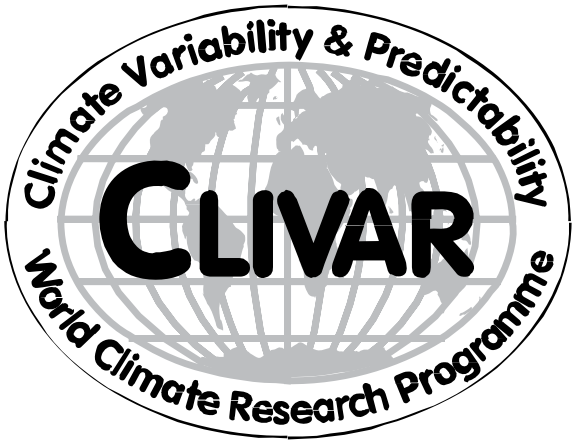
INTERNATIONAL COUNCIL FOR SCIENCE

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

WORLD METEOROLOGICAL ORGANIZATION

WORLD CLIMATE RESEARCH PROGRAMME



Report of the Ninth Session of the CLIVAR Scientific Steering Group

2-5 May 2000
Honolulu, Hawaii, U.S.A.

ICPO Publication Series No. 43

WCRP Informal Report no. 11/2001

TABLE OF CONTENTS

APPENDICES

Summary of Recommendations and Action Items

Upper Ocean Panel

1. The SSG agreed that the present CLIVAR Upper Ocean Panel should become the CLIVAR Ocean Observations Panel (OOP). The new Panel would be charged to oversee implementation of sustained and near-sustained ocean observations in support of CLIVAR research. This would include oversight, for research purposes, of the ENSO observing system, for example. Increased emphasis should be placed on ocean assimilation and surface fluxes.
   ACTION *UOP Chairman in conjunction with ICPO to develop new terms of reference and suggested membership.*

2. ICPO to write jointly to COOP and OOPC asking for advice on how to proceed on data centres, in light of recent review of the ocean thermal network and plans for ARGO.
   ACTION *ICPO*

3. COOP and Pacific Panel to assess impact on CLIVAR science of 50% ARGO deployment, taking into account in particular the possibilities of full deployment over 50% of the world ocean or 50% deployment globally.
   ACTION *COOP and Pacific Panel Chair*

4. SSG to recommend to the other sponsoring agencies that the TAO Implementation Panel (TIP) become a technical advisory committee concerned solely with the logistical and technical aspects of implementation of mooring arrays in all three tropical basins. New TIP to report to COOP (but remain as a Data Buoy Co-ordination Panel action group).
   ACTION *ICPO to invite McPhaden to draft revised TOR and suggested membership.*

WGCM

5. The SSG encourages the WGCM to undertake specific activities on the modelling aspects of climate change detection. In particular the SSG strongly supports the WGCM proposal to investigate why different coupled models react differently to similar forcing over the 20th century.

ACTION *Co-Chairs to contact Chair WGCM.*

6. SSG requests WGCM to prepare a report to be presented to SSG-10 on previous studies of the influence of changes in solar forcing.
ACTION *Chair WGCM*

WGSIP

7. SSG encourages WGSIP to pursue development of standard metrics where appropriate.
ACTION *WGSIP Chair*

8. WGSIP to review its membership at next meeting and make recommendations to SSG.
ACTION *WGSIP*

VAMOS

9. The SSG encouraged the VAMOS panels to continue to develop the 3 – tier implementation strategy for a Monsoon Experiment – South America (MESA) and a North American Monsoon Experiment (NAME).

   The SSG agreed to form jointly with GEWEX a WG on the Climatology and Hydrology of the Rio de la Plata Basin. This group would be co-chaired by Dr C R Mechoso the other co-chair representing GEWEX. The co-chairs to be asked to develop terms of reference and membership.
   ACTION *VAMOS Chair*

10. ICPO to explore with national representatives in the region the possibility/ desirability of forming a resource board or informal planning group to help with implementation of the Rio de la Plata experiment.
ACTION *ICPO, JPS*

CLIVAR Africa

11. The SSG wished to see a revised version of the report of the CLIVAR Africa Task team prepared based on input from SSG members received before mid June 2000.
ACTION *SSG Members to submit comments*

12. The ICPO to develop terms of reference and membership of a CLIVAR Africa WG (CAWG) building on the experience of the CLIVAR Africa Panel and the CATT.
ACTION *Semazzi and Thorncroft*

13. A first task for the CAWG will be the compilation (with the ICPO) of an inventory of data sources relevant to achieving CLIVAR's objectives with regard to Africa.
ACTION *ICPO and Africa WG*

14. The CAWG should be encouraged to identify a single topic of relevance throughout the continent (e.g. identifying the nature and causes of decadal climate variability).

ACTION *ICPO to inform Africa WG*

15. CAWG should explore with WGSIP the possibility of making a case study of the rainfall that caused the 2000 Mozambique floods to determine if there might be predictability; similarly WGCM and CAWG should consider the investigating the causes of decadal variability in Sahel rainfall.
ACTION *ICPO to inform CAWG, WGSIP, WGCM*

CLIVAR Pacific

16. The organising committee for the CLIVAR Pacific Workshop were encouraged to develop their plans for a Pacific Workshop at the IPRC.

An essential step towards developing specific plans was the identification of data sources for past and ongoing measurements in the Pacific sector relevant to the achievement of CLIVAR objectives on all time scales. This inventory is to be developed primarily by the IPRC in conjunction with the ICPO
ACTION *ICPO, Weller, McCreary*

CLIVAR Atlantic

17. The SSG encouraged the CLIVAR Atlantic Panel to continue the development of an Implementation strategy using the Pacific Panel as a model and encouraged them to identify new members from Brazil and Southern Africa. In the run-up to their next meeting in December 2000 they were encouraged to work with the ICPO to identify data sources relevant to CLIVAR.
ACTION *ICPO, Atlantic Panel*

18. A letter should be written to NOAA/OGP, France/IRD, and Brazil/INPE "to encourage USA, France, Brazil, and other interested countries to develop a co-ordinated approach to implementing a tropical Atlantic Observing System building on the success of the PIRATA program and the findings of the COSTA report".
ACTION *ICPO on behalf of SSG co-chairs*

A-A monsoon

19. The SSG welcomed the progress made by the A-A Monsoon panel and asked them to develop it further in conjunction with GEWEX CEOP.
ACTION *A-A Monsoon panel*

20. The SSG saw a clear need for a process study to resolve some of the outstanding questions concerning intraseasonal oscillations associated with the AA monsoon system, with a particular view to improving model performance. The SSG urged the AAMP to develop an implementation plan for such a study. They recommended that the meeting planned for November 2000 should focus on developing a concrete plan of action for regional studies during the next 2-3 years
ACTION *A-A Monsoon Panel*

CLIVAR Data Task team

21. SSG agreed that each of the WOCE DACs that might contribute to CLIVAR data delivery system should be asked to state what role they were willing and able to play in handling both research and sustained observations during CLIVAR. These responses should be considered by the DTT and COOP.
ACTION *SSG*

22. DTT should expand its terms of reference to include requirements for data assimilation and should work with the GODAE Science Team, COOP and WGSIP
ACTION *DTT GODAE and ICPO*

Interactions with panels and WGs

23. In order to improve intersessional communication between the SSG, CLIVAR Panels and WGs and the ICPO an ICPO and an SSG member is to be identified who will be copied on all correspondence related to that panel.

24. All Panels and WGs are requested to identify a data Liaison member whose task it will be to identify to the CLIVAR DTT the specific data requirements to meet the needs of the subject areas of that panel.
ACTION *ICPO to contact panel/WG chairs*

25. All panels and WGs are to ensure that the gallery of images available on the CLIVAR WWW site includes the most up-to-data and relevant material
ACTION ICPO *to contact panel/WG chairs*

ICPO activities

26. ICPO to develop more effective links with national committees and agencies in countries playing a major role in the development of CLIVAR.
ACTION *ICPO to develop strategy ,convey to SSG and implement*

27. ICPO to compile a list of applications programs to which CLIVAR research is important and to take steps to develop stronger links with these programs.
ACTION *ICPO*

WG CCD

28. WG CCD should consider the extent to which oceanic indices of climate change might be useful and if so should expand its membership to cover this area.
ACTION *WG CCD*

S Ocean

29. The SSG encouraged Doug Martinson to proceed with the planning for a workshop in Perth in November 2000 to refine D-5 Imp Plan in light of known levels of interest in the area.
ACTION *Martinson*

Influence on external bodies

30. CLIVAR should lobby for continued altimeter missions beyond Jason and Envisat, TRMM and surface salinity, continuing wind vector measurements from space, and ensuring that there are no significant gaps in high quality SST data.
ACTION *SSG Chairs to write to Space Agencies*

31. CLIVAR SSG chairs should write to Dave Evans (OAR, NOAA) to press for a reversal of the decision to remove SSP sensors from S Ocean drifters.
ACTION *Co-Chairs*

32. Weller to draft letter for SSG chairs to US NOAA, noting that high density XBT lines are a critical element of the CLIVAR observing strategy and expressing concern over the planned reduction in contribution of XBTs by NOAA.
ACTION *Weller and Co-Chairs*

33. CLIVAR to write to appropriate ARGO-contributing nations inviting them to become involved in regional ARGO implementation panels.
ACTION *ICPO to work with ARGO science team*

APPLICATIONS

34. SSG invites JSC to consider increased CLIVAR input into CLIMAG and/or Food and Fibre program.
ACTION *ICPO*

35. SSG plans a special session on applications and wishes to invite representatives from CLIPS, START and IRI to next SSG meeting.
ACTION *ICPO to arrange*

FLUXES

36. The ICPO should request the GEWEX project office to provide a status report on GEWEX efforts concerning radiative fluxes.
ACTION *ICPO and Co-Chairs*

ARCTIC OSCILLATION

37. SSG to identify a CLIVAR focal point on the Arctic oscillation to coordinate with SPARC
ACTION *ICPO (Newson recommends Palmer).*

PALEO

38. SSG endorsed proposed changes to the PAGES/CLIVAR WG membership.
ACTION *ICPO to contact Overpeck*

1. OPENING

Dr L. Maagard of the IPRC welcomed the SSG participants to Honolulu. He noted that the IPRC had been in existence only two and a half years and had grown from a staff of two to the present level of 35 employees. Tony Busalacchi, SSG co-Chair, thanked Dr Maagard for the generous support and excellent facilities provided by the IPRC. He remarked that the IPRC was an ideal host for this meeting due to its heavy commitment to CLIVAR goals and the many contributions being made to CLIVAR science, particularly in the Pacific sector. Busalacchi welcomed the new SSG members, Drs Wu and Zweirs, and also took the opportunity to express special gratitude, on behalf of himself and the rest of the SSG, to Kevin Trenberth who had just stepped down from his position as Co-chair of the SSG in which he had served with great enthusiasm and dedication for (five years).

J. Gould, Director of the ICPO, reviewed the status of action items from the eighth session of the SSG. Significant progress had been made in many of the areas, for instance, the Ocean Observations Conference in St. Raphael, France, had formulated a consensus on near future requirements, implementation panels had been formed and had met for the Pacific and Atlantic sectors, the Jasmine pilot project had taken place in the eastern Indian Ocean, the CLIVAR African Task Team had produced a draft implementation plan, VAMOS planning was well advanced for several major initiatives, and modelling groups continued to be very active.

Peter Webster expressed concern that CLIVAR was losing recognition in countries around the world and asked what should be done to raise the CLIVAR profile. Suggestions were put forward but none were thought particularly worthy of pursuit. Tim Palmer described CLIVAR as “mature science” and said that CLIVAR now must look to increase its links outside the science arena, for instance in humanitarian aid and disaster relief. R. Newson, in his opening remarks on behalf of the Director of WCRP, noted that the JSC wanted WCRP to place more emphasis on cross-cutting initiatives which brought together basic researchers with the user community. The SSG agreed to revisit these matters later in the meeting (see section 19).

Tony Busalacchi outlined the main issues before the SSG at this session. He noted that a major objective was to strengthen the links between the various CLIVAR panels and the SSG and he welcomed all the Panel Chairs who had accepted the invitation to attend this meeting. He recommended that actions be taken to increase intersession communication amongst and with the Panels. As a first step, a SSG member would be assigned as liaison to each Panel in order that the SSG be kept informed of important program developments during the year and could provide input when appropriate.

The agenda (see Appendix A) was adopted with some minor modification.

2. INDIAN OCEAN/AA MONSOON

Bill Lau, co-chair of the CLIVAR Australian-Asian Monsoon Panel (AAMP) reported that the Panel had prepared a draft implementation Plan which was on the Web (http:….) and he invited comments from the SSG. He provided some scientific background to the document and summarized the overall objectives. The main aim would be to determine predictability and to improve monsoon climate predictions. Investigations would be launched

to :

- Explore potential predictability of the monsoon climate system arising from changes in lower boundary conditions

- Determine the limit of predictability imposed by intraseasonal oscillations and high-frequency phenomena and

- Determine the effects of monsoon on climate variations and predictability of other parts of the global climate system, e.g. ENSO, North and South American climate systems..

