

WWRP 2007 - 5

Report of the First Session of the
Joint Scientific Committee (JSC) for the World
Weather Research Programme (WWRP)

(Geneva, Switzerland, 23-25 April 2007)



WORLD METEOROLOGICAL ORGANIZATION

WORLD WEATHER RESEARCH PROGRAMME

WWRP 2007- 5

REPORT OF THE FIRST SESSION OF THE JOINT SCIENTIFIC COMMITTEE (JSC)
FOR THE WORLD WEATHER RESEARCH PROGRAMME (WWRP)

(GENEVA, SWITZERLAND, 23 - 25 April 2007)



Table of Contents

EXECUTIVE SUMMARY

1.	OPENING OF THE SESSION.....	1
2.	ADOPTION OF THE AGENDA.....	2
3.	REPORT OF THE PRESIDENT OF THE COMMISSION ON ATMOSPHERIC SCIENCES (CAS) ON CAS-XIV AND EC-LVIII	2
4.	REPORT OF THE CHAIR OF THE WWRP JOINT SCIENTIFIC COMMITTEE OF OPAG-WWRP.....	2
5.	REVIEW OF THE WORK OF WWRP: PAST, PRESENT AND FUTURE	3
5.1	THORPEX	3
5.2	Working Group on Mesoscale Weather Forecasting (WGMWF).....	3
5.3	Working Group on Nowcasting Research (WGNR).....	4
5.4	Working Group on Tropical Meteorology Research (WGTMR)	5
5.5	Joint Working Group on Verification (JWGV)	6
5.6	Societal and Economic Research and Applications (SERA)	7
5.7	Forecasting Systems.....	8
5.8	The Joint WWRP/WCRP Working Group on Numerical Experimentation (WGNE)	9
5.9	WMO Sand and Dust Storm Warning System	10
5.10	Links with other WMO Technical Programmes and GEO.....	11
6.	WWRP STRATEGIC PLAN (SP): 2008-2015	14
6.1	Introduction (D/AREP and Chair JSC-WWRP).....	14
6.2	Review of the WWRP Strategic Plan Outline	14
6.3	Task Team for Drafting the Strategic Plan (SP).....	14
6.4	Strategic Plan Drafting Procedure and Timetable	15
7.	OTHER BUSINESS	15
7.1	Message from WWRP to ICSC THORPEX	15
7.2	Weather Climate Prediction White Paper	15
7.3	Year of Tropical Convection (YOTC)	16
8.	WWRP MEETINGS FOR 2007-2008.....	16
9.	DATES AND PLACE OF NEXT MEETING	16
10.	CLOSING OF THE MEETING	16
ANNEX A:	CAS/AREP Programme Structure Schematic (as of April 2007)	
B:	List of participants	
C:	Revised structure of the new WWRP Tropical Meteorology Research activity	
D:	Outline of WWRP Strategic Plan (valid at the time of distribution of this report)	
E:	Provisional plan and timetable for the preparation of the WWRP Strategic Plan (valid at the time of distribution of this report)	
F:	Summary of Decisions	



**Participants at the First Session of the Joint Scientific Committee (JSC)
for the World Weather Research Programme (WWRP)
(Geneva, Switzerland, 23-25 April 2007)**

EXECUTIVE SUMMARY

The Joint Scientific Committee (JSC) of the Open Programme Area Group (OPAG) on World Weather Research Programme (WWRP), established by the Fourteenth Session of the Commission on Atmospheric Sciences (CAS-XIV, Cape Town, February 2006), held its first meeting from 23 to 25 April 2007 at the WMO Headquarters (Geneva, Switzerland).

Following the directive of CAS-XIV, the meeting reviewed recent activities of the various working groups of the programme and discussed the development of a strategic science and technical implementation plan for WWRP and a work programme aligned with the WMO Long-term plan.

The meeting organized by WMO's Atmospheric Research and Environment Programme Department (AREP) and chaired by Dr Gilbert Brunet (Canada) was well-attended by members of the JSC, chairpersons of the working groups and expert teams of WWRP and leading atmospheric research experts. Participants were enthusiastic and committed to providing the overall scientific guidance for WWRP, in particular, and in furthering the work of the Commission of Atmospheric Sciences, in general.

This meeting report contains a summary of all the presentations made, decisions arrived at during the three day meeting, outline of the WWRP Strategic Plan (2008-2015) and timetable for its preparation. The CAS/AREP Programme Structure Schematic and revised structure of the new WWRP Tropical Meteorology Research activity are also given in the Annexes.

1. OPENING OF THE SESSION

1.1. The first session of the Joint Scientific Committee (JSC) for the Open Programme Area Group – World Weather Research Programme (OPAG-WWRP) was opened at 09:00 on Monday, 23 April 2007 at the WMO Headquarters by the chairman, Dr Gilbert Brunet (Canada).

1.2 The Deputy Secretary-General of WMO, Prof Hong Yan, welcomed participants on behalf of the Secretary-General, Michel Jarraud. He emphasized that disaster risk reduction is at the core of the mission of WMO as well as that of its 187 Members and their National Meteorological and Hydrological Services (NMHSs), which monitor and issue early warnings for a wide range of natural hazards resulting from high-impact weather. The forecast skill of high-impact weather events can be significantly improved by successfully implementing the World Weather Research Programme (WWRP), including THORPEX and other programmes.

Early warnings based on increasingly accurate forecasts over longer lead-times can contribute to the protection of life and the mitigation of damages caused by them. Since the establishment of the WWRP in 1998 several of its projects, such as the Sydney 2000 Forecast Demonstration Project (FDP), the Mesoscale Alpine Programme (MAP), the Aircraft In-flight Icing Project (AIFI) and the First Phase of MEDEX project, have been successfully completed. The MAP D-PHASE Forecast Demonstration Project, the Beijing 2008 Forecast Demonstration Project and a Research and Development Project on Mesoscale Data Assimilation and Ensemble Prediction, the Sand and Dust Storm Project, and the Convective and Orographically-induced Precipitation Study (COPS) have achieved significant progress in recent years.

Prof. Yan further remarked that he is very pleased with the decision of CAS-XIV and its Management Group to develop and implement under the Open Programme Area Group (OPAG) for WWRP a technical and strategic plan for a new WWRP that integrates WMO Member activities in THORPEX, tropical meteorology, mesoscale weather forecasting, nowcasting, verification and societal and economic benefits with those of partners in global forecast research and Earth observations. In such a plan, maintenance and strengthening of the traditional strong links with the Global Atmosphere Watch (GAW) programme, the World Climate Research Programme (WCRP), and other WMO programmes are needed. He concluded by emphasizing that the development and implementation of the WWRP Strategic Plan: 2008-2015 will undoubtedly lead to a revitalized WWRP that supports NMHS in their efforts in disaster risk reduction.

1.3 The Director of the Atmospheric Research and Environment Programme Department, Dr Leonard Barrie, welcomed all participants to the meeting and presented a brief summary of the work of the programme on the basis of the directives given by CAS-XIV. He pointed out that the two major programmes of CAS; namely GAW and WWRP including THORPEX are ripe for closer cooperation now that aerosols, ozone and their precursors are being added as dynamic elements of weather forecast models. The benefits are not only in air quality and long range transport deposition forecast but also in feedbacks on atmospheric dynamics, clouds and precipitation. The GAW Strategic Plan for 2008-2015 (GAW report #172) was approved recently by the other OPAG of CAS on Environmental Pollution and Atmospheric Chemistry. He introduced the CAS/AREP Organizational Components diagram (Annex A) that has evolved since CAS-XIV.

1.4 Dr Gilbert Brunet reviewed the terms of reference and mission of the Joint Scientific Committee (JSC) established by CAS-XIV in Cape Town, February 2006 (WMO TD 1002, Annex II). He stressed the importance of this meeting in the initiation of a new World Weather Research Programme that will join the WCRP in facing the challenge of developing the next generation of weather and climate prediction services and products for WMO Members.

1.5 The list of participants is reproduced in Annex B.

2. ADOPTION OF THE AGENDA

The agenda was adopted by the session. The structure of this report follows the agenda.

3. REPORT OF THE PRESIDENT OF THE COMMISSION ON ATMOSPHERIC SCIENCES (CAS) ON CAS-XIV AND EC-LVIII

The President of CAS, Dr Michel Béland, briefed the session on decisions of CAS-XIV and EC-LVIII related to WWRP. CAS-XIV recognized that weather research and prediction was evolving, with broad consideration of the understanding and prediction of environment variability, and increasing collaboration and integration of oceans in prediction systems and forecast applications. It noted the increasing complexity of the work of WWRP and the importance of developing and implementing a technical strategic plan to guide future work. Recognizing the need for a source of expert advice on relevant areas of WWRP during the next four years, CAS-XIV agreed that the establishment of the WWRP Open Programme Area Group (OPAG) and the integration of THORPEX with the other programme components is an effective way to organize the working structure, and enhance coordination between disciplines and other technical Commissions of WMO. The 58th WMO Executive Council in June 2006 agreed with the report of CAS-XIV. Dr Béland pointed out four challenges facing the JSC OPAG-WWRP:

- a) To provide the overall scientific guidance for the WWRP focusing on the reorganization of the weather research activities, simplifying the structure to reduce the costs without harming programme outputs.
- b) To develop a strategic science and implementation plan for WWRP and a work programme aligned with the WMO Strategic Plan.
- c) To identify two or three initiatives where WWRP can work together with the World Climate Research Programme (WCRP) and other WMO programmes.
- d) To harmonize the task and activities of the various working groups to complement each other or other WMO programmes without undue duplication.

4. REPORT OF THE CHAIR OF THE WWRP JOINT SCIENTIFIC COMMITTEE OF OPAG-WWRP

Dr Gilbert Brunet noted that the purpose of WWRP as defined in the WMO Strategic Operating Plan for 2008-2011 that was approved by CG-XV in May 2007 is to support research that:

- Develops improved and cost-effective forecasting techniques, with emphasis on high impact weather and promotes their application among Members.
- Underpins the WMO Multi-Hazard Prevention Strategy aimed at reducing by 50 per cent over the decade 2010-2019 the number of fatalities caused by meteorological, hydrological and climate related natural disasters compared with the ten-year average fatalities of 1995-2004, through improvement of the early warnings of high impact weather globally.
- Enables governments, societies and economic sectors to realize fully the benefit of weather and climate related information in critical decision-making.
- Demonstrates improvements in the prediction of high impact weather, through the exploitation of advances in scientific understanding, new observing systems, observational network design, data assimilation and modelling techniques, and information systems.
- Demonstrates the benefits of improved global, mesoscale and nowcasting forecast systems to all societies.

