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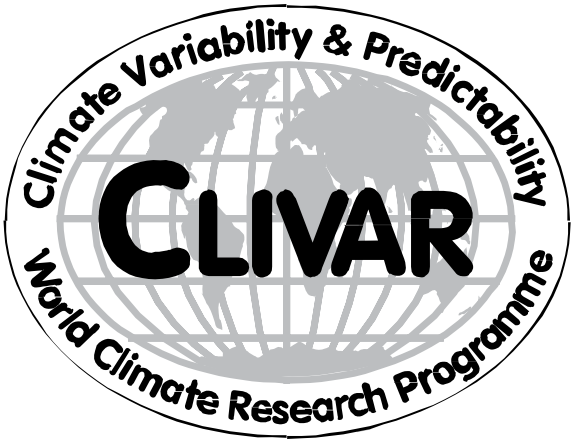
WORLD CLIMATE RESEARCH PROGRAMME



CLIVAR Working Group on Seasonal to Interannual Prediction

Report of the 7th Session

19-22. November 2002, Cape Town, South Africa

March 2003

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CLIVAR is a component of the World Climate Research Programme (WCRP), which was established by WMO and ICSU, and is carried out in association with IOC and SCOR. The scientific planning and development of CLIVAR is under the guidance of the JSC Scientific Steering Group for CLIVAR assisted by the CLIVAR International Project Office. The Joint Scientific Committee (JSC) is the main body of WMO-ICSU-IOC formulating overall WCRP scientific concepts.

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Action Items/Recommendations

Pacific OMIP

T. Stockdale to contact P. Delecluse to explore the current status of the project. To distinguish it from the OMIP associated with the WGOMD it is suggested that the name should be changed, e.g. to T-OMIP (Tropical OMIP).

Observing System Simulation Experiments (OSSE)

While WGSIP agreed strongly that such studies should be an integral part of the design for an observing system. It is also clear that the kinds of resources and expertise necessary reside mainly in groups with a strong operational aspect. WGSIP did not feel it could "commission" OSSE studies because most groups lack the resources. It may be possible to foster this activity by organizing a Workshop in conjunction with other groups and this will be considered in the future. (Chair WGSIP to SSG)

Banner Proposal

In addition to the feedback that the chair of WGSIP has already provided to JSC and SSG, the working group agreed that a top-down organizational structure would not necessarily help to address and solve problems. Collaboration and coordination must arise naturally, fostered of course by the JSC and SSG, based on scientific interests and abilities. Current activities, initiated by WGSIP, should be continued and extended in this context. It will probably not be suitable be introducing a new high level organizational infrastructure. (Chair WGSIP to JSC, resp. Task Team)

US position on SIP

WGSIP emphasised that continuous research efforts are required to establish a reliable system for Seasonal-to-Interannual Prediction. (Chair WGSIP to SSG)

C20C Project

- The C20C Project is scientifically interesting and relevant to CLIVAR although there is some concern that it is not sufficiently distinct from AMIP and the results may not be commensurate with the resources required.
- The results of the project are potentially useful for aspects of seasonal prediction.
- A close cooperation between WGNE / AMIP should be obvious and vital as well as interactions with similar studies designed by WGCM / CMIP.

(Chair WGSIP to ICPO and SSG)

ENACT and ODASI

WGSIP welcomed these activities and recommended the interaction of both groups and to encourage them in the use of a common analysis software (e.g. DODS) if feasible.

WGSIP and Applications

WGSIP noted that its main priorities are the scientific aspects of seasonal to interannual prediction. Nevertheless, informative connections to the application side of SIP are regarded as an important part of the agenda of WGSIP. Such questions as how to provide forecast information to the end users should be informed by both the science and the needs of the application.

El Niño Definition

WGSIP was to prepare a proposal for a definition or measure of the state of the ENSO for CLIVAR SSG, JSC and subsequently WMO-CBS.

The proposed definition is intended to reflect the state of the tropical Pacific ocean, as the seat of the ENSO phenomenon, in a simple and direct way. It is not intended to represent or measure the climatic perturbations associated with an SST anomaly as these depend on a variety of factors and may be masked by natural variability especially in regions remote from the tropical Pacific. The proposed oceanic El Nino index (OENX) is a continuous numerical index based on the widely accepted Niño 3.4 SST anomaly. It is desirable that the OENX become the standard reference for the state of the tropical ocean and an index reflecting the potential for local and remote ENSO climate perturbations.
(Power/Kirtman) to write a preamble (see Appendix – document to SSG).

SMIP2/HFP

WGSIP will extend the SMIP2 project to encompass a broader range of initial conditions reflecting the range of research and operational approaches being used and investigated by the SIP community.

An SMIP Panel (Boer, Davey, Kang, Sperber) will identify potential participants, promote the project, guide analysis, and encourage and coordinate diagnostic studies. A deadline for submission of SMIP2 data is proposed for July 2003. This should enable preliminary analysis in time for the next session of WGSIP.

Standards Project

WGSIP endorsed the CBS Report on verification of long-lead forecasts and regards it as an excellent starting point for a WGSIP project. Nevertheless, the CBS proposal was regarded as a minimum baseline that does not include enough diagnostics. Thus, WGSIP agreed to start a long-term evolving project on Standardised Verification Sets (SVS) for long-range forecasts based on the CBS protocol. In order to keep the project manageable and affordable, the group favoured a distributed system guided from a central website. Furthermore, the group favoured that the location and handling of this website should be done through CLIVAR, i.e. the ICPO. WGSIP recognized that this task goes beyond the present resources of the ICPO. Therefore, the group will ask CLIVAR to seek for resources to build up such as system. In addition, other mechanisms to implement this project are being explored. (Kirtman to draft a letter, WGSIP to circulate and to send to SSG / ICPO).

Climate Events

This annual assessment of specific climate events was regarded as a useful exercise. In future, the standards project should help more easy intercomparison of the capability of different models in simulating such events.

GEWEX/GLASS

WGSIP endorses the GLACE (Global Land-Atmosphere Coupling Experiment), designed to investigate the climate "signal" associated with the state of the land surface, as a jointly sponsored activity of GLASS and WGSIP. WGSIP also expresses its interest in being involved in the discussion and planning of other GLASS activities. (to be reported to GLASS and CLIVAR SSG)

START

WGSIP noted that there is some common ground with aspects of the START programme and expressed some hope for more interaction in the future.

Workshop on Ensemble Methods

WGSIP expressed its interest in sponsoring a scientific workshop on ensemble methods in weather and climate. The focus is to be on recent developments in the theory and application of ensemble methods including multi-model ensemble methods. Such a workshop would span the WCRP timescales and would potentially be cosponsored by WGSIP, WGNE and WGCM. WGSIP would prefer to hold the meeting in conjunction with its next working group meeting in November 2003

However, before proceeding with the planning of this activity, further information about a potential CAS sponsored activity, being organized by Dr. Krishnamurti (FSU), will be explored (G. Boer, A. Villwock).

Membership

There seems to be no coherent length to the membership terms (A. Villwock to explore) and a number of members have reached the end of their terms. Some terms will be renewed to ensure the continuation of work already initiated. S. Zebiak will step down as the chairman. The panel noted that a Co-chair or Vice-chair might be considered in order to reduce the call on the Chair's time.

Venue of the next meeting

The venue of the next meeting was discussed in general although no consensus was reached. The venue depends also on whether the proposed Workshop on Ensemble Methods will be held in conjunction with the working group meeting. Hawaii was considered as a possible, reasonable central location which might serve for both.

1. Welcome and opening remarks

The 7th session of the CLIVAR Working Group on Seasonal-to-Interannual Prediction (WGSIP; previously known as CLIVAR NEG-1) was held at, at the University of Cape Town, Cape Town, South Africa, 19-22. November 2002. Dr. Chris Reason from the University of Cape Town was the local host for the meeting. Dr. Steve Zebiak (Chairman of the WGSIP Panel) opened the session and welcomed the Panel members, invited experts, and local participants. The list of participants is given in appendix (A). The agenda was accepted with minor changes. Dr. M. Davey had sent apologies for being unable to attend the meeting.

During the four-day meeting there was extensive review of WGSIP research projects, discussions of plans for new initiatives, and other related international research activities.

2. Review of relevant developments and activities

2.1 News from the International CLIVAR Project Office

Dr. Villwock (ICPO) informed the Panel about the relevant developments within CLIVAR that had taken place since the previous WGSIP meeting in Budapest, Hungary 5-7 November 2001 (ICPO Publication Series No. 57).

1. **Staff changes in the CLIVAR IPO**
   The International CLIVAR Project Office (ICPO) has undergone some staff changes throughout this year. Most notable was the retirement of the ICPO director, Dr. John Gould in August. His successor is Dr. Howard Cattle, who came from the Met. Office in Bracknell. Dr. Cattle sent his regards to the panel and wishes a successful meeting. In June, Dr. Daniela Turk, formally responsible for the Pacific Panel, left the ICPO. Her successor is Katy Hill who came into post in November 2002. Dr. Mike Sparrow, responsible for the CLIVAR Southern Ocean Panel, has moved to Bejing for part of his time and is continuing his work for the CLIVAR Southern Ocean Panel from there. Dr. Katherine Bouton who was responsible for the data management -amongst other tasks, will leave the ICPO by end of 2002.

2. **CLIVAR Website**
   The CLIVAR website has been renovated very recently. Apart from technical changes, such as a table based set-up instead of frame-based system, a number of new services have been added to the site. Amongst them, the most notable items are the CLIVAR literature section and the reprints of the CLIVAR Exchanges science articles. Currently, an expansion of the scientific pages and contents is under way.

3. **CLIVAR Open Science Conference in 2004**
   An international open science meeting to review the first period of the programme will be held in Baltimore, USA, 21-25. June 2004. A conference website has been set up under http://www.clivar2004.org/
   The organising committee is currently working on the programme. The format will be based on high-profile invited presentations complemented by comprehensive poster presentations elaborating the scientific progress in further detail.

