. component to a global coral reef initiative under the CoML umbrella. This workshop is scheduled for 15-18 August 2004 at the Hawaii Institute of Marine Biology on Oahu, Hawaii. More information can be found at the workshop website: <http://www.coreocean.org/Dev2Go.web?id=260543>.

The international group met during the International Coral Reef Symposium on 27 June in Okinawa to discuss the key aspects of a global project. Striking a good balance between basic biodiversity information and utility for conservation was considered the critical factor. In addition, it was acknowledged that the diversity and physical complexity of reefs would make

designing a protocol challenging. The plans for an international coral reef field project will continue to develop.

- **DNA Barcoding.** The CONSORTIUM FOR THE BARCODE OF LIFE (CBOL) is an international collaboration of natural history museums, herbaria, biological repositories, and biodiversity inventory sites, together with academic and commercial experts in genomics, electronics, taxonomy, and computer science whose mission is to rapidly accelerate the compiling of DNA barcodes of known and newly discovered plant and animal species, establish a public database of sequences linked to vouchered specimens and associated biological information, and promote technology development for inexpensive hand-held DNA analysis for species identification. The inaugural meeting for the Consortium for the Barcode of Life was held at The Smithsonian Institution in Washington DC on 24-25 May 2004. Several CoML scientists attended. James Baker (Academy of Natural Sciences, Philadelphia) serves on the steering committees for CBOL and CoML, providing a bridge between the two programs. For Barcoding news visit <http://phe.rockefeller.edu/BarcodeConference/>.

- **Known, Unknown, Unknowable.** The Known, Unknown, Unknowable (KUU) conference on *Future Marine Biodiversity* is scheduled for 22-25 April 2005 at Scripps Institute of Oceanography in La Jolla, CA. More information will be available in the coming months.



- **Meeting of International Marine Programs.** The Scientific Committee on Oceanic Research (SCOR) will convene a meeting of representatives of the major international ocean research and observation projects and programs on 23-24 September 2004 in Venice, Italy. The Census of Marine Life will participate in this meeting, which is being held to discuss common opportunities and issues, focusing on ocean observing systems, data management and global marine assessments. More information is available at <http://www.jhu.edu/scor/ProjCoord.htm>.

General News

- **National Oceanographic Partnership Program.** The U.S. National Oceanographic Partnership Program (NOPP) has released its fiscal year 2005 Broad Agency Announcement (BAA) on July 13, 2004. Up to \$11.8M over three years may be available for this solicitation, subject to appropriation and final approval by the National Ocean Research Leadership Council (NORLC). Additionally, non-Federal institutions have expressed to the government that they have similar research interests and goals as expressed under this BAA and may potentially provide up to \$3M in separately funded non-Federal projects. NOPP seeks proposals relating to:

- Fusing multi-sensor regional scale data to monitor and quantify coastal processes;
- Integration of private and public data sets in the northern Gulf of Mexico;
- New methods for detection of fish populations or mapping of fish habitat; and
- Sensors for sustained, autonomous measurement of chemical or biological parameters in the ocean.

The response date for the NOPP BAA is 14 October 2004. Team efforts among academia, industry, and government participants are required (at least 2 of the 3). For the full announcement, visit http://www.onr.navy.mil/02/baa/docs/04_022.pdf.

- **National Science Foundation Arctic Research Program.** The U.S. National Science Foundation (NSF) is soliciting proposals under the Arctic Research Program to conduct research and perform data analysis. The goal of the program is to gain a better understanding of the earth's physical, biological, geological, chemical, social and cultural processes, and the interactions of ocean, land, atmosphere, biological, and human systems in the Arctic. Approximately \$75M per year is expected to be available for 130-160 awards; approximately \$25M is available each year for new projects. Proposals are due 30 August 2004. For more information: <http://www.nsf.gov/pubs/2004/nsf04587/nsf04587.htm>.

Calendar of Upcoming Events

August

- 4:** *G.O. Sars* MAR-ECO cruise ends in Bergen, Norway
- 5:** MAR-ECO international press release
- 11-13:** Annual HMAP workshop, Esbjerg, Denmark
- 15-18:** Coral Reef Biodiversity Workshop sponsored by the U.S. National Committee, Oahu, HI
- 23-27:** Third International Albatross and Petrel Conference (IAPC), Montevideo, Uruguay (Side Workshop on OBIS-SEAMAP)

September

- 15:** FMAP-Seamounts sampling design workshop, Woods Hole, MA, USA
- 16:** FMAP-Zooplankton sampling design workshop, Woods Hole, MA, USA
- 16-18:** OBIS Regional Nodes meeting, Bedford Institute of Oceanography, Halifax, NS, Canada
- 20-23:** Mediterranean HMAP Workshop, Barcelona, Spain
- 23-24:** SCOR Meeting on Coordination of International Marine Research Projects, Venice, Italy (CoML participates)

October

- 4-5:** EuroCoML Meeting, Location TBD
- 29-31:** Canadian National Committee Workshop, Ottawa, ON, Canada

November

- 26-27:** Meeting of the OBIS International Committee, Hamburg, Germany
- 29-1 Dec:** Ocean Biodiversity Informatics International Conference on Marine Biodiversity Data Management (co-organized by OBIS), Hamburg, Germany

December

- 2-3:** SSC Meeting, Paris, France – Chairs of National and Regional Committees to attend
- 2-3:** Meeting of the CoML Outreach Liaisons, Paris, France
- 5-10:** 6th International Aquarium Congress, Monterey, CA, USA (USNC organizing a session on CoML)

7.3.2 International Antarctic Zone Program - iAnZone (Affiliated in 1996)

Goal and Objectives:

The primary goal of the international Antarctic Zone (iAnZone) program is to advance our quantitative knowledge and modeling capability of the seasonal cycle and interannual variability of the ocean and its sea ice cover, with emphasis on climate-relevant fluxes that couple the Antarctic Zone to the atmosphere and to the global ocean. The iAnZone group has been involved in the development and coordination of three large Antarctic zone projects and also organizes meetings intended to inform others of national research and field programs for the purpose of “value-added” linkages among the participants.

Terms of Reference

- To identify, develop, and coordinate research projects meeting the iAnZone goal.
- To provide a forum for the exchange of iAnZone research plans, results, and data.
- To participate in and assist with the coordination between Antarctic Zone and global climate research programs, with other Southern Ocean programs, and with colleagues.
- To advise SCOR on the development of appropriate observing system (e.g., for GOOS, GCOS), data sets, and modeling strategies needed to understand the scales and mechanisms of climate variability within the Antarctic Zone.

