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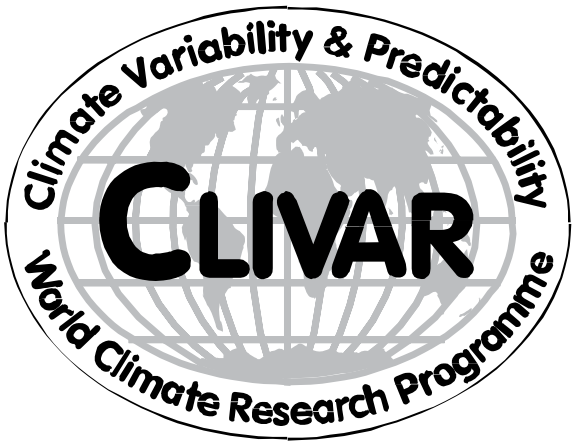
WORLD CLIMATE RESEARCH PROGRAMME



CLIVAR Working Group on Seasonal to Interannual Prediction

Report of the 5th Session

1.-3. November 2000, Buenos Aires, Argentina

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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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1. Action Items/Recommendations

i. Query to be made to ECMWF concerning the possibility of supporting an archive of high temporal resolution data (suitable for dynamic downscaling or as inputs to applications models) from global models (Kirtman, Stockdale)

ii. Contact with WCP concerning issue of generating project needs that could interface with model outputs and products (Harrison)

iii. Collection of inputs from WGSIP members with respect to currently used diagnostics, metrics of evalution for model simulations/forecasts; and current experiment design standards. To be used toward WGSIP project of developing international standards and metrics. (Zebiak, Ji, Stockdale).

iv. Discussion with ICPO on likely personnel resource needs to support web design and maintenance associated with a standards project (Semazzi).

v. Discussion with G. Boer on extending SMIP-2 to include persisted SST hindcast suite. (Zebiak)

vi. Contact member(s) of GSWP concerning a briefing and discussion session on land surface issues in seasonal prediction at next WGSIP meeting. (Zebiak)

vii. Draft a statement concerning WGSIP interests in GEWEX projects and activities, and plans for future collaboration; contact with Paul Dirmeyer (chair GSWP). (Kirtman, Zebiak).

viii. Invite contributions to a simplified OMIP "pre"-project; requesting particular outputs from proposed experiments. Follow on with evaluation of prospects for a more thorough experment (Delecluse).

ix. Communicate with M.Davey, then ad hoc panel for regional modeling, regarding WGSIP downscaling statement already drafted. (Kirtman). Pursue possibilities for further publicizing of statement with ICPO, WCRP, CLIVAR SSG (Harrison, Semazzi).

x. Pursue invitation and briefing on current status of regional dynamical downscaling and statistical downscaling for next WGSIP meeting. (Zebiak) Write outline of WGSIP interests, issues to accompany invitation (Kirtman).

xi. Make contacts with Met Service colleagues in Budapest for next meeting (Stockdale).

xii. Interact with ICPO, SSG concerning new membership (Zebiak).

2. Introduction:

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
M. K. Davey	UK Met. Office, Bracknell, UK
P. Delecluse	LODYC, Paris, France
I.S. Kang	Seoul National University, Seoul, Korea
B. Kirtman	COLA, Calverton, USA
A. Kitoh	Meteorological Research Institute, Tsukuba, Japan
R. Kleeman	Courant Institute, New York University, New York, USA
M. Latif	Max-Planck-Institut für Meteorologie, Hamburg, Germany
M. Ji	NOAA National Center for Environmental Prediction, Camp Springs, USA
K. Sperber	Program for Climate Model Diagnosis & Intercomparison, Lawrence Livermore National Laboratory, Livermore, USA
T. Stockdale	ECMWF, Reading, UK

3. Report of the Meeting

The fifth session of the CLIVAR Working Group on Seasonal-to-Interannual Prediction (WGSIP; previously known as CLIVAR NEG-1) was held at, at Hotel Carsson, Buenos Aires, Argentina, 1 to 3 November 2000. Dr. Guillermo Berri from the University of Buenos Aires was the local host for the meeting. Dr. Steve Zebiak (Chairman of the WGSIP Panel) presided over the discussions. The list of participants is given in appendix (A).

3.1. Opening session

Dr. Steve Zebiak (Chairman of the WGSIP Panel) opened the session and welcomed the Panel members, invited experts, and local participants. The agenda was accepted with minor changes. Dr. Semazzi (ICPO) reported that Dr. Newson had sent his apologies for being unable to attend the meeting.

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

3.2. Review of relevant developments and activities

Activities of the JSC/CLIVAR Working Group on Coupled Modelling (WGCM)

Dr. Semazzi (ICPO) informed the Panel about the relevant developments within CLIVAR that had taken place since the previous WGSIP meeting in Bologna, Italy, 9 - 12 November 1999 (ICPO Publication Series No. 33).

Ninth session of the CLIVAR Scientific Steering Group (Hawaii, May 2000)

(i) SSG encouraged WGSIP to pursue the development of standard metrics for its model intercomparison activities where appropriate and also asked the Panel to review its membership at next meeting.

(ii) To improve intersessional communication between the SSG, CLIVAR Panels and the ICPO, each CLIVAR Panel has been assigned a staff member of ICPO and a member of SSG member. The ICPO contact for WGSIP is Dr. F. Semazzi and the SSG liaison is Dr. Tim Palmer. All Panels and WGs have also been requested to identify a data liaison contact whose task is to provide coordination with the CLIVAR DTT regarding the specific data requirements to meet the needs of the subject areas of that panel.

CLIVAR VAMOS

Dr. Carolina Vera (University of Argentina) identified several areas of potential co-operation between VAMOS and WGSIP, such as, regional climate modelling. Dr. Semazzi briefly described two new projects VAMOS is planning. The VAMOS Panel has launched a new project known as the North American Monsoon Experiment (NAME). It is an internationally co-ordinated effort between GAPP and VAMOS to, (i) monitor, quantify and analyze low-level circulations that modulate monsoon precipitation; (ii) understand the role of the North American monsoon in the global water and energy cycles and; (iii) improve the simulation and monthly-to-seasonal prediction of the monsoon and regional water resources. VAMOS has also introduced another new research initiative PLATIN. It focuses on the study of the Rio de la Plata basin. It is going to be an integrative, interdisciplinary CLIVAR - GEWEX project. The LLJ experiment is regarded as the first stage of the project since it directly addresses the question of moisture influx into the basin.