2.2 CLIVAR Scientific Steering Group 11th session, X'ian, May 2002

Dr. Ben Kirtman, attended the 11th session of the CLIVAR SSG on behalf of Dr. Zebiak who was unable to attend. He highlighted the following action items and recommendations relevant to CLIVAR WGSIP:

- *The SSG requests the WGSIP to prepare a position paper reviewing the techniques which can be used to establish the dependence of SI predictions on existing ocean data, and hence on the design of future ocean observing systems (Observation Systems Simulation Experiments (OSSEs). In addition, WGSIP is asked to assess the current capability of SI prediction groups to perform such studies, indicating the principal limitations, and give an estimate of when viable studies can be undertaken.*
  WGSIP agreed that such studies should be integral part of the design for an observing system. Nevertheless, these kinds of experiments cannot be performed by WGSIP due to the lack of resources. (Chair WGSIP to SSG)

- *AAMP, VACS and VAMOS panel are planning a monsoon workshop that will be cosponsored by GEWEX. The relevant modelling groups, such as WGNE, WGCM and WGSIP should be involved.*
  The WG was not aware of any progress on this issue. It will be discussed in greater detail in the upcoming sessions of all 3 panels involved in early 2003 (VACS: 15-17. January, Cape Town; AA-Monsoon: 24-27. February, Atlanta; VAMOS: 23-25. April, Miami).

- *SSG recommends a closer relationship between the Pacific Panel and WGSIP and urges them to identify joint activities including possibly a joint meeting.*
  At present, membership and scope of the Pacific panel are oriented more towards an ocean observations group. One area of common interest will be on ENSO variability on multiple timescales. The Pacific Panel has already indicated their willingness to closely interact with WGSIP.

- *SSG endorses WGSIP plans for an ensemble prediction workshop*.
  This item is discussed in more detail under items 3.8 and 6.2.

- *The SSG suggested that WGSIP include 97 – 98 El Niño in their model intercomparison*
  Not sure about the response from the panel. Was it something like: We are already doing this?

- *SSG Goodrich asking WGSIP for a definition of El Niño.*
  Dr. Zebiak suggested addressing the action item in more depth under agenda item 3.1. See statement in the Appendix.

- *Banner on Predictability*
  A long discussion was devoted to the proposed Banner on Predictability, presented to the 23rd Session of the Joint Scientific Committee of WCRP by J. Shukla.

  The proposal for a new "banner" for WCRP - a "Predictability Assessment of the Climate System" with the aim of major steps forwards in climate prediction (development by 2010 of prototype prediction systems for climate on time scales from weeks to a century, and testing/improvement of systems for the full climate system 2010-2020); this would be a total WCRP activity involving all projects, beneficial to society and a contribution to the planning of sustainable development; emphasis is to be given to showing the importance of the data from the new satellite systems and provision of a firm basis for requesting developments of these systems; a task force has been set up to develop ideas and proposals for implementation to report to JSC-XXIV (March 2003): all project groups are

to discuss the "banner" and approach, and provide views to the task force by 31 July 2002.

WGSIP discussed this proposal and the feedbacks provided to the task force (convener B. Hoskins, members: J. Shukla, J. Church, representatives of all WCRP projects). Dr. A. Villwock (ICPO) provided a view from the CLIVAR standpoint. Overall, the scientific issues of the banner proposal are currently being addressed through CLIVAR. The implementation of such a proposal would lead to a further concentration of WCRP modelling activities directly under the JSC and thus presumably further disconnect these activities from the observational studies instead of fostering closer links. He also noted that WGCM had in general welcomed the proposal but argued that 'predictability' as an overarching topic might not be not very sensible but rather the focus should be on 'prediction'. Climate prediction is the more relevant issue for the public and could increase the visibility of WCRP as a whole. In addition, WGCM would prefer to see this as a refocusing within WCRP rather than a reorganization.

In addition to the feedback that the chair of WGSIP already provided to JSC and SSG, the working group pointed out that a bigger structure does not necessarily help in addressing and solving the problems. Current activities, initiated by WGSIP have to be continued. This will probably not be achieved by introducing a new high level organizational infrastructure. (Chair WGSIP to JSC, or Task Team, respectively)

2.3 Report from other Meetings and Groups relevant to WGSIP

CLIVAR VAMOS
Dr. Villwock reported briefly about the recent activities of the panel. The last meeting (VPM5) took place in San Jose, Costa Rica in March 2002. The meeting focused mainly on the development of the North American Monsoon Experiment (NAME). In addition, plans for the VAMOS extension of the US-project EPIC were further developed and the preparations of the first field experiment of the auspices of VAMOS, the Low Level Jet experiment, were reviewed. The field phase of this experiment will start mid of November 2002. For the next meeting, scheduled for April 2003 in Miami.

CLIVAR Asian-Australian Monsoon Panel
Throughout the past year, the A-A Monsoon panel has not met since the last WGSIP meeting. The next meeting is scheduled for February 2003 in Atlanta.

CLIVAR Atlantic Implementation Panel
The CLIVAR Atlantic panel met in Bermuda in July 2002. No specific topics related to WGSIP were put forward to the working group. A US CLIVAR Workshop on the Dynamics and Predictability of the Atlantic ITCZ and its Regional Climatic Influences with participation of both groups was held in September at IRI.

CLIVAR VACS (Variability of the African Climate System) Panel
The last meeting of the VACS panel was held in Niamey, Niger, January 2002 following a workshop on the African Monsoon Multidisciplinary Analysis (AMMA). The AMMA project is currently seeking for endorsement from CLIVAR. The VACS group is cooperating with the other monsoon panels. The planned global monsoon modelling workshop will be joint activity of all 3 monsoon panels (AAMON, VAMOS, VACS) with collaboration of the WGSIP and other modelling groups. Common interests of both VACS and WGSIP are on climate forecasts and their application within Africa. Since there is not official cross-representation between both panels, information exchange has to be ensured through the ICPO and on an ad-

hoc participation of panel members. The VACS panel will convene in Cape Town in January 2003.

2.4 Reports from regional or national CLIVAR Committees

US-CLIVAR

Dr. Zebiak reported that the US-CLIVAR complement of WGSIP, the Seasonal – to Interannual Modelling & Prediction Working Group is apparently discontinued and might be reconstituted as an oversight committee but not as an active working group.

The National Center for Environmental Prediction of NOAA (NCEP) is currently working on a new definition of ENSO. An expert meeting will be convened in December. The panel members stressed that a definition for ENSO should be internationally accepted. Because the CLIVAR SSG has asked WGSIP to address the issue of El Niño definition as well, the panel put up a separate agenda item to discuss this more intensively. B. Kirtman will feedback WGSIP's view to NOAA.

Within US-CLIVAR several so-called Climate Process and Modelling Teams, addressing particular processes (e.g. ocean mixing and ocean convection) and including observations and modelling aspects are being defined.

Dr. Zebiak reported about the new US Climate Research Initiative which is currently being built up replacing the present USGCRP programme. Strong impacts on the funding of NOAA are expected.

In particular within some parts of the US administration, there is a perception that the scientific issues related to Seasonal-Interannual Prediction (SIP) are solved and coupled model prediction efforts get separated from the scientific basis (CPC). WGSIP stated that their assessments during the past years, in particular on ENSO prediction, have shown that there is substantial need for research within the area of SIP. A more systematic approach to verify the quality of present model prediction capabilities is currently being planned by the group (see agenda item 3.3).

Japan

Earth Simulator
Dr. M. Sugi reported about the recent developments within the Earth Simulator Programme. The Earth Simulator, at present the World largest computer with a peak performance of app. 40 Tflops, has been in operation since spring 2002. At present 20 projects have been approved, 15 within the area of ocean-atmosphere modelling. Amongst them 7 are coordinated by the Frontier Research Institute for Global Change Research.

JRA-25
Dr. Sugi highlighted the JMA reanalysis project which will cover a 25 year period (1979 to 2004). This project, carried out by JMA and the Central Research Institute of Electric Power Industry (CRIEPI), is denominated as JRA-25 (Japanese Re-Analysis 25 years) and the data product is also called JRA-25. The model used will be a T106L40 atmospheric model with a 3DVAR data assimilation system. More information is under (http://www.jracp.org/indexe.html)

Tokyo Climate Center (http://okdk.kishou.go.jp/)
JMA established Tokyo Climate Center (TCC) in April 2002 to provide climate products from the above systems to NMHSs in the region, as its contribution to the cooperative efforts

of the Asia-Pacific region to enhance the regional capability of climate services. The objectives of the TCC are to assist NMHSs in the Asia-Pacific region mainly in issuing seasonal forecasts to their own nation with the aim of mitigating disasters and to contribute to the sustainable development in the region.

TCC Activities
1. TCC provides NMHSs with climate monitoring products, one-month ensemble forecast products and other appropriate information for climate services. TCC provides the following data and products:

- **Monthly report on climate features**
  extreme climate events, global temperature anomalies, global precipitation ratios, etc.
- **Monthly report on the global climate system**
  tropical circulation and convection, extra-tropical circulation, etc.
- **Monthly report on El Niño-Southern Oscillation**
  ENSO monitoring indices, El Niño outlook, etc.
- **Ensemble forecast products**
  Maps of predictions of a one-month forecast model and verification of predictions.

2. TCC assists in technical capacity building of climate services in the Asia-Pacific region.
3.TCC provides "News" on extreme climate events and other climate-related topics in the Asia-Pacific region.