For more detailed information on iAnZone’s scientific programs, see their Web site at <http://www.ldeo.columbia.edu/physocean/ianzone/>

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Russell Frew	NEW ZEALAND	Mike Schroeder	GERMANY
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Alexander Klepikov	RUSSIA	Timo Vihma	FINLAND
Mauricio Mata	BRAZIL	Zhanhai Zhang	CHINA-BEIJING

Executive Committee Reporter: Roberto Purini

**SCOR AFFILIATED PROGRAMME - International Antarctic Zone (iAnZone)
Report of Activities for 2003 - 2004
37th Executive Committee Meeting of SCOR, Venice, September 2004**

Dr Karen J. Heywood (Chair of iAnZone)

Introduction

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. iAnZone (1) provides for exchange of ideas, plans, results and data; (2) identifies, develops and coordinates research projects consistent with the latter 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. Highly successful iAnZone projects completed in recent years include AnzFlux and DOVETAIL.

During 2003 there was some debate whether there was still a need for iAnZone as an international coordinating body. The remit of the newly formed CLIVAR/CliC Southern Ocean Panel included coordinating science of relevance to climate in the Southern Ocean. With some overlap of membership between iAnZone and the Southern Ocean Panel, it was felt that the community was suffering from meeting overload, and (to quote our Report to SCOR in June 2003), "other programmes stand poised to take over some of the functions filled by iAnZone". This was the prevailing view of iAnZone members going into the Southern Ocean Science Week at Bremerhaven in September 2003, where meetings of the iAnZone Steering Committee and the Southern Ocean Panel were held along with other science meetings.

However, at the Southern Ocean Panel meeting directly preceding the iAnZone meeting, it quickly became apparent that the Panel is neither interested in, nor suited for, taking on the sort of coordination that has been carried out in the past by iAnZone. It was clear that the two bodies have a very complementary role: the Southern Ocean Panel will encourage and endorse activities, whereas iAnZone will be the tool through which the coordination of international efforts in the region can be achieved. CLIVAR felt that such a coordinating role was important and that iAnZone was a suitable organization to continue in this role. Furthermore, with the International Polar Year (IPY) coming up in 2007-8, it was felt that the need for iAnZone is all the stronger.

Current Scientific Activities

ANSLOPE

Recognition of the importance of shelf and slope processes to deep water formation led to the fourth international iAnZone project: the Antarctic Slope project (ANSLOPE). This seeks to define the roles of the Antarctic slope front and continental slope morphology in the exchanges of mass, heat and freshwater between the shelf and oceanic regimes. Emphasis is on processes that control deep-reaching outflows of shelf water mixtures in the Ross Sea. Although primarily US-led, other participation includes the Italian CLIMA programme. The German BRIOS-2 coupled ice-ocean

modelling programme provides a large-scale modelling capability to complement process-driven field studies.

ISPOL-1

The Ice Station Polarstern (ISPOL-1) field programme will take place during austral spring-summer of 2004-2005. This is the fifth international iAnZone project. It will use the concept of a manned drifting station to study spring to early summer ocean and sea ice conditions along the western Weddell Sea outer continental shelf and upper slope region.

Future Scientific Activities

The meeting in Bremerhaven suggested that it would be timely for iAnZone to coordinate a major circumpolar study of the freshwater budgets and processes associated with the Antarctic Slope Front and coastal current. This will be the next (sixth) major project to be coordinated by iAnZone and is scheduled for 2007-2008. It is intended to contribute to the International Polar Year (IPY). Such a frontal study would link well with a corollary study of Arctic circumpolar frontal systems. Robin Muench, on iAnZone's behalf, prepared and submitted an outline to IPY in late 2003. This document is available on the iAnZone website. The first dedicated coordination workshop for this project, tentatively named AnzFront, will take place at the University of East Anglia (UEA) in Norwich, UK during August 2004.

Future Meetings

The 9th iAnZone biennial coordination meeting is planned to take place in Venice during October 2005. This meeting will be collocated with an IPAB meeting, an ISPOL science coordination workshop and a major conference on work in the Ross Sea. It is hoped that this will provide a successful mechanism for coordination of ongoing Southern Ocean research in much the same fashion as the September 2003 Southern Ocean Science Week held at AWI.

Committee Membership

Following the 8th iAnZone meeting in Bremerhaven in September 2003, a more-or-less complete overhaul of the Steering Committee membership was embarked upon since our intended 3-year rotations had been delayed in the light of uncertainties over the group's future. We are most grateful to all those who are rotating off and have given many years of excellent service to the committee:

Nathan Bindoff (Australia)
 Marc Garcia (Spain)
 Carlos Garcia (Brazil)
 Jouko Launiainen (Finland)

Alberto Piola (Argentina)
 Masaaki Wakatsuchi (Japan)
 Peter Schlosser (USA)
 Giancarlo Spezie (Italy)

The new members are as follows:

Karen Heywood (UK) Chair
 Vicky Lyttle (Australia) Co-Chair
 Robin Muench (ex officio as previous
 Chair, USA)
 Hartmutt Hellmer (ex officio as
 previous Co-Chair, Germany)
 Alexander Klepikov (Russia)

Shuki Ushio (Japan)
 Russell Frew (New Zealand)
 Zhanhai Zhang (China)
 Andrea Bergamasco (Italy)
 Mauricio Mata (Brazil)
 Mike Schroeder (Germany)
 Timo Vihma (Finland)

The iAnZone website, open to all, is available at <http://www.ldeo.columbia.edu/res/fac/physocean/ianzone/> and is used for exchange information regarding projects and opportunities in the Antarctic Zone. We are very grateful to Bruce Huber (LDEO) for maintaining the website on our behalf. He also maintains an iAnZone mailing list (ianzone@ldeo.columbia.edu) to which anyone may subscribe, that greatly facilitates rapid exchange of information and project planning.

7.3.3 International Marine Global Change Study (IMAGES) (affiliated in 1995)

IMAGES (International Marine Global Change Study) is a 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 CO₂. 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 pCO₂ over the past 300 kyr?
3. How closely has continental climate linked to ocean surface and deep-water properties?

Chair:

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Membership:

F. Abrantes	PORTUGAL	H. Kawahata	JAPAN
J. Backman	SWEDEN	K.L. Knudsen	DENMARK
L. Carte	NEW ZEALAND	D. Kroon	NETHERLANDS
M.T. Chen	CHINA (Taipei)	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	R. Schneider	GERMANY
E. Ivanovy	RUSSIA	J. Sopaheluwakan	INDONESIA
E. Jansen	NORWAY	T. Stocker	SWITZERLAND
N. Kallel	TUNISIA	P. Wang	CHINA (Beijing)

Executive Director:

Executive Committee Reporter: Roberto Purini

7.3.4 InterRidge - International Ridge Studies (affiliated in 1996)

InterRidge is an international and interdisciplinary initiative concerned with all aspects of mid-ocean ridge research. It is designed to encourage scientific and logistical coordination between researchers in all countries of the world, with particular focus on problems that cannot be addressed as efficiently by nations acting alone or in limited partnerships. InterRidge promotes the sharing of ridge-related technologies and facilitates internationally collaborative projects. InterRidge especially encourages the involvement of less industrialized countries in the study, use and protection of ridges. InterRidge has a clear obligation to inform and involve both the public and governments in and about ridge research.

