

WWRP 2011 - 2

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

(Geneva, Switzerland, 21-24 February 2011)

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WORLD METEOROLOGICAL ORGANIZATION

WORLD WEATHER RESEARCH PROGRAMME

WWRP 2011 - 2

**Report of the 4th Session of the Joint Scientific Committee (JSC)
for the World Weather Research Programme (WWRP)
(Geneva, Switzerland, 21-24 February 2011)**



**World
Meteorological
Organization**
Weather • Climate • Water



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GENERAL SUMMARY OF THE WORK OF THE MEETING

1. ORGANIZATION OF THE SESSION

1.1 Opening of the session

1.1.1 A welcoming letter from Michel Jarraud, Secretary General of the World Meteorological Organization (WMO) was read to the participants at the opening of the meeting. It noted that this was the first session of the JSC under the new arrangement with 10 new independent committee members (7 of whom were able to be present). Their participation was much appreciated. The breadth of the programme was recognized covering a wide range of temporal and spatial scale sand ranging from nowcasting through mesoscale forecasting to THORPEX and weather modification assessment. The whole programme provided many essential international mechanisms for collaboration on scientific research on timescales up to seasonal.

1.2 Adoption of the agenda

The agenda was adopted with a few scheduling changes to facilitate the business and availability of participants.

1.3 Working arrangements for the session

The working arrangements of the session were agreed.

2. MANAGEMENT REPORTS

2.1 Report of Fifteenth Meeting of the Commission of Atmospheric Sciences CASXV (18 - 25 November 2009)

The full report from the CASXV meeting can be found at:

ftp://ftp.wmo.int/Documents/PublicWeb/mainweb/meetings/cbodies/governance/tc_reports/english/pdf/1050_en.pdf

2.1.1 CAS XV was impressed by the breadth of the WWRP and the many useful links that have been established to other programmes and organizations. It was particularly pleased to see the development of a Strategic Plan and an agreed flexible approach and direction for this OPAG.

2.1.2 The importance of the FDPs and the RDPs within the WWRP was recognized. Progress had been made in many areas. Important field experiments had been carried out by THORPEX including the A-TreC, E-TReC and T-PARC. The THORPEX IPY cluster had been very successful; the TIGGE database was now recognized as an important element for enabling and promoting research on ensemble prediction. The important and promising YOTC work had also been initiated.

2.1.3 New initiatives were suggested by CAS XV in the areas of polar prediction and sub-seasonal to seasonal prediction. These would be reported on later in the agenda of this meeting.

2.1.4 Finally, CAS established the new structure of the WWRP/JSC comprising 10 independent scientists and including Chairs of the Working Groups of WWRP and THORPEX as ex-officio members.

2.2 Report of the Chair of the WWRP/JSC

2.2.1 The long-term objectives of the WWRP were briefly outlined. These included improving public safety and economic productivity, demonstrating improvements in weather forecasting (especially of high impact weather), improving understanding of atmospheric processes,

encouraging utilization of research results and developing training programmes. The current structure to achieve these objectives was outlined and the important links to major partners e.g. WGNE emphasized.

2.2.2 Recent highlights from the programme were then noted. These included TIGGE, the Beijing Olympics FDP, field campaigns such as T-PARC, the initiation of YOTC, the SDS Warning and Advisory service, MAP D-Phase, European COPS and Integrated Mesoscale Research Environments (IMREs), participation in the EC Research Task Team, promoting weather modification, etc.

2.2.3 Of particular note was the publication of the WWRP Strategic Plan 2009-13 which was comprehensive and covered cross-cutting activities and this plan would guide the overall evolution of the WWRP over the next few years.

2.2.4 In discussions the rationale for the new JSC was queried. In response it was recognized that the desire was to achieve a better review of the programme from independent scientists and also to elevate the standing of the WWRP/JSC.

3. ACCOMPLISHMENTS, STATUS AND FUTURE RESEARCH ACTIVITIES

3.1 Report of the WCRP CAS Working Group on Numerical Experimentation (WGNE)

3.1.1 The main role of WGNE is to foster development of models on all timescales. It also provides advice and mechanisms for close international collaboration as well as conducting experiments. Workshops and publications are also key elements of the work of the group. Strong links are maintained with YOTC, the THORPEX Predictability and Dynamical Processes Working Group (PDP WG), Data Assimilation and Observing Strategies Working Group (DAOS WG), GEWEX, SPARC etc. Close liaison is also maintained with the operational centres and periodic progress reviews are produced.

3.1.2 The JSC concurred with the statement made in the WGNE report to the JSC that “strongly cautions against setting up new global atmospheric model development efforts, which artificially have a sole climate or weather focus”. The JSC urged WGNE and the WWRP to be proactive in their attempts to share this point of view with the appropriate communities.

3.1.3 The WGNE report detailed progress in activities where the WWRP is a partner such as YOTC, JWGFVR, and potential projects dealing with the non-hydrostatic Grey Zone, subseasonal to seasonal prediction and polar prediction. The JSC welcomes such joint efforts, especially given the shared WCRP and CAS parentage. The JSC further noted that the WGNE report included a brief mention of a number of other research topics that would allow WGNE to become involved in supporting the WWRP agenda, including i) model performance over the polar regions in conjunction with CONCORDIASI; ii) tropical convection (e.g. MJO, monsoons, cyclones); iii) TIGGE; iv) land-surface data assimilation; v) representation of stable boundary layers in polar regions. The JSC urged WGNE to actively work with the WWRP WG Chairs and the JSC Chair to explore mechanisms for collaboration in these areas and to report their findings at the next JSC.

3.1.4 There are currently many areas of interest including Transpose AMIP, surface fluxes (the SURFA project), the “Grey Zone” project, cloudy radiances, high resolution AMIP and verification (for NWP, climate prediction (metrics) etc.).

3.1.5 Transpose AMIP involved testing climate models in NWP mode out to 5 days ahead. Diagnostic studies are proposed across a wide range of issues.

3.1.6 The SURFA project is focussed on ocean surface fluxes.

3.1.7 Cloudy radiances work is focused on improving assimilation systems through better cloud detection algorithms; use of IASI data was expected to help.

3.1.8 The “Grey Zone” project is aimed at the requirements for, and performance of, parameterisation schemes in models that employ horizontal grid-spacings in the range 1 to 10km. The approach is to start with a “cold outbreak” study, since this was of general relevance to prediction on all timescales, then to extend the approach to tropical phenomena and to appropriate YOTC studies.

3.1.9 Workshops included the recent WGNE/PDP meeting in Zurich on forecast errors, the annual WGNE meeting with the WGCM. Planned meetings include, the joint WGNE/PDP meeting on stochastic processes (June 2011), Oceans in NWP (2012) and Aerosol and Air Chemistry (2013). It was also planned to continue the series of workshops devoted to systematic errors.

3.1.10 During discussions, the JSC:

- Confirmed the importance of a seamless approach to atmospheric model development across both weather and climate timescales.
- Welcomed the close links that have been established between WGNE and the DAOS group, and commended the suggestion by the WGNE to look at land surface data assimilation in the context of collaboration with GLASS.
- Also welcomed the close links with SPARC and WGSIP in stratospheric processes and their treatment in NWP models.
- Noted that cold-air outbreaks, the subject of the first planned “Grey Zone” study, were not identified as a priority weather event in the WWRP Strategic Plan but endorsed the idea of cold air outbreaks being selected as the first case given their ubiquitous nature, how much the simulations appear to be strongly dependent on model resolution, and the potential for such events to develop into high impact weather.
- Also noted the potential benefits of involving the ensemble community in the Grey Zone Project and recommended linkages be explored with the appropriate THORPEX Working Groups.
- Stressed the importance of the SURFA project - this was the only group supporting surface fluxes and was very important to NWP at all scales, particularly coupled ocean/atmosphere models.

Decision/Action WWRP/JSC4 (1): Requested that the WGNE seek the involvement of the various ocean wave groups in activities involving oceans in NWP.

Decision/Action WWRP/JSC4 (2): Requested that the WGNE seek the involvement of the ensemble prediction community in the “Grey Zone” work.

Decision/Action WWRP/JSC4 (3): Requested that the WGNE and the Mesoscale Working Group provide a joint report on the status the “Grey Zone” project to the next meeting of the WWRP/JSC.

3.2 THORPEX Programme

3.2.1 THE DAOS Working Group

3.2.1.1 An overview of observational matters was provided. The global AMDAR programmes continued to expand and were providing increasing amounts of water vapour data. The Chinese FY-3A microwave sounder was now considered suitable for assimilation. Increasing amounts of

IASI data were being utilized in cloudy regions. The continuity of scatterometer data is still an issue but use of an Indian Scatterometer is being pursued by EUMETSAT to improve the coverage. There was also the possibility of a Canadian polar mission to put a pair of satellites in a Molniya orbit providing effectively “geostationary” coverage of the North Pole. Raman lidars had been shown to provide good profiles of water vapour at very high spatial and temporal resolutions, but there remained a considerable challenge to get such instruments into operational use. An important need that was being addressed within the WMO was a common radar data exchange format.

3.2.1.2 In the data assimilation area, the Working Group had considered higher resolution data assimilation issues and reduced satellite observation thinning, the need for better background error co-variances, the observability of structure functions, the move to hybrid 4D-VAR and trials of EnKF systems.

3.2.1.3 Results from some recent field experiments were outlined. The CONCORDIASI driftsonde programme had been very successful - there was now an impressive data set for future analysis. It was noted that the higher resolution data from the dropsondes would be available with a delay of one year (after quality control). In AMMA some impact studies using microwave channels have been successful in reducing biases in humidity data. HyMeX was investigating various potential observational platforms including pressurized balloons.

3.2.1.4 Another major activity of the Working Group had been looking at the value of observations in NWP. Results from a number of centres showed the very high value of AMSU-A data and radiosondes. The UK Met Office results were now available and supported the results from the other centres. Results from Winter T-PARC showed that some Russian radiosonde sites were particularly important for North American regions forecasts as were dropsondes and AMDAR data.

3.2.1.5 It was recognized that additional observations from AMDAR would be very beneficial over the North Pacific, North Atlantic and the Southern hemisphere generally.

3.2.1.6 The Working Group was conducting a comprehensive review of the impact of targeted data in NWP. It had concluded that the identification of sensitive areas where targeting might be useful was not a first order problem. The results from many experiments were being considered and it was clear that to some extent the impacts were model and assimilation system dependent. In the extra-tropics the impacts, although generally small, were positive and there are still some issues related to verification metrics. For tropical cyclones the impacts were more strongly positive and significant benefits could be demonstrated. It was noted that, in general, the impact of targeted observations was short lived.

3.2.1.7 Some recommendations that were likely to emerge from this review included the need to optimise existing observational resources, account for data assimilation in developing observational strategies and to continue to carry out further evaluations of impact studies. A comprehensive review paper would be available in the near future and a shorter version will be published in the BAMS.

3.2.1.8 During discussions the JSC:

- Acknowledged the valuable work carried out by the DAOS Working Group in its comprehensive study of the impact of targeted observations. Given the importance of these results to the early formulation of THORPEX, the JSC supports the publication of these results in the referred literature and, if necessary, in a more detailed WMO report.
- Recommended that the DAOS Working Group establishes good links with the Mesoscale and Nowcasting Working Groups and improves its connections with groups involved in land-surface data assimilation.

- Recommended that the DAOS Working Group maintain active links with the Nowcasting and Mesoscale Research Working Groups on cross-cutting issues such as radar data assimilation, which is an issue in both regional and global modelling.
- Recommended strong links be developed with groups involved in land surface assimilation.
- Welcomed the efforts to develop common formats, which includes quality information, for the exchange of radar data and noted that this action benefits mesoscale data assimilation.

Decision/Action WWRP/JSC4 (4): Requested the Chair of the Nowcasting Research Working Group in collaboration with the Co-Chairs of the DAOS Working Group to keep the JSC informed on the development of common formats for the exchange of radar data.

3.2.2 The PDP Working Group

3.2.2.1 The five-year goals of the PDP group were outlined. These included the preparation and analysis of field campaigns, supporting PDP research and linking to WGNE concerning model uncertainties. PDP Workshops and the Banff Summer School (July 2011) were then summarised.

