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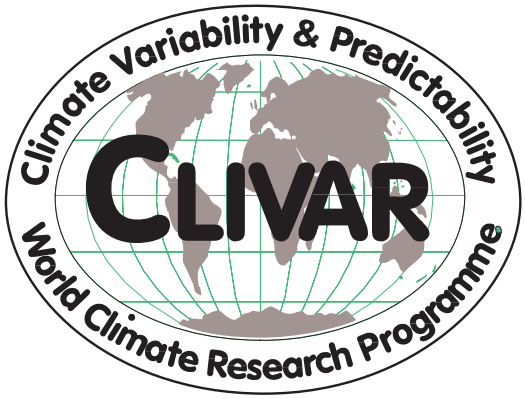

Report of the Tenth Session of the CLIVAR Working Group on Seasonal to Interannual Prediction (WGSIP)

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Summary of actions

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- Continue and develop collaboration with VAMOS (Kirtman) [2.3.1]

- Seek to reinvigorate AAMP-WGSIP interactions, including WGSIP representation on AAMP (Cattle) [2.3.2]

- Coordinate with both WGOMD and the Pacific Panel on assessment of COREs (Power, De Witt, Stockdale); maintain links to PUMP (DeWitt) [2.3.4]

- Clarify how the Atlantic Panel sees its collaboration with WGSIP developing (P Nobre) [2.3.4]

- Explore potential for links with IOP (H Cattle, T Stockdale) [2.3.5]

- Explore how WGSIP can best input to the CCl Expert Team on El Nino and La Nina with CCl involving the JPS for WCRP as necessary (H Cattle, M Harrison) [4.1.1]

- Action: Take issues raised by Dr Harrison's paper to JSC XXVII as part of TFSP presentation (B Kirtman). Redraft and distribute white paper (M Harrison) [4.1.2]

- Monitor topics for applications interface for future WGSIP work (e.g. downscaling, calibration, verification) (A Morse) [4.1.2]

- TFSP/WGSIP Workshop:
    - Meeting foci on temperature and rainfall prediction
    - Special emphasis on applications
    - Potential applications member of organising committee
- (Boer, De Witt, Kirtman, Stockdale, Morse, All) [4.1.2, relevant to 5.2]

- Dr C-K Park to join the TFSP/WGSIP Workshop organizing committee. M Harrison/A Morse to consider what user representation might be added. [5.2]

- Finalize TFSP data strategy (T Stockdale and the TFSP data management sub committee) [5.3]

- Provide link from CLIVAR WGSIP webpage to COPES website pointer to TFSP datasets (ICPO) [5.3]

- An SMIP2 letter to be distributed to the community announcing data availability at IRI, with new data at be submitted to COLA and calling for diagnostic subprojects. The SMIP2 Panel should ensure links to DEMETER, CFS and GFDL. (G Boer, B Kirtman, D DeWitt, ICPO) [6.1]

- Encourage VACS to use WGSIP datasets for skill assessments (W Landman) [6.2]

- GLACE - seek to modify proposal to meet WGSIP suggestions/concerns (Koster) and seek commitments (noting that WGSIP groups are encouraged to take part and should notify GLACE-2 accordingly (All)) [6.3]

- GEWEX/GCSS Pacific transect data from WGSIP – submit CFS data (Pan); check the status of the experiment, deadlines for submission etc and circulate WGSIP members to stimulate input (Pan, De Witt) [7.1]

- Circulate C20C meeting announcement and encourage participation (Kirtman) [7.2]

- Assess scientific needs for data assimilation for SI prediction, including OSSEs in consultation with experts; plan special session on OSSEs/OSEs at the next WGSIP meeting, with invited experts (DeWitt, Stockdale) [9.1]

- ICPO to explore issues related to SI data information [9.2]

- Consider WGCM/WGSIP cross membership (Stockdale, Kirtman); encourage assessment of IPCC-class models in and SI context (All). Consider TFSP/WGSIP contributions to any future IPCC assessment (Kirtman) [9.3]

- Consider feasibility of developing WGSIP verification standards for SI modellers (Harrison, Power, Sugi/Ose) [10]

1. Welcome and opening remarks

The 10th session of the CLIVAR Working Group on Seasonal to Interannual Prediction (WGSIP, previously known as CLIVAR NEG-1) was held at the National Institute of Water and Atmospheric Research (NIWA), Wellington, New Zealand from the 13-16 February 2006. Dr J Renwick of the NIWA acted as local host for the meeting. Drs B Kirtman and T Stockdale (co-chairs of WGSIP) opened the session and welcomed the Panel members, invited experts, and local participants. Dr H Cattle, Director of the International CLIVAR Project Office (ICPO), also extended his welcome on behalf of CLIVAR and the ICPO as did Dr Renwick on behalf of NIWA. A list of participants at the meeting can be found at Annex B. The meeting agenda is at Annex A.

2. Review of relevant developments and activities

2.1 Report from the International CLIVAR Project Office (ICPO)

Dr Cattle provided a brief overview of the role of CLIVAR within the World Climate Research Programme, including how it contributes as one of WCRP's core projects to the WCRP's ten year strategic plan "Coordinated Observation and Prediction of the Earth's Climate System" (COPES). He reminded participants of the outcomes of CLIVAR SSG-13 and the CLIVAR assessment (see the report of WGSIP-9 at http://eprints.soton.ac.uk/19334/01/icpo_pub_104.pdf). He also provided a brief outline of the functions, activities and staffing of the ICPO.

2.2 Report from the CLIVAR SSG Executive meeting, 2005

Dr Cattle next covered the WGSIP-related issues arising from the meeting of the CLIVAR Scientific Steering Group (SSG) Executive held at the European Centre for Medium Range Weather Forecasts (ECMWF), UK from 15-16 September 2005 and which Tim Stockdale attended for WGSIP-relevant items. Issues discussed relevant to WGSIP included:

- Regional analysis of global model runs and how to encourage these in a WGSIP context
- Observations and prediction including the need to address Observation System Simulation Experiments (OSSEs) and the specific request to WGSIP to consider, and perhaps make a short statement on, the prospects for OSSE-type experiments (to test the impact of specific observations on forecast skill) in the coming years.
- The activities of the JSC Task Force on Seasonal Prediction (TFSP)
- Links to the Commission for Atmospheric Systems (CAS)/WCRP Joint Scientific Committee (JSC) Working Group on Numerical Experimentation (WGNE) and the JSC/CLIVAR Working Group on Coupled Models (WGCM), in particular on the issue of how IPCC-class models perform in seasonal mode.

Dr Cattle then outlined the key agenda items for the forthcoming JSC-XXVII meeting (Pune, India, 6-11 March 2006) and the CLIVAR SSG meeting (Buenos Aires, Argentina, 19-22 April 2006) and the inputs that WGSIP was requested to make towards these, to be provided through the outcomes of this meeting.

Action: Provide inputs to the JSC XXVII meeting from WGSIP-10 outcomes (Kirtman, Stockdale, Cattle)

2.3 Reports from CLIVAR regional panels

2.3.1 CLIVAR Variability of the American Monsoon System (VAMOS) Panel

Dr Kirtman reported on the approach which VAMOS is taking to modeling and data assimilation. A draft modeling plan has been written. The VAMOS modeling strategy integrates across all three of the VAMOS programmes:

- North American Monsoon System (NAME)

    - Improving Warm Season Precipitation forecasts over North America: Multi-Scale (Tiered) Approach
- Monsoon Experiment for South America (MESA)
    - Better understanding and improved simulation and prediction of the South American monsoon system and its variability: Multi-Scale Approach.
- VAMOS Cloud Atmosphere Land Study (VOCALS)
    - Improved Understanding, Model Simulations and Predictions of the South Eastern Pacific: Multi-Scale Approach

The VAMOS modeling programme includes model assessment, hypothesis-driven numerical experimentation and, following the US Climate Process Team mechanism, model development and improvement. Science themes cover sea surface temperature (SST) variability in the Pan-American seas; monsoon maturation, onset and demise; improving the prediction of droughts and floods; the diurnal cycle of precipitation and clouds; resolution and model physics issues and wider problems relevant to American monsoon modeling, including

- Poor simulation of warm season continental climates
- Poor simulation of diurnal cycle (related to above)
    - Low Level Jets
    - PBL Processes, Stratus Clouds
    - Mixed Layer
- Poor predictions of warm season precipitation.

Prediction issues include:

- Role of SSTs (especially other than ENSO)
- Role of land surface feedbacks (strength, time scales)
- Role of intraseasonal variability (e.g. Madden Julian Oscillation (MJO))
- Seasonal differences in predictability
- Current level of skill

The VAMOS modeling plan, currently being finalized, also addresses links to e.g the NOAA Climate Test Bed, other CLIVAR panels and working groups and to the WCRP Task Force on Seasonal Prediction (TFSP) activity (see sections 5.2 and 5.3). Once complete, the plan will go to the CLIVAR SSG for approval.