Variability of the African Climate System (VACS)

The Panel was informed that following the recent completion of the CLIVAR Africa Implementation Plan by the CLIVAR Task Team (CATT), the CLIVAR Africa Panel has been formed. The new Panel will coordinate research activities on the Variability of the African Climate System (VACS). The VACS Panel is co-chaired by Dr. Chris Thorncroft and Prof. Laban Ogallo. It will have its first meeting, 1-3 March 2001 in Nairobi Kenya.

WGSIP is one of the CLIVAR Panels it is expected to interact with closely. Dr. Semazzi is the ICPO contact and Dr. Kevin Trenberth (SSG) is the CLIVAR SSG liaison for the VACS panel. A case study focussing on the 1997/98 ENSO and the Mozambique floods are among the research questions that VACS has identified to address initially. These two topics and regional climate modeling are also potential areas of cooperation between VACS and WGSIP.

Work being undertaken by the joint JSC/SCOR Working Group on Air-Sea Fluxes (WGASF)

It was reported that WGASF has completed its report, which represents a comprehensive assessment of the present state of the art concerning the determination of air-sea flux. The report may be accessed at [http://www.soc.soton.ac.uk/JRD/MET/WGASF]. It will be published in the WCRP report series later on in 2001. The report includes an extensive evaluation of flux products, ranging from in situ data sets to those inferred from remotely-sensed data, and model-based fields (i.e. from reanalyses or operational analyses). Major discrepancies between different types of data sets are still apparent. The main conclusions from the working group are summarized in the final chapter of the report, supplemented by a number of specific recommendations. Noting that the present reanalyses are far from perfect when it comes to air-sea fluxes, support is expressed for continuing reanalysis efforts (every 5-10 years by at least two centers). It was recognized that evaluation of fluxes or flux-related variables from global operational NWP systems would benefit future reanalyses as well as providing essential guidance and estimates of uncertainty in flux fields. The WGNE project to collect and study relevant flux data sets from a number of global operational centers is thus of considerable importance. The requirement for high quality in situ data for verification and calibration of model- or satellite-derived flux estimates is of significant importance. In this connection, a case is made of the need for a network of flux reference platforms (a combination of long-term moorings and ships) capable of delivering the most accurate measurements possible of stress and all components of air-sea heat fluxes. Alongside this, air-sea interaction experiments to improve flux (and boundary layer) parameterizations continue to be necessary (but it is essential to provide adequate resources to ensure a complete analysis of the data collected and realization of the full potential benefits of such experiments). Resources are also needed for the assembly of data sets, data mining/archeology and cataloguing (e.g. the continuing development of flux and flux-related data sets such as COADS based on Voluntary Observing Ships and other historical data, efforts to remove non-stationary observational biases in historical data, and maintenance of a comprehensive catalogue of flux data sets on the Internet). Finally, the Working Group pointed out that work must be continued to obtain new flux products, to compare and assess the quality of fluxes from various sources, and to evaluate the parameterizations used. Work to enhance the reliability of momentum, net heat and freshwater fluxes by combining the best estimates from the various sources should also be fostered.

The main work is now the organization of a (WCRP/SCOR) Workshop on Intercomparison and Validation of Ocean-Atmosphere Flux Fields in 2001. The workshop is intended to bring together the different scientific communities interested in air-sea fluxes and, as a first step, review the Working Group report, collect feedback from the community as a whole, and provide a wide opportunity to comment on and debate as appropriate the conclusions and opinions of the Working Group. The latest developments in obtaining flux and flux-related parameters from in situ and remotely sensed data, and from model output fields will also be presented. Further studies of uncertainties inherent in various fields are also anticipated. Although primarily concerned with global-scale flux climatologies, the elaboration of flux parameterizations, and ideas for field experiments and collection of high quality flux data will be taken up. Most importantly, the Workshop will attempt to promote further inter-disciplinary consultations, and to encourage feedback and dialogue between the producers and users of surface fluxes and related data. This will be a basis for agreeing on the strategy and internationally co-ordinated initiatives needed to make progress in studying, determining more accurately and making appropriate use of air-sea fluxes. An announcement of the workshop (to be held in Washington, DC, 21-25 May 2000) has been distributed.

An additional important aspect is to build on the expertise and collaboration between atmospheric and ocean scientists, and modelers and observationalists that was established during the TOGA Coupled Ocean Atmosphere Response Experiment (COARE), in particular to pursue the crucial problems of boundary layer parameterization

that had to be solved to achieve accurate coupled-model representation of air-sea fluxes on time- and space-scales important in climate variability. This is allied to the overall requirement to review ongoing research into flux parameterizations and their implementation in data assimilation and satellite retrievals. Other areas where work is needed is on flux variability and the role of this variability in modulating interannual to centennial climatic fluctuations such as the North Atlantic Oscillation, ENSO and other types of climate variability.

Joint WGCM and WGSIP Workshop on Decadal Climate Predictability

The joint WGCM/WGSIP Workshop on Decadal Climate Predictability took place at the Scripps Institution of Oceanography, La Jolla, CA, USA, from 4-6 October 2000. There were about 30 participants from 18 different scientific institutions/groups. The objective of the workshop was to form an overall sense of the "state of the art" in the subject of coupled ocean-atmosphere variability on decadal timescales and to identify prospects for predictability. The workshop included studies of observed and diagnosed variability, model-simulated variability, and various investigations of decadal predictability (and even one actual attempt at prediction). On the whole, it appears that work and understanding in this area is still at an early stage. After a series of presentations on observed variability, simulated variability, and prediction/predictability, three break-out working groups were formed to summarize the status in each of these areas, what is needed to be done, and recommendations/suggestions for future work/activities.

The observations break-out group identified a broad range of needs. In the oceans, the ARGO array offers the prospect of obtaining the type of global coverage needed in the future. Requirements for time-series stations, for surface flux sites, for the assembly of integrated comprehensive data sets (including deep ocean tracers), and for the continuity of altimetry and sea-level records were emphasized. For the atmosphere, reanalysis projects, efforts to deal with data inhomogeneity, the operation of GCOS upper-air, and surface networks were regarded as essential. The requirements for a proper analysis of bulk and skin sea surface temperature data sets were reiterated, as well as for an extensive variety of other parameters (global precipitation; tropospheric water vapor; remotely-sensed soil moisture, ocean salinity and ice thickness). The group also voiced the opinion that "improved data assimilation models without biases" were needed. For an extended analysis of decadal variability in the past, major data rescue/archaeology efforts were proposed, including coperation with WMO/WCP Data Rescue Project (DARE) and the declassification of sea-ice thickness data. Requirements were expressed for a broader exchange, and availability of palaeo-climatic and proxy data sets.

