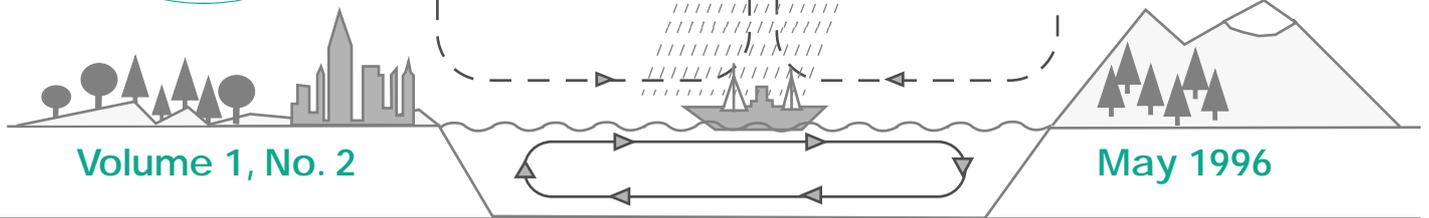


Exchanges



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Welcome to *Exchanges*

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A Note from the Director of the WCRP

CLIVAR raises high expectations in the climate research community. Many of the unanswered questions on the functioning of the climate system on time scales up to a century including the influence of mankind on global climate, are part of the CLIVAR Science Plan. Scientists, politicians and the public, alike, await rapid implementation in order to get answers to their preferred questions soon. However, the success of CLIVAR in providing these answers will also depend on the advances of each of the other WCRP component projects, namely WOCE, GEWEX, SPARC and ACSYS. The implementation of CLIVAR, therefore, is likely to proceed in a stepwise manner, on several fronts.

After TOGA has shown that there is some predictability of the strongest ocean-atmosphere interaction phenomenon the El Niño / Southern Oscillation in the tropical Pacific time is ripe for a similar attempt in CLIVAR-GOALS to detect the predictable portion of the Asian-Australian monsoon for the benefit of 3/5 of the world population. However, this means an intensified observing system in the Indian Ocean and strongly improved land surface parameterizations in Atmospheric General Circulation Models developed within GEWEX.

Extending climate variability and predictability studies to decades, as in CLIVAR DecCen, again needs a stepwise approach. CLIVAR will promote the careful diagnosis of the climate for the period of direct observations, in concert with coupled modelling studies, to determine the regions where additional observations are needed (e.g. sub-tropical gyre and/or deep oceanic convection). The new observation should try to exploit the ocean memory for predictability and build on WOCE results. An extension into the era where only proxy data exist, is needed to answer questions like "Do the frequency and intensity of El Niño show secular trends?". However, these studies should be limited to methods with a clear, yearly dating resolution and thus will

be restricted to a few centuries. This effort will continue to take advantage of the expertise in Past Global Changes (PAGES), an IGBP core project.

Any present and future climate study over the decades can no longer be conducted without considering the influence of mankind on global climate. Besides continuing its task of improving scenario calculations, CLIVAR ACC will soon be asked as the main resource for advice on regionalized climate variability information (including extremes). Such information is urgently needed for impact studies, as well as for a better understanding of ongoing climate change. A clear strategy on how to further regionalize large-scale model output is thus a key point for CLIVAR implementation (this also implies CLIVAR GOALS). I am pleased to see that CLIVAR is developing its initial implementation plan for presentation at the next JSC in March 1997.

H. Graßl

The World Climate Research Programme (WCRP)

In our first issue we described the initial components and structure of the CLIVAR programme. CLIVAR is a major component of the World Climate Research Programme, the principal, international scientific programme for addressing the physical components of the climate system. The following paragraphs briefly outline the structure of the WCRP and how its component activities are connected and reviewed. This section serves as an introduction and background to the summary of the meeting of the XVIIth Session of the Joint Scientific Committee (JSC) in Toulouse during March this year.

WCRP DEFINITION AND GOALS

The purpose of the World Climate Research Programme (WCRP), which is jointly supported by the World Meteorological Organization (WMO), the International Council of Scientific Unions (ICSU) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, is to develop the fundamental scientific understanding of the climate system and climate processes that is needed to determine the limits of climate prediction and the extent of man's influence on climate. The programme encompasses studies of the global atmosphere, oceans, sea and land ice, and the land surface as well as their coupling. The scientific priorities of WCRP are established by its Joint Scientific Committee (JSC) in concert with the international climate research community. Implementation of the programme takes place through the Joint Planning Staff (JPS) in Geneva and the International Project Offices (IPOs).

WCRP OBJECTIVES

To achieve its goals, the WCRP has the following broad objectives:

To design and implement observational and diagnostic research activities that will lead to a quantitative understanding of significant climate processes including: the transport and storage of heat by the ocean, the exchange of heat, moisture and momentum between atmosphere, ocean and sea-ice, and the interaction among cloudiness, radiation, the land-surface and the global hydrological cycle;

To develop global models capable of simulating the present climate and, to the extent possible, of predicting climate variations on a wide range of space- and time-scales.

