The WWRP Polar Prediction Project (2013-2022)

There has been a growing interest in the Polar Regions in recent years, because of concerns about the amplification of anthropogenic climate change in these areas, and the effects of polar teleconnections on lower latitude weather at medium and seasonal range. Furthermore, increased economic and transportation activities in polar regions due to thinning Arctic sea-ice are leading to more demands for sustained and improved availability of integrated observational and predictive weather, climate and water information to support decision-making. However, partly as a result of a strong emphasis of previous international efforts on lower and middle latitudes, gaps in weather, sub-seasonal and seasonal forecasting in polar regions hamper reliable decision making.

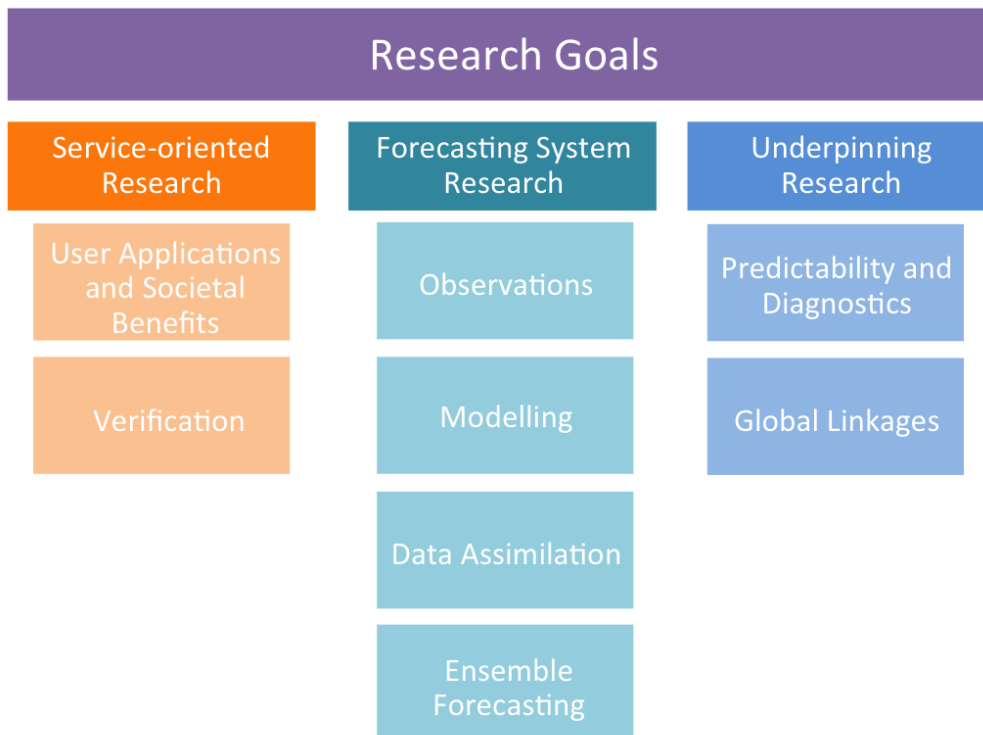The aim of the WWRP Polar Prediction Project (WWRP-PPP) therefore is to

"Promote cooperative international research enabling development of improved weather and environmental prediction services for the Polar Regions, on time scales from hours to seasonal."

This project constitutes the research component of the emerging WMO Global Integrated Polar Prediction System (GIPPS) focussing on the hours-to-seasonal time range. A closely related WCRP Polar Climate Predictability Initiative covers GIPPS research on seasonal to decadal time scales.