And that these goals will be achieved through research and capacity building activities with the following objectives:

- a) Extend the range of skillful weather forecasts to time scales of value in decision making (up to 14 days) using probabilistic ensemble forecast techniques and better process parameterization of convection, clouds, precipitation formation and the radiative forcing of aerosols, ozone and long lived greenhouse gases.
- b) Develop accurate and timely weather warnings in a form that can be readily used in decision-making support tools.
- c) Assess the impact of weather forecasts and associated outcomes on the development of mitigation strategies to minimize the impact of natural hazards.
- d) Advance the knowledge of global-to-regional influences on the initiation, evolution, and predictability of weather systems.
- e) Contribute to the process of evolution of the Global Observing System (GOS) of the WMO-WWW programme, by developing systems for interactive forecasting and assimilation of targeted observations.
- f) Improve and demonstrate decision-support tools, which utilize advanced forecast products to benefit directly social and economic sectors.
- g) Demonstrate and verify objectively, improvements in weather forecasting accuracy.
- h) Ensure that all Members could benefit from WWRP advances, by organizing and leading projects and training events in conjunction with other WMO Programmes.

Dr Brunet emphasized that the objective of this first meeting of the new WWRP JSC held back-to-back with the Sixth Meeting of the International Core Steering Committee (ICSC) of THORPEX was threefold: first, to inform each other of ongoing activities in each working group through reports of the chairs; second, to discuss and agree upon the structure and plan for production of the WWRP Strategic Plan for 2008-2015; and third to provide input to THORPEX that will enable the ICSC to make changes that align THORPEX with the new WWRP structure requested by CAS.

5. REVIEW OF THE WORK OF WWRP: PAST, PRESENT AND FUTURE

5.1 THORPEX

Dr David BurrIDGE, Director of the THORPEX International Programme Office (IPO) at WMO and chair of THORPEX Executive Board (EB)¹ briefed the group on THORPEX activities. He mentioned that traditionally WWRP dealt mostly with technology transfer and capacity building through forecast demonstration projects, meetings, training etc. In 2003, THORPEX was established by WMO Congress XIV to fill gaps in forecast research left by the old WWRP and to link to users such as the operational weather forecasters, climate modellers and seasonal climate prediction communities. Details of the THORPEX programme can be found in the report of the ICSC meeting held immediately after this meeting (WMO/TD-No.1389; WWRP/THORPEX Report No. 8).

5.2 Working Group on Mesoscale Weather Forecasting (WGMWF)

On behalf of WGMWF and its chair, Dr Jeanette Onvlee (The Netherlands), Dr Volker Wulfmeyer (Germany) presented at the meeting the report of the said working group. The group's terms of reference set by CAS-XIV are to:

- a) Promote, organize, and/or endorse end-to-end weather research and development projects (RDPs) including understanding of weather processes improving forecasting techniques, improving the utility of forecast systems with an emphasis on high-impact weather.
- b) Establish project committees and experts teams, as required, for the implementation of projects to meet the objectives of the WG.

¹ At the subsequent ICSC meeting 26-27 April 2007, Dr BurrIDGE who was retiring as Director of THORPEX IPO was appointed chair of a new streamlined ICSC that replaced the old ICSC, Technical Advisory Board and Executive Board.

- c) Actively promote the application of improvements in weather forecasting capability through forecast demonstration projects (FDPs) and the establishment of testbeds.
- d) Supervise the process of individual evaluation and quality assessment of each “pre-operational”-type projects (in particular of each demonstration project) and to validate its conclusions, in light of the state of the art.

The activities of the WGMWF will include the performance of field campaigns, test of new observation systems, the development of multi-mesoscale model ensembles with improved parameterizations, and the development and application of mesoscale data assimilation systems. These components will be used for studying the organization of mesoscale convective systems and their predictability.

Some future activities of the working group include:

- The WWRP Beijing Olympics RDP 2008 (B08) to be hosted by the China Meteorological Administration and involving participants from Australia, Canada, United Kingdom, United States, Japan, Hong Kong Special Administrative Region of China etc. One of the components of B08 is a 6 to 36 hr mesoscale ensemble prediction (MEP) research and development project to demonstrate how mesoscale Ensemble Prediction Systems (EPS) can improve high impact weather short-range forecasts and to train forecasters to apply mesoscale EPS.
- The WWRP FDP D-Phase (Demonstration of Probabilistic Hydrological and Atmospheric Simulation of Flood Events in the Alpine Region), which aims to demonstrate the benefits in forecasting heavy precipitation and related (flash) flood events, as gained from the improved understanding, refined atmospheric and hydrological modelling, and advanced technological abilities acquired through research work during the Mesoscale Alpine Programme (MAP).
- The Convective and Orographically-induced Precipitation Study (COPS) led by Dr Wulfmeyer. The goal is to advance the quality of forecasts of orographically-induced convective precipitation by 4D observations and modelling of its life cycle.

He pointed out the strong link of this group’s activities to many THORPEX activities and in particular the TIGGE local area modelling panel.

Decision 1: Develop a common vision between the WGMWF, THORPEX TIGGE and its TIGGE-LAM panel and the T-PARC and incorporate it into the WWRP Strategic Plan (**Action: Chairs of WGMWF, TIGGE-LAM, T-PARC and Secretariat, S. Nickovic**).

5.3 Working Group on Nowcasting Research (WGNR)

Dr Tom Keenan, Chair of the Working Group on Nowcasting Research (WGNR), provided the session with a review of past and future activities which included the following:

- a) FDPs Beijing Olympics 2008 (B08) and Vancouver Olympics 2010.
- b) Linking WWRP and Public Weather Service (PWS) Nowcasting support activities.
- c) Joint WWRP/CIMO/GEWEX Radar Quality Control (QC) project.
- d) Intercomparison project on Quantitative Precipitation Estimation (QPE).
- e) Capacity building projects (3rd WWRP Nowcasting Workshop, Africa 2005; EUMETCAL August 2006, Langen, Germany; Palm Cove Training Workshop Australia 2007; Latin America Training Workshop 2007, Eastern European Training Workshop 2009).
- f) Nowcasting and Very Short Range Weather Forecasting (WSN09) Symposium in Canada, Summer 2009.
- g) NRWG Meeting.

With regard to activity ‘c’, a meeting of the Joint Nowcasting Applications and Services Steering Committee (JONASSC) between PWS and WWRP on Nowcasting Applications took place in Geneva, 18-20 April, 2007. The aim was to develop a joint WWRP-PWS Nowcasting Applications implementation plan. Specific issues discussed during the meeting included: PWS

Nowcasting Applications framework, components for PWS Nowcasting service delivery, building on existing initiatives and identifying new opportunities and the terms of reference of the JONASSC. The focus was to facilitate the transition of end-end concepts, applications, systems and procedures already demonstrated in research to operations to meet PWSP objectives. The steering committee agreed that coordination through a matrix type strategy based primarily upon multi-faceted capacity building, various demonstration projects and the use of an open test bed concept should be applied regionally. Where possible, these activities will build on existing initiatives. The JSC WWRP discussed this and came to the following conclusion.

Decision 2: Define the link of the Working Group on Nowcasting (Research) of WWRP with the Working Group on Nowcasting (Applications) of WMO's Applications Department in the WWRP strategic plan with clear terms of reference for Joint Nowcasting Applications and Services Steering Committee (JONASSC). JONASSC should be limited in membership to leaders in the respective nowcasting groups and no extra meetings or travel support expended in conducting their liaison work. **(Action: Chair of all Groups T. Keenan and the Secretariat, N. Lomarda and H. Kootval).**

5.4 Working Group on Tropical Meteorology Research (WGTMR)

5.4.1 WGTMR report on March 07 Meeting

Prof. Lianshou Chen, Chairman of the Working Group on Tropical Meteorology Research, presented a detailed report on the working group meeting held in Guangzhou, China 22-24 March 2007 (Report# WWRP 2007-4; WMO TD 1393). Since CAS-XIV, the working group activities include:

- a) Quadrennial Work Report to CAS-XIV Meeting.
- b) FDP Project – EWS for PAGASA / the Philippines has been submitted.
- c) International Symposium – Winter MONEX Kuala Lumpur / Malaysia 4 – 7 April 2006.
- d) The 6th Quadrennial International Workshop on Tropical Cyclones San Jose/Costa Rica 21-30 Nov 2006 (Report# WWRP 2007-1; WMO TD 1383).
- e) An international training workshop on Tropical Cyclone Disaster Reduction Guangzhou, China 26-31 March 2007 (Report# WWRP 2007-3; WMO TD 1392).

Activity 'e' involved a research-oriented international training workshop on tropical cyclone disaster reduction which was held from 26 to 31 March 2007 at the Guangzhou Meteorological Training Centre. Of the 60 participants at the workshop, 45 were operational forecasters from the five tropical cyclone regional bodies while the workshop lecturers are leading experts in the field of tropical cyclone research and forecasting. The workshop provided training and experience on new knowledge gained from recent advances on tropical cyclone research and how best to apply these to operational prediction activities in order to enhance the accuracy and usefulness of tropical cyclone forecasts and warnings. See the report on the web for details.

In order to provide a more structured programme linked to other components of WWRP to carry out its objectives cost-effectively in the near term, the working group proposed during its March 2007 meeting, a revised structure of WGTMR as shown in Annex C.

A discussion forum was organized on how to answer questions such as: "How can we effectively harness the full potential of research to enhance the accuracy and lead time of tropical cyclone forecasts and warnings?" and "What are the focused activities in tropical cyclone research that can provide added value and build capacity to address the needs of the national tropical cyclone warning centres?" The outcome was a list of recommendations which will be submitted to the committees of the five tropical cyclone regional bodies.