- The working hypothesis behind the plan was that monsoon predictability lay in

- Basin-scale SST fluctuations, e.g. ENSO, TBO

- Regional processes within adjacent oceans/maritime continent, e.g. western Pacific, Indian Ocean, Indonesian waters, South China Sea…

- Snow cover and soil moisture in Eurasia continental regions.

Lau noted that the AAMP emphasis was on ocean-atmosphere interactions and he described some recent results which gave indications of predictability in the system. Lau remarked that in the past analyses of the monsoon had usually stopped at the dateline and analyses of North American climate extended generally only west to the dateline. Recent studies indicated that a more global approach could lead to further insights on predictability.

Stuart Godfrey went on to outline the schedule for further developing the AAMP implementation plan. The objective was to plan a suite of process studies which would coincide with the Coordinated Enhanced Observing Period (CEOP). Godfrey noted that given the current schedule for CEOP, this would require very tight planning. In this regard, a meeting was planned for November 2000 in Perth to bring together oceanographers and directors of oceanographic labs in the region to discuss concrete plans for future AAMP projects. The intentions was to have a meeting in 2001 of all scientists involved to set the overall shape of the process studies and to hold a detailed planning meeting the next year. Godfrey requested that the SSG Chairs write to Directors of research laboratories in the region asking for their participation and cooperation in these studies. The issue of data exchange and access was of concern, as was permission to deploy ARGO floats within EEZs.

Peter Webster presented results from the Jasmine field program which had taken place last summer in the Bay of Bengal- East Indian Ocean region. He emphasized the differences between the Indian and Pacific Oceans, noting that the flux variations in the Indian Ocean were much greater than those in the Pacific. Intraseasonal oscillations appear to be integral parts of the monsoon system and Webster recommended that future experiments explore potential predictability associated with these oscillations. Webster briefly outlined plans for a Jasmine follow on which would aim to:

- Obtain detailed surface flux measurements over a broader region and longer period to extend over multiple realizations of the monsoon intraseasonal oscillation (ISO);

- Determine the wider field responses of the upper ocean to intraseasonal atmospheric forcing including the heat transports associated with the variability;

- Assess the importance of diurnal variability in atmospheric and oceanic phenomena to the longer times scales of the monsoon system;

- Determine the degree of importance of the monsoon ISO in the overall structure of the monsoon.

He also recommended that a monitoring network be established to allow long-term observation of the so-called Indian Ocean dipole.

The SSG welcomed the progress made by the AA Monsoon panel and asked them to develop their plans further in conjunction with GEWEX CEOP. The SSG saw potential for a process study to resolve some of the outstanding questions concerning intraseasonal oscillations associated with the AA monsoon system, with a particular view to improving model performance. The SSG urged the AAMP to develop an implementation plan for such a study. They recommended that the meeting planned for November 2000 should focus on developing a concrete plan of action for regional studies during the next two to three years.

3. CLIVAR PACIFIC

The recently appointed CLIVAR Pacific Panel had met on the Monday just preceding the SSG in Honolulu. R. Weller, chairman of the Panel, reported on the outcomes. Various national projects and plans had been presented, and Weller remarked that there was a great deal of activity planned for the region and that there was a clear need to focus and coordinate timelines. A step in this direction had been made under the auspices of US CLIVAR; a draft US "P-BECS" plan was available for comment and input by the international community.

The first charge to the Panel by the SSG had been to organize an international CLIVAR workshop to develop an implementation plan for the Pacific. Weller presented a draft outline for such a workshop, which focussed on four main areas:

- model development
- broadscale sampling
- regional enhanced observations
- process studies.

Tentative plans were to hold the workshop 22-25 January 2001 at the East-West Center in Honolulu HI with IPRC acting as hosts. The SSG welcomed this proposal and encouraged the Panel to further develop plans for the workshop.

The Panel felt that an essential step towards developing specific plans was the identification of data sources for past and ongoing measurements in the Pacific sector relevant to the achievement of CLIVAR objectives on all time scales. J. McCreary volunteered that the IPRC could developed such an inventory in conjunction with the ICPO.

4. UPPER OCEAN PANEL

Dr. Koblinsky reported on the many activities of the Upper Ocean Panel (UOP) over the past year. Most notable was the organization, with OOPC, of the international Ocean Observations for Climate Conference, which was held in Saint Raphael, France, 18-22 October 1999. A conference statement can found at http: www.bom.gov.au along with papers presented at the meeting. The main goal of the conference was to review and make recommendations concerning those elements of the existing ocean observing system, which were most likely to contribute to an integrated system of sustained observations and to identify gaps.

Concerning the surface network, several key issues were raised including the need for further coordination and planning for follow-on satellite missions. It was noted that at present there was no commitment for sustained altimeters beyond the Jason and ENVISAT missions. Potential gaps appear in the wind vector measurements from space that may compromise the ability to resolve surface winds, both for oceanography and meteorology, at the requisite time and space scales. Commitment decisions are required now if we are to avoid significant gaps in the surface marine data sets, including remotely sensed SST. It was felt that more scientific studies of SST and wind analysis procedures were needed in order to maximize the resolution and accuracy of products, consistent with stated requirements. A need for high quality surface flux reference sites had been identified but there was no plan for implementing these.

OOPC and UOP together organized a review of the Ship of Opportunity XBT network in light of the development of ARGO. It was recommended that emphasis be placed on high density high frequency lines rather than the “broadcast” mode of sampling. The recommended sampling requires about 35,000 XBTs per year. During 1999 the number of XBTs deployed by all countries in support of the Ship of Opportunity Program (SOOP) was of the order of 28,000 XBTs. The shortfall of probes was expected to increase to 10,000 in 2000 and possibly 13,000 in 2001. The UOP expressed concern about the ramification of this shortage on the integrated strategy for upper ocean measurements, which involves XBTs, ARGO, TAO and the satellite altimeters.

Another area of concern was the north-south asymmetry of planned ARGO float deployment. To date, only the USA has spoken out strongly about the need for global coverage and expressed willingness to deploy a significant fraction of floats in remote areas, including the Southern Hemisphere. At the ARGO Pacific implementation meeting in Tokyo in April a proposal was put forward to create a “float pool” which would be used to ensure global coverage. This idea is being pursued with float suppliers. Given that the actual implementation of floats was likely to fall short of the number needed for full global coverage, the SSG recommended that the UOP (or its successor group) review the requirements and comment on the desirability of full coverage over only part of the globe versus partial coverage over most of the globe.

The UOP also pointed to the need for broad international involvement in ARGO. While floats will be provided by a relatively small number of countries, the deployment of ARGO floats and the utilization of the data will require the aid of many countries and will bring them all benefits. A mechanism for entraining more nations into the ARGO effort has not yet been well defined, but it has been suggested that the concept of “regional action groups”, such as those associated with the DBCP, could be applied. The UOP suggested that CLIVAR take the lead in inviting nations to become involved in ARGO and inviting them to form regional action groups. Such groups could identify deployment opportunities, address

EEZ concerns, and provide the link with local entities, which could take advantage of ARGO-related assimilation and prediction products.

Koblinsky reviewed the many recommendations concerning deep ocean measurements which had arisen from the Saint Raphael meeting. These include the need for repeat hydrography, carbon measurements, moored time series, acoustic tomography and more. It was noted that these observations were critical to CLIVAR's success but that currently no group in CLIVAR was specifically charged to review these requirements or to oversee implementation. Koblinsky remarked that the present terms of reference for the UOP placed much emphasis on support of seasonal to interannual prediction activities but that WGSIP had a clear mandate in this area. Considerable discussion followed about what might be the ideal role of the UOP, and it was decided that the Panel should be reconstituted to become the CLIVAR Ocean Observations Panel (OOP). The new Panel would be charged to oversee implementation of sustained and near-sustained ocean observations at all depths in support of CLIVAR research. This would include oversight, for research purposes, of the ENSO observing system, as well as repeat hydrography in support of DecCen studies, for example. It was felt that increased emphasis should be placed on ocean assimilation and surface fluxes. The UOP was charged to develop new terms of reference (see Appendix D for final agreed version) and to make recommendations for membership of the newly reconstituted Panel.

5. TAO-TRITON-PIRATA

M. McPhaden presented a review of the status of the TAO-Triton array in the Pacific and Indian Oceans. The most significant development with regard to the TAO Panel is that the TAO array became the TAO/TRITON array as of 1 January 2000. ATLAS moorings were phased out of the western Pacific along 137°E, 147°E and 156°E in 1999, and were replaced with JAMSTEC TRITON moorings. During 1998 and 1999 data from several multi-month side-by-side deployments of TRITON and ATLAS buoys were compared for various locations in the western Pacific to ensure interchangability of the mooring measurements. Real-time and delayed mode TAO/TRITON data are being made available via the GTS and the World Wide Web as a seamless data stream. The combined data sets can be viewed at: http://www.pmel.noaa.gov/toga-tao/realtime.html.

Fishing vandalism is an ongoing problem in for both the TAO/TRITON array in the far western and eastern Pacific as well as for PIRATA in the Atlantic. Efforts have been made to reduce the vandalism by supplying information for the international Fish Aggregation Device (FAD) conference. In addition the distribution of brochures to fisheries agencies, fishing associations, and fishermen about the TAO, TRITON, and PIRATA programs have been continued.

PIRATA was virtually completed with the deployment of ATLAS moorings at two sites along 10W in early November 1999. The full array now consists of 12 moorings and will be in place until the end of 2000. Planning for a 5-year continuation of PIRATA beyond its initial pilot phase is also underway. Real-time data from the array can be viewed at:
http://www.pmel.noaa.gov/pirata/.

McPhaden noted that the array was now in a mature phase whereby issues concerning the data were being considered by various scientific panels such as the UOP or OOPC or even WGSIP and the TAO Panel itself needed only to consider logistical and technical matters related to the moorings. The SSG agreed to recommend to the other sponsoring agencies that the TAO Implementation Panel (TIP) become a technical advisory committee concerned solely with the logistical and technical aspects of implementation of mooring arrays in all three tropical basins. The new group would report to CLIVAR OOP (but remain as a Data Buoy Co-ordination Panel action group).

6. GODAE-OOPC

Dr. Rienecker presented a status report concerning the status of the planning of GODAE (Global Ocean Data Assimilation Experiment; 2003-2005). GODAE is an initiative being undertaken by the OOPC. It is based on the application of state-of-the-art ocean models and assimilation methods in real-time for short-range open-ocean forecasts, for boundary conditions to extend the predictability of coastal and regional sub-systems, and for initial conditions for climate forecast models. The global ocean analyses (and reanalyses) generated would be the basis for an improved understanding of the oceans, for assessing the predictability of oceanic phenomena, and for the design of an effective ocean observing system. GODAE will require a concerted effort to implement, over a three-year period (2003-2005), a suite of global in situ and satellite measurement networks. Existing satellite schedules are in principle adequate, although there is important work to be done with respect to future missions and encouraging the transition of systems such as TOPEX/POSEIDON and JASON to operational status. For in situ measurements, a major effort is necessary to achieve the desired resolution and global coverage, requiring a significant supplement to existing elements of the global ocean observing system. A global profiling float deployment (the "ARGO" proposal) at a nominal resolution of 250-300 km (i.e. approximately 3000 required for global coverage) is being planned. Without such an array, GODAE cannot be realized and commitments to ARGO are being pursued with as much vigour as can be mustered. Substantial commitments have already been made. The WCRP/JSC had expressed strong support for GODAE. The need for close liaison with CLIVAR oceanographic research areas was stressed.

Dr. Rienecker had also given a presentation at the WGSIP annual meeting, in November 1999, to explore ways of possible collaboration. WGSIP identified two levels of potential participation in GODAE, (i) Modelling groups represented on the panel expressed interest to use the data streams which will be made available by GODAE, and (ii) NCEP and UKMO through their representatives on the WGSIP panel expressed interest to be involved in GODAE's model intercomparison activities.

7. CLIVAR ATLANTIC

The CLIVAR Atlantic Implementation Panel held its first meeting, 13-14 April 2000 in Natal, Brazil, following PIRATA 7. A number of participants in PIRATA 7 also participated in the CLIVAR Atlantic discussions. Tony Busalacchi, who attended the Panel meeting, reported briefly on its observations.

Tropical Atlantic

Since the meeting was held in conjunction with PIRATA 7, discussions began with the tropical Atlantic. PIRATA will complete its pilot phase in 2001 and they are working on securing resources from their sponsoring agencies in Brazil, France and the US for an extended consolidation phase 2001-2006. Vandalism and equipment failure has resulted in poor data return. The poor data return from several key sites makes it difficult to examine the development of events along the equator. The PIRATA community is considering replacing frequently vandalized surface moorings with sub-surface moorings although this would reduce the range of processes that could be studied. A more frequent mooring service schedule for other sites would improve the overall data return but would also increase the cost of the program.

