



3. PROGRAMME ACTIVITIES, CLOSE PARTNERS AND GUIDANCE

3.1 WORLD WEATHER RESEARCH PROGRAMME (WWRP) HIGHLIGHTS

The eighth session of the Scientific Steering Committee (SSC) meeting of the WWRP was held at the World Meteorological Organization (WMO) in Geneva, Switzerland, from 24 to 27 November 2015. The SSC meeting has been devoted to the analysis of the inputs from WWRP working groups and projects to develop the new Implementation Plan for 2016-2023 (Annex-1, executive summary).

Since the last SSC, the Polar Prediction Project (PPP) published a status report of the project, updated the Year of Polar Prediction Project (YOPP) Implementation Plan, contributed a chapter in the World Weather Open Science Conference (WWOSC) book while a paper has been prepared for submission to the Bulletin of the American Meteorological Society (BAMS). Several project related events were held which included the YOPP Summit and PPP Steering Group (SG) meetings (Geneva, WMO Secretariat, 13-16 July 2015), PPP-Societal and Economic Research and Applications (SERA) Meeting (Ottawa, Canada, 12-13 March 2015).

The Sub-seasonal to Seasonal (S2S) Project is a joint initiative of WWRP with WCRP. Key highlights in 2015 were: (i) Establishment of the S2S Database (Data Portals at the European Centre for Medium-Range Weather Forecasts (ECMWF) and China Meteorological Administration (CMA)); (ii) Subproject activities have started: a new subproject on "Teleconnections" added, some predictability results have come out; (iii) Several workshops have been organized: Sub-seasonal to Seasonal Predictability of Monsoons (Jeju, Republic of Korea, 22-24 June 2015), training course with APCC (October 2014), ECMWF Sub-seasonal Predictability Workshop (November 2015), International Centre for Theoretical Physics (ICTP) Training Workshop (November-December 2015); (iv) The first S2S Newsletter and several reports/papers have been published. There are plans to add also new ocean data.

The High-Impact Weather Project (HIWeather) has achieved several milestones in 2015: Steering Group was formed, 5 teams are building; website is available, and the first Newsletter was published. The project established good relationships with WCRP, S2S/PPP, GURME, Severe Weather Forecasting Demonstration Project (SWFDP), Integrated Research on Disaster Risk (IRDR), Predictability, Dynamics & Ensemble Forecasting (PDEF), Data Assimilation and Observing Systems (DAOS), Nowcasting and Mesoscale Research (NMR), SERA and Forecast Demonstration Projects (FDP)/Research and Development Projects (RDPs), and with national/regional HIWeather initiatives. The HIWeather project kick-off meeting took place from 25 to 29 April 2016 in Met Office, Exeter, UK (Annex-2).

SERA working group is advancing the science of the social and economic application of weather-related information and services. Involvement with the 3 major WWRP Projects: Brian Mills, former Chairperson of the WGSERA, is currently a member of the SERA sub-committee of the PPP which had its inaugural organizing meeting in Ottawa, Canada, from 12 to 13 March 2016. The discussions during the meeting were centered on developing the SERA component of PPP: key research questions, and research connections to PPP-SERA.

Joint Working Group on Forecast Verification Research (JWGFVR) in 2015, contributed to the verification plans of PPP, S2S, HIWeather and several WWRP FDP's and RDP's, and its work on spatial methods intercomparison using a rich dataset from previous research projects (MAP D-PHASE/COPS).

Predictability, Dynamics and Ensemble Forecasting (PDEF) Working Group initial meeting was organized in May 2015 in Karlsruhe, Germany (within the Progress and Future Directions of Research on Predictability and Dynamics of midlatitude Weather Systems (PANDOWAE) symposium), PDEF participated in the International Union of Geodesy and Geophysics (IUGG) in Prague, Czech Republic, Ateliers de Modélisation de l'Atmosphère (AMA) and SPARC (Stratospheric Processes and their Role in Climate) meeting on storm track dynamics (Grindelwald, Switzerland, August 2015), European storm workshop, YOPP summit, Wave 2 Weather programme.