The Tropical Cyclone Panel focus on high impact weather associated with tropical cyclone landfall led to continued efforts to find funding for the Early Warning System Forecast Demonstration Project in the Philippines. A major activity during 2008 will be the Tropical Cyclone Structure 2008 (TCS08) field project in collaboration with the THORPEX-Pacific Asian Regional

Campaign (T-PARC), which will be focused on tropical cyclone recurvature and extratropical transition and the subsequent high impact weather downstream to North America and beyond. In addition to the international training workshop on tropical cyclone disaster reduction described above, the WGTMR will continue to work closely with the Applications Department Tropical Cyclone Project to transition research to assist the NMHSs in improving forecasts, and co-sponsor the Seventh International Workshop on Tropical Cyclones (IWTC-VII) in 2010. A Second International Workshop on Tropical Cyclone Landfall Processes is also planned. Further assessment of the potential effects of climate change on tropical cyclones will continue in response to requests from the tropical cyclone regional bodies and NMHSs.

The Monsoon Panel has ongoing collaborations with the WCRP's CLIVAR (Asian-Australian Monsoon Panel) and GEWEX (Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative or MAHASRI). Panel Chair C.P. Chang (WWRP JSC Member) is currently attending the pan-WCRP Asian Monsoon Year 2008/2009 (AMY08) programme meeting in Beijing, in which the intensive observing period (IOP) of the mesoscale monsoon rainfall projects such as SCHeREX, SoWMEX etc will be coordinated with the monsoon climate projects such as MAHASRI and AIPO to benefit both the weather and climate research. The Monsoon Panel will organize the Fourth International Workshop on Monsoons (IWM-IV) and the Eighth Training Workshop on Asian/African Monsoon in 2008.

In addition, the WGTMR will organize roving seminars on Local Area Modelling (LAM) in the Tropics and a workshop on QPE/QPF with participation from both panels.

Following the announcement by the Chair that WGTMR would also organize a workshop on the effects of climate change on tropical cyclones, there were questions about the place for this topic in a World Weather Research Programme.

Decision 3: Since the weather research rather than the climate research community is most suited to addressing questions about the effect of past climate change on tropical cyclones and the adequacy of observations in detecting change, the JSC endorses the leadership WGTMR in organizing a workshop on the effects of climate change on tropical cyclones. Cooperation with other working groups of WWRP and the climate research community should be included. It is proposed that this collaborative effort is discussed in the weather-climate prediction white paper (see Section 7.2) (**Action: Chair of WGTMR**)

5.4.2 Tropical Cyclone Programme (TCP) of the Applications Programme Department

Mrs Nanette Lomarda, WWRP/AREP, on behalf of Mr K. Kuroiwa (Chief, TCP), presented a brief overview of the programme and its working relationship with AREP. The TCP is tasked to establish national and regionally coordinated systems to ensure that the loss of life and damage caused by tropical cyclones are reduced to a minimum. The activities pursued relate to three main fields: operational meteorology, hydrology, and prevention and preparedness. Although it is an applications programme to assist operational weather forecasters, it does support some special research projects undertaken by members of the five tropical cyclone regional bodies in close collaboration and full coordination with WWRP and its WGTMR.

Crosscutting Activities

5.5 Joint Working Group on Verification (JWGV)

Dr Barbara Brown, chair of the WWRP/WGNE JWGV, reported on the goals and recent activities of the working group. These include the Beijing Olympics FDP/RDP; the THORPEX International Global Grand Ensemble (TIGGE) project; MAP D-Phase and THORPEX. The JWGV strives to utilize mesoscale meteorological test beds such as that operated by the Finnish Meteorological Institute and Vaisala. Other activities of the JWGV include: research on verification methods (spatial method intercomparison), coordination with Social and Economic Research Applications (SERA) activities (user-focused verification) and coordination with other WMO verification activities.

The JWGV organized and held from 29 January to 2 February 2007 in Reading, U.K, the *Third International Verification Methods Workshop* (Report # WWRP 2007-2; WMO TD1391) with co-sponsorship from WWRP and WCRP as well as the European Cooperation in the Field of Scientific and Technical Research (COST) and the European Centre for Medium-range Weather Forecast (ECMWF). The workshop had 131 participants from 32 National Meteorological and Hydrological Services (NMHSs), 3 international organizations, 13 government agencies, 11 universities and 3 private weather service providers. The workshop focused on new verification techniques and issues related to the practice of forecast verification, as well as contributed presentations on verification methodologies applied to a variety of forecasts (including forecasts of phenomena outside of atmospheric sciences, such as economics) and the development of new verification packages (e.g. the verification package in "R"). Subjects covered included verification of ensemble/probability forecasts, extreme events, forecast value and user issues. The JWGV also provided a hands-on verification tutorial for 30 students during the 2.5 days prior to the workshop. Topics covered included basic verification principles, verification of categorical and continuous variables, evaluation of probabilistic forecasts, and inference and uncertainty in verification. The students provided very positive reviews of the tutorial sessions.

The JWGV held a coordination meeting shortly after the Reading workshop to discuss ongoing and future activities.

The JWGV is heavily involved in preparations for the Beijing Olympics FDP (B08). Dr Brown is a member of the B08 steering committee and Dr Laurence Wilson (Canada) is a member of the steering committee for the B08 Research Development Project (RDP). A major activity for B08 is the development of a Real-Time Forecast Verification (RTFV) system. This system being implemented by Dr Elizabeth Ebert (Australia), includes standard verification approaches as well as recently developed approaches for evaluation of spatial nowcasts/forecasts of precipitation and convection. It will run in real time during the Beijing Olympics FDP. The JWGV also provided guidance on verification approaches for the Beijing Olympics RDP and for the forecasts being produced as part of TIGGE.

The JWGV has prepared a document describing a standard set of approaches and measures for evaluation of non-probabilistic precipitation forecasts. This document was provided to WGNE and is available from the JWGV. The document is currently being extended to include methods for probabilistic forecasts. The JWGV has continued to support various outreach activities, including the verification web page and verification discussion group. The web page (http://www.bom.gov.au/bmrc/wefor/staff/eee/verif/verif_web_page.html) is updated on a regular basis by E. Ebert (Australia). Some new datasets have been included on the website to demonstrate various verification approaches.

L. Wilson and Dr Perti Nurmi (Finland) had developed a EUMETCAL training module on verification, and D. Stephenson recently completed a 6-month study regarding how forecasters and users assess the quality of forecast products in the UK. The JWGV is planning to organize the Fourth Workshop on Verification Methods tentatively in 2009.

Dr Miller added that as part of WGNE activities, the JWGV is currently looking into verification techniques precipitation using national high density data at several NWP Centres and cloud forecasts. Areas for future investigation include typhoon tracks and intensity for all ocean basins, the SURFA project (NWP surface fluxes), and development of metrics for climate models.

5.6 Societal and Economic Research and Applications (SERA)

Dr Jeffrey Lazo, chair of SERA, emphasized that since CAS-XIV SERA is responsible for the development of the social science agenda not only for THORPEX but for the whole of the WWRP including THORPEX. The focus is on understanding or defining the following:

- Decision processes and why a good weather forecast is unable to support a good decision.
- High impact weather forecasts from the perspective of the user/decision-maker.

- Understanding why forecasts are a problem for many application areas.
- Understanding the changes needed for meteorologists to work more closely with decision-makers.
- The use of ensemble forecasts in applications.
- Probabilistic forecasts versus deterministic decisions.
- Impact (or risk) forecasts.

Dr Lazo also talked about SERA's past activities and plans which included:

- a) Inventory studies - information use and benefit, collection of existing survey instruments, revised research agenda based on TIP - "one-pagers".
- b) SERA WG meeting with ISDR, IFRCC, WHO (high priority needs for weather information)
- c) Participation in the THORPEX Science Symposium in Germany (December 2006).
- d) WMO SEB conference (March 2007).
- e) WMO Task Force on SEA.

He also elaborated on accomplishments of SERA and challenges. Accomplishments include: initiation of the WG, identifying WG group activities, developing baseline efforts and coordinating work with other groups. The challenges are to improve limited social-economic community involvement, coordinating verification activities, integration of SERA activities throughout WWRP-THORPEX and the question of funding for SERA-type work. The WG is looking forward to restructuring/re-energizing SERA based on the outcome of this WWRP and the following THORPEX meeting. What is needed is a social science capacity, interest sub-groups (TIGGE, communications, decision making, decision support/applications, user-relevant verification and valuation).

The JSC discussed briefly the idea of conducting a WMO Global Assessment of the Societal and Economic Benefits of Weather Forecasting.

Decision 4: Consider a WMO global assessment of the Societal and Economic Benefits of Weather Forecasting project to the SERA contribution to the WWRP Strategic Plan (**Action: Chair of SERA**)

5.7 Forecasting Systems

Dr Tom Keenan, chair of the Working Group on Nowcasting, presented a proposal on the development of a forecast system project that was first introduced to the old WWRP steering committee at a meeting in China, October 2005. It recommended that a mechanism is provided for international collaboration on the development and application of forecast systems such as WGNE does for NWP. The 56th and 57th Executive Council meetings of WMO called for the enhancement of NWP products for better forecasting of high-impact weather. Within WMO, responsibilities for forecast systems cut across existing commissions (CBS and CAS) and programmes (WWRP, WWW/DPFS and Applications/PWS). The original suggestion by WWRP was that a small meeting of experts is held to consider processes to:

- Increase information exchange on forecast system development and implementation,
- Establish standards and criteria for forecast systems and their components, including verification and forecast processes, including automated worded forecasts,
- Conduct studies to compare alternative solutions to problems in the design and implementation of forecast systems,
- Enhance communication on the costs and benefits of forecast systems.
- Transfer to developing countries.

Such a meeting has not been undertaken due to changes within WWRP and scheduling issues with CBS.

Decision 5: The JSC supported the recommendation that a meeting of experts on the development and application of forecast systems is held in 2008 cutting across commissions (CBS and CAS) and programmes (WWRP, WWW/DPFS and Applications/PWS). Initial coordination of this meeting should be undertaken under the direction of the chair of the WWRP Working Group on Nowcasting Research consulting with other WWRP WG's and the other WMO programmes (**Action: Chair of WG on Nowcasting Research**).

5.8 The Joint WWRP/WCRP Working Group on Numerical Experimentation (WGNE)

Dr Martin Miller (U.K.), chair of WGNE, reported the main activities of WGNE jointly supported by WWRP and WCRP with emphasis on items arising at its 22nd session hosted by the National Centre for Atmospheric Research (Colorado, USA, October 2006). The WGNE Chair is a member of the JSC of the new WWRP, the CAS Management Group and the THORPEX International Core Steering Committee. WGNE hosts THORPEX sessions at its meetings. The close relationship that exists between research and operational NWP centres underpins many of the activities of WGNE. Emphasis has been given to activities where international coordination is paramount.