The break-out group reviewing model simulations concluded that the understanding of the dynamics of the thermohaline circulation might now be adequate to embark on decadal predictions provided that initial oceanic conditions could be satisfactorily specified (viz. temperature/salinity in the top 1000m as might be obtained from ARGO). However, the impact of the North Atlantic Oscillation on the export of freshwater from the Arctic remains to be clarified. Improved simulations of overflows and deep (ocean) convection which radically affect temperature/salinity locally were also needed. It was noted that the interaction between ENSO variability on decadal timescales and the thermohaline circulation was not understood. The requirement was expressed for a multi-decadal ocean and/or coupled ocean/atmosphere reanalysis for initializing simulations and hypothesis testing. With regard to the North Atlantic Oscillation, no clear consensus emerged as to the preferred timescale. To the first order, it appears that the atmosphere forces the sea surface temperature via heat flux and Ekman currents. A secondary effect is due to changes in the Atlantic gyre or ocean advection responsible for anomalies. As well as uncertainties in the underlying mechanism for the North Atlantic Oscillation, simulations of response/feedback to the associated sea surface temperature anomalies often differed. Concerning the North Pacific Oscillation (or Interdecadal Pacific Oscillation), understanding is also rudimentary, although there has recently been progress in modelling decadal changes in the North Pacific (hindcasting with coupled models). In the tropical Pacific, coupling to mid-latitudes does not appear to explain much of the variance (temperature/salinity anomalies may be the key, but these anomalies are small). The role of the Southern Hemisphere oceans, if any, is unknown. Decadal variability could also not be separated from global warming - this might itself be responsible for decadal variability and dominate variance. How global warming might interact with "natural" decadal variability is not clear yet. As a basis for further progress, much longer time series

of data and model runs were seen as essential (i.e. reanalyses, palaeoclimatic data, extended coupled model integrations).

The sub-group on predictability also concluded that there appeared to be a possibility of predicting the ocean circulation in higher latitudes (particularly the thermohaline circulation) on decadal timescales (from potential predictability studies and perfect model experiments). Associated variations over land might be predictable also, but only explain a small fraction of the total variance. In the tropical Pacific, some weak evidence of decadal predictability was noted (but the question of how decadal and interannual variability interact is unanswered). There are large areas where there are as yet no firm conclusions and/or a general lack of understanding, namely in the tropical Atlantic, the Interdecadal Pacific Oscillation, the North Atlantic and the predictability of the North Atlantic Oscillation. A first real attempt at a decadal prediction (by the Hadley Centre) achieved only modest results. The predictability sub-group emphasized that a vital first step in making any significant progress from the present elementary position was work on elucidation of potential mechanisms that might underline predictability (including study of particular modes) - understanding of the dynamics involved was very limited. Time-scale interactions (e.g. Interdecadal Pacific Oscillation and ENSO) also needed study. The possibility of a "Historical Decadal Forecast Project" was raised, which would include efforts for an improved understanding of mechanisms, use of initial conditions from atmospheric and oceanic reanalyses (based on data from merging all available observations and model simulations), model developments (in particular sub-grid scale ocean features such as overflow, convection) investigations of ensemble approaches (forecasts from sequential analyses and from different models, historical forecasts (estimates of skill, statistical treatments, probabilistic forecasts). Other areas where work was needed in a better international co-ordination of ocean analysis as basis for initializing decadal forecasts (including quality control of data, obtaining more salinity observations), study of the relative roles of sea surface temperature, sea-ice, vegetation cover, external effects. Another useful step would be to begin to document the potential societal impact of decadal predictions.

The full report of the workshop, including extended abstracts of presentations and summary of main conclusions and recommendations, will be produced as an appropriate WCRP publication.

WGCM-WGNE-WGSIP Panel on regional climate models

This Panel has been tasked to look into the question of the utility of regional climate models. The Panel has noted that the overall issues concerning the application of regional climate models (RCMs) are well addressed in the paper by Giorgi and Mearns in JGR-1999. The report emphasizes the need for "customizing" a model for the particular region for which it is intended to be used and the target application. The Panel noted the concerns regarding the proliferation and use of RCMs without due scientific care and consideration of aspects such as attention to domain size, scaling parameterizations etc. Added value certainly appears in RCMs when driven by well-defined boundary conditions (such as reanalyses) but for climate integrations and seasonal predictions, the added value may be less clear. In either case, RCMs should not be expected to correct the climatology of unsatisfactory global driving models. In all respects, one of the most crucial factors is the performance of the global driving model - and the simulation of modes of natural variability in global simulations (e.g. ENSO, NAO) is usually inadequate. Unless large scale variability is properly represented in the boundary forcing, there can obviously be no confidence of changes in or the variability of local climate simulated by RCMs. The Panel noted unconfirmed information that NSF and DOE will be sponsoring a meeting at NCAR in early April 2001 to address the issues of "Regional Climate Research: Needs and Opportunities").

Reanalysis Conference Proceedings

The proceedings were published some months ago in the WCRP report series (WCRP-109). Present plans for reanalyses are as follows:

NCEP: a second reanalysis for a limited period 1979-1998 is being undertaken using an updated forecast model and data assimilation, improved diagnostic outputs, and including corrections for many of the known problems in

the first NCEP/NCAR reanalysis. This should also provide the bridge to a much more advanced next generation reanalysis planned for about 2003 or later. A regional USA reanalysis is also being prepared.

ECMWF: an ambitious and comprehensive 40-year reanalysis project (ERA-40) for the period 1958-present has begun. A much wider selection of data sources is used in the ERA-40 reanalyses, but the reanalyses may then inevitably reflect the changes in the observing system since 1958. ERA-40 employs a 3DVAR scheme, and a 60-level T159 forecast-model coupled with an ocean-wave model.

NASA/DAO: major upgrades have been made to the data assimilation system (the Goddard Earth Observing System, GEOS) employed in NASA's first reanalysis,. These include a physical-space statistical analysis system and numerous improvements to the forecast model. The revised analysis scheme has the capability of assimilating TRMM and SSM/I precipitation observations. It is planned to produce a reanalysis for the TRMM period with the latest version of GEOS.

Status of ECMWF and NCEP reanalysis

The first year 1986 of the ECMWF 40-year reanalysis ERA-40 is now complete. NCEP continues to be actively interested in reanalyses and, as well as the second reanalysis for a limited period (1979-1998) and preparation for a regional reanalysis. There have been various meetings considering a further global reanalysis. Whilst there is strong support from the scientific community for further reanalyses, there seems less evidence of firm support in terms of resources or of willingness for NCEP to undertake this task. On the positive side Japan Meteorological Agency is examining the possibility of undertaking a reanalysis in two to three year's time. This would particularly focus on the behavior of monsoons and Pacific tropical cyclones.