Following the 66th Executive Council Resolution 13, SDS-WAS established the SDS-WAS Steering Committee (SC) in October 2015. The SC is formed to coordinate global research coordination of regional activities. An SDS-WAS trust fund has been established to secure funding of the SDS-WAS activities. During the last year, WWRP published the SDS-WAS Science and Implementation Plan: 2015-2020, several scientific papers and a book, organized several meetings and workshops in collaboration with WHO, UNEP and UNCCD.

Aviation RDP: A kick-off meeting was held from 24 to 25 June 2015 in Shanghai, China. The meeting reviewed and refined the science plan, the implementation plan, adopted the membership of the AvRDP Science Steering Committee (SSC), discussed data policy and other relevant issues. Further details are available in Annex-3.

Resource mobilization strategy

A strategy formulation comprises the articulation of a mission, a set of long term objectives, and an action plan specifying how the mission and objectives will be realized. In this paragraph, we are concentrating on the first two elements, mission and long-term objectives with elements to be further elaborated in an action plan.

Resource mobilization is the process by which an organization acquires and manages the financial, human and logistical resources it needs to fulfill its mission. It cannot be limited to the fund-raising component. It means that we are not just applying for a specific fund, but we are creating a long-term partnership with donors and international institutions in order to influence the alignment of their scientific objectives with ours.

Mission

WMO is fostering the members capacity to tackle Weather, Climate, Water related problems and to take advantages of the benefit of the society at country level and internationally. This overarching mission can be decoded into the capacity to dream, design,

develop and delivery new weather, climate, water related services. Research is a key element for the dreaming and designing phase, but it plays even a role for the developing and delivering phase where user's feedbacks can suggest refinements and additional research tasks.

Objectives of a resource mobilization strategy for research

A global strategy

Recent research outcomes which had in depth impacts in developing new services, have been developed under large-scale international projects. Ensemble forecasting which is widely used nowadays for weather and climate products, has been dreamed and designed under the THORPEX umbrella. This successful story suggests us the need for strengthening the relationship with organizations that are planning and funding large-scale initiatives whose outcomes can be effective worldwide not only for developed countries. A unique voice for WMO research representing all programmes (GAW, WWRP, WCRP and research components in other Technical Commissions) would be an advantage.

Elements for an action plan

- *European Commission is certainly an important partner but with several entry points.*
 - *DG Research is overseen Horizon2020 and starting to organize the post-Horizon2020. WMO as an international advisor concerning research topics. In recent years, this goal has been easily achieved (Polar Prediction calls as an example). However a continuous networking is needed, and involvement in other initiatives such as Research Infrastructures (ESFRI).*
 - *DG Connect is responsible for the Digital Economy and Society. Important research activities related to High-Performance Computing and Big-Data depend on this Directorate.*
 - *The Directorate-General (DG) for Internal Market, Industry, Entrepreneurship and SMEs, is the European Commission service responsible for COPERNICUS. COPERNICUS is not directly supporting research activities, however it can be seen as driver for many up-stream research programmes.*
- *Other international organizations can be seen both as partners and competitors. ICSU (co-sponsoring WCRP), UNEP, UNESCO. A much more proactive strategy should be implemented.*
- *Several countries have National Science Foundations and large research or applied centres able to influence the research agenda at international level. The Belmont Forum which is issuing international calls for coordinated research is one example. There is a need for a continuous and proactive dialogue between WMO and these national institutions.*
- *Last but not least, there is a need for a long-term interaction with large private foundations and companies.*

Regional to local scale

Members need to be supported at regional and local level for leveraging their RTD capacity. In this context, important players are international funds and national agencies that are working to improve local developments. They are not funding research, however, implementing observational and computational facilities in countries with a certain degree of development can facilitate the establishment of national and regional research programmes.

Elements for an action plan

- *Support to the Resource Mobilization Office in interacting with: international trust funds (GEF, CREWS, Green Climate Fund), national development agencies (USAID, DFID, etc.), European Commission international directorate (DEVCOM).*
- *To make the best use of Regional Association and Technical Commission Meetings organizing interactions between regional stakeholders/donors and WMO initiatives (from research to applications).*
- *To promote the link to regional initiatives in different continents (for instance in Africa CR4D).*

Branding for funding

Promoting WMO leadership in key sectors is a powerful tool to engage relevant stakeholders in our resource mobilization strategy. An important element is focusing on an integrated communication strategy to sustain long-term resource mobilization actions and to promote WMO research activities with a unique voice. Research WMO activities can be seen also as facilitating mechanisms for the Sustainable Developing Goals.