WGNE has the responsibility of fostering the development of atmospheric models for use in weather prediction and climate studies on all space and timescales. Dr Miller noted that unified (coupled) forecast systems that provide forecasts from days out to seasons will also provide new opportunities for utilizing ensemble techniques and bring the NWP and climate communities even closer together. In WCRP, WGNE is at the core of the global modelling effort. The chair is a member of the WCRP Modelling Panel (WMP). Co-ordination between WGNE, WCRP/WG on Coupled Modelling (WGCM) and WCRP/WG on Seasonal to Inter-annual Prediction (WGSIP) is maintained primarily through ex officio meeting attendances. WGNE is also represented on the WCRP Observation and Assimilation Panel (WOAP).

WGNE also works in close conjunction with the WCRP Global Energy and Water Cycle Experiment (GEWEX) particularly in the development of atmospheric model parameterizations, with WGNE sessions held jointly with the GEWEX Modelling and Prediction Panel (GMPP). The close working relationship with GMPP (the GEWEX Modelling and Prediction Panel) provides the focus for the development, refinement and evaluation of parameterizations, notably those for clouds, precipitation, radiation, land surface, soil moisture and atmospheric boundary layer processes. WGNE reiterated the value of the collaboration with GMPP, particularly with GEWEX Cloud System Studies (GCSS). A joint WGNE/GCSS model inter-comparison study of a Pacific cross section (GPCI) to evaluate physical parameterizations along the atmospheric cross section following the trade winds is in progress, with excellent support from both NWP and climate modelling groups.

The JSC discussed the need for an expert group on parameterization to advise both WCRP and WWRP (and their Working Groups).

Decision 6: In consultation with the WCRP Global Energy and Water Cycle Experiment (GEWEX) consideration should be given to the need for a WWRP expert group on model parameterizations for NWP models particularly for convection, clouds and precipitation processes and the outcome reflected in the WWRP strategic plan (**Action: Chairs of WGNE and JSC-WWRP**).

Dr Miller noted the progress of NWP centres in better resolving processes through improvements in resolution. Although encouraging results have been obtained for macrostructures such as downdraught outflows (cold-pools etc) and other mesoscale forcing processes, parameterization of the PBL including shallow convection, and cloud microphysics is still essential. Both global 3.5 km and large domain 1km experiments have been conducted using the Japanese Earth Simulator. Plans are underway to do similar studies for large-scale tropical convection in the UK and at that the new Science and Technology Centre at Colorado State University (Centre for Multi-Scale Modelling of Atmospheric Processes, CMMAP). These will accelerate progress in the use of cloud system resolving models in global domains.

The JSC agreed that model spatial resolutions of much less than 100 km are needed to properly simulate extra-tropical storms. It expressed serious concern for the lack of resolution of such weather phenomenon in typical climate models.

Plans are underway to organize a WGNE/PCMDI Workshop on Systematic Errors in Climate and NWP models San Francisco (2007) with the focus on the following topics: metrics for short-range forecasts from NWP analyses, the value of running suitably initialized coupled models in forecast mode over seasonal time scales, accurate representation of the diurnal cycle, persistent errors (e.g. onset/breaks in MJO, monsoons), opportunities afforded by the 'Golden Age' of satellite data, benefits of substantially increased resolution, cloud feedbacks (low clouds), complexity versus basic physical realism, systematic error reduction through high resolution, need of major increases in computing power with a balanced investment in manpower.

Dr Miller ended his presentation noting the following:

- The need to cope with rapid progress in NWP both global and regional, deterministic and probabilistic.
- Resolution challenges for parameterizations.
- Verification challenges of very high resolution.
- Importance of capturing $\sim 5/3$ part of KE spectrum.
- Major problems in predicting the diurnal cycle accurately.
- Major problems in the tropics with prediction of the Madden Julian Oscillation (MJO) and monsoons.
- Opportunities from new satellite observations.
- Growing application of NWP techniques for climate model development.
- The fundamental need for 10-100 km simulations because of ensemble requirements and demands of geo/bio-complexity, inadequate climate model resolution.
- The need for a good set of climate model metrics.

Decision 7 WWRP should continue to jointly organize and support with WCRP, the annual WGNE meeting (the next is 22-26 October 2007 in Shanghai) and to ensure that not only THORPEX but the whole of WWRP is addressed. **(Action: D/AREP)**

5.9 WMO Sand and Dust Storm Warning System

Dr Slobodan Nickovic, AREP, reported on the WWRP Sand and Dust Storm Project and the status of development of a *WMO Sand and Dust Storm Warning System (SDSWS)*. The latter was established as the focus of the project by the Scientific Steering Committee (SSC) meeting in Shanghai, China, November 2006. The objectives of SDSWS:

- a) To coordinate a global network of sand and dust storm forecasting research centres delivering warning products useful to a wide range of users in understanding and reducing the impacts of sand and dust storms.
- b) To promote research and applications related to sand and dust storm processes.

During the aforementioned SDS SSC meeting three SDSWS centres have been designated for the following regions: North African/European region (hosting country – Spain), East Asian/Pacific region (hosting country – China), and North American region (to be determined). There are plans to establish a WMO portal website to the regional SDS centres. Special emphasis will be placed on the provision of SDS forecasts that are tailored to the needs of the 'community of practice'. Among various SDS impacts, health problems induced by sand (such as cardio-vascular problems, eye infections, valley fever transmitted by dust, meningitis related to dusty weather) are rather important. A WMO/GEO Expert Meeting on an International Sand and Dust Storm Warning System" will be hosted by Spain in November 2007. An ad-hoc inter-programme group at the WMO Secretariat has been formed representing WWW, Aviation Applications, Agricultural Applications and GEO. A draft implementation plan for SDSWS is being developed by a sub-group of the SDS SSC chaired by Dr W. Sprigg and will be reviewed at a meeting of the SSC in Barcelona after the meeting.

Decision 8: The JSC-WWRP endorsed the WMO Sand and Dust Storm Warning System as a project of WWRP and recommended that it be submitted to WMO as a Disaster Risk Reduction Project of widespread interest to WMO members in Africa, the Middle East and Asia (**Action: D/AREP**).

5.10 Links with other WMO Technical Programmes and GEO

5.10.1 World Weather Watch

Dr Jack Hayes, Director of the World Weather Watch (WWW) Programme, presented a brief overview of activities focussing on the partnership between research and operations, in particular on technology transfer. Under this aspect he talked about goals such as ensuring that: operational science and technology capabilities are as close to the “cutting edge” as possible; what is transitioned is sustainable (for developing and least developed countries, as well as developed countries; appropriate balance between research “push” and “pull”; the smooth and timely transition of new science and technology at the lowest feasible cost; and maximizing the use of funding for targeted work.

Based on past experiences, Dr Hayes encouraged the timely implementation of end-to-end planning and programming between research activities and operational end-users. He emphasized the need to facilitate the transition between research and operations.

Decision 9: The JSC-WWRP welcomed collaboration with the operational NWP programmes of WMO and emphasized that a seamless link between research and operations through technology transfer, training and capacity building will be part of the strategic plan of WWRP (**Action: Chair JSC-WWRP**).

5.10.2 WMO Information System

Mr David Thomas, WMO Information System (WIS) Project Manager, reviewed the status of WIS implementation and commented on the role of WWRP. WIS is a unique, coordinated global infrastructure for the collection and sharing of information. It will enhance access to more services and will be the integrated system for all WMO programmes that generate and wish to distribute high volumes of information in a timely and secure way. This should facilitate the active participation of the less developed Members in WMO programmes such as WWRP and WWW.

The system includes three levels of responsibilities: Global Information System Centres (GISC), Data Collection or Product Centres (DCPC) and National Centres (NC). It should be noted that this is a logical description and that one physical centre could perform the functions of all of the centres defined. Likewise, several physical centres could cooperate to perform the functions of a single logical centre. Four to ten Global Information System Centres (GISC) will form the hub of WIS. These centres will collect all observations and products intended for global distribution from supplying centres within their area of responsibility. Each supplier will send its observations and products intended for global exchange to its designated GISC directly or via a DCPC where they would be forwarded to all of the other GISCs. The collection of observations would thus be organised into a series of star networks connected by a logical ring at the centre comprised of the GISCs. Each GISC will maintain a synchronised catalogue of such information and services available in WIS. Several prototype GISCs and DCPCs will become operational supporting specific programmes (THORPEX, TIGGE, GAW, etc.). Some key data management and communication features of GISCs are: metadata; internet portals; push/pull dissemination; system performance monitoring; connection of selected research facilities (e.g. NCAR, IRI, Max Planck), data centres (e.g. GAW World Data Centres) and disaster management agencies/organizations,

Aside from registering metadata in a standard format in a GISC about information and services, it is not necessary nor the intention of WIS to standardise beyond the core network the physical links and protocols to be used between all of the suppliers and collectors. Although Members are encouraged to use the data representation and codes available under WIS project or activity specific connectivity could instead be decided by bilateral agreement to best match the requirements and capabilities of the parties involved. This approach is currently used with effective

results linking a number of NMHSs. The difference under WIS will be that metadata describing information exchanged on bilateral links will still be registered in the central GISC catalogues. Several dozen centres will serve as DCPCs including existing World Meteorological Centres and Regional/Specialized Meteorological Centres.

Individual users will benefit from WIS, which will provide a single entry point for any data discovery and request, be it on a routine basis by dissemination of certain user defined information sets or on an ad-hoc basis for a special data set. The current diversification of access points and methods would be harmonised by a common approach. Furthermore, the portal structure provided by WIS will make it possible for WWRP and THORPEX to present their data to users in a programme specific query format.

Mr Thomas addressed specifically the participation of WWRP in WIS. In the first phase of THORPEX TIGGE, it is planned to generate and, deliver through WIS, a global data set of all ensemble prediction forecasts available at any given time. During a workshop held at ECMWF in March 2005, CMA, ECMWF and NCAR agreed to host the data and make them accessible to research groups as required. TIGGE work on file switching and upgrade of GRIB has improved access to data and contributed greatly to WIS DCPC implementation. The use of table driven codes for BUFR, GRIB2 and CREX has been accelerated through TIGGE. Thus investments of WWRP-THORPEX time resources and research benefit other programmes through WIS.