GEWEX

A recent development in GEWEX that is relevant to the interests of WGSIP is the new organization of studies of land-surface parameterizations. Challenges such as the "greening" of land-surface parameterizations, and a more comprehensive treatment of soil freezing have to be taken into account, bringing new prognostic variables into land-surface schemes. Also, whereas the first generation of land-surface treatments were characterized by a highly detailed representation of vertical processes and simple assumptions on horizontal variability, the new generation would need to increase horizontal complexity and include a representation of the sub-grid scale variability of surface properties. The development of improved land surface parameterization schemes and encouraging their incorporation into general circulation models is being supported by a new structure of complementary scientific activities. The "greening" of land-surface parameterizations, requiring international intercomparisons to validate representations of new features will continue to depend fundamentally on PILPS and its pioneering work in local off-line validation of land-surface schemes (as described above). The Global Soil Wetness Project is another essential element, enabling comparisons of new schemes at a global scale and identification of critical regions in which inadequate treatments and lack of data lead to divergence of results. Two further elements would be, firstly, study of issues of heterogeneity and data assimilation (of particular interest for operational modelling centres), and, secondly, exploration of the impact of land-surface processes on climate through carefully organized and co-ordinated coupled land-atmosphere modelling. In addition to these four scientific activities, a co-ordinated data and model infrastructure for advancing land-surface modelling and analysis should be developed. All these components would be complementary and interconnected under the umbrella of a new "Global Land Atmosphere System Study" (GLASS). Another potentially important activity in GEWEX is the "Co-ordinated Enhanced Observing Period" (CEOP). This was originally conceived as a co-ordinated enhanced observing period by four of the GEWEX continental-scale experiments, involving a year-long effort to collect common data sets from which the impact of soil moisture in the climate system on a global scale could be evaluated and several fundamental land surface/atmospheric interactions could be better understood. It has now evolved into an important activity that could underpin progress in understanding and predicting the climate system, to be undertaken in conjunction with other components of the WCRP, focussing particularly on the source and sink regions forcing or modifying the atmospheric circulation.

WGSIP Panel reiterated the importance of the ongoing interactions with GEWEX and prospects to strengthen this collaboration. Dr. Kitoh gave some details regarding the plan for the GEWEX GSWP-II project. The Panel reiterated that that this project could provide valuable contribution to future phases of WGSIP SMIP project. The Panel agreed to invite one or two experts who are closely associated with GSWP-II project to the next WGSIP meeting, to explore areas of future collaboration.

Developments at the International Research Institute (IRI)

Dr. Zebiak outlined the major developments, which had taken place over the past year at IRI. He noted that the primary emphasis of the IRI mission is to produce useable prediction products through a network of activities. Dr. Zebiak noted the following achievements over the past year:

(i) The present work force of IRI is about 30 people and it is expected to grow significantly in the future.

(ii) The new building for IRI has been completed and all the primary functions of IRI will be moved to the new building.

(iii) The IRI dynamical climate forecast system continues to be improved. The forecasts are based on the ECHAM3.6, NCEP, and CCM3 (NCAR) GCMs. The ECHAM3.6 (T42 with 19 vertical layers) forecasts are forced by prescribed SST. Initial forecast boundary conditions are supplied by "current" AGCM restart files from an integration in which ECHAM is forced with observed SSTA for many years up to the initial conditions of the forecast period. At the beginning of the first forecast, nine sets of restart files are generated, each for a successive model day, to yield nine additional forecast initial conditions. An ensemble of ten forecasts are run every month (prior to April 1996, the persisted forecast was based on ensemble of 6 runs). The NCEP model forecasts are forced by the prescribed SST field. The resolution of the model is T40 with 10 vertical layers. These forecasts are based on an ensemble of 18 runs based on random initial conditions. The NCAR-CCM3 (T42 with 18 vertical layers) forecasts are forced by the persisted SST anomaly forecasts (PSST) or the blended SST anomaly forecasts (BSST). Initial forecast boundary conditions are supplied by "current" AGCM restart files from an integration in which CCM3 has been forced with observed SSTA for many years up through the forecast start date. At the beginning of the first forecast, nine sets of restart files are generated, each for a successive model day, to yield nine additional forecast initial conditions. An ensemble of ten forecasts are run every month. The atmospheric GCM is forced with persisted SST anomaly forecasts (PSST) and/or the blended SST anomaly forecasts (BSST).

Other key components of the forecast system include, the Regional Spectral Model (RCM) and MM4 regional models for downscaling, post processing which performs the multi-model ensembling, and a historical data component for producing extended simulations from 1950 to the present.

(iv) The collaborative Coupled Model Project, which is designed to evaluate the performance of the atmospheric component of the coupled models has been launched. It is a partnership among, the International Research Institute for Climate Prediction (IRI), the Center for Ocean-Land Atmosphere Studies (COLA), the National Center for Environmental Prediction (NCEP), the Geophysical Fluid Dynamics Laboratory (NOAA-GFDL), and the National Center for Atmospheric Research (NCAR), and CPTEC (Brazil). This 2-year project has three milestones:

Six months milestone
- GFDL provides MOM3, conducts ocean analysis with feedback for others
- NCAR/GFDL/NCEP/COLA/IRI configure coupled models
- Hindcasts begin (jan/apr/jul/oct 1980-1999 initial conditions, run to 12 months)
- preliminary evaluation; possible repeats

Twelve months milestone
- Initial forecasts experiments completed

- Outputs generated, made available to all

Two-years milestone
- expand suite to monthly 1980-1999 initial conditions
- ensembles analysed from consecutive monthly initial conditions
- examine air temp, precipitation over continental regions
- ensembles analyzed from consecutive monthly initial conditions
- examine air temp, precipitation over continental regions
- ensembles from single initial conditions for selected IC's (including statistics of high frequency variability)

(v) In the future, IRI focus will include the following issues:
- regional scale resolution, global domain and coupling
- higher order statistics (extreme events, weather sequences …)
- better probabilistic products
- ensemble methodologies
- computing, software, numerical methods to meet these demands.
- technology transfer
- controlled experimentation
- increased collaboration, communication

Other developments mentioned included advancement of an IRI climate information system (Web based), initial applications activities, and recent international training activities.

