

WWRP POLAR PREDICTION PROJECT (WWRP-PPP)

NINTH PPP STEERING GROUP MEETING (PPP-SG9)

13-15 MARCH 2018

ICELANDIC METEOROLOGICAL OFFICE (IMO)

VENUE: BUSTADAVEGI 7-9

108 REYKJAVIK

ICELAND



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Executive Summary

The ninth session of the Polar Prediction Project Steering Group (PPP-SG) took place in Reykjavík, Iceland at the headquarters of the Icelandic Meteorological Office (IMO) from Tuesday 13th March 2018 to Thursday 15th March 2018.

This meeting occurred during the first of the Northern Hemisphere Special Observing Periods (NH-SOP1) of the Year of Polar Prediction (YOPP) and thus marked the transition from seven years of YOPP planning to the Core Phase of 18 months of field study. The session reviewed progress to date as well as the upcoming Northern and Southern Hemisphere Special Observing Periods (SOPs) and commenced preliminary planning for the YOPP Consolidation Phase that follows the YOPP Core Phase with field campaigns.

The key outcomes from this session are summarized below:

Risk factors

- Identification that there is a serious risk that the global community will not be able to take the full benefit of YOPP datasets unless the long-term sustainability (2023, and possibly beyond) of the observational and model data archives are urgently addressed.

Strategic

- To hold a third Northern Hemisphere (NH) Special Observing Period (SOP3) to support MOSAiC during NH winter 2019/2020 with timing same as SOP1, i.e., February/March 2020. This decision was further supported by the following decisions:
 - To include lessons learnt from SOP1 and SOP2 in the planning of NH-SOP3.
 - To request EC-PHORS (the WMO Executive Council Panel of Experts on Polar and High Mountain Observations, Research and Services) for advice on how to get support from WMO Member States for a third SOP in the NH.
 - That the PPP International Coordination Office (ICO) and PPP-SG members should informally contact their national meteorological services and other institutes involved in YOPP regarding the decision to hold a third NH-SOP so the meteorological services and associated institutes can consider this additional SOP in their future planning.
- The Consolidation Phase of YOPP will start with dedicated and focused workshops and then broaden into a YOPP Synthesis Summit to be held in 2022.
- The ICO to investigate opportunities for a recognized science journal to publish a special edition showcasing the findings of YOPP.

Tactical¹

- The YOPP endorsement process continue past the YOPP Core Phase ending in mid-2019 but results from any projects endorsed under this decision need to be included in the YOPP Consolidation Phase. This decision implies that YOPP endorsements are concluded by the end of 2021.
- For NH-SOP2 EUMETNET be requested to continue the additional one flight / day at Egilstaðir and Danmarkshavn and use any remaining radiosondes at Aasiaat (West Greenland).
- PPP-SG members to advise ICO of data sets that do not have a sustainable medium to long-term home so the YOPP Data Portal team is aware of new

¹ A strategic decision is whether there is an SOP3 whilst a tactical decision is about whether it starts in Feb 16 or Feb 17, for example.

datasets or datasets in danger of being lost. The ICO to consider what sort of solutions can be found to save the datasets.

- PPP-SG considered that the aims of the YOPP would not be unduly compromised by the SAR (Synthetic Aperture Radar) hole over the South Pole and thus the WMO Polar Satellite Task Group would not be approached to fill in the SAR hole during the SOP for the Southern Hemisphere as the SAR data is primarily used for ice sheet dynamics which is outside the scope of YOPP.
- Accept and adopt the WMO Gender Action Plan for PPP-YOPP.
- Recommend to the Chair of the WWRP the following changes to the PPP-SG:
 - Machiel Lamers (Wageningen University, The Netherlands) to take over the PPP-SERA role from Jackie Dawson (University of Ottawa, Canada);
 - Irina Sandu take over from Peter Bauer (both ECMWF, United Kingdom);
 - Janet Intrieri to take over from Chris Fairall (both NOAA, Boulder).

1. OPENING OF PPP-SG9

1.1 Welcome and Purpose of the Meeting

The Chair of the Polar Prediction Project (PPP) Steering Group (PPP-SG), Dr Thomas Jung, opened the 9th session of the PPP-SG at 0830 on Tuesday 13th March welcoming old and new members. Dr Jung thanked Dr Arni Snorrason, Director-General of the Icelandic Meteorological Office, for agreeing to host the meeting at IMO in Reykjavik. Dr Jung reminded the PPP-SG that the purpose of the session was to review progress with the YOPP Core Phase as well as discuss plans and activities associated with the Consolidation Phase of YOPP, see figure 1 below.

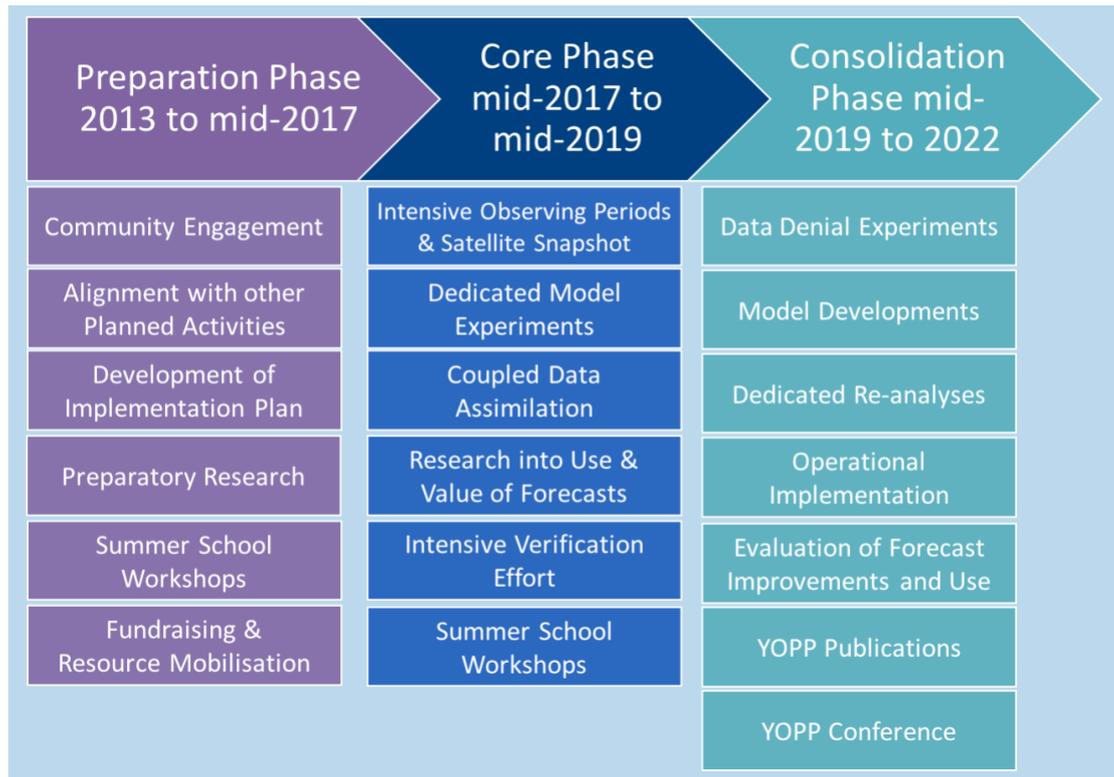


Figure 1. Key activities for each of the YOPP phases from the 2013 PPP Implementation Plan

The Chair recalled that recommendations from this session will go to the EC-PHORS (WMO Executive Council Expert Panel on Polar and High Mountain Observations, Research and Services) meeting which was scheduled for the following week in Finland. The Chair further noted that the EC-PHORS meeting provided a pathway for any recommendations from PPP-SG that needed to be considered at the World Meteorological Congress in 2019.

1.2 Adoption of the Agenda

The agenda shown in Annex I was accepted.

1.3 Working Arrangements

Dr Arni Snorrason, Director-General of the Icelandic Meteorological Office, welcomed everyone to the meeting and wished them a pleasant and productive stay in Iceland. Working and social arrangements were described. Dr Snorrason remarked that IMO were honoured to have the meeting in Iceland and that he looked forward to taking recommendations and a report from this meeting to the EC-PHORS session.

2. STATUS OF WWRP AND WCRP-CLIC

2.1 Update on WWRP Developments

Dr Paolo Ruti from the WMO Secretariat provided an update for the PPP-SG on the World Weather Research Programme (WWRP). As one of the core WWRP projects, PPP is seen as a flagship project as it addresses each of the five action areas identified for weather and climate research during the WMO Summit for Science that occurred immediately prior to the 17th Session of the WMO Commission for Atmospheric Science (CAS) in Geneva in 2016. The five action areas are: Deliver Science for Services; Build Seamless Models; Improve Infrastructure; Nurture a Diverse Workforce; and, Build New Partnerships. Further details about the Summit for Science can be found in Nature, vol 552, Dec 2017 (see <https://www.nature.com/articles/d41586-017-08463-3>). Of particular importance for PPP was the inclusion of the activities of the Societal and Economic Research and Applications Task Team (PPP-SERA).

Dr Ruti noted that the resources for the Year of Polar Prediction (YOPP) came from voluntary contributions from Member countries; some of these were essentially in-kind support by increasing observation programmes, undertaking additional research; and some were direct financial support to develop and run the project. The notional budget for the PPP is of the order of 100 to 120k CHF/annually for the next three years. This budget is to support costs for the PPP-SG, PPP-SERA, consultancies as well as funding for activities that maybe be identified during this session of the PPP-SG. Key activities to be funded include:

- Support to the PPP-SG activities, involving indigenous people and representatives of the climate community for YOPP planning and exploitation of YOPP;
- Support to PPP-SERA activities focusing on understanding human behaviours and decision-making processes;
- Support to the coordination of modeling activities on Earth System;
- Development of coupled data assimilation and new Information for the Polar Regional Climate Center;
- Coordination of YOPP modeling experimentations with MOSAiC (Multi-disciplinary drifting Observatory for the Study of Arctic Climate) experiment.

Dr Ruti finished his review noting the importance for this session of the PPP-SG to make recommendations to the next session of EC-PHORS being held in Finland during the following week on the:

- Long term development of the YOPP legacy;
- Multi-disciplinary observation systems;
- Seamless weather to climate science for polar regions.

EC-PHORS would then be able to make recommendations for these items to be considered during the WMO Executive Council in June 2018 and the World Meteorological Congress in 2019.

2.2 Update on WCRP-CliC Developments

The Climate and Cryosphere Project (CliC) of the World Climate Research Programme (WCRP) is hosted by the Norwegian Polar Institute. Dr Lawrence Hislop, Director of the CliC Project, updated the PPP-SG on the project and its activities via a remote presentation.

Dr Hislop recalled that the objectives of CliC were to:

- Improve understanding of the cryosphere and its interactions with the global climate system;
- Improve the ability to make quantitative predictions and projections of the cryosphere in a changing climate;

- Link observation and modelling communities.

CliC addresses activities in the following domains: Sea Ice, Ice Sheets, Glaciers, Permafrost, Snow cover, and Freshwater. Within these domains CliC has Four General Science Themes: Observing the Cryosphere; Physical Processes and Dynamical Understanding; Modelling the Cryosphere; and, Global and Regional Prediction and Predictability.