Elements for an action plan

- *In coordination with the Resource Mobilization Office develop communication initiatives around WMO assets, a successful example is the Polar Region communication, where several WMO programmes are working together across-departments.*

This year outcomes on resource mobilization

Polar Regions – EU call

European Commission issued three calls under Horizon 2020 focusing on Arctic Regions. Two of them will support Polar Prediction activities for the Year of Polar Prediction. The consortia, that will be funded, will be officially presented next September.

Africa and Lake Victoria

Under the WISER (Weather and climate Information and SERvices for Africa) initiative of DFID (UK, Department for International Development) two main proposals have been developed:

1. *Sub-Saharan Africa project*

The goal of this project is to reduce exposure and strengthen resilience to flooding and drought risks in Sub-Saharan Africa. Together with key stakeholders (regional and national technical agencies, local governments, NGOs, agricultural producer organizations, scientists, communication media, farmers), we will develop more granular and actionable early warning systems for flood and drought based on vulnerability and risk maps, real-time hydrological monitoring and improved 1-week, sub-seasonal and seasonal forecasts. This consortium brings together international research excellence in sub-seasonal to seasonal climate forecasting, hydrologic modelling, remote sensing, data product development, climate risk management and vulnerability mapping, with the development context and practical decisions through African climate centres, a national meteorological service, and major food security and humanitarian aid programs. It will harness research for development impact through co-production of flood and drought early warning (main theme), risk

monitoring, and improved forecast products for multi-hazard early warning (cross-cutting themes); it will communicate, and prompt early-action through the development of user-centric "maproom" products for decision makers (pilot study: Senegal). Longstanding relationships between the consortium members and the leveraging of existing projects (WWRP/WCRP-S2S, CCAFS-CASCAID, WFP-FoodSECuRE) will increase return on investment towards the use of climate science to reduce disaster risk in Sub-Saharan Africa.

2. *Lake Victoria proposal*

The project aims at the resilience of communities on, and around Lake Victoria, by enhancing safety of navigation and efficient exploitation of natural resources over Lake Victoria and its basin, by strengthening multi-sectorial meteorological services on the Lake. The project has four components. The project focuses on improving the observational network to be able to respond to multi-user's requirements through planning and benchmarking the Marine and Meteorological Observational Network over parts of Lake Victoria, including land-based weather stations and water-based buoy systems. These monitoring stations will be optimally and strategically located, based on user requirements and on a weather and marine observation study.

A US strategy

A constructive discussion started with John Cortinas (Director office of weather and air quality, NOAA) who is coordinating two post-THORPEX committees:

- Donors's committee with NOAA, NASA, NSF, NRL.
- Scientific committee coordinating the three WWRP projects at US level.

We agreed on key elements to support his work in promoting WWRP projects at US level:

- Share a synthesis document based on WWRP Implementation Plan.
- Include examples answering the question "Why does US need international research?" (Arctic example ...)
- Organize webinar with NOAA to explain the WWRP projects structure.
- Organize a side-event next AGU or AMS.

Green Climate Fund

WMO has been accredited to the Green Climate Fund. WMO can submit projects on behalf of eligible countries for funds ranging from 10M to 50M. The Green Climate Fund does not support research per se, but development projects. Nevertheless, WMO has proposed a Urban project where HIWeather, GURME, and IGIS can benefit from this large initiative.

Young Scientists support

Young Earth System Scientists Workshop 2015, Earth System Science Frontiers *28–30 October 2015, Offenbach, Germany*

The workshop aimed to discuss the current challenges in Earth system science in an interdisciplinary and comprehensive way. Three key Earth system science frontier topics were discussed: "Seamless Earth system prediction/Representation of scale interactions", "Communication of uncertainty/Sustainability of user-driven science" and "Earth System Science Frontiers/Interdisciplinarity". Participants also identified the structural needs of an ECS network that would be necessary to tackle these science challenges and developed implementation strategies for formally establishing the network and enhancing its reach.