3.2.2.2 Recent activities included work on T-PARC. Very large data sets were now available for 4 typhoons including for typhoon Sinlaku which was especially comprehensive and included documentation of the entire Extra Tropical (ET) process and life cycle of the storm. The ET of typhoon Jangmi has shown that the outflow of the typhoon led to a rapid intensification of the mid-latitude jet. In the extra-tropics there were examples of Rossby wave trains leading to high impact weather.

3.2.2.3 Some examples of PV profiles in extratropical storms were then presented. The PV amplitude was much higher for storms deeper than 960hPa indicating that diabatic processes were very important. The models currently do not handle the Atlantic warm conveyor belt very well and examples were shown of how this resulted in serious downstream errors. The recent T-NAWDEX pilot project was outlined and estimates of the contribution from boundary layer heating, cloud microphysics on the PV field were obtained.

3.2.2.4 The DIAMET (Diabatic influences on mesoscale structures in extra-tropical storms) project was then outlined. This has 3 major work packages:

- WPA – includes the field campaign looking at mesoscale structures in 2011/2012 using Doppler radar and employing PV diagnostic techniques.
- WPB - considering parameterization of key processes especially convection.
- WPC – predictability and data assimilation for high resolution models.

3.2.2.5 PANDOWAE has been running successfully since 2008 and was expected to continue for another 3 years. The area of interest includes Rossby waves, diabatic processes and ensembles. Significant use is being made of the YOTC, TIGGE and other data sets and strong links to HyMEX have been established.

3.2.2.5 The overall outlook for the group was bright with major new data sets becoming available such as T-PARC, YOTC, TIGGE, Transpose AMIP etc. New field experiments were being planned such as DIAMET, HyMeX, DYNAMO and T-NAWDEX which should all facilitate basic PDP studies.

3.2.2.6 During discussions:

- It was confirmed that some physical (diabatic) processes were being calculated along (the Lagrangian) trajectories.

- The JSC stated that the PDP group was tackling some of the main mission objectives of THORPEX and was a key to the long-term success of THORPEX and that there is a real need to continue to identify the important areas where progress is likely to be made in order to push predictive skill forward. Boundary layer moisture and cold air outbreaks have been identified as important areas on which to focus in the future, but achieving continuous progress remains a difficult challenge which needs the support of the whole THORPEX programme and resources.
- Was pleased with the success of PANDOWAE and the planning for DIAMET and T-NAWDEX. The JSC notes that these successes in Europe in PDP research should serve as a model for getting similar basic predictability and dynamical process activities organized and funded in other geographic regions.
- It was noted that understanding errors remains a major topic. The YOTC data sets could be very helpful for understanding the errors in tropical regions especially because of the availability of physical process tendencies and the JSC encouraged intensive use of the YOTC datasets.

3.2.3 GIFS-TIGGE Working Group

3.2.3.1 TIGGE was a major THORPEX activity and appeared in the GEO context as Task WE-06-03. Ten major global data providers were sending ensemble data to three archive centres. This data was made available to the research community with a 48 hour delay. Over 1000 researchers have registered to use the TIGGE data sets at NCAR and there are now about 60 very active users downloading data each month at the ECMWF and NCAR. Significant efforts had been made to publicize the TIGGE archives. A major BAMS article had been written. A new TIGGE leaflet was being widely distributed. An article had been drafted for GEO that was widely distributed at the GEO ministerial Plenary held in Beijing during November 2010. An article on tropical cyclones had been published in the WMO Bulletin and the TIGGE website had been expanded and further developed.

3.2.3.2 Now that the databases had been established and populated the main focus was now on research. There were three main interests. These were the calibration of ensemble prediction systems, the combination of multi-model ensembles and Research and Development concerning the construction of probabilistic forecast products. It was also noted that TIGGE data was being used in research projects concerning dynamical processes and that some 43 papers related to TIGGE had appeared in the literature.

3.2.3.3 Some examples of TIGGE results were then outlined. It was shown that combining the 4 best models exceeded ECMWF skill for 850hPa and surface air temperatures. This was possibly due to the ensemble benefiting from differing aspects of the model physics.

3.2.3.4 Other areas being considered were multi-model forecasts of precipitation, cyclone tracks (although it was difficult to track weak cyclones), blocking and MJO skill.

3.2.3.5 As part of the development of GIFS through the SWFDPs, TC tracks were being exchanged in CXML format and the forecast data displayed on the Japanese MRI website including strike probability etc. Further GIFS products would be developed in due course (e.g. heavy precipitation) and tested and evaluated through appropriate SWFDPs.

3.2.3.6 During discussions the JSC:

- Queried the future of TIGGE archiving since the databases are expanding rapidly; however, it was expected that archiving would continue for the time being in the absence of pressure from the archive centres to reduce data volumes.

- Progress in establishing really effective links with the SWFDPs was also queried but this was said to be proceeding steadily if somewhat slowly - the importance of this aspect was emphasized and the JSC asked that the Working Group specifically report on the status of our collaborations with the SWFDP at the next JSC.
- It was also noted that advances and activities were mainly in the Northern Hemisphere but this was felt due to a lack of relevant resources in the Southern Hemisphere. The suggestion was made later in the meeting that the design of the THORPEX regional committees might not be optimal for activities in some regions of the Southern Hemisphere. For example, many of the nations in South America have developed strong links with nations in Central and North America so that a Regional Committee for the Americas may be more appropriate. The JSC suggests that such a regional organizational issue be discussed at the next THORPEX ICSC.
- Noted the changed emphasis of the work for Global Interactive Forecast Systems (GIFS), away from seeking to establish GIFS Demonstration Projects, towards research on probabilistic prediction of high impact weather and their evaluation in conjunction with the SWFDP regional projects and other RDPs and FDPs.
- Noted the success of the TIGGE archive as shown by the large and growing number of active users and publications of research based on TIGGE data. The knowledge about the use being made of the data is supported by the monitoring of archive usage by the TIGGE data centres and the tracking of "TIGGE" publications on the GIFS-TIGGE web site, and thanks the Working Group for undertaking these tasks. The JSC urges that continual stressing of this success story and that programme managers in the nations funding TIGGE be made aware of this success story.
- Suggested that at an appropriate time, the Working Group should consider a review article in the referred literature that summarizes the key findings of TIGGE research.

3.2.4 Status of the Year of Tropical Convection

3.2.4.1 YOTC is focused on the fundamental problems of understanding mechanisms for and effects of organized tropical convection, which are vital to improving weather and climate predictions. YOTC is now established with a small project office at NCAR. The project is being well publicized with more than 100 presentations in the recent past. NASA HQ was supporting the satellite element through Giovanni system and important analysis and visualization tools were now available.

3.2.4.2 Research spans weather and climate on timescales from diurnal out to seasonal. Close links have been maintained with other activities such as the GEWEX (GPCI). YOTC also provides a strong linkage between WWRP and WCRP, with YOTC highlighted in a series of papers provided for the WCC-3 and in forthcoming publications in BAMS. An important legacy of YOTC will be data sets collected from May 2008 to April 2010, which include high resolution analyses and forecasts and satellite data available through NASA Giovanni. These datasets will provide a foundation for improving understanding of processes and their representation in weather and climate models, including CMIP-5 model evaluations. A YOTC Science Symposium is planned for Beijing in May 2011. This meeting will involve oral presentations, poster sessions and open discussions led by moderators. A Report will be written including recommendations for future work. Links to AMY will be explored in the workshop following the Symposium.

3.2.4.3 The JSC recommended that YOTC:

- Continue and expand a process to monitor users of the databases and track publications in order to assess YOTC's scientific impacts.

- Strengthen connections with TIGGE, although the initial perturbations for most of ensembles available in the TIGGE base are not tuned for the tropics the assessment of the skill of the TIGGE ensembles will be useful for identifying model deficiencies and priorities for future improvements.
- Strengthen connections with the UK Cascade project to support studies of convection at higher horizontal resolution and comparisons with satellite data.
- Strengthen links to research groups working on understanding the two-way interactions between the tropics and extra-tropics - these interactions are vital for improving predictive skill across a broad range of time scales and such interactions often lead to high impact phenomena around the world.
- Strengthen the connections between DYNAMO and YOTC and explore whether a collaborative relationship between DYNAMO and THORPEX is possible due to the overlap of research interests. DYNAMO is a major upcoming field experiment on MJO initiation focused on the Indian Ocean that will begin in October 2011; many DYNAMO data will be put on the GTS.

Decision/Action WWRP/JSC4 (5): Requested the Co-Chairs of YOTC to report by 1 September on the outcome of the YOTC Science Symposium that will take place in Beijing in May 2011.

3.2.4.4 Finally, the JSC expressed its appreciation for the extensive efforts that have been put in organizing and leading YOTC to significant new advances in the understanding and predictions of organized tropical convection.

3.2.5 Status of HYMEX

3.2.5.1 An outline of the proposals was given. The basic objective was better understanding of the water cycle and high impact weather events in the Mediterranean basin. Of special interest was extreme precipitation and flooding. A HyMeX Implementation Plan had been prepared and included Special, Enhanced and Long observational phases. There is also a modelling strategy which includes improving parameterization for high-resolution NWP systems, (microphysical processes, cloud parameterization, precipitation, air-sea flux interactions etc. Ocean/atmosphere coupled models will be developed. It is intended to maintain close links with TIGGE LAM and convection permitting EPSs will be developed. Another important area is hydrological forecasting. Proposed mesoscale data assimilation activities were noted including assimilation of satellite radiances, radar data, new observational types etc.

Decision/Action WWRP/JSC4 (6): The JSC requested that Veronique Ducrocq should impress on the HyMeX data owners the need to adopt a flexible approach to the release of HyMeX data for WWRP and THORPEX related research and report back to the WWRP/JSC.

Decision/Action WWRP/JSC4 (7): Noting the importance of the socioeconomic aspects of HyMeX to the goals of WWRP and to the inhabitants of both the developing and developed nations of the region, the JSC requested HyMeX to consider whether these activities should be expanded including exploring links to the WMO flash flooding prediction programme and SERA through building on the foundation of efforts within HyMeX by the Universities of Barcelona and Grenoble.

Decision/Action WWRP/JSC4 (8): The JSC requested that Veronique Ducrocq in collaboration with the Co-Chairs of the PDP Working Group to make efforts to ensure the links to T-NAWDEX community and the DIAMET community are maintained – noting that it was particularly important that parallel activities in late summer 2012 should be coordinated where possible.

3.2.6 Status of the Polar Prediction Research Project

3.2.6.1 CAS XV had recommended that consideration be given to the establishment of a THORPEX Polar Prediction Research Project. As a first step, a joint WWRP-THORPEX / WCRP Workshop was hosted in Oslo in Oct 2010.

3.2.6.2 The main recommendations from the workshop can be found at:

http://www.wmo.int/pages/prog/arep/wwrp/new/thorpex_new.html

3.2.6.3 The overall result from the workshop was the proposal for the development of an IPY Legacy Project. This should be based on a few internationally coordinated NWP projects. It might have a construction similar to the YOTC project. Hence, a Steering Group should be established and a Project Office set up.

3.2.6.4 During discussions it was noted that:

- The first aim of the project is to improve forecasts in polar regions and advance understanding of the connection between the polar regions and the mid-latitudes. This should be better highlighted.
- Several aspects will be considered in the future phases of the project such as effects of sea ice changes, AO, upper atmosphere and interaction between the MJO and the AO. Regarding the stable boundary layer aspects.

Decision/Action WWRP/JSC4 (9): The JSC requested C/WWR and the Manager of the THORPEX IPO ensure that that strong links be established with GEWEX GABLS for the Polar Prediction Research Project when it is established.

Decision/Action WWRP/JSC4 (10): The JSC, noting that the WCRP Bergen Workshop (which focused on longer time-ranges and the high atmosphere) was seen to be complementary to the Oslo WWRP-THORPEX/WCRP workshop, requested that Vladimir Ryabinin to report the Bergen Workshop and circulate to the JSC.

Decision/Action WWRP/JSC4 (11): The JSC requested C/WWR and the Manager of the THORPEX to report progress with the proposed Polar Prediction Research Project to the next meeting of the JSC.