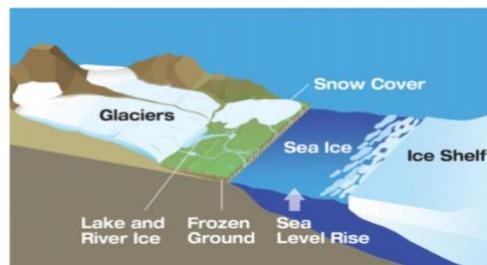


Figure 2. Overview of the WCRP CliC domains of interest

CliC activities are overseen by a number of working groups. Of particular importance to the PPP-SG is the work of the CliC Arctic Sea Ice

Working Group (CASIWG) which has been working on developing, standardizing, and implementing observation and measurement protocols for Arctic sea ice as well as integrating surface-based observations with remote sensing and modelling efforts. Dr Hislop emphasized the importance of YOPP for CliC as a source of detailed high-quality sea-ice observations, particularly from the Arctic. Furthermore, the increased understanding of sea-ice dynamics that should come from activities such as YOPP will assist CliC in building better sea-ice models for model intercomparison work associated with CMIP6 (Coupled Model Intercomparison Project Phase 6).

Dr Hislop concluded his presentation noting that 2017 had been a very busy year for CliC featuring 17 workshops totalling more than 430 participants and coming from more than 25 countries; presentations on CliC at five major conferences (ASSW, EGU, AGU+), more than eighty online project meetings and active on social media with 1700 likes on Facebook and more than 2300 followers on Twitter. Dr Hislop reminded the PPP-SG of the POLAR2018 Meeting in Davos Switzerland in June 2018.

2.2 Request: Dr Jung requested Dr Hislop to provide the ICO with information on how the CASIWG went about combining the sea-ice observations with model data as the processes for the CliC climate data should be similar to the weather data being examined under PPP.

3. MOSAIC AND LINK TO PPP: The Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAiC) and the potential SOP-NH3

Dr Anja Sommerfeld from AWI briefed the PPP-SG on the current status and plans for the Multi-disciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) planned for the high Arctic September 2019 to September 2020, covering the Northern Hemisphere winter season.

Dr Sommerfeld recalled that the objective of MOSAiC was to improve the understanding and model representation of coupled atmosphere-ice-ocean-ecosystem-biogeochemistry processes in the Central Arctic to support improved sea-ice forecasting, regional weather forecasting, and climate predictions.

To identify the interactions between the various components, the experiment will be using the German research vessel RV Polarstern as a central laboratory drifting in the ice pack, and this will be complemented with satellite stations at various distances from the ship, aircraft and other ice breakers.

Prior to MOSAiC, there will be a pre-campaign observation period of drifting buoys to help

determine likely drift tracks for RV Polarstern. MOSAiC will be split into six legs of approximately two months each. There will also be aircraft campaigns in spring and summer 2020. There will be an ice runway next to the ship to allow forays towards the north pole. The ship will have an intensive upper air sounding programme during the voyage as well as year-round tethered balloon flights and wind profiling lidars.

The major discussion point for this agenda item was whether to hold a third special observing period in the Northern Hemisphere, and if so when, to complement and take advantage of the wide range of observations and science being planned around MOSAiC. Following detailed discussions regarding logistics, support and optimum timing, the PPP-SG decided to hold a third SOP in February/March 2020 that would take advantage of MOSAiC and contribute to its activities.

It was noted during the discussion that RV Polarstern will have access to forecasts from the German Weather Service (DWD) as well as by an in-house meteorologist. These forecasts will only address atmospheric state not sea-ice forecasts. As many numerical weather prediction (NWP) centres are now running ensemble systems for atmosphere and sea-ice drift, it is important to use and test these. MOSAiC could be a YOPP Supersite which will be useful for the Consolidation Phase of YOPP. Dr Sommerfeld was advised that the YOPP website shows the centres willing to support field campaigns.

Machiel Lamers from PPP-SERA noted their interest in this field campaign and asked if social scientists could be involved in some of the observation periods to look at how people work together, how decisions are made, and how data is used.

3.1 Decision: To hold a third NH-SOP in February/March 2020 to complement the MOSAiC field study and provide an opportunity to contrast with the NH-SOP1 in 2018.

3.1 Recommendation: MOSAiC community to investigate how to access and use products from a number of operational NWP/sea-ice centres for operational planning and later use in the YOPP Consolidation Phase.

3.2 Recommendation: PPP-SERA to liaise with the MOSAiC planning team for possible involvement of social scientists.

4. YOPP SUPERSITES AND VERIFICATION: Overview

Dr Gunilla Svensson from Norway provided an overview of the activities and proposals for verification of observation and model data taken at the so-called supersites during the various SOPs.

Dr Svensson noted that 33 supersites had been identified for YOPP. Twelve supersites in the Arctic, 17 in the Antarctic, and four at the Third Pole (the Himalayas). Arctic and Antarctic supersites have suites of instruments, using both direct and remote techniques (such as lidars, radars, ceilometers, radiometers), that provide detailed measurements of the vertical column of the atmosphere as well as the surface conditions and energy and momentum fluxes.

For each of the supersites, NWP model output are archived at high frequency (~ minutes) for a beam/cylinder of grid-points surrounding the supersite location (ideally a 20-km radius), for the physical variables supported by the observations at the site.

The observation and NWP data will be used to target processes such as:

- The representation of (surface and upper air) energy and momentum fluxes;

- The closure of the radiation budget, turbulence and energy budgets;
- Cloud micro - and macro-physics (vertical profiles of water vapour, liquid and ice water content);
- Aerosols and hydro-meteors, micro-physics.

Dr Svensson noted that the proposed architecture for verification of YOPP data was similar to that being used by the HIRLAM (High Resolution Local Area Modelling for numerical weather prediction) community for model intercomparison with observational data, but the proposed architecture had not yet been agreed by the participating YOPP NWP centres as they did not all run OPeNDAP (Open-source Project for a Network Data Access Protocol). To use OPeNDAP or similar, systems would also require common naming conventions for the NWP and observation variables and this had not occurred.

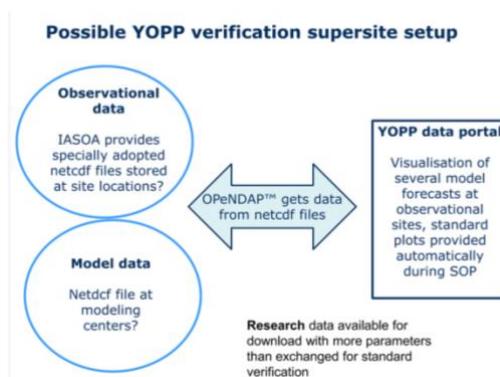


Figure 3. Possible YOPP verification supersite setup

Dr Svensson posed the following questions for the discussion:

- Are there any other modelling centres interested in contributing NWP data to verify against the supersite output? How should we advertise the availability and access rights of this unique data to the wider communities?
- Should we involve the HIRLAM community in the verification process?
- Is there a technical solution to be able to provide “standard” plots:
 - Where should NWP and observational data be stored?
 - What plots to keep? How near real time? All sites? Only SOPs?
- Research oriented, continued collaboration with GEWEX GASS – SCM, NWP etc.
- Should we be providing forecast data for ice-breaker expeditions, i.e. “moving supersites”? Who may be interested?
 - For example, the RV Oden expedition 1st August – 25th September, 2018.

The PPP-SG observed that the technical questions Dr Svensson posed are holding the YOPP efforts back at the moment. Dr Svensson advised that the observation and NWP model data were being held in NetCDF, however, there is need for offline discussion to reach agreement on the details such as file types and parameter names.

The project is using a distributed data model where the owner of the data stores the data. This has two aspects, i) getting all partners to use OPeNDAP and ii) furthermore having all partners maintain the NWP and observation data for at least the agreed time period. PANGAEA does not have OPeNDAP. Met Norway, Environment Canada, NOAA do have OPeNDAP but have not formally agreed to make the YOPP data available via this mechanism. The PPP-SG noted that the cost of providing open access to all the data for the period of YOPP and for some years beyond will be high, but will need to be addressed to ensure the legacy of YOPP.

The PPP-SG set up a small offline group (PPP-SG members Gunilla Svensson, Barbara Casati, Jonathan Day, Siri Jodha Singh Khalsa, Mikhail Tolstykh, plus Eric Bazile/MétéoFrance,

Øystein Godøy, Morten Koltzow/both MetNorway) to clarify the issues of data volume, naming conventions and access types around NWP and observational data retention. They expressed interest in joining the project and possibly providing time series for the Russian model. The PPP-SG observed that the data needs to be available for at least ten years after the end of YOPP to ensure that all verification and research has been completed. Jørn Kristiansen mentioned that Met Norway offers to host the supersite time series model output from the modeling centres contributing such output.

The PPP-SG identified three further questions that need to be clarified as soon as possible.

- How will we deal with further requests for supersites?
- Will there be a pseudo reference site for the Arctic, i.e., the North Pole?
- What do we do with additional high resolution data and aircraft observations from non-SOP and non-supersites?

The PPP-SG made the following recommendations:

- Use the Oden experiment to test the relevance and utility of the moving supersites concept and then pre-MOSAiC experiment and then MOSAiC;
- Send operational forecast data in grid point form to the RV Polarstern for use during the MOSAiC campaign if feasible.

4.1 Recommendation: Use the Oden experiment to test the relevance and utility of the moving supersites concept and then pre-MOSAiC experiment and then MOSAiC. Send operational forecast data in grid point form to RV Polarstern for use during the MOSAiC campaign if feasible.

5. YOPP MODELLING

5.1 Overview, status quo and open issues

In introducing this agenda item, Dr Jung recalled the recently released YOPP Modelling Plan and its components (see

http://www.polarprediction.net/fileadmin/user_upload/www.polarprediction.net/Home/Documents/FINAL_WWRP_PPP_No_6_2017_2_Nov_revised.pdf).

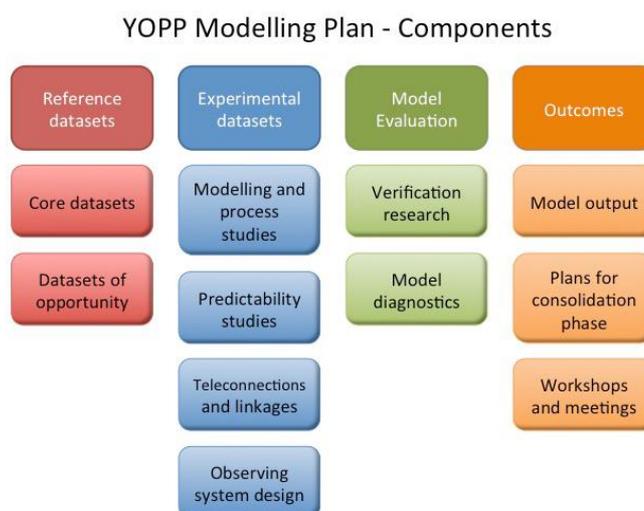


Figure 4. YOPP Modelling Plan components

Following Dr Jung's overview, the PPP-SG received reports on progress from members.

5.2 Canadian Contributions to YOPP Modelling (Greg Smith, ECCC)

There are a few prediction systems up and running (e.g., the Canadian Arctic Prediction System CAPS). CAPS is the main Canadian/ECCC contribution to YOPP. The CAPS domain is much bigger than the Canadian operational atmospheric system.

CAPS and RIOPS (Regional Ice Ocean Prediction System) are being held online rather than written over for the YOPP period.

The two ocean systems are nested within each other. The 32-day ensemble forecast is considered useful by the Canadian Ice Service although not fully tested. Also, for the NavCanada shipping service it is valuable for long-term planning.

5.3 Reports from Centres

ECMWF – Providing coupled forecasts at 16 km resolution. Tendencies will be added soon.