Activities of the InterRidge office range from dissemination of information on existing, single-institution experiments to initiation of fully multi-national projects. The InterRidge website can be found at www.interridge.org.

Terms of Reference:

- To assist in defining and coordinating field programs and experiments through InterRidge working groups.
- To facilitate exchange of ideas/plans, e.g. by convening international workshops.
- To provide current information about research activities, especially sea-going operations through the InterRidge website and *IR News*.
- To help improve procedures for data management, exchange, synthesis, and preservation.
- To encourage participation of smaller oceanographic countries and individual scientists from non-seagoing countries.
- To continue to develop scientific, technical and logistical co-operation among nations and to strengthen international foundations for innovative research.

Chair:

Colin Devey
Head of Research Division "Dynamics of the
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Leibniz-Institut für Meereswissenschaften IFM-
GEOMAR
Gebäude Ostufer

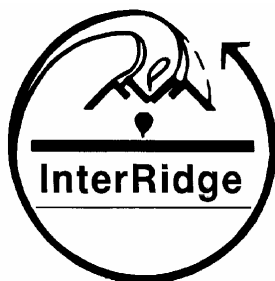
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Membership: InterRidge 2004 Steering Committee

<i>Canada</i>	Prof. Steven Scott	<i>Japan</i>	Prof. Kensaku Tamaki (ex-chair)
<i>China</i>	Dr. John Chen	<i>Norway</i>	Prof. Rolf Pedersen
<i>France</i>	Dr. Jérôme Dymont	<i>Portugal</i>	Prof. Fernando Barriga
<i>France</i>	Dr. Françoise Gaill	<i>Korea</i>	Dr. Sang-Mook Lee
<i>Germany</i>	Prof. Colin W. Devey	<i>UK Prof.</i>	Paul R. Dando
<i>Germany</i>	Dr. Nicole Dublier	<i>UK</i>	Dr. Damon Teagle
<i>India</i>	Dr. Abhay Mudholkar	<i>USA</i>	Dr. Charles Fisher
<i>Japan</i>	Prof. Toshitaka Gamo	<i>USA</i>	Dr. Deborah Smith
<i>Japan</i>	Dr. Masataka Kinoshita		

Programme coordinator: Katja Freitag

Executive Committee Reporter: Laurent Labeyrie



InterRidge Report 2004
By Katja Freitag
InterRidge Coordinator

Summary

The ocean ridges, which are the primary site of volcanic activity on the planet, form a close to 60 000 km long chain on the ocean floor. The associated hydrothermal activity exerts a major influence on the ocean's chemistry, while the hydrothermal vents support unique and complex ecosystems adapted to the high pressure, high thermal gradient conditions. Furthermore, mineral deposits have accumulated locally at some hydrothermal vent sites and mining companies are already investigating the possibility of economically exploiting these. And still, our understanding of many aspects of mid-ocean ridges is poor. Increased understanding of the mid-ocean ridges will be crucial for management and conservation of the oceans' resources in the future.

The scientific purpose of InterRidge is to discover and quantify the inter-relationships among the various manifestations of the ridge system and to integrate growing understanding of ridge dynamics with knowledge about the functioning of the Earth as a whole. These goals concern many subjects, from seismology to bacteriology, and require a variety of approaches at many different scales. To acquire global-scale data on the entire mid-ocean ridge system, international cooperation and planning is a necessity. InterRidge plays a vital role to facilitate international cooperation and thereby pool resources and expertise to address complex scientific ridge-related questions.

InterRidge provides a means to coordinate research projects that provides significant added value to the member nations who are part of an international program. Workshops organized by InterRidge working groups result in a synthesis of international/multidisciplinary effort that clearly identify scientific questions and areas that require investigation, as well as write project plans on how best to address these problems.

Providing up-to-date information is a fundamental part of InterRidge office activities, and the latest results from cruises are available on the InterRidge website as well as distributed to over 2700 scientists in the annual newsletter *IR News*. All relevant information obtained by the InterRidge office is available to the general community *via* the InterRidge website: <http://www.interridge.org>.

The second decade of InterRidge which began on 1 January 2004 will focus on bringing more countries into the program, increasing the profile of the program among the general public, governments and funding agencies as well as fostering more sophisticated and long-term research projects.

Background

InterRidge is an initiative that was created in 1992 with the main objective to support and develop programs addressing mid-oceanic ridge research. The programs are of major scientific interest, interdisciplinary, globally or thematically defined and, most importantly, require or will benefit from international discussion, planning and implementation. The original science plan for InterRidge was written in 1994 to cover a period of 10 years which came to an end in 2003. The InterRidge steering committee unanimously voted that the program should continue to exist and a new science plan was drafted for the second decade of InterRidge.

The first decade of InterRidge activity produced a united, coordinated international ridge community consisting of over 2700 active researchers from 55 countries. A number of countries that joined InterRidge (for example, Japan, India and China) can boast a great positive change in their ridge research activities within just a short period of time. Furthermore, important research projects were undertaken including workshops on many aspects of ridge science as well as global sampling of the ridges. Thus, the primary objective of InterRidge was achieved, and the focus in the new decade will reflect a shift of emphasis away from primarily fostering of contacts within the active community and move more strongly towards focusing on major, long-term scientific goals as well as education and outreach initiatives.

The second decade of InterRidge starts off with a new science plan, a strong sense of an integrated international ridge community and a strong foundation of scientific research achieved by InterRidge in the first decade. The program is ideally placed to play a leading role in facilitating major advances in ridge science. This includes more in-depth studies of the ridges and a look at future technological developments (including ships of the future). InterRidge will also focus on the sharing of resources, expertise and costs of scientific cruises as well as future ocean bottom observatories, all of which will increasingly depend on international and multidisciplinary collaborations to minimize research costs to individual nations while at the same time maximizing research output.