Global Oceanography Data Assimilation experiment (GODAE)

Dr. Rienecker (NASA, Goddard) gave an update regarding the status of the Global Oceanography Data Assimilation experiment (GODAE). This experiment will involve global system of observations, communications, modelling and assimilation that will deliver regular, comprehensive information on the state of the oceans in a way that will promote and encourage wide utility and availability of this resource for maximum benefit to the community. The GODAE Monterey Server, sponsored mainly by the Office of Naval Research (ONR), is intended to be a principal node in the GODAE architecture. The server will contain, (i) real-time and historical oceanographic observations, (ii) real-time and historical surface atmospheric forcing fields from Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC) and NOAA's National Centers for Environmental Prediction (NCEP) suitable for driving GODAE ocean models, (iii) upper-air fields from FNMOC's Navy Operational Global Atmospheric Prediction System (NOGAPS) model sufficient to meet the needs of the Cooperative Opportunity for NCEP Data Using Internet data distribution Technology (CONDUIT) program, (iv) selected U.S. Navy operational ocean products, (v) ancillary data sets, such ocean climatology and bathymetry, important to GODAE ocean modeling efforts, and (vi) GODAE demonstration products from various GODAE modeling groups. Expected benefits from GODAE include:
- Improved assimilation methodologies: OI, 3DVAR, generalized inverse method, asymptotic Kalman Filter, Ensemble Kalman filter
- Better error covariance models, including data and representation errors, forcing errors, etc.
- The organization and ready availability of quality-controlled observations and surface forcing,
- Assessments of data impact,
- Consistent, global analyses for validation

It was reported that the GODAE project plans to disseminate analyses to a variety of users including SI prediction centres.

NASA (Goddard Space Flight Center) Seasonal-to-Interannual Prediction Project (NASA-SIPP)

The Panel was given an update regarding the status of NASA-SIPP. The project's goal is to develop an assimilation and forecast system based an coupled atmosphere-ocean-land-surface-sea-ice models capable of

using a combination of satellite and in situ data sources to improve the prediction of ENSO and other major S-1 signals and their global teleconnections. SIPP is designed to demonstrate the utility of satellite data, especially surface height (altimeter), air-sea flux observations (scatterometer, microwave) and soil moisture (microwave), in a coupled model prediction system.

The project is based on a 2-tier approach. Tier-1 is based on a coupled ocean-atmosphere-land model. The primary components are, (i) initialization of the ocean with observed forcing (SSMI, scatterometer) and assimilation of SSH and T(z), (ii) initialization of land with observed forcing, (iii) 12-month forecast, and (iv) obtaining ansembles from different ocean states. Tier-2 is based on a coupled atmosphere-land model. The main components are, (i) 120-day forecast ensembles, (ii) use of forecast SST from Tier-1, (iii) initialization of land with observed forcing and assimilation of soil moisture, and snow, (iv) application of a variable resolution model, and (iv) targeting the output for downscaling applications.

The Panel was informed that the recent NASA climate prediction system includes a procedure for assimilating soil moisture

Recent Developments of climate prediction in China

Mr. Zhai, Panmao (CMA/National Climate Center) reported that China has established a National Climate Center in 1995 and launched a key national project on Short Term Climate Prediction. More than 400 scientists have been involved in this project. The project includes five sub-projects, (i) Study of physical processes and signals responsible for short climate prediction; (ii) Development of a dynamical model system for short term climate prediction; (iii) Development of an impact assessment system for climate variability; (iv) Development of a syntheses operational system for short term climate prediction; (v) Establishment of regional climate prediction system and study on application of climate products.

Over a period of nearly five years the following achievements have been made towards the development of the dynamical climate model and operational system, (i) development of AGCM, OGCM, CGCM, RCM, as well as ENSO models, (ii) development of the AGCM (T63L16) based on the NWP model used at NMN, China, (iii) implementation of modifications in the dynamical framework and improvements in the physical parameterization schemes. This model has been used in experimental prediction of seasonal rain belt in East Asia, especially in the Meiyu season, (iv) development of a T63 Global Ocean model, (v) development of a Coupled Atmosphere-Ocean model. The coupled model has no significant climate drift and describes the ENSO events appropriately. This model has been integrated for over 50 years up to now, and (vi) development of an operational ENSO Monitoring and Prediction System.

Another important activity is the regular annual forum between China, Korea and Japan on summer monsoon prediction, which has been going on for many years. This year NCC will host a winter monsoon prediction meeting in Beijing in November. More participants in East Asia region are expected to join this effort.

Dynamical Long-range Forecasting Activities at the Japan Meteorological Agency (JMA)

Dr. Akio Kitoh reported that the Japan Meteorological Agency (JMA) has long been engaged in operational long-range weather forecasting. To support the preparation of one-month forecast, a dynamical ensemble forecast has been operationally conducted since March 1996. The JMA established the El Niño Monitoring Center (now the El Niño Monitoring and Prediction Center) in 1992. It started to issue outlook information concerning the El Niño phenomena to the public in August 1999 based on the prediction of the coupled ocean and atmosphere model.

Now the JMA is developing the seasonal prediction model system based on the ensemble forecast of atmospheric global model with the SST prediction by the coupled ocean and atmosphere model.

Operation one-month dynamical ensemble forecast: The preparation of forecast had mainly been based on statistical and empirical methods until the initiation of one-month forecasting based on dynamical ensemble prediction in March 1996. The JMA introduced the dynamical method to the one-month forecast as a first step to realize the seasonal dynamical forecast. The concept of probabilistic forecast was introduced to the long-range forecast at the same time.

The numerical prediction model used for the ensemble prediction is a T63 version of the Global Spectral Model (GSM9603). The specifications of the model are shown in Table 1. For the lower boundary condition to the model, SST anomalies are fixed during the 30-day time integration. Soil moisture and snow depth are predicted by the model, although their initial states are taken from climatological values.

An ensemble consists of ten one-month forecast members. The ten members are prepared with a combination of the singular vectors (SV) method and lagged average forecast (LAF) method. That is, five forecasts are computed from 1200 UTC initial fields on Wednesday and the remaining five from 1200 UTC on Thursday. Singular vectors are calculated with a T21L2 hemispheric balance model, and growing perturbations are determined for the first two days of the forecast period. The perturbations, whose amplitudes vary by month according to a function of climatological variance of the atmosphere, are added to the initial fields only in the Northern Hemisphere.

A model systematic bias was estimated as an average forecast error, which was calculated from hindcast experiments for years of 1989 to 1994. The bias is removed from forecast fields, and then grid point value are processed to produce several forecast materials (ensemble mean map, spread map, time sequences figures etc.). Objective guidance products of forecast elements are also derived from the ensemble forecast by the Perfect Prognosis Method (PPM).