Canada

Dr. G. Boer reported on some recent developments in Canada. A number of CLIVAR related activities are co-ordinated through the Canadian Climate Variability Research Network. The research projects within the network are oriented along the three streams of CLIVAR (GOALS, DecCen and ACC). They include:
Stream 1: Seasonal-to-Interannual Variability and Predictability projects:

- Seasonal Predictability and Predictions with a Simple General Circulation Model (*J. Derome and G. Brunet)*
- The Historical Seasonal Forecasting Project (HFP) (*J. Derome, G.J. Boer, G. Brunet and F.W. Zwiers)*
- Coupled Model Prediction and Predictability (*G.J. Boer, G. Flato and J. Derome)*
- Accuracy of Downscaling of Seasonal Predictions (*D. Caya and R. Laprise)*
- Evaluation of Approaches to Dynamical Downscaling (*R. Laprise and D. Caya)*

Stream 2: Decadal to Century Variability and Predictability Projects:

- Northern Hemisphere Circulation Modes and Regimes (*J. Fyfe and L. Pandolfo)*
- North Atlantic Climate Variability and the North Atlantic Oscillation (*R.J. Greatbatch and H. Ritchie*)
- Tidally Induced Mixing and the Meridional Overturning Circulation in the North Atlantic (*K.G. Lamb)*
- Subgrid-Scale Parameterizations for Ocean Eddy Resolving GCMs (*D.N. Straub)*
- Pacific Decadal Variability in the CCCma Coupled GCM (*G. Boer, G. Flato and J. Fyfe)*
- The South Pacific Subduction Process (*A.J. Weaver and J. Fyfe)*
- Interbasin Freshwater Transport and North Atlantic Deep Water Formation (*A.J. Weaver and J. Fyfe)*

Stream 3: Anthropogenic Climate Change Projects:

- Detection with Non-Traditional Variables (*A.J. Weaver and F.W. Zwiers)*
- Detection of "Multi-Model" Ensemble Mean Signal (*F.W. Zwiers)*

- Bayesian Detection and Attribution (*F.W. Zwiers and A.J. Weaver)*
- Continental-Scale Detection and Attribution (*F.W. Zwiers, A.J. Weaver and R. Laprise)*
- Differential Surface and Lower Tropospheric Temperature Trends (*A.J. Weaver and F.W. Zwiers)*
- Natural (Solar and Volcanic) Forcing of the Climate System (*A.J. Weaver)*
- Influence of Land Surface Changes (*A.J. Weaver)*
- Development of a Coupled Ocean-Atmosphere Canadian Regional Climate Model for Upper Coastal Oceans (*F. Saucier, D. Caya and R. Laprise)*
- The Influence of a Changing Arctic Sea Ice Cover on the Atlantic Thermohaline Circulation and Northern High Latitude Climate (*L.A. Mysak)*

More information about this activity can be found under:
http://www.clivar.ca/network/home.htm

Australia

The Bureau of Meteorology Research Centre (BMRC) has, in collaboration with the Commonwealth Scientific and Industrial Research Organization (CSIRO) Marine Research, developed a CGCM-based system called the Predictive Ocean Atmosphere Model for Australia (POAMA). The model incorporates the BMRC Atmospheric Model and a global version of the GFDL modular ocean model. One 8-month forecast is produced each day. Please see www.bom.gov.au/bmrc/ocean/JAFOOS/POAMA for further details. Contact: O. Alves or G. Wang.

Work also continues on the examination of the dynamics of ENSO and its decadal variability in multi-century integrations of an earlier version of the BMRC CGCM. Contact: S. Power.

The CSIRO CGCM (Mark 2) is being used to investigate the nature and climatic significance of Indian Ocean SST variability. Contact: W. Cai (CSIRO Atmospheric Research) or H. Hendon (BMRC).

The Bureau of Meteorology will act as a lead centre for the CBS “long-range forecast” verification. Contact: N. Plummer or T. Hart.

$1.3M U.S will be made available through Australia’s foreign aid agency (AusAID) for a three year climate project on risk management. The project will enhance the capacity of participating National Meteorological and Hydrological Services (NMHSs) to produce and disseminate climate information including forecasts and to facilitate the incorporation of the climate information into planning (where appropriate) by key decision-makers. Contact: S. Power or N. Plummer.

The Queensland Department of Natural Resources and Mines is evaluating a dynamical downscaling approach to seasonal forecasting. The NCEP MRF9 T40 AGCM was forced by observed SST for the period 1965-2002. 6 hourly output was used as lateral conditions for the CSIRO Regional Climate Model (DARLAM) at a horizontal resolution of 75 km over the Australian region and double nested over Queensland at 15 km resolution. 15 member ensembles were constructed. Dynamical downscaling in forecast mode out to 7 months has also been performed since late 1998 using predicted SST from the IRI. Contact: J. Syktus.

CSIRO runs a CGCM which provides guidance as to the evolution of SST in the equatorial Pacific Ocean. The NINO3.4 anomalies appear to provide a useful indicator for Australian rainfall and predictions for this index are available up to 11 months ahead in real time. Rainfall forecasts based on the expectation of the NINO3.4 index falling into specific tercile

categories over the coming 3 to 9 months are also produced.
Seehttp://www.dar.csiro.au/climate/coca.html for further details. Contact: I. Smith or S. Wilson.

South Africa uses the forecasted SSTs from CSIRO as boundary forcing for an AGCM-based system. The forecasts are now available on the web. The forecasts will be issued by the South African Weather Service from early 2003. Contact: H. Rautenbach (University of Pretoria), B. Hewitson & C. Reason (U. Capetown), W. Tennant & W. Landman (SAWS).

A wide range of applications for seasonal forecasts continues to be developed and evaluated at the Queensland Centre for Climate Applications and the Agricultural Production Systems Research Unit. Seasonal forecasts are combined with a large amount of other information in consultation with and to assist farmers e.g. in the South Australia Research and Development Institute and NSW Agriculture. Contact: R. Stone (QCCA), H. Meinke (APSRU), M. Truscott (SARDI), P. Hayman (NSW Ag).

2.5 Other WCRP modelling Activities

Working Group on Numerical Experimentation (WGNE)

The group is meeting at the same time as WGSIP. Therefore no report could be provided. A main activity of the group was the AMIP Workshop 'Towards Innovative Climate Model Diagnostics' that took place in Toulouse, France, 12.-15. November 2002. The two objectives of the workshop were:

- to highlight the research of selected AMIP2 diagnostic subprojects and participating modelling groups
- to foster increased interaction with key diagnostic and observationally-driven activities (e.g., GEWEX and CLIVAR).

JSC/CLIVAR Working Group on Coupled Modelling (WGCM)

The 6th meeting of the joint JSC/CLIVAR Working Group on Coupled Modelling was held during October 7-10, 2002 in Victoria, Canada. The following action items of relevance for WGSIP were noted.
1. Coupled Model Intercomparison Project (CMIP)
WGCM felt that the Modelling Intercomparison Projects (MIPS) should in time be more integrated towards an Earth System Modelling umbrella. The Coupled Model Intercomparison Project (CMIP) could serve as the overarching MIP. The group encourages the display of the accomplishments of the MIP's in the newsletters of the various programmes. CMIP is currently assembling information about the various MIP's as part a joint WGCM/GAIM activity.

2. Data Management
WGCM to ask the JSC to set up an ad-hoc task team on data management with representatives of all WCRP projects to develop a comprehensive data management strategy for WCRP.

3. C20C Project
Since this activity is performed with atmosphere-only AMIP type runs, WGCM felt that this activity would be better placed under the scope of AMIP. Nevertheless, a coordination of the forcing with the ongoing CMIP activity on (coupled) C20C runs would be useful.
WGSIP discussed this issue at length since the group was asked to express their opinion on request of C20C for endorsement by CLIVAR. Finally, the group stated:

- The C20C Project is scientifically interesting and relevant to CLIVAR although there is some concern that it is not sufficiently distinct from AMIP and the results may not be commensurate with the resources
- The results of the project are potentially useful for aspects of seasonal prediction.
- Close cooperation between WGNE / AMIP is vital as well as interactions with similar studies designed by WGCM / CMIP.

2.6 National Multi-national Projects

Seasonal Diagnostics Consortium

The Seasonal Diagnostics Consortium is an OGP/NOAA sponsored activity to understand seasonal predictability and to seek attribution for the observed seasonal climate anomalies on a near-real time basis. It is well known that observed seasonal climate anomalies are a blend of the atmospheric response to the observed SST forcing, and a variability which is not related to SSTs (the so called atmospheric internal variability). The focus of this consortium is to understand the contribution of these two components to observed seasonal climate anomalies. One way to separate out the influence of SSTs from the atmospheric internal variability is to have an ensemble of AGCM realizations forced with identical SSTs. Ensemble mean atmospheric anomalies then provide information about the SST forced component of the observed seasonal means. However, because of different biases in the AGCMs, attribution of seasonal climate anomalies based on a simulations from a single AGCM alone, can lead to incorrect conclusions. In this consortium activity, this potential problem is partially overcome by bringing together atmospheric simulations from many different models. An agreement between the atmospheric responses from different AGCMs adds to our confidence in the attribution aspect of the atmospheric climate anomalies.

Participating institutions are: Climate Diagnostics Center (CDC), NASA Seasonal-to-Interannual Prediction Project (NSIPP), International Research Institute for Climate Prediction (IRI), National Centers for Environmental Prediction (NCEP), Center for Ocean-Land-Atmosphere (COLA) Scripps Institute for Oceanography (SIO), and Geophysical Fluid Dynamics Laboratory (GFDL)

The general approach within this project is:

- Make a prediction for SST anomalies - SSTP
- Force an ensemble of AGCM realizations with SSTP
- Construct an ensemble mean response
- A prediction could be the ensemble mean response

Dr. Zebiak showed an example of unskilful predictions of DFJ 2001/02. Possible reasons for this failure are:

- The observed anomalies were a chance occurrence, and from the knowledge of SSTs, were unpredictable;
- The predicted SSTs which were used to force the AGCM were themselves incorrect, and this could have led to incorrect predictions;
- The AGCM's atmospheric response to predicted SSTs could be biased, leading to incorrect ensemble mean as the prediction.

The consortium hopes to accomplish:

- An attribution for the observed seasonal climate anomalies, and assessment of their potential predictability from SSTs;
- Comparison of atmospheric responses to SSTs for different AGCMs;
- Diagnostics analysis of AGCM biases and their atmospheric responses to SSTs;

More information can be found under
http://www.emc.ncep.noaa.gov/cmb/atm_forecast/consortium
Contact is Arun Kumar (arun.kumar@noaa.gov).