Met Norway – Only observational data being added. Tendencies being added including output from a snow model. Met.No is also coordinating the supersites. The University has been using the data. Would like to have ensemble approach to data assimilation and dealing with the boundary layer.

Météo France – In terms of NWP, Météo France intends to make the standard ARPEGE output available. For the Southern Hemisphere (SH), they will have a higher resolution (stretching pole) over the Antarctic, and the data will also be available during YOPP-SH. For the Arctic, they have a special version (APPLICATE) setup in collaboration with Met.No. Here, the supersites will be included. Seasonal forecasting for sea-ice will be provided as a contribution to the sea ice prediction networks. As well, Météo France may contribute to the SH Observing System Experiments, depending on resources.

US National Weather Service (NWS) – The US NWS will run a 15-day ensemble model to create drift parameters for sea ice. A 12-degree coupled ocean-atmosphere model producing forecasts out to eight days went operational recently. Also, they plan to make contributions to the Arctic SIPN (Sea Ice Prediction Network, see <https://www.arcus.org/sipn>) effort. However, they won't be able to do the supersites in high resolution. Maintaining the data archive problem will be an issue. Undertaking research on coupled air-sea ice. The model for weather forecasts is run at higher spatial and temporal resolution to eight days. There is a different model running out to thirty days and a further model for the seasonal time scales. US NWS also looks at subseasonal time scales. NOAA research producing zero to ten day coupled ice-atmosphere at 10 km resolution. For MOSAiC, they will be providing year-round products. Also, US NWS can do the IASOA supersites.

Met Office – The Met Office will run a global coupled model with coupled ocean-ice model in research mode at 10 km resolution; the data will be archived at the Met Office.

China – The Chinese National Marine Environmental Forecasting Center (NMEFC) has the APPLICATE system with 3 km resolution using GTS data. They are hoping to do something similar for the Arctic in the next few months. Also, they are using a MIT sea-ice model to produce the input parameters.

5.4 Discussion

The discussion on YOPP Modelling centred around the following topics:

- How do we get the wider use and ensure ongoing access to the YOPP special data sets?
- How to ensure that the data sets for the Southern and Northern Hemisphere are comparable?
- Identifying who will be carrying out Observation System Experiments.

Ensuring ongoing access and wider use of YOPP data sets

The PPP-SG spent some time examining aspects around the YOPP potential legacy. The discussions centred around:

- We need to give the community plenty of time to develop interest and skills in

predictability of Arctic and Antarctic environmental parameters.

- Advertising and promoting the data sets and the “big” questions through summer schools, EGU Open Hall events etc.
- Making the data sets more useable and accessible
- Ensuring the sustainability and longevity of the YOPP data sets through the YOPP Data Portal.

The discussions resulted in the following recommendations:

5.4 Recommendation to EC-PHORS: The PPP-SG considers that there is a serious risk that the global community will not be able to take the full benefit of the YOPP work unless the long-term sustainability of the data archives is urgently addressed. This is a problem for all research projects but particularly for YOPP due to the data volumes in the short term.

5.4 Request: That the PPP-SERA Task Team considers potential downstream users and uses of the data archive and provides the PPP-SG with information on how these groups could be targeted to access and use the datasets.

5.4 Action: ICO develops a slide deck and brochure showing what is available for the spectrum of users and can be promoted to the wider community.

Comparability of the Southern and Northern Hemisphere data sets

The PPP-SG noted that the temporal and spatial resolution of data for the Southern Hemisphere SOP seems to be lagging behind that being obtained in the Arctic. The Southern Hemisphere SOP planning meeting is coming up in Madison in July 2018 when the plans need to be finalized. The PPP-SG was advised of the need for turnkey information for the supersites to enable the operational observations in the Antarctic to be spooled up and for data to be stored for future use. Sub-hourly temporal resolution was desirable (aiming for 15 mins) for the processes with grid boxes of at least 5 grid points to give 20 km resolution.

The PPP-SG made the following recommendation:

5.4 Recommendation: The PPP-SG recommends that the data sets for the Southern Hemisphere should ideally be the same as that proposed for the Arctic, but if this is not possible temporal and spatial resolution should be sufficient to elaborate the key processes identified for the Southern Hemisphere in the YOPP Modelling Plan.

Observing System Experiments (OSEs)

Discussion identified the following questions regarding YOPP OSEs:

- What is the zero order/baseline observation network that will be used for the OSEs? This includes the frequency of radiosonde flights in the troposphere and stratosphere as well as distribution of buoys.
- Is it possible to isolate the regional models from the additional data in the global models?
- Should there be coordination/collaboration between the modelling centres around OSEs? Yes, but this comes with its own overheads. It may be possible to use some existing coordination mechanisms to do this.
- Should the OSEs be used to identify sensitivity of where additional observations need to be taken at what levels and what variables?
- Should the results of the OSEs be published in one journal edition?

The PPP-SG made the following recommendations:

5.4 Action: The ICO establishes a list of additional observations that are YOPP specific so we know what has been added to operational forecasting as a result of YOPP. These include buoys, probably based on numbers two seasons ago (baseline).

5.5 Action: The NWP Centres to advise the ICO if they are looking at doing denial of observation experiments, or observations system design. The Eastern Arctic is one area that could be targeted for buoys by denying the “Russian buoys”.

6. ARCTIC OBSERVATIONS

6.1 Overview, status quo and open issues

The PPP-SG noted that the first of the Northern Hemisphere SOPs (1st February 2018 to 31st March 2018) was currently underway. Dr Jung noted that it was estimated that an additional 1,900 radiosonde flights from 16 Arctic stations including five field campaigns would be made during NH-SOP1. During the coming NH summer, additional buoys would be deployed that would support NH-SOP2 (1st July 2018 to 30th September 2018).

Dr Jung recalled the YOPP-endorsed campaigns for NH-SOP1 and SOP2:

- Iceland-Greenland Seas Project (N Atlantic) – 100 sondes from vessel
- OASIS-YOPP (Thule Base, Greenland) – Helium shortage but three sondes
- ICECAPS (Summit Camp, Greenland) – two daily sondes, no extra
- MACSSIMIZE (Alaska, Canada) – aircraft campaign over Canada, snow emissivity
- (AC)³– PAMARCMIP (Villum Station, North Greenland) – aircraft campaign, black carbon

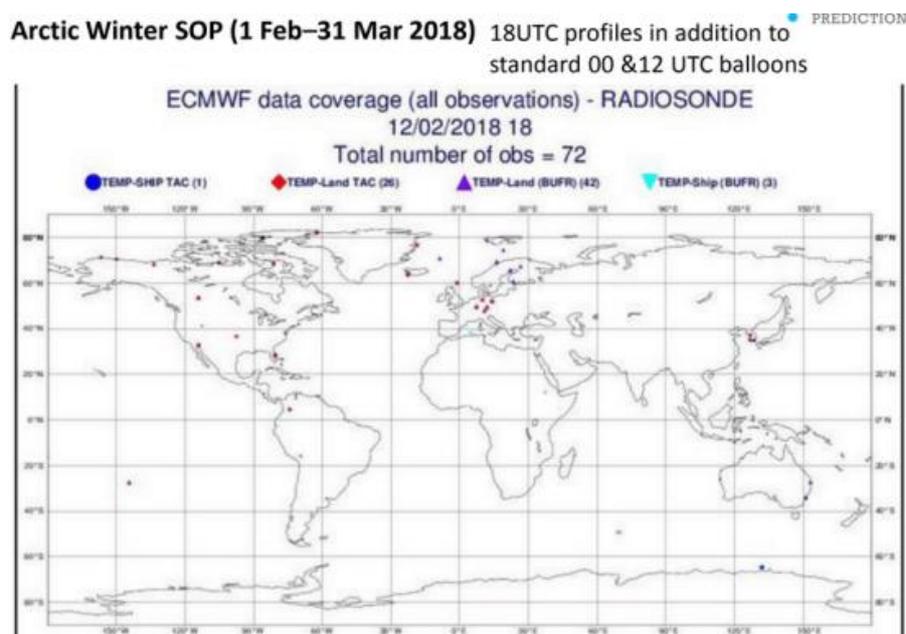


Figure 5. Example of additional radiosondes on 12th February (Source: ECMWF)

6.2 Canadian Contributions to YOPP Observations

The PPP-SG was advised by Dr Paul Pestieau (ECCC) that the objectives of YOPP align very closely to those of the Canadian Government for research and services in the Arctic region. Canada is supporting YOPP through additional observations, modelling, forecasting and verification of model results. Additional radiosonde flights have been undertaken in NH-SOP1, and extra funding has been secured for additional sondes for NH-SOP2. Two hundred radiosondes are being sent to the University of Stockholm for the YOPP-endorsed Arctic Climate Across Scales experiment (ACAS, see more <http://www.aces.su.se/research/projects/arctic-climate-across-spatial-and-temporal-scales-acas/>). Additional buoys are being deployed by a range of Canadian groups with a number

being deployed from the air by C130.

The network of surface observations has been strengthened including Automated Voluntary Observing Ships Systems (AVOS). However, there are still data-sparse areas in the Eurasian part of the Arctic.

The Meteorological Service of Canada is operating a virtual desk for operational forecasts:

- Operational support for field campaigns
- Contribute to the post-SOP reports by supplementing the objective verification
 - Conducting daily intermodel comparisons of CAPS – RIOPS
 - Canadian Ice Service collecting daily ice-edge data
 - Collecting and posting cases from regional forecasters
 - Working with NOAA (National Ice Center (NIC) and Alaska) to share processes and results of model verification
- Collecting user feedback

ECCC is producing sea-ice motion in gridded format from radarsat data.

Dr Paul Pestieau from ECCC further noted that:

- Few forecast products for the Arctic are automated;
- Forecasters need to know expectations from researchers on evaluation/cases of interest.

It will be important to

- Share evaluation methods with other centres;
- Get model data to forecasters and through YOPP portal in time for SOP1;
- Collect feedback from end users.

Canada has 200k Canadian Dollar available for buoys for a potential NH-SOP3, funds available in 2019 but buoys can be deployed in 2020. Canada may need assistance to deploy some of the buoys in 2020.

6.3 Collaboration with EUMETNET

Dr Sabine Hafner from DWD advised the PPP-SG that EUMETNET had spent about 95k Euro to buy extra buoys for the Eastern Arctic for the two NH-SOPs. Even with the additional funding, some holes in the Exclusive Economic Zone exist.

The Russian buoys are on the verge of deployment. Eleven of them have now been delivered to the Arctic and Antarctic Research Institute (AARI) in St Petersburg. The first deployment is planned for April via helicopter. Experimental sensors need to be added to the later buoys. EUMETNET deployments are delayed and will now be done in August 2018 with the Oden cruise. The PPP-SG noted the need to advise the community when buoys have been deployed to ensure that their data is flowing into the NWP centres. EUMETNET will be checking to see what impact the additional YOPP buoys or radiosondes are making.

95k Euro are available for buoys in 2017/2018, and 99k Euro in 2018 are available for additional radiosondes from land stations with one additional flight/day from two stations for SOP1 and one additional flight/day for three stations for SOP2 with possible additional funds if some left over would be available from SOP1.

Dr Hafner noted that EUMETNET members have made possible additional radiosonde flights for YOPP, for example Finland, Denmark, Sweden, Iceland, Norway, Canada.

6.3 Action: As part of the YOPP Consolidation, PPP-SG and ICO to provide feedback to donors

(EUMETNET and member states) about the utility of the additional flights and buoys.

6.3 Action: ICO to advise the community when buoys have been deployed to ensure that their data is flowing into the NWP centres.