Other agencies are seeking to extend the PIRATA array geographically within the tropical Atlantic. An extension to the SE could focus on the development of SST anomalies offshore of the Congo. An extension to the NE could examine coastal upwelling and its link to local fisheries issues. An extension to the west would provide data that will contribute to seasonal and hydrological forecasts for the tropical Americas. PIRATA is encouraging these extensions but will ensure that full funding is available for these extensions before they are implemented.

There is growing evidence that SST signals from the tropical Atlantic affect the extratropical atmospheric circulation over the North Atlantic. Equatorial SST variations can arise through a variety of mechanisms. Variations in winds can lead to variations in equatorial upwelling. Changes in the cross equatorial exchanges could also lead to SST variations, as would changes in the air-sea fluxes. PIRATA is just part of the observational system needed to study this part of the Atlantic.

Other observations are made in this region. The US and Germany are planning a current meter array across the western boundary current at 17 N. IFM Kiel is planning a similar western boundary current array at 10 S. There will also be drifter and profiling float deployments, hydrographic sections and XBT lines. A US produced report entitled …. (COSTA) calls for a more co-ordinated approach to implementing a tropical Atlantic Observing system. The SSG endorsed this concept and agreed to write to nations active in the region, encouraging them to work together to develop a coordinated plan.

South Atlantic

The issue of climate variability over the Atlantic involves SST variability, which is related to upper ocean heat storage, air-sea fluxes and circulation changes. Since the upper ocean waters of the Atlantic flow from south to north, the circulation of the South as well as the North Atlantic must be understood in order to evaluate the role of oceanic advection of temperature variability in the Atlantic. The Panel recognised the need to extend its region of concern south to include the inflows of upper and intermediate waters around both Cape Horn and the Cape of Good Hope.

North Atlantic Oscillation

The NAO has considerable impact on a wide variety of atmospheric and oceanographic signals such as SST, sea ice and the Meridional Overturning Circulation (MOC). It appears to be mostly an internal atmospheric mode of variability, but tropical Atlantic SST variability seems to play a role in its development and structure, as do interactions with the troposphere. Also, there is evidence that the ocean carries forward information from the late winter of one year to the fall of the following year through deep winter mixed layers.

The panel proposed to hold its second session in conjunction with the Chapman Conference on the NAO, in northern Spain in late November/early December 2000, to review CLIVAR requirements for NAO research.

Meridional Overturning Circulation

The deeper layers of the ocean respond to climate forcing as a low pass filter. The deeper one goes, the lower the filter period. Within the sub surface ocean, temperature anomalies can arise from both changes in air-sea fluxes and changes in the transport. A review of the potential energy differences between the Labrador Sea and Bermuda over the past 40 years, implies changes in the baroclinic transport of the gyres of 20 sverdrups. Monitoring the temperature and salinity profiles of the water column at a few key locations around the gyres, would enable description of these large changes in gyre circulation. Much of what is known about variations in the meridional overturning circulation comes from observations that are very sparsely sampled in time. The few well sampled and well place time series stations would allow us to see how these large-scale changes in gyre circulation evolve with time.

The way forward

* There need to be more studies of how poleward heat transport arises and varies within couple climate models. Such studies should examine how the coupled system adjusts and varies as compared to how ocean or atmospheric models adjust and change.

* Need to look more at the small perturbations on the meridional overturning circulation in models rather than the large perturbations and the collapse of the MOC.

* While these studies are looking at processes with an Atlantic focus, they need to be done with a global model.

* We need to understand the limitations of our estimate of air-sea fluxes and why they appear to fail over particular parts of the North Atlantic. Need more air-sea flux buoy measurements.

Membership

` The panel would like to strengthen its southern hemisphere representation. It recommends adding a Brazilian with interest in the role the western boundary current plays in the upper ocean heat and salt budgets and a South African who is interested in the connections between the Atlantic and the climate of Africa.

8. SPARC

The SSG was informed by R. Newson about recent efforts by the WCRP SPARC Project to understand the role of stratospheric processes in climate. The presentation outlined recent evidence concerning the contribution of stratospheric-tropospheric coupling processes in providing a link between the North Atlantic (NAO) and Arctic (AO) Oscillations. These findings (SPARC Newsletter, 14) indicate potential opportunities for potential interactions between CLIVAR, ACSYS and SPARC toward a more comprehensive understanding of the problem.

The well-known teleconnection pattern known as the North Atlantic Oscillation (NAO) may be regarded as the manifestation of the AO in the Atlantic sector, and maps of the AO and NAO over the Atlantic half of the Northern Hemisphere are nearly identical. Its similarity to the NAO has caused some confusion, and led to the explanation of how the AO and NAO may be viewed as a single phenomenon through two different paradigms. The AO provides a useful way through which to evaluate and understand climate variability and trends, the occurrence of significant weather events, and the role of stratosphere-troposphere coupling. The AO paradigm provides a framework in which remote linkages, such as between tropical Atlantic climate variability and North Atlantic variability can be better understood.

There are three principal mechanisms by which the stratosphere can affect tropospheric climate. The first is through radiative transfer, either by changes in the amount of solar radiation that reaches the surface (e.g. after a volcanic eruption), or by changes in the amount of downwelling longwave radiation emitted by the stratosphere (e.g. because of stratospheric ozone depletion). The fact that thedistribution of radiatively active substances is controlled by the Brewer-Dobson circulation together with quasi-horizontal inmixing into the lowermost stratosphere emphasizes that climate models need to represent these processes with sufficient fidelity in order to capture this sensitivity. The second and third mechanisms by which the stratosphere can affect tropospheric climate take account of the basic dynamical fact that tropospherically forced waves propagate up, while zonal-mean anomalies propagate down. Thus, the second mechanism is that the stratosphere can affect the "upper boundary condition" of the troposphere by affecting the propagation characteristics of tropospheric waves. The third mechanism is downward propagation of zonal-mean anomalies. Since the zonal-mean anomalies are themselves caused by wave-induced forces whose ultimate origin is the troposphere, this provides a purely dynamical troposphere-stratosphere feedback loop, which may account for the well-documented troposphere-stratosphere anomaly correlations seen in observations.

SPARC is addressing a series of modeling issues through GRIPS (GCM — Reality Intercomparison Project for SPARC). The initial intercomparison of model stratospheric simulations showed a wide spread of skills, but almost all suffered from a cold bias in the global mean at all levels. This has prompted an investigation of radiative codes being used (on the lines of Intercomparison of Radiation Codes in Climate Models, ICRCCM, conducted under the auspices of the Working Group on Radiative Fluxes during the 1980s). The ozone distributions being used also need examination. It has furthermore been seen that the simulated planetary waves differ considerably between models, as does the structure of the stratosphere polar vortex. There are significant systematic errors in zonal-mean zonal winds, which are related to the drag due to resolved and parameterized waves in the models. In particular, the spectra of convectively-forced gravity waves resolved differs widely between models. These waves depend on the convective parameterization employed and the ability of

numerical schemes to allow their propagation. These differences mean that models require varying amounts of forcing due to parameterized gravity waves. This process has a primary role in driving the middle atmosphere, and more realistic parameterizations are needed as well as observational validation. (The planned SPARC initiative "Effect of Tropical Convection Experiment" being held over Northern Australia in 2002-2003 should be of considerable assistance in this respect.)

The simulation of the quasi-biennial oscillation (QBO) remains a challenge for climate models. While a few models are now able to reproduce this feature (although differing more or less from that observed), in some cases, the QBO-like oscillation appears as the vertical resolution increases, in others it occurs as the representation of physical processes (in particular, the parameterization of gravity waves) is varied. A detailed evaluation of this question is being planned as part of GRIPS. Another essential requirement for (stratospheric) climate simulations is the realistic specification of forcing fields such as ozone, solar irradiance and aerosol loadings. SPARC has been undertaking a review of stratospheric aspects of climate forcing with the objective of providing the current best estimates of relevant parameters. (This work complements that of WGCM in considering standardized forcing scenarios used in transient coupled model integrations). Comparative experimentation with different models including specific forcings as a means of assessing projections of climate change related to solar variability ozone changes is needed and will be undertaken in GRIPS.

A further issue of fundamental importance is the representation of the transport of trace gases in the upper troposphere and lower stratosphere, in particular in understanding the coupled chemistry-climate relationship. A satisfactory simulation of the "barrier-like" character of the tropopause is necessary.

In summary, major advances have been accomplished in the recent past however, several fundamental questions remain (SPARC Newsletter, 14). The SPARC Scientific Steering Group has organized an informal study group on stratosphere-troposphere coupling. The group will at first be based on an e-mail list of interested persons. The contact for being added to the mailing list is mark@nwra.com.

9. ACSYS-NEG

R. Newson reported on the ACSYS-NEG activities. One of the key issues is proper representation of sea ice in climate models, which is essential in order to clarify whether the simulated polar amplification of the response to increasing CO2 is due to real feedbacks or a consequence of an overly simplified treatment of sea ice. Moreover, sea ice is a major component of freshwater transport to lower latitudes and contributes "conveyor belt" mechanism. Again, this role of sea ice needs to be satisfactorily represented. In collaboration with other WCRP modelling groups, ACSYS-NEG is working to provide improved treatment of the Arctic components in climate models, including aspects such as sea-ice dynamics, lead and polynya behaviour, and clouds and radiation over sea ice. Other questions being considered were the optimization of coupled atmosphere/sea-ice/ocean models and their sensitivity and response to forcing, the variability of sea ice and freshwater export, and hydrological modelling in high-latitude regions (particularly model-derived Arctic precipitation and hydrology at river catchment scales). Specific relevant activities were the derivation of standard forcing data sets for sea-ice models, the Sea-Ice Model Intercomparison Project (SIMIP), the development of coupled sea-ice/ocean models, and Arctic regional atmospheric modelling. The findings from SIMIP were of particular interest to WGCM. A two-level dynamic/ thermodynamic model with a viscous plastic sea-ice rheology was judged to give

the best results at present and to be adequate and appropriate for climate models. (More detail and references are listed on the SIMIP home age:
www.ifm.uni-kiel.de/me/research/Projekte/SIMIP/simip.html.

10. Southern Ocean- CliC

As reported to the previous CLIVAR SSG meeting, the Joint Scientific Committee for the WCRP had established a Climate and Cryosphere (CliC) project task force in order to develop an initial science and coordination plan for addressing the role of the cryosphere in climate. "Cryosphere" in this context includes all polar region processes (air, sea, ice, snow, land, but not cirrus clouds) and extra-polar alpine glaciers, permafrost, snow belts and lake ice. Doug Martinson, a member of the task force reported on recent developments. The Task Force produced a draft plan, which was presented to the ACSYS SSG at its annual meeting in Tokyo during fall, 1998. At this meeting, the ACSYS SSG provided feedback and suggested modifications to the report, but approved of its general tone, scope and content. It is anticipated that ACSYS, with its focus primarily on the Arctic, will continue to function until its regular sunset data (31 Dec 2003), after which any residual ACSYS programs will be subsumed by CliC. CliC will come online whenever it is formally approved, initially operating in parallel (and complementary to) ACSYS. CliC will oversee all crysopheric issues, but will do so by not only directing its own specific programs, but also by coordinating between the various projects (inside and outside of the WCRP) to assure that all of the relevant cryospheric issues are ultimately addressed. More information on CliC can be found on the web site http://www.npolar.no/acsys/CLIC.

The JSC at its meeting in March 1999 highlighted the need for a close interaction between CliC and other WCRP projects. The CLIVAR SSG has been invited to comment on the initial draft science and coordination plan. The SSG noted that high latitude processes are both sensitive indicators of and are important in driving global climate variability and thus CLIVAR will have a clear intersection with CliC issues.

An area of immediate coordination was the development of plans for Southern Ocean research in support of CLIVAR and Clic. The SSG encouraged Dr Martinson to proceed with the planning for a joint CLIVAR/CliC workshop in Perth in November 2000 to refine Southern Ocean implementation plans in light of known levels of interest in the area.

11. CLIVAR WG on Seasonal-Interannual Prediction Chair (WGSIP)

Dr. Zebiak (WGSIP Chair) reported on progress of the Group's research activities. He gave an overview of the current understanding of the failure modes in the prediction of ENSO, and in particular concerning the 1997/98 event. The predictions made for the 1997/1998 El Niño were also reviewed. It was apparent that present models (coupled ocean-atmosphere or statistical) demonstrated only relatively limited ability in exploiting the predictability of ENSO. Generally, neither the onset nor the amplitude of the event was well predicted and the overall treatment of the evolution (growth, decay) was mixed. On the whole, the more comprehensive (primitive-equation) coupled models gave better and more useful results. Many models continue to have shortcomings in representing the variability of the coupled ocean-atmosphere system and, in particular, errors in the annual cycle appear to have a strong impact on the skill of predictions. Concerning the initialization of forecasts, although it seemed that several different methods could be employed, there was evidence that the use of sub-surface temperatures were critical for dynamical forecasts. There remain

several outstanding questions concerning the sensitivity of tropical ocean models and climate forecasts to surface winds, and there is evidence that intraseasonal variability (e.g., westerly wind bursts) may also play a part. It was found that both dynamical and statistical models successfully captured the peak phase of warm and cold events up to two seasons in advance, but none represented adequately the detailed life cycle of ENSO events.