El Niño monitoring and prediction: Monitoring: In 1995, an Ocean Data Assimilation system (ODAS) was developed to comprehensively monitor ENSO-related phenomena below the sea surface. Its Ocean General Circulation Model (OGCM) has a horizontal resolution of 2.0 degrees in latitude and 2.5 degrees in longitude except near the equator where the latitudinal grid spacing is reduced to 0.5 degrees. It has 20 levels in the vertical and most of them are placed in the upper 500 m.

The OGCM is forced with daily averaged value of surface wind obtained from the JMA operational atmospheric data assimilation system. All available subsurface thermal data are used in an ocean analysis, which is performed every five days using a two-dimensional optimal interpolation methods. A forecast field of the OGCM is used as a first guess for the analysis. The model subsurface temperature is relaxed to the analysis field by nudging. The model SST is relaxed to an SST analysis obtained independently from the system. On the other hand, the model salinity is relaxed to a climatological field. An assimilation method of TOPEX/POSEIDON sea surface height observations and a three-dimensional objective analysis method are now under development.

Prediction: JMA has been developing an coupled ocean-atmosphere model for El Niño prediction. The model consists of an Atmospheric General Circulation Model (AGCM) and the OGCM, which is the same as in the ODAS. The AGCM is a global spectral model with a horizontal resolution of T42 and 21 levels in the vertical. Initial conditions for the ocean are obtained from the ODAS. Currently no adjustment is carried out to reduce the imbalance between the atmospheric and oceanic initial states. Heat and momentum flux corrections are applied to forecast fields in order to suppress climate drifts in the prediction. The coupled model is integrated forward for 17 months twice a month. In August 1999, the JMA started to issue outlook information concerning the El Niño phenomena to the public every month. The outlook information is based on an ensemble prediction of six members.

Development of the seasonal forecast model system: Predictability study by experimental seasonal model runs with the observed SST. The JMA aims to introduce dynamical methods into the operational seasonal forecast (now the preparation of seasonal forecast is mainly based on statistical and empirical methods except for one-month forecast). As the pilot study, JMA carried out seasonal prediction experiments with an atmospheric model

forced by observed SST. The averaged forecast skill of this type of experiments will give us the information of maximum skill of seasonal forecast using a coupled ocean-atmosphere model as they are the case when SSTs are predicted perfectly.

This experiment started as a contribution to the Seasonal prediction Model Intercomparison Project (SMIP) organized by the Climate Variability and Predictability (CLIVAR) programme Numerical Experimental Group in support of seasonal to interannual prediction studies (CLIVAR NEG-1) of the WCRP. The experiment plan was extended to apply for many cases (every season, 15 years from 1979 to 1993) in the same way as PROVOST project in Europe. The atmospheric model used in the experiment is the same as operational one-month forecast model of JMA (T63L30). Time integrations were made for about 120 days. Each prediction consists of 9 members.

Development if seasonal prediction model system: Now JMA is developing the prototype of seasonal prediction system, which consists of an atmospheric model for ensemble runs and a coupled ocean-atmosphere model which provide the atmospheric ensemble forecast with SST prediction. At present the SST anomalies used as the lower boundary condition of the atmospheric model are provided by the coupled model in the equatorial region but by persistence or climatology in the middle or high latitude regions.

Now, the real time ensemble seasonal prediction (up to 4-8 month ahead) is performed every month in an experimental mode. The JMA plans to introduce a new super computer system (the peak speed of it is 768 G Flops) in 2001. On the new system, dynamical seasonal forecast is planned to be executed in an operational mode.

Links with the applications global change projects

Dr. Semazzi informed the panel 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 change projects.

Climate Prediction and Agriculture (CLIMAG): The goal of CLIMAG is to utilize 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 Nino although, subsequent hindcasts of the 1997-98 El Nino event are more encouraging. Some of areas of initial cooperation between CLIVAR and CLIMAG that were discussed include, (i) assessment of current climate conditions from agricultural standpoint, (ii) assessment of regional seasonal climate variability and predictability, (iii) 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 (iv) cooperation of CLIVAR and CLIMAG in capacity building activities.

At a recent international workshop on Climate Prediction and Agriculture (CLIMAG), Geneva, Switzerland, September 27- 29, 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 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 Socio-economic Consequences of Adapting Food Systems. It is envisaged that the project will likely be implemented as a set of commissioned studies within the context provided by questions that frame the study. A 6-person Planning Group, with members representing the broad interests of the co-sponsors, has being 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 meeting, Reading, UK 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 (Focus 2; February 2001) and Washington-USA (Focus 3; April 2001). 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): Dr. Neil Ward reported that 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 need to understand the variability and predictability of the marine ecosystem.

Discussions for closer cooperation have evolved around a number of themes. There is 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 uncover 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 modelers, 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 has encouraged ICPO to continue the ongoing efforts to strengthen existing links and explores new ones with the customers of the developments taking place under the CLIVAR banner. The SSG recommended that the collaboration with CLIMAG, GECaFS, and GLOBEC should proceed in association with the overall WCRP structure.

3.3. Reports on initiatives undertaken by WGSIP

Topics that were taken up under this agenda item included consideration of the status of the initiatives inherited from CLIVAR NEG-1, as well as a number of new issues and activities (including points raised by the CLIVAR Scientific Steering Group).

NINO3 intercomparison project

Dr. Kirtman gave a summary of the outcome from the CLIVAR Intercomparison of NINO3 prediction and predictability project which was recently completed. A report on the project main is found at the CLIVAR website [http://www.clivar.org/]. The purpose of this comparison project was to assess the current state-of-the-art in predicting tropical Pacific sea surface temperature anomalies (SSTA). In order to make this assessment, retrospective forecasts of NINO3 (150-90 W, 5S-5N) SSTA made by various research groups have been compared. Six dynamical (of various degrees of sophistication) prediction systems and one statistical prediction systems are considered here. The retrospective forecasts have been compared in terms of their correlation and root mean square error with respect to observations. Hit rate and false alarm rates are also compared. Remarkably, a forecast developed as a consensus of at least three separate prediction systems is arguably more skillful than any of the individual prediction systems.

Comparisons have also been made to determine how well the models forecast the various phases of ENSO. Both the dynamical and statistical models produce useful forecast of the peak phase of the extreme warm and cold events up to two seasons in advance. However, none of the models adequately capture the detailed life cycle of the ENSO events nor are the models particularly good at predicting the timing of the onset of El Niño events. The period of retrospective forecasting is too short to adequately distinguish among the various models in terms of the correlation coefficient and the root mean square error.

A number of different unsuccessful attempts to measure the uncertainty in the forecast are described. These techniques try to relate the consistency of forecasts initialized one month apart to the error of the forecast. This approach fails because the forecasts initialized one month apart can be very consistent, but also can have large errors. Better ensembling techniques need to be developed to accurately measure the uncertainty in the forecasts.