6.4 International Arctic Buoy Programme (IABP)

Dr Don Perovich from IABP advised the PPP-SG that things are going well but we still have lots of empty space with regards to the YOPP Buoys (see http://iabp.apl.washington.edu/maps_daily_map.html, the maps are updated daily). A large number of opportunities to deploy buoys from ship and aircraft are coming up this NH summer. The map below shows the proposed timing and location of buoy deployment.

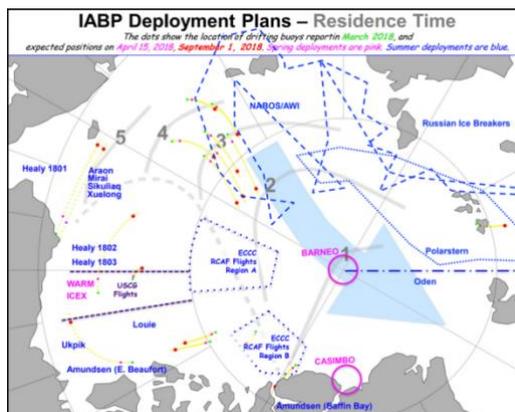


Figure 6. IABP Deployment Plans. Estimated residence time (source: IABP)

In the general discussion, the PPP-SG agreed that the additional ice/ocean data from the special buoys are useful for YOPP and if possible it should be distributed via the GTS. If it is not possible to distribute the data via the GTS, it will still be very useful for verification purposes in the YOPP Consolidation Phase.

6.4 Action: The YOPP Buoy Task Team be requested to update the list of possible deployment missions showing name of mission, contact officers, when commencing and where mission will sail from.

6.4 Action: Greg Smith to advise the ICO how the temperature measurements from the ice mass balance buoys can be included in the GTS.

6.5 Discussion

Dr Jun Inoue (Japan) informed the PPP-SG that Japan has supported Russia with additional radiosondes for NH-SOP1 and to provide additional flights for NH-SOP2 but the additional data did not make the GTS.

The PPP-SG was advised that China will launch an additional 100 radiosondes for NH-SOP2 north of 50°N.

Following the discussion of the reports under this agenda item, the PPP-SG decided upon following actions, recommendations, statements and decisions:

6.5 Statement: The PPP-SG encourages the deployment of specialist ice/ocean data buoys to better understand ice/ocean processes and for use in verification during the YOPP Consolidation Phase.

6.5 Action: ICO to be updated on deployments and deployment opportunities and they will distribute the information widely amongst the polar prediction community including the

NWP community.

6.5 Action: ICO to circulate a request to organizers of field campaigns (tour ships??) and other groups seeking information about possible buoy deployments in open water in the Arctic during SOP2.

6.5 Decision: PPP-SG decides that for the NH-SOP2, EUMETNET continues the additional one flight/day for the SOP1 sites and uses the additional thirty sondes for Aasiaat (West Greenland).

6.5 Decision: PPP-SG decides:

- About a third NH Special Observation Period (NH-SOP3) to support MOSAiC during NH winter 2019/2020 with same timing as NH-SOP1 (February/March).
- Planning for NH-SOP3 includes lessons learnt from NH-SOP1 and NH-SOP2.
- To request Dr Ruti to ask EC-PHORS for advice on how to get support from WMO Member States for a third SOP in the NH.
- ICO and PPP-SG members to informally contact national services and institutes regarding a possible third NH-SOP so they can commence to include in their planning.

6.5 Request: PPP-SG requests ECMWF to provide feedback from the next ECMWF ODRD meeting (quarterly internal meetings where ECMWF research and operations department reviews prediction performance of past season) on whether there was any impact on skill from the additional observations/radiosondes during NH-SOP1.

6.5 Observation: PPP-SG takes note of Dr Jun Inoue's suggestion of identifying coverage of open water buoys and buoys in marginal sea ice zone in the verification/Consolidation Phase.

7. YOPP SERA AND VERIFICATION

7.1 YOPP SERA – Overview, status quo and open issues (Machiel Lamers, University of Wageningen)

Dr Machiel Lamers from the University of Wageningen (The Netherlands) advised the PPP-SG that there have been some changes in the working group with Jackie Dawson stepping down and Machiel Lamers/Daniela Liggett taking over as co-chairs. There have also been some changes in the general membership of PPP-SERA. PPP-SERA is looking at expanding the membership of the group to include more end-user groups.

The flagship project for the last year has been the publication of 'Navigating Weather, Water, Ice and Climate for Safe Polar Mobilities' publication (see https://epic.awi.de/46211/1/012_WWRP_PPP_No_5_2017_11_OCT.pdf). The publication describes the movement of people, finances, phenomena and information in the polar regions and how weather and climate affect this movement. It also looks at the value chain/interface/platforms of the information product. These are the two central concepts in the report. It has been scoped around different providers and users of information for each pole and those involved in both poles.

The key messages are:

- Recognizing that just because information exists does not necessarily mean it will be used;
- Near-real time Weather, Water, Ice and Climate (WWIC) information is required to provide relevant information for a diversity of user groups;
- Experience and trust in sub-seasonal to seasonal scales is limited;

- Higher quality information and greater resolution of data needs to be made available in small file sizes for many user groups – transferability is the key;
- More work is needed to collect data on cases of human activities and service uses in the polar regions;
- More information is required about the factors that enable or constrain access to, or provision of, information services;
- There is a need for systematic documentation of the use of existing information services (e.g., case studies of feedback and partnerships) in order to improve and tailor products to enhance their utility.

PPP-SERA has been involved in dedicated sessions of a number of polar-related conferences and will also be part of the Pan-Arctic Regional Climate Outlook Forum (PARCOF) in May this year in Canada.

The task team is currently working on the following publications that arose from the PPP-SERA scoping document:

- Publication on mobile sectors, vulnerabilities and service needs; and
- A publication on the provider-user interface.

PPP-SERA wishes to carry out a joint network analysis of how WWIC information is provided and used. It will require the providers of WWIC information as well as the users to be involved and will look at how the information is used to examine the value chain.

The following activities are planned by PPP-SERA:

- Organize a polar Weather and Society workshop;
- Work with YOPP-endorsed SERA projects; and
- Identify relevant projects and expertise.

Further plans for the YOPP Consolidation Phase will be discussed by the PPP-SERA Task Team during their next meeting at the Wageningen University and at the PPP-SERA Open Session in The Hague (16th to 20th April 2018).

Discussion

The PPP-SG were supportive of the next steps proposed by PPP-SERA. The PPP-SG noted that there are various opportunities for social science research within YOPP to bridge the geophysical and social sciences.

The PPP-SG recognized that for the YOPP legacy it will be important to generate societal value during the YOPP Consolidation Phase with regards to the following points:

- Why do we do generate and provide WWIC information (e.g., safety, sustainability)?
- Who do we do generate and provide WWIC information for (e.g., public private interests)?

Amongst others, these questions could be addressed during the planned Weather and Society workshop. The PPP-SG noted that with regards to the PPP vision, it will be important to keep a balance between the Arctic and Antarctic in PPP-SERA activities as the Arctic seems quite dominant at the present time.

Further points were addressed during the discussion:

- Paolo Ruti confirmed that participants for the next PPP-SERA meeting should soon receive the paperwork from WMO for the travel support.
- Consideration is being given to turning the PPP-SERA scoping document into a scientific paper but no journal has been targeted yet.
- The potential for increasing the use of the YOPP data and Data Portal by the natural

science community.

7.1 Action: ICO to consider options for aligning the next PPP-SERA meeting with the next PPP-SG scheduled for Finland in Jan 2019.

7.1 Action: The PPP-SERA Task Team is invited to provide feedback to the YOPP Data Portal group with regards to the user friendliness of the user interface for the various user communities PPP-SERA have identified.

7.1 Action: PPP-SERA to identify what sort of future support they need and for what sort of activities and report back to the ICO/PPP-SG.

7.1 Action: How can the ICO support the PPP-SERA meeting in April 2018 by promoting the virtues of the YOPP dataset and Data Portal?

7.2 Verification – Overview, status quo and open issues (Barbara Casati, ECCO)

Dr Barbara Casati provided the PPP-SG with an update to the work of the Verification Task Team. She noted that there have been some changes in membership and that there are a lot of verification projects underway. The four major clusters of activities are:

- Numerical Weather Prediction (NWP) process-based verification against high frequency multivariate observations at the YOPP supersites – four big projects in this cluster;
- Operational summary of verification scores – three sub-structures: pre-YOPP NWP system performance; operational verification practices in polar regions; objective verification exchange during the NH-SOPs;
- Verification of sea-ice prediction during YOPP;
- Coupling; storm tracks as in YOPP-endorsed project ALERTNESS.

Dr Casati advised the PPP-SG that the Verification Task Team had identified the following tasks as priority work for 2018 and 2019:

- Updating their website (<http://www.polarprediction.net/yopp-activities/yopp-task-teams/verification/>) to include ongoing work, presentations, reports and eventually published articles.
- For the supersites – publish data, methods and score exchange (general summary scores). Results from specific process evaluation will be a deliverable of the YOPP Consolidation Phase.
- Operational summary scores exchange using the WMO Score Exchange (see WMO No 485, https://www.wmo.int/pages/prog/www/DPFS/documents/485_Vol_I_en.pdf) of scores for surface variables is still not implemented. The group is starting to identify gaps in verification practice (precipitation under-catchment, network inhomogeneity in space etc.). They are also starting to identify systematic model behaviours (this will be further addressed in the Consolidation Phase).
- Sea-ice verification intercomparison still needs to be coordinated, consideration is being given to clustering projects, rather than attempt an all-models inclusive (deterministic and ensembles, short and medium range with sub-seasonal to seasonal) intercomparison.

Three verification documents are planned:

- Verification of environmental prediction in polar regions, recommendations from YOPP;
- YOPP verification goals and standards;
- Verification needs for planning the YOPP archive.

Dr Casati reminded the PPP-SG of the primary goals of the YOPP Verification Task Team:

1a) Demonstrate the added value of enhanced observations in:

- Data assimilation (data denial, x-validation, standard scores);
- Prediction (data denial, x-validation, standard scores, Data Assimilation);
- Verification practices (thinning, spatial representativeness).

1b) Verification research opportunities: verification in data-sparse regions; observation uncertainty; verification against analysis; synergies with Data Assimilation.

2) Quantify the accuracy of current numerical models in polar regions:

- Compare coupled versus uncoupled systems;
- Assess the impact of dynamical sea-ice models;
- Identify model systematic errors - verification of upper-air and surface variables; verification of ocean variables; verification of the radiation budget in presence/absence of clouds; verification of energy fluxes over ocean/land in presence/absence of sea-ice/snow. YOPP verification primary goals.

3) Analyze the performance of dynamical sea-ice models for sea-ice concentration, thickness, drift, extent, edge, pressure.

4) Demonstrate advancements associated with the YOPP modeling effort: pre-YOPP versus post-YOPP.

5) Linkages: demonstrate that improvements in the forecast accuracy in polar regions transfer to improvements in the predictability at mid-latitudes.

In the following discussion, the PPP-SG decided upon the following actions:

7.2 Action: ALL task team leaders to advise ICO of the team members names so the ICO can update the website.

7.2 Action: ICO to identify data sets that do not have a sustainable medium to long-term home so the YOPP Data Portal team is aware of new datasets or datasets in danger of being lost.