The CLIVAR Intercomparison of NINO3 prediction and predictability project was recently completed. The purpose of this initiative was to assess skill of current "state-of-the-art" ENSO prediction systems that are used to make regular forecasts. The assessment is based on ensembles of forecasts initialized one month apart. Key results are: (i) all the models produce skillful forecasts of NINO3 six months in advance (ii) a consensus forecast (i.e. average of all the models) was the most skillful and (iii) much longer periods of retrospective forecasting are required in order to distinguish among the models. The final report is available. A related study on the variability of the tropical oceans on seasonal and interannual time scales other than ENSO (STOIC) was also nearing completion. STOIC is a companion project to the NINO3 forecast comparison project. Given the diversity in the contributing models, one of the significant outcomes is the degree of commonality in many of the biases that have been detected. This suggests that there are some real improvements to be gained if we can understand the underlying causes. The shortfall in wind stress variability is one of the main features that need correction. The final report will be published in the CLIVAR Exchanges. The Seasonal Prediction Model Intercomparison Project (SMIP) which begun in 1986 and involved 8 models was also in its final stages. SMIP was based on 4-month ensemble forecasts. The study involved data from seven models, focussed on the winters of 1982-83, 1986-87, 1987-88 and 1992-93, and the summers of 1987, 1988, 1993 and 1994. A key result is that skill and reliability differ largely among individual models. Skill of the multi-model ensemble is nearly the same as that of the best available model, except for the case when some members show very poor skill. It was found that the prediction skill of precipitation is low except for the region directly affected by ENSO.

WGSIP is in the process of launching several new major projects. Under one of these initiatives, the Panel will develop a standard set of diagnostics and guidelines for evaluating model performance, facilitating model intercomparison, and promoting model improvement. Future model intercomparisons (MIPs) will be designed with emphasis on promoting and encouraging model improvement and development of the interface with the applications community. A new project, SMIP-2, will be launched in the coming year. SMIP-2 will be an extension of the original SMIP that was done only for 4 selected summer and 4 winter cases. SMIP-2 will involve 15 cases (years). As a follow-on activity for the NINO3 forecast comparison project, WGSIP is experimenting with a prototype of real-time NINO3 intercomparison study. Under this project the Panel will undertake collection (verification) and publication of ENSO forecasts statistics in quasi-real time. Routine intercomparisons will be published in the Experimental Long Lead Bulletin. On the issue of regional downscaling, WGSIP will prepare a statement to provide guidance on downscaling methodology for seasonal to interannual prediction.

12. Working Group on Coupled Modelling (WGCM)

SSG was given an update by R. Newson of the state of development of coupled models and in particular on their use to address issues of concern to CLIVAR in the areas of decadal variability and predictability and anthropogenic climate change. CMIP is one of the most important and long-standing initiatives of WGCM, having been started in 1995. It comprises two components: CMIP1 to collect and document features of global coupled model

simulations of present-day climate (control runs); CMIP2, to document features of climate sensitivity experiments with CO2 increasing at 1% per year. CMIP1 and CMIP2 databases have been established at PCMDI. Data from the control runs of global coupled models (CMIP1) have been collected from twenty modelling groups in eight countries (representing virtually every group in the world with a functioning coupled model), and from transient climate integrations from sixteen groups (all that are expected). The model documentation for CMIP1 is now fairly complete (and accessible via the web) and CMIP2 model documentation is in progress. PCMDI is also compiling an atlas of CMIP results including overview figures and various statistical summaries, mean maps of basic parameters

WGCM additionally proposed that the initiation of a third phase of CMIP (CMIP3) should be explored. This would focus specifically on twentieth and twenty-first century coupled model simulations, but the exact approach to be followed is complicated by the numerous scenarios employed and lack of agreement on forcing data sets. The activity would be linked to that of IPCC Data Distribution Centres, which are also archiving data from these runs. The CMIP Panel will examine the questions involved, including the possibility of agreeing on a single forcing data set, the collection of just a single (100-year) integration from each modelling

Other WGCM subprojects include, (i) Idealized Sensitivity Experiments; in this suite of experiments a slab Ocean is adopted thus not involving the complexity of the ocean response. These experiments revealed interesting differences in the inferred cloud feedbacks. This feedback and that linked to upper tropospheric water vapour remain among the largest uncertainties in climate sensitivity, (ii) Standardized Forcing Scenarios; The range of forcing data sets (greenhouse gases, aerosols, ozone, solar, volcanic aerosols) that have generally been used up to now are well publicized. However, an IPCC Special Report on Emission Scenarios (SRES) has proposed four new "marker scenarios" based on different demographic and technological developments. A particular feature of these scenarios is that the rise in sulphur dioxide emissions is cut dramatically by 2030 and fall below 1990 levels by 2070. These scenarios, each of which assumes distinctly different changes in levels of population, economic growth, etc., are currently under government and expert review and will be considered by the IPCC Plenary in 2000. In the meantime, some centres are already performing experiments with these scenarios. IPCC has indicated that the older emissions scenario (IS92a) will be maintained in parallel with the SRES scenarios to provide continuity, (iii) Stratospheric Aspects of Climate Forcing; In this study a primary objective is to identify the current best estimates of relevant parameters that determine recent time-varying climate forcing in the stratosphere. The work has now been completed and a full report would appear in SPARC Newsletter No. 14 due for publication in January 2000, and (iv) Initialization of Coupled Models; Although there has been no organized work by WGCM on the initialization of coupled models, it is a topic that is kept under close review significant progress has been achieved on a number of important question.

WGCM recognized that progress in the questions being taken up in GRIPS (see Section 8) was essential in refining projections of climate change. Drawing on findings from GRIPS, WGCM pointed out that a full representation of the stratosphere was needed in climate models in order to be able to simulate realistically chemistry-climate coupling and solar forcing. WGCM duly encouraged all climate modelling groups to incorporate an adequately resolved stratosphere in their models.

WGCM expects to fully exploit the availability of a new generation of sea-ice models (see Section 9) that could now be incorporated into global climate models, and strongly

encouraged modelling groups to review their existing treatments of sea ice, with a view to making use of a more advanced representation of the type that had been assessed by ACSYS-NEG.

On regional climate modelling an account was given on progress regarding the co-operation between WGCM and WGNE to consider how the scientific foundation of this approach could be strengthened. A joint ad hoc committee tasked to address this problem had concluded that a balanced view of regional climate modelling was required and that, although there were technical issues to be considered, there were many successful applications and uses. A serious problem was the reduction of errors, systematic or otherwise, in the large-scale driving fields. WGCM agreed that a joint WGCM/WGNE review of the results being achieved by regional climate models was necessary to clarify outstanding questions, to point to strengths and weaknesses, and to draw attention to the importance of the correct and careful use of regional climate models. Techniques such as variable resolution models and non-dynamical (statistical) downscaling should also be taken up. Finally, the "added-value" given by different methods to regional detail and the validation of regional-scale results should be considered. An ad hoc group would be set up jointly with WGNE; this could possibly lead to a joint WGCM/WGNE workshop in 2001.

13. Working Group on Numerical Experimentation (WGNE)

R. Newson reported on the extensive range of WGNE activities. In the area of climate model intercomparisons, the principal initiative conducted under WGNE auspices is the Atmospheric Model Intercomparison Project (AMIP), carried out by the Program for Climate Model Diagnosis and Intercomparison (PCMDI) at the US Department of Energy Lawrence Livermore National Laboratory. The second phase of AMIP is centred on a standard experiment over an extended period (January 1979-March 1996) with an initial spin-up period to quasi-equilibrium designed to avoid trends in deep soil moisture and temperature apparent in the first phase. Over thirty groups have undertaken the required integrations and many already have submitted the data to PCMDI. As in the case of the first phase of AMIP, a range of diagnostic studies has been organized. A number of more comprehensive projects looking at such aspects as AMIP ensembles and resolution sensitivity are also being undertaken. A "quick-look" set of diagrams and statistics enabling an evaluation of each participating AMIP model is available. It is foreseen that AMIP will become a "quasi-operational" community exercise in which modelling groups would periodically contribute revised model simulations (e.g., every two to three years). The experimental protocol will be updated annually by extending the sea-surface temperature/sea-ice boundary conditions to near present and reviewing the standard output list.

Other comparison activities underway or being planned by WGNE are runs of atmospheric climate models in the prediction mode. This should provide a basis for understanding and improving models by being able to exploit the wide range of NWP verification techniques. A snow model intercomparison project is also being organized. As well as co-operation with SPARC in GRIPS, WGNE is continuing its own intercomparison of deterministic prediction of stratospheric activities. A workshop to review the current status of systematic errors in atmospheric models is being planned (in Melbourne, Australia, October 2000). WGNE also continues to monitor closely progress in atmospheric data assimilation/analysis systems, particularly the development of (three-dimensional and four-dimensional) variational techniques. WGNE has an important role in fostering reanalysis projects and initiated the organization of the second Conference on Reanalyses in the United

Kingdom in August 1999. A comprehensive land-surface parameterization project is being planned in collaboration with GEWEX.

14. Working Group on Climate Change Detection (WGCCD)

Tom Peterson, Chair of the joint WMO Commission for Climatology/CLIVAR Working Group on Climate Change Detection (WGCCD) reported on the Group's activities. He reviewed the Group's mandate, which is to manage the intersection between observational data and models in support of climate change detection (and monitoring). The CLIVAR nominated members are Gabi Hegerl (US), Phil Jones (UK), David Karoly (Australia), and John Mitchell (UK). Nominated by the Commission for Climatology are S. Dolgikh (Kazakstan), Chris Folland (vice-chair, UK), Chet Ropelewski (US), and A. Sun (China). Together with a variety of collaborators around the world, the Group is trying to address questions such as: What data are needed for climate change detection? What analyses can provide information useful for climate change detection? And what international coordination would improve climate change detection?

At the first meeting in Geneva in November 1999, the Group agreed to focus on two main activities. The first is analysis of indices derived from daily data. This effort started in September 1998 when Chris Folland organized a meeting of a special task group on indices. Long-term daily data allows for analyses of a wide variety of extreme events such as heat waves and flood producing rains that are of great interest to the general public as well as derived parameters that would be of interest to modellers. Global analyses are greatly facilitated by focussing in on derived indices: we've been pleased to find that many countries which would not exchange their long-term daily data are often willing to exchange long-term time series of indices derived from these data. Gabi Hegerl has begun to study which of our indices are relevant to climate models.

The second focus of the Working Group's activities is to foster regional climate workshops. The model for these was the very successful Asia-Pacific Network meetings that Mike Manton (Australia) organized. In these workshops, representatives of participating countries will (a) listen to talks from outside experts on quality control and homogeneity data, (b) participate in discussions on climate change for their region as projected by models, (c) participate in hands-on work with their country's data that they brought with them as the data are processed through quality control and homogeneity software, (d) perform climate change analyses on these data focusing on a core set of indices from daily data, and (e) produce a regional climate change assessment.

These capacity building meetings are not designed to result in the release of data. We believe that trying to encourage the sharing of data too strongly might decrease participation. But the meetings will result in the release of information derived from these data. This information from these regions can fill in another piece of the global climate puzzle. We are currently making plans for several regional workshops. First up will probably be one in the Caribbean organized by Michael Taylor (Jamaica) with my assistance followed by one in North Africa organized by Abdalah Mokssit (Morocco). Under discussion are workshops for northern or southern South America and southern Africa.

15. SURFACE FLUXES

David Legler reported on the Working Group on Air-Sea Fluxes and related activities. The WGASF report on intercomparison and validation of ocean-atmosphere energy fluxes was in final draft. The report stressed the need for further product evaluation and the importance of surface reference platforms, both on moorings and ships. It should be recalled that the latter point was also raised in the report of the Upper Ocean Panel as an outcome of the Ocean Obs 99 Conference. The SSG reemphasized the need for the successor OOP to take up this requirement. Legler reported on some observational initiatives which were being taken, including the upgrade of the TAO moorings to include longwave radiation measurements and the placement of IMET sensors on certain moored buoys and a pilot effort to put IMET sensors on two Voluntary Observing Ships in the Pacific.

Legler highlighted several issues of continuing concern, including the source of funding for high-quality reference flux observations, the availability and evaluation of radiative flux and precipitation products (it was recognized that GEWEX had some activities in this respect) and the need for improvements to NWP products. A major flux workshop, under the joint sponsorship of SCOR and WCRP, was to be held in Spring 2001. The WOCE transport workshop would also consider the use of hydrographic data to estimate fluxes. The SSG looked forward to the recommendations of these workshops and urged the OOP to pursue with vigour CLIVAR requirements in this area. It was also noted that the IGBP project SOLAS would have a strong requirement for surface fluxes and that more coordination was probably required here.