3.2.7 Status of the Sub-Seasonal Prediction Project

3.2.7.1 A workshop, sponsored by WCRP, WWRP and THORPEX, had been hosted by the UK Met Office from 1-3 Dec 2010. The main objective was to set up a collaborative structure to take this topic forward. It was important to begin by considering the potential societal and economic benefits. It might be possible to design a few demonstration projects that would ultimately help with securing additional funding. An insurance project had been described at the meeting and there was a possibility of a South American project based on the La Plata basin. There might also be a South Asian Demonstration Project involving flooding and hydro -meteorological topics. The review paper on capabilities in sub-seasonal prediction, had been prepared for the workshop by David Anderson was now available.

3.2.7.2 For verification and archiving of seasonal forecasts there were 12 WMO lead centres. In Europe there was the project, EUROpean Seasonal to Inter-annual Prediction (EUROSIP), which involved ECMWF, the Met Office, Meteo France with NCEP as an associate member. Other relevant databases included the Climate Historical Forecast Project (CHFP) and the Stratosphere Historical Forecast Project. It was widely recognized that much more standardization was needed for seasonal forecast prediction and verification.

3.2.7.3 At least six operational centres had expressed a willingness to co-operate more closely in order to co-ordinate operational approaches for monthly to sub-seasonal prediction and test the feasibility of data exchange.

3.2.7.4 The workshop recommended that a Panel/Project for Sub-seasonal prediction research should be established. Panel members should include representatives from WWRP-THORPEX, WCRP, CBS and CCI and their relevant programme bodies. The first task for the Panel will be the preparation of an Implementation Plan which is consistent with the outcome of this Workshop - the main emphasis being on sub-seasonal prediction.

3.2.7.5 Such an Implementation Plan should give high priority to:

- Sponsorship of a few international research activities.
- The establishment of collaboration and co-ordination between operational centres undertaking sub-seasonal prediction to ensure, where possible, consistency between operational approaches to enable the production of databases of operational sub-seasonal predictions to support research.
- Utilization of data collected for the CHFP, TIGGE and YOTC for research.
- The establishment of a series of regular Workshops on sub-seasonal prediction.
- Development of societal projects particularly efforts to quantify the benefits to decision makers, through working together by the WWRP/SERA and WCRP.

3.2.7.6 During discussions it was noted that:

- The CHFP database is now a useful facility for research and should be fully exploited.
- There was support for the proposal to co-ordinate operational sub-seasonal prediction systems and to eventually provide these predictions for research.
- There is a need to rationalize from a research viewpoint what is needed to do to improve the models.
- There is also a need to consider how to present the forecasts from the point of view of benefits to decision makers – a few suitable demonstration projects could help address this aspect.
- Sub-seasonal prediction topic should be followed up at the forthcoming WMO Congress (CgXVI).

Decision/Action WWRP/JSC4 (12): The JSC requested C/WWR and the Manager of the THORPEX IPO to report progress with the proposed sub-Seasonal Project to the next meeting of the JSC.

3.3 WCRP Activities

The Director of the WCRP, Dr Ghassem Asrar, explained that following reviews by the programme's sponsors, the WCRP Officers and the WCRP/JSC were seeking to focus its research on understanding climate science in order to address a wide range of societal applications including food security and transport. Fitting future WCRP activities within the emerging Global Framework for Climate Service (GFCS) was crucial and it is intended that the WCRP contribution would focus on:

- Climate information and analysis.

- Delivery of the science to user interfaces.

The next steps in the consultation process would take place at the next meeting of the WCRP/JSC (Exeter, April 2011).

Dr Asrar then outlined the plans for the WCRP Open Science Conference (OSC) that will take place in Denver from 24-28 October 2011). It is planned to prepare a monograph summarising the outcomes of the OSC and it is expected that this monograph will provide a blueprint for the work on the WCRP over the coming decade.

3.4 Tropical Meteorological Research

3.4.1 Working Group on Tropical Meteorological Research

3.4.1.1 The Working Group on Tropical Meteorological Research (WGTMR) had established close ties with the World Weather Watch Tropical Cyclone Programme (WWW/TCP) by jointly hosting workshops and conferences which has helped to ensure that forecasters are able to provide input to research activities and development of technologies. These meetings have included IWTC-VII (La Reunion, November 2010) and the Second International Workshop on Tropical Cyclone Landfall Processes (IWTCLP-II) (Shanghai, October 2009).

3.4.1.2 The establishment of the WWRP project Typhoon Landfall Forecast Demonstration Project (TLFDP) was proposed at IWTCLP-II – in cooperation with the THORPEX Northwest Pacific Typhoon Ensemble Prediction, this project resulted in the development of improved forecast products for tropical cyclone track and intensity in readiness for the Shanghai World Expo in May 2010. A forecaster training workshop focusing on the use of these products was also held. This is one of the first projects to use ensemble forecasts (as opposed to a consensus of deterministic model tracks that is the standard procedure) for tropical cyclone prediction, and the goal over the next two seasons is to develop wind structure and precipitation products.

3.4.1.3 In April 2010 the book “Global Perspectives on Tropical Cyclones: From Science to Mitigation” was published - the web version of the operational manual “A Global Tropical Cyclone Forecast Guide II” is nearing completion. Also in 2010, an assessment of recent advances in understanding tropical cyclones and climate change was published in Nature Geosciences and a new summary statement for use by WMO and the NMHSs has been provided by a distinguished WG TMR Expert Panel.

3.4.1.4 A WMO website, <http://www.wmo.int/pages/prog/arep/wwrp/tmr/SeasonalFCST.html> has been established for seasonal forecasts of tropical cyclone activity that are more consistent in space and time. After developing the website, and testing it over two Northern Hemisphere seasons, the second phase will be to include other operational or research groups who prepare seasonal tropical cyclone activity forecasts.

3.4.1.5 In October 2010, the WGTMR and JWGFVR co-sponsored the Third WMO International Conference on Quantitative Precipitation Estimation (QPE) and Quantitative Precipitation Forecasts (QPF) and Hydrology was held in Nanjing (October 2010). The keynote sessions were on heavy precipitation events associated with tropical cyclones and monsoons. In addition to the presentations on the rainfall directly associated with the inner core of tropical cyclones, examples of Predecessor Rain Events (PRE) or remote rainfall events far from the centre were also presented. Since the heavy rain may trigger Rossby wave propagation downstream in a wave guide, tropical cyclone-related rainfall may have an impact on the midlatitude circulation far from the centre.

3.4.1.6 Many research results from the combined Tropical Cyclone Structure (TCS-08) and THORPEX Pacific Asian Regional Campaign (T-PARC) are now appearing in the literature. The relative contribution of the mesoscale convective systems versus the synoptic-scale environmental conditions is still a matter of discussion in some of the cases. Some of the early results are of

interest to the tropical cyclone warning centres. The WGTMR also collaborated with the THORPEX Pacific Asia Regional Committee to provide meteorological support to the Impact of Typhoons on the Ocean in the Pacific (ITOP). This oceanographic field experiment studied the ocean response to typhoons with moorings, drifters, and buoys and the air-sea fluxes in high winds that are important for tropical cyclone intensification and maintenance.

3.4.1.7 A meeting report of the Fourth WMO International Workshop on Monsoons (IWM-IV) held in Beijing from 20-25 October 2008 was submitted to the Bulletin of American Meteorological Society in 2009. The report, entitled "BRIDGING WEATHER AND CLIMATE IN RESEARCH AND FORECASTS OF THE GLOBAL MONSOON SYSTEM", was accepted for publication in May 2010 and was published by BAMS in February 2010. Editing of the book, "The Global Monsoon System: Research and Forecast, 2nd Edition", was completed in November 2010 and the book will be published in March 2011 as Vol. 5 of the World Scientific Series on Asia-Pacific Weather and Climate (WSS-APWC).

3.4.1.8 Two of the three planned monsoon data centres had been established in the interim period by WGTMR's Monsoon Panel to facilitate the archiving and exchange of field observational data and special data for monitoring extreme events. They are (i) The Centre for Monsoon Field Campaign Legacy Data Sets (Colorado State University, USA) and (ii) The Centre for Extreme Events Monitoring in Asia (EAMAC/Beijing Climate Centre, CMA, China). The establishment of the third monsoon data centre, the Monsoon Radar Meteorology Data Information Centre (Nagoya University, Japan) has been delayed because of unexpected staff resignations. Recruitment and hiring of a new staff is well underway and it is expected that the effort to establish the centre will be revived soon.

3.4.1.9 WGTMR's Monsoon Panel and Tropical Cyclone Panel both have activities on the Year of Tropical Convection (YOTC). Members of the Monsoon Panel's Expert Team on Climate Impacts on Monsoon Weather are participating in the Asian Monsoon Year (AMY) programme, which includes research using YOTC data sets. These members are actually directly involved in YOTC activities through the WCRP-CLIVAR programme. The WGTMR cooperated with YOTC to gain access to the full (T799) resolution ECMWF analyses and forecasts during TCS-08/T-PARC. These analyses at 25 km resolution have provided good background fields for higher resolution analyses that incorporate the special observations from the field experiment. A fortunate byproduct of the arrangement with ECMWF was that they also provided access to an experimental 32-day ensemble prediction of western North Pacific tropical cyclone – like vortices from the 51 members. During the field experiment, these weekly forecasts provided an indication of active and inactive periods of formations. Converting similar member vortices into ensemble storms, it has been demonstrated that this ECMWF ensemble could predict the formation and early tracks of the three intense typhoons and the strong tropical cyclones out to weeks 2, 3, and 4! This remarkable performance has been confirmed in a detailed study of the 2009 season as well, when more typical monsoon trough conditions existed and many more typhoons developed. An intraseasonal (10-30 days) forecast that a typhoon will develop and move into an area could be of great value to many water resource agencies or other public sectors.

3.4.1.10 During discussions it was noted that:

- Given the operational forecaster requirements for tropical cyclone-related precipitation, and the keynote session and discussions at IWTC-VII, plans are in hand to initiate a Research Development Project (RDP) or a Forecast Demonstration Project (FDP); this RDP or FDP would address the direct effect of inner-core rainfall and the PRE or remote rainfall that affects mid-latitudes.
- During the Third WMO QPE/QPF and Hydrology Meeting (Nanjing, October 2010), the Monsoon Panel discussed a proposal for a WWRP RDP to study the heavy rainfall system in southern China during the East Asian summer monsoon. The southern China summer heavy rainfall is a major component of the Meiyu-Baiu-Changma rainfall system that affects a large part of Southeast and East Asia including Indochina Peninsula, southern and

eastern China, Korea and Japan, and the adjacent oceanic regions. The rainfall system often causes severe floods with major life and property losses. It was decided that the 2011 heavy monsoon rainfall workshop and associated training, originally scheduled for Busan, Korea, will be moved to Beijing in the summer or fall 2011 and hosted by CMA in order for international experts to discuss a CMA draft proposal. It is expected that this workshop will help finalize the CMA proposal before submission to the WWRP JSC. Monsoon rainfall experts from several regions, including Japan, Korea and U.S., have expressed strong interest in participation.

3.4.1.11 The JSC welcomed the new chair of the WGTMR. The JSC acknowledge the impressive work it had accomplished and especially commended the work of the Working Group in particular its role in publications such as the article on global change and tropical cyclones, review documents on monsoon and tropical cyclones, meetings such as IWTC that bring together forecasters, researchers, instrument developers and others interested in tropical meteorology.

3.4.1.12 During discussions the JSC recommended:

- Greater involvement in initiating and guiding international research projects in tropical meteorology and was pleased to note the movement of the working group in this direction, such as the planned RDP on monsoon meteorology. In this regard, a greater concentration by the working group on research efforts to improve numerical weather prediction is specifically encouraged.
- Reporting on field campaigns to only those projects where the Working Group and its expert bodies have clear involvement and focus their coordination and guidance efforts on these field experiments, such as encouraging participation of the CEATIC in the WWRP projects on targeted observations for tropical cyclones.

Decision/Action WWRP/JSC4 (13): The JSC requested the TMR Working Group to design a template of best practices for field campaigns in the tropics in cooperation with WCRP to improve such efforts and improve collaboration between nations.

Decision/Action WWRP/JSC4 (14): The JSC requested the new Chair of the Working Group, the Chair of the JSC and the Secretariat work together on several governance issues (e.g., membership and the number of expert bodies) before the next CAS Management Group Meeting.