Action: Continue and develop collaboration with VAMOS (Kirtman)

2.3.2 CLIVAR Asian-Australian Monsoon Panel (AAMP)

Dr Kirtman next outlined WGSIP's interactions with AAMP. He noted that key issues in Asian-Australian monsoon predictability and variability include:

- ENSO-Monsoon interactions
- Monsoon predictability
    - Extreme Events, variations in predictability, forecast skill, …
- Air-sea interactions in surrounding seas
    - Role of ocean dynamics in Western Pacific and Indian Oceans
    - Importance of coupled feedbacks
- Atmosphere-land interactions
- Systematic errors
    - Model improvements
    - 1-Tier vs. 2-Tier prediction systems
- Interactions with modes of variability
    - Diurnal cycle, intraseasonal variability, IOZM, PDO, AO,…
- Aerosols, land use change, changing climate

These emphasise the need for coordinated WGSIP-AAMP efforts. Dr Kirtman suggested that these be built around the following two key areas, which Dr Kirtman had presented to the the last meeting of the AAMP when it met in Irvine, Ca, USA in June 2006 (see the report of AAMP-7 at: http://eprints.soton.ac.uk/41422/)

- Rigorous evaluation by AAMP of seasonal and sub-seasonal prediction skill in current (and future) model experiments
    - WGSIP SMIP/HFP, APCC, TFSP, DEMETER, ENSEMBLES

- Studies of monsoon predictability and variability
    - Air-sea feedbacks in surrounding seas
    - Land-atmosphere feedbacks
    - Impact of aerosols

Action: Seek to reinvigorate AAMP-WGSIP interactions, including WGSIP representation on AAMP (Cattle)

2.3.3 CLIVAR Variability of the African Climate System (VACS) Panel

Dr Cattle provided a brief overview of VACS activities (but see section 6.2 also). Much of the VACS emphasis has been on the African Monsoon Multidisciplinary Analysis (AMMA) programme which is now in its field phase. AMMA, which is co-sponsored internationally by both CLIVAR and GEWEX (amongst others), held its first international conference in Dakar from 28 Nov-2 Dec 2005. Future VACS activities include focus on East African climate variability and Southern Africa (see 6.2). VACS are currently planning a workshop in Tanzania (July 2006) to address issues relating to the Prediction and Predictability of the Climate of Eastern and Southern Africa. The VACS panel is also concerned with interannual modes in the Indian and Atlantic Oceans such as the Indian Ocean Zonal Dipole Mode and the Benguela Niño and Atlantic zonal gradient and meridional gradient modes – these impact significantly on the climate and fisheries of various regions of sub-Saharan Africa. They are also points of collaboration between VACS and the Atlantic and Indian Ocean panels.

2.3.4 CLIVAR Pacific Panel

Dr Cattle continued with an outline of the agenda for the meeting of the CLIVAR Pacific Panel which was meeting parallel to WGSIP in Hawaii, USA, from 15-17 February 2006. The Panel has been reconstituted with Axel Timmermann as chair. Scott Power, who is now a member of the Panel would represent WGSIP at the meeting. There is a clear need for strong links between the Panel and WGSIP, in particular because of the Panel's increased emphasis on ENSO but also from the perspective of links to the Pacific Upwelling and Mixing Physics (PUMP) activity. There is also a need to coordinate with the Pacific Panel on the CLIVAR Working Group on Ocean Model Development (WGOMD) Core Ocean and sea ice Reference Experiments (CORE) for which the assessment of the representation of the Pacific is a key issue both for the Panel and WGSIP.

Action: Coordinate with both WGOMD and the Pacific Panel on assessment of COREs (Power, De Witt, Stockdale); maintain links to PUMP (DeWitt)

2.3.5 CLIVAR Atlantic Panel

Dr Cattle next outlined the recent activities of CLIVAR's Atlantic Panel. The Panel has 3 key foci:

- Tropical Atlantic variability
- Decadal Atlantic variability and the THC
- The Atlantic sustained observing system

A particular activity had been the development of plans for a Tropical Atlantic Climate Experiment (TACE) as an enhanced monitoring study. The Panel had also recently:

- Set up a review of PIRATA jointly with the Ocean Observing Panel for Climate (OOPC)
- Promoted a VAMOS-Atlantic Panel south-western TACE now known as WAVEs (south Western tropical Atlantic climate Variability Experiment – see Section 7.3 below).

The Panel has also been active in promotion of coordinated activities in North Atlantic: (including RAPID, ASOF, CLIMODE and DAMOCLES) to assess abrupt changes in the Atlantic large scale circulation. It also seeks collaboration with WGSIP (and with the joint JSC/CLIVAR Working Group on Coupled Modelling (WGCM) and the CLIVAR Working Group on Ocean Model Development (WGOMD) in order to contribute to the design of appropriate numerical experiments and implement the requirements for data sets needed to validate and initialize models. As yet, WGSIP did not feel that the mechanisms for this are yet in place. The Atlantic Panel's intentions in this regard need to be clarified therefore. WGSIP members noted that Dr P Nobre is to be invited to membership of the Atlantic Panel, providing a direct link to between the Panel and WGSIP.

Action: Clarify how the Atlantic Panel sees its collaboration with WGSIP developing (P Nobre)

2.3.5 AAMP Indian Ocean Basin Panel

Dr Cattle finally gave a brief presentation on the activities of the Indian Ocean Panel (IOP) the focus for which had been the development of an Implementation Plan for the Indian Ocean Climate Observing System. The plan, recently published, has been developed with the aid of scientists from the Indian Ocean region. It can be accessed from http://eprints.soton.ac.uk/20357/01/IOP_Impl_Plan.pdf.

In discussion, it was recognized that there are, as yet, no strong links between WGSIP and the IOP. There may be benefit in doing so. This needs to be explored.

Action: Explore potential for links with IOP (H Cattle, T Stockdale)

3. Review of national and regional activities

3.1 Reports from regional or national CLIVAR committees

3.1.1 Japan

Dr M Sugi provided a brief report covering the Japanese 25 year reanalysis project which is based on collaboration between the Japan Meteorological Agency (JMA) and the Central Research Institute of the Electric Power Industry (CREPI). The project, running from 2001-2005 had the objective of productin a high quality climatological dataset to enhance seasonal prediction and climate studies. Dr Sugi also illustrated results from a high resolution atmosphere-only model runs on the Earth Simulator aimed at studies of how climate change affects typhoons and from an aquaplanet version of a global cloud resolving model at 3.5 km resolution which demonstrated intraseasonal variability.

3.1.2 US CLIVAR

Dr Kirtman provided the group with a briefing on the reorganization which had taken place within US CLIVAR. There are now three panels:

- Process studies and model improvement (PSMI)
- Predictability, predictions and applications interface (PPAI)
- Phenomenology, observations and synthesis (POS)

There are also opportunities for limited life working groups for specific tasks. International participation in these is possible. Dr Kirtman outlined the nature of each of the panels The PPAI

panel is of particular relevance to WGSIP. Its mission is to "*foster improved practices in the provision, validation, and uses of climate information and forecasts through coordinated participation within U.S. and international climate science and applications communities*". It has the following goals:

1. Further fundamental understanding of climate predictability at seasonal to centennial timescales
2. Improve provision of climate forecast information, particularly with respect to drought and extreme events
3. Foster research and development of predeiction systems for climate impacts on ecosystems
4. Enable use of CLIVAR science for improved decision support.

Further information can be found via http://www.usclivar.org.

3.1.3 Canadian CLIVAR Network

Dr G Boer provided a summary of the Canadian CLIVAR Network which is now coming to closure. There were some 23 principal investigators involved, plus graduate students, postdoctoral follows etc from 10 universities and 3 Federal Government laboratories across Canada. It has been funded since 2001 by the Canadian Foundation for Climate and Atmospheric Science (CFCAS) with major computing resources provided by the Meteorological Service of Canada. There were 3 research themes covering seasonal to interannual variability and prediction; decadal to century timescales and the century time scale. The network's final workshop is in March 2006 in Victoria, Canada. For the future there was the prospect of a new network which if funded would have emphasis on ocean data assimilation; "seamless prediction" from days to decades; short term forecasts with a coupled weather forecasting model and seasonal to decadal forecasting with coupled climate model(s).

3.2 Update on coordinated national and international projects

3.2.1 ENSEMBLES

Dr Stockdale described the status of and plans for the European Commission's ENSEMBLES project emphasizing that this is a large project covering multiple timescales with many partners and various project areas but that his presentation would concentrate only on seasonal to interannual timescales. The ENSEMBLES stream 1 multi-model ensemble system has 6 coupled GCMs running 9 member ensembles at ECMWF with a 10 year hindcast production period from 1991-2001. Stream 2 is more "heavy duty" with 7 coupled GCMs running 9 member ensembles for a 40 year hindcast period from 1960-2001. Output lists for atmosphere and ocean were presented. These are relevant to TFSP discussion on this topic (see Section 5.3). Output, storage and dissemination were being handled at ECMWF. Further information on ENSEMBLES can be found at http://www.ensembles-eu.org.