WIS is also WMO's component of GEOSS. Information in WIS catalogues will be discoverable through GEOSS and, where data policy allows, will also be retrievable through GEOSS. To this end, participation in GEOSS Architecture and Data tasks is a key focus of the WIS Project Office to ensure that this interoperability is delivered.

5.10.3 Disaster Prevention and Mitigation

Dr Leonard Barrie, Director/AREP, presented the WMO Natural Disaster Prevention and Mitigation Programme based on the CAS/AREP perspective. He emphasized the importance of enhancing the contributions of NMHSs to systems dedicated to protection of lives, livelihoods and property. One way to accomplish this is through cooperation in Disaster Risk Reduction (DRR) programmes at national to international levels by undertaking a focused number of well integrated pilot projects that have strong support from host countries, technical commissions and crosscutting links to other WMO technical programmes. He mentioned concrete projects within the WMO DRR programme as defined by a crosscutting Secretariat group on DRR chaired by the Deputy Secretary General of WMO. He presented a brief overview of the following initiatives including: South East Africa Weather Forecast project led by WWW/GDPFS; Multi-Hazard Early Warning System (MHEWS)-France led by the DRR department and MHEWS-Shanghai led by AREP. The latter involves both air quality and air pollution hazards and the GAW-GURME project as well as meteorological hazards, nowcasting, mesoscale research and the TIGGE-LAM application. It is connected with World Expo 2010 in Shanghai.

Decision 10: The JSC acknowledged the importance of DRR projects but expressed some confusion regarding the transparency of the project selection process. It endorsed the Shanghai initiative led by AREP. It also noted that the WMO Sand and Dust Storm Project as well as TIGGE Phase II are prime candidates for future projects. It requested the Director of AREP to keep the JSC informed and to provide guidance on the steps toward establishing a DRR project (**Action: D/AREP**).

5.10.4 Group on Earth Observations

Mr Datong Zhao, Senior Scientific Expert, delivered an overview of the Global Earth Observation System of Systems (GEOSS) and GEO Weather Tasks. GEO, the intergovernmental Group on Earth Observations (EO), was established in February 2005 through a series of ministerial-level EO summits. Currently, it has 68 Members, the European Commission and 46 Participating Organizations. GEO has a single vision, the GEOSS. The basic idea of GEOSS is that the Earth is a complex system of systems, and to understand it, data are required from multiple observation networks and systems. Therefore, we must have observing systems that

transmit in the same format to serve a large number of applications across the diverse Social Benefit Areas.

GEOSS is a globally distributed system, including in-situ, air-borne and space-based systems. It consists of existing and future earth observation systems across the processing cycle from primary observation to information production, supplementing but not supplanting their own mandates and governance arrangements. As a participating organization of GEO, WMO has worked alongside GEO to expand global observations for a better understanding of global environmental trends. In just over three years, GEO has been able to bring together dozens of countries and international organizations, adopt and begin implementing a 10-year development plan, and agree upon a focus of nine societal benefit areas (SBAs):

- Reduction and Prevention of Disasters
- Biodiversity
- Agriculture
- Ecosystem
- Human Health
- Water Management
- Climate Change
- Weather Forecasting
- Energy Management

GEO is neither an implementation nor a funding organization but a high level coordinating organization that builds on and *adds value* to existing observation systems by coordinating their efforts, addressing critical gaps, supporting their interoperability, sharing information, reaching a common understanding of user requirements and improving delivery of information to users. GEOSS implementation is a voluntary process whereby the success of GEOSS will depend on data and information providers accepting and implementing a set of interoperability arrangements, including technical specifications for collecting, processing, storing, and disseminating shared data, metadata, and products. GEOSS is to be driven by user needs, support a broad range of implementation options, and be able to incorporate new technology and methods. It builds on and adds value to existing observation systems by reaching a common understanding of user requirements and improving delivery of information to users.

GEO will perform a coordination role to ensure that user requirements are being met, and transmit recommendations for improvements to the relevant contributing systems. A good example of coordination is regarding access to meteorological data for the diverse societal benefit areas under GEO. WWRP themes address under GEO tasks are:

- THORPEX/TIGGE (GEO 2006 Work Plan and 2007-2009 Work Plan Task)
- Seamless Weather Forecasting and Climate Prediction (GEO 2007-2009 Work Plan Task).
- WMO Sand and Dust Storm Warning System (GEO 2007-2009 Work Plan Task)

Mr Zhao mentioned that creating common, cross-disciplinary tools is also a significant aspect of GEOSS with high relevance to WWRP. As defined in WMO Resolution 40 (Cg-XII), observations will be made available through the GEOSS interoperable arrangements to serve the needs of the diverse SBAs under GEO. A good example of voluntary cooperation is GEO-NETCast project, which is a near real-time data dissemination system in support of all GEO SBAs. Surface-based, airborne, and space-based observations are transmitted to users through communication satellites maintained through GEO-NETCast. Building on existing networks, it will create a dissemination system by which environmental satellite and surface-based network data, products, and services from GEOSS are transmitted to users through a global network of communications satellites. EUMETSAT, NOAA and CMA have offered to join in the development of GEONETCast. The next step is to evolve it to a fully operational system with diverse data and product contributions to serve all GEO societal benefit areas.

The initiation of GEOSS implementation has generated a significant enthusiasm across all societal benefit areas and numerous activities launched in the first and second years of GEOSS implementation. The 2007-2009 Work Plan, entitled "Toward Convergence", presents an

opportunity to build on the mobilization of 2006 and, simultaneously, drive the process toward convergence of the large number of independent tasks into less numerous but more encompassing cross-disciplinary actions over the next three years. GEO supported TIGGE development (enhanced visibility; special session at THORPEX Symposium, Dec 2006). In future, GEO will help WWRP-THORPEX deliver TIGGE ensemble-based services and products in the nine GEO SBAs. It will do this through helping to ensure:

- Broad & easy data access through GEO Portal.
- Awareness of data availability.
- Development of socio-economic applications (Health, Energy, Water, Agriculture, etc.).

Mr Zhao reported that the WWRP-THORPEX TIGGE-LAM expert panel will ensure close collaboration and co-operation between activities at the global and regional scales and that data will be available for research in near real-time and will be provided in real-time to support the Beijing Olympics 2008, the International Polar Year and other activities in the areas of Health, Energy and Disaster mitigation supported by GEO Tasks. He mentioned that the best time frame for the TIGGE user workshop is the second half of 2008 and perhaps be joined with the Third WWRP-THORPEX science symposium, and that GEO will be closely involved in its preparation.

Decision 11: The JSC welcomed cooperation with GEO especially in strengthening the delivery of WWRP-THORPEX research through applications serving the nine GEO Societal Benefit Areas. Activities of the new WWRP programme including THORPEX should be represented in GEO and include TIGGE, seamless weather/climate prediction, and the WMO Sand and Dust Storm Project. **(Action: D/AREP)**

6. WWRP STRATEGIC PLAN (SP): 2008-2015

6.1 Introduction (D/AREP and Chair JSC-WWRP)

Dr L. Barrie (D/AREP) and Dr G. Brunet (Chair, JSC-WWRP) reminded the group that the WWRP Strategic Plan: 2008-2015 will include a technical implementation plan to be used to more effectively manage the diversity of projects supporting activities of the global weather research community and its collaboration with the climate research programme of WCRP. The plan is needed by the WMO Secretariat as a project framework document to effectively plan its support of the components of WWRP and other programmes and to assist working groups in making linkages to cross-cutting initiatives. Thus, working groups are requested to define the scope of their activities and specific tasks for the first half of the eight year period. The third GAW Strategic Plan:2008-2015 approved by the CAS OPAG for Environmental Pollution and Atmospheric Chemistry (WMO TD No. 1384; GAW Rep #172) was cited as a possible role model (see the GAW website under AREP Programme). The WWRP Strategic Plan:2008-2015 is also needed as a general reference document for scientists, managers and others interested in learning about the World Weather Research Programme and why it is an essential component of the weather-climate-environment analysis, prediction and assessment process that governments need to address global change.

6.2 Review of the WWRP Strategic Plan Outline

Dr Brunet presented a draft outline for comments and extensive discussion ensued.

Decision 12: The JSC supported the development of a Strategic Plan and requested the Chair to finalize the outline before issuing writing assignments. It was agreed that this is a dynamic working document that will evolve and change as the strategic plan is produced {the most recent outline valid at the time of distribution of this report is attached in Annex E} **(Action: Chair JSC-WWRP)**

6.3 Task Team for Drafting the Strategic Plan (SP)

Decision 13: The JSC agreed that the task team for coordinating the development of the SP will be composed of a small sub-group on the Strategic Plan Development composed of G. Brunet

(Chair, JSC-WWRP), D. McCulloch (Environment Canada, Executive Secretary), L. Barrie (D/AREP), Chief of AREP/WWRP Division (To be determined), S. Nickovich (Scientific Officer) and N. Lomarda (Senior Scientific Officer) and that the plan development and review include Chairs of the WWRP Working Groups and Expert Teams and other experts.

6.4 Strategic Plan Drafting Procedure and Timetable

The meeting agreed that the proposed length of contributions should be about two pages and that the tasks/goals should indicate who is responsible for the preparation of the contribution. A provisional plan and timetable is attached in Annex F.

Decision 14: The procedure and timetable suggested by the Chair of JSC-WWRP and D/AREP for developing the WWRP Strategic Plan: 2008-2015 was accepted by the JSC-WWRP.

7. OTHER BUSINESS

7.1 Message from WWRP to ICSC THORPEX

Dr G. Brunet, JSC Chair, will make a presentation at the THORPEX ICWSC meeting 25 to 27 April 2007 immediately following this one and invite comments on the draft outline of the WWRP Strategic Plan: 2008-2015 before finalizing it {this was done and the outline in Annex D has taken into account the ICSC comments; see THORPEX website for the report of their meeting}.