In order to meet growing demand for skilful and reliable predictions in Polar Regions and beyond the following eight key research goals were identified:

1) Improve the understanding of the requirements for, and evaluate the benefits of, enhanced prediction information and services in polar regions

2) Establish and apply verification methods appropriate for polar regions

3) Provide guidance on optimizing polar observing systems, and coordinate additional observations to support modelling and verification

4) Improve representation of key processes in models of the polar atmosphere, land, ocean and cryosphere

5) Develop data assimilation systems that account for the unique characteristics of polar regions

6) Develop and exploit ensemble prediction systems with appropriate representation of initial condition and model uncertainty for polar regions

7) Determine predictability and identify key sources of forecast errors in polar regions

8) Improve knowledge of two-way linkages between polar and lower latitudes, and their implications for global prediction

In order to achieve the above research goals it is advocated to enhance international and interdisciplinary collaboration through the development of strong linkages with related initiatives; strengthen linkages between academia, research institutions and operational forecasting centres; promote interactions and communication between research and stakeholders; and foster education and outreach.

Grouping of research goals of the WWRP Polar Prediction Project.

It is emphasized that the expected benefits go beyond the time scales (hours to seasonal) and regions (Arctic and Antarctic) considered in the proposed research project. Anticipated improvements in the representation of key polar processes in (coupled) models such as stable boundary layers, troposphere-stratosphere interactions and sea ice dynamics are expected to reduce systematic errors in climate model integrations and, hence, help narrow uncertainties of regional climate change projections. Furthermore, improved environmental predictions in the Polar Regions will lead to more precise weather predictions for non-polar regions due to the existence of global connectivities. To exploit the full potential of this truly "seamless" area of research, it will be mandatory to maintain and develop close ties with the climate research community and that part of the weather prediction community, which has traditionally focussed on the non-polar regions.

Implementation

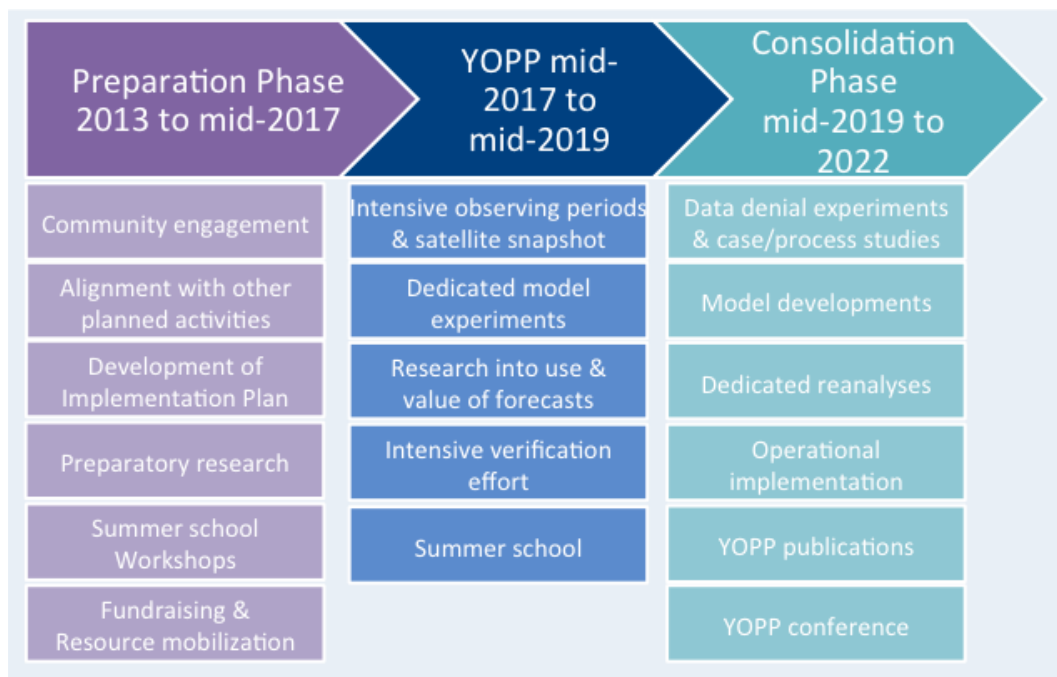In order to deliver its goals the WWRP Polar Prediction Project will require:

