The Year of Polar Prediction (YOPP) and objectives for Canada – an Environment and Climate Change Canada perspective

What is YOPP

YOPP is a major initiative of the WMO World Weather Research Programme's Polar Prediction Project (WWRP-PPP) which will span ten years (see figure1). YOPP is the core phase of PPP comprising of intensive observing, modelling, verification, user-engagement and education activities planned for mid-2017 to mid-2019, centred on 2018. Its goal 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 educational activities.

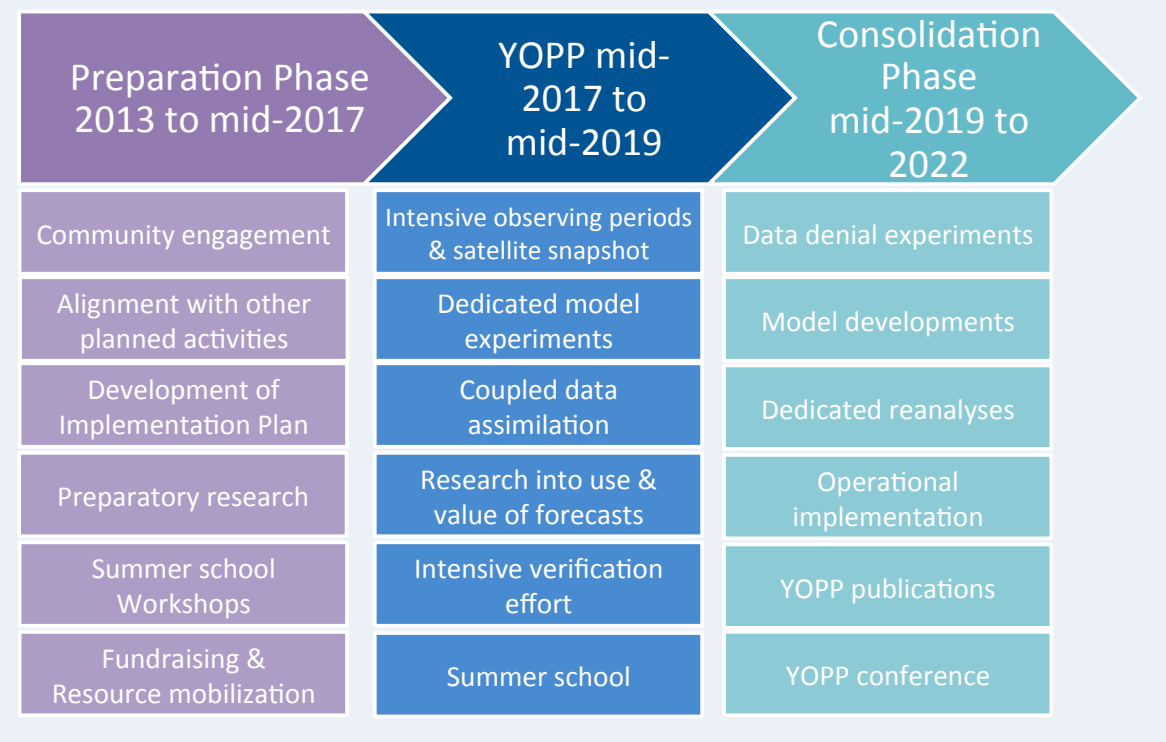

Figure 1. The Polar Prediction Project and YOPP core phase. Note the ongoing research and development ongoing during the consolidation phase until 2022.

Understanding the challenges of sustaining intensive observation campaigns in polar regions, several Special Observing Periods (SOPs) have been set with two in the Arctic in 2018 (see figure 2). These SOPs will examine the impact of enhanced observations in Polar Regions and will enable the extent of YOPP activities.

Plans are underway to secure the instrumentation and their deployment to be in place in time for the SOPs. However help is needed in this respect as the added observations during the SOPs is the foundation to all YOPP activities.