7.2 Weather-Climate Prediction White Paper

Dr Mel Shapiro, presented a brief summary of the Weather-Climate Prediction White Paper entitled: "Toward a seamless process for the prediction of weather and climate". This is a collaborative effort between the WWRP-THORPEX and WCRP. Contributors of the first draft include: Gilbert Brunet (Environment Canada), Randall Dole (NOAA), Brian Hoskins (Reading U.), George Kiladis (NOAA), Ben Kirtman (GMU/COLA), Mitch Moncrieff (NCAR), Rebecca E. Morss (NCAR), Saroja Polaravapu (Environment Canada), Mel Shapiro (NOAA), Julia Slingo (Reading U.), Istvan Szunyogh (Maryland U.) and Duane Waliser (JPL). The white paper proposes collaborative research between WWRP-THORPEX and WCRP involving global climate simulations with much improved representation of the variability associated with transient weather events, particularly extreme events, such as tropical and extra-tropical cyclones. An additional goal is to better understand the limits of predictability in the intra-seasonal (10 to 90 day) forecast range and weather predictions than can exploit predictability in that forecast range.

The proposed collaboration is timely because of the unprecedented advances of the last few decades in High Performance Computing (HPC), high-speed telecommunication, ground-, space-, and aircraft-based measurement technologies, systematic observations, remote sensing, field and laboratory process studies, data assimilation techniques, systematic observations, remote sensing, field and laboratory process studies, data assimilation techniques, and in highly performing coupled numerical models of weather and climate prediction. A WWRP-THORPEX/WCRP collaborative programme is planned to address specific scientific issues in order to accelerate the process of improving our understanding of the past and present state of the environment and to accelerate the improvement of our capabilities to make scientifically sound predictions of the future state of the Earth-system from days to seasons.

Considerable discussion took place. There was general agreement that WWRP and WCRP should work together to address the gaps identified. The plan for moving forward with this idea was not clear. The first draft of the Weather-Climate Prediction White Paper will be sent to WGNE and circulated to a wider international audience for comments and additional contributions between March-May 2007.

Decision 15: As part of the WWRP strategic planning process address this important issue with concrete tasks and assigned leads (**Action: Chair JSC-WWRP; D/AREP, WCRP**).

7.3 Year of Tropical Convection (YOTC)

Dr Mel Shapiro briefed the meeting on the plans and activities related to the YOTC. The idea arose out of a recommendation by the THORPEX/WCRP/ICTP Workshop on Organization and Maintenance of Tropical Convection and the Madden Julian Oscillation, held in Trieste in March 2006. A draft proposal for YOTC was presented at the CLIVAR SSG Meeting in Buenos Aires in April 2006. Based on positive feedback from the WCRP Director, the CLIVAR Scientific Steering Group endorsed the proposal and asked that it should be developed in cooperation with other groups such as THORPEX and GEWEX. One goal of YOTC would be to leverage the vast new observational datasets and computational resources in conjunction with new high-resolution modelling frameworks to better characterize, understand, model, and forecast multi-scale convective processes and dynamical interactions in the Tropics. The suggested region and time scales are ~ 40 N to 40 S and diurnal to seasonal. It would involve case studies of Madden-Julian Oscillation events and convectively coupled waves. It is relevant to better prediction of onset and breaks in monsoons, typhoons/hurricanes and easterly waves.

In this connection, Dr Volker Wulfmeyer pointed out that it is still very difficult to access gridded data sets of key observations for model evaluation and process studies. Even in Europe, no high-resolution data set of precipitation exists using all available observations and blended with weather radar and satellite observations. He suggested to start actions on the production of corresponding data sets, which can easily be assessed by scientists. It will be important to identify "world weather data centres" where these data can be stored.

The JSC agreed that if properly planned and executed, YOTC would lead to significant and important advances in 'seamless' weather and climate prediction on all timescales currently labelled under prediction. The JSC strongly supported the idea of YOTC but felt that it was less clear how the aims of the YOTC would be achieved.

Decision 16 : The JSC supports WWRP-THORPEX collaboration with WCRP to develop a strategy and implementation plan for YOTC in late 2007 and 2008 and recommended close coordination with the WWRP Working Group on Tropical Meteorology Research and its Panels **(Action: D/AREP)**

8. WWRP MEETINGS FOR 2007-2008

The session reviewed the list of WWRP meetings as presented by the Secretariat.

Decision 17: Make a proposal to the THORPEX ICSC that a joint WWRP-THORPEX Science Conference should be held in 4 years **(Action: Chair JSC-WWRP)**.

9. DATES AND PLACE OF NEXT MEETING

The JSC expressed the need to meet in a year's time in Geneva to finalize the WWRP Strategic Plan the precise dates will be determined later.

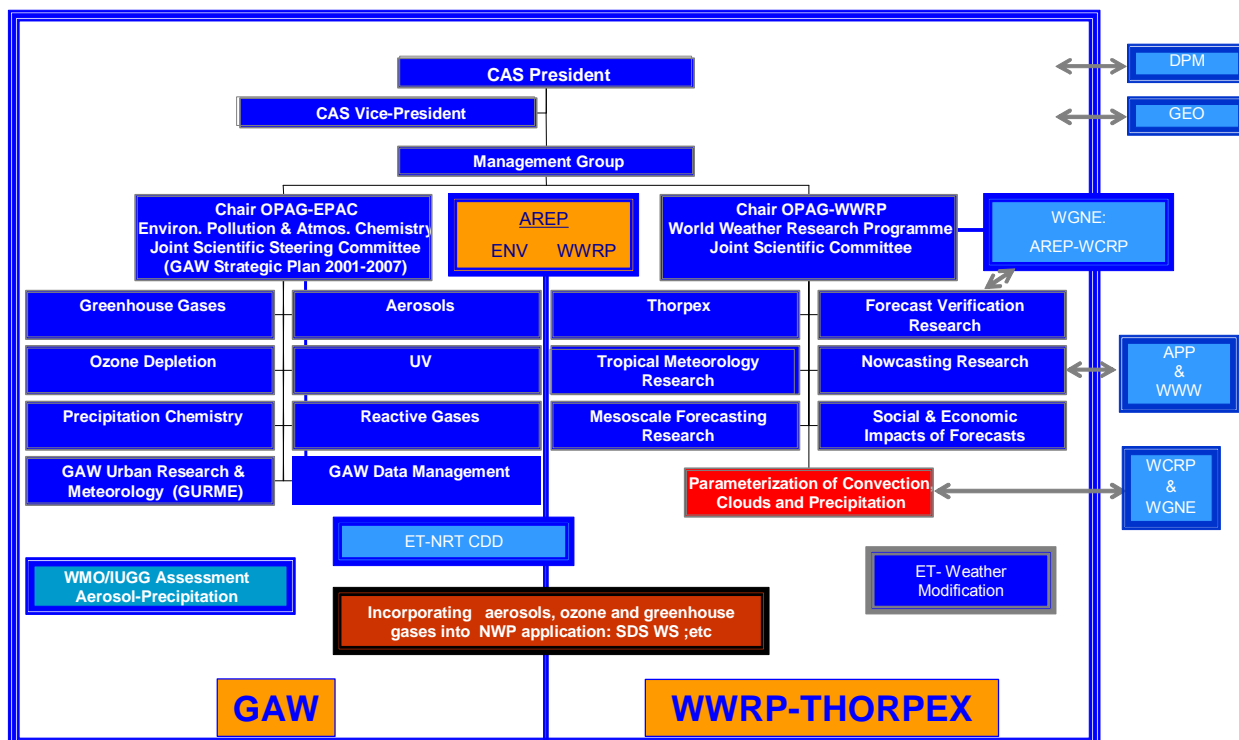
Decision 18: Hold the next meeting of the JSC in 2008 in Geneva at a time to be determined later **(Action: D/AREP and Chair JSC-WWRP)**.

10. CLOSING OF THE MEETING

The Chairman thanked the participants for their valuable collaboration and the Secretariat for the support rendered and declared the meeting closed at 12:30, 25 April 2007.

CAS/AREP Programme Structure Schematic as of April 2007

CAS/AREP PROGRAMME COMPONENTS



20 April 07

**Report of the First Session of the Joint Scientific Committee (JSC)
for the World Weather Research Programme (WWRP)**

(Geneva, Switzerland, 23 - 25 April 2007)

List of Participants

Dr Michel BELAND
President of CAS
Meteorological Service of Canada
2121 Voie de Service Nord, 404 Transcanadienne
H9P 1J3 DORVAL Quebec
Canada
Tel: 001 514 421 4771
Fax: 001 514 421 2106
e-mail: michel.beland@ec.gc.ca

Dr Gilbert BRUNET
Chairman, JSC-WWRP
Environment Canada
2121 Transcanada Highway - 5th floor
DORVAL, Quebec H9P 1J3
Canada
Tel: 001 514 421 4617
Fax: 001 514 421 2106
e-mail: Gilbert.Brunet@ec.gc.ca

Members of JSC OPAG-WWRP

Dr Barbara BROWN
Chairperson, WWRP/WGNE Joint Working Group
on Verification
NCAR, P.O. Box 3000
BOULDER, CO 80307-3000
USA
Tel: 1 303 497 8468
Fax: 1 303 497 8386
e-mail: bgb@ucar.edu

Dr David BURRIDGE
Director, THORPEX International Programme
Committee
ECMWF, Shinfield Park
READING, Berkshire RG2 9AX
United Kingdom
e-mail: d.m.burridge@btinternet.com

Prof. Lianshou CHEN
Chairman, Working Group on Tropical
Meteorology, CAMS
China Meteorological Administration
46 Zhong Guan Cun South Street
10081 BEIJING
China
Tel: 86 10 6840 7056
Fax: 86 10 6217 5931
e-mail: lschen@cams.cma.gov.cn

Dr Huw DAVIES
Member, JSC-WWRP
Institute for Atmospheric and Climate Science
ETH, Universitastrasse 16
CH 8092 ZURICH
Switzerland
Tel: 41 44 633 3506
Fax: 41 44 633 1058
e-mail: huw.davies@env.ethz.ch

Dr Tom KEENAN
Chairman, Working Group on Nowcasting
Weather Forecasting Group
Bureau of Meteorology Research Center, GPO
Box 1289 K
MELBOURNE 3001
Australia
Tel: 613 9669 4483
Fax: 613 9669 4660
e-mail: T.Keenan@bom.gov.au

Mr Koi KOIZUMI
Member, JSC-WWRP
Numerical Prediction Division
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku
TOKYO
Japan
Tel: 81 33 212 8341
Fax: 81 33 211 8407
e-mail : kkoizumi@met.kishou.go.jp