Representatives of WWRP, WCRP and GAW joined the meeting to follow the discussions and to provide advice regarding the WMO research programs. The majority of the YESS-ISG was able to join the workshop, and their enthusiasm and inspiration made it a very successful and vibrant event. The outcome of the workshop have been documented in a white paper.

Annex 1

WWRP Implementation Plan Executive Summary

Following decisions and guidance from Cg-17, the Sixteenth Session of the Commission for Atmospheric Sciences (CAS) and tenth meeting of the CAS Management Group, the World Weather Research Programme (WWRP) Scientific Steering Committee (SSC), in its 8th session, established a road-map to develop its new Implementation Plan which will guide its activities since 2016 to 2023¹.

The plan relies on the key scientific achievements the WWRP community made since its foundation in 1998. Recently WMO has taken the lead and co-organized the World Weather Open Science Conference (Montréal, Canada, 16-21 August 2014), the first-of-a-kind event bringing together a diverse community in order to foster the science needed to make society less vulnerable to weather-related impacts. This conference has brought together the entire weather science and user communities for the first time to review the state-of-the-art and map out the scientific frontiers for the next decade and more. The outcomes of the debates and discussions have been synthesized in this book: "Seamless prediction of the Earth-System: from minutes to months".

Thus, the new Implementation Plan builds upon new challenges for the weather science. As weather science advances, critical questions are arising such as about the possible sources of predictability on weekly, monthly and longer time-scales; seamless prediction; the development and application of new observing systems; the effective utilization of massively-parallel supercomputers; the communication, interpretation, and application of weather-related information; and the quantification of the societal impacts. The science is primed for a step forward informed by the realization that there can be predictive power on all space and time-scales arising from currently poorly-understood sources of potential predictability.

The new Implementation Plan has been developed along four main societal challenges proposed by CAS: (a) High-impact Weather and its socio-economic effect in the context of global change; (b) Water, modelling and predicting the water cycle for improved disaster risk reduction and resource management; (c) Urbanization, research and services for megacities and large urban complexes; (d) Evolving Technologies, their impact on science and their use.

Per each societal challenge, the WWRP scientific community (Scientific Steering Committee, Working Groups, Expert Teams, Projects) has identified: key scientific challenges; key implementation challenges; International Coordination needs; Resulting Benefits for WMO Members; Action Areas.

Here the action areas list per each societal challenge:

- a. High-Impact Weather: i) Address limitations; ii) Uncertainty; iii) Fully Coupled; iv) Applications; v) Verification; vi) Attribution.
- b. Water: i) Integrated Water Cycle; ii) New Observations; iii) Precipitation; iv) Hydrological Uncertainty.
- c. Urbanization: i) Understand Needs; ii) Observations and Processes; iii) Urban Prediction.

¹ [Draft plan for the Implementation of WMO's World Weather Research Programme \(WWRP\): 2016-2023.](#)

- d. Evolving Technologies: i) Advanced Methods; ii) Support Facilities; iii) Tools; iv) New Observations; v) Future Global Observing Systems;

The proposed structure of the implementation plan consists of two booklets. The first booklet describes the major societal challenges and action areas that WWRP will promote and undertake during the next 8 years. The first booklet has two purposes: providing a complete and synthetic overview of WWRP Implementation Plan and promoting his activities for external stakeholders and donors. The second booklet will contain a detailed description of the Action Areas and the associated tasks for Working Groups and Projects. A further level of the details will be added considering a in deep two years plan which will be used to monitor the WGs and Projects activities.

Annex 2

Short Summary HIWeather Kickoff meeting

At least 80 attendees (Europe, US, Canada, Asia, Africa and South America) from weather and social research communities. UK Met Office has been a great host.

Here just a short-summary:

1. **HIW - Implementation Plan**

The work done by breakout groups will prioritize next two-year activities. A short document will be made available by the end of May and it will be used to update the HIWeather Implementation Plan.