3.4.2 Results from the T-PARC (SUMMER)

3.4.2.1 During the field programme period of 1 August – 4 October 2008, four typhoons, four tropical storms, and four tropical depressions occurred over the western North Pacific. In addition to these systems, for which official forecasts were issued by the Regional Specialized Meteorological Center (RSMC, Tokyo), a separate set of 51 tropical systems were identified by the T-PARC/TCS-08 research team. These systems were defined as tropical cloud clusters, low-level waves, or subtropical circulations of interest to the project.

3.4.2.2 During the period, 500 aircraft mission hours were flown during a total of 76 missions. The missions were flown into 4 typhoons, one tropical depression, and 5 tropical cloud clusters. Overall, 72% of the flight missions were flown into the four typhoons. The T-PARC/TCS-08 programme was the first to use driftsondes in the equatorial Pacific.

3.4.2.3 For the first time, the entire process of Extra-tropical transition (ET) was investigated by aircraft in such a manner that the impact of the ET on the mid-latitude circulation can be examined with respect to important physical processes that occur over regions of the decaying tropical cyclone and the interface with the mid-latitude circulation.

3.4.2.4 During discussions it was noted that:

- To date, 10 scientific papers were published as a result of the T-PARC.
- Publications based on the T-PARC observations and model data sets are appearing in literature. The JSC urged the T-PARC leads to expand tracking of referred T-PARC publications and present a status of the research findings and operational impacts at the next JSC.
- The review paper being prepared by Sharan Majumdar for the DAOS Working Group will discuss the impact of the T-PARC field experiment data.

Decision/Action WWRP/JSC4 (15): C/WWR is requested to ensure that the availability of the T-PARC data is advertised widely.

Decision/Action WWRP/JSC4 (16): C/WWR should keep the WWRP/JSC informed on the usage of T-PARC data and number publications based on T-PARC data.

3.4.3 Severe Weather Forecast Demonstration Projects

3.4.3.1 The WWRP/JSC took note of the following activities carried out under auspices of the Severe Weather Forecasting Demonstration Project (SWFDP).

3.4.3.2 The SWFDP is an initiative to further explore and enhance the use of outputs of existing Numerical Weather Prediction (NWP) systems, including Ensemble Prediction Systems (EPS). Its aim is to contribute to the capacity-building in National Meteorological and Hydrological Services (NHMSs), particularly in developing countries through the implementation of the best possible use of existing NWP products and the improvement of their warning systems of hazardous weather conditions and weather-related hazards. The SWFDP has achieved significant results and benefits related to the Global Data Processing and Forecasting System (GDPFS) and Public Weather Service (PWS) programmes in its first regional subproject in southern Africa. After the expanded phase, this subproject is now transferring into the operational phase. Similar regional subprojects are on-going or arising in other regions such as in Southern Pacific Islands in RA V, in Eastern Africa in RA I and in Southeast Asia in RA II. Through the lessons learnt from the first subproject in southern Africa, technological gaps are identified in several fields such as nowcasting, very-short-range forecasting, and verification of NWP products, and socio-economic impacts in relation to delivery of meteorological services. SWFDP tackles these issues, including through collaborating with WWRP working groups of JWGFVR, WGNR and SERA.

3.4.3.3 The SWFDP will also provide an opportunity to demonstrate and realise the benefits of promising outputs of new forecasting research through collaboration with the THORPEX GIFS-TIGGE Working Group. GIFS-TIGGE Working Group has been developing new products, particularly multi-model ensemble products, and aims to develop the new GIFS (Global Interactive Forecast System) through the cascading products in support of the SWFDP. The SWFDP regional projects could well serve as a trialling environment for promising outputs from GIFS, and the implementation of new products from TIGGE.

3.4.3.4 The JSC noted with much pleasure the rapid expansion of the SWFDP concept to include plans for East Africa, Southeast Asia, and the Pacific Island. However, the JSC further noted that the research links discussed between GIFS-TIGGE and GDPFS (e.g., heavy rainfall products, incorporation of TIGGE cyclone track forecasts) have been slow to develop and asked for a reporting on progress on this topic at the next JSC.

3.4.3.5 The JSC also notes that the SWFDPs do not quantify the economic and societal benefit of forecast improvements, which is a measure often desired by the BMHCs to help justify their expenditures and improve their practices. The JSC notes that the upcoming document to be produced by the SERA Working Group establishing best practices for SERA components of FDPs

would help assist in the development of such practices and should be shared with those organizing the SWFDPs. Such efforts, however, typically have to be built in the project from the onset as tackling such issues in retrospect is difficult.

3.4.3.6 The JSC noted that the EC-LXII request by Kenya for a research experiment to understand what types of weather events cause fatalities on Lake Victoria has not taken place due in large part to funding limitations and the development of a SWFDP over the region. Due to the GDPFS presence in East Africa, the JSC requested and the Secretariat supporting GDPFS agreed to provide the mortality information on the loss of life on the lake to further the original research requested by Kenya.

3.4.3.7 In the subproject in Southeast Asia that is being developed, CMA, JMA and KMA will participate as Global Centres. CMA is one of three archive centres of TIGGE data, gathering EPS products from 10 NWP centres. Meteorological Research Institute of JMA conducts a five-year project which started in 2009 as a joint project of WWRP and Tropical Cyclone Programme (TCP). It is planned that the GIFS-TIGGE products from this project are provided to participating countries: Viet Nam, Cambodia, Lao P.D.R. and Thailand.

3.4.3.8 The JSC requested the Chair of the JSC to further discuss on the SWFDP issues between the CAS and CBS Presidents. The JSC noted that having the Chair of the OPAG GDPFS present at the next JSC would help facilitate discussions on the SWFDP and other areas.

3.5 MESOSCALE WORKING GROUP

3.5.1 The report of the plans and progress of the Working Group on Mesoscale Forecasting Research were presented. In particular the following were highlighted:

- The “Convective and Orographically-induced Precipitation Study” (COPS) RDP which has the goal to advance the quality of forecasts of orographically-induced convective precipitation by 4D observations and modelling of its life cycle
- Work with WGNE on Grey zone project
- Preparations for Sochi-2014 Winter Olympics
- HyMex
- Ensemble predictions (TIGGE-LAM)
- Mesoscale model verification
- Crosscutting activities with the verification and nowcasting Working Groups
- Training

COPS

3.5.2 The COPS project has been wrapping up its scientific activities with the publication of a series of papers on the scientific outcomes in a special journal issue.

Decision/Action WWRP/JSC4 (17): The JSC noted the success of COPS and requested the Chair of the Mesoscale Working Group to arrange that a brief report on the lessons learnt from COPS be prepared for the next meeting of the JSC.

Grey Zone project

3.5.6 Dr Jeanette Onvlee, Chair of the Mesoscale Working Group, presented plans for the Grey Zone project. The main focus of the Grey Zone project is the requirements for the parameterisation of convection in models which employ horizontal resolutions of 10 km and finer.

3.5.7 Considering the strong and complex interactions involving turbulence and convective behaviour on these length scales, a need for idealized experimentation has been identified. Following discussions at the 2010 WGNE meeting, it was decided that a Grey Zone Team consisting of representatives from WGNE, GCSS and the Mesoscale Working Group should work

out a proposal for such experimentation. For the first experiment, the Team has chosen a cold air outbreak case study (over sea). Modelling groups from the LES, mesoscale and global modelling communities will be invited to participate in the experimentation with the first case study and this will provide a starting point for a multi-year international Grey Zone modelling project.

Decision/Action WWRP/JSC4 (18): The JSC supported the Grey Zone project as proposed and requested the Chairs of the Mesoscale Working Group and the WGNE to provide status reports on the Grey Zone project to future meetings of the JSC.

Sochi 2014

3.5.8 The Sochi 2014 RDP/FDP will be focused on the demonstrating prediction systems for the 2014 Winter Olympics. Research activities will be focused on:

- Winter weather in stable conditions and mountainous terrain
- Mesoscale data assimilation involving extensive use of radars and vertical profiling instruments
- The application of high-resolution modelling
- The use of ensembles of predictions from convection-permitting models

3.5.9 The Mesoscale Working Group is providing advice to Roshydromet and members of the Working Group together with representatives from Nowcasting and Verification Working Groups will participate in the Sochi 2014 kick-off meeting, in which the exact scope of the project will be defined, to be held in March 2011.

Decision/Action WWRP/JSC4 (19): The JSC was pleased that an RDP/FDP is being prepared for Sochi 2014 and recommended that such a project should build on the experiences gained in SNOW-V10 and requested that the Project Leader and the Chairs of the Nowcasting/Mesoscale Working Group report on progress to the next meeting of the JSC.

Data assimilation

3.5.10 The JSC noted that there is potential in using data assimilation to initialise mesoscale prediction models but many scientific issues remain and recommended that:

- The design of experiments to determine the most effective data assimilation approaches for initialising mesoscale models.
- Wide-ranging experimental use of a variety of observation types including surface observations, radar observations and lidar.

Decision/Action WWRP/JSC4 (20): The JSC, noting that there is potential in employing mesoscale prediction systems for nowcasting, requested the Mesoscale Working Group and the Nowcasting Working Group to organize a joint workshop to scope out activities in this field.

Decision/Action WWRP/JSC4 (21): The JSC was pleased that the Mesoscale Working Group has begun to identify gaps in training on mesoscale NWP and requested that the Working Group prepare an inventory of available mesoscale NWP training material before the next JSC meeting.

3.5A Update on TIGGE-LAM Panel

3.5a.1 The main interests include perturbation of initial conditions, model perturbations, the surface, working towards convective permitting LAM EPSs and the area of LAM EPS and data assimilation combinations. The Panel was restructured into regional bodies e.g. Europe, North America etc., The TIGGE-LAM Plan was making progress but not very many comments had been received and more were welcome as efforts are made to finish the document. Some aspects needed further work – there is still a need to address some scientific issues. There needs to be

more coordination of the research. The Plan contains a list of actions/activities which are being steadily addressed. It is hoped to have a final version of the Plan by the summer of 2011.

3.5a.2 Archiving has been discussed for some time and is now just beginning at CMA. Work at ECMWF has slowed up. It is now considered better to archive on the native grid. There is some prospect of obtaining funds for archiving if the GEOSS interoperability for Weather, Ocean and Water (GEOWOW) proposal to the EC is successful. TIGGE is a major part of this proposal.

3.5a.3 Work is also proceeding on a high resolution observations data set e.g. precipitation analysis at ECMWF. Strong links are maintained with the EUMETNET Short Range Numerical Weather Prediction (SRNWP) project which addresses interoperability issues. Links are also in place to the "DISTRIBUTED RESEARCH INFRASTRUCTURE FOR HYDRO-METEOROLOGY STUDY" (DHRIMS) group and the evolving HyMeX plans.

3.5a.4 In discussions it was noted that:

- The JSC noted that the original emphasis on TIGGE-style data sets may not be appropriate in all regions and that, in general, the emphasis is shifting away from the original concept of interactive deployment of limited area models on demand and towards research on the design and utilization of regional ensembles. Several members of the JSC suggested that, in view of these issues and, since the project is not global, the group consider renaming the project to LAM EPS.
- The JSC urged comments on the Science Plan be sent as soon as possible and include comments on the noted shift in emphasis.
- The JSC suggested it was not necessary to change the organizational structure at this time, but noted that the evolution of this project was moving the effort closer to the Mesoscale Forecast Research Working Group and that the emphasis on implementation should take into account existing regional efforts.

Decision/Action WWRP/JSC4 (22): The JSC, noting that there were strong links between the TIGGE-LAM Panel and the Mesoscale Working Group, recommended that the TIGGE-LAM Panel be integrated into the Mesoscale Working and requested the Manager of the THORPEX IPO to convey this recommendation to the GIFS-TIGGE Working Group and the THORPEX ICSC with the view to getting agreement with this recommendation before the next JSC meeting.

3.5B Sand and Dust Storm Warning, Advisory and Assessment System (SDS-WAS)

3.5b.1 The highlights of the activities included in the tabled SDS-WAS Science and Implementation Plan were presented and these include:

- A workshop on the Implementation of the SDS-WAS in Asia (2009) which resulted in the agreement to establish a common portal for regional data exchange and exchange of scientific experience in the region.
- A meeting (2010) on joint research on SDS among Mongolia, China, Korea and Japan.
- A Hands-on workshop (2010) on use of the SDS-WAS products in the African user community.
- The shipment, by AEMET (Spanish Met Office), of sun photometers to Morocco and Tunisia to be used to validate dust forecasting.

