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Submitted by: S Jones, M Morgan, PM Ruti
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World Weather Research Programme Report

1. Highlights for JSC

- Seamless Prediction

  The grand challenge of accelerating advances in Earth system observation, analysis, and prediction capabilities was postulated by Shapiro et al. (2010). In this context seamless prediction was introduced for sub-seasonal to seasonal prediction to span the boundary between weather and climate (Brunet et al. 2010). These authors extended the notion of seamlessness beyond the realm of atmospheric predictions to include the consideration of biophysical, medical, and socioeconomic factors pertinent to successful decision making.

  At the World Weather Open Science Conference (2014) seamless prediction was used more generally to cover timescales from minutes to months, considering all compartments of the Earth System including hydrology and air quality, and linking to users, applications and social sciences

  Seamlessness is now viewed as a useful concept to express the need for information for users, stakeholders, decision makers that is smooth and consistent across the artificial barriers that exist because the information comes from different observing systems, models, time and space scales, or compartments of the earth system.

  Thus, in the context of WMO, seamless prediction considers not only all compartments of the Earth system, but also all disciplines of the weather–climate–water–environment value chain (monitoring and observation, models, forecasting, dissemination and communication, perception and interpretation, decision-making, end-user products) to deliver tailor-made weather, climate, water and environmental information covering minutes to centuries and local to global scales.

- World Weather Research Programme Implementation Plan 2016-23:

  Improving countries' capacity to face weather hazards in the context of global change and providing better services to all citizens worldwide are at the heart of the WMO strategy. Science and innovation are prerequisite for achieving these goals. Through the World Weather Research Programme (WWRP), WMO will push forwards the frontiers of weather science, exploring new predictive capabilities, connecting weather and climate communities, and improving all elements of the weather information value chain.

  For 2016-2023 WWRP activities will focus on four major challenges, as identified by WMO's Commission for Atmospheric Sciences: High-Impact Weather, Water, Urbanization, and Evolving Technologies. Each of these challenges comes with specific key research needs that are addressed by all component parts of the WWRP through

concrete activities in 18 Action Areas. The Implementation plan emphasizes the need for international and interdisciplinary coordination, and the resulting benefits to WMO members. It provides the basis for the WWRP Scientific Steering Committee and external experts to evaluate the progress made. Here the link for downloading the WWRP implementation plan.

Achieving these goals depends critically on partnerships between the global public, private and academic sectors of the weather enterprise. WWRP will link to those affected by weather and related multi-hazards and those charged with the responsibility of managing risks and consequences. Collaborations with key partners, such as Global Atmosphere Watch, the World Climate Research Programme, the WMO Commission for Basic Systems, and the hydrological operational and research communities are essential to address jointly areas of common interest, exploit synergies between the activities and avoid duplication.

2. Issues and challenges:

- Three core projects and links to WCRP

1. High Impact Weather Project: HIWeather aims to improve the end-to-end-to-end forecasting and warning process for weather-related hazards through research in predicting urban flood, wildfire, disruptive winter weather, extreme local wind, urban heat and pollution and their human and economic impacts, and through developing best practice in communication of forecasts and warnings. HIWeather is the youngest of all three projects with a very good interdisciplinary leadership team, with strong scientists from meteorology and social sciences, a project office in China, funded activities such as the Lake Victoria HIGHWAY project, the German Waves-to-Weather and the NAWDEX field campaign last year (another legacy of THORPEX). HIWeather is linked to WCRP Grand Challenge on Extremes and it is actively participating in the next GEWEX Open Science Conference.

2. Polar Prediction Project: The Year of Polar Prediction (YOPP) is the key deliverable of the decade long Polar Prediction Project (PPP), which is one of three projects within the World Meteorological Organization's World Weather Research Programme (WWRP). The core phase of YOPP covers two years from mid 2017 to mid 2019. By coordinating a period of intensive observing, modelling, verification, user engagement and education activities, YOPP enables a significant improvement in environmental prediction capabilities for the polar regions and beyond, fostering the development of coupled data-assimilation and improving simulations of coupled processes through the establishment of super-site's network. Sea-ice buoys are deployed over both North and South Pole. Linkages to various organizations (e.g., SCAR; IASC, CliC, IMO) has been established during the preparation phase of YOPP. CLIVAR could be interested also collaborating in YOPP. Links: http://www.polarprediction.net, http://www.polarprediction.net/yopp-activities/

3. Sub-seasonal to Seasonal Prediction Project (a joint project with WCRP): S2S is about to enter its 2nd phase. The S2S database is established and being used, the 2nd phase will link to operational forecast production and address key scientific challenges: Improving the prediction of the MJO; addressing systematic errors in the representation of the tropical-extratropical teleconnections; Land, ocean, sea ice initialization/observation/processes; Ensemble generation and representation of

uncertainty; Stratosphere/troposphere interaction as a major source of predictability. Resources are a big issue for S2S coordination.

- A road map for co-designing activities

  As highlighted in the description of the three WWRP core projects, several links already exist between WWRP and WCRP. We need now to improve the co-design and joint high-level steering. The development of WCRP strategy is an important occasion for collaborating in developing a joint plan. This will strengthen already existing links (i.e., GASS panel is now co-chaired between WCRP and WWRP) and it will further exploit other links, for example between the Working Group on Predictability, Dynamics and Ensemble Forecasting (i.e. NAWDEX campaign) and GC clouds-circulation, and between the Working Group on Data Assimilation and Observing Systems and reanalysis activities.

  An initial meeting was organized in March by the WMO Commission for Atmospheric Sciences gathering together Oystein Hov (President of the WMO Commission), Sarah Jones (Chair of WWRP steering committee), Greg Carmichael (Chair of GAW steering committee), Amanda Lynch (WCRP vice-chair) and Guy Brasseur (online from US). An initial discussion touched on GAW/WWRP Implementation Plans and WCRP strategy.

  In order to progress in this road-map, the following topics could guide further interactions:

  1. Advancing modelling and observations, seeking integrated approaches that could lead to joint advancements in weather and climate prediction and projection:
     a. Research to define the future observing system must consider needs for weather, climate, and the environment
     b. Process understanding needs to be translated into predictive skill.
     c. Modelling and observing impacts requires shared expertise on vulnerability and risk

  2. Supporting development of joint research infrastructure and networks
     a. Facilities allowing enhanced access to services (observations, model output, data collection and preprocessing and global and regional models) that require exceptional HPC and data handling
     b. Tools: Share specialist methods and tools enabling complex modelling systems to be run by a wider community, including beyond WWRP, must be shared.
     c. Research expertise must contribute to capacity development, e.g. Joint WG on Verification Research training courses
     d. The long term success of research programmes needs securing through the involvement of Early Career Scientists – YESS

  3. Strengthening regional activities:
     a. Sustainable development requires working in partnership to enhance regional capacity and linking disaster risk reduction to regional climate assessment
     b. Societal impacts depend crucially on regional characteristics: joint regional projects across weather and climate are needed.
     c. Focusing on Extremes and High impact events across the value chain or value cycle

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