Collection of ENSO forecasts in Quasi-real time

Dr. Kirtman gave a report on the 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 Forecast Bulletin (ELLFB). Data collection has begun and prototype web pages under development.

Study of Tropical Oceans In Coupled models (STOIC): Study of the variability of the tropical oceans on seasonal and interannual time scales other than ENSO

The group was given an update on the status of STOIC project, which was recently completed. STOIC is a companion project to NINO3 forecast comparison project (see above). It addresses the variability of the tropical oceans on seasonal and interannual time scales other than ENSO. The STOIC analyses extend beyond the equatorial Pacific, to examine behavior in all three tropical ocean basins. 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 has been published in the Exchanges (September 2000). Overall, the results show that the equatorial oceans are still a major problem area for coupled models. Pacific SST remains the main climatological error, but there are also substantial biases in the other oceans. Surface wind stress is a major common problem with regard to the seasonal cycle in all ocean sectors and levels of variability in the Pacific. As the errors also arise for models in

the 'adjusted' group, which generally have an SST climatology kept close to that observed, these errors cannot simply be attributed to coupled drift.

The 20-year samples used for STOIC and ENSIP seem to be adequate for assessing annual mean and seasonal cycle behavior; particularly as the model biases are large and gross errors are readily apparent. The samples also seem adequate for assessing the dominant features in patterns of variability, and for determining gross errors in levels of variability. However, the reliability of quantitative results is questionable, as the statistics of both models and observations vary on decadal and longer timescales.

Seasonal Prediction Model Intercomparison Project (SMIP-1 & SMIP-2)

The Seasonal Prediction Model Intercomparison Project (SMIP) which begun in 1986 and involved 8 models was completed recently. SMIP was based on 4-month ensemble forecasts. The study involving 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.

Plans for a follow-on project SMIP-2 to phase 1 (SMIP) were summarized. The Panel has approved the new project. SMIP-2 will involve 15 cases (years) compared to SMIP-1 that was done only for 4-selected summer and 4 winter cases. Participating groups will produce ensemble seasonal predictions from AGCMs with observed initial conditions and prescribed boundary conditions. Again, PCMDI has agreed to act as clearing house for the model predictions, and to provide its comprehensive facilities for storing data sets, generating diagnostics and displaying results. The main attributes of SMIP-2 are briefly summarized below.

- Seven-month ensemble integrations of atmospheric GCMs with observed initial conditions and observed (prescribed) boundary conditions
- 21 years from 1979 to 1999 and 10 case ensembles
- Initial Conditions (I.C.)
  00Z & 12Z of 24, 25, 26, 27, 28 February
  00Z & 12Z of 27, 28, 29, 30, 31 May
  00Z & 12Z of 27, 28, 29, 30, 31 August
  00Z & 12Z of 26, 27, 28, 29, 30 November
- Each model will determine its own best atmospheric initial conditions (e.g., NCEP reanalysis, ECMWF reanalysis, or their own analysis)

We recommend option 1. Please identify how land conditions are initialized

- The data should be prepared with the LATS (Library of AMIP data Transmission Standards) format as in AMIPII. LATS can be obtained through the SMIP web page.

Other details regarding the design of SMIP-2 are available at (http://www-pcmdi.llnl.gov/smip/).

Intra-seasonal variability (model comparison for all India rainfall indices & monsoon-related fields)

WGSIP was informed that the analysis which previously (see last years report) covered 4 models had now been extended to include other SMIP models. Dr. Sperber gave an outline on the status of intercomparison. The results based on the expanded pool of models confirm the earlier results. In the expanded analysis, the goals include: (1) ascertain the ability of atmospheric GCMs to hindcast the summer monsoons of 1987, 1988, and 1993, (2) to determine how well the models represent the dominant modes of subseasonal variability of the 850hPa flow, (3) to determine if the models can represent the strong link between the subseasonal modes of variability and the rainfall, (4) to determine if the models properly project these modes onto interannual timescales, (5) to determine if it is possible to objectively discriminate among the ensemble members to ascertain which members are most reliable.

To varying degree the models represent some but not all of the dominate modes of subseasonal variability during the Asian summer monsoon. For the afore-mentioned modes, the models usually represent the subseasonal link between the 850hPa flow and the rainfall. However, in most cases the models do not properly represent the projection of these modes onto the interannual variability. Consequently, the hindcasts are typically poor. When an ensemble member qualitatively represents the seasonal projections of the individual modes, then that member gives a more realistic representation of the observed seasonal anomalies of 850hPa wind and precipitation. The converse is also true. At least 2 possible causes exist for the poor performance of the hindcasts. These include: (1) the strong spin-up due to the initial shock of using observed initial conditions (not shown) which are out of balance with the usual parameter space of the model, and (2) systematic errors of the model climatologies need to be reduced since this is associated with the improper simulation of remote teleconnections.

Intercomparison of the simulations of Monsoon variability and predictability

Dr. Kang gave an update regarding the CLIVAR/Monsoon AGCM Intercomparison, which was initiated by the CLIVAR Asian-Australian Monsoon Panel. The atmosphere anomalies for the 1997-98 ENSO period simulated by a number of GCMs have been analyzed and intercompared using the data from the Monsoon GCM Intercomparison project initiated by the CLIVAR/Asian-Australian Monsoon Panel. Eleven GCM groups such as COLA, DNM, GEOS, GFDL, IAP, IITM, MRI, NCAR, NECP, SNU, and SUNY/GLA participate in the intercomparison. Each participating GCM group has performed a set of 10 ensemble simulations for 1 September 1996 - 31 August 1998 using a same SST condition but different initial conditions (see table below). The study is aimed at presenting an overview of the present intercomparison project and the intercomparison results of global atmospheric anomalies during the 1997-98 ENSO period, particularly focusing on the tropical rainfall anomalies over the Monsoon-ENSO region and the upper tropospheric circulation anomalies in the Pacific/North American (PNA) region.

The simulated precipitation anomalies show that all of the models simulate reasonably well the spatial pattern of the observed ENSO anomalies in the tropical central Pacific, although their amplitudes show large differences between the models. On the other hands, most of the models except GFDL and NCEP have a difficulty in simulating the negative anomalies over the Maritime continent during the ENSO. The 200hPa geopotential anomalies over the PNA region are reasonably well reproduced by most of the models. However, the models generally underestimate the amplitude of the PNA pattern. In particular, the PNA pattern simulated by the models such as IAP and MRI are significantly weaker than the observed, and those weak amplitudes are related to the weak precipitation anomalies in the tropical Pacific. It is also noted that the tropical precipitation anomalies are closely related to the SST anomalies not only for the ENSO seasons but also for the normal seasons with weak SST anomalies in the tropical Pacific. In particular, the pattern correlation values of the 11 model composite with the observed counterparts for the normal seasons are near 0.5 for the tropical region between 30S and 30N.