ODASI (Ocean Data Assimilation Consortium for Seasonal-to-Interannual Prediction)
Consortium for NOAA/OGP/CDEP with participation from COLA, IRI, LDEO, NCEP and NSIPP. This plans to provide:

- *in situ* data stream QC's for S-I applications (contribution to GODAE)
- a suite of retrospective and real-time products (GODAE, CLIVAR)
- a suite of initial conditions that can be used for multi-model ensemble forecasts
- an ensemble of forecasts, 1980 - present: useful for Tier2 ensembles
- metrics designed to discriminate between products
- an evaluation of the products

1. ODA product intercomparisons (models, assimilation methodologies, assimilation parameters)
   Models: MOM4, MOM3, Poseidon, Cane-Patton, LDEO4
   Methodologies: 3DVAR, OI, EnKF, Reduced state KF and optimal smoother, bias correction strategies
1. Development of observational data streams
   Participation: NCEP, NSIPP, GFDL - QC, software issues, data representation errors, validation suite
2. Model sensitivity experiments
   Participation: COLA, IRI (reduce model biases)
3. Evaluation of assimilation products in forecast experiments
   Participation: all
   COLA, IRI: how to best use ocean assimilation products to initialize coupled forecast
   All: are the best products for best forecasts different from best analyses (closest to observations)?

<u>The Plan:</u>

- Distribute analyses through DODS servers (DODS, GRADS-DODS, LAS, ...)
- Build a gallery of plots in common format for web display

<u>The Ultimate goal:</u>

- What works best and why - assimilation and/or model
- Multi-model ensemble forecast suite

IRI/ARCS Regional Applications Project

This consortium is a cooperation of ECPC, UW, NCEP, FSU and IRI. During its first phase (1999-2002) the consortium developed a regional model intercomparison project for S. America, centred on Brazil. The purpose of this project was to evaluate the various regional models that had been developed and were being analysed by IRI. NCEP, and various ARCs. Brazil was chosen for the first intercomparison, in part because global models had previously shown great skill in describing ENSO and other seasonal anomalies there and we wanted to determine the additional skill that might be provided by regional models. The initial goal was to drive these regional models by the global analysis and then in the second phase to drive the regional models by global forecasts. The first phase has now been finished and results are being prepared for publication.

Future plans
The second phase of the project was not funded. Nevertheless. The IRI/ARCS regional model consortium has now moved beyond simply comparing regional simulations and forecasts over

a specific domain to connect these regional models to the application community. In that regard, it should be noted that the application community has in many cases already connected directly to the global modelling community, in part because this community has larger ensembles available. For example, it is now thought that the more extensive output from global models can more easily be downscaled and biased corrected and disaggregated than the more limited output from regional models. To provide additional regional model ensembles, NCEP is gearing up to develop a large ensemble of regional model forecasts for the US and IRI is also developing a large ensemble of regional forecasts for Brazil. The ARCS will attempt to take advantage of these regional model ensembles, as well as the global ensembles to develop links to regional application models pertinent to seasonal forecasting and climate change.

Development of a European Multimodel Ensemble system for seasonal to inTER annual prediction (DEMETER)

The objective of the project is to develop a well-validated European coupled multi-model ensemble forecast system for reliable seasonal to interannual prediction. A fundamental aspect is to establish the practical utility of such a system, particularly to the agriculture and health sectors. DEMETER has 12 partners and has been funded by the European Union for the period April 2000-March 2003. More information is available under http://www.ecmwf.int/research/demeter/
Dr. T. Stockdale reported that the data availability has improved significantly. The 9-member ensemble data from 1989-1998 will become available in GRIB and NetCDF format very soon. Some enhancement of the meta data information is still required. The WG welcomed this good progress in response to their request from the last years meeting.

Dynamical Seasonal Prediction (DSP)

Dr. B. Kirtman reported about this project. He highlighted with some examples the role of land-surface memory on dynamical seasonal predictability. The land surface "memory" is concentrated in the seasonal time-scale (1-4 months) and it can be regarded as an ideal piece of potential predictability to be harvested for seasonal forecasts.
In conjunction with the Dynamical Seasonal Prediction (DSP) Project (Shukla *et al.*, 2001) the COLA model and a simplified simple Biosphere (SSIB) has been used to perform u*ncoupled 3-4 Month Hindcasts initialized from Reanalysis Atmospheric ICs for 1982-1999.* 10-member ensembles covering four seasonal simulation periods: Northern Hemisphere winter (December-March), spring (March-June), summer (June-September), and fall (September-November). The results document that:

- There is seasonal climate predictability outside of winter, even from SST alone.
- The background (climatological) state of the land surface is very important for predictability.
- Climate drift in the coupled land-atmosphere model system can drive the land surface to a "black and white" regime where the impact of land surface anomalies is lost.
- Land surface initial conditions have little impact when this drift is prominent, suggesting some sort of flux correction or anomaly coupling strategy may be necessary.

Enhanced Ocean Data Assimilation and Climate Prediction (ENACT)

ENACT is a project within the Vth European Framework Programme running from 2002-2004. The project has 10 partners (Met Office., U. Reading, Collecte Localisation Satellites (CLS). European Centre for Research and Advanced Training in Scientific Computation (CERFACS), Laboratoire d'Océanographie Dynamique et de Climatologie (LODYC), European Centre for Medium-Range Weather Forecasts (ECMWF), Max Planck Institute for

Meteorology, The Royal Netherlands Meteorological Institute (KNMI), Nansen Environmental and Remote Sensing Center (NERSC), and Istituto Nazionale di Geofisica e Vulcanologia (INGV).

ENACT aims:
(A) to enhance ocean data assimilation systems and produce improved practical global ocean analyses,

- assemble high-quality *in situ* and satellite-derived ocean observational datasets
- develop and implement state-of-the-art data assimilation systems.
- produce ocean analyses extending over a 40 year period
- assessment

(B) to use the analyses to improve seasonal climate prediction and investigate ocean climate.

- quantify seasonal to multi-annual climate prediction impact
- sets of retrospective forecasts using coupled ocean-atmosphere GCMs
- assess ocean analyses jointly to quantify uncertainties
- investigate the mean state and variability of ocean circulation on seasonal to multi-decadal timescales.

- Primarily an EU project to inter-compare ocean analysis systems
  'OI', 3D-var, 4D-var, EnKF
  HOPE-E, HOPE-C, UM, OPA
- Analyses produced for ERA40 period using a common set of observations 1957-2004
- CGCM forecasts will be made to assess analyses, some out to 5 years
- project manager: Mike Davey (Met Office)

More information is available under:
http://www.lodyc.jussieu.fr/equipes_lodyc/ecume/CONTRIBUTION/ENACT/index.html

WGSIP agreed to facilitate the interaction of the ENACT and ODASI groups and to encourage them in the use of common analysis software. (Action item)

Asian-Pacific Climate Network (APCN)

Dr. I.-S. Kang reported about the multi-model ensemble modelling approach of the APCN. The objectives of this study are:

- To develop and maintain an infrastructure of a well-validated multi-model ensemble system (MMES) to produce seasonal climate predictions for the Asian Pacific Economic Cooperation (APEC) member countries and to use it as an economic tool to effectively manage future weather and climate risks
- The APCN-MMES will produce real-time seasonal forecasts and disseminate the forecast products to member countries.

The APCN Prediction Experiment consists of a two-tier approach
(1) Potential Predictability of One Prediction System (KMA/SNU AGCM)
- Systematic error correction
(2) Potential Predictability of Multi-Model Ensemble Prediction System

More information is available under http://www.apcn21.net

2.7 Application Programmes

Dr. Buruhani Nyenzi, director of the World Climate Applications and Climate Information and Prediction Services (CLIPS) division provided an outline of CLIPS
CLIPS has four main objectives:

- To develop the infrastructure for Seasonal to Interannual Prediction (SIP)
- To develop the concept of Regional Climate Centres
- To promote the science and the application of SIP prediction product
- To promote capacity building of producers and users of SIP

Dr. Nyenzi recalled results from a survey on use of SIP by NMHSs to underpin the needs for forecast verification but also capacity building in a number of countries. For details, see the last years' report of WGSIP.

Dr. Nyenzi also stressed the importance of capacity building and its cornerstones.

- **Focal Points**
  - CLIPS National Focal Points have been nominated for RA's I, III, V and VI. Details can be found under: http://www.wmo.ch/web/wcp/clips2001/html/fp_menu.html.

Training Workshops

4 Training Workshops took place in 2002, namely:

- The Asian Climate Training (ACT) Workshop on Climate Information Applications, Bangkok,
- Conference and Workshop on Climate Variability and Change and their Health Effects in the Caribbean, Barbados,
- Fourth Training Workshop on Climate Prediction and Application – Tropical Pacific Islands and Rim Nations, Oklahoma, USA,
- CLIPS Training Workshop for Eastern and Southern African Countries, Nairobi, Kenya

Climate Outlook Forum (COF)

7 Climate Outlook Fora were held in 2002:

- Climate Outlook Forum for the Greater Horn of Africa in Eldoret, Kenya,
- South American Climate Outlook Forum for the Mercosur Countries, Montevideo, Uruguay,
- Seasonal Forecasting Forum Presanor – 01, Algiers, Algeria,
- Climate Regional Forum for Central-America, Santa Ana, Costa Rica,
- Climate Outlook Forum for IGAD Countries, Nairobi, Kenya,
- Climate Outlook Forum for SADC Countries, Harare, Zimbabwe,
- Climate Outlook Forum for the West Coast of South America, Guayaquil, Ecuador

Curriculum

- Modules and Other Presentations

http://www.wmo.ch/web/wcp/clips2001/html/Curriculum_menu.html

Proposed Activities for the Regional Climate Centres:

- Operational activities
- Coordination functions
- Data services
- Training and capacity building
- Research and development

Further information is available under
http://www.wmo.ch/web/wcp/clips2001/html/index.html

3. WGSIP Activities

3.1 El Niño Definition

The CLIVAR SSG has asked WGSIP to address the problem that no widely accepted definition of El Niño exists. Within the scientific community, the definition by Trenberth (Trenberth, K. E., 1997: The definition of El Niño *Bull. Amer. Meteor. Soc.*, **78**, 2771-2777.) is often used. The main disadvantage of this definition is that it requires 12 months of data before an El Niño can officially be declared. The working group argued that a widely used definition of El Niño should have a real-time benefit. Based on a study of the characterization of ENSO using a multi-index approach, S. Zebiak concluded that the NINO3.4 index contains the basic information on the state of the tropical Pacific Ocean as it affects ENSO and relates to global climate. The working group discussed potential definitions based on the NINIO3.4 index in depth. Major issues were potential categories, averaging (base) periods to be defined and used in an index definition and whether or not a definition should characterize the phenomenon in terms of impacts or not. The WG agreed on the definition of a continuous numerical oceanic El Nino index (OENX), based on the NINO3.4 index, which is intended to characterize the state of the tropical pacific as it relates to ENSO, but which avoids "categories" and which does not attempt to directly imply local and remote climatic impacts. The full statement of WGSIP proposal can be found in Appendix D.