8. YOPP CONSOLIDATION PHASE I: Discussion of Priorities during YOPP Consolidation Phase I based on SOPs (led by Thomas Jung, AWI)

The PPP-SG recalled that the key objectives for YOPP from the 2013 PPP Implementation Plan for the Consolidation Phase are building on the experience of the SOPs in the Core Phase for:

1. Observing system design (making use of data denial experiments etc., from YOPP);
2. Operational implementation of improved forecasting systems;
3. Ongoing innovation based on what has been learned, with proven benefits through prediction experiments etc.;
4. A legacy of YOPP data which can be used for ongoing work.

The major activities identified in the YOPP Implementation Plan for the Consolidation Phase are contained in the figure below:

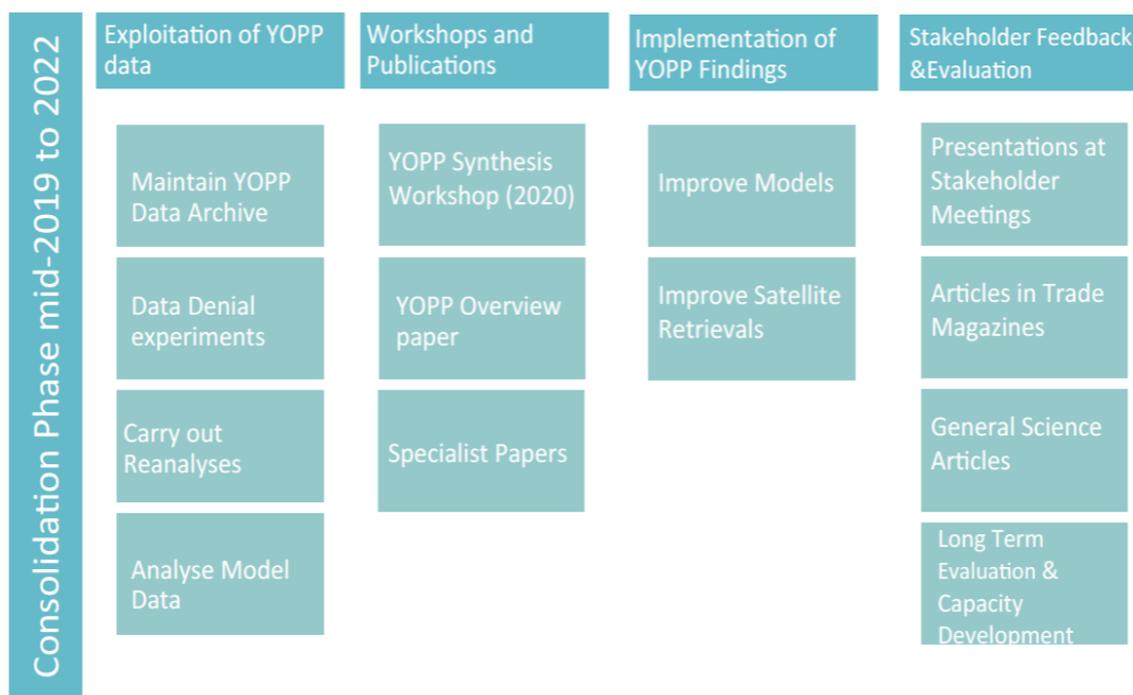


Figure 7. Key activity areas for the YOPP Consolidation Phase (from PPP Implementation Plan, 2013)

Following discussion around the theme areas and key activities the PPP-SG made the following decisions.

8.1 Decision: Only one synthesis document for the Consolidation Phase blending the work of the PPP-SERA with the other task teams. The reports from the various groups should include reference to how innovations have enabled integration of new observations into the modelling systems.

8.1 Decision: PPP-SG to provide ICO with input to develop a standard acknowledgement that can be included with each dataset to help with traceability of YOPP projects. If the datasets have a Digital Object Identifier (DOI) this could be linked to the acknowledgement.

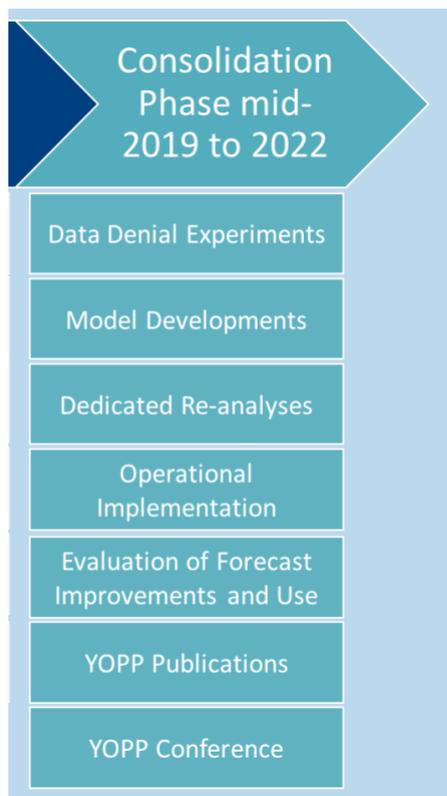
8.1 Decision: ICO to include an area on the website where YOPP papers can be linked.

8.1 Decision: In 2022, a YOPP/MOSAiC combined workshop will be required to blend the large scale (YOPP) with the fine scale from MOSAiC.

8.1 Decision: Start with dedicated and focused workshops and then broaden into a YOPP Synthesis Summit (2022).

8.1 Decision: To run a YOPP session at each EGU for the period 2020 to 2022 and look for options for open sessions at other major conferences. Also look at POLAR2020. The ICO to investigate the opportunity to hold the Synthesis Summit in Canada in 2022 to acknowledge the support Canada has provided to PPP. Include the PPP-SERA weather and society theme in the Synthesis Summit (co-design one central theme).

8.1 Decision: PPP-SG to create a Working Group to look after an observing system design workshop before SOP3. PPP-SG to identify two co-chairs, one from a modelling perspective (OSSE) and another from the observation system background.



8.1 Decision: The Chair of the PPP-SG to advise the editor of Tellus A (open access) that in principle the PPP-SG is interested in a special Tellus A edition summarizing YOPP and its outcomes.

8.1 Decision: The PPP-SG are appreciative and supportive of Greg Smith, Matthieu Chevallier and Steffen Olsen offering to submit a YOPP proposal to OCEANOBS'19 conference.

Figure 8. Key activities foreseen for the Consolidation Phase in the YOPP IP. These build upon and expand those activities originally foreseen in the 2013 PPP Implementation Plan.

9. YOPP CONSOLIDATION PHASE II: Discussion of Priorities during YOPP Consolidation Phase II based on SOPs

The PPP-SG further elaborated on the broad-scale activities and considerations for the YOPP Consolidation Phase using theme headings shown in Figure 8 from the YOPP Implementation Plan. Noting the earlier decision to hold a third Special Observing Period (NH SOP-3) in the Northern Hemisphere to coincide with the MOSAiC experiment, the PPP-SG noted the importance of using lessons learnt from the first and second SOP to plan the third SOP. The MOSAiC meeting end of May 2018 and the IASC-YOPP meeting in Helsinki in January 2019 could be useful venues for these discussions. Similarly, there should be a YOPP-MOSAiC workshop in the first post-MOSAiC meeting to include results into the Consolidation Phase of YOPP.

Regarding the data legacy, the PPP-SG recalled its earlier concerns about ensuring that the major datasets remain publically accessible and are well used by the science and PPP-SERA communities during and after the formal end of PPP. The PPP-SG agreed that the decisions made under agenda item 8 were a necessary first step to ensuring that there would be a YOPP legacy but the PPP-SG would need to actively encourage and monitor activities to ensure that the key objectives were met.

In discussing the workshops and conferences to be carried out in the Consolidation Phase, the PPP-SG suggested that workshops on the following were required:

- Polar parameterization;
- An observing system design workshop linking with OSEs being conducted under YOPP-endorsed projects APPLICATE and ALERTNESS;
- Modelling, forecast and verification workshops. Look for options to link with the WMO verification workshop due in 2020 but noting this is later than desirable. Look for options of linking with the IICWG in 2019;

- Weather and Society workshops to be led by PPP-SERA looking at the links between services and end users. The framework for these workshops yet to be determined;
- As decided in agenda item 8 to look for opportunities to hold YOPP at major conferences.

The PPP-SG noted the importance of providing stakeholders feedback and evaluation on YOPP and its legacy. The PPP-SG identified the following initial group of stakeholders: researchers, WWRP Scientific Steering Committee, World Meteorological Congress and WMO Executive Council, the various funding agencies, the national meteorological and hydrological services (NMHSs) and operational centres who are supporting YOPP activities, other in-kind supporters and of course the end-users of the services who were providing feedback on the utility of the forecast products and services. The PPP-SG discussed options for providing the stakeholders with feedback, and evaluation included: presentations at stakeholder meetings, articles in trade magazines, general science articles and evaluation and long term capacity development. The PPP-SG noted the importance of PPP-SERA to assist in identifying and working with the stakeholders to help get the messages out.

The PPP-SG noted that they would need cooperation from a range of other groups such as WMO Global Data Processing and Forecasting System (GDPFS), MOSAiC, Global Cryosphere Watch and the Arctic Regional Climate Centre. Close cooperation and handover of lessons learnt from YOPP/PPP to these groups would be essential to ensure that the findings from YOPP were put into operations.

10. YOPP DATA COMPONENT

10.1 Overview, status quo and open issues (Øystein Godøy, MET Norway)

Dr Øystein Godøy from Met Norway briefed the PPP-SG on the current status and future activities for YOPP data management. The YOPP Data Portal (<https://yopp.met.no>) is online and has recently been updated. The purpose of the Data Portal is to provide:

- An overview of datasets relevant to YOPP;
- Access to datasets wherever possible;
- Access to near real time data streams;
- Access to archived data.

The Data Portal shall connect YOPP with the WMO Information System, including the WMO GTS.

The PPP-SG recalled that the YOPP Data Portal is a physically distributed data model with:

- One central discovery metadata repository harvesting information from contributing data centres.
- It does not host data centrally, all data served from host data centre.
- Contributing data centres considered authoritative for information on data sets.
- Standardization of data documentation and interfaces to data and discovery metadata is required for full integration.

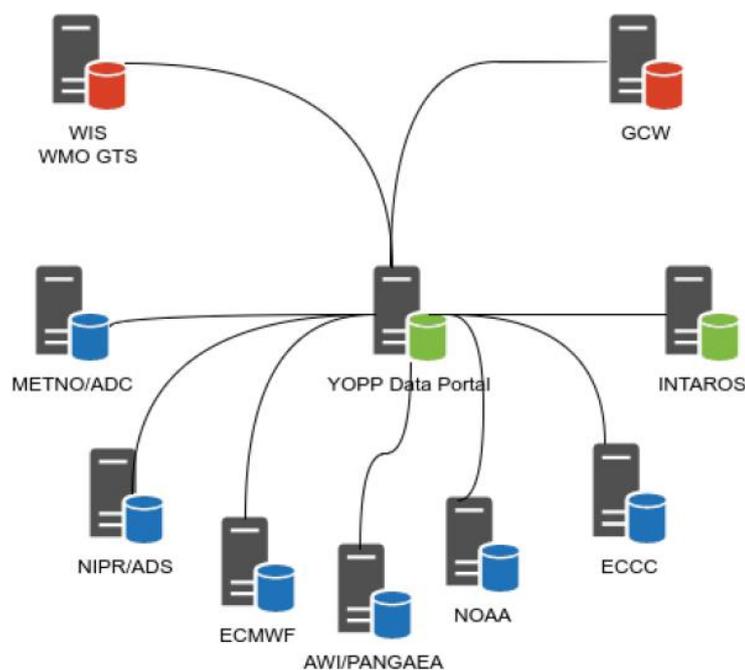


Figure 9 YOPP Data Portal showing links to data providers (Source: Øystein Godøy, MET Norway)

Dr Godøy advised the PPP-SG that the following functions are now active on the Data Portal: search, download of single products, basket to download multiple products, some visualization functionality (gridded working but no support for vertical levels), time series under re-implementation, profiles missing. Additionally, Met Norway is harvesting the WMO GTS for Arctic weather stations (approximately 400 stations) and radiosondes (standard levels only). The GTS data is dumped to NetCDF/CF (Climate and Forecast Convention) and served through OPeNDAP. The main focus is on the Arctic not Antarctic. The Data Portal will include weather stations, radiosonde and moving surface stations.