16. Variability of the American Monsoon Systems (VAMOS)

Roberto Mechoso reported on the implementation progress that VAMOS has made with respect to a three-tiered implementation strategy for studying the warm season precipitation within the Americas which will include process studies under the stratus deck off the west coast of South America, field studies of the South American low level jet, and a coordinated study of the climatology and hydrology of the Rio de la Plata basin.

Mechoso reviewed the overall goals of VAMOS which are to improve, for the Americas, the

- understanding of the monsoons in the context of the global climate system,
- capacity for seasonal to interannual climate predictions, and
- assessment of anthropogenic climate change impacts.

The VAMOS Panel's strategy to achieve these goals is based on the

- identification of scientifically important climate phenomena with demonstrated potential for predictable components,
- encouragement of partnerships between scientists in interested countries and contributions to the development of national and international research plans, and
- promotion of broad participation in field programmes, both to bring local expertise to an international setting and to enhance scientific exchange and capacity building.

The VAMOS Panel has focused on the definition of key problems and on the formulation of hypotheses for guidance of future empirical and modelling research as well as on the design of field experiments. A unifying view has started to emerge as similarities and differences between North and South American monsoon systems have been further clarified.

The current plans are centred on two internationally coordinated efforts to improve prediction of warm season precipitation over South and North America:

- Monsoon Experiment South America (MESA), and
- North American Monsoon Experiment (NAME).

The principal objectives of MESA and NAME are

- a better understanding of the key components of the American monsoon systems and their variability
- a better understanding of the role of those systems in the global water cycle
- improved observational data sets, and
- improved simulation and monthly-to-seasonal prediction of the monsoon and regional water resources.

MESA and NAME are both organised in three stages or tiers.

Mechoso presented some of the features of South American climate which form the basis for MESA studies. He noted that, over South America, the summer circulation is dominated by the monsoon system. Important geographical factors determining the evolution of this system are the large land mass bisected by the equator, very high mountains to the west that effectively block air transport in the zonal direction, and surface cover that varies from tropical forests in Amazonia to high altitude deserts in the Bolivian Altiplano. Plentiful moisture supply from the Atlantic maintains a precipitation maximum over central Brazil. A major seasonal feature of the monsoonal circulation over South America is the South Atlantic Convergence Zone along the north-eastern boundary of the La Plata Basin. A low-level northerly/northeasterly jet (known as the SALLJ) flows east of the Andes.

An important component of MESA's Stage 1 focuses on the SALLJ and the moisture corridor between the Andes and the Brazilian Altiplano. The main objective of this component is to better understand the role of the SALLJ on the moisture transports, their variability and links to remote and local climate anomalies. Stage 1 also comprises VEPIC (VAMOS-EPIC: Eastern Pacific Investigation of Climate Processes in the Coupled Ocean-Atmosphere System), which targets the links between continental convection and marine stratocumulus along the Chilean coast.

MESA's Stage 2 will be a study of the hydroclimatology of the La Plata River Basin. The current consensus is that climate variability in the La Plata Basin has remote influences. Positive precipitation anomalies in the basin tend to correspond to warm events in the tropical Pacific, warm sea surface temperature (SST) anomalies in the western South Atlantic, and cold SST anomalies in the north tropical Atlantic. The current consensus also states that, at least during the monsoon season, the major contribution to the moisture flux into the basin comes through a "moisture corridor east of the Andes". There is also evidence that precipitation in the basin is inversely correlated with the intensity of the SACZ. Understanding the mechanisms at work for these connections is a principal goal of MESA. Stage 3, towards

the end of the decade, will link the Rio de La Plata basin project (PLATIN) to the climate monitoring efforts under development by the South American countries along the Pacific coast. Data gathered in these programmes will be made available in a VAMOS database.

The North American Monsoon Experiment (NAME) is an internationally coordinated effort to improve the prediction of warm season precipitation over southwestern North America on seasonal time scales. NAME is designed to link CLIVAR/VAMOS, which has an emphasis on ocean-atmosphere interactions and GEWEX/GAPP, which has an emphasis on land-atmosphere interactions. Some anticipated benefits from NAME include

- a better understanding of the key components of the North American Monsoon System (NAMS) and their variability
- a better understanding of the role of the NAMS in the global water cycle
- improved observational data sets and
- improved simulation and monthly-to-seasonal prediction of the monsoon and regional water resources.

NAME is designed using a 3 tiered approach involving different spatial scales. Tier I focuses on mesoscale-features in the core mosoon region over southwestern North America. The goal of activities in this region is to improve the monitoring and modelling of the diurnal heating cycle and its influence on convection as a necessary step towards improved warm season precipitation prediction. Tier II focuses on regional-scale features over southwestern North America and the warm pool region to the southwest of Mexico. The goal of activities in this region is an improved description and understanding of intraseasonal aspects of the monsoon. Tier III focuses on aspects of the continental-scale monsoon circulation. Here the goal is an improved description and understanding of spatial/temporal linkages between warm season precipitation, circulation parameters and the dominant boundary forcing parameters.

A NAME Science and Implementation Plan is in preparation and a CLIVAR/GEWEX workshop will be held to consider the plan. NAME preparations will include a build-up phase leading to a two-summer Enhanced Observing Period (EOP). A two-year period (possibly 2003-2004) has been identified as providing an excellent opportunity to carry out NAME data collection activities because

i. a new generation of remote sensing satellites will be available to provide unprecedented enhancement of observing capabilities to quantify critical atmospheric, surface, hydrologic and oceanographic parameters
ii. several NWP centres (e.g. NCEP, ECMWF) are able to run their coupled modelling system to provide dynamically consistent datasets over the NAMS domain, and
iii. other GEWEX/GAPP and CLIVAR/VAMOS field experiments are planned during this period.

Mechoso emphasized that MESA and NAME will provide an important linkage between CLIVAR and GEWEX. The GEWEX Continental-scale International Project (GCIP) has promoted much research into aspects of the North American monsoon system, which will continue and expand under the new GEWEX Americas Prediction Project (GAPP). Similarly, the GEWEX Coordinated Enhanced Observing Period (CEOP) will coincide with the first MESA field programmes. Finally, PLATIN will be the first large-scale, international project to be jointly sponsored and developed by CLIVAR and GEWEX.

The SSG welcomed the report by Prof Mechoso and encouraged the VAMOS panel to continue to develop the 3–tier implementation strategy for a Monsoon Experiment – South America (MESA) and a North American Monsoon Experiment (NAME).

The SSG agreed to form jointly with GEWEX a WG on the Climatology and Hydrology of the Rio de la Plata Basin. Dr Mechoso was nominated as co-chair and the SSG invited the GEWEX SSG to identify the other chair. Together the co-chairs should develop terms of reference and membership for the WG and report back to the SSG. The ICPO agreed to explore with national representatives in the region the possibility/ desirability of forming a resource board or informal planning group to help with implementation of the Rio de la Plata experiment.

17. Africa

Dr. Semazzi summarized the Science Implementation Plan that was prepared by the CLIVAR Africa Task Team (CATT). The Task Team chaired by Dr Chris Thorncroft, had been given the following mandate:

- Develop an implementation plan for an international project to investigate the variability and predictability of the African climate. An important goal of the CLIVAR Africa research agenda would be to advance our understanding of the variability and predictability of the African climate and to promote relevant experimental prediction activities.

- Build on the science report prepared by the CLIVAR Africa Study Group and to advise the SSG on the next steps for the development of an implementation plan. The study group is tasked to identify a manageable set of phenomena for which the respective states of readiness, from both scientific and resource points of view are sufficient for them to be the initial foci of the CLIVAR-Africa research agenda.

- Prepare a report with recommendations to be considered by the next CLIVAR SSG meeting in May 2000. Initially it is expected that the task team will work by e-mail to develop the framework for its work but it will also meet in the coming months to discuss the issues.

The Implementation Plan describes an implementation strategy for the CLIVAR Africa principal research area (PRA). A draft of the IP was reviewed by the CLIVAR SSG and also distributed for comments to a cross-section of the CLIVAR research community with expertise in the variability of the climate of Africa. The research strategy consists of four primary projects

i. the annual cycle project, with initial emphasis on the study of the South-East Atlantic Stratocumulus problem
ii. the inter-annual climate variability project, with initial focus on the study of the 1997/98 ENSO climate anomalies over East African/Southern Africa
iii. the intraseasonal variability project, and
iv. decadal climate variability project.

The SSG approved the IP and agreed to its publication as a CLIVAR report. The SSG also agreed to the formation of a Panel on the Variability of the African Climate System (VACS) to carry forward these plans, and tasked the ICPO to initiate the process of identifying suitable Panel members. The terms of reference agreed by the SSG for the VACS Panel can be found in Appendix C.

18. GEWEX-CEOP

The organizational structure formulated for GEWEX has grouped the existing sub-activities and projects into three disciplines namely Hydrometeorology, Atmospheric Radiation Processes and, Modelling and Prediction. S. Sorooshian reviewed recent developments in these programs of special interest to CLIVAR.

The GEWEX Hydrometeorology Panel (GHP) is continuing the development of plans for the five GEWEX Continental Scale Experiments (CSE's) to participate in a Co-ordinated Enhanced Observing Period (CEOP). Emphasis has been placed on more clearly articulating strategies for the use of satellite data, distribution of as much data as possible by way of the Global Telecommunications System (GTS), management and collection of results into a single unique dataset on appropriate media (i.e. CD-ROM), and execution of activities that could be undertaken jointly with other elements of WCRP (e.g. CLIVAR, CliC). A Water and Energy Balance Study (WEBS) and a Water Resources Applications Initiative have been organized to focus on specific research goals as reflected in the criteria for establishment of the CSE's. The Coupling of the Tropical Atmosphere and Hydrological Cycle (CATCH) Project in Africa was given Continental-Scale Affilitate (CSA) status within GHP. This action acknowledges the important contributions CATCH can make towards the GHP/GEWEX global objectives, but recognizes the difficulty CATCH will have in fully meeting all of the CSE criteria.

Under the auspices of the GEWEX Radiation Panel (GRP), climate forcing and climate feedback have become the two broad science issues of importance in fulfilling the main GRP research goals. The need to identify gaps and reduce the uncertainties associated with these phenomena is critical to making significant progress towards improved climate predictions. The technical issues in understanding these principals and acting on them are forming the framework for research being fostered by GRP. A workshop and a journal article are planned to synthesize progress associated with both the observational and model based assessments being undertaken within the GRP sub-projects. The SSG was informed of relevant actions associated with this strategy that are underway as part of the GEWEX Global Aerosol Climatology Project (GACP); the next phase of the GEWEX Global Water Vapour Project (GvaP); Global Precipitation Climatology Project (GPCP) enhanced datasets; efforts to build and launch international GEWEX multi-sensor cloud/radiation/aerosol missions; and continuation, beyond 2000, of the International Satellite Cloud Climatology Project (ISCCP) and other GEWEX global data projects. The SSG asked if the GEWEX Project Office could provide a more detailed status report on GEWEX activities related to radioactive fluxes. Sorooshian encouraged the SSG, upon receipt of this report, to provide feedback on how GEWEX efforts could better serve CLIVAR requirements.

The GEWEX Modelling and Prediction Panel (GMPP) is working in association with the Working Group on Numerical Experimentation (WGNE) to meet its commitment to assist in the production of improved cloud and land-surface parameterizations for use in General Circulation Models (GCMs). Plans are being developed for a GEWEX Global Land/Atmosphere System Study (GLASS). GLASS has four main activity elements, which

correspond to work on off-line and coupled functions at both the point to regional scales and the global scale. Development of a standardized interface that will facilitate the inter-comparison activities within GLASS is also underway. GLASS will work in close association with GHP and especially with the International Satellite Land-Surface Climatology Project (ISLSCP). Connections betrween ISLSCP and the Biospheric Aspects of the Hydrological Cycle (BAHC) core project of the International Geosphere/Biosphere Program (IGBP), have led to an agreement for GLASS to co-ordinate the model inter-comparisons BAHC wishes to perform.

19. Interactions with other Global Change Research and Applications Programs

The SSG was informed about the preliminary efforts undertaken by ICPO to establish closer collaboration between CLIVAR and the applications community. These efforts presently involve interactions with the CLIMAG, GECaFS, and GLOBEC global projects.

Climate Prediction and Agriculture (CLIMAG)

The goal of CLIMAG is to utilise the ability to predict climate variability on the scale of months to a year to improve management and decision-making in respect of crop production at farm and up to national scales. Knowledge of the past and current state, such as soil conditions, is of enormous value for agriculture and prediction of crop yields regardless of future climatic conditions. This is particularly significant considering the marginal skill exhibited by some of the global models in the prediction of the very strong 1997-98 El Niño. Some of the areas of initial cooperation between CLIVAR and CLIMAG that were discussed include:

i. assessment of regional seasonal climate variability and predictability
ii. development of tools, including models, to exploit the predictability where possible. Important activities include development of methodology for assessing useable skill; downscaling, assembling and creation of high resolution data archives for validating downscaling methodology, and
iii. cooperation of CLIVAR and CLIMAG in capacity building activities.