3.2.2 ENACT and MERSEA

- Dr Stockdale then outlined the coupled seasonal hindcasts which had been carried out for the European Commission's ENACT (ENhanced ocean data Assimilation and Climate predicTion) project. These have illustrated the role of initial conditions (data assimilation vs no assimilation) on hindcast skill showing that it is hard to improve on good wind forcing and that more advanced methods of data assimilation are unable to do as well as 3-D-VAR. The ENACT analyses, now on line on a standard 1x1 grid at http://www.ecmwf.int/research/EU_projects/ENACT/index.html, cover the following:

- 1962 -2001 global ocean analyses (some to 2003)

- 3 models (soon 4), plus a stand-alone analysis

Dr Stockdale then provided a brief summary of the ECMWF contribution to MERSEA which aims to develop a European system for operational monitoring and forecasting of the ocean on global and regional scales and on time scales from days to months. The ECMWF contribution focuses on forecasting the ocean-atmosphere physical system on daily to seasonal timescales. There are 4 tasks that ECMWF with partners MeteoFrance, Mercator & INGV are contributing to:

1. Development of the interpolation package, installation of a parallelised version of the Mersea-¼ model and installation of the coupled models
2. Assessment of the impact of MERSEA-¼ analyses on seasonal forecasts
3. Assessment of the impact of improved model resolution on seasonal timescale forecasts
4. Assessment of the impact of MERSEA-¼ on the Medium-Range forecasts.

3.2.3 Development & plans for the APEC Climate Centre (APCC)

Dr C-K Park provided a summary of the development history of the Asia-Pacific Climate Network under APEC (Asia-Pacific Economic Cooperation) and of the APCC which has evolved from it. The APCC occupies a floor of a 12 storey building in Busan, Korea, and shares high performance computing resources with the KMA. It also employs a high performance networking system. The goals of APCC are to:

- Facilitate the sharing of high-cost climate data and information
- Develop capacity building in prediction and sustainable social and economic applications of climate information
- Minimize climate related damages
- Capitalize on non-preventable damages
- Accelerate and extend socio-economic innovation

It acts as an operational and research facility with 15 institutes taking part. Research and development is carried out through multi-institutional collaboration. Dr Park outlined the current APEC multi-model ensemble (MME) system which uses statistical techniques to combine model outputs from partner organizations. He illustrated hindcast skill, showing that the skill scores demonstrate that MME enhances predictability but only marginally. Finally Dr Park provided some examples of how predictability can be improved in mid-latitudes, potentially through inclusion of stratospheric processes, improved representation of tropical heating and use of a very high resolution global model.

4. Review of developments in applications and operations

4.1 Applications programmes

4.1.1 The WMO Technical Conference on Climate as a Resource (Beijing, China 1-2 Nov 2005) and the 14th Session of the WMO Commission for Climatology (CCl) (Beijing, China, 3-10 Nov 2005)

Dr Sugi outlined the nature of these two meetings to the group. The technical conference was centred around four sessions:

- Session 1: Climate, Sustainable Development and Economy - Tourism, Energy
- Session 2: Climate and Water
- Session 3: Climate and Food Production - Agriculture
- Session 4: Climate Applications

It stressed the importance of strengthening partnerships between the WMO Commission for Climatology (CCl) and socio-economic sectors to further develop climate applications incorporating risk management in food, water, tourism, health, energy, and urban planning. A WMO Climate Risk Conference “Living with Climate Variability and Change: Understanding the uncertainties and

managing the risks" would take place in Espoo, Finland, 17-21 July 2006 – for further information see http://www.livinwithclimate.fi.

Dr Sugi outlined the new structure of CCl which is as follows:

- President
- Vice President
- Management Group
- Implementation Coordination Team

- Open Programme Area Group 1 (OPAG1): Climate Data & Data Management
  1.1 Expert Team on Climate Data Management including Metadata
  1.2 Expert Team on Observing Requirements and Standards for Climate
  1.3 Expert Team on the Rescue, Preservation and Digitalization of Climate Records

- OPAG2: Analysis of Climate Variability and Change
  2.1 Joint CCl/CLIVAR Expert Team on Climate Change Detection and Indices
  2.2 Expert Team on Climate Monitoring including the Use of Satellite and Marine Data and Products

- OPAG3: Climate Information and Prediction Services (CLIPS)
  3.1 Expert Team on Research Needs for Intraseasonal, Seasonal and Interannual Prediction, including the Application of these Predictions
  3.2 Expert Team on CLIPS Operations, Verification and Application Services
  3.3 Expert Team on El Nino and La Nina

- OPAG4: Applications
  4.1 Expert Team on Climate and Health
  4.2 Expert Team on Climate and Energy
  4.3 Expert Team on Climate and Tourism
  4.4 Expert Team on Climate and Urban and Building Climatology
  4.5 Rapporteur on Climate and Water to liaise with CHy
  4.6 Rapporteur on Climate and Agrometeorology to liaise with CAgM

- Expert Teams and rapporteurs reporting directly to the president or MG
  - *Rapporteur on Climate-related Hazards*
  - *Expert Team on Guide to Climatological Practices (WMO-No. 100)*
  - *Gender Focal Point*
  - *Rapporteur on GEOSS*
  - *Rapporteur on Metadata*

It was noted that Dr P Nobre is a member of the OPAG3 Expert Team on "Research Needs for Intraseasonal, Seasonal and Interannual Prediction, including the Application of these Predictions", providing a direct link between WGSIP and this group. The group noted that WGSIP is not represented on the Expert Team on El Nino and La Nina, despite its previous work and recommendations in this area. There is a need to communicate the WGSIP position on El Nino definition to CCl and this Expert Team.

Action: Explore how WGSIP can best input to the CCl Expert Team on El Nino and La Nina with CCl involving the JPS for WCRP as necessary (H Cattle, M Harrison)

4.1.2 Linking WGSIP to Applications Programmes

In response to requests from the CLIVAR SSG to build CLIVAR activity in the applications area following the CLIVAR Conference and the SSG-13 Assessment of CLIVAR progress, WGSIP-9 identified the need for it to re-establish its connections to the applications community, in particular the SysTem for Analysis, Research and Training (START) and the CCl Climate Information and

Prediction Services (CLIPS) activity. Dr M Harrison had been asked to take this forward. Thanks to START, a side meeting was held at a side meeting of CLIMAG in Geneva in May 2005 with representatives from CLIVAR, START, CLIPS, the International Human Dimensions Programme (IHDP), the International Research Institute (IRI), the Australian Bureau of Meteorology (BoM) and the Australian Agricultural Production Systems Research Unit (APSRU). Time constraints at that meeting resulted in a request to present a position paper that was subsequently developed by Dr Harrison. The paper (tabled at WGSIP-10) identified two primary areas of activity at international level relating to improved coordination and the development of a new process.

In terms of developing improved coordination between programmes related to applications, Dr Harrison's paper suggested that a new cross-Programme Coordination Committee be formed to take an overview of all activities and to propose/promote coordinated activities. Candidate programmes include all under WCRP, WCP, IGBP, IHDP, START, (UNFCCC), UNDP & UNEP. Dr Harrison suggested that at the lowest level, and as an initial step, a cross-Programme Coordination Committee could be formed from the Chairs of CLIVAR Panels and Working Groups meeting in association with the CLIVAR SSG.

There were multiple options to the process approach advocated by Dr Harrison, some of which were discussed in his position paper. The objective would be to tie seasonal to interannual prediction into an internationally-recognised issue. Dr Harrison's key recommendation was for an Assessment to be carried out which would:

- Focus on Climate Variability – parallel to but not overlapping IPCC
- Cover all aspects of our knowledge of, and our ability to manage under, climate variability
- Assess the scope of needed future research and development
- Provide authoritative statements to decision makers
- Bring in all appropriate Programmes, and link to other pertinent Assessments

The ultimate objective would be not only to provide an authoritative statement, but also to provide a basis for coordination. The process could be started at a lower level with fewer Programmes involved, but Dr Harrison emphasized that such an approach needs care, and would delay the outcomes of a full Assessment. He recognized that there is, of course, the problem of already limited and overstretched resources but suggested that such an Assessment be fully scoped and its feasibility tested. It could be linked to an existing process through e.g. UNFCC, Millennium Development Goals (MDGs) etc. The previously mentioned "Living with Climate" conference in Finland may provide asn opportunity to develop ideas for such a process.