Organizational structure of InterRidge

The organizational structure of InterRidge established during the first decade has been found to work well and will be maintained. InterRidge is managed through the InterRidge office. The office is supported by annual membership fee contributions of the Principal (25 000 USD per annum) and Associate (5000 USD per annum) member countries. The location of the office rotates between the Principal member nations. This usually occurs every 3 years. As of the beginning of 2004, the office is hosted by Germany. The office moved from Tokyo to Bremen, and then moved to Kiel in May 2004 when the Chair, Colin Devey, accepted a position at the Leibniz Institut für

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Meeresforschung, IFM-GEOMAR. The office is currently managed by Colin Devey (Chair of the steering committee) and Katja Freitag (InterRidge Coordinator).

InterRidge has 3 levels of membership but only two of these (Principal and Associate) provide the opportunity for a given nation to be actively involved in InterRidge affairs, planning of future research programs and research direction. Germany upgraded its membership status to become a Principal member nation in 2003.

Currently 29 countries form the InterRidge member nations:

- 5 Principal members (France, Germany, Japan, UK and USA),
- 6 Associate members (Canada, China, India, Korea, Portugal and Norway),
- 18 Corresponding members (Australia, Austria, Brazil, China, Denmark, Iceland, Italy, Mauritius, Mexico, Morocco, New Zealand, Philippines, Russia, Spain, South Africa, Sweden, Switzerland and SOPAC).

Representatives from the Principal and Associate member nations form the steering committee. Principal member nations may have 2 steering committee members and Associate member nations may have 1 steering committee member. Ex-InterRidge chairs may remain on the steering committee. Working group chairs are invited to the steering committee meetings. The steering committee meets annually to plan and direct InterRidge activities. This is when the steering committee assesses working group proposals, establishes working group membership to oversee development and execution of various aspects of the InterRidge program. The InterRidge steering committee for 2004 was confirmed at the May 2004 steering committee meeting in Seoul, Korea.

2004 InterRidge Steering Committee

<i>Canada</i>	Prof. Steven Scott	<i>Japan</i>	Prof. Kensaku Tamaki (ex-chair)
<i>China</i>	Dr. John Chen	<i>Norway</i>	Prof. Rolf Pedersen
<i>France</i>	Dr. Jérôme Dymont	<i>Portugal</i>	Prof. Fernando Barriga
<i>France</i>	Dr. Françoise Gaill	<i>Rep of Korea</i>	Dr. Sang-Mook Lee
<i>Germany</i>	Prof. Colin W. Devey (Chair, 2004)	<i>UK</i>	Prof. Paul R. Dando
<i>Germany</i>	Dr. Nicole Dublier	<i>UK</i>	Dr. Damon Teagle
<i>India</i>	Dr. Abhay Mudholkar	<i>USA</i>	Dr. Charles Fisher
<i>Japan</i>	Prof. Toshitaka Gamo	<i>USA</i>	Dr. Deborah Smith
<i>Japan</i>	Dr. Masataka Kinoshita		

Each member nation has a national correspondent. This person is a vital component of InterRidge, as the national correspondents represent the main nodes of communication between InterRidge and the member nations.

2004 InterRidge National Correspondents*Principal Members:*

France	Dr. Jérôme Dymont	UK	Dr. Damon Teagle
Germany	Dr. Colin Devey	USA	Dr. Charles Fisher, RIDGE Chair
Japan	Prof. Nobuhiro Isezaki		

Associate Members:

Canada	Dr. Steve D. Scott	Korea	Dr. Sang-Mook Lee
China	Dr. Y. John Chen	Norway	Prof. Rolf Pedersen
India	Drs. Sridhar D. Iyer & K.A. Kamesh Raju	Portugal	Prof. Fernando Barriga

Corresponding Members:

Australia	Dr. Dietmar Müller	New Zealand	Dr. Ian Wright
Austria	Dr. Monika Bright	Philippines	Dr. Graciano P. Yumul, Jr.
Brazil	Dr. Suzanna Sichel	Russia	Dr. Sergei A. Silantyev
Iceland	Dr. Karl Gronvold	SOPAC	Dr. Russell Howorth
Italy	Prof. Paola Tartarotti	South Africa	Dr. Anton P. le Roex
Mauritius	Dr. Daniel P. E. Marie	Spain	Dr. Juan José Dañobeitia
Mexico	Dr. J. Eduardo Aguayo- Camargo	Sweden	Dr. Nils Holm
Morocco	Prof. Jamal Auajjar	Switzerland	Dr. Gretchen Früh-Green

InterRidge working groups remain the principal mechanism for implementation of the InterRidge program. Working groups oversee development and execution of various projects identified by the steering committee as areas that require, or will benefit from, international and multidisciplinary collaborations. The main function of the working groups is to provide a forum for the international ridge community to utilize their expertise to define and refine scientific questions and to focus interests, both geographically and thematically. This is achieved in the form of workshops, symposia and theoretical institutes. The end products are reports, which represent a synthesis of international and multidisciplinary efforts to pose the scientific questions and propose how best to address them. The reports often form the basis of grant proposals and carry the weight of international support and recognition.

InterRidge has no budget for funding data collection or analysis. Instead, its contribution to international ridge research is to facilitate and coordinate research. InterRidge achieves its objectives by:

- bringing the expertise of the international ridge research community together to identify priority issues, define questions and focus interests both geographically and thematically;

- facilitating the exchange of ideas and planning, for example, by convening international meetings and workshops;
- providing a unified voice to express the views and priorities of the international ridge community to other scientists, the general community, and most importantly, to government bodies, including national funding agencies and other international programs;
- assisting in defining and coordinating field programs and experiments;
- providing current information about research activities, especially seagoing operations, by publication of workshop reports and a semi-annual newsletter;
- encouraging participation of smaller oceanographic nations and individual scientists from non-seagoing nations; and
- providing an international electronic directory of InterRidge researchers.

InterRidge “Next Decade” Science Plan

The working structure of InterRidge during its first decade was very effective. There were three InterRidge themes - (1) Global Studies, (2) Meso-Scale Studies and (3) Active Processes – that were subdivided into various working groups. Five of the nine working groups completed their plans, four will continue to be active during the next decade (Table 1). In general, the working structure of InterRidge will continue into the next decade, the focus will, however, be slightly changed. In the next decade InterRidge will be looking towards long-term observatories and more complex investigations.