WCRP RESEARCH ACTIVITIES

Research activities in WCRP may be characterized as:

Studies aiming to understand and model the "fast" climate processes, mainly in the atmosphere and at the Earth surface, that regulate the flow and transformation of energy, radiation and heat as well as the near-surface hydrological processes. The Global Energy and Water Cycle Experiment (GEWEX) provides the scientific focus for studies of the atmospheric thermodynamic variations that determine the global hydrological cycle and energy budget;

Studies aiming to understand and model the "slow" response of the ocean and ice to changes in atmospheric forcing, in order to predict natural climate variations and the transient response of climate to progressively changing environmental conditions. WCRP's Climate Variability and Predictability programme (CLIVAR) is being implemented to deal with these issues. As described in the first issue of Exchanges, CLIVAR will advance the findings of the successfully completed Tropical Ocean and Global Atmosphere (TOGA) Programme, and will expand on work now under way in WCRP's World Ocean Circulation Experiment (WOCE) and the Arctic Climate System Study (ACSYS).

Another WCRP research activity playing an important role in better understanding the climate system is the Stratospheric Processes and their Role in Climate (SPARC) study.

Each of the component programmes has several panels and working groups to address specific scientific issues with oversight effected through a scientific steering group.

The development of global climate models is an important unifying component of the WCRP, building on scientific and technical advances in the discipline-oriented activities. Models also provide the essential means of ex-

plotting and synthesizing in a synergistic manner all relevant atmospheric, oceanographic, cryospheric and land-surface data collected in WCRP and other programmes. The Working Group on Numerical Experimentation (WGNE), jointly sponsored by the JSC of WCRP and the WMO Commission for Atmospheric Sciences (CAS), together with the numerical experimentation groups of the component WCRP programmes lead and co-ordinate the development and use of atmospheric circulation models and coupled ocean-atmosphere-land models for climate studies.

WCRP OBSERVATIONAL NEEDS

A primary requirement for achieving the goals of WCRP is a comprehensive global system for observing the climate parameters needed to improve the understanding of climate-forming mechanisms, to provide a description of the present state of climate, to monitor climate variability, and to serve as a basis for initiating climate predictions.

Existing observing programmes implemented through the World Weather Watch (WWW) and other WMO activities provide for the acquisition and processing of important climate information. The Global Climate Observing System (GCOS) now being developed is expected to include operational or quasi-operational observing systems that could be used to support well-established climate prediction capabilities and applications, and to characterize climate impacts on the environment.

The needs of the climate research community, however, include data not usually available from operational centres. WCRP therefore plans to continue observational projects as part of its overall strategy in order to satisfy specific and evolving scientific needs. Examples of such projects include the International Satellite Cloud Climatology Project ISCCP, the International Satellite Land-Surface Climatology Project ISLSCP and the Global Precipitation Climatology Project GPCP currently being developed principally within the context of GEWEX. As CLIVAR develops, we expect to see requirements being laid down for the continuation of WOCE and TOGA observing systems and expansions beyond that will not necessarily be incorporated into GCOS. Plans are being developed to manage the data from all of the WCRP programmes within a WCRP Data and Information Service that will produce reliable and documented global research/quality datasets on appropriate media (e.g. CD-ROM) for use by the climate research community.

For additional information, see the WCRP Web site at:

<http://www.wmo.ch/web/wcrp/wcrp-home.html>

Further links to WCRP related Web sites can be found at this site and at the CLIVAR site:

<http://www.dkrz.de/clivar/hp.html>

XVIIth session of the Joint Scientific Committee

The XVIIth session of the Joint Scientific Committee (JSC) took place in Toulouse France, March 11-15, 1996. The key issues for CLIVAR that emerged are:

- the need to scale responses in the climate system to regional and local impacts, and to identify likely changes in the statistics of extreme events;
- the need for more effective involvement of lesser developed countries, through "capacity building" and
- the need for improved interactions with relevant projects of the International Geosphere and Biosphere Programme (IGBP) and the International Human Dimensions of Global Environmental Change Programme (IHDP).

The JSC was pleased with the overall pace of the development of an implementation plan for CLIVAR and requested that an initial document be ready for the next session at JSC-XVIII in Toronto in March, 1997.

In addressing the key issues, the JSC requested that CLIVAR's DecCen and ACC Numerical Experimentation Group (NEG-2) look closely at how it proposes to speed the development of comprehensively coupled models. This will require cooperation with the IGBP GAIM¹ project and accordingly, a representative of that programme has been invited to attend the second session of NEG-2 in September.

In reviewing the overall progress in climate modelling, the JSC agreed that all WCRP's modelling groups must interact effectively with each other. While no formal structure was proposed for this purpose, improved means are to be instituted for communicating meeting agendas and reports, and progress on modelling initiatives between the different groups.

The JSC considered a proposal for an end-to-end project on application of climate information (including predictions) to agriculture to be implemented in the START² framework. The project will draw extensively on, and bring together, the results from CLIVAR, GEWEX and the IGBP core projects GCTE³ and BAHC⁴ and would also have a strong human-dimensions component (IHDP). The JSC was also briefed on progress within the United States on the establishment of an International Research Institute for Climate Prediction within the Lamont-Doherty Earth Observing Laboratory and the Scripps Institution of Oceanography (see article on Page 4). CLIVAR was asked to be the principal point of contact for the

-
1. Global Analysis, Interpretation and Modelling
 2. System for Analysis, Research and Training
 3. Global Change and Terrestrial Ecosystems
 4. Biospheric Aspects of the Hydrological Cycle

WCRP in this initiative.

The continued development of projects and programmes under GCOS, the Global Climate Observing System and relevant parts of GOOS, the Global Ocean Observing System, also needed to be factored into planning under CLIVAR. The JSC asked the Scientific Steering Group to consider at its next session in Sapporo, Japan in June, the specific data requirements expected by CLIVAR from operational global climate systems.