The YOPP Data Portal runs under the open source content-management framework DRUPAL and can be used to create static description pages on the data etc. The PPP-SG noted that the data provider must generate the meta-data information, not Met Norway.

Dr Godøy outlined the plans for the Data Portal for 2018/2019

- 2018Q1 – update the portal software with better support for transformations, visualisation etc. for gridded data;
- 2018Q3 – update the portal with better support for time series;
- 2018Q3 – add support for OpeNDAP/NetCDF to BUFR conversion for potential GTS push.

10.2 Discussion – Data sharing/Coordination YOPP Supersites

The PPP-SG thanked Dr Godøy for the comprehensive overview of the Data Portal and his recommendations and open issues.

As in agenda item 4, the question of data volumes and longer term sustainability of the YOPP data sets was considered by the PPP-SG to be a major risk to the project. The PPP-SG identified some options for holding smaller sets of observational data (PANGAEA and NSIDC) but they were not considered suitable for the issues facing YOPP.

10.2 Action: Take the list of variable names and keywords that the modelling centres are developing for the verification work, some will be standard and the ones that are not standard. Dr Barbara Casati, Dr Irina Sandu, Dr. Vasily Smolyanitsky and Dr Jørn Kristiansen to

provide the variable names and keywords to Dr Godøy and to Dr Siri Jodha S. Khalsa who will then consider making a submission to the NetCDF/CF to create new standard for those not covered in the existing NetCDF/CF standard.

10.2 Action: Dr Godøy to provide ICO with the “how to” documentation on metadata and data encoding.

10.2 Action: ICO to advise the YOPP-endorsed projects of the developments with the YOPP Data Portal, including page of keywords and other information from Dr Godøy regarding use of NetCDF/CF etc.

11. IASC-YOPP ACTIVITIES

11.1 IASC and YOPP (Allen Pope, International Arctic Science Committee, IASC)

Dr Allen Pope, Executive Secretary of the International Arctic Science Committee (IASC, see <https://iasc.info/>), gave an overview of the IASC and its Arctic-focused work. He noted that IASC has five working groups (terrestrial, atmosphere, marine, social and human, cryosphere) and the links to the work of YOPP and the PPP-SG activities.

11.2 General Discussion – YOPP Arctic Science Workshop

The PPP-SG noted that an Arctic YOPP Science Workshop will be held together with IASC and combined with the next PPP-SG meeting in Helsinki (14th-16th Jan 2019). The PPP-SG recognized that it could be very useful to also hold the next PPP-SERA meeting around the same time to improve interaction between the various IASC/PPP groups, in particular the PPP-SERA could potentially link with the IASC Human and Society WG.

The PPP-SG noted that the Principal Investigators (PI's) of YOPP-endorsed projects could be encouraged to attend to present abstracts to the Arctic YOPP Science Workshop. The auditorium can hold around 120 people. The current planning is based primarily on plenary sessions with some posters and possibly some breakout groups. The outcome(s) or theme for the workshop have not yet been really defined – perhaps it is a science update rather than working on defining specific problems. One suggestion put forward was to focus on “Latest Arctic observations and modelling efforts on time scales from hours to seasonal”. Other iterations included introducing the term “coupled” such as “Studies of coupled atmospheric, ocean, sea ice, and land processes will be addressed to share feedback on ...”).

Overall the PPP-SG recommended the workshop to focus on the YOPP Core Phase, the SOPs, and address the PPP-SERA issues. The following PPP-SG members offered to assist in the development of the programme and themes for the Arctic YOPP Science Workshop: Dr Jonathan Day, Dr Machiel Lamers.

11.2 Recommendation: The PPP-SG recommended to focus on the YOPP Core Phase, the SOPs and address the SERA issues. The following PPP-SG members offered to assist in the development of the program and themes for the Arctic YOPP Science Workshop: Dr Jonathan Day, Dr Machiel Lamers.

11.2 Action: PPP-SG members to contribute to the development of the second brochure for the YOPP Arctic Science Workshop that will include some Human and Social impacts.

12. YOPP SATELLITE COMPONENT: Overview, status quo and open issues

Dr Stephan Bojinski (WMO Secretariat) provided an online briefing to the PPP-SG on the work of the WMO Polar Space Task Group (PSTG). The thirteen space agencies involved in the PSTG have recently developed information for YOPP projects regarding the range of remotely sensed data and variables and access options for the space craft under their control (more information on PSTG at http://www.wmo.int/pages/prog/sat/pstg_en.php). The constellations include ESA's Aeolus mission.

Dr Bojinski raised two issues for consideration by the PPP-SG:

- Antarctic Synthetic Aperture Radar (SAR) hole – One of the major issues for the Antarctic is coverage by SAR as the instruments are usually right looking meaning there is a “hole” over the Antarctic making it difficult to get frequent coverage for certain parameters. The hole can be filled by reconfiguring the satellites but this takes time and resources. In response to this question the PPP-SG noted that the SAR data is primarily important for ice dynamics rather than YOPP objectives so the PPP-SG do not see the need to reconfigure orbits or missions in order to meet YOPP objectives.
- The need for special observations from PSTG to support field campaigns – The PPP-SG recalled that the Oden cruise will have cloud lidar on board, and this ground-truthing data may be of interest to the space agencies as well as satellite data being of interest to the researchers on board the Oden for operational purposes and subsequent write up. Dr Bojinski provided contact points in NOAA, EUMETSAT and China for use by YOPP-endorsed project managers interested in accessing near-real time data for field experiments. He also offered to advise the PSTG agencies about the cloud lidar data that would be available from the Oden and some of the supersites. The Calypso and Aeolus (due for launch at the end of August 2018) missions can provide information regarding blowing snow over the Antarctic and Arctic and the resultant atmospheric dynamic and thermodynamic processes. The space agencies may be interested in the supersite data for their own ground-truthing activities.

12.1 Decision: The PPP-SG considered whether the PSTG should be approached to fill in the SAR hole around the South Pole during the SOP for the Southern Hemisphere and decided no. As SAR is primarily for ice sheet dynamics, the PPP-SG considered that the aims of the YOPP would not be compromised by the SAR hole.

12.1 Observation: The organizers of the Oden expedition are interested in holding discussions with the German Aerospace Center (DLR) on the availability of TerraSAR-X for the cruise.

12.1 Request: Greg Smith/Paul Pestieau (ECCC) to provide the PPP-SG with the URL of the high-resolution SAR data that could be used to initialize sea-ice movement predictions.

12.1 Decision: ICO to contact the YOPP-endorsed projects to advise them that there is the potential for space-based data for their projects and that they should advise the ICO of their needs. The ICO to include information about the opportunities provided by the micro-satellites.

12.1 Decision: The ICO to provide the PSTG with a list of YOPP Supersites including location, instruments, data types and contact information for possible ground-truthing of the remotely sensed data.

13. YOPP SOUTHERN HEMISPHERE: Overview, status quo and open issues

Dr David Bromwich updated the PPP-SG on the YOPP activities planned for the Antarctic. Dr Bromwich noted that the Coordination committee includes representatives from Argentina, Australia, Brazil, Chile, Germany, Italy, Japan, New Zealand, Russia, UK, USA, the Southern Ocean Observing System (SOOS), the Southern Ocean Regional Panel (SORP) but no one from China. The first Antarctic SOP (SH-SOP1) is scheduled from 16th November 2018 to 15th February 2019. The next YOPP-SH planning meeting (YOPP-SH#3) is scheduled for 19th July 2018 in Madison, Wisconsin, USA (see <http://polarmet.osu.edu/YOPP-SH/>).

The YOPP-SH committee has been meeting via teleconference with a meeting held in February 2018 that looked at preliminary results from the:

- SOCRATES (Southern Ocean Clouds Radiation Aerosol Transport Experimental Study which just had run its six-week aircraft programme as funded by NSF from Hobart, Australia) and
- MARCUS (Measurements of Aerosols Radiation and Clouds over the Southern Oceans. MARCUS targets observations of clouds, aerosols, precipitation and radiation over the Southern Ocean (SO) and was run by the Australian Antarctic Division during the 2017/2018 SH summer resupply season) field experiments.

The next teleconference is scheduled for 27th March where SIPN-South, and PPP-SERA activities, among others, will be covered.

In terms of observations, Dr Bromwich was pleased to advise the PPP-SG that many additional radiosonde flights had been pledged for the SH-SOP and furthermore approximately 100 buoys were deployed last SH summer season with approximately another 100 this coming SH summer season.

Ocean developments. Deployments of ocean observation buoys will continue through the YOPP-SH SOP. ECMWF found that the observations at 55S, 90W made a big difference and thus the buoys will continue to be in place for the SH-SOP. This was a YOPP initiative and thus could be part of the OSEs/data denial experiments.

Real-time NWP

ECMWF – 9 km global forecast with 16 km coupled forecast and output and tendencies at supersites available for all Antarctic nations.

NCAR's Antarctic Mesoscale Prediction System (AMPS) is a regionally dedicated NWP system for Antarctica at 8 km horizontal resolution, the finest grid is in Western Ross Sea and Ross Ice Shelf at 0.9 km. Runs at 00 and 12 UTC for various durations and has data assimilation. Global access via AMPS website. Supersite output yet to be established. Bob Grumbine advised that it was possible to provide the supersite output but NCEP needed somewhere to send and archive the data. It would be possible to use this model for data denial and air sea interaction experiments.

MetOffice Nil report.

MétéoFrance – Perhaps near real time: ARPEGE stretched global grid centred over Antarctica. Limited area runs with AROME for Dome C/Concordia and Dumont D'Urville.

China – Polar version of WRF running over Antarctica in real time for katabatic wind studies and operational work. New station planned for Inaccessible Island.

Korea Polar WRF perhaps near real time in King George Island, Antarctic Peninsula area.

Chile – Perhaps near-real time: Polar WRF runs for the Antarctic Peninsula, southern Chile region.

Observing System Experiments (OSEs)

The AMPS team recently submitted a proposal to NSF with a focus on the YOPP-SH SOP. Observations from the SH-SOP will be used to evaluate their forecast impact in AMPS. This will be done by two data assimilation techniques in order to see which approach results in the greatest forecast improvement as a result of the extra observations during the SH-SOP.

The PPP-SG noted that problems arise in OSE when the nesting global models include the data that the limited area models are denying. NCEP has ideas to deal with this via reduced resolution paired data denial experiments which they prefer to run in real time. Timo Vihma (FMI) to be asked to advise on implications for OSEs where the nesting global model has the data but the regional model doesn't.

ECMWF considering doing an experiment to see where buoys should be placed, looking at regional. This is an ongoing exercise and related to YOPP but not part of YOPP (part of APPLICATE).

Japan and possibly Météo France will be running data denial experiments for the YOPP-SH SOP with their global models. Japan did data denial for the tropics last year and wishes to compare data sensitivity between the tropics and poles.