Table 1. FIRST DECADE INTERRIDGE WORKING GROUPS

<i>Theme</i>	Timeframe	Chair	Country
1. Global Studies			
<i>Arctic ridges WG</i>	1995-2003	Colin W. Devey	Germany
<i>Global digital database WG</i>	1995-2002	Philippe Blondel	UK
<i>Global distribution of hydrothermal activity WG</i>	1998-2002	Chris German	UK
<i>SWIR (Southwest Indian ridge) WG</i>	1994-2002	Catherine Mével	France
2. Meso-Scale Studies			
<i>Back-arc basins database WG</i>	1995-present	Sang-Mook Lee	Korea
3. Active Processes			
<i>Biological studies at the ridge crest WG</i>	1994-present	Françoise Gaill S. Kim Juniper	France Canada
<i>Undersea technology WG</i>	1996-2002	Spahr C. Webb	USA
<i>Hotspot-ridge interactions WG</i>	2000-present	Jian Lin Jerome Dymont	USA France
<i>Monitoring and observatories WG</i>	2002-present	Javier Escartin	France

The initial Working Groups identified in the “Next Decade” science plan are not intended to be the exclusive research areas of interest to InterRidge. Therefore, the InterRidge “Next Decade” science plan allows for new ideas and working groups to be proposed. New proposals from the international ridge community must require/benefit from coordination on international and interdisciplinary levels and will be assessed at the annual InterRidge steering committee meetings.

Scientific objectives

New scientific objectives have been outlined for the various principal themes. The details can be obtained from the “Next Decade” science plan available on the InterRidge website: <http://www.interridge.org/irnd.pdf>.

The InterRidge working groups have proven very effective at both fostering international collaboration and, through the organization of workshops, in defining clear program plans for the attainment of new ridge research objectives. Without InterRidge it is clear that many projects would not have been achieved. The “Next Decade” science plan identifies a number of themes that will constitute the core of InterRidge research focus in the upcoming decade (Table 2).

Table 2. “NEXT DECADE” INTERRIDGE WORKING GROUPS

<i>Theme</i>	<i>Background</i>	<i>Start</i>	Chair
Ultraslow-spreading ridges	<i>Non-geographic emphasis, merged Artic & SWIR Ridge WGs</i>	2004	Jon Snow Germany
Ridge-hotspot interaction	<i>No change to previous WG</i>	2000	Jian Lin USA Jérôme Dymont France
Back-arc spreading systems/Back-arc basins	<i>Continuation of Back-arc basins database W/G</i>	1995	Sang-Mook Lee Korea
Mid-oceanic ridge ecosystems	<i>Continuation of Biological studies at the ridge crest WG, new co-chair</i>	1994	Françoise Gaill France Nicole Dublier Germany
Monitoring and observatories	<i>No change to previous WG</i>	2002	Javier Escartin France Ricardo Santos Azores
Deep earth sampling	<i>New WG</i>	2004	Benoit Ilsedefonse France
Global exploration	<i>New WG</i>		<i>to be announced</i>
Biogeochemical interactions at deep-sea vents	<i>New WG (proposal accepted May 2004)</i>	2004	Nadine le Bris France

InterRidge also plans to redouble its efforts in strengthening contacts to the less industrialized and non-coastal nations, heightening the appreciation that the world’s oceans are relevant to the lives of all the peoples on Earth.

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InterRidge meetings and workshops 2003 - 2005

Recent and upcoming meetings

IR Symposium and Workshop: Ridge-Hotspot Interaction: Recent Progress and Prospects for Enhanced International Collaboration, 8 - 10 September 2003, Brest, France

InterRidge Workshop: Opportunities and Contributions of Asian Countries to the InterRidge Next Decade Initiative, 27-29 October 2003, Beijing, China

Joint R2K-InterRidge Theoretical Institute: Interactions among Physical, Chemical, Biological, and Geological Processes in Back-arc Spreading Systems on back-arc basins and back-arc spreading systems, 24-28 May 2004, Jeju Is., Korea

InterRidge Steering Committee Meeting 21-22 May 2004, Korea

InterRidge/IndiaRidge workshop: Indian Ocean Ridges 19-21 January 2005, Goa, India.

Recent workshops

RIDGE 2000-InterRidge Joint Theoretical Institute (R2K-IRTI): Interactions among Physical, Chemical, Biological, and Geological Processes in Back-arc Spreading Systems, May 2004

Objectives

- What can we learn from back-arc spreading systems about larger, global geological, biological and oceanographic systems?
- What can we learn from back-arc regions about the interconnectedness of, and interplay among the solid earth, magmatic, hydrothermal, biological, and oceanic components of individual spreading systems?

Functional goals

- To foster communication among individuals from different national and disciplinary groups
- To identify timely and emerging research directions and scientific questions, emphasizing the interactions, linkages, and feedbacks among the various part so back-arc spreading systems, “from mantle to microbe.....”

Organizing Committee

Sang-Mook Lee, KORDI, Korea – Local Organizer (smlee@kordi.re.kr)
 Kensaku Tamaki, Univ. of Tokyo, ORI, Japan (tamaki@ori.u-tokyo.ac.jp)
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 Daniel Desbruyeres, IFREMER, France (Daniel.Desbruyeres@ifremer.fr)
 Anna-Louise Reysenbach, Portland State Univ., USA (reysenbacha@pdx.edu)

This was a highly successful Ridge2000-InterRidge Joint Theoretical Institute that took place on Jeju Island in Korea. 80 researchers from around the world took part, and the outcome was a new way forward for the back arc basin working group's research as well as finding a new membership for the working group.

Thanks to a travel grant from SCOR, a person from Tonga took part in this TI. This person is influential in his government in that he recommends accepting or rejecting cruise proposals in Tongan waters to his king. He agreed that by participating in the TI, he has a better understanding of the research that is proposed, and he now sees the positive implications for allowing back arc basin research to take place in his part of the world.

Distribution of information by the InterRidge office

Information and data exchange services are a major component of the InterRidge office activities. We provide information to a worldwide audience, mainly in electronic format. This includes regular emails on upcoming events of interest to the scientific community, current articles on cruises, working groups etc. that are posted on the InterRidge website and then collated into an annual newsletter, and publications that result from InterRidge workshops and symposia. Publications are freely available to scientists and students and with the onset of online publications, InterRidge can be accessed by a wide community.

Hardcopies of all publications can be requested from the office. Currently, over 2700 people from 55 countries receive IR News. IR News is an important means of providing the most recent and up-to-date research articles to scientists without easy access to the web. Due to budget constraints, IR News will come out annually rather than biannually, however all IR News articles will be available online as soon as they are accepted and edited.

The InterRidge website contains various information including databases. It has become clear that the resources of the InterRidge office are not sufficient to maintain extensive databases. During the next decade the InterRidge office will concentrate on maintaining the database of ridge researchers and will create portal pages with information about relevant databases around the world. The existing InterRidge databases will be amalgamated with other databases such as "pangea" and/or "ChEss" databases.

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Summary of 2003-2004 Publications

IR News, vol. 12, no. 1, pp. 52, May 2003

InterRidge Steering Committee Report, June 2003

InterRidge – the next decade: a science and structure plan for ridge research 2004-2013, August 2003

Abstract volume - IR Symposium and Workshop: Ridge-Hotspot Interaction: Recent Progress and Prospects for Enhanced International Collaboration.