CLIVAR was asked to work with the Arctic Climate System Studies (ACSYS) to develop an effective base of relevant polar research programmes for the WCRP. More specifically, both programmes were invited to develop joint plans for studying the mass-balance of the Greenland ice-sheet and its stability. CLIVAR NEG-2 was also asked to collaborate with the Working Group on Numerical Experimentation (WGNE) on an assessment of existing climate simulations from the point of view of mass-balance of ice-sheets. In addition to being asked to help forge these important links within the WCRP, CLIVAR was asked to give special attention to developing links with the Scientific Committee for Antarctic Research (SCAR), GLOCHANT¹ programme and especially its project on Antarctic Sea-Ice Processes, Ecology and Climate (ASPECT).

M. Coughlan

The International Research Institute for Climate Prediction (IRICP) Established

"Our goal is to provide the public with the means to act upon our knowledge that next year's weather will be significantly different from this year's." -- D. James Baker, Administrator of the U.S. National Oceanic and Atmospheric Administration

Two of the world's leading oceanographic institutions -- the Lamont-Doherty Earth Observatory of Columbia University and the Scripps Institution of Oceanography (SIO), University of California, San Diego -- have joined to create a new research centre to predict El Niño and other short-term climate changes several months to a year in advance. The new International Research Institute for Climate Prediction, established by the United States National Oceanic and Atmospheric Administration (NOAA) will disseminate forecasts to agencies and policymakers around the world. Through national interfaces, it will offer farmers, fishermen, water resource managers, utilities, relief workers, transportation experts and others a chance to reduce the human and economic devastation caused by extreme weather conditions.

As recently as 1982, the most intense El Niño of the cen-

tury was not predicted and barely recognized by scientists during its early stages. It caused thousands of deaths and more than \$13 billion in damage worldwide. In 1986, Lamont-Doherty scientists Mark Cane and Stephen Zebiak developed a computer model that made the first successful prediction of an El Niño. During the decade that followed, several other groups including the one led by Tim Barnett and Nicholas Graham at SIO, developed other successful models.

In 1994, the scientists at Lamont-Doherty showed that forecasts based on an understanding of El Niño and the Southern Oscillation could also point to possible variations in Southern African corn harvests a year in advance. Retrospective analysis and computer model predictions showed that such information might have helped avert the worst of the region's most severe drought in a century. This drought in 1991-92 affected nearly 100 million people. Large-scale and expensive relief efforts, initiated only after the drought had begun to take hold, had to be mounted by local governments and the international community to avert widespread famine.

NOAA has launched the International Research Institute for Climate Prediction to speed the translation of the scientific successes of TOGA and related research into beneficial social policies and strategies. The goals are to further advance basic research in understanding and predicting short-term climate cycles, and to produce information that can be expeditiously transferred and put into practice by farmers, water resource managers and other potential users, most of whom have little detailed knowledge of the complexities of the climate system. Forecasts will be disseminated to a multinational network of regional research centres in areas vulnerable to ENSO-related changes. Local research centres will fine-tune global forecasts to their particular areas and supply feedback to the main centre in a continuing effort to improve the global prediction models.

Local policymakers will learn how best to apply more understandable forecasts that will include measures of uncertainty, in order to manage food, water and energy more efficiently. For example they might recommend increases in storage or export of grain; adjustments to fertilizing regimes, planting schedules or crop types to avoid or minimize crop failures or improve yields; conservation or release of water; special alerts to fishing fleets; institution of health and emergency procedures, and many other measures that might lessen the damage caused by climate fluctuations.

In 1993, NOAA launched a pilot project to demonstrate the operating concepts of an International Research Institute for Climate Prediction. In all, the project brought 56 climatologists and scientists in agriculture and water resources from around the world to the Lamont-Doherty Campus where they received training in the latest climate models and their potential for practical applications. They

1. Global Change and the Antarctic

came from 20 countries: Argentina, Australia, Brazil, Chile, China, Colombia, Ecuador, India, Indonesia, Japan, Kenya, Mexico, Paraguay, Panama, Peru, South Africa, the U.S. Pacific Islands, Uruguay, Venezuela and Zimbabwe.

Simply planning for normal conditions is not good economic or social policy. Life depends on rainfall, and the climate will always create times of excess and deficit. It is believed that the International Research Institute for Climate Prediction will go a long way towards providing the information societies need to adapt to unusual and extreme climate periods in order to save lives, reduce economic losses and avoid suffering.

For more information, contact:

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Environmental Verification and Analysis Center at the University of Oklahoma

From Mark L. Morrissey

It is widely recognized that one of the most difficult obstacles confronting climate modellers is obtaining reliable observations with which to validate their models. One of the principal reasons for this difficulty is the difference in scale between model output and observations. Most observations represent point values or one dimensional vertical soundings, while model outputs, usually in the form of a grid, represent smoothed areal estimates. This mismatch introduces substantial sampling errors. In addition, random errors and systematic biases are often present in instrumental readings. These problems also complicate the task of developing and validating remote sensing algorithms for quantities like precipitation. One of the primary goals of CLIVAR is to increase the accuracy of climate model output. It is highly desirable that models be validated at locations where well instrumented networks exist. This provides a baseline against which validation efforts in less well-instrumented areas can be compared. This strategy is underlies the basis for projects like GCIP (GEWEX Continental-Scale International Project) which are aiming to improve access to all available and pertinent data. In areas with relatively dense networks of well instrumented sites, where the accuracy of the instruments is well established, scaling methods can be used to reduce sampling error in the observations. With these ideas in mind, the University of Oklahoma has established an Environmental Verification and Analysis Center (EVAC), centrally located in the Sarkey's Energy Center in Norman, Oklahoma. EVAC's mission is to initiate interdisciplinary collaboration among scientists