Dr Jean-Philippe LAFORE
Member, JSC-WWRP
CNRM, Météo France
42 avenue Coriolis
31057 TOULOUSE Cedex
France
Tel: 33 56 107 9325
Fax: 33 56 107 9626
e-mail: jean-philippe.lafore@meteo.fr

Dr Jeffrey LAZO
Chairman, Working Group on Social and
Economic Research and Applications
National Centre for Atmospheric Research
P.O. Box 3000
BOULDER, CO 80307
USA
Tel: 001 303 497 2857
Fax: 001 303 497 8401
e-mail: lazo@ucar.edu

Dr Martin MILLER
Chairman, Working Group on Numerical
Experimentation
ECMWF, Shinfield Park
READING, Berkshire RG2 9AX
United Kingdom
Tel: 118 949 9070
Fax: 119 986 9450
e-mail: pab@ecmwf.int

Dr Dave PARSONS
Member, JSC-WWRP
NCAR, P.O. Box 3000
BOULDER, CO 80307-3000
Tel: 001 303 497 8749
Fax: 001 303 497 8700
e-mail: parsons@ucar.edu

Dr Mel SHAPIRO
Member, JSC-WWRP
NCAR, P.O. Box 3000
BOULDER, CO 80307-3000
USA
Tel: 001 303 497 8965
Fax: 001 303 497 8171
e-mail: mshapiro@ucar.edu

Dr Volker WULFMEYER
Member, Working Group on Mesoscale Weather
Forecasting
Universität Hohenheim, IPM
Garbenstraße 30
D-70599 STUTTGART
Tel: 49 711 459 22150
Fax: 49 711 459 2461
e-mail: wulfmeyer@uni-hohenheim.de

Invited expert

Prof. Russell ELSBERRY
US Naval Postgraduate School
589 Dyer Road
MONTEREY, CA 93943
USA
Tel: 001 831 656 2373
Fax: 001 831 656 3061
e-mail: elsberry@nps.edu

WMO Secretariat

Dr Leonard BARRIE
Director, AREP

Dr Jack HAYES
Director, WWW

Dr A. HENDERSON-SELLERS
Director, WCRP

Dr Zhaochong LEI
Chief, WWRP, AREP

Mrs Nanette LOMARDA
Senior Scientific Officer, WWRP, AREP

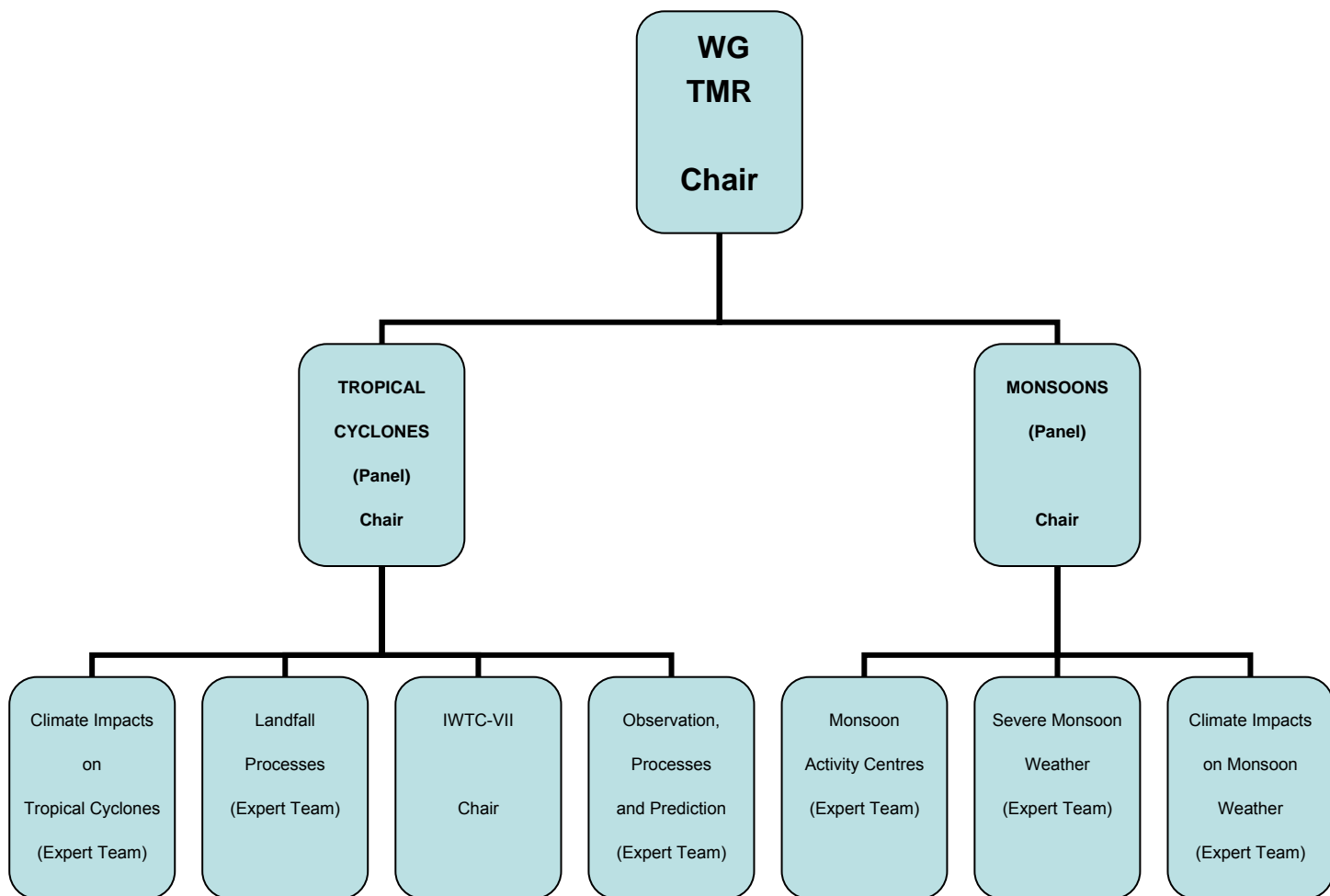
Dr Slobodan NICKOVIC
Scientific Officer, ENV, AREP

Dr David THOMAS
Project Manager
WMO Information System

GEO Secretariat

Dr Datong Zhao
Senior Scientific Expert

The Revised Structure of the New WWRP Tropical Meteorology Research Activity



Outline of the WWRP Strategic Plan: 2008-2015 (valid at the time of distribution of this report)

FOREWORD (Secretary General)

EXECUTIVE SUMMARY

1. INTRODUCTION

- 1.1. The Rationale for WWRP including THORPEX (G. Brunet (GB), M. Shapiro (MS) and H. Davies (HD))
- 1.2. WWRP Mission (GB)
- 1.3. Main Long-Term Objectives (GB)
- 1.4. Implementation Strategy (GB, V. Wulfmeyer (VW) and Z. Lei (ZL))
- 1.5. Implementation Principles (L. Barrie (LB))
 - 1.5.1 Added value
 - 1.5.2 Criteria for projects
 - 1.5.3 Linkage identified and insured (CBS ...)

2. ORGANIZATIONAL COMPONENTS

- 2.1. The Structure of WWRP including THORPEX (LB: Figure)
- 2.2. National Meteorological and Hydrological Services (NMHSs) (ZL and LB)
- 2.3. Working Groups (General terms of reference) (LB)
- 2.4. Secretariat (LB)
- 2.5. WWRP Partners (LB)

3. WWRP RESEARCH ISSUES

- 3.1. Introduction (GB)
- 3.2. Predictability and Dynamical Processes (all working groups contributing)
- 3.3. Observing Systems and Strategies (all working groups contributing)
- 3.4. Data Assimilation and Model Development (all working groups contributing)
- 3.5. Societal and Economic Applications (all working groups contributing)

4. WWRP RESEARCH ACTIVITIES

- 4.1 THORPEX Programme (MS, HD and J. Caughey (JC))
 - 4.1.1 Scope, Research Goals and Objectives
 - 4.1.2 Structure of Working Groups (specific terms of reference)
 - 4.1.3 Research Activities
 - 4.1.4 Products , Services and Technology transfer
 - 4.1.5 Observing System Design and Optimization Research
 - 4.1.6 Data Assimilation Research
 - 4.1.7 Predictability and Dynamical Processes Research
 - 4.1.8 Global Interactive Forecasting System (GIFS) & TIGGE
 - 4.1.9 THORPEX Regional Campaigns (TReCs)
- 4.2 Nowcasting Research (T. Keenan (TK))
 - 4.2.1 Scope, Research Goals and Objectives
 - 4.2.2 Working Group (specific terms of reference); links to WMO-APP/Nowcasting
 - 4.2.3 Research Activities
 - 4.2.3.1 Nowcasting Systems Research
 - 4.2.3.2 Forecasting Demonstration Projects (FDPs) (e.g. Beijing, Vancouver etc)
 - 4.2.4 Products, Services and Technology transfer
- 4.3 Mesoscale Weather Forecasting Research (J. Onvlee (JO) and VW)
 - 4.3.1 Scope, Research Goals and Objectives
 - 4.3.2 Working Group (specific terms of reference)
 - 4.3.3 Research Activities
 - 4.3.3.1 Role of FDPs and RDPs, endorsement process, RDPs and FDPs for developing countries
 - a) FDPs (MAP D- PHASE, Beijing 2008, etc.)
 - b) RDPs (COPS, Vancouver 2010, etc.)
 - 4.3.3.2 Links to other international activities (skill scores on the mesoscale, COPES, parameterizations, ...)
 - 4.3.3.3 Test-Beds
 - Definitions, criteria, law issues, rules, endorsement process
 - a) NOAA International. Hydrometeorological Test bed
 - b) Helsinki Mesoscale Testbed