3.5b.2 Research activities of the two SDS-WAS partners were presented, including the most critical issues related to improving the observation, verification, predictability and modelling of these dust events, participation in international projects such as Meningitis Environmental Risk

Information Technologies (MERIT) (BSC, AEMET), NASA (university of Arizona), Monitoring Atmospheric Composition and Climate (MACC) (AEMET, BSC), examining Saharan dust trends in the last decades using dust model re-analysis, intercomparison of BSC-DREAM, and ECMWF and INCA models via the AEROCOM web interface, assimilation of satellite data in dust forecast systems in the global (MACC) and regional dust model.

3.5b.3 The JSC was extremely pleased to learn of the role of the SDS-WAS partners in reaching users in the developing and least developing nations of Africa including supporting the MERIT project. The JSC asks that these successes be publicized at an appropriate time by the Secretariat for WWRP.

Decision/Action WWRP/JSC4 (23): The JSC took note of the tabled draft of the SDS-WAS Science and Implementation Plans and agreed that these plans could be endorsed provided:

- The plan listed recent scientific papers published by the SDS-WAS partners.
- The Secretariat finalized operational procedures to designate appropriate SDS-WAS partners performing operational dust forecasting who are capable of providing sustained operations as RSMC centres.
- Collaboration is established with the Verification WG to improve dust forecast verification.
- The possibility of distributing dust-related data through the WMO WIS (or GTS) is explored.
- The amended plans are provided to the next meeting of the JSC.

3.6 Nowcasting Working Group

3.6.1 Following the decisions of the third meeting of the WWRP/JSC, the CAS XV decisions and the requirements of the Strategic Plan, five new members, including a new Chair (Paul Joe), have joined the Working Group.

Decision/Action WWRP/JSC4 (24): The JSC recognised that the outgoing Chair, Dr Tom Keenan, had provided exceptional leadership to the Group and requested the WWRP/JSC Chair to send a letter of thanks to Dr Keenan.

3.6.2 The Chair of the Working Group on Nowcasting Research presented the activities of the Group and the plans for the future work.

Meetings

- The World Symposium on Nowcasting 2009 (Whistler, BC Canada) focussed on multi-element winter Nowcasting. The next World Symposium on Nowcasting will be held in Rio de Janeiro from 20-24 August 2012.
- The Shanghai World Expo on Nowcasting led by PWS was supported by WWRP.
- A capacity building workshop led by PWS will be held in November 2011 in Shanghai - WWRP will be invited to participate.
- A capacity building workshop for Asia based on Beijing 2008 will be conducted in first half of 2012 and will be used as a motivator to prepare journal publications.
- GDFS is organizing an Expert Team on Very Short-Range Forecasting (21-23 March 2011). The JSC appreciates the invitation for WWRP to attend this meeting and encourages WWRP participation. The JSC, however, was very concerned that a joint CBS-CAS meeting on Forecast Systems was proposed several times and delayed, in part, due

to a lack of funding on the CBS side. The JSC suggests that the decision of CBS to hold their own meeting on this topic is a lost opportunity for collaboration and could limit the effectiveness of the research prospective on the future of forecast systems.

- Two specialty meetings on Heuristic Nowcasting (2012) and on Bridging the Mesoscale / Nowcasting (summer 2011) time scales are planned.

Decision/Action WWRP/JSC4 (25): The JSC requested the Chair of the Nowcasting Research Working Group and C/WWR to coordinate participation in the meetings listed in Meetings (see Annex IV).

Projects – Lake Victoria

3.6.3 As a result of discussions at the WMO Executive Council, the WWRP tasked the WGMFR, WGMR, SERA and Verification to explore an understanding project on the “dynamics of Lake Victoria” in support of improving predictions for fisheries activities and reduce loss of live due to severe weather storms. Agriculture is also a key end users. There are many unknowns – weather types, local expertise, operational capabilities and the status of any existing radars or observation systems. An expert team visit is required to progress a potential project.

3.6.4 Since there is an existing SWFDP project, it is proposed to “piggyback” on the SWFDP effort – particularly for short-range and very short-range prediction. In particular, it is planned that the Working Group:

- Will support the Mobile Weather Alert project to demonstrate the value of the MSG products to the Lake Victoria NHMS forecasters.
- Focus on Satellite and lightning nowcasting in this Region.
- Explore the requirements for a Nowcasting service particularly with respect to lead time requirements.
- Identification of convective initiation mechanisms of the thunderstorm phenomena over the Lake.
- Await the information from the Secretariat supporting GDPFS on mortality events over the Lake.

3.6.5 It should be noted that there are other regions in Africa where lightning Nowcasts would be useful. In particular, in South Africa there are 150 deaths per year where public awareness is a key to an effective warning service. Some low-cost new technologies (such as CASA Solar Powered Radar) that require low infrastructure using cell phone telecommunications may be effective for near shore warning applications.

Decision/Action WWRP/JSC4 (26): The JSC requested the Chair of the Nowcasting Research Working Group to report on the Group’s Lake Victoria plans and activities.

Nowcasting Project for South East Asia

3.6.6 A SWFDP by CBS is in formulation stage for South East Asia. And, it is planned that SWFDP, CBS/PWS and the Nowcasting research Working Group will explore and co-ordinate a Nowcasting project in South East Asia. Since there are many unknown issues and an expert team visit will be necessary.

Decision/Action WWRP/JSC4 (27): The JSC requested the Chair of the Nowcasting Research Working Group report on the Group’s plans and activities for a Nowcasting Project for South East Asia.

The INCA-CE Forecast Demonstration Project (FDP)

3.6.7 The INCA-CE (Integrated Nowcasting System for the Central European Area) project aims at reducing adverse effects of weather-related natural disasters (e.g. wind-storms, flooding, mudflows, icing, drought) by establishing a state-of-the-art, high-resolution, real-time analysis and forecast system on atmospheric, hydrological, and surface conditions. Main goal is the improvement of risk management standards and methodology in order to enable management institutions and authorities to issue more detailed assessments and warnings.

3.6.8 Preliminary discussions of designating INCA-CE FDP as a WWRP FDP have taken place.

NOTE: In all the cases of the development of potential projects, detailed proposals are requested and expert team visits and assessments and visits are required before progress can be made. Several of these projects have long-term implications with operational deployment in mind. Consequently, collaboration and coordination with several divisions in CBS is required.

Decision/Action WWRP/JSC4 (28): The JSC requested the Chair of the Nowcasting Research Working Group to report on the Group's plans and activities for the INCA-CE Forecast Demonstration Project (FDP).

South American Nowcasting Regional training Centre

3.6.9 A proposal for an advanced Regional Training Centre focussing on Nowcasting for South America (RTC-N) was submitted by the University of Sao Paolo. The JSC noted that South America be the focus of such an RTC. This project could lead to a test bed that could have elements of advanced end-user engagement, verification and social-economic research with the potential focus on urban hydrology and flash flooding and a link with the Regional Flash Flood Guidance project. It is planned that the Mesoscale, Verification and SERA Working Groups will be involved with this activity.

Decision/Action WWRP/JSC4 (29): The JSC requested C/WWR that a project plan for a South American Nowcasting Regional training Centre should be provided to the next meeting of the JSC – such a plan should describe the concepts and also the sustainability of the RTC-N.

The Joint Nowcasting Applications and Services (JONAS)

3.6.10 The objectives of JONAS include:

- Explore the potential use of Nowcasting information as operational service products.
- Promote the operational implementation of end-to-end Nowcasting systems.
- Establish good practices and guidelines for information transfer.
- Facilitate the exchange of information of Nowcasting information and experience.
- Transfer knowledge and technology relating to public weather service products in developing countries.

3.6.11 The Commission supported the establishment of JONAS and agreed that it fills an important gap in the advancement of operational Nowcasting in NMHSs. The Commission requested that JONAS continue to be engaged in the application of Nowcasting to public weather services supplementing the operational transition of Nowcasting systems and services through the FDPs and training undertaken by the WWRP.

3.6.12 The Chair of WWRP Nowcasting Research Working Group is the Co-chair of JONAS and the membership include a CBS representative.

3.6.13 The first meeting of JONAS Steering Committee at the WMO in Geneva (18-20 April 2007) and unfortunately no progress has been made since then and an alternative path be developed to guide this important technology transfer from nowcasting research to operational practice. Thus the JSC requested that JONAS be dissolved. Possible vehicles to guide this technology transfer include having the Chair of OPAG PWS attend the JSC and/or assigning an appropriate person(s) from the Working Group to represent the Working Group on an as needed/project-by-project basis.

Decision/Action WWRP/JSC4 (30): The JSC requested the Nowcasting Research Working Group review the continuing necessity for JONAS and also the potential for a replacement and to provide a proposal to the next meeting of the JSC.

Observations and data assimilation

3.6.14 The JSC was pleased to see the developing relationship with the Mesoscale Working Group and encouraged further development in this area as NWP becomes an increasingly important component of Nowcasting and stressed that it was important that a coordinated approach to mesoscale data assimilation was pursued. In this regard, the JSC noted that there is a gap in the observational research carried out for Nowcasting and mesoscale data assimilation – the THORPEX DAOS Working group covers global data assimilation and observing strategies.

Decision/Action WWRP/JSC4 (31): Consequently, the JSC requested that Nowcasting Research Working Group in collaboration with the Chair of the Mesoscale Working Group accept the responsibility of covering the issues of observation, data quality and measurement research particularly at the mesoscale and nowcasting scales.

SNOW-V10

3.6.15 Dr George Isaac summarised the outcome of the SNOW-V10 project. SNOW-V10 is part of the World Meteorological Organization's (WMO) World Weather Research Programme (WWRP) and is the first WWRP project conducted during a Winter Olympic Games. SNOW-V10 focused on Nowcasting research and development on multi-weather element (precipitation, precipitation type, visibility, wind) nowcasting in complex terrain in winter.

3.6.16 The SNOW-V10 international team augmented the instrumentation associated with the Winter Games and several new numerical weather forecasting and Nowcasting systems were added. The project demonstrated the potential of improved techniques for short term (0-6h) forecasts of winter weather over complex terrain and results and included predictions of visibility, low-level cloud, wind gusts, precipitation rate and type that were made and are being evaluated against observational data.

3.6.17 A special issue of Pure and Applied Geophysics (PAGEOPH) is being prepared for submission of papers. Thirty-one papers are in preparation.

3.6.18 The JSC was pleased with the outcome of SNOW-V10 and encouraged those involved to continue the exploitation of the data. In lieu of a capacity building workshop, a final seminar may be more appropriate of raising the profile of the scientific outcomes.

Summary

3.6.19 The JSC commended the group for the success of its activities; especially in the technology transfer area. However, concerns were expressed that the group should not extend its activities too widely and that it should focus on priority areas. The JSC recommended that new project proposals identify science issues clearly and should be presented within common research frameworks (for example, Snow and complex terrain meteorology for the Olympic Nowcasting projects), The group should capitalize on the lessons learnt from one project to the next one and clearly describe the new science issues that would be addressed in the follow-up projects. At subsequent discussions during the later sessions of the meeting, a member of the JSC suggested

that this common research framework could be an umbrella project that covers broad research areas such as nowcasting and short-range prediction for winter, orographic weather to cover SNOW-V10 and Sochi. This packaging would raise the visibility of important topics within the Working Group and possibly assist in generating long-term support.

3.7 Presentation of and Decision on the Endorsement of the Proposed SOCHI 2014 Winter Olympics FDP and/or RDP

3.7.1 Dmitry Kiktev presented a FDP/RDP proposal for Sochi 2014 Winter Olympics. The Olympics is envisaged as an opportunity to develop and test new techniques for weather forecasting and nowcasting. The complex orography and related weather conditions result in frequent high winds, low visibility and cloudiness, and intense precipitation. Roshydromet is proposing a blended RDP/FDP under the auspices of the Nowcasting and Mesoscale Weather Forecasting Working Groups that includes the following project components: nowcasting of multi-weather elements – wind speed and wind gust, visibility, fog, precipitation intensity and type; mesoscale ensemble modelling; high resolution (radar) data assimilation; verification using remote sensing data.