Dr Harrison further identified a number of perceived priority activities for WGSIP from the user perspective:

- Empirical approaches – comparison with GCMs
    - Intercomparison project
    - Workshop on intercomparison/combination
- Downscaling, spatial and temporal detail
    - Promotion of approaches
    - Intercomparison project
    - Workshop/statement on capability
- Combination/Post-Processing
    - Verification
    - Assessment of approaches/workshop
- Seamless approaches to prediction; integration of all information sources
    - Workshop
    - Assessment
- Verification appropriate to end users
    - Coordination with CCl
    - Workshop on verification
    - Intercomparison using user-focused methods

    - Best practices
- Presentation appropriate to end users
    - Workshop with CCl
    - Best practices
- Focus on temperature, rainfall etc. prediction
    - Assessment
- Observation requirements
    - Workshop on 'end-to-end' needs

There was considerable WGSIP discussion on this item. The overall topic of cross-programme coordination and the proposals for an assessment, was agreed to be much wider than WGSIP and should be elevated to JSC level for consideration. To do this, there was a need for a redraft of the paper

Action: Take issues raised by Dr Harrison's paper to JSC XXVII as part of TFSP presentation (B Kirtman). Redraft and distribute white paper (M Harrison)

Overall it was felt that the list of topics proposed by Dr Harrison for WGSIP to address were certainly ones that WGSIP could take on. Downscaling was identified as one area. With a focus on temperature and precipitation, discussion centred around the levels of skill required for user applications. The planned TFSP workshop could seek to develop the applications theme further. A key issue for WGSIP is interaction with CLIVAR panels, WGSIP's role in making data available to them and the panel's role to carry out regional analysis/verification of global model runs. Overall actions emerging were:

Action: Monitor topics for applications interface for future WGSIP work (e.g. downscaling, calibration, verification) (A Morse)

Action: TFSP/WGSIP Workshop:

- **Meeting foci on temperature and rainfall prediction**
- **Special emphasis on applications**
- **Potential applications member of organising committee**

(Boer, De Witt, Kirtman, Stockdale, Morse, All)

5. Review of WCRP and COPES initiatives

5.1 Report of WCRP Modelling Panel (WMP)

Dr Kirtman outlined the role of the WMP (see http://copes.ipsl.jussieu.fr/Organization/COPESStructure/ModellingPanel.html) which has been set up to coordinate modelling activities across WCRP. Dr Kirtman also reviewed the overall list of WCRP modelling panels the WMP has overview of, its membership and the overall modelling issues identified in the WCRP's 10 year strategic plan (see http://copes.ipsl.jussieu.fr/PDF/WCRPStrategImpl/WCRP_StrateIgmpl.pdf). Key issues discussed at WMP included causes of model error, high vs low resolution (should the modeling community define an optimum strategy for utilization of computing resources for cloud-system resolving high resolution models for predicting regional weather and climate variations, and cyclone-resolving low resolution models for understanding the mechanisms of climate variability?); plus computing power and the issue of seamless prediction. In terms of the last of these, the view is prediction across timescales is (a) Conceptually seamless - climate is the statistics of weather - separation is artificial; (b) Scientifically seamless - initial conditions matter for weather, seasonal, decadal and maybe climate change; (c) Seamless programmatically and (d) Seamless institutionally.

For WGSIP, the key issues to be addressed were for encouragement under TFSP for NWP Models (THORPEX) and for IPCC-class models (WGCM) to be used on the seasonal problem and possibly for seasonal (and decadal) prediction to be carried out using cloud resolving models. In the US, an ad-hoc panel has been set up under the National Science Foundation (NSF) which is

developing a “white paper” on how to define seamless prediction and plans for an accompanying workshop.

5.2 *WCRP JSC Task Force on Seasonal Prediction (TFSP) Pan-WCRP Climate System Retrospective Seasonal Forecasting Experiments.*

Dr Kirtman reminded the group of the key objectives of the TFSP which would seek to involve all of the projects of WCRP:

- Determine the extent to which seasonal prediction of the global climate System is possible with currently available models and data
- Identify the current limitations of the climate system model and observational data sets used to determine seasonal predictability
- Develop a coordinated plan for pan-wcrp climate system retrospective seasonal forecasting experiments

The aim of the Pan-WCRP Climate System Retrospective Seasonal Forecasting Experiments is to test the hypothesis that “there is currently untapped seasonal predictability due to interactions (and memory) among all the elements of the climate system (Atmosphere-Ocean-Land-Ice)”. In addition, seasonal predictability needs to be assessed with respect to a changing climate, demonstrating the relevance of including the use of IPCC class models under the TFSP experimental plan (see above discussion of seamless prediction also).

The nature of the interactive Atmosphere-Ocean-Land-Ice prediction experiment being planned under TFSP was as follows:

- Best possible observationally based initialization of all the components of climate system
- Six month lead ensemble (10 member) fully interactive predictions of the climate system
    - predictions initialized four times per year for each year 1979-present
- Some predictions by some groups extended to decadal
- Interactive models:
    - Ocean – open but interactive (e.g., slab mixed layer or GCM)
    - Atmosphere – open but interactive, most likely a GCM
    - Land – open but interactive, e.g. SSiB, Mosaic, BATS, CLM, Bucket …
    - Ice – open but interactive (e.g., thermodynamic or dynamic)

The (level 1) experimental design is as follows:

- Atmospheric initial states to be taken from NCEP (or ECMWF, or other analysis products) reanalysis each February, May, August and November (note that the level 2a design specifies “each month” here) each year from 1979-present (level 2b specifies 1960-present). Initialized on 00Z and 12Z on the last five days of each preceding month forming a 10-member ensemble. Other strategies for generating the ensemble members are acceptable as long as the basic principle of **no future information as the forecast evolves** is not violated. Each ensemble member should be run for at least seven months. Additional ensemble members and longer leads are encouraged.
- Oceanic initial states: (if appropriate) to be taken from most appropriate ocean data assimilation system.
- Sea Ice initial states: (if appropriate) to be taken from best available observational data.
- Land initial states: (if appropriate) to be taken from most appropriate land data assimilation system or consistent offline analyses driven by observed meteorology (i.e., GSWP; Suggestion for “Poor Man’s Data Assimilation)
- Soil wetness: predicted (i.e., interactive Land Model)
- Snow cover and depth predicted (i.e., interactive Land Model)
- Chemical Composition (carbon dioxide, ozone …) prescribed and varying. This explicitly includes the transient changes in the chemical composition from 1979-present.

Atmosphere/ocean/sea ice outputs are

Atmosphere:

- Every 24 hours at 00 GMT:
  - Pressure levels (instantaneous): Geopotential Height, Temperature, Velocity and specific humidity for 850, 500, 200, (if available 100, 50, 10; these higher pressure levels are used for interactions with SPARC) hPa.
  - Surface (instantaneous): 2m Tmax – daily, 2m Tmin – daily, Total soil moisture, Snow depth, Snow water equivalent, Sea surface temperature and skin temperature (surface radiative) over land, Mean sea level pressure, Soil Heat Flux.
  - Surface (accumulated): Total precipitation, Downward surface solar radiation, Downward surface longwave radiation, Surface net solar radiation, Surface net longwave radiation, Top net solar radiation, Top net longwave radiation, Surface momentum flux, latent and sensible heat flux.
- Every 6 hours at 00, 06, 12, 18 GMT
  - Surface (instantaneous): Total cloud cover, 10m wind, 2m Temperature, 2 m specific humidity.

Ocean (where appropriate):

- Every Month -
  - Accumulate temperature, salinity and currents in the (at least) the upper 400 meters, surface fluxes of heat, momentum and fresh water, sea level height, mixed layer depth (monthly means)
- Every 24 hours at 00 GMT-
  - Vertical temperature, salinity and currents sections in the (at least) upper 400 meters at the equator and 2N and 2S (5N and 5S optional)
- Every 6 hours at 00, 06, 12 18 GMT-
  - Surface fluxes of heat, momentum, and freshwater. Sea Surface Temperature and mixed layer depth

Sea Ice (where appropriate):

- Every 24 hours at GMT –
  - Surface fluxes of heat and momentum. Snow cover, Sea ice concentration, thickness and temperature.

The implementation strategy to meet the key objectives of the TFSP would be through:

- Rigorous evaluation of current (sub) seasonal prediction capability and skill, collaborating with the CLIVAR regional panels for local evaluation of skill and using currently available forecast data (e.g., DEMETER-ECMWF, NOAA-CTB, IRI, SMIP2/HFP, APCC…). Links would be made to operational centres via WMO SVS-LRF
- Coordination with operational seasonal forecast centers, research groups and IPCC Modeling Groups in the implementation of the COPES-TFSP experiment, with encouragement of analysis through diagnostic sub-projects

A letter from the Chair of the JSC for WCRP would be sent out shortly to (i) announce the TFSP experiment (ii) the seasonal forecast assessment of current skill (based on SMIP/HFP2, DEMETER, CTB, APCC, …) and (iii) a TFSP/WGSIP/SMIP First Seasonal Prediction Workshop, to be held in 2007 and which would focus on the results from the assessment and preliminary results from TFSP Experiment. The present timetable is for TFSP experiment hindcasts to be complete by Fall 2007 with a further workshop in 2009. Future assessments would be managed by CLIVAR through WGSIP.

An organizing committee for the 2007 workshop had been set up comprising B Kirtman (chair), G Boer, M Davey, F Molteni, Guomin Wang. It was agreed that Dr C-K Park should also join. The need for more user community involvement was also identified.

Action: Dr C-K Park to join the TFSP/WGSIP Workshop organizing committee. M Harrison/A Morse to consider what user representation might be added.