There is a need for the observation data to be organized in the same manner in the Antarctic as in the Arctic to allow verification and intermodal comparison. Someone from the supersites group to attend the meeting in Madison to encourage the SH countries operating supersites to organize their data in the same manner as the Arctic countries.

14. ICO MATTERS

14.1 Endorsements, KML-Layer; Next Priorities; Coordination

Dr Jung provided the PPP-SG an update on the status of the International Coordination Office (ICO), noting that changes in staffing have left the ICO short staffed at the present time. The main area of impact was with the google KML layer. The PPP-SG advised Dr Jung that it would be acceptable to temporarily halt new development on the KML layer until the staffing situation was resolved as long as maintenance activities were undertaken.

Dr Jung requested the PPP-SG to consider how long the YOPP endorsement period should continue for. ICO have a request for endorsement for aircraft observations and operations in the Antarctic in 2019 after the SH-SOP.

Workshop / meeting organization:

- YOPP side event POLAR2018 (19th June 2018) need people to assist (volunteers Øystein Godoy, David Bromwich, Siri Jodha S. Khalsa, and Ian Renfrew).
- Joint IASC Arctic YOPP workshop (14th-16th January 2019) needs people to help organize – (volunteers Jonathan Day, Machiel Lamers, Gunilla Svensson).

The PPP-SG thanked Dr Jung and the ICO team for their excellent leadership and support for YOPP activities.

14.1 Decision: PPP-SG decides that the endorsement process can continue past the YOPP Core Phase but results need to be included in the Consolidation Phase. Potentially conclude endorsements up to the end of 2021.

14.1 Decision: Add a miscellaneous section to the webpage (check).

14.1 Decision: Modelling plan table to be updated to include links to the observation data and additional modelling experiments.

14.2 Gender Equality

On behalf of the Chair of the PPP-SG, Dr Kirstin Werner from the ICO recalled that the Seventeenth session of the Commission for Atmospheric Sciences (CAS-17) incorporated the WMO Gender Action Plan into its activities. As PPP is one of the flagship projects of the WWRP, the PPP-SG are thus expected to:

- Promote the active role of female experts engaged in YOPP/PPP;
- Urge members to increase participation and involvement of women in research activities of YOPP/PPP;
- Ensure that communication materials/tools highlight gender issues, avoid gender bias and value the experience of women and men;
- Call for new approaches in the education and training of scientists, independent of their gender and nationality and in the development and dissemination of knowledge;
- Strengthen the capacity of young professionals, and especially young female professionals, in YOPP/PPP activities (e.g., the Polar Prediction School);
- Make an effort to increase gender balance in their working groups and expert teams; and,
- Keep considering, monitoring and questioning what is the obstruction for achieving gender equality within the community if necessary.

The PPP-SG accepted and endorsed the WMO Gender Plan as described in the CAS Gender Action Plan and requested that the ICO undertake the following actions in the coming months:

- Include the statement on the YOPP website;
- Update the wording in the statement to reflect the PPP governance structure of task teams and Steering Group;
- Set times for teleconferences to predictable working times (no weekends, holidays and avoiding common vacation time);
- Organize meetings during weekdays (including travelling);
- Gender-neutral language on website, newsletter, email list etc.;
- Promote gender balance in communication to encourage YOPP-related projects and partners to implement gender equality in their activities;
- Increase the number of female members in PPP Steering Group to at least a (WMO-recommended) minimum of 30% (currently 20%);
- Pay attention to gender equality in YOPP education activities such as the 2018 Polar Prediction School:
 - students: 11 females (37%), 19 male
 - lecturers: 6 females (42%), 8 male

Following PPP-SG 09, the Gender Action Statement was further updated to acknowledge that some people do not align with either male or female gender models. The updated statement can be found at <http://www.polarprediction.net/background/pppyopp-statement-on-gender-equality/>.

14.2 *Decision*: Accept, adopt and implement the WMO Gender Action Plan.

15. YOPP OUTREACH, COMMUNICATION AND EDUCATION: Overview, status quo and open issues

Dr Kirstin Werner from the ICO briefed the PPP/SG on the outreach and communication activities undertaken since PPP-SG08. It has been a very successful year with the launch of the YOPP (nearly 60k impressions on Twitter in a 90 day period), the launch of the blog Polar Prediction Matters blog in September 2017 with something like 150 visits per day over a six month period (<http://blogs.helmholtz.de/polarpredictionmatters/>) and the commencement of the first NH-SOP on 1st February 2018 (more than 84k impressions in February). All of these have attracted attention in the standard media as well as social media such as Facebook and Twitter. The PPP-SG noted the media statistics were good. The PPP-SG noted their pleasure with the joint ICO/WMO animation on YOPP (<https://www.youtube.com/watch?v=fMKo5zlzx9A>).

Mailing list: 630 subscriptions

Twitter: 752 followers (up from 169 followers in May 2016)

Media entries mentioning YOPP:

- before launch 76 entries;
- with regards to YOPP launch (14 May to 30 June) 164 entries
- since 30th June 2017: 18 entries

In the discussion on this agenda item the following suggestions arose:

- The ICO examine the option of posting YOPP-related photographs to Instagram. Stella Melo offered to forward suggestions for hashtags.
- To minimize the workload associated with posting to social media, the ICO could examine options to use software that supports posts to Twitter, Instagram and Facebook.
- ICO to examine the option of making better use of the communication channels of the weather services as they have close contacts with stakeholders and end users.
- Suggest that Dr Werner includes an article in the PolarPredictNews advising readers what promotional material is available for people to use. Dr Werner could also send around the group photo from this session stating it is for promotional purposes and provide some suggested text.
- If something like the dramatic warming event observed in the Arctic in February 2018 happens again see if we could take advantage of it to promote YOPP.
- PPP-SG members to advise the ICO when like-minded groups make posts on polar matters, then the ICO can take advantage of these posts by responding to them and thus gain a bigger audience for YOPP.
- PPP-SG members to examine options to engage someone from the science blogger/ radio show to do a show on YOPP. The animation may provide a gateway into that group of presenters.
- ICO to prepare posts at the end of SOPs' to summarize activities, thank people and groups.
- Start planning the media campaign for the Consolidation Phase including the use wrap ups from seasonal forecasts and events where statements are sought from PPP-SG members.

The ICO would like PPP-SERA assistance to develop short versions of polarpredictionmatters topics suitable for tweets. Machiel Lamers also noted PPP-SERA were interested in developing case studies of end users and how social media is being used to promote YOPP.

Education and Outreach – Jonathan Day
Abisko Polar Prediction School 2018 (Lapland)

The 2018 Polar Prediction School is planned for the Swedish research station at Abisko in Lapland/Sweden from 17th to 27th April 2018. The school will have 30 students and it builds upon the very successful course held in 2016. This end-to-end programme on polar prediction (from observations to uses of forecasts) is sponsored by H2020 APPLICATE, WWRP-PPP, IASC, CliC, and SCAR. Many of the lecturers from 2016 are back again. See BAMS article from 2017 <https://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-16-0119.1>.

The PPP-SG encouraged Dr Day to stay on as the lead on YOPP Education for the next twelve months. One of the main tasks for the Education Task Team will be to prepare for the next school in 2021. The PPP-SG noted that PPP-SERA would like to see some more of the social science aspects in the programme that could include interacting with the local inhabitants. The PPP-SG were advised that there are initiatives in Canada to involve first-nation people in schools and YOPP may benefit from such an approach. The PPP-SG would like to engage with early career indigenous scientists. The next education lead would be encouraged to take this into account when refining the program and the next Polar Prediction School.

15.1 Recommendation: For the Polar Prediction School and other upcoming PPP activities, PPP-SERA recommends to put increased focus on social science aspects within YOPP/PPP, e.g., initiatives in Canada to involve first-nation people in schools and early career indigenous scientists.

16. STEERING GROUP MATTERS – CLOSED SESSION

16.1 Budget

The PPP-SG recalled that the notional budget for PPP is of the order of 100 to 120k CHF/annually for the next three years. This budget is to support costs for the PPP-SG, PPP-SERA, consultancies as well as funding for activities agreed during PPP-SG sessions. The PPP-SG agreed that no decisions were required at this stage.

16.2 Membership

The PPP-SG reviewed its membership noting that:

- Jackie Dawson from PPP-SERA would like to step down due to other duties. PPP-SG recommended that Machiel Lamers takes over from Jackie Dawson.
- Peter Bauer (ECMWF) wants to step down and suggested that Irina Sandu takes over from him. PPP-SG recommended that Irina Sandu takes over from Peter Bauer.
- Chris Fairall from NOAA research has stepped down. PPP-SG recommended Janet Intriери takes over providing a good interface into MOSAiC.

The Chair of the PPP-SG recalled that Dr Sarah Jones, Chair of the WWRP Steering Group, would make the final decision on membership.

16.2 Decision:

- Jackie Dawson from PPP-SERA would like to step down due to other duties. PPP-SG recommended that Machiel Lamers takes over from Jackie Dawson.
- Peter Bauer (ECMWF) wants to step down and suggested that Irina Sandu takes over from him. PPP-SG recommended that Irina Sandu takes over from Peter Bauer.
- Chris Fairall from NOAA research has stepped down. PPP-SG recommended Janet Intriери takes over providing a good interface into MOSAiC.

17. WRAP-UP, NEXT STEPS AND CLOSING

17.1 Wrap-up and Next Steps

The PPP-SG reviewed the draft actions, decisions and recommendations made during this session and requested that the ICO and Dr Ruti advise the EC-PHORS of the decisions and recommendations of this session.

17.2 Closure

Dr Jung thanked Dr Arni Snorrason for hosting this session in Iceland and the generous support he and his staff had provided to the smooth running of the session. Dr Jung further thanked all members and observers for attending this session and contributing to the discussions in a collegiate and constructive manner. Dr Jung reminded the PPP-SG that the next session was tentatively planned for Finland in January 2019 in conjunction with the IASC/YOPP Arctic Science Workshop.

Dr Snorrason thanked the PPP-SG for holding this session in Iceland and for their interesting and constructive discussions. Dr Snorrason looked forward to helping the EC-PHORS group consider the recommendations the PPP-SG had made for them during this session.

Dr Jung wished everyone a safe trip home and closed the session at 1100 on Thursday 16th March.

