Annex to paragraph 11.9.5 of the general summary

Concept Paper
Global Integrated Polar Prediction System (GIPPS)

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GIPPS in context

The World Meteorological Organization's (WMO) Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS), at its Second Session in Hobart in October 2010, agreed to the concept of a major decadal initiative to develop a Polar Prediction System. The Panel entitled this new initiative the **Global Integrated Polar Prediction System** (GIPPS). The word 'Global' reflects that it would be an international effort and that the poles, including the *third* pole[1], affect systems (weather, climate, hydrological, biological, chemical, etc.) globally; 'Integrated' reflects the interconnections between all these systems, and also because the System itself will be based on the principles of research, observations and services that are integrated and aligned[2]. For polar areas, GIPPS is seen as becoming a foundation of delivering the WMO's substantial contribution to "*the protection of life and property against natural disasters, to safeguarding the environment and to enhancing the economic and social well-being of all sectors of society in areas such as food security, water resources and transport*[3]."

The basic aims of GIPPS

In championing a '*Polar Prediction System*' EC-PORS is mindful that it should be primarily service-driven (i.e. is operational in focus) and provides 'predictions' from daily to inter-decadal time-frames (and possibly beyond). In other words, GIPPS needs to:

- Meet 'user requirements';
- Accurately predict the future state of the atmosphere, ocean, and hydrosphere/cryosphere for high northern and southern latitudes, particularly where prediction systems that are tuned for lower latitudes are less robust; and,
- Be supported by appropriate observational systems and enabling scientific research and development.

Three time scales are envisaged for GIPPS to cover:

- Short-term prediction underpinned by deterministic fully coupled models (hours-days) and, perhaps by ensemble approaches for the days to weeks periods;
- Medium-term (months to decades) prediction, most likely relying on ensemble approaches; and,
- Long-term projections (in the IPCC sense) of ice sheet mass balance, sea level and climate variability and change for the next few centuries, perhaps based on the scenario approach.

There is evidence that polar processes are not well modelled in current global systems and getting the polar atmospheric physics right will not only improve polar forecasting but should improve global forecasting as well.

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1 Himalaya and Tibetan Plateau region
2 See Section 6.4 at http://www.wmo.int/pages/prog/www/WIGOS_6_EC_PORS/Final_Report2010.pdf
3 http://www.wmo.int/pages/about/index_en.html

Values of a Polar Prediction System

A Polar Prediction System will deliver benefits to a very wide range of users and communities. Not only will it enhance the scientific understanding of polar meteorology, but also will fundamentally underpin improved services for those engaged in polar activities. An effective polar prediction system will also directly contribute to the global modelling effort and provide benefits to communities at all latitudes. Benefits that will flow from a polar prediction system include:

- Improved services to key users, including those involved in transportation, logistics and planning, biological and energy resource management, water resources, tourism, marine and aviation activities and Disaster Risk Reduction (DRR);
- Improved understanding of key physical process that drive the polar weather and climate system and to diagnose the benefits of particular observational technologies and approaches;
- Providing input to global models to ensure that polar processes and teleconnections are effectively captured.

In addition to typical synoptic variables, a Polar Prediction System should focus on specialized variables, such as sea ice, permafrost, polar clouds, ice sheet mass balance, and snow cover.

Stakeholders

Partners in specifying GIPPS – the end-users:

Primacy in this task is that GIPPS should be “service-driven”. In other words, the Polar Prediction System needs to provide outputs which provide end-users with intelligence about their environment that will enable them to maximize the best outcomes from their activities. To this end the EC-PORS Services Task Team will develop a White Paper that comprehensively describes the global community’s polar services requirements and articulates the value to be delivered by a GIPPS - the White Paper itself will be made available for consideration at the next session of EC-PORS in the boreal autumn of 2011.

As a foray into understanding end-user requirement the EC-PORS Research Task Team undertook an initial ‘gap analysis’ which asked simple questions concerning perceived service/observational/modelling deficiencies in current polar prediction systems. The respondents to this pilot survey were mostly operational or research-based professionals in the areas of meteorology; the cryosphere; the hydrosphere; and numerical modelling. And so it is not surprising that many of the gaps identified were of a technical nature. For example, the need for more comprehensive sea-ice modelling across both polar areas, and the need for better observations and modelling of boundary-layer fluxes. And so it will be the task of the EC-PORS Services Task Team to articulate the requirements of the ‘real’ end-users, that is, the ‘expeditioners’ (e.g.: geologists; glaciologists; biologists) who work ‘in the field’ in both polar areas; the citizens and utility providers of, in particular, the northern polar area; polar shipping and aviation, including tourism, fisheries and other commercial ventures. It is likely that there will be synergies between end-user requirements and service providers – for example, the aforementioned sea-ice modelling will lead to more efficient and safer routing of ship traffic in polar waters.

Partners in developing GIPPS

It is clear from above that the *‘Polar Prediction System*’ will need to be an end-to-end, fully supported, *operational* prediction system, if it is to serve polar citizens in a completely reliable way – reliable not only in the underpinning science, but also in the robustness of supporting processing (computer modelling resources) and communication infrastructure. Therefore, it is equally clear that the skills, requirements and ideas of researchers and modellers (atmospheric; cryospheric; hydrospheric; chemistry; oceanographic; soil, etc.) will need to be at the forefront of the *‘Polar*

Prediction System' development, as do the institutions, agencies and national hydrological, meteorological and oceanographic services that are the foundation of year-round, day-by-day operational service delivery. The proposed development of cross-regional Polar Regional Climate Centres (RCCs) and Polar Climate Outlook Forums (PCOFs) would be very useful for addressing services in the Polar Regions.