At a recent international workshop on Climate Prediction and Agriculture (CLIMAG), Geneva, Switzerland, 27-29 September 1999, downscaling of global model prediction products and up-scaling of crop model output were identified as areas that need significant attention. The CLIVAR Working Group on Seasonal-to-interannual Prediction (WGSIP) and other WCRP modelling initiatives are taking a close look at the existing methodologies for downscaling. This and other overlapping areas of research interest underscore the need for closer collaboration between CLIVAR and CLIMAG.

Global Environmental Change and Food Systems (GECaFS)

The proposed GECaFS project is a joint venture involving IGBP, IHDP and WCRP. Its goal is to estimate the impacts of Global Environmental Change on food production, availability and accessibility across biophysical and socio-economic systems from regional to global scales, and to analyse the effectiveness of adaptive strategies to reduce societal vulnerability. The planning of the project is presently underpinned by three foci:

- Focus 1 - Impacts: Effects of Global Environmental Change on Food Provision
- Focus 2 - Vulnerability and Adaptations: Global Environmental Change and Options for Enhancing Food Provision, and
- Focus 3 - Feedbacks: Environmental and Socioeconomic Consequences of Adapting Food Systems.

It is envisaged that the project will likely be implemented as a set of commissioned studies. A six-person Planning Group, with members representing the broad interests of the co-sponsors, has been established to guide the planning phase during 2000/01. WCRP was represented by Dr Douglas Whelpdale (JSC) and Dr Fredrick Semazzi (ICPO) at the previous two planning meetings, Reading, United Kingdom, 20-21 July 2000, and the Royal Swedish Academy of Science, Stockholm, 20-22 November 2000 (Focus 1). The next two planning meetings will be in Chang Mai, China, February 2001 (Focus 2) and Washington, USA, April 2001 (Focus 3). This timetable is designed so as to be able to present the full plans at the IGBP Open Science Conference in July 2001. It is expected that WCRP will be represented at these future meetings.

Global Ocean Ecosystem Dynamics (GLOBEC)

The goal of GLOBEC is to advance the understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem to global change. Within the GLOBEC mission there is a need to understand the variability and predictability of the marine ecosystem.

Discussions for closer cooperation with GLOBEC have evolved around a number of themes. There is a need for targeted diagnostic studies to reveal the associations between climate, marine ecosystems and fish populations on timescales from interannual to centuries. The marine ecosystem is believed to be sensitive to climate forcing in key locations and at key times of the year, requiring specific climate-fishery collaborative studies bringing expertise from both disciplines to determine the linkages and their mechanisms. In addition to diagnostic analysis in the historical record, this leads to a need for paleo studies to extend the observation record of climate and marine ecosystem. The potential for joint research between GLOBEC, CLIVAR and PAGES on decadal-to-century timescale variability should yield high benefits. GLOBEC has a need for interaction with climate modellers, to explore nesting marine ecosystem models within ocean models. Some thinking is emerging that climate variability may even be a key missing link to explain variations in the population dynamics of many fish species. There is a need to identify a strategy for how to make the necessary diagnostic and modelling studies. A number of common historical and real-time monitoring data issues are emerging which might be usefully addressed by bringing together CLIVAR working groups and GLOBEC in these areas, particularly, for real-time monitoring and forecasting.

The SSG encouraged ICPO to continue the ongoing efforts to strengthen existing links and explore new ones but recommended that the collaboration with CLIMAG, GECaFS and GLOBEC should proceed in association with the overall WCRP structure.

20. PAGES/CLIVAR

Dr. Overpeck reported on the many exciting results which had been published recently by the paleoclimate community and which formed much of the basis for the latest IPCC assessment. These included reconstruction of climate forcings for the past 500 years, the M. Mann composite paleo reconstruction of temperature for the past 500 years and new borehole measurements which indicate a global temperature rise since pre-industrial times of order one degree Celsius (previous reconstructions based primarily on tree rings have indicted a significantly smaller warming on the order of 0.6 degrees C.)

The PAGES/CLIVAR Intersection seeks to promote international, interdisciplinary collaboration between paleoscientists and the climate modelling community. The four principal areas of research emphasized are:

- Extending the instrumental climate record back in time with quantitative, annually resolved proxy data.
- Documenting and understanding rapid climate change events.
- Documenting and understanding natural climate variability during warm interglacial periods with background climatic states similar to those of today.
- Testing the ability of climate models to capture known past climate variability.

The interaction between PAGES and CLIVAR is driven by the overlapping interests of the paleoclimate and climate prediction research communities. Paleoscientists rely on modern instrumental records in order to calibrate and validate their proxy climate reconstructions while climate prediction relies on the information about decadal and century scale variability which only, high resolution, multi/proxy paleorecords provide. Project-driven interactions of this nature have led to significant scientific advances. However, the tremendous range of proxy material needs to be harmonised and made readily available to the wider climate research community. The task of co-ordinating this effort is central to the PAGES/CLIVAR Intersection.

An ambitious series of PAGES/CLIVAR workshops, open meetings and short courses, with equal representation from the paleoclimate and climate dynamics communities, is underway. Each individual meeting is organized around a specific, well-defined topic. As a series they will provide continuity and momentum to this interdisciplinary effort, and help to develop the PAGES/CLIVAR intersection.

A joint workshop Climate Variability of Last 300 to 1000 Years: http://www.pagesclivar.unibe.ch/venice/ was held in Venice in November 1999. A report of this meeting is in preparation. A PAGES/CLIVAR newsletter was issued in March 2000.

Other successful activities during the last year were:

- Data (both a workshop and an implemented public-domain data effort): http://www.ngdc.noaa.gov/paleo/data.html

- Annual Records of Tropical Systems (a focused research initiative): http://www.pages.unibe.ch/publications/publications.html

- Paleoclimate Modelling Inter/comparison Project (PMIP) focused research initiative with annual workshops (WCRP report in press).

An overview of the PAGES/CLIVAR program and some recent scientific highlights is available at: http://www.pages.unibe.ch/news/pagcliv2000.html/pagcliv/html

The PAGES/CLIVAR Working Group has been restructured to reduce it in size and to introduce some rotation of members. The CLIVAR SSG endorsed the following recommendation for membership:

J. Overpeck (co-chair, USA, lake sediments)
J-C. Duplessy (co-chair, France, sediments)
Abe-Ouchi (Japan, modelling)
K. Briffa (UK, tree rings)
M. Cane (USA, modelling)
M. Claussen (Germany, modelling)
J. Cole (USA, corals)
M. Gagan (Australia, corals
S. Joussaume (France, modelling)
J. Jouzel (France, isotopes)
M. Mann (USA, multi proxy data sets)
T. Stocker (Switzerland, modelling)

Overpeck noted that the new Working Group would focus primarily on the past 200 years. He concluded by stating that despite the major contributions of paleo work to the IPCC assessments, funding for data collection was still a problem. He noted that many of the best sources of proxy data were fast disappearing; most of the world's glaciers were melting, large areas of coral were dying off due to fishing, disease or climate variability, and trees were being cut down.

21. DATA TASK TEAM

The CLIVAR Data Task Team (DTT) has so far held only a one-day meeting, on 23 October 1999, in St. Raphaël, France.

The DTT is charged with the description and development of a data system for the Climate Variability and Predictability Study (CLIVAR). The challenge for the DTT is that in order to serve atmospheric, oceanic, palaeoclimatic and modelling research, such a system must have a broad scope. It may well be that a single type of data system will not serve the varied needs of all the CLIVAR components.

In the course of the first meeting, a number of issued arose.

In order to define a data system, the DTT needs to develop a two-way communication with each CLIVAR Panel. The DTT recommends that each CLIVAR Panel designate a data-products liaison panel member to help identify data needs based on its scientific program.

As part of this process, the DTT also recommends that each CLIVAR Panel and Working Group begin the task of

- Identifying its data and data product needs.
- Identifying data sources specific to their panel's program.
- Alerting the DTT to inadequacies of the present data system.

The DTT meeting held immediately after the Ocean Observations conference was particularly concerned that as the World Ocean Circulation Experiment (WOCE) reaches its end, key elements of the WOCE data system be maintained to meet CLIVAR needs. The SSG noted that at its previous meeting it had already recommended that the WOCE data centres continue until an in-depth review of CLIVAR requirements for these centres be made. There was some discussion as to whether it was wise to review these requirements by platform, or rather to take a more integrated approach. It was also noted that the management of real-time data for CLIVAR should be coordinated with data assimilation efforts such as GODAE which would QC real time data.

Following the meeting, members of the DTT prepared supplementary reports on data issues relevant to CLIVAR. The following reports are available as annexes to the report of the first session of the DTT. (Report from the First Session of the CLIVAR Data Task Team, Document 19.2 for this meeting):

- Principles relevant to CLIVAR oceanographic data needs.
- A list of atmospheric datasets relevant to CLIVAR.
- Criteria for archiving and disseminating modelling data.

The SSG expressed some frustration as to the slow pace of data management planning for CLIVAR. The SSG considered that the liaisons with the individual science panels would play a key role in identifying requirements and developing further plans.

22. ICPO

John Gould presented a report on ICPO staffing and activities. He reported that staff effort available to the ICPO presently stands at approximately 3.4 p.y. per annum made up of:

- **John Gould** (Director) 0.7 p.y. (seconded by UK Natural Environment Research Council until retirement date August 2002. Remaining 0.3 p.y. of Gould's time taken up with responsibilities for WOCE and continuing science research).
- **Fred Semazzi** (Senior Scientist) 0.8 p.y. (seconded from NC State and supported by US CLIVAR IAG through NOAA. Agreement on secondment formally ends at end CY 2000. Remaining 0.2 p.y. taken up with continuing responsibilities at North Carolina State and IPCC).

- **Andreas Villwock** (Staff Scientist located in Hamburg) 0.8 p.y. (CY 1999) 0.4 p.y. (CY 2000 limited in CY 2000 by available German funding for ICPO support). Support recently received from Canada will allow increased commitment for remainder of CY 2000. Bid for full-time support by Germany for 2001 onwards being prepared.

- **Katherine Bouton** (Data specialist) 0.5 p.y.). (Started in ICPO July 1999. Seconded from U Delaware and supported by US CLIVAR IAG through NASA. Secondment for 2 years with request for year 2 needed in July 2000).

Note: This summary does not include the substantial support provided to CLIVAR by Valery Detemmerman in the JPS.

John noted that the ICPO's ability to adequately interact with the present 14 CLIVAR panels and working groups and to attend relevant science conferences and meeting was severely restricted by the amount of available ICPO staff time.

Gould reported that there had been a very positive development in funding for the ICPO: Canada had committed CAN$ 50,000 this year and it was hoped that this would be a recurring contribution.

In addition to staff costs outlined above, the ICPO received/will receive the following (converted to US$k):

Source		CY 1999	CY 2000	CY 2001
Japan (JAMSTEC)	(Y 4m)	38.0	38.0	38.0
Australia (BoM)	($Aus 15k)	9.0	9.0	0.0
UK (UKMO)	(£10k)	16.0	0.0	???
Canada (Met Serv)	($Can 50k)		34,0	34.0
TOTAL		**63.0**	**81.0**	**72.0+UKMO**

The Canadian funds will go towards salary support for Villock; the bulk of the remaining funds are used to print and mail CLIVAR Exchanges.

Already at its last session, the SSG had recommended that the ICPO work towards the establishment of a staff position dedicated to coordination of CLIVAR activities in the Americas. Preliminary discussion had taken place with the USA concerning potential funding for such a position, but at present the resources have not been secured nor has the appropriate person been identified.

The SSG agreed that the format for the current meeting with reports from most of the panel or working group chairs had been very successful and encouraged the ICPO to continue to organise the meetings in such a manner. However, intersessional communication between the SSG, CLIVAR panels and the ICPO could be increased and the SSG recommended that an SSG member be identified in liaison with each panel or group and that at a minimum, they be copied on all relevant correspondence. A suggested list of liaison is:

Panels /WGs	ICPO/JPS staff	SSG link
JSC/JPS	Gould	Co-chairs
SSG	Gould	Co-Chairs
WGOMD	Gould	Willebrand
Pacific	Gould	Hanawa
S Ocean	Gould	Martinson
WGCM	Semazzi/Newson	Zwiers
WGSIP	Semazzi	Palmer
Africa	Semazzi	Trenberth
A-A Monsoon	Semazzi	Wu
VAMOS	Villwock	Busalacchi
PAGES	Villwock	Jouzel
COOP	Detemmerman	Weller
WGCCD	Detemmerman	Nicholls
DTT	Bouton	Jouzel
Atlantic	Boscolo	Busalacchi

John Gould closed his presentation by noting that some difficulties had been encountered in engaging nations in the international infrastructure, despite the impressive show of interest and support demonstrated by the CLIVAR Conference. Few national reports had been received, even from the major CLIVAR participants, and those which were in hand were of widely varying length and detail. Discussion amongst SSG members indicated that in some countries it was difficult to identify who might produce such a report, and the question was raised as to whether it was cost effective, for the country and the ICPO, for nations to report on all streams of CLIVAR research in which they were involved. There was a general sense that some central repository of information was needed in order to be able to effectively manage the program, and that the Tracking Project could serve this function. The ICPO was encouraged to pursue with vigour inputting and updating information on this web site and SSG members were charged to encourage input from their own countries.

