Winter Targeted Observing Periods and Further Plans of the Year of Polar Prediction in the Southern Hemisphere (YOPP-SH)

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An Information Paper submitted by WMO

Summary

#### This report is an update to that provided to ATCM XLIII - CEP XXIII in 2021. Recent activities undertaken in the Antarctic as part of the World Meteorological Organization's (WMO) Polar Prediction Project (PPP) are summarized. The Year of Polar Prediction (YOPP), which is a hallmark activity of the PPP, has galvanised extra observation and modelling efforts in both the Arctic and Antarctic.

From July 2019, the Polar Prediction Project moved into its Consolidation Phase. This final phase of PPP (until end of 2022) is crucial to synthesize the data and research from the Preparation and Core Phases, to determine the long-term success of YOPP. YOPP-SH (Southern Hemisphere) is currently running a second Special Observing Period (SOP), mid-April to mid-July 2022, coinciding with the rapid expansion of the sea-ice cover. The analysis of these results will continue into 2023/24.

In late 2021 the World Weather Watch Scientific Steering Committee agreed to the extension of YOPP-SH and the Model Intercomparison Project (MIP) to the end of 2023 to allow the results from these PPP activities to be reported and actioned within the WMO decision making framework.

Introduction

PPP is coordinating international research with the main goal of significantly improving weather and sea-ice prediction capabilities in the polar regions, on time scales from hours to seasonal. It is part of the World Weather Research Programme (WWRP) of WMO, with close links to its sister programme, the WMO/IOC-UNESCO/ISC World Climate Research Programme (WCRP).

The YOPP Core Phase and – to some extent also its Consolidation Phase – included Special Observing Periods and a Target Observing Period (aligned with the MOSAiC ice drift - https://mosaic-expedition.org/) in the Arctic and Antarctic to increase the number of atmospheric and oceanographic observations. Extra radiosondes were launched from polar meteorological stations, and additional buoys were deployed from research vessels. The additional data enables improved representation of polar key processes in uncoupled and coupled models used for high-quality prediction in polar regions.

Contributions to the Antarctic Special Observing Period

The first Antarctic Special Observing Period (SOP) took place from 16 November 2018 to 15 February 2019. An overview of the activities during the YOPP-SH SOP is available from the PPP website, in particular from the [YOPP Observations Layer](https://www.polarprediction.net/data/yopp-observations-layer/).

An evaluation of global model forecasts during the Antarctic SOP confirmed that extratropical Southern Hemisphere forecast skill is lower than in the Northern Hemisphere with the contrast being greatest between the Antarctic and Arctic (Fig. 1).

Chart

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***Figure 1:*** *Anomaly correlation coefficient of operational global models for the 500-hPa geopotential height field for (top) Antarctica (solid lines) vs the extratropical Southern Hemisphere (dashed lines), and (bottom) the Arctic (solid lines) vs the extratropical Northern Hemisphere (dashed lines), during the respective summers. Verification is against each model’s own forecast. Notice the superior forecast performance for the Arctic shown by the larger anomaly correlation coefficients vs the Antarctic (solid colors). The Australian BOM SH performance (gray, top) is degraded during the SOP because of numerical instability over Antarctica. Subsequently, their new ACCESS-G model version has a forecast performance approaching that of the related UKMO (source: Bromwich et al., 2020; Fig. 5).*

Observing system experiments show that the additional radiosondes yield a better description of atmospheric conditions over Antarctica and as a result improve the forecasts of strong cyclones impacting the Antarctic coast. SOP data have been applied to study an atmospheric river event that was challenging to forecast and that impacted southern South America and the Antarctic Peninsula (Bromwich et al., 2020). Seasonal predictions by coupled atmosphere–ocean–sea ice models struggle to capture the spatial and temporal characteristics of the Antarctic sea ice minimum.

Winter Antarctic Special Observing Period in 2022

The second SOP from mid-April to mid-July 2022 is now underway. This period coincides with the rapid expansion of the Antarctic sea-ice cover. The goal of the winter SOP is to improve forecast capabilities during the non-summer months as nations contemplate expanding to year-round scientific field investigations. In recognition of limited personnel and resources at this time of year, the Targeted Observing Period (TOP) approach from the MOSAiC TOP (see above) is being adopted.

It is expected that four TOPs of ~5 days duration will be scheduled during the SOP with the focus on major oceanic cyclones, atmospheric rivers, and related events. The Antarctic Peninsula and Weddell Sea along with East Antarctica and the greater Ross Sea region are of particular emphasis. The primary additional observations will be radiosonde ascents although additional instrumentation has been added to many stations, particularly in the Antarctic Peninsula to aid in the investigation of the atmospheric river events. Expanded oceanic observations are also planned.

The recent dramatic warning event in the Eastern Antarctic was used as a test event for the forecasting and analysis activities for the TOPs. In general, the current numerical weather prediction model forecasts gave at least 120 hours (5 days) lead time on the extreme temperature rises but this was an extreme event with the study events expected to be of a lessor scale.

***YOPP-SH Data***

The [YOPP Data Portal](https://yopp.met.no/) is a metadata catalogue that connects to data held by the different data centres contributing to YOPP, including data centres that are connected to the WMO Information System’s (WIS) Global Telecommunication System (GTS).