working on environmental problems, and to strengthen existing links between research programmes such as CLIVAR and GEWEX. The driving force behind EVAC is the need for scientists who are experts in environmental climate modelling and remote sensing algorithm development to work collaboratively with scientists who specialize in surface data analysis, especially scale-analysis. Locating EVAC at the University of Oklahoma is especially valuable due to the huge archive of surface and radar data already obtained from the extensive observational networks in Oklahoma, which probably has the most comprehensive set of surface environmental monitoring networks in the world. Within Oklahoma are the Department of Energy's Atmosphere Radiation Measurement (ARM) Southern Great Plains sites, the Agricultural Research Services Little Washita micronet and the Oklahoma Mesonet. Also included are five NOAA, National Weather Service meteorological doppler radars which provide overlapping coverage of the state. EVAC will use all these resources to maximize the potential for comparing reality with estimates from weather and climate models, and from remote sensing algorithms. EVAC has a team of surface data analysis experts and already maintains extensive sample databases with which it will be able to conduct various verification exercises sponsored by CLIVAR, GEWEX and other programmes. The Center also supports the interdisciplinary emphasis through a visiting scientist programme and will conduct various educational efforts aimed at teaching instrumentation, scaling and interpolation methods to students.

For more information please see EVAC's web page at:

<http://radar.metr.uoknor.edu/evac/evac.htm>

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CLIVAR NEG-1 Programme launched to a Reggae Beat!

The CLIVAR GOALS Numerical Experimentation Group (NEG-1) held its first session in Montego Bay Jamaica, February 26-29. The meeting was hosted by the University of the West Indies - Mona and was graciously opened in a welcoming speech by Professor B. Persaud, Director of the Centre for Environment and Development.

The Group's primary function is to provide a focus for a programme of numerical experimentation using coupled ocean-atmosphere models for seasonal to interannual prediction, for predictability studies on these time scales and for model validation.

As a starting point, the Panel reviewed the scientific and modelling questions remaining at the end of the TOGA, which were listed as follows:

- What are the ENSO-predictability limits?
- What are the underlying ENSO dynamics (stochastically driven linear system, low order non-linear system)?
- What is the role of data assimilation (models with rather different initializations have similar skill levels)?
- What are the reasons for the seasonal and decadal variations in skill?
- What is a suitable ensemble forecast strategy?
- What is the nature of air-sea interactions over the tropical Indian and Atlantic Oceans?
- What are the relationships between the Monsoons and ENSO?
- What is the nature of air-sea interactions in middle latitudes?
- What is the nature of tropical/extratropical interactions?
- How do we extract information on a regional scale and how do we make best use of the forecasts?

Several issues carrying over from the work of the earlier Monsoon Numerical Experimentation Group (MONEG) were also highlighted.

- How do global teleconnections transmit monsoon variability?
- What are the impacts of tropospheric biennial oscillations on the monsoon?
- What are the impacts of stratospheric biennial oscillations on monsoon circulations?
- How important are non-linear internal dynamics in determining monsoon variability?

While atmospheric GCM's employed by MONEG have shown some skill in representing the monsoon they are generally deficient in their representations of interannual variability, and ultimately the monsoons will have to be adequately represented in fully coupled models. MONEG had also organized some numerical experimentations on the sensitivity of the monsoons to sea surface temperature anomalies in different oceanic areas, and this activity will be extended with more modelling groups invited to participate. NEG-1 will interact at several levels with the CLIVAR Monsoon and Upper Ocean Panels to develop an effective CLIVAR Monsoon initiative. The group was also briefed on the establishment of a monsoon modelling project SHIVA (Studies of the Hydrology, Influence and Variability of the Asian Summer Monsoon), sponsored by the European Union. Research groups are only beginning to address the effect of atmosphere-land surface interactions on monsoon variability at a comprehensive level. NEG-1 will work closely with GEWEX, which has prime responsibility for developing parameterizations in this area of modelling within the WCRP.

Although appropriately coupled modelling experiments will form the basis of most NEG-1 studies, the group recognized that there were good reasons for continuing to use AGCM's to study a range of scientific issues. In particular, NEG-1 will take advantage of the Atmospheric Modelling Intercomparison Project (AMIP) data base. AMIP is conducted by the WCRP/CAS Working Group on Numerical Experimentation in association with the U.S. Department of Energy's Program for Climate Model Diagnosis and Intercomparison (PCMDI). Co-operation and interactions with NEG-2 on coupled modelling activities will be essential for developing a productive analysis of decadal scale variability of processes within ENSO, the monsoons.

Several presentations were made by NEG members and invited experts on relevant activities in modelling centres to which they are affiliated. A number of suggestions for modelling projects to be sponsored by NEG-1 emerged from these presentations.