APPENDICES

Annex A

Agenda of the Ninth Session of the CLIVAR Scientific Steering Group (SSG)

Tuesday, May 2, 2000

8:30 a.m. Welcome by Prof. Lorenz Magaard, Associate Dean, SOEST, and Executive Associate Director, IPRC.

1. **Introduction** **Busalacchi/Willebrand/Gould** (45 min)

The SSG co-chairs and ICPO Director will review developments since SSG-8, including a report on issues raised at the recent JSC-21 meeting in Tokyo. They will summarize the overall objectives for SSG-9 which will include consideration of how to ensure that the SSG can work effectively to cover a project as broad as CLIVAR.

2. **Indian Ocean/A-A Monsoon** **Lau and/or Godfrey** (45 min)
The A-A Monsoon Panel met in December 1999 and subsequently developed a strategy for a sustained Monsoon observing system. Issues concerning both the scientific understanding of the A-A Monsoon, the requirements to implement both observations and modeling within CLIVAR and areas of interaction with GEWEX will be presented. Any issues relating to panel membership and meetings will also be raised.

10:15 a.m. **BREAK**

Process study proposal **P Webster** (30min)
Process studies have in the past shed much light on the physical mechanisms involved in Monsoon systems. The case for further process studies will be presented.

3. **Pacific Panel** **Weller** (30 min)

A small group charged with planning a CLIVAR Pacific Implementation workshop met May 1. R Weller will report on the recommendations of the group.

4. **TAO/Triton IP** **McPhaden** (30min)
A report will be given on the state of implementation of the TAO/Triton array. This will touch on the problems of vandalism and of funding

5. **IPRC summary** **McCreary** (30 min)

The Director of the IPRC will make a presentation to the SSG on the organization, objectives and work of the IPRC.

12:00 LUNCH

6. **Upper Ocean Panel** **Koblinsky** (30 min)
A report will be given on the work of the UOP. The SSG should consider the future directions and terms of reference of the panel particularly in respect of possible overlaps in responsibility between UOP and the CLIVAR ocean sector panels and the OOPC. Implementation of suggested changes in UOP membership have been deferred until new TOR have been agreed by SSG.

3:00 p.m. BREAK

7. **GODAE/OOPC**
Neville Smith, Chairman OOPC and GODAE will not be able to attend SSG-9. Interactions will be dealt with under agenda item 6. The meeting will be attended by Michelle Rienecker, a member of GODAE Science team, who will be able to report on GODAE activities.

5:30 p.m. ADJOURN Meeting

6:00 – 7:30 p.m RECEPTION at E-W Center, Wailana Room

Wednesday, May 3, 2000

8:30 a.m. Start

8. **Atlantic Panel/Pirata/Tropical Atlantic** **Busalacchi** (45 min)

The newly formed Atlantic Sector Implementation Panel first met in Brazil in conjunction with a meeting of the Pirata Panel in mid April 2000. Although the Atlantic Panel Chairman, Allyn Clarke, will not be able to attend SSG-9 a verbal report on both meetings will be given by A Busalacchi.

9. **SPARC Arctic Oscillation** **Newson** (20 min)

Stratospheric-tropospheric coupling processes have been implicated in linking the North Atlantic and Arctic Oscillations. A presentation will be given on this topic with emphasis on the potential for interactions between CLIVAR, ACSYS and SPARC.

10:15 a.m. BREAK

10. **S.Ocean/CLIC** **Martinson** (30 min)

At CLIVAR-8 John Church and Doug Martinson were charged with arranging a workshop/meeting to start implementation of CLIVAR in the Southern Ocean Sector.
A meeting has been scheduled for Perth Australia in the week beginning November 13 2000.

A report will be given on the possible scope and objectives of this meeting.

Modelling issues

11. **WGSIP** **Zebiak** (45min)

The Chairman of the CLIVAR WG on Seasonal-Interannual prediction will summarise the recent work of the group which has included a study of the failure modes of prediction for the recent ENSO event. Future modelling activities and model intercomparisons experiments will be summarised. Suggested changed in WG membership will be presented to SSG for ratification. There will be a presentation (approx 30 minutes) on NASA's Seasonal-Interannual prediction project by Michelle Rienecker.

Steve Zebiak will give the SSG an update in the status of the International Research Institute for Climate Prediction (IRI) stressing the contribution that the IRI is and will be able to make to the achievement of CLIVAR objectives status (30 min)

12:00 LUNCH

12. **WCRP WG on Coupled Modelling** **Newson** (45min)

Neither the chairman of the WGCM (Lennart Bengtsson) nor John Mitchell is able to attend SSG-9. Instead a presentation on the work of the group will be given by Roger Newson. He will report on the state of development of coupled models and in particular on the ways in which these models can be used to address issues of concern to CLIVAR in particular in the areas of decadal variability and predictability and of anthropogenic climate change. Since SSG-8 a WG on Ocean Model Development has been established that reports to both WGCM and to the WOCE SSG.

A presentation (approx 45 min) will be given by Ants Leetmaa on "Decadal influence on US climate"

13. **WG on Climate Change Detection** **Petersen** (30min)

This serves as an advisory body to the WMO commission for climatology. Within its remit are close links with WGCM on the roles of greenhouse gases and aerosols, with GCOS on the maintenance of appropriate climate change data sets and with IPCC. It also has responsibilities in the field of capacity building for climate change detection.

3:00 p.m. BREAK

Total time for formal presentations 3hr 35 min leaving of order 4 hrs for discussions and for a science presentation from IPRC/SOEST staff.

5:30 p.m. ADJOURN

Thursday, May 4, 2000

8:30 a.m. Regional issues and GEWEX

14. **Variability of the American Monsoon System (VAMOS) Mechoso** (45min)

The VAMOS Panel met in April 2000 and a report will be given on the outcome of that meeting, on the state of implementation of the VAMOS programme and limitations imposed by funding and lack of infrastructure

15. **Africa Semazzi** (45min)

The CLIVAR Africa Panel published its report on African Climate Variability in 1999. SSG members all received a copy and are encouraged to read it. It can be downloaded from :-

Subsequently a CLIVAR Africa Task team was established to develop an implementation plan. A report will be given on the work of the CATT towards implementation highlighting limitations imposed by funding and lack of infrastructure and also identifying the practical applicability of CLIVAR research in Africa.

10:15 a.m. BREAK

16. **Global Energy and Water Experiment (GEWEX) and its Co-ordinated Enhanced Observing Period (CEOP) Sorooshian/Try/Stewart** (30min)

There are many areas in which CLIVAR's interests in seasonal to interannual prediction closely intersect with concerns that fall with the remit of GEWEX. The potential for collaboration will be discussed particularly as it related to activities falling within the planned 2002-3 CEOP.

17. **UNESCO HELP programme Shuttleworth** (30min)
In 1999, the Joint UNESCO/WMO Conference on International Hydrology endorsed a new global initiative, HELP (Hydrology for the Environment, Life, and Policy), to establish a global network of catchments to improve the links between hydrology and the needs of society. The main purpose of HELP is to deliver social, economic, and environmental benefits through the sustainable and appropriate use of water by deploying hydrological science in support of improved integrated catchment management. The presentation will demonstrate areas in which there is potential for CLIVAR research to assist HELP.

F Semazzi will provide a brief overview of the potential interactions of CLIVAR with the IGBP/IHDP/WCRP programme on "Global Change and Food and Fibre".

12:00 LUNCH

Overarching CLIVAR issues

18. **CLIVAR/PAGES** **Overpeck** (45min)

Understanding present and future climate variability and change depends on developing reliable proxy indicators of past climate. CLIVAR has always had a strong and productive interaction with the PAGES programme of IGBP as a means of developing these proxy indicators. The work is nicely demonstrated by the most recent joint PAGES/CLIVAR issue of Exchanges. A report will be given on the CLIVAR/PAGES WG including recommendations for a smaller membership.

19. **Data Task Team** **F. Webster** (45min)

CLIVAR researchers will require simple and timely access to a wide range of meteorological, oceanographic and paleoclimate data sets as well as products and model output. The CLIVAR DTT was established to recommend the means by which this should be achieved, building on existing mechanisms and making use of rapidly-developing information exchange mechanisms using the WWW. The work of the DTT will be summarized.

3:00 p.m. BREAK

20. **IPRC Data Center** **McCreary** (15min)
A summary will be given of the scope and capabilities of the data center

Day 3 Total time for formal presentations 4hrs 15 mins leaving of order 3 hrs 45 mins for discussions)

Note. 1) National reports submitted in time for the meeting will be available on the WWW site. Where appropriate, SSG members and other SSG-9 attendees should highlight national initiatives relevant to each agenda item.

5:00 p.m. ADJOURN

Friday, May 5, 2000 Scientific Steering Group (SSG) members only

8:30 a.m. Start

21. **ICPO report Gould**

22. **National implementation summary** **Gould**
An assessment will be given of the highlights of national activities. Summaries of national projects are accessible via the searchable CLIVAR project web pages at :-http:// clivar-seach.cms.udel.edu

10:15 a. m. COFFEE BREAK

23. **Discussion of future CLIVAR related meetings and workshops**

A summary will be provided of up-coming CLIVAR-related meetings and workshops. SSG members should work to ensure that CLIVAR researchers use these to demonstrate the breadth and importance of CLIVAR science.

The SSG should consider the steps that need to be taken to mount a dedicated CLIVAR science conference in 2003 (5 years after the CLIVAR International Conference)

24. **Identification of key science issues and agreement of action items.**

25. **Membership issues**
The SSG should recommend/endorse changes to the membership of its panels and WGs and to its own membership taking into account a balance of scientific expertise and geographical distribution.

26. **Date and place of next meeting**
The SSG should consider an appropriate time and place for its 10th meeting bearing in mind past locations and ease and cost of travel.

SSG-8 Southampton UK
SSG-7 Santiago Chile
SSG-6 Washington DC
SSG-5 Sapporo Japan
SSG-4 Hamburg Germany
SSG-3 London UK
SSG-2 Miami USA
SSG-1 Palisades USA

27. **Any other business**

12:30 p.m. ADJOURN

List of Participants

CLIVAR SSG-9 PARTICIPANTS

SSG MEMBERS

DR A.J. BUSALACCHI (co-chair)
Director, Earth System Science Interdisciplinary Center (ESSIC)
224 Computer and Space Science Building, Room 2207
University of Maryland
College Park
Maryland 20742-2425
UNITED STATES OF AMERICA

Tel: **+1-301-405-5599**
Fax: **+1-301-405-8468**
Email: **tonyb@essic.umd.edu**
Home page:

DR J. JOUZEL
Laboratoire des Sciences du Climat et de l'Environnement
CEA/CNRS Saclay
Batiment 709, Orme des Merisiers
Gif-sur-Yvette Cedex
F-91191
FRANCE

Tel: **+33-1-6908-7713**
Fax: **+33-1-6908-7716**
Email: **jouzel@asterix.saclay.cea.fr**

HANAWA K., DR
Tohoko University
Department of Geophysics
Graduate School of Science
Aoba-ku
Sendai 980-8578
JAPAN

Tel: **+81-22-217-6526**
Fax: **+81-22-217-6530**
Email: Hanawa@pol.geophys.tohoku.ac.jp

DR D. MARTINSON

Columbia University
Lamont-Doherty Earth Observatory
Rt. 9W
P.O. Box 1000
Palisades
New York 10964-0190
UNITED STATES OF AMERICA

Tel: **+1-914-365-8830**
Fax: **+1-914-365-8736**
Email: dgm@ldeo.columbia.edu

MITCHELL J., DR

Meteorological Office
Hadley Centre for Climate Prediction and Research
London Road
Bracknell
Berkshire RG12 2SZ
UNITED KINGDOM

Tel: **+44-1344-856613**
Fax: **+44-1344-856912**
Email: jfbmitchell@meto.gov.uk

NICHOLLS N., DR

Bureau of Meteorology Research Centre (BMRC)
G.P.O. Box 1289K
Melbourne
Victoria 3001
AUSTRALIA

Tel: **+61-39-669-4407**
Fax: **+61-39-669-4660**
Email: **n.nicholls@bom.gov.au**

DR T.N. PALMER

European Centre for Medium-Range Weather Forecasts (ECMWF)
Shinfield Park
Reading
Berkshire RG1 9AX
UNITED KINGDOM

Tel: **+44-1-118 949 9600**
Fax: **+44-1-118 986 9450**
Email: **tim.palmer@ecmwf.int**