5.3 *Progress report from TFSP data committee*

A data sharing sub-committee has been set up including T Stockdale (Chair), G Boer, D DeWitt, I-S Kang, and a representative of the THORPEX Interactive Grand Global Ensemble (TIGGE)). Its task is to develop a data sharing and implementation strategy for the TFSP experiment, including development of a data catalogue and establishment of a data policy. It would encourage a distributed data sharing approach. In reviewing the list of output fields (section 5.2), Dr Stockdale noted a number of differences between, ENSEMBLES, ECMWF and planned TFSP outputs. It was questioned as to whether land skin temperature needed to be included (not included in either the ENSEMBLES or ECMWF outputs) but agreed that surface momentum flux is a key element which does need to be output (not included in ENSEMBLES output). The TFSP data sub committee had produced a draft document which:

- Defines metadata, both definitional and descriptive
- Outlines a netCDF implementation
- Discusses other issues, including links to work by others

Data gridding was still an issue not yet resolved. Serving the data on a common grid helps most users considerably. However, serving on the original grid maximizes the quality of the data. Much depends on the tools available to the user. The overall WGSIP recommendation was to supply the data on the original grid bearing in mind that appropriate tools would need to be available.

Test data would soon be available from ECMWF. The next steps therefore were to (i) check test data; (ii) agree data specification; (iii) circulate plans more widely; (iv) submit to WMP for comment/agreement; (v) modify existing data streams / servers if needed; (vi) notify users.

Physical distribution plans were as yet somewhat uncertain. ECMWF will serve ENSEMBLES data (and operational multi-model probably). The strategy at present is that most groups will serve their own data themselves though there may be some groups not able to do this. It was noted that the COPES website will have a link pointing to TFSP data; the ICPO pages need to be linked across to this.

Action: Finalize TFSP data strategy (T Stockdale and the TFSP data management sub committee)

Action: Provide link from CLIVAR WGSIP webpage to COPES website pointer to TFSP datasets (ICPO)

6. Ongoing WGSIP activities, interactions and links

6.1 *SMIP2 status and plans*

Dr George Boer outlined the approaches taken in SMIP2 and SMIP/HFP (see http://www-pcmdi.llnl.gov/projects/smip/smip2.php).

SMIP-2 is looking at 1st and 2nd season *potential* predictability based on initial conditions from reanalyses and AGCM response to specified *observed* SST and sea ice.

SMIP-2/HFP is examining 1st season *actual* predictability in an operational context (with no information from the future). It is based around a 2-tier forecast with objective prediction of boundary conditions (SST and sea ice) *or* a one-tier forecast using a coupled atmosphere-ocean forecast system. Initialisation is again from reanalyses in both cases.

Key principles of SMIP are as follows:

- Forecasts must be based on procedures that can be clearly described, explained, justified and reproduced; that is *objective* methods.
- Forecasts must provide clearly defined and *quantitiative* results that may be objectively verified
- Forecasts must be accompanied by *measures of skill*.
- Changes in forecast procedures require *objective* evidence of improvement.

SMIP-2 has been organized to provide new knowledge on seasonal to interannual prediction, to allow intercomparison of models in the seasonal to interannual context, to provide measures of potential and/or actual predictability in current models and to provide a collection of results for research into multi-model approaches to seasonal to interannual prediction. It is also the forerunner/prototype/precursor/exemplar of the COPES TFSP experiment. Diagnostic subprojects provide the opportunity to entrain "outside expertise" to help analyse results.

As yet, however, participation has somewhat disappointing and data handling has proved problematic. The initial approach to SMIP data management had been to seek to set up the traditional approach of a single data archive at PCMDI for the SMIP2 and the smaller SMIP2/HFP datasets. Unfortunately PCMDI had not been able to give this priority so that whilst a number of datasets were held there, resources for ongoing archiving and distribution had been problematic. A second approach had therefore been undertaken to transfer the archive to IRI. However, whilst IRI could accept the archive to date, they were unable to accommodate new data. Arrangements had now been made with COLA who will accept and serve new SMIP2 datasets. These arrangements were confirmed by Drs DeWitt (for IRI) and Kirtman (for COLA) with Dr DeWitt confirming that IRI was ready to serve the data received to date now.

Final steps under SMIP2 were now to (i) put out a final call to the community for data submission (ii) to call for diagnostic subprojects with notification of data availability (iii) give notice of the planned 2007 workshop (see 5.2 above). The SMIP2 Panel will summarize the outcomes following the workshop, after which SMIP2 will close.

Action: An SMIP2 letter to be distributed to the community announcing data availability at IRI, with new data at be submitted to COLA and calling for diagnostic subprojects. The SMIP2 Panel should ensure links to DEMETER, CFS and GFDL. (G Boer, B Kirtman, D DeWitt, ICPO)

6.2 Links with VACS

Dr Landman's presentation on "Suggested interactions with VACS" (co-authored with Chris Reason (VACS co-chair) and Richard Washington) demonstrated a number of issues in seasonal prediction over Southern Africa. In particular, a proposal being developed under VACS for a Southern African research proposal, SAGRADEX, focused on the very tight gradients in SST, topography, vegetation and soil moisture which characterize the region and which are unique in the Southern Hemisphere as a whole. In addition, variability in tight wind gradients north of Madagascar is very important for Eastern and Southern African rainfall variability. Models have difficulty in adequately resolving these gradients (indeed overseas models used in the region may need to be "customised" to the local conditions of very tight SST, topographic and vegetation gradients) – this hampers understanding of regional climate variability, seasonal forecasting and climate prediction efforts, and assessing the likely impacts of climate change over the region. Key questions are:

- How do gradients in the surface boundary conditions influence southern African climate and its variability?
- How well do these gradients need to be represented in models for climate prediction?
- How do these gradients interact with remotely forced signals like ENSO to modify impacts at the regional and local scale?

Many parts of southern Africa rely on subsistence agriculture and are vulnerable to extreme events and related disasters. Recent examples are the 2000 Mozambique/NE South Africa flooding, 2002/3 drought and famine in Malawi/Zimbabwe/Zambia. Improved prediction of intra-seasonal rainfall characteristics (onset, frequency and severity of dry spells) would be of great benefit as would prediction of variability in extreme event occurrence.

As well as modeling uncertainties, a number of data problems exist in the region, including the need over the ocean for better monitoring of surface fluxes, SSTs, and upper ocean variability poleward of PIRATA array; the cut back in radiosondes over the region, leading , for example, to differences in the ERA / NCEP reanalyses there, though AMDAR is now starting to be incorporated; reductions in rainfall and other station observations for model verification etc.

Other areas covered in Dr Landman's presentation included comparison of observed and modelled rainfall over the Southern African regions, work on tropical-temperate troughs, use of downscaling techniques including use of RCMs and Model Output Statistics (MOS) and the multi-model system used for seasonal prediction at the South African Weather Service.

Following Dr Landman's presentation, the panel discussed the way forward for interactions between WGSIP and VACS. One area would be assessment of the skill of models over the region. This could be built on the SMIP2 effort and (in the future) the planned TFSP experiment.

Action: Encourage VACS to use WGSIP datasets for skill assessments (W Landman)

6.3 Interactions with GEWEX – GLACE

Dr R Koster began by noting the wrap-up of the present GLACE effort with the experiment completed and 5 Journal publications on the outcomes. Attention is now turning to GLACE-2, the motivation for which is that for soil moisture initialization to add to subseasonal or seasonal forecast skill, two criteria must be satisfied:

1) An initialized anomaly must be "remembered" into the forecast period, and
2) The atmosphere must be able to respond to the remembered anomaly.

The second of these (only) was addressed by GLACE. GLACE-2 will focus on both: the full initialization forecast problem.

The experimental overview of GLACE-2 is as follows:

Firstly carry out a "Step 1" which would involve: (i) initializing land states with "observations" using the Global Soil Wetness Project (GSWP) approach and (ii) Initializing the atmosphere with "observations" via reanalysis; (iii) performing ensembles of retrospective seasonal forecasts with prescribed, observed SSTs (or use of a coupled ocean model) and (iv) to then evaluate the forecasts against observations.

Step 2 would be the same, but for a given start date, would draw land initial conditions for different ensemble members from broad range of possible values.

Step 3 would compare skill and isolate the contribution of a realistic land initialization from the simulations. Forecast skill due to land initialization would be derived from the difference between forecast skill obtained in experiments using realistic land initialization and forecast skill obtained in identical experiments, except that land is not initialized to realistic values.

Dr Koster presented a proposed set of start dates for the 1st and 15th of each month for the periods 1 April-15 August from 1986 to 1995. This would give 100 different 10-member forecast ensembles. Each ensemble would consist of 10 simulations, each running for 2 months. The total simulation period would be: 10x10x10x2x2 = 4000 months = 333 years. He also outlined the procedure for land state initialization which would be to input observed precipitation and radiation

and wind speed, humidity, air temperature etc from reanalysis into a land surface model (LSM). A decade of offline integration with then provide a decade of LSM initial conditions for seasonal forecasts, reflecting observed antecedent atmospheric forcing.