Seven principal projects were eventually identified by the group:

1. Intercomparison of ENSO simulations in coupled models. This project will be coordinated with the CLIVAR NEG-2 Coupled Model Intercomparison Project - CMIP (See Exchanges Vol.1, No. 1).
2. Dynamical seasonal prediction, a project to assess the predictability of the seasonal mean circulation and rainfall for one season in advance. Several modelling groups will use their atmospheric GCM's to make ensemble seasonal predictions with observed initial conditions and prescribed boundary conditions; the results will be compared and assessed.
3. A programme of numerical experimentation on the Indian Monsoon, focused on the model simulations of intraseasonal variability, making use of the experiments carried out in the seasonal predictability experiments.
4. An examination of the potential for prediction of climatic phenomena on seasonal to interannual timescales other than ENSO.
5. An intercomparison of ocean analyses, especially those used as initial conditions for ENSO forecasts. This activity will be closely coordinated with the CLIVAR Upper Ocean Panel.
6. An intercomparison of ocean model simulations forced by NCEP¹, ECMWF and GSFC² reanalysis wind stress products.
7. A coordinated comparison of measures intended to predict expected ENSO forecast skill (for example, the spread of ensemble forecasts). This will also include a study of the consistency of forecasts among different

1. National Center of Environmental Prediction

2. Goddard Space Flight Center (NASA)

models.

Details on this suite of projects can be found in the full report of the Session obtainable from the Project Office.

There are rumours (surely unfounded) that the high point of the meeting was the crowning of Ants Leetmaa as Reggae King (Ants, of course, is best known for his expositions of Estonian folkdance). However, there can be no doubt that NEG-1 and the invited experts under co-chairs Mark Cane and Neville Smith, matched their NEG-2 colleagues by constructing another cornerstone in CLIVAR's modelling programme. Warmest thanks to Dr. Anthony Chen and his staff from the University of the West Indies for providing such an inspirational venue and excellent local arrangements.

M. Coughlan

Euroclivar Kick-off meeting

Euroclivar comes under the heading of a "Concerted Action" project of the European Union. The project, which brings together the expertise of many of Europe's premier climate research institutions, has the following objectives:

1. to review ongoing Clivar-related activities in Europe;
2. to stimulate Clivar-related research in Europe;
3. to encourage the exchange of information between Clivar-related programme components;
4. to increase the awareness of Clivar and the Clivar objectives among European scientists;
5. to define scientific priorities for future programmes. It is expected that this will contribute to an increased coherence and effectiveness of climate research in Europe.

A Euroclivar-committee will monitor progress in achieving these objectives by:

1. reviewing ongoing Clivar related activities in Europe;
2. formulating specific European goals;
3. identifying gaps in the coordination of certain programme components and the need for communication between specific programme components;
4. organizing a workshops; and
5. making recommendations for future priorities.

The committee, chaired by Gerbrand Komen of the Royal Netherlands Meteorological Institute, and supported by several invited experts held its kick-off meeting on 1-2 April 1996, in Baarn, the Netherlands.

Participants gave brief presentation of their respective institutions. On the basis of these presentations discussions were held which resulted in the identification of a number of specific European CLIVAR focuses. These will be

worked out in a "Preliminary European CLIVAR Implementation Plan", which will also serve as basis for the formulation of European priorities for the study of climate variability, with a time horizon well into the 21st century. The aim is to have the outline of this document presented to the International CLIVAR SSG in Sapporo, Japan in June this year.

Complete discussion papers will be prepared, including a detailed proposal, for a specialized workshop to be held at a later date. However, opportunities will also be available for further discussion of Euroclivar's plans at the series of International CLIVAR workshops being planned for the coming months. One of the primary objectives of Euroclivar is to stimulate the discussion of CLIVAR related research in Europe. Suggestions or inquiries should be directed to Gerbrand Komen (komen@knmi.nl).

G. Komen

Summary of the JCESS / CLIVAR Workshop on Decadal Climate Variability

The JCESS / CLIVAR workshop on decadal climate variability was held at the Columbia Inn in Columbia, Maryland, USA from April 22-24, 1996. JCESS - the Joint Center for Earth System Science is co-sponsored by the US National Aeronautics and Space Administration (NASA) and the University of Maryland. About 40 scientists were welcomed by the local organizer Vikram Mehta, Mike Coughlan (International CLIVAR), Bob Hudson (JCESS), and Tony Busalacchi (NASA).

The workshop brought together researchers active in the area of decadal climate variability to assess the state of the science of decadal variability and its societal impacts, and to formulate a programme of research into various aspects of decadal climate variability, its predictability, and applications of the predicted information. Scientific presentations were given on the following broad topics:

- observations of decadal variability
- modelling of decadal variability
- external influences,
- societal impacts on decadal timescales

The instrumental record is barely adequate for studying the characteristics of decadal-scale climate variability and the record can only be extended using proxy, paleoclimatic information from different sources (e.g. tree rings, corals, ice cores). Nevertheless, it was stressed that special attention must still be given to the rescue, maintenance and reanalysis of instrumentally based data records. Efforts should continue on the development of new methods

of data analysis to extract the decadal climate variability signal from what are typically very noisy records. Regions where it is believed the signal-to-noise ratio is large should be monitored and explored with higher priority. In this context, it was noted that high signal-to-noise ratios would be more readily found in highly damped variables that acted as integrators, such as subsurface ocean temperature and deep soil moisture.

In general, the participants agreed there are identifiable decadal processes but that it is not easy to detect whether there are preferred timescales. There was further agreement that at this time the best tool for identifying physical mechanisms for decadal climate variability are coupled model simulations. Model studies will also provide the basis for the implementation of a coherent observational programme.