SARACHIK E., PROFESSOR

University of Washington
Department of Atmospheric Sciences
Box 351640
Seattle
Washington 98195-1640
UNITED STATES OF AMERICA

Tel: **+1-206-543-6720**
Fax: **+1-206-685-3397**
Email: **sarachik@atmos.washington.edu**

DR K. TRENBERTH

National Center for Atmospheric Research (NCAR)
Head, Climate Analysis Section
P.O. Box 3000
Boulder
Colorado 80307
UNITED STATES OF AMERICA

Tel: **+1-303-497-1318**
Fax: **+1-303-497-1333**
Email: **trenbert@ucar.edu**
Home page:

DR ROBERT A. WELLER

Woods Hole Oceanographic Institution
Clark 204a MS29
38 Water Street
Woods Hole
Massachusetts 02543-1541
UNITED STATES OF AMERICA

Tel: **+1-508-289-2508**
Fax: **+1-508-457-2163**
Email: **rweller@whoi.edu**
Home page:

DR J. WILLEBRAND (co-chair)

lInstitut für Meereskunde
Universität Kiel
Düsternbrooker Weg 20
Kiel
D-24105
GERMANY

Tel: **+49-431-597-3800**
Fax: **+49-431-597 56587**

Email: **jwillebrand@ifm.uni-kiel.de**

DR GUOXIONG WU

Institute of Atmospheric Physics
Chinese Academy of Sciences
Laboratory of Climate Research
P.O. Box 2718
Beijing
100080
CHINA

Tel:
Fax: **+8610 625 62347**
Email: gxwu@asgsgi4.iap.ac.cn

DR F.W. ZWIERS

c/o University of Victoria
Canadian Ctr for Climate Modelling and Analysis
Meteorological Service of Canada
P.O. Box 1700, STN CSC
Victoria
B.C. V8W 2Y2
CANADA

Tel: **250 363 8229**
Fax: **250 363 8247**
Email: **francis.zwiers@ec.gc.ca**
Home page: **www.ccma.bc.ec.gc.ca**

INVITED GUESTS

ALEXIOU A.

IOC/UNESCO
1, rue Miollis
Paris Cedex 15
F-75732
FRANCE

Tel: **+33-1-45-68-40-40**
Fax: **+33-1-45-68-58-12**
Email: **a.alexiou@unesco.org**

DAVIS R.E., DR (US CLIVAR SSC)

University of California
Scripps Institution of Oceanography

Physical Ocean Research Division 0230
San Diego
California 92093-0230
UNITED STATES OF AMERICA

GODFREY J.S., DR, (AAMP)
CSIRO
Marine Research
G.P.O. Box 1538
Hobart
Tasmania 7001
AUSTRALIA

Tel: **+61-3-6232-5210**
Fax: **+61-3-6232-5123**
Email: **godfrey@marine.csiro.au**

KOBLINSKY CHET, DR (UOP)
Chair
NASA/GSFC/971
Greenbelt
Maryland 20771
UNITED STATES OF AMERICA

Tel: **301 614 5697**
Fax: **301 614 5644**
Email: koblinsky@gsfc.nasa.gov

LAU WILLIAM K.M., DR (AAMP)
Head
Climate & Radiation Branch
Building 33, Room 325
Mail Code 913
Greenbelt
Maryland 20771
UNITED STATES OF AMERICA

Tel: **+1-301-614-6185/301-614-6183**
Fax: **+1-301-614-6307**
Email: **lau@climate.gsfc.nasa.gov**

LEGLER D.M., DR
US CLIVAR Office
400 Virginia Avenue, SW, Suite 750
Washington, D.C.
20024

UNITED STATES OF AMERICA

Tel: **+1-202-314-2237**

Fax: **+1-202-488-8681**

Email: **legler@usclivar.org**
Home Page:

LUKAS ROGER, PROFESSOR

University of Hawaii
Department of Oceanography
1000 Pope Road
Honolulu
Hawaii 96822
UNITED STATES OF AMERICA

Tel: **+1-808-956-7896**

Fax: **+1-808-956-9222**

Email: **rlukas@soest.hawaii.edu**
Home Page:

MCCREARY J.P., PROFESSOR

SOEST/IPRC
University of Hawaii
1000 Pope Road
Honolulu
Hawaii 96822
UNITED STATES OF AMERICA

Tel: **+1-954-920-1909**

Fax: **+1-954-947-8559**

Email: **jay@ocean.nova.edu**

MCPHADEN M.J., DR (TIP)

NOAA/PMEL
Bldg 3
7600 Sand Point Way, NE
Seattle
Washington 98115
UNITED STATES OF AMERICA

Tel:

Fax:
Email:

MECHOSO C.R., PROFESSOR (VAMOS)
University of California, Los Angeles
Department of Atmospheric Sciences
7127 Math Sciences Building
405 Hilgard Avenue
Los Angeles
California 90095-1565
UNITED STATES OF AMERICA

Tel: **+1-310-825-3057**
Fax: **+1-310-206-5219**
Email: **mechoso@atmos.ucla.edu**

NEWSON, R.
Joint Planning Staff, WCRP
c/o WMO
CP 2300
1211 Geneva 2
SWITZERLAND

Tel: **+41-22 730 8418**
Fax: **+41-22 730 8036**
Email: **newson_r@gateway.wmo.ch**

OVERPECK, J., DR (CLIVAR/PAGES)
Inst. for the Study of Planet Earth
University of Arizona
Tucson
Arizona 85721
UNITED STATES OF AMERICA

Tel: **+1-520-622 9065**
Fax: **+1-520-792 8795**
Email: **jto@u.arizona.edu**

PETERSON TOM C., DR (WGCCD)
National Climatic Data Center
Climate Archaeology and Analysis Branch
151 Patton Avenue
Asheville
North Carolina 28801-5001
UNITED STATES OF AMERICA

Tel: **+1-828-271-4265**
Fax: **+1-828-271-4328**

Email: **tpeterso@ncdc.noaa.gov**
Home Page:

RIENECKER M.M., DR (GODAE)

NASA Goddard Space Flight Center
Code 671
Greenbelt
Maryland 20771
UNITED STATES OF AMERICA

Tel:

Fax:

Email:

SHUTTLEWORTH J., PROFESSOR (GEWEX)

Hydrology and Water Resources
Harshbarger Building 11
Tucson
Arizona 85721
UNITED STATES OF AMERICA

Tel: **+1-520-621-8787**

Fax: **+1-520-621-1422**

Email: **shuttle@hwr.arizona.edu**

PROF SOROOSH SOROOSHIAN (GEWEX SSG Chair)

University of Arizona
Department of Hydrology and Water Resources
Harshbarger Building, Room 122
Tucson
Arizona 85721
UNITED STATES OF AMERICA

Tel: **+1-520-621-1661**

Fax: **+1-520-626-2488**

Email: soroosh@hwr.arizona.edu

STEWART R., DR (GEWEX)

Meteorological Service of Canada (MSC)
Climate Research Branch
4905 Dufferin Street
Downsview
Ontario M3H 5T4
CANADA

Tel: **+1-416-739-4122**

Fax: **+1-416-739-5700**

Email: **Ron.Stewart@ec.gc.ca**

TODD J., DR

NOAA/OGP
1100 Wayne Avenue, Suite 1225
Silver Spring
Maryland 20910
UNITED STATES OF AMERICA

Tel: **+1-301-427-2089 ext 32**
Fax: **+1-301-427-2073**
Email: **todd@ogp.noaa.gov**

TROEN I., DR

European Commission DG XII-D-2
SDME 7/40
Rue de la Loi 200
Bruxelles
B-1049
BELGIUM

Tel: **+32-2-295-0465**
Fax: **+32-2-296-3024**
Email: **ib.troen@dg12.cec.be**
Home Page:

TRY P.D., DR

International GEWEX Project Office (IGPO)
1010 Wayne Avenue, Suite 450
Silver Spring
Maryland 20910
UNITED STATES OF AMERICA

Tel: **+1-301-565-8345**
Fax: **+1-301-565-8279**
Email: **gewex@cais.com**

WEBSTER, F. DR (DTT)

Data Information Unit
University of Delaware
Lewes
Delaware
UNITED STATES OF AMERICA

Tel: **+1-302 645 4266**
Fax: **+1-302-645 4266**
Email: **ferris@delocn.udel.edu**

WEBSTER P., PROFESSOR (AAMP)

University of Colorado - Boulder

Program in Atmospheric and Ocean Science
Campus Box 311
Boulder
Colorado 80309
UNITED STATES OF AMERICA

Tel: **+1-303-492-5882**
Fax: **+1-303-492-3524**
Email: **pjw@willywilly.colorado.edu**

YAMAGATA T., PROFESSOR

University of Tokyo
Department of Earth and Planetary Science
Graduate School of Science
Tokyo
113-0033
JAPAN

Tel: **+81-3-5841-4297**
Fax: **+81-3-5841-8791**
Email: **yamagata@eps.s.u-tokyo-ac.jp**
Home Page:

DR ZEBIAK S., (WGSIP)

Columbia University
Lamont Doherty Earth Observatory
6 rte Monell Bldg
Palisades
New York 10964
UNITED STATES OF AMERICA

Tel: **(845) 680 4497**
Fax: **(845) 680 4865**
Email: **steve@iri.ldeo.columbia.edu**
Home page:

STAFF

DETEMMERMAN, V.
Joint Planning Staff, WCRP
c/o WMO
CP 2300
1211 Geneva 2
SWITZERLAND

Tel: **+41-22 730 8242**
Fax: **+41-22 730 8036**
Email: **detemmerman_v@gateway.wmo.ch**

GOULD J., DR
Director, WOCE & CLIVAR International Project Office
Southampton Oceanography Centre
Room 256
Empress Dock
Southampton
SO14 3ZH
UNITED KINGDOM

Tel: **+44-2380-596208**
Fax: **+44-2380-596204**
Email: **john.gould@soc.soton.ac.uk**

SEMAZZI, F., DR
CLIVAR International Project Office
Southampton Oceanography Centre
Room 256
Empress Dock
Southampton
SO14 3ZH
UNITED KINGDOM

Tel: **+44-2380-596208**
Fax: **+44-2380-596204**

CLIVAR VACS Panel Terms of Reference

1. Develop and refine a VACS implementation plan, based on the work of the CAWG and CATT, to diagnose the variability and predictability of African climate and its relationship to the global climate system. This plan should take into account the objectives listed below in points 2-9.

2. Prepare requirements for limited-period and sustained observations in support of the CLIVAR Program in and around the African continent; establish links with, and present the requirements to, the other major climate-observing programs (eg. GCOS, WWW, GOOS, etc).

3. To promote and coordinate efforts for evaluations and improvements of model simulations (e.g. AMIP, CMIP, IPCC, etc.) for the African region.

4. Promote development of African climate data bases and foster access thereto for research purposes in cooperation with projects such as CLICOM, DARE, INFOCLIMA, etc.

5. Promote the involvement of African scientists within VACS and the use of VACS products in capacity building activities.

6. Develop cooperative investigations with other CLIVAR groups and national, regional or international research programs and organizations interested in this area of research.

7. Develop links with programs and organizations interested in the application of VACS research (e.g. CLIPS, and START) and, as far as feasible, integrate requirements of these programs and organizations into VACS.

8. Execute the VACS implementation plan and measure the success of the plan against stated objectives.

9. Report to the CLIVAR SSG as required on progress and problems in developing and implementing the VACS plan.

Clivar Ocean Observations Panel Terms of Reference

1. To evolve, evaluate, and report to the CLIVAR Science Steering Group (SSG) the implementation strategy for sustained ocean observations to meet the CLIVAR requirements for variability and predictability studies, monitoring and basic research. This strategy should comprise the appropriate mix of measurement platforms and synthesis techniques to determine the full suite of ocean variables, including air-sea fluxes, required by CLIVAR taking into account existing and new technologies and the emerging operational observing systems of the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS) and the deliberations of the Joint Commission on Oceanography and Marine Meteorology and its panels.

2. To study and take action to improve the effectiveness of the ocean observing system to achieve the CLIVAR objectives from measurement to end-user by examining actual data flow and synthesis techniques to produce useful information for the CLIVAR research programmes. This study will include research and, as appropriate, operational data assimilation methodologies, techniques, and products.

3. To study and take action to improve the effectiveness and impact of the ocean observing system to achieve the CLIVAR objectives through liaison with the CLIVAR Working Group on Seasonal-to-Interannual Prediction (WGSIP), the Data Task Team (DTT), the CLIVAR Principle Research Area (PRA) science teams and the various Ocean Basin Implementation panels, as well as other WCRP panels, as appropriate.

4. To work jointly with the WGSIP to determine observational requirements for experimental and operational predictions of ENSO and other predictable components of the climate system and develop a strategy for implementing these requirements.

5. To liaise with GOOS/GCOS and, in particular the Ocean Observations Panel for Climate (OOPC) and the Global Ocean Data Assimilation Experiment (GODAE), in regard to the development of the implementation strategy and evaluation for common elements of the sustained observing system, as well as operational and quasi-operational systems and products.