- 4.3.3.4 Products and Services
 - Output of RDPs and FDPs
 - Data exchange of RDPs and FDPs
 - Technology transfer
 - Transfer of RDP and FDP results to operational applications
 - Data exchange of Testbeds
 - Links to end users
- 4.3.4 Products, Services and Technology transfer
- 4.4 Tropical Meteorology Research (L. Chen (LC), R. Elsberry (RE), and C.P. Chang (CPC))
 - 4.4.1 Scope, Research Goals and Objectives
 - 4.4.2 Working Group (specific terms of reference; links to other WMO TMR groups)
 - 4.4.3 Research Activities
 - 4.4.3.1 Tropical Cyclone Research
 - 4.4.3.2 Monsoon Research
 - 4.4.4 Products, Services and Technology transfer
- 4.5 Verification Research (B. Brown (BB))
 - 4.5.1 Scope, Research Goals and Objectives
 - 4.5.2 Joint WGNE/WWRP Working Group on Verification (specific terms of reference)
 - 4.5.3 Research Activities
 - 5.5.3.1 Research on New Verification Methodology
 - 4.5.4 Products, Services and Technology transfer
 - 4.5.5 Links to specific WWRP RDPs, FDPs and Test Beds
- 4.6 Societal and Economic Research and Applications (J. Lazo (LZ))
 - 4.6.1 Scope, Research Goals and Objectives
 - 4.6.2 Working Group (specific terms of reference; links to APP/S&E Group and to core activities groups 4.1 to 4.4)
 - 4.6.3 Research Activities
 - 4.6.3.1 Defining High-impact Weather Forecasts and Assessing their Value
 - 4.6.3.2 Evaluating the Costs and Benefits of Improved Forecasts
 - 4.6.4 Products, Services and Technology transfer
 - 4.6.5 Support of WWRP-THORPEX Projects and Campaigns

5. CROSS CUTTING RESEARCH ACTIVITIES

- 5.1 T-PARC (D. Parsons (DP))
- 5.2 TIGGE (P. Bougeault (PB))
- 5.3 The WMO Sand and Dust Storm Warning System (LB and SN)
- 5.4 Approaches to integrated forecasting systems (TK)
- 5.5 Climate, Weather and Interface (YOTC ...)
- 5.6 IPY (T. E. Nodeng (TEN))
- 5.7 WWRP RDPs and FDPs (TK and VW)
- 5.8 Major Quadrennials Symposia and Workshops (LB, GB)

6. INTEGRATED APPROACH TO WEATHER, CLIMATE AND ATMOSPHERIC CHEMISTRY

- 6.1 Introduction (GB)
- 6.2 Organization and maintenance of organized tropical convection and interaction with the planetary circulation (WCRP/THORPEX ...) (GB and C.P. Chang (CPC))
- 6.3 Seamless prediction with multi-model ensemble (TFSP, TIGGE) (GB)
- 6.4 Data assimilation as a prediction and validation tool for the climate and weather and a design tool for observation networks (WCRP/THORPEX...) (GB) (WCRP/THORPEX) (GB)
- 6.5 High-impact weather in observations and models (including Regional Climate Models) (WCRP/THORPEX...) (GB)
- 6.6 Atmospheric Chemistry and Weather (GEMS etc) (LB)

7. OUTREACH OF WWRP (DP and LB)

- 7.1 Transfer Research results to policy- and decision-makers
- 7.2 General Capacity Building
- 7.3 Catalogue of RDPs and FDPs (TK and VW)

8. RESOURCES

9. OUTLOOK

REFERENCES

LIST OF FIGURES AND TABLES

ANNEX: ACRONYMS

**Provisional Plan and Timetable for the Preparation of the WWRP Strategic Plan
(valid at the time of distribution of this report)**

1 May – 15 July 2007	Submission of 1 st draft by individual contributors to Dave McCulloch
1 August 2007	First rough draft for SP drafting team to review
August 2007	E-mail Comments & meeting/conference call
1 September 2007	1 st draft to be sent to all involved for review and comments
23 September 2007	CAS Management Group Meeting
1 October 2007	Deadline for input to Dave McCulloch
15 October 2007	2 nd Draft
Late October 2007	Meeting of SP Drafting Team
1 December 2007	3 rd Draft to be sent to WWRP Partners (WGNE, WWW, WCRP, APP, HWR, ETR etc.) and members for review and comments
15 February 2008	Response to 3 rd draft
1 March 2008	4 th Draft to be sent to drafting team for final check
April or May 2008	WWRP/JSC-II meeting for final review and approval
June 2008	CAS President Report on AREP Progress
September 2008	Report to the CAS Management Group
Autumn 2009	CAS XV

Summary of Decisions

Decision 1: Develop a common vision between the WGMWF, THORPEX TIGGE and its TIGGE-LAM panel and the T-PARC and incorporate it into the WWRP Strategic Plan (Action: Chairs of WGMWF, TIGGE-LAM, T-PARC and Secretariat, S. Nickovic).

Decision 2: Define the link of the Working Group on Nowcasting (Research) of WWRP with the Working Group on Nowcasting (Applications) of WMO's Applications Department in the WWRP strategic plan with clear terms of reference for Joint Nowcasting Applications and Services Steering Committee (JONASSC). JONASSC should be limited in membership to leaders in the respective nowcasting groups and no extra meetings or travel support expended in conducting their liaison work. (Action: Chair of all Groups T. Keenan and the Secretariat, N. Lomarda and H. Kootval).

Decision 3: Since the weather research rather than the climate research community is most suited to addressing questions about the effect of past climate change on tropical cyclones and the adequacy of observations in detecting change, the JSC endorses the leadership WGTMR in organizing a workshop on the effects of climate change on tropical cyclones. Cooperation with other working groups of WWRP and the climate research community should be included. It is proposed that this collaborative effort is discussed in the weather-climate prediction white paper (see Section 7.2) (Action: Chair of WGTMR)

Decision 4: Consider a WMO global assessment of the Societal and Economic Benefits of Weather Forecasting project to the SERA contribution to the WWRP Strategic Plan (Action: Chair of SERA)

Decision 5: The JSC supported the recommendation that a meeting of experts on the development and application of forecast systems is held in 2008 cutting across commissions (CBS and CAS) and programmes (WWRP, WWW/DPFS and Applications/PWS). Initial coordination of this meeting should be undertaken under the direction of the chair of the WWRP Nowcasting Research Working Group consulting with other WWRP WG's and the other WMO programmes (Action: Chair of WG on Nowcasting).

Decision 6: In consultation with the WCRP Global Energy and Water Cycle Experiment (GEWEX) consideration should be given to the need for a WWRP expert group on model parameterizations for NWP models particularly for convection, clouds and precipitation processes and the outcome reflected in the WWRP strategic plan (Action: Chairs of WGNE and JSC-WWRP).

Decision 7: WWRP should continue to jointly organize and support with WCRP, the annual WGNE meeting (the next is 22-26 October 2007 in Shanghai) and to ensure that not only THORPEX but the whole of WWRP is addressed (Action: D/AREP).

Decision 8: The JSC-WWRP endorsed the WMO Sand and Dust Storm Warning System as a project of WWRP and recommended that it be submitted to WMO as a Disaster Risk Reduction Project of widespread interest to WMO members in Africa, the Middle East and Asia (Action: D/AREP).

Decision 9: The JSC-WWRP welcomed collaboration with the operational NWP programmes of WMO and emphasized that a seamless link between research and operations through technology transfer, training and capacity building will be part of the strategic plan of WWRP (Action: Chair JSC-WWRP).

Decision 10: The JSC acknowledged the importance of DRR projects but expressed some confusion regarding the transparency of the project selection process. It endorsed the Shanghai initiative led by AREP. It also noted that the WMO Sand and Dust Storm Project as well as TIGGE Phase II are prime candidates for future projects. It requested the Director of AREP to keep the JSC informed and to provide guidance on the steps toward establishing a DRR project (Action: D/AREP).

Decision 11: The JSC welcomed cooperation with GEO especially in strengthening the delivery of WWRP-THORPEX research through applications serving the nine GEO Societal Benefit Areas. Activities of the new WWRP programme including THORPEX should be represented in GEO and include TIGGE, seamless weather/climate prediction, and the WMO Sand and Dust Storm Project (Action: D/AREP).

Decision 12: The JSC supported the development of a Strategic Plan and requested the Chair to finalize the outline before issuing writing assignments. It was agreed that this is a dynamic working document that will evolve and change as the strategic plan is produced { the most recent outline valid at the time of distribution of this report is attached in Annex E} (Action Chair JSC-WWRP).

Decision 13: The JSC agreed that the task team for coordinating the development of the SP will be composed of a small sub-group on the Strategic Plan Development composed of G. Brunet (Chair), D. McCulloch (Environment Canada, Executive Secretary), L. Barrie (D/AREP), Chief of AREP/WWRP Division (To be determined), S. Nickovich (Scientific Officer) and N. Lomarda (Senior Scientific Officer) and that the plan development and review include Chairs of the WWRP Working Groups and Expert Teams and other experts.

Decision 14: The procedure and timetable suggested by the Chair of JSC and D/AREP for developing the WWRP Strategic Plan: 2008-2015 was accepted by the JSC-WWRP.

Decision 15: As part of the WWRP strategic planning process address this important issue with concrete tasks and assigned leads (Action: Chair JSC-WWRP; D/AREP, WCRP).

Decision 16: The JSC supports WWRP-THORPEX collaboration with WCRP to develop a strategy and implementation plan for YOTC in late 2007 and 2008 and recommended close coordination with the WWRP Working Group on Tropical Meteorology Research and its Panels (Action: D/AREP).

Decision 17: Make a proposal to the THORPEX ICSC that a joint WWRP-THORPEX Science Conference should be held in 4 years (Action: Chair JSC-WWRP).

Decision 18: Hold the next meeting of the JSC in 2008 in Geneva at a time to be determined later (Action: D/AREP and Chair JSC-WWRP).

World Weather Research Programme (WWRP)

Report Series 2007

Sixth WMO International Workshop on Tropical Cyclones (IWTC-VI), San Jose, Costa Rica, 21-30 November 2006 (WMO TD No. 1383) (**WWRP 2007 - 1**).

Third WMO International Verification Workshop Emphasizing Training Aspects, ECMWF, Reading, UK, 29 January - 2 February 2007) (WMO TD No. 1391) (**WWRP 2007 - 2**).

WMO International Training Workshop on Tropical Cyclone Disaster Reduction (Guangzhou, China, 26 - 31 March 2007) (WMO TD No. 1392) (**WWRP 2007 - 3**).

Report of the WMO/CAS Working Group on Tropical Meteorology Research, Guangzhou, China, 22-24 March 2007 (WMO TD No. 1393) (**WWRP 2007 - 4**).