A [GTS monitoring page](http://www2.mmm.ucar.edu/rt/amps/status/prepbufr_raob_accounting.html) set up by Kevin Manning (NCAR, Boulder, CO) has proven extremely useful for planning the data denial experiments. This archive has led to the decision to collect all the detailed radiosonde ascents from national operators and reformatted into a standard format by Steve Colwell (BAS FTP [site](https://legacy.bas.ac.uk/met/READER/YOPP-SH/)).

Radiosonde flights have also been archived by the British Antarctic Survey and the University of Wisconsin also has a data centre for Antarctic observations that may not be in the Portal.

***YOPP-SH Modelling and Forecasting***

Modelling efforts, e.g., with the Polar Weather Research and Forecasting model (PolarWRF) are based around the YOPP Supersites with enhanced verification and data assimilation efforts. Data denial experiments by different operational centres, such as Météo France, were carried out using extra observations during the YOPP-SH Special Observing Period. Extra observations from the SOP were also used in a range of data assimilation techniques to evaluate the forecast impact in the Antarctic Mesoscale Prediction System (AMPS). The work includes data denial experiments resulting in a more advanced data assimilation approach. The Chilean Weather Service is using the Polar WRF model for its Antarctic Peninsula forecasts. Further studies of this type are expected using the data from the Winter SOP which will highlight seasonal differences.

**YOPPSiteMIP**

In order to best use observations to understand the sources of forecast error in polar regions, the YOPP Supersite Model Inter-comparison Project (YOPPsiteMIP) aims to use observations from YOPP Supersites to do process level assessment of the performance of different forecast models in the Arctic and Antarctic. Efforts are carried out to synergistically combine information from Arctic and Antarctic Observatories and Numerical Weather Forecasts to further both the understanding of the mechanisms of the polar environment and to improve model forecast skill. High frequency model data is being archived for a number of the Antarctic sites to support these comparison and process investigation studies.

**Sea ice prediction in Antarctica**

One of the flagship activities of YOPP-SH is the Sea Ice Prediction Network South ([SIPN South](https://fmassonn.github.io/sipn-south.github.io/)), initiated in 2017 and that has run without interruption since then. SIPN South was launched due to the increasing need for sea ice information in the Southern Ocean, the existence of predictability mechanisms for summer sea ice recently suggested in the scientific literature, and the lack of knowledge regarding the skill of state-of-the-art operational forecasts at the seasonal time scale.

In five years, SIPN South has received more 52 contributions from 20 unique groups representing five continents, totalling more than 906 forecasts (most forecasts are expressed as ensembles). Forecasts conducted from the 2020-2021 summer season (Fig. 2) are currently being analyzed and a scientific paper is in preparation to investigate the skill of contemporary dynamical models and statistical models in predicting summer Antarctic sea ice at the global and regional scales.

SIPN South will continue running for the next years, and an additional exercise will be conducted during the Targeted Observing Period of fall-winter 2022. Sea ice forecasts from YOPP activities were used as part of the logistic support by the expedition involved in the recent discovery of the Endurance.

Gráfico, Histograma

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***Figure 2:*** *Forecasts of total Antarctic sea ice area for the 2021-2022 melting season (submitted before 1st December 2021) contributed by 15 groups. Verifying observations are in black.*

***Outreach***

**Second Season of *The IcePod***

In the second season of the IcePod focus was placed on the user perspective. Two episodes from the second series interview tour guides who work in the Antarctic. Details of the episodes in series two can be found [here](https://podcasts.apple.com/lt/podcast/the-icepod/id1480223567)

Meetings

**YOPP-SH Community**

The YOPP-SH community is meeting monthly online in two calls so that people from all time zones can attend. The seventh Year of Polar Prediction in the Southern Hemisphere meeting will be held in person and online, from 6th and 7th of August at the Pyle Centre at the University of Wisconsin, Madison. The meeting is organized by the Byrd Polar and Climate Research Center, Columbus, Ohio, USA and will, again, be aligned with the annual Workshop on Antarctic Meteorology and Climate (4th and 5th of August). During the meeting the first results from the Targeted Observing Periods (TOPs) will be discussed. Registration for the meeting is available at this [link](http://amrc.ssec.wisc.edu/meetings/meeting2022/before_registration.shtml).

**YOPP Final Summit**

The Year of Polar Prediction (YOPP) Final Summit will take place in Montreal (QC), Canada, 29 August - 1 September 2022, it was delayed from May 2022 due to COVID-19. The conference will bring together the polar prediction community, from operational centres and academia, to environment services and polar prediction users and northern communities, to showcase the successes of YOPP and contribute to the legacy of the Polar Prediction Project (Fig. 3). The YOPP in the Southern Hemisphere effort will provide an important contribution to the summit where highlights of the YOPP-SH effort will be showcased. See more on the Final Summit [here](https://www.polarprediction.net/meetings-workshops-and-science-sessions/yopp-final-summit/).

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***Figure 3:*** *The YOPP Final Summit is scheduled to take place 29 August to 1 September 2022 in Montréal, Canada*

***PPP encourages Antarctic Treaty Parties to share information about the*** [***YOPP Data Portal***](https://yopp.met.no/) ***to enable the national research communities to make use of the portal and to contribute their own data via their national data centres in an effort to build a comprehensive polar meteorological database.***

***For further details please contact*** [***office@polarprediction.net @awi.de***](mailto:office@polarprediction.net%20@awi.de) ***in the first instance.***