3.2 SMIP2

Dr. G. Boer gave a progress report on the SMIP Project which was initiated about two years ago. SMIP-2 is a follow–on experiment to the Seasonal Prediction Model Intercomparison Project (SMIP) which began in 1996. In SMIP-1, 4-month ensemble forecasts for 5 (or 9) initial conditions were carried out with respect to the winters (December-March) of 1982-83, 1986-87, 1987-88, and 1992-93, and the summers (June-September) 1987, 1988, 1993, and 1994.

WGSIP proposed a second phase of SMIP at its 4th session in Bologna, 1999, directed toward an expanded investigation of potential forecast skill using observed boundary conditions. The objectives of SMIP-2 are:

- to extend atmospheric GCM DSP experiments to more complete cases, including the evaluation of "second" season predictability
- to initialise and/or nudge ground surface conditions in collaboration with the GSWP (Global Soil Wetness Project)
- to perform seasonal prediction experiments with coupled ocean-atmosphere models

A second SMIP2 component was subsequently included. SMIP-2/HFP (historical forecast project) aims to investigate the "actual" 1-season forecast skill that can be obtained using current model-based objective methods. Thus, SMIP-2/HFP compliments the standard SMIP-2 experiment which assesses the "potential" forecast skill that could be obtained if a perfect forecast of ocean and sea-ice conditions were available. In particular, SMIP2/HFP includes both coupled model and 2-tier forecast systems.

The specific objectives of SMIP-2/HPF are to:

- establish the "actual" 1-season forecast skill that is currently possible in a realistic operational, objective context
- provide a hindcast data set that has been produced with a uniform approach and which may be used to:
  - demonstrate currently achievable 1-season forecast skill for a range of variables
  - support the development and application of probability forecast methods including measures of reliability

- encourage the further development and application of ensemble methods including multi-model ensemble approaches
- provide a benchmark against which to demonstrate improvement and to justify changes in operational 1-season forecast approaches and methods

To date, 4 groups (CMC/CCCma/RPN/McGill, MRI/JMA, NCEP/SPM and SNU/KMA) have indicated their participation in SMIP2. Further information about these studies can be found under: http://www-pcmdi.llnl.gov/smip/

The working group discussed ways to encourage participation in SMIP2 and to expand the project to encompass the range of research and operational approaches currently being used by the SIP community. It was decided that this could be accomplished by accepting a broader range of initial conditions for the forecasts. The SMIP web-page will be modified and groups will be alerted to these extensions and modifications to the SMIP2 protocol by email.

An SMIP Panel (Boer, Davey, Kang, Sperber) will identify potential participants, promote the project, guide analysis, and encourage and coordinate diagnostic subprojects. A deadline for submission of SMIP2 data is proposed for July 2003 in order to enable preliminary analysis in time for the next session of WGSIP. (Action Item).

3.3 Model experimentation and output standards experiment

This new activity had been initiated by WGSIP two years ago. During the past year a proposal for a first stage of such a project on the exchange of LRF verification information has been written by the Commission for Basic Systems (CBS) Expert Team on LRF Verification (based on a an earlier proposal written by Drs. M. Harrison and N. Nicholls). WGSIP reviewed and discussed the CBS proposal.

WGSIP endorsed the CBS Report on verification of long-lead forecasts and regard it as an excellent starting point for a WGSIP project. Nevertheless, the CBS proposal was regarded as a minimum baseline that does not include enough diagnostics for WGSIP purposes.
Thus, WGSIP agreed to start a long-term evolving project on Standardised Verification Sets (SVS) for long-range forecasts based on the CBS protocol. In order to keep the project manageable and affordable, the group favoured a distributed system guided from a central website. Furthermore, the group favoured that the location and handling of this website should be done through CLIVAR, i.e. the ICPO. WGSIP recognized that this task goes beyond the present resources of the ICPO. Therefore, the group will ask CLIVAR to seek resources to build up such as system. In addition, other mechanisms to implement this project are being explored. (Action item: Kirtman to draft a letter, WGSIP to circulate and to send to SSG / ICPO).

3.4 Climate events of the past year

Dr. Zebiak presented information on a number of climate events which occurred during the past year. Since this information was circulated beforehand, other group members added whether or not their seasonal forecasts were capable of tracking these events.
1. In 2002 the Indian summer monsoon has noted the driest July on record.
The ECMWF forecast was dry but did not extend that far over the Indian subcontinent whereas COLA forecasts were not as good. The JMA model had a very similar large-scale pattern to ECMWF but the precipitation minimum was biased towards the western Indian Ocean. The IRI forecasts showed higher probabilities for dry conditions in JJA in April but not in May.
Overall, the model forecasts where not very good and the reasons for the overall failure of the predictions are unknown. There were speculations about a potentially changed relationship of

the ENSO-Monsoon relationship over the past years, ocean and land surface feedbacks and also global change aspects.

2. The SE of South American (N. Uruguay / S. Brazil) has been wet for 15 months.
Neither ECMWF nor COLA captured this feature whereas JMA reproduces it to some extent.

3. Southern Africa very dry through Jan.-Mar. 2002.
The 3-month mean of the ECMWF forecast showed wetter than normal conditions, in detail (Feb. was wet, March normal, and April dry). NSIPP model showed better results using AMIP SST than with predicted SST's. The IRI multi model forecast did not capture this event.

4. Dry conditions in Indonesia. Until October 2002, deficits as large as 1000mm were noted. This drought shows the typical signature of an El Niño event and was captured to some extent by IRI and ECMWF forecasts.

5. Drought over Australia. Dr. Power outlined work by Dr N. Nicholls which suggests that this may well be the worst Australian drought on record - the impact of low winter precipitation has been amplified by accompanying record warm temperatures. So while the signature of the rainfall deficiency may be typical for El Niño, temperatures are much higher than might expected on the basis of natural variability alone The model forecasts presented were consistent with a rainfall decline.

6. High Temperatures over Asia. Very warm winter conditions were noted over central Asia (anomalies of more than 10K!). Neither ECMWF nor IRI forecasts were able to capture this feature very well. It was speculated whether this strong anomaly might have had an impact on the Indian summer monsoon.

7. Sahel drought July-September 2002. To some extent all model results captured this event, (ECMWF pattern further north, IRI only the western part)

WGSIP regarded this annual assessment of specific climate events as a useful exercise. In future, the standards project should help WGSIP to intercompare the capability of different models in simulating such events more easily.

3.5 Monsoon Predictability

Dr. I.-S. Kang gave an overview about the activities related to the modelling of the Asian-Australian Monsoon VAMOS and AA Monsoon Panel had agreed to have a joint meeting on monsoon modelling and prediction. The next AA monsoon panel will be held in February in Atlanta. One aspect of recent research interest in Monsoon modelling focuses on better simulation of western Pacific anomalies. Monsoon GCM intercomparison studies have shown that the simulations of the annual cycle and anomalies over the western Pacific are in general poor. Since in the western Pacific the atmosphere-ocean coupling is important coupled models are more suitable to better simulate the climatological mean and interannual variability in that region. In all regions where atmospheric fluxes contribute to the SST variability, the relationship between the modelled local SST and rainfall is wrong. Thus, Dr. Kang concluded that a two-tier approach may not be appropriate for the prediction within the western Pacific.

3.6 GEWEX – GLASS

Dr. Koster focused in his presentation on the relationship and interaction of the GEWEX Global Land-Atmosphere System Study (GLASS) and WGSIP. Two GLASS projects have significant overlap with WGSIP objectives:
1. "GLACE" (Global Land-Atmosphere Coupling Experiment)
2. "Poor-Man's LDAS"
Proposal: Let these projects be jointly sponsored by GLASS and WGSIP.

1. The "GLACE" (Global Land-Atmosphere Coupling Experiment) is a broad follow-on to the four-model intercomparison study described by Koster et al. (*J. Hydrometeorology*, *3*, 363-375, 2002), hereafter referred to as K02. The strategy of the original experiment was:

- Establish a time series of surface conditions.
- Run a 16-member ensemble, with each member forced to maintain the same time series of surface prognostic variables.

GLACE will build on previous study through:

- *Participation from a wider range of models*. The idea is to generate a comprehensive "table" of coupling strengths, a table that can help in the interpretation of the published results of a wide variety of models.
- *Separation of the effects of "fast" and "slow" reservoirs*. The K02 results largely reflect the specification of the "fast" reservoirs (e.g., surface temperature). They thus may have little relevance to issues of seasonal prediction.
- *Effect on air temperature*. Ignored in the K02 study is the effect of the specification of surface variables on the evolution of air temperature. (This is a particularly interesting issue when only the "slow" soil moisture reservoirs are specified.)
- *Correction of miscellaneous technical issues*. Lessons learned from the K02 study can be applied immediately to GLACE.

Proposed plan for GLACE

- Step 1: 16-member ensemble, with prognostic states written out at each time step by one of the members.
- Step 2: 16-member ensemble, with all members forced to use the same time series of surface prognostic states.
- Step 3: 16-member ensemble, with all members forced to use the same time series of deeper (root zone and below) soil moisture states.

All simulations are run from June through August

Timetable for GLACE

November, 2002:	Experiment plan distributed
December, 2002:	Feedback from modelling groups.
	How many will participate? Do we have a critical mass?
June, 2003:	Deadline for finishing simulations
June – Sept., 2003:	Processing of results, preparation of papers.

No physical workshop is planned. Preliminary findings will be continually communicated with participants, who will be encouraged to participate in the interpretation of the results.