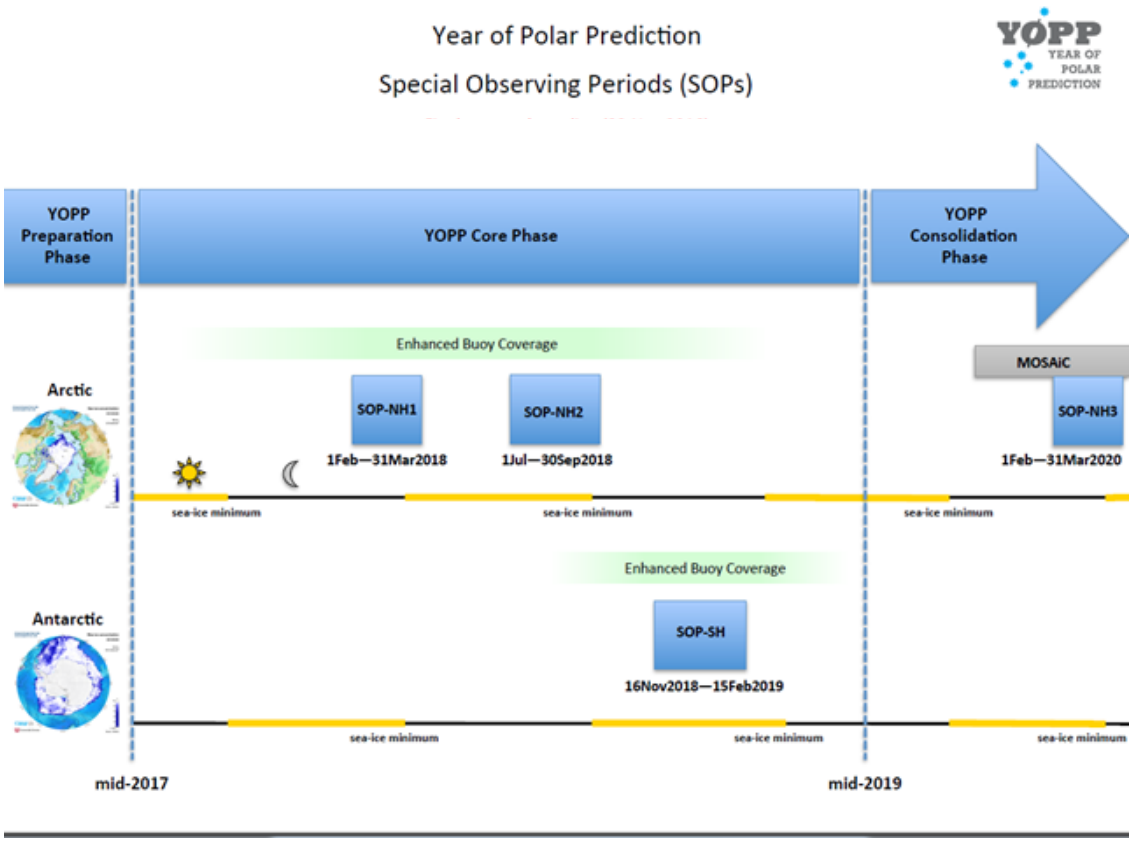

Figure 2. Timelines of Special Observing Periods.

Here below are the YOPP objectives as an integral part of the WWRP-PPP:

1. Improve the polar observing system to provide better coverage of high-quality observations in a cost effective manner.
2. Gather additional observations through field programmes aimed at improving understanding of key polar processes.
3. Develop improved representation of key polar processes in uncoupled and coupled models used for prediction, including those which are particular hindrances to high-quality prediction for the Polar Regions, such as those relating to stable boundary layer representation, surface exchange, permafrost, mixed phase clouds, winds, extreme thermal contrasts, and steep orography.
4. Develop improved data assimilation systems that account for challenges in the polar regions such as sparseness of observational data, steep orography, cryosphere uncertainties, model error and the importance of coupled processes (e.g., atmosphere-sea ice interaction).

5. Explore the predictability of the atmosphere-cryosphere-ocean, with a focus on sea ice, on time scales from days to seasons.
6. Improve understanding of linkages between Polar Regions and lower latitudes and assess skill of models representing these.
7. Improve verification of polar weather and environmental predictions to obtain quantitative knowledge on model performance; on the skill of operational forecasting systems for user-relevant parameters; and efficiently monitor progress.
8. 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.

Canadian science has a unique engagement with YOPP

The Year of Polar Prediction has its roots in the Canadian scientific community. It was first a Canadian idea following the International Polar Year (IPY). YOPP is now actively supported by Canada's international partners in the Arctic and by the WMO, YOPP task teams and governance are in full activity, with many ECCC leads. Canadian academia are being mobilised inter alia by the recent calls for proposals from MEOPAR and Polar Knowledge Canada looking for projects with strong linkages to YOPP objectives.