IR News, vol. 12, no. 2, pp. 52, November 2003

Working group meeting report – Mid-ocean ridge ecosystems, February 2004

Outreach

InterRidge has a major role to play in educating the public and policy-makers about the global significance of ridges. For this reason, InterRidge has hired Kristen Kusek into a new position, education and outreach coordinator. Kristen has spearheaded deep ocean education outreach efforts for the last five years. The InterRidge outreach goals are timely and significant. They include a wide variety of initiatives, such as downloadable presentations on the web to be used by InterRidge scientists in any member country, a video series highlighting ridge research for school systems and informal education settings (e.g., museums, science centers) worldwide, and education workshops to be held at various IR-related meetings. InterRidge is seeking outside funding to be able to support these outreach initiatives.

InterRidge contacts with other programs

InterRidge is also concerned with research carried out under other programs, providing it is highly relevant to achieving overall InterRidge aims. An example is strengthening interactions with the Integrated Ocean Drilling Program (IODP). Similarly, research areas such as whole-mantle seismic tomography, satellite altimetry, and certain theoretical and experimental studies are of vital interest to the development of ridge science.

Collaborations with other international programs, SCOR, ODP, IAVCEI, were pursued through the joint coordination of working groups and workshops.

- ChEss (Biogeography of Chemosynthetic Ecosystems), a project of the Census of Marine Life
- ILP (International Lithosphere Project)
- SOPAC (South Pacific Geosciences Applied Commission)
- SCOR (Scientific Committee on Oceanic Research)
- ODP/IODP (Ocean Drilling Program/Integrated Ocean Drilling Program)
- ISA (International Seabed Authority)

Benefits of affiliation to SCOR

The prime objective of InterRidge is to facilitate collaborative research at an international level and thereby maximize the use of resources. For InterRidge to live up to its goal of facilitating international/multidisciplinary collaboration it needs to be able to interact with scientists from many nations and organize meetings to create opportunities for scientists to get together. Countries without the capacity to carry out ridge research independently most often also have difficulty in raising funds to send representatives to InterRidge meetings and workshops.

There are many benefits that InterRidge gains through its affiliation to SCOR and vice versa. Recently SCOR has, for the first time, provided financial support for a representative from a developing nation (Tonga) to attend an InterRidge meeting (Theoretical Institute on Back-arc basins, Korea May 2004), giving Tonga an outstanding opportunity to become actively involved in a research field which directly affects them and their territorial waters. InterRidge itself has, at present, no resources to provide such financial support, so this support from SCOR is enormously important to help our efforts to reach and involve developing nations. Also, the advice provided by the SCOR Executive Committee about the possible liaisons of InterRidge to other international projects such as IODP is invaluable. The InterRidge deep earth sampling working group was formed which will, among other issues, focus on submitting “project-type” proposals to IODP (as opposed to individual-type drilling proposals).

The success of InterRidge is measured by the benefit of the program to the international ridge community. InterRidge therefore benefits from an affiliation with SCOR in that the international profile and impact of InterRidge on ridge research worldwide is increased. This enhances its support and the facilitation of international collaborations and development of new research projects. Closer ties between InterRidge and SCOR will definitely be beneficial to both programs. InterRidge can benefit by receiving support and advice from SCOR, and SCOR will definitely benefit by giving a boost to this internationally successful program.

7.3.5 International Ocean Colour Coordinating Group (IOCCG) (Affiliated in 1997)

IOCCG is an international group of experts in the field of satellite ocean colour that acts as a liaison and communication channel between users, managers, and agencies in the ocean colour arena.

Terms of Reference:

- To serve as a communication and coordination channel between data providers and the global user community of satellite ocean-colour data, and so to maximize the benefits that accumulate from international investments in ocean-colour science and technology.
- To construct a partnership, at the international level, between the space agencies and the users of satellite ocean-colour data to develop and coordinate data utilization.
- To work closely with the appropriate international bodies (including CEOS, IOC and SCOR), international scientific programs (such as IGBP and GOOS), satellite ocean-colour mission offices and other agencies (such as environmental and fishing agencies) to harmonize the international effort and advance ocean-colour science and its applications.
- To develop a collective voice for the community of users of ocean-colour data and to articulate this voice to the appropriate international bodies, international scientific programs and space agencies.
- To promote the long-term continuity of satellite ocean-colour data sets; the development of operational, ocean-colour data services and new generations of ocean-colour sensors; and the integration of data from complementary ocean sensors.

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Huang Ahn	KOREA	Nicolas Hoepffner	ITALY/JRC
David Antoine	FRANCE	Vivian Lutz	ARGENTINA
Ichio Asanuma	JAPAN/NASDA	Mervyn Lynch	AUSTRALIA
Ray Barlow	SOUTH AFRICA	Shailesh Nayak	INDIA
Paula Bontempi	USA/NASA	Michael Rast	ESA
Christopher Brown	USA/NOAA	Ian Robinson	UK
Curtiss Davis	USA/Naval Res. Lab	Tasuku Tanaka	JAPAN
Pan Delu	CHINA	Eric Thouvenot	FRANCE/CNES
Roland Doerffer	GERMANY	Ron Zaneffeld	USA
Robert Frouin	USA		

Executive Committee Reporter: John Field

International Ocean-Colour Co-ordinating Group (IOCCG)

an Affiliated Program of the Scientific Committee on Oceanic Research (SCOR), and
an Associate Member of the Committee on Earth Observation Satellites (CEOS)

June, 2004

Background

The International Ocean-Colour Co-ordinating Group (IOCCG) was founded in 1996 following a resolution endorsed by the Committee on Earth Observation Satellites (CEOS). The group acts as a liaison and communication channel between the providers and users of ocean-colour data, promoting international co-operation in various aspects of ocean-colour science and technology. In 1998 the group became an Affiliated Program of the SCOR, which provided infrastructure support and financial management to the group. This year, SCOR will be transferring all IOCCG funds to the POGO Secretariat, which is also housed in the Bedford Institute of Oceanography. POGO will then be responsible for the overall management of IOCCG finances, although SCOR would still act as a conduit for funds from selected Agencies. The IOCCG is chaired by Dr. Trevor Platt of the Bedford Institute of Oceanography, Canada and a Project Office has been set up at the Institute, staffed by a Project Scientist (Dr. Venetia Stuart). In 1999 the IOCCG became an Associate Member of CEOS.