In reviewing the results presented from several modelling studies, the participants identified four key areas for investigation:

- Decadal variability of ENSO
- Decadal variability induced by the subtropical ocean gyres interacting with the atmosphere
- Decadal variability induced by the thermohaline circulation
- Decadal variability of the Asian-Australian monsoon

The workshop concluded that the implementation of a research programme on decadal-scale climate variability should clearly address the processes involved in these four areas. In addition, special attention should be paid to the impacts of decadal climate variability on society, since society will ultimately benefit from scientific research leading to better predictions of long term climate variability. The research programme proposed at this workshop would work to integrate model simulations, data analysis, and observations

The programme would also seek to integrate its activities with national and international research projects under the US and International DecCen Programmes as appropriate. Links to other programmes, especially to those focusing on polar research, would also need to be identified and initiated.

V. Mehta and M. Coughlan

U.S. National Research Council DEC-CEN Panel

- Relationship Between U.S. DEC-CEN and CLIVAR -

The focus of the U.S. National Research Council Panel on Climate Variability on Decade-to-Century Time Scales (DEC-CEN panel) is generally aligned with the longer

time-scale components of international CLIVAR. However, to understand the exact relationship between the U.S. DEC-CEN panel and CLIVAR it is helpful to examine the rationale for setting up the U.S. DEC-CEN panel.

The DEC-CEN panel, and its shorter timescales-of-interest companions, the Global Ocean-Atmosphere-Land System (GOALS) and Global Energy and Water Cycle Experiment (GEWEX) panels, are sponsored by the U.S. Global Change Research Program (USGCRP) through the U.S. National Research Council (NRC). These panels were formed by the U.S. Climate Research Committee (CRC) to provide smooth interfaces with the WCRP organizational structures. The CRC is a committee under the NRC's Board on Atmospheric Sciences and Climate (BASC); it is largely funded by the USGCRP and it serves as the U.S. National Committee for the WCRP. Thus the DEC-CEN, GOALS and GEWEX panels do represent formal links to their international WCRP (incl. CLIVAR) counterparts.

However, the CRC also represents many of the interests of the International Geosphere and Biosphere Programme (IGBP) as well as those of the USGCRP. This results in a somewhat broader role for the U.S. DEC-CEN panel relative to its international counterpart within CLIVAR. Thus, while the U.S. DEC-CEN panel directly addresses CLIVAR-DecCen objectives, it must also address the decade-to-century time-scale objectives of the IGBP and USGCRP; in particular, the bio-geochemical and anthropogenic change issues. As and when required, CLIVAR establishes interfaces with the IGBP on biogeochemical issues, while the issue of anthropogenic change is encompassed within CLIVAR's Anthropogenic Climate Change (ACC) component.

U.S. DEC-CEN Panel Strategy

The U.S. DEC-CEN panel is currently developing the U.S. national science plan for decade-to-century time-scale climate research. The panel recognizes that the scope of its charge presents a formidable challenge, while the international implementation planning workshops scheduled for later this year (1996) impose a significant time constraint. In order to meet this challenge and time constraint, the panel has adopted the following strategy for producing the U.S. science plan.

First, the panel will rely heavily on the CLIVAR-DecCen and CLIVAR-ACC science plan sections where appropriate. This represents a considerable savings in time and effort, and acknowledges internationally recognized issues, although, as to be expected for each individual nation, particular U.S. interests and prioritization may differ somewhat. The panel will interact directly (and in some cases is already doing so) with the broader scientific community throughout the development of the plan. This should minimize the magnitude of revisions following the presentation of the draft plan.

U.S. DEC-CEN Science Plan Structure

The U.S. DEC-CEN Science Plan (in its current draft form) focuses on six attributes of the Earth's environmental system considered to be the most important to society, and identifies ten components of the climate system that control these attributes. The attributes are: fresh water (including precipitation, soil moisture, water vapour, etc.), temperature, radiation, storms, sea level and ecosystems. The controls are: (1) the carbon cycle, (2) solar variability, (3) ocean circulation, (4) cryospheric variability, (5) the hydrologic cycle, (6) ocean-atmosphere interaction, (7) atmospheric composition and dynamics, (8) land and vegetation, (9) volcanic eruptions and (10) atmospheric circulation.

The draft science plan characterizes each attribute and component, illustrates how they have varied in the past over decade-to-century time scales, explains mechanisms and interactions between and within them, describes the predictability of each, and finally, presents the remaining issues and questions that surround them. This structure should allow the plan to maintain focus while naturally leading to an overall science plan for future research. The issues and questions will serve to define and justify the science requirements presented in the plan.

Please direct any correspondence for the U.S. DEC-CEN panel to Ellen Rice at the National Academy of Sciences, erice@nas.edu.

Douglas Martinson
Chair, U.S. DEC-CEN Panel

WCRP/GCOS/GOOS Ocean Observation Panel for Climate (OOPC) holds its First Meeting

The Ocean Observation Panel for Climate (OOPC) is a panel sponsored jointly by the World Climate Research Programme (WCRP), the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS). It was formed from the Oceans Observation System Development Panel (OOSDP). The OOPC will build on the work of its predecessor in designing an ocean observing system by:

- addressing areas not considered by the OOSDP,
- establishing priorities for recommended elements,
- devising alternate sampling strategies,
- assisting in the construction of inventories of available data and products needed for the GCOS/GOOS common module.

At its first meeting, which took place from 25-27 March,

at the Rosenstiel School for Marine and Atmospheric Sciences in Miami, USA, the Panel and several invited experts addressed the following issues :

- (i) user needs and products, and a strategy to bring the OOSDP Ocean Climate Observing System (OCOS) design to the user community;
- (ii) implementation of operational programmes for:
 - (a) measuring sea surface temperature (SST),
 - (b) deployment of expendable bathythermographs (XBTs) from ships-of-opportunity,
 - (c) remote sensing;
- (iii) an appropriate strategy for the Panel's own work.