Dr Koster continued by outlining a number of technical details for experimental running. Here it was revealed that there would in fact be 3 options for land initialization, which is not a straightforward issue. These are (in order of preference):

1) Regrid GWSP forcing data to the model grid, then drive the land model offline with the regridded forcing.
2) Drive the land model offline at 1x1 resolution using original GSWP forcing data, then regrid the land states to the forecast model grid
3) Regrid the multi-model land states obtained by GSWP-2 to the forecast model grid.

In each case it would be important (absolutely essential in case 3) to rescale the outputs for use in the forecast model.

Required output diagnostics (to be provided to the GLACE data centre) are, for each day of forcing, for global fields of:

- Daily total precipitation
- Daily average near-surface air temperature (in the lowest AGCM level)
- Daily total evaporation
- Daily average net radiation
- Daily average vertically-integrated soil moisture content.

He then outlined the proposed analyses to be carried out and the optional runs which could be included. The timetable for GLACE-2 is as follows:

Midsummer 2006:	Identify interested modeling groups
Fall 2006:	Provide data to participants (met forcing data, atmospheric initialization, SST conditions)
Summer 2007:	Simulations due
Winter 2008:	First analyses performed

There was some discussion of the 3 approaches. Dr Kirtman wondered why case 3 was necessarily multi-model. There was also concern, expressed by Tim Stockdale that whilst GWSP gives the best estimate of the real world, the model may drift. In response to a question from Dr DeWitt, Dr Koster confirmed that initialization from reanalysis was not compulsory but that GLACE would need to know what was used. There was some discussion of the supplemental runs which would involve initialization with fields that the model actually produces on its own, including concerns about the approach. With regard to run dates for the main experiments and in response to a question from Dr Boer as to whether monthly runs would be acceptable, Dr Koster felt that every 2 weeks was necessary to look at time evolution. Dr DeWitt expressed a concern that the run dates would only simulate the northern hemisphere (NH) summer and asked if GLACE-2 was only looking for NH participants therefore. Dr Koster stated that the bias reflects the much larger land area of the NH. Overall it was agreed that southern hemisphere (SH) interests needed to be defined and that nothing would be lost by encouraging a supplemental experiment to address these. Better buy-in might certainly gained by SH teams concentrating on the SH summer period.

Overall, and despite concerns raised, WGSIP fully endorsed the GLACE-2 experiment and encouraged groups to take part in it.

Actions: GLACE - seek to modify proposal to meet WGSIP suggestions/concerns (Koster) and seek commitments (noting that WGSIP groups are encouraged to take part and should notify GLACE-2 accordingly (All))

7 Reports from other groups involving possible WGSIP collaborations

7.1 JSC/CAS Working Group on Numerical Experimentation (WGNE) and areas of possible collaboration

Dr Déqué outlined the outcomes of the last meeting of the WGNE which took place in St Petersburg, Russian Federation, from 7-11 November 2005. In outlining the agenda he noted the key role which the session on "recent developments at forecast centres" makes. Though the THORPEX/TFSP connection had been noted by the WGNE, the session on seasonal forecasting had had to be cut due to time pressure. Dr Déqué drew attention to the "Transpose AMIP" activity aimed at use of climate GCMs for short range forecast runs. Community buy-in had to date been low since it was always possible to pick up short range forecasts from the first days of seasonal forecast runs.

In response to a previous request to WGNE on the evaluation of surface fluxes in NWP and climate models, Dr Déque pointed to the existence of the WGNE SURFA Pilot Project. The objective of SURFA is to evaluate near real-time NWP fluxes (and related fields) with high quality reference data. During the pilot study phase the feasibility and value of this activity will be reviewed before the decision is made to develop a full operational program. If successful, the SURFA infrastructure could also be utilized to evaluate climate models with the most accurate observations available. A data management system is being developed to automatically archive NWP near real-time fluxes and related fields at PCMDI. The motivation for the near real-time collection of data is twofold. Firstly, SURFA research will be most valuable if it can provide an evaluation of existing NWP rather than historical systems. Secondly, with the near real-time approach there is hope that a data management system could be largely automated. In order to further optimize the use of available resources, SURFA has been designed to coordinate ocean and land surface research, with the initial thrust coming from the ocean observation and modeling communities. All incoming data will be quality assured and the organized infrastructure that has been developed for the Atmospheric Model Intercomparison Project (AMIP) employed. Major NWP centres have expressed their intention to participate in SURFA. However, the level of activity on SURFA is currently very low.

Dr Déqué also reminded the WGSIP of the WGNE's request for seasonal model input into the GEWEX/GCSS as discussed at WGSIP-9. The motivation for the study, which will utilize a new generation of satellite datasets (e.g. AIRS, GPS, CloudSat) is to seek to evaluate whether NWP/ seasonal climate models can reproduce the main properties of the diurnal cycle over the (sub)tropical oceans and to explore if appropriate combination of models and observations can help in characterizing the humidity structure of the (sub)tropical upper-troposphere. Dr Pan noted that NCEP has done additional run for diagnostics and submitted data.

Action: GEWEX/GCSS Pacific transect data from WGSIP – submit CFS data (Pan); check the status of the experiment, deadlines for submission etc and circulate WGSIP members to stimulate input (Pan, De Witt)

Finally, Dr Déque drew attention to the WGNE workshop on systematic errors, San Francisco 12-16 Feb 2007. WGSIP participation was welcomed

7.2 International Climate of the 20th Century (C20C) Project

Dr Kirtman provided the background to C20C which the WGSIP had received a presentation on from Dr C K Folland (UK Met Office) at its last meeting. The C20C, participants in which had met in Prague in June 2005 was considering how to evolve into the artea of coupled modelling, complementary to the WGCM CMIP C20C activity. A number of experiments had been defined including pacemaker experiments. The next C20C meeting will be in Exeter, UK on dates to be decided. BK will not attend. WGSIP attendance would be welcomed. Dr Morse agreed to consider the relevance of C20C activities to the applications community.

Action: Circulate C20C meeting announcement and encourage participation (Kirtman)

7.3 Proposed south Western tropical Atlantic climate Variability Experiment (WAVEs)

Dr P Nobre presented the current proposal outline for WAVEs as a research programme focused on the SW Atlantic Basin. WAVEs is a combined field experiment and coupled land-atmosphere-ocean modeling programme to study phenomena related to SW tropical Atlantic/South American climate variability and change. The concept, which would be presented to both CLIVAR's Atlantic and VAMOS Panels, arises from a PIRATA white paper (Nobre et al, 2004). The focus for WAVEs is the South Atlantic Convergence Zone (SACZ) which is found to be poorly represented in AMIP simulations. Topics for WAVEs will include:

- **Coupled o-a variability associated to SACZ:**
  - SST-Solar Radiation-Rainfall feedback processes
  - Barrier layers due to SACZ rainfall over the ocean and river discharges
  - Amazon forest-rainfall memory: ITCZ-SACZ-LLJ interactions
  - Teleconnections from the SPCZ
- **SW tropical Atlantic oceanic circulation:**
  - Density anomaly (T-S) advection by the SEC
  - SEC bifurcation
  - MOC-STC pathways
  - Brazil-Malvinas confluence zone
- **Global Climate Change**
  - Sea level: in situ and satellite estimates
  - CO_2 cycle
- **Other phenomena**
  - Surface wave modeling
  - South Atlantic Subtropical High pressure variability and climate fluctuations over South America and southern Africa.

Modeling experiments planned are directed towards coupled ocean-atmosphere tests of hypotheses for:

- SACZ modulation of underlying SST variability
- Amazon soil moisture memory on IC
- MOC-STC modulation of meridional heat transport across the equatorial Atlantic
- Remote influences on SW tropical Atlantic climate variability
- Biological CO_2 pumping on the ocean.

The observational framework will encompass

- The array of moored ATLAS buoys to estimate upper ocean heat storage and fluxes at the surface (extension of PIRATA);
- High density of XBT, ADCP lines;
- Drifters and Argo floats array;
- Island (F.N., ASPSP, Trindade) meteorological and tide automatic stations;
- Satellite altimetry data;
- Airborne and dissolved oceanic CO2
- Wind & temperature profiling of the atmospheric boundary layer

8 Contributions from NIWA, New Zealand

During this session, the WGSIP were pleased to receive presentations on NIWA activities on the following topics:

- Overview of NIWA & NIWA Wellington activities in climate (J Renwick)
- Sea temperatures in the Tasman Sea (P Sutton)
- Heat content North of New Zealand

- Statistical prediction of SH h500 seasonal mean fields (Xiaogu Zheng)

The WGSIP expressed its appreciation of the presentations made and the overview of key NIWA climate activities that they provided.

9. Requested issues for WGSIP to consider

9.1 Observing system experiments, statements on what is needed for observing system (T. Stockdale)

Dr Stockdale introduced this item which the CLIVAR SSG had requested the WGSIP consider in the context of observing system requirements for S-I prediction. Dr Dewitt noted that a set of limited OSSEs has been done between various US institutions but results had been equivocal, the readiness of models to carry out such experiments being a significant factor. Dr Stockdale raised the possibility of carrying out model sampling experiments, requiring different groups to work together. Dr Dewitt noted the distinction between Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs): At this stage, Dr Stockdale felt more comfortable with WGSIP spinning up an activity covering the latter type of experimentation, though there were clearly manpower issues involved at the institutional level.