About the IOCCG

The IOCCG consists of an international committee of 20 experts in the field of satellite ocean colour, with representatives from the providers of ocean colour data (*i.e.* space Agencies) as well as the user communities (*i.e.* scientists, managers). IOCCG's mandate is to serve as an international focal point for the promotion of ocean-colour remote sensing, the discussion and resolution of technical and scientific issues, and training in the use of ocean-colour data. One of the Terms of Reference of the IOCCG is to promote the long-term continuity of ocean-colour data sets by building a multi-sensor, multi-year ocean-colour archive to examine mid- to long-term changes in phytoplankton biomass. A number of issues need to be addressed before this can be done including the calibration of each sensor, inter-calibration between different instruments, algorithm differences and also data-binning issues. Many of these issues are currently being addressed by various IOCCG working groups (see below).

The IOCCG also has a strong interest in education, especially in developing countries, and has conducted and sponsored a number of advanced training courses on applications of ocean-colour data. These courses have been in high demand and have helped to broaden the ocean-colour user community as well as advocate the importance of ocean-colour data.

Activities of the IOCCG are dependent upon financial contributions from national Space Agencies and other ocean-colour related groups, and upon infrastructure support from SCOR.

On-going Activities of the IOCCG

Scientific Working Groups

A number of specialised working groups have been set up by IOCCG to investigate various aspects of ocean-colour technology and its applications. Many of the working groups are examining issues that need to be addressed before data from different sensors can be merged. The end product of these working groups is usually the publication of an IOCCG report, a technical memorandum or a recommendation to Space Agencies or to CEOS. To date, three such reports have been published by the IOCCG, a recommendation on Standardizing the Extraterrestrial Solar Flux Spectrum has been endorsed by CEOS, and numerous letters of recommendation have been written to various Space Agencies on technical matters.

Currently, there are seven IOCCG working groups in various stages of progress. A brief summary of each working group's activities is given below.

- i) **Ocean-Colour Data Binning Issues** (Chair: Dr. David Antoine, LOV, France). The objectives of this group were to examine the time-and space-binning schemes used by various ocean-colour missions, to summarise the rationale for the different approaches and to recommend one or more approaches that each mission should incorporate in order to facilitate the merging of data sets from different ocean-colour sensors. The final report, entitled “***Guide to the Creation and Use of Ocean Colour, Level-3, Binned Data Products***” is currently being typeset, and will be published by the IOCCG this year. Copies will be mailed, free of charge, to all subscribers.
- ii) **Comparison of Atmospheric Correction Algorithms** (Chair: Dr. Menghua Wang, Univ. Maryland). The objectives of the working group are to quantify the performance of atmospheric correction algorithms used by various ocean-colour satellite sensors. In addition the group has examined how the derived products from various ocean-colour missions could be meaningfully compared and possibly merged. Some additional analyses of the performance of various algorithms still need to be carried out, but the group hopes to meet again sometime within this calendar year to complete the draft report, which should be submitted by the end of 2004. The draft report is entitled “***Comparison of Atmospheric Correction Algorithms from the Various Operational Ocean-Colour Missions***”.
- iii) **Co-ordination of Merged Data Sets** (Co-chairs: Watson Gregg and Paula Bontempi, NASA). The objectives of this working group are to develop a procedure to be used by Agencies to merge ocean-colour data from various ocean-colour sensors in order to produce a self-consistent, long-term time series of satellite-derived ocean biogeochemical observations. Although the IOCCG does not have the resources to produce a large, merged, data set, it could help implement a strategy to achieve this. The group plans to schedule a meeting in summer/fall this year, to try to reach a consensus about how ocean-colour data should be merged. Possible topics for the final

report would include the benefits of merging (better coverage, improved accuracy), which missions are available, knowledge requirements for merging, output requirements, products to be merged (just chlorophyll, or Lwn, PAR etc.), a review of methodologies in use, and conclusions/recommendations.

- iv) **Operational Ocean-Colour** (Chair Dr. Christopher Brown, NOAA). The goals of this working group are to promote the use of near-real-time ocean-colour products, to facilitate the exchange of ocean-colour applications, and to assist in the exchange of ideas and approaches among Agencies that currently possess, or will establish, an operational ocean-colour mission. The group intends to publish a report entitled “*Why Ocean Colour?*”, a draft report of which will be submitted to the Committee on 12 October 2004.
- v) **Radiometric Calibration of Satellite Ocean-Colour Sensors** (Chair Dr. Robert Frouin, Scripps). The objectives of this group are to make recommendations about how to calibrate satellite ocean-colour sensors based on requirements and available calibration techniques. The group plans to hold a one-day workshop in Perth this year (after the Ocean Optics XVII symposium) and will eventually publish a report, which will include interpretation of pre-launch and post-launch calibration procedures. The final IOCCG report will address the advantages and disadvantages of various calibration methods, and will also include recommendations from NASA’s MODIS calibration workshop and CEOS’s IVOS inter-comparison of all large-scale optical sensors.
- vi) **Ocean Colour Algorithm Working Group** (Chair Dr. ZhongPing Lee, Naval Research Laboratory). The objectives of this group are to perform algorithm cross-comparisons, and to report on the progress of algorithm development. The group has synthesised a database (with the help of Dr. Du in China) for systematic comparison and testing of algorithms, which is now available on the IOCCG web page. Preliminary comparisons using a number of different inversion algorithms have been carried out. The group is currently creating another dataset that will include contributions from inelastic scattering and the algorithms will be tested again. In addition, a dataset using *in situ* measurements from the SeaBASS Programme will also be compiled (with the help of Dr. Stephane Maritorena), for algorithm testing. A workshop will be held later this year.
- vii) **Global Ecological Provinces** (Chair Dr. Mark Dowell, JRC). The objectives of this group are to review various aspects of the use of ocean colour as a tool for delineation of dynamic boundaries in ocean partitions, and to write a synthesis in the form of an IOCCG report. A successful meeting was held in Villefranche last year (15-17 October 2003), where the Terms of Reference for the working group were defined and a detailed outline of the report was drawn up, with associated writing responsibilities. Another meeting is planned for September this year, in Ispra (Italy). Draft copies of the first four chapters of the report will be distributed to all participants of the second workshop. The report will be tentatively entitled “*Role of Ocean Colour in Ecological Partitioning of the Sea: Development and Applications*”.