2. Poor Man's LDAS (Land data assimilation study):
The aim of the project is to study the impacts of soil moisture initialization on seasonal forecasts.
The experimental design is as follows:
At every time step in a GCM simulation, the land surface model is forced with observed precipitation rather than GCM-generated precipitation. The observed global daily

precipitation data comes from GPCP and covers the period 1997-2001 at a resolution of 1^o X 1^o (George Huffman, pers. comm.). The daily precipitation is applied evenly over the day.

Status of "Poor-Man's LDAS" project:
A pilot study has been performed. The project was presented at the AMIP conference (Nov. 2002) in hopes of sparking interest in making it an AMIP sub-project, to be performed by a number of modelling groups.

WGSIP welcomes and endorses the GLASS project GLACE (Global Land-Atmosphere Coupling Experiment) as a joint cosponsored activity of GLASS and WGSIP. WGSIP expressed its interested to be involved in the discussion and planning of other GLASS activities, such as the Poor man's LDAS. (Action item: to be reported to GLASS and CLIVAR SSG).

3.7 Regional Modelling

Some updates on relevant studies with respect to regional modelling were provided by G. Boer and S. Zebiak. Dr. Boer highlighted the ongoing activities in the field of so-called 'big-brother experiments undertaken with the Canadian Regional Climate Model (CRCM) by researchers at the University of Quebec a Montreal (UQAM). Dr. Zebiak emphasised the importance of regional studies for aspects of application and training. A tropical 'big-brother' experiment as suggested on the last session is currently performed at IRI.
As an example, he presented results from a regional study to investigate the capabilities to simulate dry spells in the NE of Brazil (State of Ceara).
A RSM at resolution of 60km is capable of producing both large-scale and local-scale information and their interannual variability at seasonal scale. The probabilistic information in RSM simulation is better than that in the ECHAM 4.5 AGCM. The RSM has skills in simulating sub-seasonal events, such as dry spell and rainfall intensity distribution. The downscaling forecasts highly depend on the skills of SST forecasts.

3.8 Workshop on Ensemble Methods in Weather and Climate

As in introduction to this topic, Dr. G. Boer gave examples illustrating potential applications of ensemble methods, in particular multi-model ensemble methods, in climate and seasonal prediction. The zonally averaged Dec.-Feb. mean-sea level pressure and precipitation simulated by state-of-the-art climate models developed and used over three decades showed that while some model results had improved considerably the overall spread of model results had not shown a great deal of convergence. This, in turn, reiterated the difficulties that modellers face in overcoming uncertainties in model parameterizations and deficiencies in numerics/resolution. Multi-model ensemble methods may provide a way of focussing on the climate "signal" in the presence of both the "noise" of natural variability but also the "noise" introduced by model deficiencies. For instance, an analysis of a multi-model ensemble of results from the CMIP experiment showed that, although models exhibit a considerable spread and no one model is consistently superior, the ensemble "mean model" is generally the "best" model, at least in terms of the climatic distribution of standard variables such as surface temperature, precipitation and mean sea-level pressure.

As another example, Dr. Boer reported on an analysis of a multi-model ensemble of AMIP2 results performed by S. Kharin of CCCma. The skill of the models in reproducing the observed climate variability, forced by the prescribed SSTs, was considered. A statistical combination of results from different models was able to improve the skill but it was also

shown that skill declined as the number of models entering the statistical combination increased beyond a comparatively small number. In fact the skill of the ensemble mean result was difficult to surpass in an overall sense, although this depends on the signal to noise ratio and the amount of data available.

Examples such as these indicate that ensemble methods are of growing interest and potential utility but also that there remain many theoretical and practical questions deserving in-depth analysis and research. A scientific workshop on ensemble methods has therefore been proposed by WGSIP and approved by the CLIVAR SSG. Theoretical and practical aspects ensemble methods, particularly muli-model ensemble methods, as applied across the timescales from weather to climate are of interest. This suggests that the Workshop be co-sponsored by WGSIP, WGNE and WGCM and the interest and collaboration of these WGs will be sought. WGSIP would aim to hold the meeting in conjunction with the next working group meeting in November 2003 if this is feasible

Before proceeding with the planning of this activity, however, further information about an WMO-CAS activity organized by Dr. Krishnamurti (FSU) has to be explored (G. Boer, A. Villwock).

3.9 START reorganisation

The three sponsoring programmes of START (global change SysTem for Analysis, Research and Training) - WCRP, IGBP and IHDP - decided recently that it was time to do a strategic review of START and of capacity building and regional research within the core projects/activities in our respective programmes, and also in the evolving Earth System Science Partnership (ESSP) joint projects (carbon, food, water). The director of WCRP had asked for input to a document that he distributed recently. For technical reasons this was not available to WGSIP. Nevertheless, WGSIP notified that there is some common ground with aspects of the START programme and expressed some hope for more interaction in the future.

4. Presentations by WGSIP members

BMRC (S. Power)

Dr. Power reported on progress at BMRC and CSIRO jointly building up the POAMA (Predictive Ocean Atmosphere Model for Australia) model for seasonal prediction:

POAMA (version 1.0)

- Operationally 8 month forecast per day using very latest ocean/atmospheric initial conditions
- Nino 3 skill significantly better than persistence at all lead times
- Skill competitive with best of international models
- Web site - details of forecasts and hind-casts (dynamical diagnostics)

To do:

- Improve: BAM, ACOM2 (with CSIRO), Ocean data assimilation, atmospheric initialisation, Land surface
- Understand modes of variability in model (& real world) - link between intra-seasonal and inter-annual
- Ensembles - How to generate and how to use?

More information is available under http://www.bom.gov.au/bmrc/ocean/JAFOOS/POAMA

Further experiments were performed with a later version of the BMRC CGCM described by Power et al. (1998). This model consists of a MOM-type OGCM (Pacanowski et al., 1991), with 25 vertical levels and a horizontal spacing of 2 degrees E-W and a N-S spacing ranging from 0.5 near the equator, up to 6 deg near the poles a hybrid mixing scheme (after Chen et al. 1994)), a thermodynamic sea-ice model and a R21 L17 “unified” AGCM (Colman, 2000)). For the coupling, a flux adjustment technique is applied. This model is being used to investigate interannual as well as decadal fluctuations and their predictability within the Indo-Pacific sector.

CMC/CCCma/RPN/McGill (G. Boer)

The 2- tier seasonal forecasts produced by the CMC are based on models and methodologies developed in collaboration with CCCma, RPN, and McGill University. Currently, operational 1-season forecasts are produced for 4 seasons during the year. It is planned that 1-season forecasts will be produced each month beginning in the coming year. As well as the “deterministic” forecasts currently produced, probabilistic forecasts for above, normal and below terciles will become operational.

Two new atmospheric models have been developed and are being used for research into SIP. AGCM3, developed at CCCma, is a third-generation atmospheric model which retains a spectral dynamical core while incorporating a range of improvements in physical parameterizations and in resolution. The GEM model, developed at RPN, represents a change in both parameterizations an in the dynamical core where semi-Lagrangian methods are now used. Both models are being used to produce a new HFP with the possibility of a 4-model ensemble (together with the current two models) being used to produce seasonal forecasts in the future.

ECMWF (T. Stockdale)

The seasonal prediction project at ECMWF is still running in a research mode. It is expected to move to operational forecasts within the next year. The current seasonal ensemble forecast predicts the peak of the current ENSO for November 2002 with a small spread amongst the ensemble members in contrast to the predictions from the Met. Office, UK, where a large spread was notified. This might be attributed to problems within the data assimilation. The precipitation signal of both models is very similar, with general stronger amplitude of the

ECMWF model.

NSIPP (R. Koster)

The overall goal of NASA's Seasonal-to-interannual Prediction Project is to demonstrate the utility of remotely sensed observations of the ocean and land surface for enhancing seasonal prediction and guide development of future observing systems.
The NSIPP model configuration used is:

- AGCM: NSIPP1 AGCM, 2 x 2.5 x L34
- LSM: Mosaic (SVAT)
- OGCM: Poseidon v4, 1/3 x 5/8 x L27, with embedded mixed layer physics
- CGCM: Full coupling, once per day

The new tier 1 system is running for two months now. Hindcasts from 1993 and forecasts are performed. Other details of the model set-up are:

- One atmosphere, one ocean simulation (with assimilation) prior to start of forecast. ensemble members defined by parallel AMIP simulations for the atmosphere and by snapshots of prior ocean run for ocean.
- Ocean assimilation is optimal interpolation, conducted daily with the global *in situ* temperature database
- Salinity is adjusted commensurate with the temperature adjustments and the models' water masses
- Random perturbations are generated from differences between randomly selected snapshots for the ocean and for the atmosphere. For the ocean these differences are applied with a randomly generated amplitude (usually 0 - 0.2)
- Current real-time forecasts use 19 ensemble members: a mixture of ocean-only and atmosphere-only perturbations, with (in addition) one set of 6 ocean perturbations forced by a single atmospheric perturbation.
- Land is initialised only through AMIP

Dr. Koster demonstrated that the performance of the new system is much better compared to the old one. The hindcast experiment showed pretty good skill and small spread for Niño3, in particular for September. More spread was noted for April.