User Needs and Products :

The favoured approach is to select key observation-to-product "lines" and to produce illustrative documents demonstrating their value. These documents (e.g. electronic and printed brochures) would be scientifically faithful to the OCOS design but would be in a form more suitable for "promoting" the OCOS. The material encourage participation by national agencies and provide them with easy-to-understand descriptions of where their contributions would lead and the benefits that would ensue. The OOPC will work on a few prototypes and test reactions in targeted communities. The selected product lines must have real substance and, through well tested research and application, be subject to few uncertainties. The TOGA upper ocean network, in support of operational climate prediction, was chosen as the first case.

In addressing issues of implementation, the Panel noted the following points:

For operational remote sensing of SST, the orbiting satellite-borne ATSR (Along-Track Scanning Radiometer) is potentially useful, but current algorithms for deriving reliable sea surface temperatures are not adequate. The GOES (Geostationary Operational Environmental Satellite) data also has significant untapped potential, particularly its capability for resolving the diurnal cycle.

The importance of implementing hull-contact sensors on Voluntary Observing Ships (VOS) was highlighted. For implementation, the OOPC will provide more specific guidance on what is required for buoys and/or hull-contact sensors.

The OOPC is keen to provide advice and guidance to the proposed Ship-of-Opportunity (SOOP) programme, recognising the importance of this undertaking. The strategy, that needs to be worked out in consultation with CLIVAR UOP should include:

- Maintenance of the TOGA/WOCE low-density network, at least in the short-term;
- Specific guidance by the OOPC for the tropical Pacific and N. Pacific over the next 12 months through commissioned reports;
- guidance by the OOPC to ship-of-opportunity manage-

ment structure.

- mechanisms for seeking and receiving specific advice from CLIVAR UOP on research enhancements.

The Panel concluded that the implied prioritization in the OOSDP report for the satellite altimeter needs to be revisited because of recent advances in

- (i) the use of altimeter data for monitoring heat content,
- (ii) monitoring the seasonal cycle,
- (iii) monitoring sea level change.

The combination of altimeter and *in situ* data for monitoring climate change appears to be viewed differently now compared with the situation reported by OOSDP. In particular, the combination seems to offer a product that retains the benefits of both the long *in situ* record and the global coverage of the altimeter. In effect, it gives useful global estimates of long-term change at large space scales. This conclusion has ramifications for the tide gauge network, implying a critical role for a set of fast-response, referenced gauges.

The OOPC decided that this was a second good example to explore with an end-to-end demonstration. In addition, a background report is to be commissioned in order to determine the optimal *in situ* network in support of such a goal.

In conclusion, the OOPC devised various strategies for developing the plan of the OCOS and for assisting in its implementation :

- (i) End-to-end illustrations;
- (ii) Commissioned reports and workshops
 - Report on the N. Pacific thermal sampling programme
 - Report on detecting long-term sea level change from a combination of altimeter and *in situ* data.
 - Workshop on time series stations. This could be done in collaboration with JGOFS¹ and CLIVAR DecCen/ACC.
- (iii) Specific advice to implementation groups
- (iv) Updating the OOSDP Report/OCOS design every 4 years.
- (v) Maintaining interactions with research programmes:
 - CLIVAR Upper Ocean Panel & NEG-1: SST, ship-of-opportunity programmes, sea level, ocean analysis evaluation and observing system simulation experiments.
 - CLIVAR DecCen and ACC: the altimeter-sea level issue and time series stations.
 - JGOFS: Time series stations.
 - GEWEX: Hydrological cycle, air-sea fluxes and sea-ice.
 - IGBP & IPCC

Neville Smith, Chair OOPC

Summary of the WOCE-DPC-9 Meeting

The ninth session of the WOCE² Data Products Committee (DPC) was held from February 6-9, 1996 at IFREMER (Brest, France). The DPC is responsible for the timely production and delivery of WOCE data and data products to the scientific community. As the main part of the WOCE observational programme will be finished at the end of 1997 and the implementation planning for CLIVAR is under way, a close cooperation between these two programmes is essential. The goal of the collaboration is to avoid undesirable interruptions in the data flow and improve the planning process for future research observation programmes in the world's oceans.

The DPC-9 meeting in Brest was held within the context of the Analysis, Interpretation, Synthesis and Modelling (AIMS) phase that WOCE has just entered. Most of the scientific seminars and reports of the DPC committee members addressed activities related to this phase.

A major problem WOCE has encountered in moving towards comprehensive suites of data products has been the large delay that different Data Assembly Centres (DACs) and Special Analysis Centres (SACs) have experienced in receiving data. Although investigators have been requested to release data sets to the WOCE data processing centres within two years after the last measurements, many data sets are still missing. The delayed mode upper ocean thermal data was singled out as one data set that will probably not be processed until after WOCE has formally ended. This contrasts somewhat to the practice in TOGA where data as far as possible was made available to all investigators in near-real-time. These data sets were then updated as appropriate with higher quality-controlled data.

The DPC made a strong recommendation that CLIVAR should consider, as a matter of some urgency, the establishment of its observational and data collection strategy to avoid breaks in the data collection and processing. The CLIVAR / WOCE liaison group and the CLIVAR Upper Ocean Panel will focus on this problem.

In summary, the meeting has stimulated an important discussion about the data products that should be made available to the scientific community. The instrument based data sets do not fulfil the requirements for many research issues (e.g. data assimilation, modelling). Therefore an assimilation-type concept needs to be adopted, whereby the key data elements are merged and stratified by different variables instead of by instrument-based data sampling. A move towards the adoption of this concept is now being discussed and reviewed within the WOCE community.