2. **Resource Mobilization**

A round-table has been organized the first day with Virginia Murray (UNISDR and UK Health Sector), Jan Polcher (WCRP-GEWEX), Ned Garrett (NERC-UK), Bill Leathes (UK-MetOffice and DFID), and a representative of EU Commission. It has been an important step forward for resource mobilization strategy. A short document will be organized focusing on the role of HIWeather for underpinning research on Disaster Risk Reduction and Adaptation to be circulated among the panelists. This document will be used by other experts to influence their National Science Foundations (Brian Mills suggestion).

3. **ICO**

International Office of CMA is proposing to host ICO, a representative of the CMA Academy of Science was attending the kickoff.

4. **HIWeather Advisory Body**

It has been agreed to have a small group with possibly rotating members. The member's profiles could be summarized as follow:

- a. UN agencies with a strong disaster risk reduction focus (UNISDR, WHO, etc.)
- one rotating member every two years;
- b. A champion from the academic world with a strong link to international initiatives such as ICSU, Future Earth, etc.;
- c. Climate research, climate impact and adaptation. A rotating member from the World Climate Research Programme and IPCC WGs;
- d. Donors. A rotating member from World Bank, development agencies (USAID, DFID);
- e. NMHS representatives through the WMO Commission of Basic System.

Annex 3

Aviation Research Development Project

The project is composed of two phases (see Implementation Plan):

- Phase I – MET capability research (May 2015 – July 2017), focusing on MET research and development. Airports which need longer preparation time may have chosen to enter Phase I in late 2015 or after.
- Phase II – MET-ATM impact translation and validation (July 2016 - June 2018), focusing on translating MET information into ATM impact. Airports which started the Intense Observation Period (IOP) in late 2015 or later, may choose to enter Phase II in late 2016.

A dedicated website (<https://avrdp.hko.gov.hk>) has been established for providing background information of the project, progress, meetings, documentation and forum. An AvRDP Data Server has also been established for facilitating data exchange. A “data policy” governing how to use the data available on the AvRDP data server has been finalized.

1st IOP for convective weather for airport in Northern Hemisphere (15 May-30 September 2015) has completed (HKG). A number of significant convective cases which brought impacts to air traffic over HKG have been collected. MET data including nowcast and mesoscale modelling data for HKG and within HK Flight Information Region (HKFIR) have been collected. ATM data including aircraft flow, airport arrival capacity notification have been collected as well. Both MET and ATM data have been uploaded onto the AvRDP Data Server.

2nd IOP for convective weather for airport in Southern Hemisphere (1 November 2015–31 March 2016) is on-going. JNB is collecting cases which brought significant traffic impact to the airport. Satellite nowcasting products such as the Rapidly Developing Thunderstorms (RDT) are used to provide guidance to forecasters in real time. Radar products, NWP fields and all possible observations are utilized for the study. Feedback was provided by Airport Management Company (AMC) on how the weather affected operations on the ground and Air Traffic Navigation Systems (ATNS) also provided comprehensive statistics on all the delayed flights. Meanwhile, JNB has installed the radar-based nowcasting system, Community-SWIRLS (Com-SWIRLS), adapted from HKO, and was collecting convective weather cases. SHA in collaboration with Shanghai Meteorological Services (SMS) was implementing the Com-SWILRS over Shanghai area. SHA has also started selecting cases and collecting MET/ATM data for convective and low visibility and ceiling cases (May 2015–July 2017) and also started to work on mesoscale model rapid refresh (October 2015–July 2017).

1st IOP for winter weather and visibility for airport in Northern Hemisphere (1 November 2015–31 March 2016) is on-going. CDG will collect a few winter precipitation and/or fog occurrence cases for study using the 1 km resolution NWP Nowcasting system AROME-PI. Data are to be uploaded onto the AvRDP Data Server. YYZ has been collecting airport surface and remote sensing observations, NWP and nowcasting data. Some nowcast systems will be run in hindcast mode after the IOP has concluded. Following the IOP, a met verification will be undertaken for the available systems and NWP. Early results are planned to be presented at the annual Congress of the Canadian Meteorological and Oceanographic Society (CMOS) in late May and at WSN16 in July 2016. YFB has been working on site infrastructure and planned to collect data and nowcasting contributions for the 2nd winter IOP (2016-2017).