Overall it was agreed that WGSIP should continue to seek to explore this issue and develop a plan, appropriately vetted to ensure buy-in. This should be consolidated at the next WGSIP meeting with a special session of panel on experimental design and with involvement of appropriate experts in this area.

Action: Assess scientific needs for data assimilation for SI prediction, including OSSEs in consultation with experts; plan special session on OSSEs/OSEs at the next WGSIP meeting, with invited experts (DeWitt, Stockdale)

9.2 Discussion on model development: how to entrain university expertise in development and/or analysis; what else is needed; possible statement on what is required (T. Stockdale)

In leading this item, Dr Stockdale clarified that the issue here is not model development per se but how best to make seasonal prediction data available to the university community. With the seasonal model evaluation workshop coming up there is a need to help entrain as many diagnostic subprojects from as many sources as possible. A particular issue is the need for funders of university research to meet the costs of making data available both for the SMIP2 activity and in the future for TFSP. One possible route to encourage funding would be through the International Group of Funding Agencies (IGFA) via the JSC for WCRP. The issue needed to be raised with the WMP. What is also needed is a central website with information on where data are can be found. For TFSP this will be COPES website (with a link from the CLIVAR pages). Dr Harrison noted a potential role for the ICPO here, in proactively broadcasting WGSIP activities to the university community, including data links.

Action: ICPO to explore issues related to SI data information

9.3 Linkage with WGCM

Following previous discussion, it was agreed that the WGSIP co-Chairs would approach an individual to act as link to WGCM. A key issue is to encourage assessment of IPCC models in a seasonal to interannual prediction context. Longer term consideration should be given to a TFSP/WGSIP to any further IPCXC assessment.

Action: Consider WGCM/WGSIP cross membership (Stockdale, Kirtman); encourage assessment of IPCC-class models in and SI context (All). Consider TFSP/WGSIP contributions to any future IPCC assessment (Kirtman)

10 Developments in coupled seasonal/interannual forecasting systems

Here participants were given the opportunity to summarise briefly developments in coupled seasonal/interannual forecasting systems at their home institutions, where not previously discussed. The following contributions were made:

Dr Pan presented the status of the Climate Forecast System (CFS) at NCEP. Which is making twice-daily 9-month forecasts making a monthly ensemble of up to 60 members. In addition, 15-member hindcasts are being carried out each month for the period from 1981-2005, for calibration, skill estimation and analogue and statistical forecast purposes. Products are available on operational servers and on CPC and CTB web sites. Development work using a 100 km version of the CFS was aimed at looking for useful products to fill the forecast gap between week 2 and seasonal timescales. Multi model ensemble trials are also being spun up. A range of CFS model development activities are also in hand.

Dr Koster outlined work at Goddard on seasonal prediction out to 1 year. This includes use of ocean data assimilation and land surface initialisation with atmospheric intiialization from NCEP analyses. In parallel is development of a new model (GEOS5).

Dr Nobre described work at CPTEC to evaluate coupled ocean-atmosphere model climatology and forecast skill. He then went on to outline work to introduce a diurnal cycle into the MOM3 model by Stephen George aimed at improving the simulation of the South Atlantic Convergence Zone in present models.

Dr Boer provided a **s**ummary of the joint WGNE, WGSIP, WGCM Workshop on Ensemble Methods held at the Met Office, Exeter, UK from 18-21 October 2004. Overall the workshop appears to have been very successful and thanks were due to the Met Office for their generous local support. The workshop had more than 165 registrants, 10 invited speakers, 50 each oral and poster presentations and 5 summary plenary speakers. Presentations had been placed on the web at http://cccma.seos.uvic.ca/ensemble, though the site would be closed shortly. Whilst a further ensemble methods workshop is not proposed at this time, Dr Boer suggested that a special session be held at the upcoming TFSP Workshop in June 2007.

Dr Boer continued with a description of work in Canada towards a global assimilation and prediction capability for the coupled atmosphere-ocean-ice system. 3 years of planning have assessed the cost/benefits of such a system, determined feasibility and mapped out the most effective ways of proceeding. Meteorological service needs for such a system are for improved short and medium range forecasts of extreme marine weather; seasonal, interannual and decadal forecasts and for reducing biases and "spin up" time in climate change projections. Fisheries and Oceans management requirements cover time scales of hours to decades, space scales from small bays to global oceans and from the surface layer to the deep ocean and to cover a range of biological/ecosystem/physical and chemical parameters. An interdepartmental and university group was formed to build a plan for such a system. The current draft implementation plan takes a 3-track approach:

- Operational: with a "fast start" provided by importing an ocean data assimilation and modelling system and coupling it with GEM
- Research and development: consisting of long-term government research and complementary academic research networks
- Products: to identify, develop and disseminate relevant products & outputs

Dr DeWitt provided an overview of IRI website tools related to climate information resources for malaria control planning. This is based around a "climatic suitability interface providing and interactive product focused on climatic suitability for malaria transmission linking relative humidity to mosquito survival, temperature to the development rate of falciparum and precipitation to the mosquito life cycle.

Dr DeWitt then gave an overview of recent seasonal- interannual prediction activities at IRI. This covered (i) work on a climate predictability tool which is an easy to use Windows-based software package for making downscaled statistical seasonal forecasts using either GCM output or fields of SSTs; (ii) comparisons of coupled and uncoupled simulations of Indian monsoon precipitation demonstrating improved correlations with observed daily rainfall with coupling; (iii) initial coupled modelling work at IRI and the planned development path for the next generation of coupled models at the institute and (iv) enhanced predictive skill achieved by "selective coupling".

Dr Morse's presentation provided further insights into malaria forecasting. He provided a detailed outline of the current status of the topic, noting as he did so two key areas for linking seasonal scale ensemble prediction systems to users:

> ***Technical*** - downscaling, bias correction, weighting of ensemble members, development of user methodologies and models, tailoring of products and validation for users, skill in forecasts and ultimately their value
>
> ***Structural*** – training of forecasters, dissemination of products (*data not just charts*) to users, lack of feedback to forecasters from users.

He further noted that there is clear demand from users in Africa from many sectors – e.g. agriculture, water and health – and many 'non-technical' issues.

Dr Morse noted that progress requires ongoing integrative approaches with users and developers. He identified a number of areas which might be achievable against these lists, namely:

> ***Technical*** -
> **Validation-** tailored 'meteorology' for users e.g. *tropics* – rainfall onset, cessation, break cycles; temperature –'degree day' with thresholds; *extra-tropics* – 'degree days', pptn totals, pptn thresholds, 'rainy days', wind thresholds. N.B. to be accompanied by 'standard' validation – 'totals'.
> **Data** – use ENSEMBLES s2d list or subset – **priority** T 2m, Tdew 2m, 10m u,v; Tmax, Tmin, pptn (all daily or snapshot 00Z) & 850 u,v,T,q (snapshot 00Z) – extraction of timeseries, use of all members.
> **Bias correction** of EPS – resolution and reliability at daily scale
>
> ***Structural*** – training of forecasters, dissemination of products - **data**, overcoming a lack of feedback to forecasters from users, …

Dr Déqué described progress in seasonal forecasting at Météo-France. The previous system was based around statistical SST prediction and uncoupled forecasts. These have been operational since 1999 using the ARPEGE v3 TL63L31 model to provide 9 member forecasts over a 4 month range. Coupled forecasts have been pseudo-operational since 2004. They show better scores than the uncoupled forecasts. ARPEGE v4 TL63L31 coupled to the ORCA ocean model through the OASIS interface is used to provide 41 member forecasts over a 6 month range. Ocean analyses from MERCATOR provide input to ORCA. The activity is part of EUROSIP**.** Major research projects at Météo-France include contributions to ENSEMBLES and MERSEA.

Dr Sugi briefed the group on the development of a new MRI/JMA coupled model for El Nino and Seasonal Prediction, planned to replace the current JMA operational system in 2008. System components comprise:

> a) the TL95L40 version of the JMA atmospheric model.
> b) the new MRI Community Ocean Model (MRI.COM).
> c) the new Ocean Data Assimilation System "Multivariate Ocean Variational Estimation System (MOVE)" developed in MR

Dr Landman provided information on Long Range Forecast (LRF) operational model development at the South African Weather Service (SAWS). A new MOS-PP model was completed in December 2005 and Dr Landman outlined the latest Dec-Feb and Feb-Apr forecasts from this. He also described the methodology for providing seasonal forecasts of extremes which uses seasonal rainfall data for 963 South African rainfall stations and a statistical post-processing technique to downscale large-scale dynamical model forecasts (24 ensemble members) to 5 equi-probable rainfall categories. A multi-model system has been developed at the SAWS based on 7 IRI

models and MOS for post-processing which will be operational in September 2006. Further developments will become operational in 2007.