COLA (B. Kirtman)

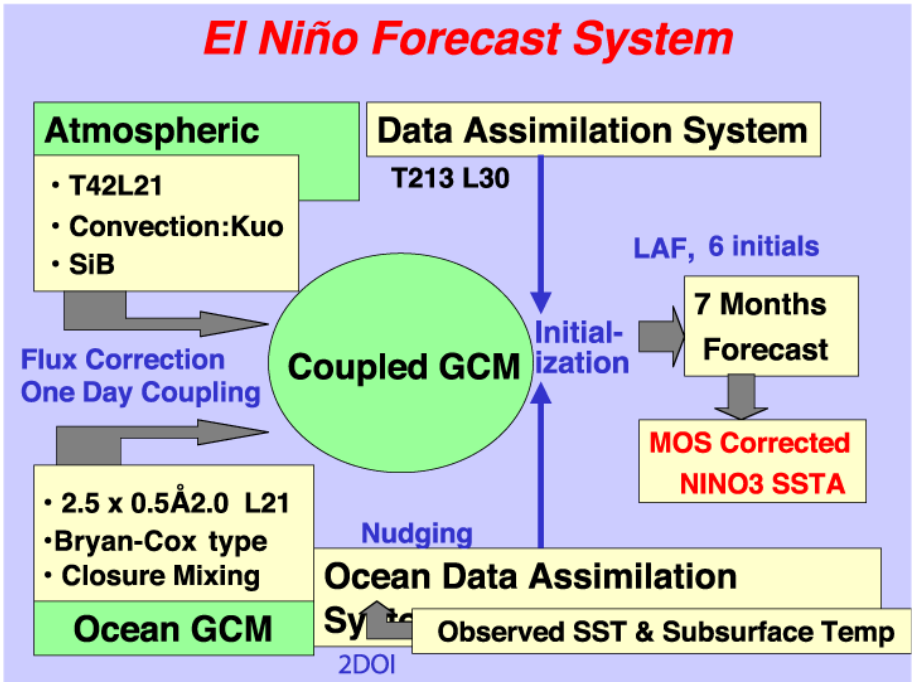
Ensemble ENSO Prediction at COLA. Results were described from a large sample of coupled ocean-atmosphere retrospective forecasts during 1980-1999. The prediction system includes a global anomaly coupled general circulation model and a state-of-the-art ocean data assimilation system. The retrospective forecasts are initialised each January, April, July and October of each year, and ensembles of six forecasts are run for each initial month, yielding a total of 480 one-year predictions.

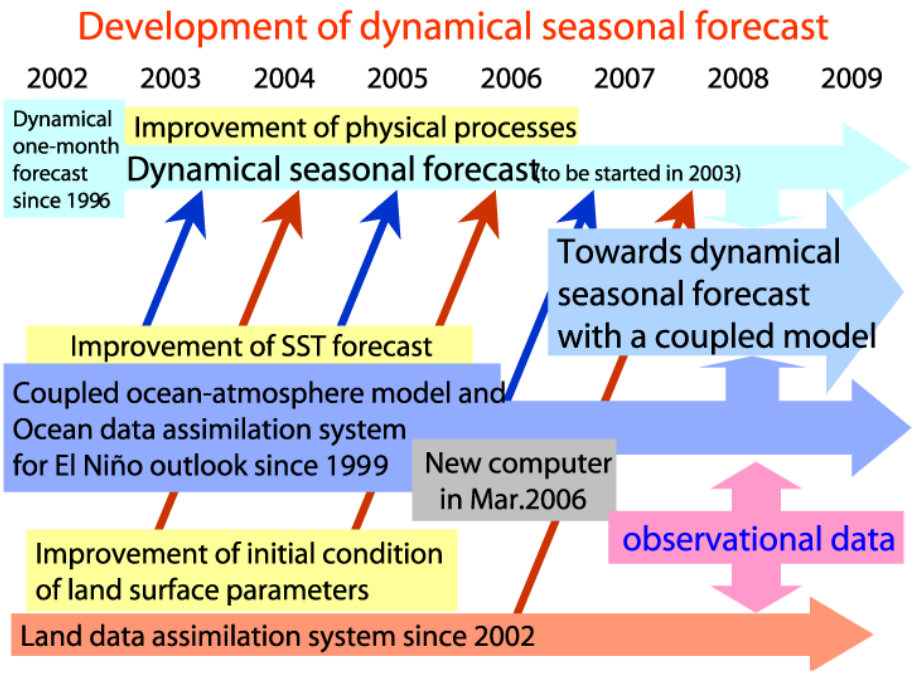
In generating the ensemble members, perturbations are added to the atmospheric initial state only. The skill of the prediction system is analysed from both a deterministic and a probabilistic perspective. The probabilistic approach is used to quantify the uncertainty in any given forecast. The deterministic measures of skill for eastern tropical Pacific SSTA suggest that the ensemble mean forecasts are useful up to lead times of 7-9 months. At somewhat shorter leads, the forecasts capture some aspects of the variability in the tropical Indian and Atlantic Oceans. The ensemble mean precipitation anomaly has disappointingly low correlation with observed rainfall. The probabilistic measures of skill (relative operating characteristics) indicate that the distribution of the ensemble provides useful forecast information that could not easily be gleaned from the ensemble mean. In particular, the prediction system has more skill at forecasting cold ENSO events compared to warm events. Despite the fact that the ensemble mean rainfall is not well correlated with the observed, the ensemble distribution does indicate significant regions where there is useful information in

the forecast ensemble. In fact, it is possible to detect that droughts over land are more predictable than floods. It was argued that probabilistic verification is an important complement to any deterministic verification, and provides a useful and quantitative way to measure uncertainty. A cost-loss decision model analysis was also applied to the precipitation forecasts and the value of the forecasts was assessed.

JMA (M. Sugi)

Dr. Sugi presented the current configuration of the coupled model run at JMA for seasonal forecasting. The main components of the model are an atmospheric GCM with T42L21 resolution and an oceanic GCM with 2-0.5°x 2.5°L20. More details are displayed in figure 1.

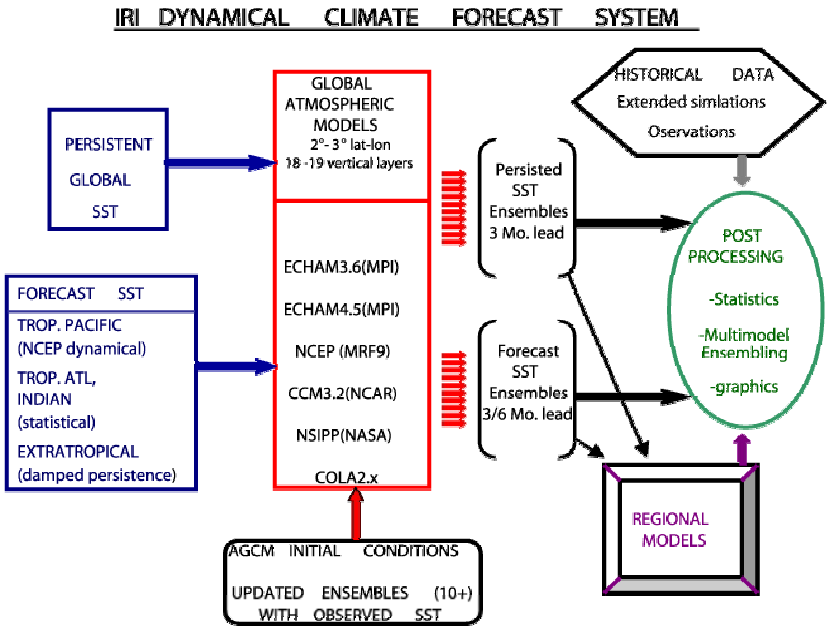




Within the next year a number of changes are planned to the current system, such as a modified Ocean initialization, using a 3DVAR technique, Incremental Analysis Update, Temperature, Salinity and Sea Surface Height assimilation as well as wind stress + heat and water fluxes. A dynamical seasonal forecast system will be started within the next year. For 2005 a new model using an AGCM T63L40 and an ocean component with 1-1/3°x 1°L50 resolution are planned. Fig 2 summarizes the detailed plans for the coming years.

IRI (S. Zebiak)

The current IRI dynamical climate forecast system is displayed in Fig. 1



Several additional atmospheric models have been added recently. Over the past year some analysis of both hindcast and real-time forecast skill have been conducted. The results show that the consolidated IRI forecasts outperform significantly the raw GCM-based probabilistic forecasts of precipitation. Analyses of reliability were also interesting, showing that the new objective multimodel ensemble forecasts are considerably more reliable than the raw GCMs and in terms of temperature outperform the subjective IRI forecasts over the past several years as well. For precipitation, the subjective forecasts overall were slightly better due to better spatial coherence. The issue of spatial correlation is being investigated presently as an enhancement of the current objective scheme. Other recent areas of research include prototypes of coupled forecast systems of the intermediate class, as well as a hybrid coupled system using a statistical atmosphere component (derived from AGCM ensemble output) and ocean GCM, and another using a full AGCM and simplified ocean. Additional work involves methods of downscaling regional climate forecasts (from global predictions), both dynamically and statistically. Model output statistics have demonstrated considerable improvements beyond what can be achieved with standard ensemble methods, by incorporating spatial biases, and relationships among meteorological variables.

5. Local Presentations

1. **Review of southern African rainfall variability and regional forcing** (*Chris Reason*)
   Prof. Reason reviewed the impacts of large-scale modes of interannual variability on southern African rainfall as well as relationships with regional SST. On interdecadal scales, a strong signal can be seen in both the summer and winter rainfall regions and this may be related to ENSO-like decadal modes.
2. **South east Atlantic warm and cold events** (*Pierre Florenchie*)
   Dr. Florenchie presented analyses from OI SST, altimeter, NCEP winds and an ocean GCM on the variability in the southeast Atlantic. His studies document that the signal originates in the equatorial region as a result of changes in the trade winds, propagates eastward as an equatorial Kelvin wave and then southward along the southwestern coast of Africa.
3. **Interannual rainfall variability and potential predictability of Northern Zambian rainfall** (*Henry Mulenga*)
   In his presentation, Dr. Mulenga focused on the interannual variability of rainfall in northern Zambia. He stated that the rainfall variability in that region is related to the SST in the southern Indian Ocean as well as to anomalies in the eastern Atlantic. On the other hand, a relationship to ENSO was not so obvious.
4. **Overview of DACST[1] seasonal forecast project** (*Bruce Hewitson*)
   Prof. Hewitson gave a short overview of the collaborative seasonal forecasting project (Universities of Cape Town, Pretoria, Zululand and the South African Weather Service) sponsored by the South African government DACST Innovation Fund. Due to computational resources and a lack of trained modellers, the current capabilities are limited. Currently, three models are used in a multimodel approach, namely: HadAM3, CSIRO-S, COLA and a 15-year ensemble hindcast has been performed. A regional model (MM5) is being nested within the GCMs. Preliminary results show trends towards longer duration of wet and dry spells of precipitation in Southern Africa and a general increase in the intensity of rainfall.
5. **Statistical Forecasting and Predictability of Indian Ocean Sea Surface temperature** (*Dan Collins*)
   Dr Collins talked about statistical modelling of SST in the tropical Indian Ocean, a region important for African rainfall variability. Some skill has been achieved in predicting SSTs in this region using CCA and neural net techniques.
6. **Seasonal forecasting of climate over southern Africa using HadAM3** (*Mark Tadross*)
   Dr. Tadross discussed some prototype seasonal forecasting products for the South African region using two versions of HadAM3 model (with and without the mixed phase precipitation parameterisation) using CSIRO COCA SSTs.
7. **A validation of HadAM3 and COLA AGCM hindcasts over southern Africa 1986-99** (*Deveerappa Jagadeesha*)
   In his presentation, Dr. Jagadeesh a presented results from a validation hindcasts performed with the HadAM3 and COLA models. He stated that the overall interannual variability in rainfall of both models is underestimated compared to the CMAP data set.
8. **Current operational forecasting capability at the South African Weather Service** (*Warren Tennant*)
   Dr. Tennant reviewed the present capabilities for operational forecasting in the South African Weather Service. At present, statistical methods and output from the COLA model and the IRI seasonal forecast products such as outlook papers and terciles are used.