Capacity-Building Initiatives

The IOCCG is committed to expanding the user base worldwide in the applications of ocean-colour data through training courses and workshops, particularly in developing countries. Over the past year, IOCCG has sponsored a number of training activities:

- i) Last year IOCCG sponsored a workshop in Mar del Plata, Argentina (7-11 July 2003) to help establish a South American network to study long-term changes in coastal ecosystems, and to set up a database of satellite and *in situ* observations for scientific, educational, and management purposes. The main outcomes from the workshop were the definition of the main goals and specific objectives of such a network, to be called ANTARES, and the draft of a Small Grant Proposal (SPG). The proposal was submitted to IAI and was recently approved. This group has gained credibility with their first proposal, and should be able to approach other bodies for funding. This is a good example of the beneficial side-effects of IOCCG training courses (the idea of the workshop was developed at an IOCCG training course held in Chile the previous year).
- ii) IOCCG co-ordinated and sponsored an ocean-colour training course in Bali, Indonesia (1-5 September 2003), coinciding with the inauguration of CreSOS (Center for Remote Sensing and Ocean Science). IOCCG sponsored 8 trainees from outside Indonesia, as well as two lecturers. A total of 21 students learnt to process ocean-colour data from OCTS, GLI and SeaWiFS sensors using SeaDAS software and were also given a number of lectures on the basics of ocean-colour.
- iii) IOCCG sponsored an Ocean Remote Sensing Capacity Building workshop in Brisbane, Australia (30 September - 3 October, 2003) aimed at participants from South Pacific nations. Topics covered included coral reefs and fisheries management, with several case studies and presentations from delegates. There was an expertise base in GIS, but little knowledge in ocean science. An interest was shown in assimilating remote-sensing data into ecological models.
- iv) IOCCG offered a total of three fellowships for on-board, bio-optical training during the JAMSTEC BEAGLE expedition (July 2003 – February 2004). Each student participated in one leg of the cruise (~ 4 weeks long) and received intensive training in light measurements, CTD sampling, collecting pigment samples, measuring phytoplankton and CDOM absorption and performing photosynthesis-irradiance measurements. Trainees submitted detailed reports with preliminary results after each leg (reports available on IOCCG homepage).
- v) Last year IOCCG implemented a Fellowship Programme for young scientists from developing countries to receive training at a foreign institute. This year, three Fellowships were awarded to students from Brazil, China and Korea. These students received hands-on training at an institute of their choice for up to 3 months. The IOCCG fellowship programme is very successful, but is based on surplus funding, which dictates the number of students sponsored each year.

IOCCG Homepage

IOCCG advocates the importance of ocean-colour data to the global community through maintaining and updating a comprehensive web page (<http://www.ioccg.org>), which provides a wealth of information on many aspects of ocean-colour including sensors, publications, conferences, training opportunities, ocean-colour data and employment opportunities. In addition, the IOCCG distributes a newsletter via the internet every 2-3 months to around 1,000 subscribers. These newsletters keep the ocean-colour community informed of important events, research activities, training initiatives and instrument news. NASA has acknowledged the importance of the IOCCG homepage by creating a prominent link from their “Ocean Color Web” page.

IOCCG Committee Meetings

The IOCCG Committee meets once a year to co-ordinate the activities of the group as a whole and to plan and discuss future activities. The Executive Committee also meets once a year to discuss financial matters. The next Committee meeting is scheduled to take place in Venezuela (Margarita Island) from 19-21 January 2005.

Plans for 2004/2005

Many of the activities of the IOCCG are ongoing. IOCCG will support the meetings of the various scientific working groups including the Data-Merging (summer/fall), Ecological Provinces (September), Calibration (October) and the Algorithm working groups, and will encourage all groups to prepare and submit draft reports. IOCCG will also prepare the final report of the Data-Binning working group for publication (editing, formatting in Tex, figure preparation) and will distribute it free of charge to anyone with a bona fide interest.

As far as training activities are concerned, IOCCG will support a workshop on ocean colour immediately preceding the Ocean Optics XXVII conference in Perth (October 2004). IOCCG will also sponsor and co-ordinate a workshop in Montevideo (Uruguay) in early December, to train students in the use of remotely sensed ocean-colour data. Scholarships will be offered to students from Latin America to attend this training course.

The Project Office will continue to maintain and update the IOCCG website and provide a news service. The annual IOCCG Committee meeting is scheduled to take place in January 2005.

Current Membership of the IOCCG

The IOCCG Committee is chaired by Dr. Trevor Platt and consists of 20 members drawn from Space Agencies and the ocean-colour community, selected to reflect a balance of both providers and users of ocean-colour data as well as geographical location. The term of service is usually three years except where the members’ participation is governed by a Space Agency nomination. Rotation of members is being implemented according to a roster. Next year, three members (indicated with an asterisk) will step down from the Committee.

IOCCG Committee Members (2004)

Ahn, Huang	-	Korea Ocean Research and Development Institute
Antoine, David	-	Laboratoire de Physique et Chimie Marines, France
Asanuma, Ichio	-	NASDA/EORC, Japan
Barlow, Ray	-	MCM, Cape Town, South Africa
Bontempi, Paula	-	NASA HQ, USA
Brown, Chris	-	NOAA/NESDIS, USA
Davis, Curtiss	-	Naval Research Lab, USA
Delu, Pan	-	Second Institute of Oceanography, China
Doerffer, Roland*	-	GKSS, Germany
Frouin, Robert*	-	Scripps, USA
Hoepffner, Nicolas	-	Joint Research Center, Ispra, Italy
Lutz, Vivian	-	INIDEP, Argentina
Lynch, Mervyn	-	Curtin University, Australia
Nayak, Shailesh*	-	ISRO, India
Platt, Trevor	-	Bedford Institute of Oceanography, Canada
Rast, Michael	-	ESA/ESTEC, Netherlands
Robinson, Ian	-	University of Southampton, UK
Tanaka, Tasuku	-	EORC/NASDA, Tokyo, Japan
Thouvenot, Eric	-	CNES, France
Zaneveld, Ron	-	Oregon State University, USA

List of Current Sponsors

- BIO (Bedford Institute of Oceanography)
- CNES (Centre National d'Etudes Spatiales)
- CSA (Canadian Space Agency)
- ESA (European Space Agency)
- IOC (Intergovernmental Oceanographic Commission)
- JAXA (Japanese Aerospace Exploration Agency)
- JRC (Joint Research Centre, EC)
- NASA (National Aeronautics and Space Administration)
- NOAA (National Oceanic and Atmospheric Administration)

This year, the Canadian Space Agency became a new sponsor of the IOCCG. The recent loss of the Japanese ADEOS-II satellite had serious impacts on funds available for ocean-colour activities; consequently JAXA was not be able to provide support for IOCCG this year, although there is a strong possibility for future sponsorship from JAXA. The Bedford Institute of Oceanography (Department of Fisheries and Oceans) provides a range of in-kind support to IOCCG (office space, informatics support, postage, telephone etc.). SCOR has provided financial management of IOCCG

funds, and an efficient mechanism for coordination with organizations such as the IOC.

7.4 Other Organizations

7.4.1 Partnership for Observation of the Global Ocean (POGO)