Dr Stockdale described developments in ECMWF System 3 and the EUROSIP multi-model forecasting system which is hosted by ECMWF. The configuration of and developments to System 3 include:

- **IFS (atmosphere)**
  - T_L159L62 Cy30r1/2, 1.125 deg grid for physics (operational in 2006)
  - A full set of singular vectors from EPS system to perturb atmosphere initial conditions (more sophisticated than needed …)
  - An option for ocean currents to be coupled to atmosphere boundary layer calculations

- **HOPE (ocean)**
  - Essentially the same ocean model
  - Improvements to the ocean analyses, including analysis of salinity, multivariate bias corrections and use of altimetry.

- **Coupling**
  - Somewhat better treatment of sea-ice, but still no proper model.

System 3 ensemble sizes comprise:

- **5 member ensemble ocean analysis**
  - Differences driven by wind perturbations, based on sampling monthly mean differences in ERA-40 and CORE stresses.

- **41 member ensemble forecast, to 7 months**
  - SST perturbations added to each member
  - Atmospheric perturbations from singular vector computations

- **11 member ensemble forecast to 13 months**
  - Designed to give an 'outlook' for ENSO
  - Only once per quarter (Feb, May, Aug and Nov starts)

- **Back integrations from 1981-2005 (25 years)**
  - 11 member ensemble every month
  - 5 members to 13 months once per quarter

Dr Stockdale provided examples of the performance of the system, noting improved performance over System 2 in the tropics but that, as yet, improvements in mid-latitude skill relative to System 2 not yet clear.

The EUROSIP multi-model ensemble is currently comprised of three models running at ECMWF:

- ECMWF
- Met Office – HADCM3 model, Met Office ocean analyses
- Meteo-France – Meteo-France model, Mercator ocean analyses

It is a unified system with all data in the ECMWF operational archive, a common operational schedule (products released at 12Z on 15th), common products and a coordinated development strategy (e.g. 41 member ensemble). ECMWF would be releasing web products very soon whilst at present the Met Office have a 2-member combination on their website

Dr Kirtman outlined climate modelling and prediction research activities at COLA, focussing on work with multiple US national climate models (NSF (CCSM), NOAA (CFS) and NASA (GEOS) Climate Models) which are being used in (a) the following prediction research areas:

- CCSM Tier-1 Hindcasts in Development (Collaboration with NCAR)
- Multi-Model (GFS+CAM+MOM) Interactive Ensemble Hindcasts (Collaboration with NCAR and NOAA)
- Land Initialization
    - GOLD-GSWP2 Initial Conditions
    - Land-Atmosphere Coupling (GLACE)
- Coupled Ocean-Atmosphere Initialization
    - Anomaly Initialization
    - Coupled Nudging
    - High Resolution Satellite Data Assimilation
- Empirical Corrections of Land and Atmosphere Models

And (b) the following predictability research areas:

- Predictability of Significant Intra-Seasonal Climate Anomalies
    - Identical Twin Coupled Experiments
- Land Interactive Ensemble Development (Noah, SSiB, CLM)
    - Mosaic Tiling Approach
- Impact of Atmospheric Internal Dynamics on Climate Predictability and Variability
    - Single Model Interactive Ensemble
- Regional Coupling
    - Impact of Pacific on Atlantic
    - ENSO-Monsoon Interactions
    - Climate of the 20th Century Pace-Maker Experiments
- Multi-Model (GFS+CAM+MOM) Interactive Ensemble Simulations

Following these presentations, Dr Harrison noted, as a generic point, various inconsistencies and correlations of one form or other which give very little information overall in terms of validation. He asked whether, from an applications perspective, there is one verification approach that WGSIP could recommend that could be a standard part of presentation. Would we get more out of ROC scores for example? Dr Sugi felt that verification needs for users and modellers could be quite different. Dr Koster saw value in the use of correlations. He noted that forecasts are, by necessity, probabilistic so we need to look for and use methods of verification appropriate to this. It was thought overall that there was certainly merit in giving this some further consideration which Dr Harrison agreed to do in discussion with other members, in particular Dr Power.

Action: Consider feasibility of developing WGSIP verification standards for SI modellers (Harrison, Power, Sugi/Ose)

11 Action items and organization of future activities

11.1 Review of action items from the WGSIP-9

Dr Kirtman provided an overview the action items from WGSIP-9, noting good progress against the items which the SSG had asked WGSIP to pursue , namely to: (a) Develop the programme contributing to model improvement; (b) Contribute to the design of OSSEs and data assimilation activities relevant to S-I Prediction; (c) Improve interactions with the various regional panels, WGNE and WGCM and (d) Consider the utility of seasonal forecasts for applications, with interactions with regional panels. A particular item which needed following up again was that of El Nino definition in the context of the proposed activity by the Commission for Climatology.

11.2 Action items and work plan for the coming year

These were discussed against Dr Kirtman's consolidated list of action items as summarized at the head of this report.

11.3 Membership changes

It was noted that a number of membership changes were pending with Drs Kirtman, Boer, Koster, Harrison, Kang, Power and Sugi having come to the end of their term in December 2005. Several members expressed a willingness to stay on the group for an extended term. It was agreed that recommendation would be made by the WGSIP co-Chairs who would work through the ICPO to seek CLIVAR SSG agreement.

11.4 Suggested date and place for WGSIP-11

It was agreed that this would take place in association with the planned TFSP/WGSIP/SMIP First Seasonal Prediction Workshop in 2007.

12. Closure of the session

The session was closed by the co-chairs with grateful thanks to NIWA, Wellington, for their generous hosting of the meeting.

Annex A

CLIVAR Working Group on Seasonal-to-Interannual Prediction 10th session

Wellington, NZ, 13-16 February 2006

AGENDA (Draft)

Monday 13 February 2006

1. **Welcome and opening remarks** (T. Stockdale and Ben Kirtman (co-chairs, WGSIP), Howard Cattle)

2. **Review of CLIVAR activities**

   2.1. Report from the CLIVAR IPO (H. Cattle)

   2.2. Report from the CLIVAR SSG Executive meeting, 2005 (T. Stockdale, H. Cattle)

   2.3. Reports from CLIVAR regional panels: (VAMOS, AAMON, VACS, Pacific Panel, Atlantic Panel, Indian Ocean Basin Panel) (all, lead B. Kirtman, H. Cattle)

   2.4. Reports from JSC/CLIVAR Working Group on Coupled Modelling (WGCM) and WGOMD

3. **Review of national and regional activities**

   3.1. Reports from regional or national CLIVAR Committees (e.g., US CLIVAR). (all, lead B. Kirtman)

   3.2. Update on studies such as the European ENSEMBLES project (T. Stockdale), multi-model ensemble prediction from US Clivar (B. Kirtman); European ENACT and MERSEA projects on ocean data assimilation for seasonal prediction.

   3.3. Developments at and plans for APCC (I. Kang)

4. **Review of developments in applications and operations**

   4.1. Application programmes (Clips, START, etc.) (M. Harrison)

   4.2. Status of WMO CBS infrastructure for long-range forecasting products (S. Power)

   4.3. Status of GODAE

Tuesday 14 February 2006

5. **Review of WCRP and COPES activities**

   5.1. Report on WCRP modelling panel (WMP) meeting (B. Kirtman)

   5.2. Report on TFSP-TIGGE workshop, Trieste (B. Kirtman, T. Stockdale)

   5.3. Progress report from TFSP data committee (D. DeWitt, T. Stockdale, G. Boer, I. Kang)

   5.4. Discussion and decisions on progressing TFSP experimentation

   5.5. Discussion and decisions on data exchange for research and links to operations

6. Ongoing WGSIP activities

6.1. Model experimentation and outputs standards project (T. Stockdale)

6.2. Expert Team for Long Range Forecast Verification (S. Power)

6.3. SMIP-2 status and plans (G. Boer, M. Sugi)

6.4. AA-Monsoon Collaboration (I. Kang)

6.5. VAMOS Modeling Collaboration (P. Nobre and B. Kirtman)

6.6. Pacific Panel Collaboration (S. Power)

6.7. Interactions with GEWEX (R. Koster)

7. Reports from other groups involving (possible) WGSIP collaborations

7.1. JSC/CAS Working Group on Numerical Experimentation (WGNE) and areas of possible collaboration, M. Deque

7.2. Status of C20C project (B. Kirtman)

8. Contributions from NIWA, New Zealand (details to follow)

Wednesday 15 February 2006

9. Requested issues for WGSIP to consider

9.1. Observing system experiments, statements on what is needed for observing system (T. Stockdale)

9.2. Discussion on model development: how to entrain university expertise in development and/or analysis; what else is needed; possible statement on what is required (T. Stockdale)

9.3. Discussion on linkage with WGCM (B. Kirtman)

10. Developments in coupled seasonal/interannual forecasting systems

10.1. Participants will be given the opportunity to summarise briefly developments in coupled seasonal/interannual forecasting systems at their home institutions, where not previously discussed. (all)

Thursday 16 February 2006

11. Action items and organization of future activities (T. Stockdale and B. Kirtman).

11.1. Review of action items from last meeting

11.2. Agreement on overall work plan, including new topics and continuation of existing activities

11.3. Action items for the coming year

11.4. Membership changes

11.5. Suggested date and place for next WGSIP session.

Annex B – List of attendees

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