A. Villwock

1. Joint Global Ocean Flux Study (IGBP Core Project)

2. World Ocean Circulation Experiment

International Workshop on Pacific Ocean Buoy Network

The Japan Marine Science and Technology Center (JAMSTEC) hosted the "International Workshop on Ocean Climate Variations from Seasons to Decades with Special Emphasis on Pacific Ocean Buoy Network", May 29-31, in Mutsu, Aomori-prefecture, Japan, just prior to the Sapporo CLIVAR SSG. JAMSTEC has proposed that a moored-buoy network be developed for observing oceanic and atmospheric variabilities in the Pacific ocean and its adjacent seas, in cooperation with domestic and foreign agencies and institutions. The principal scientific objective is to understand the detailed ocean circulation and heat transports, while directing attention on ENSO, the Asian Monsoon and decadal scale oceanic variabilities influencing climate change in the Pacific rim and the whole world. The purpose of the workshop was to discuss, in an international context, the future action plan for Japanese activities related to ocean climate research, ranging from seasons to decades, emphasizing the buoy development plan. The workshop also provided an opportunity to promote an exchange of ideas on the implementation phase of CLIVAR. The convenor was Prof. Yoshiaki Toba, and around 35 invited experts from 8 countries (including 20 Japanese experts) participated. A more comprehensive report of the meeting will appear in the next issue of *Exchanges*.

Masataka Hishida, Director, Ocean Research Department Japan Marine Science and Technology Center (JAMSTEC)

CLIVAR Meetings & Workshops in 1996

As mentioned in our first issue, two CLIVAR DecCen Workshops will take place later this year (see the Calendar for the dates). Detailed descriptions and agendas of the workshops are still under development and will appear in the next issue of *Exchanges*.

A CLIVAR Upper Ocean Observations Workshop dealing with observing systems for seasonal to interannual prediction and research will be held in conjunction with the second session of the CLIVAR Upper Ocean Panel from Oct. 21-25, 1996 in Villefranche-sur-Mer, France. The CLIVAR Monsoon Panel will meet for its first session from Nov. 20-23, 1996 in Goa, India. This meeting will be preceded by the fifth session of the TAO Implementation Panel Meeting (Nov. 18-20). More detailed descriptions and agendas of the workshops will be available via the CLIVAR WWW site, and in the next issues of *Exchanges*.



News from the ICPO



CLIVAR

We moved !



MPI

At the beginning of April, the ICPO moved to the main building of the Max-Planck-Institut für Meteorologie (MPI). We anticipate that the ICPO will operate much more effectively in its new location due to the strong administrative coupling to the MPI. We expect also that the move will bring ICPO staff into closer productive contact with the many scientists involved in CLIVAR related research both resident in MPI or passing through as visitors.

The new address details are:

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Error in the CLIVAR Homepage address

We apologize for a typographical error in the first issue of *Exchanges*. In case you haven't already found it, the right address to get on the CLIVAR homepage is the URL-location :

<http://www.dkrz.de/clivar/hp.html>.

Most of the articles in this newsletter and earlier issues is now accessible from our homepage on the www-server. To speed up the transfer of information we would like to mirror our homepage at a server in the US. We would appreciate hearing from any group there who would be willing to act as the US. WWW site for CLIVAR.

CLIVAR Calendar

ICPO can provide further information about the meetings on this calendar.

Date	Meeting	Location	Attendance
June 3 - 7, 1996	CLIVAR SSG 5th Session	Sapporo, Japan	Invitation
June 10 - 13, 1996	US Ocean CLIVAR Meeting	San Antonio, TX, USA	Open
June 17 - 21, 1996	2nd Int. GEWEX Conference	Washington DC, USA	Open
July 8 - 11, 1996	The Oceanography Society's 1996 Meeting	Amsterdam, The Netherlands	Open
July 15 - 26, 1996	Workshop on ENSO and Monsoon	Trieste, Italy	Limited
July 23 - 27, 1996	Western Pacific Geophysics Meeting	Brisbane, Australia	Open
Aug., 19 - 23, 1996	WOCE Pacific Workshop	Newport Beach, CA, USA	Limited
Sep. 4 - 6, 1996	CLIVAR DecCen Workshop on the Induction of DecCen Climate Variability by Large-scale Atmosphere - Ocean Interactions	Vancouver, Canada	Limited
Sep. 9 - 11, 1996	CLIVAR NEG-2, 2nd Session	Victoria, BC, Canada	Invitation
Sep. 27 - 1. Oct. 1996	ICES Annual Science Conference, special WOCE/JGOFS/CLIVAR Session	Reykjavik, Iceland	Open
Oct. 7 - 11, 1996	First International Conference on EuroGOOS	The Hague, The Netherlands	Open
Oct. 21 - 25, 1996	CLIVAR Upper Ocean Observations Workshop and CLIVAR Upper Ocean Panel - 2nd Session	Villefranche-sur-Mer, France	Invitation
Oct. 28 - 31, 1996	CLIVAR DecCen Ocean Circulation and Climate Workshop	Villefranche-sur-Mer, France	Limited
Nov. 18 - 20, 1996	TAO Implementation Panel Meeting, 5th Session	Goa, India	Invitation
Nov. 20 - 23, 1996	CLIVAR Monsoon Panel - First Session	Goa, India	Invitation

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