Supporting and steering the substantial depth of energy already in play in the polar prediction area will be a key focus for EC-PORS who can tap the work of *Research and Observational Groups* such as: the Antarctic Mesoscale Prediction System (AMPS) developers; the Antarctic Meteorological Observations, Modelling and Forecasting Workshop (AMOMFW) forums; the Scientific Committee for Antarctic Research (SCAR) Operational Meteorology Group; various Working Groups of the International Arctic Science Committee (IASC); the International Commission on Polar Meteorology (ICPM); WMO's World Weather Research Programme (WWRP) and The (WMO) Observing System Research and Predictability EXperiment (THORPEX), and the World Climate Research Programme (WCRP); the British Antarctic Survey (BAS); and the Byrd Polar Institute etc. All are key players specifying the observational and research requirements for a '*Polar Prediction System*'. Moreover *Operational Numerical Weather systems* such as: the European Centre for Medium-Range Weather Forecasts (ECMWF); the US National Centers for Environmental Prediction (NCEP); and various national NWP centres all will have key implementation roles, not to mention key roles in informing the overall process as to what can be pragmatically/realistically implemented on a sustainable operational basis.

GIPPS: a 10-year milestone

The International Polar Year (IPY) 2007-08[4] continued the success of outcomes underpinned by concentrated efforts into polar research facilitated by IPYs in 1882-3, 1932-3, and 1957-8. There are sure to be more IPYs and no doubt polar prediction will *incrementally* improve as the operational global prediction systems become more fully coupled and earth-system integrated. The word, *incrementally*, is deliberately emphasized here since globally focused modellers tend to focus on globally-measured improvements (e.g. skill scores), not on individual regional outcomes. Therefore, EC-PORS sees a fully operational, end-to-end, polar-tuned but Global(ly) Integrated, Polar Prediction System, which meets the contemporary needs of the citizens of Polar Regions and beyond, as a decadal endeavour towards an operational GIPPS.

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[4] http://www.ipy.org/

Res. 11.9/3 (Cg-XVI)

GLOBAL INTEGRATED POLAR PREDICTION SYSTEM (GIPPS)

THE CONGRESS,

Noting:

(1) Resolution 36 (Cg-XV) - International Polar Year 2007-2008,

(2) EC-LXII agreement that it would be highly desirable for coordinated international efforts to secure and develop an IPY legacy process,

Considering:

(1) The concerns about amplification of anthropogenic climate change at higher latitudes combined with an increasing interest of many governments in Polar Regions calls for a better understanding of weather, climate, water and related environmental variability and change to improve our ability to make reliable, quantitative predictions out to seasons, decades and centuries ahead,

(2) The increased economic and transportation activities in Polar Regions, and the associated long-term requirement for sustained integrated observational and predictive weather, climate and water information to support decision making,

(3) That there remain key gaps in:

   (a) Scientific understanding of processes and interactions in Polar Regions, including stable boundary layers, polar clouds and precipitation, sea ice/ocean dynamics, hydrology, permafrost and ice sheet dynamics,

   (b) Sustaining in-situ and satellite observations in Polar Regions, including reference observations,

   (c) Products and services for Polar Regions,

(4) The global benefits of a Polar Prediction System, enabling not only service delivery and observing strategies in Polar Regions, but also addressing key uncertainties in weather, climate, water and related environmental variability and change, thereby improving global prediction, contributing to all WMO high priorities, in particular Disaster Risk Reduction, and to the Global Framework for Climate Services,

(5) That this cannot be accomplished by WMO alone, and will require collaborative research and development involving WWRP/THORPEX and WCRP, other WMO Programmes and external partners,

Acknowledging in particular the contributions of Members' national operational and research programmes to monitoring and real-time data provision, process studies, and current prediction systems for Polar Regions,

Decides:

(1) To embark on a decadal endeavour towards a Global Integrated Polar Prediction System (GIPPS), as an IPY Legacy to benefit the global community;

(2) That the GIPPS should provide information to meet user needs for decision making on timescales from hours to centuries;

Requests the Executive Council:

(1) To develop a scalable, detailed strategic plan for GIPPS, laying out a path that WMO will take to identify and address gaps in our scientific understanding of polar processes, improve data and service delivery, and promote or establish national research programmes;

(2) To implement this decision and establish the initial governance mechanism by providing broad oversight, guidance and monitoring of progress;

(3) To ensure there is broad consultation and participation from other international organizations and agencies that wish to contribute to the development of GIPPS;

(4) To submit a comprehensive report on the development of GIPPS to the Seventeenth Congress;

Requests technical commissions and regional associations to support the work of the Executive Council through the coordinated international research, development and implementation of GIPPS and to advise on possible future governance structures;

Invites relevant national bodies and international organizations, academic research programmes, such as the International Council for Science (ICSU), Scientific Committee on Antarctic Research (SCAR), UNESCO's Intergovernmental Oceanographic Commission (IOC), and International Arctic Science Committee (IASC), the International Association of Cryospheric Sciences (IACS) and other relevant associations of IUGG and WMO co-sponsored and WMO-led Programmes such as WCRP and GCOS, to join in the multi-year endeavour towards an operational GIPPS;

Requests Members:

(1) To support efforts to address the key gaps in scientific understanding of the Earth system and environmental processes and interactions in Polar Regions;

(2) To promote and/or establish national research programmes towards this endeavour;

(3) To provide adequate voluntary resources to support development of GIPPS;

Requests the Secretary-General:

(1) To strengthen coordination and collaborate closely with relevant international partner organizations and programmes in pursuing this endeavour;

(2) To take any further actions necessary to implement these decisions;

(3) To bring this resolution to the attention of all concerned.

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