Monsoon intercomparison experiments

Experiment	Integration Period	Boundary Conditions		Note
		SST	Sea Ice	
'97-98 Ensemble Experiment	1 Sep 1996 ~ 31 Aug 1998	Weekly Mean OISST (NCEP)	AMIP II Climatological Cycle	10 member ensemble simulations with different Initial conditions
Observed SST Run (AMIP II)	1 Jan 1979 ~ 31 Aug 1998	AMIP II Monthly Mean		OISST After Mar 1996
Climatological SST Run	1 Jan 1979 ~ 31 Aug 1998	AMIP II Climatological Cycle		

Theoretical study of the role of IC on climate predictability

Dr. Richard Kleeman reviewed his recent work concerning the role of initial conditions on interannual climate predictability. By asking the question of what determines reliability or utility of a climate forecast the results show that factors that are responsible for uncertainty in NWP are different from those in climate predictions. The results based on BRMK ensemble forecasts show that for a large signal in the initial conditions (IC) the spread in the forecasts is strongly related to the amplitude of the signal in the initial conditions. The future of this project will test the theory using other models.

Ocean Models Intercomparison Project (OMIP)

Dr. Pascal Delecluse outlined the current status in the planning of a CLIVAR/WGSIP Ocean models intercomparison experiment.

It was agreed that Dr. Pascale will invite scaled-down contributions to a simplified OMIP pre-project; requesting particular figures produced from proposed experiments. This represents a scaled down version of the project that was proposed at the previous WGSIP session (Bologna, 1999) which was subsequently found to be impractical due to lack of resources and enthusiasm in the community to undertake a project on a scale that was originally envisioned. The revised pre-project will evaluate the desirability of moving to a more thorough experiment.

Regional Climate Models and downscaling

In the discussion on this issue WGSIP acknowledged that, (i) downscaling of SIP is important for applications, (ii) a sound knowledge base exists regarding techniques for downscaling in NWP but not in SIP, (iii) that several ongoing projects, such as PIRCS, are examining the question of dowscaling (iv) downscaling techniques can be used to improve understanding of SIP and, and (v) there is need to exercise caution in the application of various downscaling methods.

The group was informed that a panel dealing with various research issues concerning Regional Climate Models (RCMs) had been set up by the CLIVAR JSC, although this has not yet met. Also an April 2001 Workshop is being planned at NCAR, which could affect the need for the proposed WGSIP Workshop – the organizer is Dr Lung of PML and DOE is involved. Discussion was held on the possibility of undertaking a coordinated experiment with RCMs to provide an overview of the capabilities of these models by using boundary conditions

from the DEMETER, DSP2 and SMIP2 projects. Representatives of these projects were not convinced of the possibilities.

It was decided that a statement from WGSIP on the state of the art regarding RCMs to advise those planning to use RCMs for research/operations, will be produced. This statement will contain a strong cautionary element. However it was considered that his statement would not be sufficiently weighty because of lack of expertise in the area within WGSIP. This will be addressed through an appropriate invitation in 2001.

Status on the overall review of WGSIP intercomparison projects

The Panel conducted a "self-review" of recent NEG1 and WGSIP activities. In part this review was in reaction to the emerging perception that MIPS (are expensive to run) and there are possibly too many of them in comparison to the returns measured in terms of model improvements. It was acknowledged that MIPS have produced positive impacts on decisions that have lead to various important improvements of models. Examples include, (i) detection of universal model deficiencies, (ii) non-flux corrected models are giving similar variability as flux corrected model, (iii) prioritizing model physics problems, (iv) climate model evaluation of IPCC has benefited from MIPS-based approach. It was further acknowledged that WGSIP should consider the development of clear definitions of why MIPS are performed.

The group considered initial ideas for a set of standardized model outputs and evaluation metrics, and how these could reflect "user" needs. It was decided that a subgroup of WGSIP would consolidate and prepare draft for this initiative. WGSIP expressed the wish to explore the possibility of establishing a web-based repository, perhaps hosted by CLIVAR, which can document the standards, and hold the key output diagnostics (not the raw model data!) to the ever-growing sets of model experiments. It is envisaged that this would provide a dynamic resource that continually serves the scientific and applications needs.

It is judged preferable at this point to pursue two distinct paths: one where multiple model ensembles, downscaling methods, data assimilation methods, coupling strategies are utilized to define better products from existing models/methods; and another where specific science questions dictate the experimentation, such as, cases of unsuccessful forecasts, or focus on specific phenomena such as intraseasonal variability impact on seasonal-interannual prediction/predictability.

Climate prediction research activities in Argentina

The participants from Argentina presented highlights of some of the ongoing climate prediction research activities in the region. The summary also included a description of potential climate prediction applications in the region. One of the highlights is a study investigating the relationship between river systems in South America and the conditions over the surrounding ocean basins. The results show a distinct correlation pattern between the tropical Pacific SSTs and river flow that is consistent with the well known pattern of the ENSO signal. The results of CCA analysis on the Atlantic, Pacific, and 68 rainfall stations over the Rio de la Plata basin reconfirms the strong association between the Pacific SSTs. Another project also based on CCA regression analysis to predict rainfall in Argentina is showing high potential. In future the intentions are to shift more toward techniques based on dynamical methods supported by collaboration with the international community. Part of the presentation covered ongoing multination research partnership among the countries in South America for the purpose of advancing knowledge of regional climate variability and change.

Climate events of the past year

Dr. Neil Ward reviewed the global state of the climate over the past year and in particular the drifting of the climate out of the La Nina conditions. Highlights of the significant climate events included, the December 1999 severe flooding in Venezuela, the flooding in Mozambique, and the unexpected severe drought in West Africa. It was agreed that this kind of presentation should be continued in the future along with the real time ENSO forecasts coordinated by Dr. Ben Kirtman.

WGSIP membership

The membership of WGSIP was reviewed particularly with regard to the expanded needs in the areas of regional climate modeling and land processes, and replacement of members who are about to rotate off the Panel. It was agreed that further discussion of this issue by the panel would be pursued by email since all the members of WGSIP were not present at the meeting to provide their input.

4 Next WGSIP session

It was agreed that the next session of WGSIP will be held 6-8 November in Budapest.

Appendix A

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