3.7.2 The JSC noted that a mobile radar system will be added to other observational platforms. Visibility and surface observations are identified as the most critical parameters for nowcasting/mesoscale activities. The JSC noted that one of the models to be used, COSMO, does not include surface analyses.

3.7.3 The JSC supported the ongoing efforts to develop the Sochi project and urged: i) completion of the written plans for this project to focus and guide this effort; ii) a societal component be considered for inclusion in view of the importance of a societal and verification components to measure the benefits the project as noted by CAS-XV.

Decision/Action WWRP/JSC4 (32): The JSC were looking forward to the outcome, include revised plans, of the Sochi 2014 kick-off meeting and agreed to consider endorsement of SOCHI 2014 as a WWRP RDP/FDP by email.

3.8 Joint Working Group on Verification Research

3.8.1 Since the last meeting of the JSC, the JWGFVR had participated in a number of WWRP activities namely: Typhoon Landfall FDP, SWFDP, SNOW V-10 RDP and plans to participate in the proposed Sochi 2014 FDP. It also intends to establish collaboration with SERA on the several projects, such as the proposed Lake Victoria project.

3.8.2 The JWGFVR has also been active in training of forecasters and administrators in southern and eastern Africa on basic verification techniques as part of the Severe Weather FDP. The priority has been official forecasts of heavy precipitation (>50 mm in 24h). The scarcity of observations on the GTS has been challenging for SWFDP verification.

3.8.3 The Working Group is currently collaborating with the Working Group on Tropical Meteorology Research (WGTMR) to provide verification of seasonal hurricane predictions for the number of storms in a basin, will provide advice to the Working Group on Mesoscale Weather Forecasting Research (WGMWFR) and Working Group on Numerical Experimentation (WGNE) on the verification of high resolution models in an Integrated Mesoscale Research Environment (IMRE; examples are COPS and HyMeX) and will together with SERA Working Group design an assessment project around tropical cyclone forecasting that addresses user needs for warning information and also research questions about the accuracy and effectiveness of the forecasts and verification.

3.8.4 The precipitation verification phase of the Spatial Verification Intercomparison Project has been completed, with many new verification methods demonstrated and 13 papers published in a special collection of Weather and Forecasting in 2009-10. Datasets of real and idealized

precipitation forecasts are available online to be used as a test bed for investigating new verification techniques. The next project phase is likely to include verification of wind fields and diagnosis of timing errors in spatial fields.

3.8.5 A draft document on methods for the verification of cloud forecasts is under review in JWGFVR, and is expected to be published as a WMO Technical Document in 2011. The Group is also preparing a document describing methods for verifying tropical cyclone forecasts, in support of GIFS-TIGGE and the Typhoon Landfall FDP.

3.8.6 The "Forecast Verification: Issues, Methods and FAQ" web page underwent a facelift and a new URL:- <http://www.cawcr.gov.au/projects/verification> . "Travelling tutorials," continued in 2009-10, with training material prepared by JWGFVR being successfully used in SWFDP verification training in southern Africa, and a (FMI-funded) verification training course for the Peru Meteorological Service.

3.8.7 During discussions it was noted that:

- There are plans for the Working Group to undertake a travelling tutorial in South America in 2012 in combination with proposed training on nowcasting.
- In the Sochi 2014 Winter Olympics FDP/RDP the JWGFVR plans to look into observational uncertainty in addition to doing standard forecast evaluation; the Working Group would like to test innovations in temporal verification (onset/cessation of high impact weather), spatial/2D verification (possibly including the time-height field), and ensemble verification in the said FDP/RDP.
- For sub-seasonal to seasonal verification, the Group is still struggling with the issue on which approaches to use to verify in a consistent way across various spatial and temporal scales and forecast ranges.
- There is a need to look into a verification approach to which forecasters and users can better relate.
- In the verification of extreme events, which is still a new area in verification, there is a need to define a scale which could be more useful to decision makers.
- There is a need to look more into the multiple element approach in verification.
- There is a need to strengthen ties with the Tropical Meteorology Research Working Group.

3.8.8 During discussions the JSC recommended that:

- Future projects be packaged under a focussed research area (such as seamless verification) which would be more attractive to the research community and especially to funding agencies; a project structure for seamless verification may be more suitable for bringing in verification researchers from the climate and seasonal prediction community.
- One or two forecasters from the Sochi 2014 FDP who attend the upcoming 5th International Verification Workshop (Melbourne, 1-7 December 2011) to receive training.
- That JWG work with the THORPEX PDP WG on a seamless diagnostic approach to understand the origin of model errors at the process level by focusing on the first few days.
- That JWG work with the THORPEX Polar Prediction Project to assist with a formal inter-comparison of polar prediction using the existing WMO procedures, and the adoption of new metrics using operational and research databases such as CONCORDIASI.

- That JWG support the use of output from high resolution regional climate models and regional reanalyses to explore concepts of seamless verification.

3.8.9 The JSC welcomed the plans of the JWGFVR to work on new focus areas namely: "Seamless verification" will be tackled using consistent approaches across a range of scales for different types of forecasts (for example, applying averaging and probabilistic approaches and tercile exceedance statistics to both medium-range EPS and monthly/seasonal forecasts), extension of spatial verification methods to ensembles, timing verification of manual and numerical warnings and their downstream impacts (e.g., road friction, river discharge), aviation forecasts (e.g., fog, TAF), and bivariate verification (e.g., intensity and location).

3.8.10 The Committee welcomed the addition of new members from NCEP, IRI, and CPTEC who will facilitate collaboration with hydrological and seasonal forecasting communities.

3.8.11 It was impressed with the work of JWGFVR and commended it successfully undertaking a number of important tasks for WWRP since its establishment in 2003 and working closely with the other WWRP working groups in various projects. The Committee noted the effectiveness of the working group in producing guidance for verification efforts in the various projects of the WWRP and how it could serve as a model for SERA activities.

3.9 Societal and Economic Research Applications

3.9.1 In the interim period since the third meeting of the JSC, members of SERA Working Group have provided input into several meetings and projects including:

- WWRP THORPEX/GEO/RIPIECSA Workshop on High Impact Weather Predictability and Information System for Africa (Trieste, Italy, 5-8 October 2009).
- Shanghai World EXPO 2010 Nowcasting Service Demonstration Project (WENS) Science Steering Group (SSG) meeting (Shanghai, China, 27-29 October 2009).
- Meeting of the Integrated Research on Disaster Risk (IRDR) Ad Hoc Group on Forensic Investigations into Natural Disasters, Toronto, Canada, 1-4 February 2010.
- THORPEX North America Regional Committee meeting, Cuernavaca, Mexico, 19-20 May 2010.
- WWRP/WCRP Workshop on Sub-seasonal to Seasonal Prediction, UK Met Office, Exeter, 1-3 December 2010.

3.9.2 The second Working Group meeting was held jointly with the JWGFVR in Toulouse in September 2010. Potential collaborations were discussed with the Co-Chairs and volunteer members of the Working Groups tasked to develop a small, specific joint JWGFVR/SERA project focused on The TIGGE tropical cyclone tracks (CXML data) or heavy precipitation product.

3.9.3 The structure of the Working Group, designed to access a wide variety of disciplinary expertise, inform other Working Groups, and link to both WMO (for example PWS) and external organizations, is slowly being realized. Finalizing the terms of involvement of the Integrated Research on Disaster Risk (IRDR) programme supported by the International Council for Science (ICSU), International Social Science Council (ISSC), and United Nations International Strategy for Disaster Reduction (UN ISDR) IRDR programme are a priority. Discussions continue with the scientific committee chair and director of IRDR to formalize joint membership and associated collaborations. Where possible and practical, joint members will be selected to establish representation from South East Asia and South America. The goal is to have arrangements in place by December 2011.

3.9.4 Key activities in 2011 and early 2012 include preparation of the publication “Applications of seasonal to sub-seasonal weather and climate predictions: An annotated bibliography in support of the WWRP/WCRP project on seasonal prediction”; a guidance document that will assist project proponents from other Working Groups in the design, costing and implementation of SERA elements of proposals seeking sanction from the WWRP; and further development of the research framework supporting a SERA research demonstration project to understand the societal and economic dimensions of weather-related warning systems. The framework and specified research questions will be applied in the selection of appropriate SERA studies from a large list of candidate collaborative projects, including: various WMO Lake Victoria initiatives; WWRP/WCRP/THORPEX sub-seasonal to seasonal prediction international research project; PWS Severe Weather Forecast Demonstration Projects (Eastern Africa, SE Asia, South Pacific); Integrated Nowcasting for Central Europe Area (INCA-CE) project; JCOMM/CHy Coastal Inundation FDP; South African/Southern Africa Flood Forecast Guidance projects; Sochi 2014 Winter Olympics; IRDR projects (forensic case studies); and MeteoAlarm and similar NMHS country efforts.

3.9.5 Other activities include the development of an externally-managed SERA website (and social media pages) and associated resource clearing house with links to the WMO/WWRP site and a social science experts/practitioners session that will adjoin the next regular SERA Working Group meeting in Melbourne (late 2011 or early 2012). The session will involve inviting up to 20 international social and applied science experts/risk managers to engage in focused discussion on several weather-hazard-disaster management themes, in particular the evaluation and measurement of the social and economic benefits of weather-related risk information. Potential social science capacity-building and training activities have been identified for late 2012 and 2013.

3.9.6 The JSC:

- Discussed and supported the WWRP guidelines that FDPs should include a SERA component and that RDPs have a SERA effort when suitable and practical. The JSC welcomed the plans of SERA to develop a best practice guidance document that would assist in the development of SERA components for WWRP projects, since it is simply not practical for the SERA WG to be actively involved in SERA components for each project. The JSC encouraged the SERA WG to have this document ready for approval by the next JSC.
- Welcomed and supported the described plans of the “reconstituted” SERA WG that include the partnership with IRDR, the external SERA website, the annotated bibliography related to subseasonal and seasonal prediction, their future meetings, and the proposed joint project developed by JWGFVR and the SERA WG. The JSC urged WMO Secretariat support for these activities and reporting on the progress at the next JSC.
- Enquired about past planes and whether the project to normalize the national disaster economic impacts by the economic capacity of the nations affected was completed. The JSC was pleased to hear that the project was still underway and requested a briefing on the topic at the next JSC.
- Cautioned advancing a Lake Victoria early warning demonstration project until it was clear that on-going work in the region was not already addressing SERA issues (avoid duplication); they recommended working with PWS in the Eastern Africa SWFDP where connections with regional users have already been established to some extent; additional candidate collaborations with the HyMeX programme in Europe and efforts in the La Plata Basin in South American were identified as worthy of pursuit.
- Recommended that SERA consider expanding membership in the area of weather, climate and human health; representative from IRI could help advance health-related activities in the developing countries.
- Encouraged adding a SERA element to any training initiatives in South America.

Decision/Action WWRP/JSC4 (33): The JSC requested the Chair of the SERA Working Group to report on the status of the Guidance document at the next meeting of the JSC.

3.9.7 In closing, the JSC looks forward to future developments of more tangible projects. There will be a need for some activities or a research demonstration project to be sustained over time in order to assess co-learning and the development of benefits over the long-term.

3.10 Weather Modification Research (WMR) Assessment

3.10.1 The Expert Team on WMR (ET-WMR) met in Abu Dhabi, United Arab Emirates (UAE) in 2010 to review the WMO status and guidance documents related to weather modification and these have been finalized, approved and published on the WMO webpage. The Expert Team also reviewed a proposal from the UAE National Centre for Meteorology and Seismology (NCMS), "to establish an International Centre for Weather Modification Research (ICWMR) in the UAE. The documents related to the international centre has been reviewed and supported by both the WMO and authorities in the UAE and finalization of a corresponding MoU is expected early in 2011.

3.10.2 Concerning further actions in 2011/12 the 10th WMO Scientific Conference on Weather Modification is scheduled to take place in Bali, Indonesia in late 2011 or beginning 2012. A thorough scientific review of scientific lessons learned from weather modification and possible links to emerging issues related to climate change and geo-engineering is also planned.