Objectives for ECCC

Canada has a unique engagement with YOPP as it builds on the Government of Canada's leadership in the Arctic such as its ongoing investments in response to its responsibilities for the 2 of the 5 International Maritime Organisation (IMO) Arctic Met/Nav areas (XVII and XVIII). It also befalls on ECCC the responsibility to provide ice information to support the new IMO Polar Code, effective January 1st 2017 this code will provide guidance on the ice capabilities needed for ships venturing in ice infested waters.

More recently the Federal Government has announced its commitment to large investments in Emergency Prevention and Response to help Arctic shipping and Northerners in the form of Canada's Oceans Protection Plan. Other Federal initiatives underway that align with YOPP desired outcomes are the work towards a Polar Regional Climate Centre and the Department of Fisheries and Oceans (DFO) led Canadian Integrated Ocean Observations System (CIOOS).

ECCC will look to leverage its Atmosphere-Ice-Ocean prediction systems thanks to its international leadership in coupled environmental modelling. The Meteorological Service of Canada has the first global forecasting system fully coupling atmospheric, ice and ocean models. Two new systems will be running experimentally in time for the YOPP Special Observing Periods: a high-resolution regional pan-Arctic coupled system with resolution of 2.5 km in the atmosphere and lead times up to 3-5 days; and a 20 member global ensemble ice-ocean forecasting system with forecasts out to 32 days.

ECCC current plans for YOPP

ECCC has two major areas of focus which participation in YOPP will enable:

- **Improved forecasting**
  - Explore the predictability of the atmosphere-ice-ocean system on time scales from days to seasons
  - Develop improved data assimilation systems in polar regions with sparse data
  - Improve modelling of key polar processes
- **Product & Services**
  - Product & Services development such as sea-ice forecasts and climate prediction
  - Better understanding of user needs for prediction information and services in the Arctic

Here below is a list of activities ECCC has planned in support of YOPP:

- **Observations:** Deployment in time for SOPs identified as time sensitive and will need national and international coordination
  - Partnering nationally and internationally to maximise International Arctic Buoy Programme (IABP) coverage
  - YOPP buoy task team identified surface pressure and temperature as first order priority, air and ocean profiling as second order
  - ECCC-DFO-DND (CONCEPTS) aiming to deploy Argo floats
  - Increasing radiosondes frequency to 4/day from many existing sites
  - Additional monitoring capacity (radar, lidar) at Iqaluit and Whitehorse ECCC supersites to improve microphysics in atmospheric modelling for visibility and light precipitation
- **Modelling:** ECCC will extend its leadership in fully coupled environmental modelling
  - Fully coupled high-res regional, global and ensembles will be ready for YOPP
  - Develop better coupled and uncoupled processes particular to an Arctic environment, for example a better understanding of the boundary layer is one project already underway
  - Coordinating outputs to share and archive – Norway to develop the portal
  - Real time model output evaluation in an operational context
    - Looking to partner with NWS Alaska
  - Reanalyses and data denial experiments
- **Verification:** YOPP verification task team considering three projects
  - Demonstrate the added value of enhanced observations
  - Analyse accuracy and predictability of coupled forecasting systems

- Analyse the performance of sea-ice models

- **Product development and user needs**
  - New sea-ice forecast products and supporting pan-Arctic climate services
  - Impacts of Arctic weather and climate to lower latitudes
  - Socio-Economic Research and Activities (SERA-PPP subcommittee) to better define user needs

Linkages to MEOPAR

Improving forecasts for the Arctic and globally and improving products and services for user in the Arctic, both of these YOPP objectives for ECCC are also drivers to MEOPAR's latest research plan:

- Bridge the data coordination gap in ocean observation;
- Strengthen predictive capacity and environmental forecasts in the Arctic;
- Provide knowledge-based and forecasting solutions to increase coastal community resilience;
- Provide technology and data solutions that minimize risk and maximise efficiency of maritime operations.

MEOPAR's current call for proposals puts a strong emphasis on the need to involve end-users beyond partners. This is an area where ECCC could gain great benefit from existing relationships that Canadian academics have built with local populations and industry in the North as these are afforded after a sustained investment in time and interest and are most often based on person to person relationships. For example, while ECCC seeks to leverage product development during YOPP it will need help to adequately respond to user needs in the Arctic. Research that includes partnerships and consultation of Northerners and the industries that operate in the Arctic would be viewed by ECCC as a way forward to bring environmental forecasting to the people that need it and for whom it was intended.

ECCC point of contact

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