[1] Department of Arts, Culture, Science & Technology

9. **Strengthening forecast and early application in the SADC[2] region: a focus on the 02/03 season**. (*Emma Archer*)
   In her presentation, Dr. Archer highlighted three projects, one in cooperation with NOAA OGP to build up a seasonal forecasting system for South Africa, secondly, a project with the Tyndall Centre on *Anticipating and reacting to climate change in southern Africa* (TBC) and in cooperation with USAID (US Agency for International Development's) a project to monitor the effects of hydroclimatic extremes in South Africa. In addition, Dr. Archer reported about the main requirements for seasonal forecasts that came out of an AGROMET workshop that was held recently in Harare, Zimbabwe. In detail, these requirements were:
   1. temporal distribution of rainfall three months in advance (onset, length and amount)
   2. adequate and appropriate backstopping for NMS's.
10. **A qualitative review of 2001/02 seasonal forecast for South Africa from a user's point of view**. (*Peter Johnston*)

    Mr. Johnston provided a qualitative review of the seasonal forecast for 2001/02 South African summer rainfall and temperature from a more applications standpoint.

6. Other business

6.1 Membership

There seem to be no coherent length to the membership terms (A. Villwock to explore and fix).
A number of members have reached the end of their terms. Some of them will be offered a renewal to ensure the continuation of the work initiated. S. Zebiak will step down as the chairman. A co-chairman solution was favoured amongst the panel members.

6.2 Next meeting

Several places were suggested but not obvious consensus could be accomplished. A preference was given to IPRC, Hawaii. The venue for the next meeting also depends whether or not the workshop mentioned above will be held in conjunction with the working group meeting.

[2] South African Development Community

Appendices

Appendix A: WGSIP Terms of Reference and Membership

The CLIVAR Working Group on Seasonal-to-Interannual Prediction (WGSIP; previously known as CLIVAR NEG-1) is a part of the CLIVAR organization. The overall responsibility of the panel is seasonal-to-interannual prediction. More specifically its terms of references are:

1. Develop a programme of numerical experimentation for seasonal-to-interannual variability and predictability, paying special attention to assessing and improving predictions.

2. Develop appropriate data assimilation, model initialization and forecasting procedures for seasonal-to-interannual predictions, considering such factors as observing system evaluation, use of ensemble and probabilistic methods and statistical and empirical enhancements, and measures of forecast skill.

3. Advise the CLIVAR SSG on the status of seasonal to interannual forecasting and on the adequacy of the CLIVAR observing system, and to liase with JSC/CLIVAR Working Group on Coupled Modelling and the JSC/CAS Working Group on Numerical Experimentation.

The Working Group comprises:

S. Zebiak (chair)	Lamont-Doherty Earth Observatory, Palisades, USA
G. J. Boer	Meteorological Service of Canada, University of Victoria, Victoria, Canada
M.K. Davey	Met. Office, Bracknell, UK
M. Harrison	Met. Office, Bracknell, UK
I.S. Kang	Seoul National University, Seoul, Korea
R. Kleeman	Courant Institute, New York University, New York, USA
B. Kirtman	COLA, Calverton, USA
R. Koster	NASA/GSFC, Greenbelt, USA
S. Power	BMRC, Melbourne, Australia
T. Stockdale	ECMWF, Reading, UK
M. Sugi	JMA, Tokyo, Japan

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Appendix C: Agenda

Tuesday, November 19th

1. Welcome and opening remarks (Steve Zebiak (chair, WGSIP), Chris Reason (local host), Andreas Villwock (ICPO)

2. Review of relevant developments and activities

2.1 Report from the CLIVAR IPO (A. Villwock)

2.2 Report from the 11th session of the CLIVAR SSG, including discussion on Banner on Predictability (B. Kirtman, A. Villwock)

2.3 Report from other meetings and groups relevant to WGSIP (AAMON (Global Monsoon Modelling Initiative), VACS, VAMOS, Atlantic, etc.) (all, lead S. Zebiak, A. Villwock)

2.4 Reports from regional or national CLIVAR Committees (e.g., US CLIVAR). (all, lead S. Zebiak)

2.5 Other WCRP modelling activities; JSC/CLIVAR Working Group on Coupled Modelling (WGCM); the JSC/CAS Working Group on Numerical Experimentation (WGNE); C20C project (to be advised, lead S. Zebiak, A. Villwock)

2.6 Update on related studies such as the IRI/ARCs project (S. Zebiak) and the European DEMETER project (T. Stockdale), multi-model ensemble prediction project intercomparison projects; COLA/GFDL/GSFC/NCAR/NCEP study on DSP (B. Kirtman); Asia-Pacific Economic Cooperation (APEC) Climate Network (I. Kang), European ENACT project on ocean data assimilation for seasonal prediction (M. Davey).

2.7 Application programmes (Clips, START, etc.) (B. Nyenzi, S. Zebiak)

Wednesday, November 20th

3. WGSIP activities

3.1 WGSIP activities on El Niño Definition (S. Zebiak, G. Boer, M. Sugi, T. Stockdale)

3.2 Climate "events and forecasts of the preceding year: (S. Zebiak, and all)

3.3 Model experimentation and outputs standards project (T. Stockdale, S. Zebiak) and Expert Team for Long Range Forecast Verification (B. Kirtman, S. Power)

3.4 Dynamical seasonal prediction project: Progress of "SMIP-2" as a follow-on to phase 1 (SMIP). (G. Boer, M. Sugi);

3.5 AA-Monsoon update (I. Kang)

3.6 Down-scaling/regional models: review last years activities on this sector, special presentation by invited speaker(s) (S. Zebiak, others?)

Thursday, November 21st

3.7 Ocean Models Intercomparison experiment: update on this project (T. Stockdale ?);

3.8 Interactions with GEWEX (R. Koster)

3.9 Multimodel ensemble techniques (G. Boer)

4. Developments in coupled seasonal/interannual forecasting systems (Friday)

4.1 Participants will be given the opportunity to summarise briefly developments in coupled seasonal/interannual forecasting systems at their home institutions (if not already covered in previous discussion); (All)

5. Local Presentations *(Chris Reason et al.)*

Friday, November 22nd

6. **Other business** (S. Zebiak).

6.1 Membership

6.2 Agree on a date and place for next WGSIP session.

Appendix D: El Niño scale

WGSIP, on request from the CLIVAR SSG, proposes a scale for the real-time monitoring of the state of the tropical Pacific Ocean that takes the following into consideration:

- the definition needs to be scientifically robust
- the definition should assist in the difficult task of communicating potential impacts that changes in the tropical Pacific might have in particular regions
- the use of terms such as “El Nino”, “La Nina” and “strong El Nino” is currently widespread
- use of terms such as those in the previous bullet has caused difficulties in communicating both the probabilistic nature of possible impacts as well as the range of possible impacts. *[Many people have come to equate the occurrence of an El Nino with a definite impact, e.g. widespread drought in Australia, that may in fact not eventuate. A more balanced view is that drought in Australia is more likely - though not certain - if an El Nino occurs.]*
- ENSO is a continuous phenomenon without step changes or boundaries
- defining an El Nino event involves a certain amount of subjectivity and is not context-free. Consequently a range of definitions is currently available.

WGSIP recommends using a 3 month or 90 day average of the NINO3.4 SST index based on data sources as recommended in the CBS SVS as an “oceanic El Nino scale” because the scale:

- is readily available in near-real-time and is an internationally-accepted measure
- is linked to global-scale temperature and rainfall teleconnections
- permits ready comparison with past events, both warm and cold, without being prescriptive concerning impacts.

In the proposed terminology, the word ‘oceanic’ emphasises that the scale does not refer directly to impacts, the term ‘El Nino’ provides a link to current terminological usage, and the word ‘scale’ indicates that it is a continuous, unbounded variable.

Advantages of using the concept of an “oceanic El Nino scale” include:

- such language is familiar to the public in other contexts, such as earthquake magnitudes
- it will provide a consistent international standard but impacts nevertheless may be interpreted in a local context, without reference to specific terms such as ‘El Nino’.

WGSIP envisages that use of the oceanic El Nino scale may develop in the following manner:

- NMHSs and other concerned bodies will interpret values on the scale in terms of the range of impacts previously observed in their region
- information on the range of impacts will be made available to users
- in time the name of the scale may be changed to remove the focus on ‘El Nino’
- forecasts will be expressed in terms of a range on the scale
- the concepts that El Nino and La Nina are linked, that El Nino is not a concrete concept, and that local impacts are not guaranteed under any specific circumstances will become generally accepted.

In defining the scale WGSIP recommended that:

- given the likelihood that global warming is occurring it is appropriate to use a sliding 30 year period for defining the climatological reference period for the NINO3.4 index.
- this proposed approach is circulated widely in the climate science community and amongst climate prediction service providers in order to gain feedback.

In summary, WGSIP concludes that: NINO3.4 is widely recognized as a robust index for ENSO; ENSO is a continuous phenomenon and provision of a scale is better suited to providing a balanced probabilistic description of potential impacts; and that the proposed new approach is a scientifically sound, pragmatic approach to monitoring the current status of the tropical Pacific Ocean. The definition outlined above is specifically designed for operational monitoring and prediction purposes, and complements rather than replaces alternative definitions of value in other contexts, e.g. research.