3.10.3 The JSC noted with appreciation the contributions that ET-WMR made in the process of establishing ICWMR. JSC was informed that in the first 5 years period the UAE will contribute with about 1 million USD to support scientific conferences, ET meetings, expert workshops and awards to scientists in the WM field.

3.10.4 The JSC clarified that the planned ICWMR is not a WMO centre but WMO will review and provide guidance on scientific issues in WM. JSC also requested to be updated on and to review research activities/issues of the Centre. Interactions of ET with other WWRP WGs if appropriate are encouraged.

4. VISIONS FOR THE FUTURE

Publications - a guideline for all Working Groups

The JSC strongly recommended the publication of project (for example RDP/FDPs) results and meeting reports, if appropriate, in refereed journals. This would ensure the high quality of the science, promote of the understanding of the science and publicize the benefits of the WWRP projects.

4.1 BAMS Papers and Future Initiatives

4.1.1 The JSC has discussed the willingness, readiness and capacity of the WWRP community to participate to the establishment of an international Earth-system Prediction Initiative to provide research and services required to accelerate advances in weather, climate and Earth-system prediction. Elements of the Initiative are introduced in a compendium of papers appearing in the October 2010 issue of the *Bulletin of the American Meteorological Society*^j and in the Belmont Reportⁱⁱ, prepared by scientists associated with the World Meteorological Organization (WMO) World Weather Research Programme (WWRP), World Climate Research Programme (WCRP), International Geosphere-Biosphere Programme (IGBP), Global Climate Observing System (GCOS), and natural-hazards and socioeconomic communities. It will build upon the WMO, the Group on Earth Observations (GEO), the Global Earth Observation System of Systems (GEOSS), the International Council for Science (ICSU) and national operational and research agencies to develop, implement and coordinate the effort across the weather, climate, Earth-system, natural-hazards, and socioeconomic disciplines.

4.1.2 To be successful, this endeavour demands collaborations among physical and social scientists to facilitate: i) global Earth-system analysis and prediction models that account for physical, chemical, biological and societal processes in a coupled atmosphere–ocean–land–ice system; ii) an international-to-regional framework that links observed and predicted climate and weather to seamless interactions and feedbacks with biogeochemistry, biology, and socioeconomic impacts and drivers.

4.1.3 Advances in global-to-regional Earth-system weather and climate monitoring, prediction and applications would be accelerated through: i) investments in maintaining existing and new observation systems; ii) enhancement of existing national operational capabilities; iii) support for academic engagement; iv) establishment of multinational, regional interdisciplinary-research centres with high-performance computing facilities and cyber infrastructure.

4.1.4 The global scope of the effort required to accelerate advances in Earth-system monitoring, prediction and services is inescapable. Unprecedented international collaboration and goodwill are necessary for success. NMHSs have collaborated to advance global observing systems, weather forecasting, climate prediction, communication networks, and emergency preparedness and response. NMHSs must now extend this collaboration to embrace the full Earth system and the next frontier of socioeconomic and environmental applications of our science. The JSC and WG chairs concur with this proposed direction. The WWRP effort will focus on the establishment of this prediction initiative for time scale spanning a few minutes to subseasonal. The extension of this initiative beyond the subseasonal time scale is left to the climate community with collaborative opportunities already identified in the BAMS, October 2010, compendium of papers. The proposed initiative needs to be aligned and built on the projects already initiated by WWRP and THORPEX on subseasonal and seasonal forecasts and polar research or endorsed like HYMEX.

4.1.5 Two important components of this initiatives has been discussed: i) Interdisciplinary Summer School Programme: a first step toward informing the next generation of the excitement and opportunities of the research and multifaceted deliverables at the forefront of society; and ii) WWRP Earth-system Open Science Conference in 2013 (a proposition from president of the Commission of Atmospheric Science, M. Béland).

4.1.6 The WWRP Earth-system Open Science Conference (EOSC) will put emphasis on environmental services derived from the deployed core operational weather analyses and prediction systems. This is motivated by the increasing convergence between atmospheric chemistry, climate, weather and water sciences. The WWRP EOSC should have: i) a traditional science programme area, but with a clear focus on the principal challenges ahead; ii) a programme area of integrated talks or presentations on a small number of high priority topics and issues; iii) an important programme area on environmental applications, as well as the gaps in meeting the needs of the clients and stakeholders; and iv) programme area on dissemination, communications and outreach, and the challenges in improving this.

Decision/Action WWRP/JSC4 (34): The JSC proposes to enlarge the discussion and to promote the different components of this Earth-system initiative and to seek potential major sponsors. This Earth-system initiative has been identified by the JSC as the possible next major WWRP trust fund that could build on the legacy of THORPEX. This Earth-system initiative should attract much interests and support from the NMHSs.

4.2 Global Prediction Research

Decision/Action WWRP/JSC4 (35): Noting that the ten-year (2005-2014) THORPEX programme was now a major element of the WWRP and recognizing that, together with the WGNE, THORPEX activities covered a wide-range of global weather prediction research, the JSC strongly recommends that THORPEX should become an integral component of the WWRP with global focus to ensure adequate resources is available to the WWR Division to fulfil the identified high priority research activities for the next biennium when contributions to the THORPEX trust fund begin to “tail off” towards the end of the ten-year period of the programme.

4.3 Open Discussion

The JSC agreed with the suggestion of the THORPEX IPO that a portion of next year's meeting concentrate on developing an understanding of the needs of the rapidly evolving meteorological services, the long range vision for future research directions, and how these factors will impact the organization of the WWRP. The approaching conclusion of the ten-year implementation phase of THORPEX is another driver in this discussion. The goal would be to have a plan for the future ready for the CAS in 2014.

5. UPCOMING MEETINGS FOR 2011 AND BEYOND

Upcoming meetings for 2011 and beyond are listed in Annex IV.

6. REVIEW OF DECISIONS AND ACTIONS

The Decisions/Actions are listed in Annex III.

7. DATE AND PLACE OF NEXT MEETING

The date of the next meeting would be February 2012, venue to be decided.

8. CLOSURE OF THE MEETING

Gilbert Brunet, Chair of the WWRP/JSC, closed the meeting at 12.30 on 24 February 2011.

**Report of the 4th Session of the Joint Scientific Committee (JSC)
for the World Weather Research Programme (WWRP)**

(Geneva, Switzerland, 21-24 February 2011)

Meeting Agenda

- | | |
|---|---|
| 1. ORGANIZATION OF THE MEETING | <i>Gilbert Brunet and Tetsuo Nakazawa</i> |
| 1.1 Opening of the meeting (10 am, 21 February 2011) | |
| 1.2 Adoption of the agenda | |
| 1.3 Working arrangements for the meeting | |
| 2. MANAGEMENT REPORTS | |
| 2.1 Report on CAS XV (18-25 November 2009) | <i>David Burridge</i> |
| 2.2 Report of the Chair of the WWRP JSC | <i>Gilbert Brunet</i> |
| 3. ACCOMPLISHMENTS, STATUS AND FUTURE RESEARCH ACTIVITIES | |
| 3.1 Report of the WCRP-CAS Working Group on Numerical Experimentation (WGNE) | <i>Andy Brown; Christian Jakob</i> |
| 3.2 THORPEX PROGRAMME | <i>Alan Dickinson</i> |
| 3.2.1 DAOS Working Group | <i>Roger Saunders; Pierre Gauthier</i> |
| 3.2.2 PDP Working Group | <i>Heini Wernli; Istvan Szuyogh</i> |
| 3.2.3 GIFS-TIGGE Working Group | <i>Richard Swinbank; Zoltan Toth</i> |
| 3.2.4 Results from T-PARC (Winter) | <i>Roger Saunders;</i> |
| 3.2.5 Status of the Year of Tropical Convection | <i>Mitch Moncrief</i> |
| 3.2.6 Status of HyMeX | <i>Véronique Ducrocq</i> |
| 3.2.7 Status of the Polar research project | <i>Thor Erik Nordeng</i> |
| 3.2.8 Status of the Seasonal Prediction project | <i>Gilbert Brunet and David Burridge</i> |
| 3.3 WCRP activities | <i>Tony Busalacchi; Ghassem Asrar</i> |
| 3.4 TROPICAL METEOROLOGICAL RESEARCH | <i>Yihong Duan</i> |
| 3.4.1 Status of TMR report | <i>Yihong Duan</i> |
| 3.4.2 Results from T-PARC (Summer) | <i>Pat Harr</i> |
| 3.4.3 Severe Weather Forecast Demonstration Projects | <i>Yuuki Honda Peter Chen</i> |
| 3.5 MESOSCALE WORKING GROUP | <i>Jeanette Onvlee</i> |
| 3.5.1 The "Grey Zone" project | <i>Jeanette Onvlee; Martin Miller</i> |
| 3.5.2 Sand and Dust Storm Warning, Advisory and Assessment System | <i>Michael Schulz and Soon-Ung Park</i> |
| 3.5.3 Update on TIGGE-LAM | <i>Tiziana Paccagnella</i> |
| 3.6 NOWCASTING WORKING GROUP | <i>Paul Joe</i> |
| 3.6.1 SNOW-V10 | <i>George Isaac</i> |
| 3.7 Presentation of, and decision on, the endorsement of the proposed Sochi 2014 Winter Olympics FDP and/or RDP | <i>Dmitry Kiktev</i> |
| 3.8 JOINT WORKING GROUP ON VERIFICATION RESEARCH | <i>Beth Ebert</i> |
| 3.9 SOCIETAL AND ECONOMIC RESEARCH APPLICATIONS (SERA) | <i>Brian Mills</i> |

**Report of the 4th Session of the Joint Scientific Committee (JSC)
for the World Weather Research Programme (WWRP)**

(Geneva, Switzerland, 21-24 February 2011)

List of Participants

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| Leader of the Projects | | | |
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| Kiktev | Dimitry | kiktev@mecom.ru | Sochi (FDP / RDP) |
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|----------|----------|--|--------|
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List of Decisions/Actions

| WWRP JSC-4 Decisions/Actions | Responsibility | Timescale |
|--|--|------------------|
| WWRP/JSC4 (1): To seek the involvement of the various ocean wave groups in activities involving oceans in NWP. | WGNE | ASAP |
| WWRP/JSC4 (2): To seek the involvement of the ensemble prediction community in the "Grey Zone" work. | WGNE | ASAP |
| WWRP/JSC4 (3): To provide a joint report on the status the "Grey Zone" project to the next meeting of the WWRP/JSC. | WGNE and the Mesoscale Working Group | Next JSC meeting |
| WWRP/JSC4 (4): To keep the JSC informed on the development of common formats for the exchange of radar data. | Chair of the Nowcasting Research Working Group in collaboration with the Co-Chairs of the DAOS Working Group | ASAP |
| WWRP/JSC4 (5): To report on the outcome of the YOTC Science Symposium that will take place in Beijing in May 2011. | Co-Chairs of YOTC | 1 September 2011 |
| WWRP/JSC4 (6): To impress on the HyMeX data owners the need to adopt a flexible approach to the release of HyMeX data for general research and report back to the WWRP/JSC | Veronique Ducrocq | ASAP |
| WWRP/JSC4 (7): To help to develop the socioeconomic aspects of HyMeX further whilst recognising that this was beginning to happen through the Universities of Barcelona and Grenoble. | SERA Working Group | Next JSC meeting |
| WWRP/JSC4 (8): To make efforts to ensure the links to T-NAWDEX community and the DIAMET community are maintained – noting that it was particularly important that parallel activities in late summer 2012 should be coordinated where possible | Veronique Ducrocq in collaboration with the Co-Chairs of the PDP Working Group | Next JSC meeting |
| WWRP/JSC4 (9): To ensure that that strong links be established with GEWEX GABLS for the Polar Project when it is established | C/WWR and the Manager of the THORPEX IPO | Next JSC meeting |
| WWRP/JSC4 (10): Noting that the WCRP Bergen Workshop (which focused on longer time-ranges and the high atmosphere) was seen to be complementary to the Oslo WWRP-THORPEX/WCRP workshop, to circulate the report from the Bergen Workshop to the JSC. | Vladimir Ryabinin | ASAP |
| WWRP/JSC4 (11): To report progress with the proposed Polar Project to the next meeting of the JSC. | C/WWR and the Manager of the THORPEX IPO | Next JSC meeting |
| WWRP/JSC4 (12): To report progress with the proposed sub-Seasonal Project to the next meeting of the JSC. | C/WWR and the Manager of the THORPEX IPO | Next JSC meeting |