- A Steering Group representing both the research and operational communities. The steering group will be responsible for the implementation of the project;
- The establishment of an international coordination office to coordinate the day-to-day activities of the project and manage the logistics of workshops and meetings. It is desirable to share an office with the WCRP Polar Climate Predictability Initiative and other international efforts to ensure close coordination of planned activities;
- A major research activity in the optimization of the observing system, development of forecast models, enhancement of data assimilation systems and improvements of the ensemble prediction capabilities taking into account particularities of the polar regions;

- A major research effort in evaluating polar predictability, diagnosing forecasting system short-comings, forecast verification and user needs;
- An intensive observing and modelling effort to advance polar prediction. This activity, termed the Year of Polar Prediction (YOPP), is envisaged to take place from mid-2017 to mid-2019 and will require close coordination with other planned activities;
- Establishment and exploitation of special research data sets that can be used by the wider research community and forecast product users;
- A series of science workshops and educational events on polar prediction;
- Support from WMO Members through contributions to the Polar Prediction Trust Fund to ensure proper international coordination, on in-kind support from operational centres, research institutions and universities, and on an enhanced level of interest in polar prediction by national and international funding agencies.

The Year of Polar Prediction (YOPP)

YOPP is one of PPP's flagship activities planned for the period from 2013 to 2022. Its mission is to *„Enable a significant improvement in environmental prediction capabilities for the polar regions and beyond, by coordinating a period of intensive observing, modelling, verification, user-engagement and education activities."*

YOPP will be carried out in close collaboration with the Polar Climate Prediction Initiative (PCPI) of WCRP and other related initiatives. YOPP encompasses four major elements: an intensive observing period, a complementary intensive modelling and forecasting period, a period of enhanced monitoring of forecast use in decision making including verification, and a special educational effort. YOPP is structured in three phases: the preparation phase, central YOPP and the consolidation phase.

Preparation Phase 2013 to mid-2017	YOPP mid-2017 to mid-2019	Consolidation Phase mid-2019 to 2022
Community engagement	Intensive observing periods & satellite snapshot	Data denial experiments & case/process studies
Alignment with other planned activities	Dedicated model experiments	Model developments
Development of Implementation Plan	Research into use & value of forecasts	Dedicated reanalyses
Preparatory research	Intensive verification effort	Operational implementation
Summer school Workshops	Summer school	YOPP publications
Fundraising & Resource mobilization		YOPP conference

Three stages of YOPP, including the main activities for each stage.

The preparation phase of YOPP covers the period from 2013 to mid-2017 and is charactrized by the following key activities: community engagement, coordination with other planned activities, preparatory experimentation, preparation of observational and modelling strategies, development of implementation plan, organisation of summer school and workshops, liaision with funders. YOPP itself extends over the period from mid-2017 to mid-2019 and comprises periods of intensive observations, dedicated model experiments, research into the use and value of forecasts and intensive verification efforts. A consolidation phase marks the end of the YOPP decade. Data denial experiments, targeted model development, dedicated reanalyses, operational implementation and YOPP-specific publications are core elements of YOPP.

Specific objectives of YOPP are to:
- Improve the polar observing system to provide good coverage of high-quality observations in a cost effective manner. Gather additional observations through field programmes aimed at improving understanding of polar key processes.
- Develop improved representation of polar key processes in uncoupled and coupled models used for prediction, including those which are a particular hindrance to high-quality prediction for the polar regions, such as stable boundary layer representation, surface exchange, and steep orography.
- Develop improved data assimilation systems that account for challenges in the polar regions such as sparseness of observational data, steep orography, model error and the importance of coupled processes (e.g., atmosphere-sea ice interaction).
- Explore the predictability of sea ice on time scales from days to a season.
- Improve understanding of linkages between polar regions and lower latitudes and assess skill of models representing these.
- Improve verification of polar weather and environmental predictions to obtain quantitative knowledge on model performance, and on the skill of operational forecasting systems for user-relevant parameters; and efficiently monitor progress.
- Improve understanding of the benefits of using existing prediction information and services in the polar regions, differentiated across the spectrum of user types and benefit areas.
- Provide training opportunities to generate a sound knowledge base on polar prediction related issues.

Further information is available from the website of the International Coordination Office: http://polarprediction.net