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

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

An Information Paper submitted by WMO

Summary

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, 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 is currently planning a second SOP, mid-April to mid-July 2022, coinciding with the rapid expansion of the sea-ice cover.

During the 11th annual PPP Steering Group meeting, it was agreed to extend the YOPP-SH effort to the end of 2024 due to the YOPP-SH Targeted Observing Periods (TOPs) scheduled for mid 2022.

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) 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). 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.

Chart

Description automatically generated with low confidence

***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).*

Winter Antarctic Special Observing Period in 2022

Concrete plans are now underway for a second Antarctic Special Observing Period (SOP) scheduled for mid-April to mid-July 2022, coinciding 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.

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 the greater Ross Sea region are of particular emphasis. The primary additional observations will be radiosonde ascents. Expanded oceanic observations are also planned.

***Extension of YOPP-SH until 2024***

During their 11th annual session held from 19 to 21 February 2020 in Bremerhaven, Germany, PPP-SG members agreed to extend YOPP-SH to the end of 2024 due to the YOPP-SH Targeted Observing Periods scheduled for mid 2022.

***Overview Paper in BAMS and Special Issue on Antarctica in Advances in Atmospheric Sciences***

Activities to enhance forecast capabilities in the Antarctic and the Southern Ocean around the Special Observing Period (SOP) during the Antarctic summer 2018/2019 have been summarized in the Bulletin of the American Meteorological Society (BAMS).

The overview paper on the YOPP in the Southern Hemisphere effort published in 2020 in BAMS has nicely added to the [YOPP special issue](https://link.springer.com/journal/376/volumes-and-issues/37-5) (‘Towards improving understanding and prediction of Arctic change and its linkage with Eurasian mid-latitude weather and climate’), published already in 2018.

Bromwich, D., Werner, K., Casati, B., Powers, J.G., Gorodetskaya, I., Massonnet, F. et al.: The Year of Polar Prediction in the Southern Hemisphere (YOPP-SH). Bull. Amer. Meteor. Soc., 101(10), E1653–E1676 (2020), doi.org/10.1175BAMS-D-19-0255.1

Zhang, X., Jung, T., Wang, M., Luo, Y., Semmler, T., Orr, A. (2017): Preface to the special issue: Towards improving understanding and prediction of Arctic change and its linkage with Eurasian mid-latitude weather and climate. Advances in Atmospheric Sciences, 35, 1-4, [doi.org/10.1007/s00376-017-7004-7](https://link.springer.com/article/10.1007/s00376-017-7004-7#citeas)

***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](ftp://ftp.bas.ac.uk/src/YOPP-SH/radiosondes/)).

***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.

**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.

**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 four years, SIPN South has received 52 contributions from 20 unique groups representing five continents, totalling 906 forecasts (most forecasts are expressed as ensembles). Forecasts conducted for the previous summer season (2020-2021, Fig. 2) are currently 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.

Chart, histogram

Description automatically generated

***Figure 2:*** *Forecasts of total Antarctic sea ice area for the 2020-2021 melting season (submitted before 1st December 2020) contributed by 13 groups. Verifying observations are in black.*

***Education***

**APECS Online Workshop “Antarctic Science: Global Connections” aligned to SCAR Open Science Conference**

On 11 August 2020, YOPP-SH researchers participated in the APECS Online Workshop “Antarctic Science: Global Connections” that took place alongside the online events for the cancelled Scientific Committee on Antarctic Research biennial Open Science Conference and Delegates Meeting (SCARCOMNAP2020). The recordings from the YOPP-SH workshop session are available at the APECS vimeo site.

**Live Episode of *The IcePod***

In the first-ever live broadcast of *The IcePod*, the official podcast of the YOPP initiative to improve weather and sea-ice forecast in the Arctic and Antarctic, Vicki Heinrich, a psychology PhD candidate at the University of Tasmania in Hobart, Australia, and member of the YOPP-SH Task Team was interviewed. She described her experiences as an Antarctic weather observer, what life is like on the ice, and how understanding the weather helps in decision-making (Fig. 3). The podcast episode is available [here](https://open.spotify.com/episode/789gfBN3FO27wfBmNjT3ei).

A picture containing text, outdoor

Description automatically generated

***Figure 3:*** *The first live session of The IcePod with weather observer and psychology PhD student Vicki Heinrich was broadcast as part of the YOPP Sessions at the APECS Workshop (photo: Peter Hargreaves).*

**YOPP-SH Science Session**

The YOPP-SH science session on 11 August 2020 was supported by ten speakers from the YOPP-SH community who presented an overview of some of the key activities associated with YOPP-SH. This was a session bursting with information on a wide range of YOPP-SH activities such as the SIPN South sea-ice prediction initiative, the Antarctic Automatic Weather Stations network, and a project where Antarctica atmospheric observations were carried out by a windsled. The presentations therefore provided early career researchers (ECRs) with a great opportunity to find out more about some of the projects associated with YOPP, how they can use weather and ice forecasts in their research, the different kinds of data that are available, and ways to contribute to YOPP and PPP. There were also examples of some innovative ways that projects and programs work to overcome the challenges of collecting data in and around Antarctica. Recordings of the YOPP-SH session during the APECS can be found [here](https://vimeo.com/455682238).

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 sixth Year of Polar Prediction in the Southern Hemisphere meeting will be held online, from 24 to 25 June 2021. 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 (21-23 June 2021). During the meeting, national commitments will be coordinated amongst the different action teams that look at various Antarctic regions to develop the Targeted Observing Periods (TOPs) to explore the predictability of impactful atmospheric phenomena such major oceanic cyclones and atmospheric rivers. Registration for the meeting is open until 31 May 2021 at this [link](https://byrd.osu.edu/events/yopp-sh/register).

**YOPP Final Summit**

The Year of Polar Prediction (YOPP) Final Summit will take place in Montreal (QC), Canada, 1-4 May 2022. 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. 4). 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/).

Graphical user interface

Description automatically generated with medium confidence

***Figure 4:*** *The YOPP Final Summit is scheduled to take place 1 to 4 May 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*** [***kirstin.werner@awi.de***](mailto:kirstin.werner@awi.de) ***in the first instance.***