| WWRP JSC-4 Decisions/Actions | Responsibility | Timescale |
|---|--|-------------------------------------|
| WWRP/JSC4 (13): To design a template of best practices for field campaigns in the tropics in cooperation with WCRP to improve such efforts and improve collaboration between nations. | TMR Working Group | Next JSC meeting |
| WWRP/JSC4 (14): To work together on several governance issues (e.g., membership and the number of expert bodies). | New Chair of the Working Group, the Chair of the JSC and the Secretariat | For the next CAS Management meeting |
| WWRP/JSC4 (15): To ensure that the availability of the T-PARC data is advertised widely. | C/WWR | ASAP |
| WWRP/JSC4 (16): To keep the WWRP/JSC informed on the usage of T-PARC data and number publications based on T-PARC data. | C/WWR | April 2011 |
| WWRP/JSC4 (17): To arrange that a brief report on the lessons learnt from COPS be prepared for the next meeting of the JSC. | Chair of the Mesoscale Working Group | Next JSC meeting |
| WWRP/JSC4 (18): To provide status reports on the Grey Zone project to future meetings of the JSC. | Chairs of the Mesoscale Working Group and the WGNE | Future JSC meetings |
| WWRP/JSC4 (19): To report to the next meeting of the JSC on the RDP/FDP project prepared for Sochi 2014 and on the experiences gained in SNOW-V10. | Project Leader and Chair of the Mesoscale Working Group | Next JSC meeting |
| WWRP/JSC4 (20): To organize a joint workshop to scope out activities in this field. | Mesoscale Working Group and the Nowcasting Working Group | 2011/2012 |
| WWRP/JSC4 (21): To prepare an inventory of available mesoscale NWP training material. | Mesoscale Working Group | Next JSC meeting |
| WWRP/JSC4 (22): TIGGE-LAM Panel to be integrated into the Mesoscale Working Group and to convey this recommendation to the GIFS-TIGGE Working Group and the THORPEX ICSC with the view to getting agreement with this recommendation. | TIGGE-LAM Panel and Manager of the THORPEX IPO | Next JSC meeting? |
| WWRP/JSC4 (23): The JSC took note of the tabled draft of the SDS-WAS Science and Implementation Plans and agreed that these plans could be endorsed provided: <ul style="list-style-type: none"> - The plan listed recent scientific papers published by the SDS-WAS partners - The Secretariat finalized operational procedures to designate appropriate SDS-WAS partners performing operational dust forecasting who are capable of providing sustained operations as RSMC centres - Collaboration is established with the Verification WG to improve dust forecast verification - The possibility of distributing dust-related data through the WMO WIS (or GTS) is explored - The amended plans are provided to the next CAS Management Group meeting | JSC, C/WWR and D/AER | Next CAS/MG meeting |

| WWRP JSC-4 Decisions/Actions | Responsibility | Timescale |
|--|---|------------------|
| WWRP/JSC4 (24): To send a letter of thanks to Dr. Keenan for his exceptional leadership to the Group. | WWRP/JSC Chair | ASAP |
| WWRP/JSC4 (25): To coordinate participation in the meetings listed in Meetings paragraph in section 3.6 | Chair of the Nowcasting Research Working Group and C/WWR | ASAP |
| WWRP/JSC4 (26): To report on the Group's Lake Victoria plans and activities. | Chair of the Nowcasting Research Working Group | ASAP |
| WWRP/JSC4 (27): To report on the Group's plans and activities for a Nowcasting Project for South East Asia. | Chair of the Nowcasting Research Working Group | ASAP |
| WWRP/JSC4 (28): To report on the Group's plans and activities for a The INCA-CE Forecast Demonstration Project (FDP). | Chair of the Nowcasting Research Working Group | ASAP |
| WWRP/JSC4 (29): The JSC requested that a project plan for a South American Nowcasting Regional training Centre should be provided to the next meeting of the JSC – such a plan should describe the concepts and also the sustainability of the RTC-N. | Nowcasting Research Working Group? | Next JSC meeting |
| WWRP/JSC4 (30): To review the continuing necessity for JONAS and also the necessity for a replacement and to provide a proposal to the next meeting of the JSC. | Nowcasting Research Working Group | Next JSC meeting |
| WWRP/JSC4 (31): To accept the responsibility of covering the issues of observation, data quality and measurement research particularly at the mesoscale and nowcasting scales. | Nowcasting Research Working Group in collaboration with the Chair of the Mesoscale Working Group | ASAP |
| WWRP/JSC4 (32): The JSC were looking forward to the outcome, include revised plans, of the Sochi 2014 kick-off meeting and agreed to consider endorsement of SOCHI 2014 as a WWRP RDP/FDP by email. | Dimitry Kiktev for the outcome of the Sochi 2014 kick-off meeting WWRP/JSC Chair for endorsement | ASAP |
| WWRP/JSC4 (33): To report on the status of the Guidance document at the next meeting of the JSC. | Chair of the SERA Working Group | Next JSC meeting |
| WWRP/JSC4 (34): To enlarge the discussion and to promote the different components of this Earth-system initiative and to seek potential major sponsors. This Earth-system initiative has been identified by the JSC as the possible next major WWRP trust fund that could build on the legacy of THORPEX. This Earth-system initiative should attract much interests and support from the NMHSs. | - | - |
| WWRP/JSC4 (35): To strongly support that THORPEX should become an integral component of the WWRP with global focus to ensure adequate resources is available to the WWR Division to fulfil the identified high priority research activities for the next biennium when contributions to the THORPEX trust fund begin to "tail off" towards the end of the ten-year period of the programme. | - | - |

Upcoming Meetings* for 2011 and Beyond

Planned training efforts

| Title of meeting | Dates and place |
|---|---|
| Tropical Cyclone Ensemble Forecast Training Course (in conjunction with International Workshop on Rapid Changes in TC Intensity and Track) | (Beijing, 22-24 October 2011) |
| SDS 2nd Hands-on Training Course for African Countries | (TBD, November 2011) |
| Training Course on Forecast Verification Methods | (Melbourne, Australia, 1-3 December 2011) |
| Nowcasting Training for South America | (Rio, Brazil, August 2012) |

Planned meetings

| Title of meeting | Dates and place |
|--|--|
| Nowcasting Working Group Meeting | (Geneva, WMO, 8-10 February 2011) |
| Fourth meeting of the WWRP-JSC | (Geneva, WMO 21-24 February 2011) |
| Sochi-2014 Olympic Games Kick Off Meeting | (Sochi, Russia, 1-3 March 2011) |
| WMO SDS-WAS/GESAMP Workshop SDS Steering Group Meeting | (Malta, 7-9 March 2011) (Malta, 10-11 March 2011) |
| YOTC International Science Symposium | (Beijing, China, 16-19 May 2011) |
| THORPEX European Regional meeting | (Karlsruhe, Germany, 24-27 May 2011) |
| WGNE/THORPEX PDP Workshop | (Reading, UK, 20-24 June 2011) |
| THORPEX PDP WG meeting | (TBD) |
| THORPEX DAOS WG meeting | (Exeter, UK, 27-28 June 2011) |
| THORPEX GIFS-TIGGE WG meeting | (Geneva, 31 Aug-2 Sep 2011) |
| Mesoscale Working Group Meeting | (Berlin, 10-11 September 2011) |
| Joint Working Group on Forecast Verification Meeting | (Berlin, 8-10 September 2011) |
| Nowcasting WG/Mesoscale WG Bridging the Gap Specialty Meeting | (Boulder, late summer- fall 2011) |
| THORPEX ICSC-9 meeting | (Geneva, 21-22 September 2011) |
| 10th Scientific Conference on Weather Modification | (Bali, 4-7 October 2011) |
| WGTRM Meeting and the WMO/WWRP Monsoon Heavy Rainfall Workshop | (Beijing, 10-11 October, 12-15 October 2011) |
| International Workshop on Rapid Changes in TC Intensity and Track | (TBD, 17-19 October 2011) |
| Annual WGNE meeting | (Boulder, October 2011) |
| SERA Working Group Meeting | (TBD, ?? December 2011) |
| THORPEX Asian Regional meeting | (Tokyo?, 2 December 2011) |
| 5th International Verification Methods Workshop | (Melbourne, Australia, 1-7 December 2011) |

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| 2nd International Conference on Indian Ocean Tropical Cyclone and Climate Change | (New Delhi, 14-17 February 2012) |
| International Conference on Monsoon and Climate Change | (Pune, 21-24 February 2012) |
| SNOW-V10 Final Seminar | (TBD, February 2012) |
| Nowcasting WG Meeting | (TBD, TBD) |
| Physics of weather/climate models | Spring 2012 |
| 2nd Scientific Conference for SDS-WAS | 2012 (TBD) |
| Nowcasting/Mesoscale Workshop | 2012 (TBD) |
| Nowcasting Scientific Conference | (Rio, Brazil, 20-25 August 2012) |
| Oceans for NWP | 2012 ? |
| WGNE meeting | 2012 |
| 5th International Workshop on Monsoons | (Kuala Lumpur, December 2012) |
| 3rd International Workshop on Tropical Cyclone Landfall Processes | (Manila, January 2013) |

* Please note that the listing above does not mean that the listed meeting has been funded by the WMO.

World Weather Research Programme (WWRP) Report Series

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**).

Report of the First Session of the Joint Scientific Committee (JSC) for the World Weather Research Programme (WWRP), (Geneva, Switzerland, 23-25 April 2007) (WMO TD No. 1412) (**WWRP 2007 - 5**).

Report of the CAS Working Group on Tropical Meteorology Research (Shenzhen, China, 12-16 December 2005) (WMO TD No. 1414) (**WWRP 2007 - 6**).

Preprints of Abstracts of Papers for the Fourth WMO International Workshop on Monsoons (IWM-IV) (Beijing, China, 20-25 October 2008) (WMO TD No. 1446) (**WWRP 2008 - 1**).

Proceedings of the Fourth WMO International Workshop on Monsoons (IWM-IV) (Beijing, China, 20-25 October 2008) (WMO TD No. 1447) (**WWRP 2008 - 2**).

WMO Training Workshop on Operational Monsoon Research and Forecast Issues – Lecture Notes, Beijing, China, 24-25 October 2008 (WMO TD No. 1453) (**WWRP 2008 - 3**).

Expert Meeting to Evaluate Skill of Tropical Cyclone Seasonal Forecasts (Boulder, Colorado, USA, 24-25 April 2008) (WMO TD No. 1455) (**WWRP 2008 - 4**).

Recommendations for the Verification and Intercomparison of QPFS and PQPFS from Operational NWP Models – Revision 2 - October 2008 (WMO TD No. 1485) (**WWRP 2009 - 1**).

Strategic Plan for the Implementation of WMO's World Weather Research Programme (WWRP): 2009-2017 (WMO TD No. 1505) (**WWRP 2009 - 2**).

4th WMO International Verification Methods Workshop, Helsinki, Finland, 8-10 June 2009 (WMO TD No. 1540) (**WWRP 2010 - 1**).

1st WMO International Conference on Indian Ocean Tropical Cyclones and Climate Change, Muscat, Sultanate of Oman, 8-11 March 2009 (WMO TD No. 1541) (**WWRP 2010 - 2**).

Training Workshop on Tropical Cyclone Forecasting WMO Typhoon Landfall Forecast Demonstration Project, Shanghai, China, 24-28 May 2010 (WMO TD No. 1547) (**WWRP 2010 - 3**) (CD only).

2nd WMO International Workshop on Tropical Cyclone Landfall Processes (IWTCLP-II), Shanghai, China, 19-23 October 2009 (WMO TD No. 1548) (**WWRP 2010 - 4**).

5th WMO Symposium on Data Assimilation, Melbourne, Australia, 5-9 October 2009 (WMO TD No. 1549) (**WWRP 2010 - 5**).

7th International Workshop on Tropical Cyclones (IWTC-VII), Saint-Gilles-Les-Bains, La Réunion, France, 15-20 November 2010 (WMO TD No. 1561) (**WWRP 2011 - 1**).