Annex I- Meeting Agenda

WWRP POLAR PREDICTION PROJECT (WWRP- PPP)
NINTH PPP STEERING GROUP MEETING (PPP- SG9)
13 -15 MARCH 2018
ICELANDIC MET OFFICE (IMO)

ICELAND

Agenda

TUESDAY, 13 MARCH	[0830-1800]
SESSION 1: OPENING OF PPP-SG9	[0830-0845]
Welcome and Purpose of the Meeting (Thomas Jung, AWI)	[0830-0835]
Adoption of the Agenda (Thomas Jung, AWI)	[0835-0840]
Working Arrangements (Ami Snorrason, IMO)	[0840-0845]
SESSION 2: STATUS OF WWRP AND WCRP-CLIC	[0845-0915]
Update on WWRP Developments (Paolo Ruti, WMO WWRP)	[0845-0900]
Update on WCRP-CLiC Development (<i>remote</i> : Lawrence Hislop, WMO WCRP-CLiC)	[0900-0915]
SESSION 3: MOSAIC AND LINK TO PPP	[0915-0945]
The Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAIC) and the potential SOP-NH3 (Anja Sommerfeld, AWI)	[0915-0925]
Discussion	[0925-0945]
GROUP PHOTO, COFFEE BREAK AND NETWORKING	
SESSION 4: YOPP SUPERSITES AND VERIFICATION	[1015-1100]
Overview (Gunilla Svensson, Stockholm University)	
Discussion	
SESSION 5: YOPP MODELLING	[1100-1230]
Overview, status quo and open issues (Thomas Jung, AWI)	
Canadian Contributions to YOPP Modelling (Paul Pestieau, ECCC)	
Discussion	
LUNCH	[1230-1330]
SESSION 6: ARCTIC OBSERVATIONS	[1330-1445]
Overview, status quo and open issues (Thomas Jung, AWI)	
Canadian Contributions to YOPP Observations (Paul Pestieau, ECCC)	
Collaboration with EUMETNET (Sabine Hafner, DWD)	
Arctic Buoy Component (Don Perovich)	
Discussion	
COFFEE BREAK	[1600-1630]
SESSION 7: YOPP SERA AND VERIFICATION	[1630-1745]
YOPP SERA - Overview, status quo and open issues (Machiel Lamers,	

University of Wageningen)

Verification - Overview, status quo and open issues (Barbara Casati, ECCC)

Discussion

SESSION 8: YOPP CONSOLIDATION PHASE I

[1745-1830]

Discussion of Priorities during YOPP Consolidation Phase based on SOPs (led by Thomas Jung, AWI)

- YOPP Consolidation Plan

WEDNESDAY, 14 MARCH

[0830-1815]

SESSION 9: YOPP CONSOLIDATION PHASE II

[0830-1030]

Discussion of Priorities during YOPP Consolidation Phase based on SOPs (led by Thomas Jung, AWI)

- YOPP Consolidation Plan

COFFEE BREAK

[1030-1045]

SESSION 10: YOPP DATA COMPONENT

[1045-1215]

Overview, status quo and open issues (Oystein God0y, MET Norway)

[1045-1055]

Discussion

[1055-1215]

- Data sharing/Coordination YOPP Supersites

SESSION 11: IASC-YOPP ACTIVITIES

[1215-1300]

IASC and YOPP (Allen Pope, IASC)

[1215-1225]

General Discussion

[1225-1300]

- YOPP Arctic Science Workshop

LUNCH

[1300-1400]

12. SESSION 12: YOPP SATELLITE COMPONENT

[1400-1530]

Overview, status quo and open issues (Thomas Jung, AWI/
remote: Stephan Bojinski, WMO/PSTG secretary)

[1400-1410]

Discussion

- Evaluation/Validation of ADM Aeolus

[1410-1530]

13. SESSION 13: YOPP SOUTHERN HEMISPHERE

[1545-1715]

Overview, status quo and open issues (David Bromwich, BPCRC)

[1545-1555]

Discussion

[1555-1715]

SESSION 14: ICO MATTERS

[1715-1800]

14.1 Endorsements, KML-Layer; Next Priorities; Coordination

[1715-1745]

General Discussion

[1745-1800]

THURSDAY, 15 MAR [0830-1130]

SESSION 15: YOPP OUTREACH, COMMUNICATION, AND EDUCATION

[0830-1000]

Overview, status quo and open issues (Kirstin Werner, AWI;
Jonathan Day, ECMWF)

[0830-0845]

Discussion

[0845-1000]

COFFEE BREAK

[1000-1015]

16. STEERING GROUP MATTERS - CLOSED SESSION	[1015-1115]
Budget	[1015-1030]
Gender Equality (Thomas Jung, AWI)	[1030-1100]
Membership	[1100-1115]

17. WRAP-UP, NEXT STEPS AND CLOSING (THOMAS JUNG, AWI)	[1115-1145]
Wrap-up and Next Steps	[1115-1140]
Closure	[1140-1145]

LUNCH BREAK (optional)

Annex II – PPP-SG09 participants

PPP-SG members

Thomas Jung (Chair) - AWI
David Bromwich - University of Ohio
Barbara Casati - Environment and Climate Change Canada
Matthieu Chevallier - MétéoFrance
Jonnathan Day - ECMWF
Robert Grumbine - NOAA
Jun Inoue - NIPR
Siri Jodha S. Khalsa - NSIDC
Steffen Malskaer Olsen – Danish Met Institute
Donald Perovich - Dartmouth College
Ian Renfrew – University of East Anglia
Gregory Smith - Environment and Climate Change Canada
Vasily Smolyanitsky – Arctic and Antarctic Research Institute, Russian Federation.
Gunilla Svensson – University of Stockholm
Mikhail Tolstykh - Hydrometcentre of Russia

Invited Experts

Øystein Godoy -Met Norway
Sabine Hafner - DWD
Janet Intrieri - NOAA
Machiel Lamers - University of Wageningen
Stella Melo – Environment and Climate Change Canada
Paul Pestieau – Environment and Climate Change Canada
Allen Pope - IASC
Qizhen Sun - NMEFC
Irina Sandu - ECMWF
Arni Snorrason – Icelandic Met Office
Anja Sommerfeld - AWI

ICO and WMO Secretariat

Paolo Ruti - WMO
Helge Goessling – AWI/ICO
Kirstin Werner – AWI/ICO

Jeff Wilson – WMO Consultant

Annex III – Decisions and actions from PPP-SG09

2.2 Request: Dr Jung requested Dr Hislop to provide the ICO with information on how the CASIWG went about combining the sea-ice observations with model data as the processes for the CliC climate data should be similar to the weather data being examined under PPP.

3.1 Decision: To hold a third NH-SOP in February/March 2020 to complement the MOSAiC field study and provide an opportunity to contrast with the NH-SOP1 in 2018.

3.1 Recommendation: MOSAiC community to investigate how to access and use products from a number of operational NWP/sea-ice centres for operational planning and later use in the YOPP Consolidation Phase.

3.2 Recommendation: PPP-SERA to liaise with the MOSAiC planning team for possible involvement of social scientists.

4.1 Recommendation: Use the Oden experiment to test the relevance and utility of the moving supersites concept and then pre-MOSAiC experiment and then MOSAiC. Send operational forecast data in grid point form to RV Polarstern for use during the MOSAiC campaign if feasible.

5.4 Recommendation to EC-PHORS: The PPP-SG considers that there is a serious risk that the global community will not be able to take the full benefit of the YOPP work unless the long-term sustainability of the data archives is urgently addressed. This is a problem for all research projects but particularly for YOPP due to the data volumes in the short term.

5.4 Request: That the PPP-SERA Task Team considers potential downstream users and uses of the data archive and provides the PPP-SG with information on how these groups could be targeted to access and use the datasets.

5.4 Action: ICO develops a slide deck and brochure showing what is available for the spectrum of users and can be promoted to the wider community.

5.4 Recommendation: The PPP-SG recommends that the data sets for the Southern Hemisphere should ideally be the same as that proposed for the Arctic, but if this is not possible temporal and spatial resolution should be sufficient to elaborate the key processes identified for the Southern Hemisphere in the YOPP Modelling Plan.

5.4 Action: The ICO establishes a list of additional observations that are YOPP specific so we know what has been added to operational forecasting as a result of YOPP. These include buoys, probably based on numbers two seasons ago (baseline).

5.4 Action: The NWP Centres to advise the ICO if they are looking at doing denial of observation experiments, or observations system design. The Eastern Arctic is one area that could be targeted for buoys by denying the “Russian buoys”.

6.3 Action: As part of the YOPP Consolidation, PPP-SG and ICO to provide feedback to donors (EUMETNET and member states) about the utility of the additional flights and buoys.

6.3 Action: ICO to advise the community when buoys have been deployed to ensure that their data is flowing into the NWP centres.

6.4 Action: The YOPP Buoy Task Team be requested to update the list of possible deployment

missions showing name of mission, contact officers, when commencing and where mission will sail from.

6.4 Action: Greg Smith to advise the ICO how the temperature measurements from the ice mass balance buoys can be included in the GTS.

6.5 Statement: The PPP-SG encourages the deployment of specialist ice/ocean data buoys to better understand ice/ocean processes and for use in verification during the YOPP Consolidation Phase.

6.5 Action: ICO to be updated on deployments and deployment opportunities and they will distribute the information widely amongst the polar prediction community including the NWP community.

6.5 Action: ICO to circulate a request to organizers of field campaigns (tour ships??) and other groups seeking information about possible buoy deployments in open water in the Arctic during SOP2.

6.5 Decision: PPP-SG decides that for the NH-SOP2, EUMETNET continues the additional one flight/day for the SOP1 sites and uses the additional thirty sondes for Aasiaat (West Greenland).

6.5 Decision: PPP-SG decides:

- About a third NH Special Observation Period (NH-SOP3) to support MOSAiC during NH winter 2019/2020 with same timing as NH-SOP1 (February/March).
- Planning for NH-SOP3 includes lessons learnt from NH-SOP1 and NH-SOP2.
- To request Dr Ruti to ask EC-PHORS for advice on how to get support from WMO Member States for a third SOP in the NH.
- ICO and PPP-SG members to informally contact national services and institutes regarding a possible third NH-SOP so they can commence to include in their planning.

6.5 Request: PPP-SG requests ECMWF to provide feedback from the next ECMWF ODRD meeting (quarterly internal meetings where ECMWF research and operations department reviews prediction performance of past season) on whether there was any impact on skill from the additional observations/radiosondes during NH-SOP1.

6.5 Observation: PPP-SG takes note of Dr Jun Inoue's suggestion of identifying coverage of open water buoys and buoys in marginal sea ice zone in the verification/Consolidation Phase.

7.1 Action: ICO to consider options for aligning the next PPP-SERA meeting with the next PPP-SG scheduled for Finland in Jan 2019.

7.1 Action: The PPP-SERA Task Team is invited to provide feedback to the YOPP Data Portal group with regards to the user friendliness of the user interface for the various user communities PPP-SERA have identified.

7.1 Action: PPP-SERA to identify what sort of future support they need and for what sort of activities and report back to the ICO/PPP-SG.

7.1 Action: How can the ICO support the PPP-SERA meeting in April 2018 by promoting the virtues of the YOPP dataset and Data Portal?

7.2 Action: ALL task team leaders to advise ICO of the team members names so the ICO can

update the website.

7.2 Action: ICO to identify data sets that do not have a sustainable medium to long-term home so the YOPP Data Portal team is aware of new datasets or datasets in danger of being lost.

8.1 Decision: Only one synthesis document for the Consolidation Phase blending the work of the PPP-SERA with the other task teams. The reports from the various groups should include reference to how innovations have enabled integration of new observations into the modelling systems.

8.1 Decision: PPP-SG to provide ICO with input to develop a standard acknowledgement that can be included with each dataset to help with traceability of YOPP projects. If the datasets have a Digital Object Identifier (DOI) this could be linked to the acknowledgement.

8.1 Decision: ICO to include an area on the website where people can upload links to their YOPP papers.

8.1 Decision: In 2022, a YOPP/MOSAIc combined workshop will be required to blend the large scale (YOPP) with the fine scale from MOSAIc.

8.1 Decision: Start with dedicated and focused workshops and then broaden into a YOPP Synthesis summit (2022).

8.1 Decision: To run a YOPP session at each EGU for the period 2020 to 2022 and look for options for open sessions at other major conferences. Also look at POLAR2020. The ICO to investigate the opportunity to hold the Synthesis Summit in Canada in 2022 to acknowledge the support Canada has provided to PPP. Include the SERA weather and society theme in the Synthesis Summit (co-design one central theme).

8.1 Decision: PPP-SG to create a Working Group to look after an observing system design workshop before SOP3. PPP-SG to identify two co-chairs, one from a modeling perspective (OSSE) and another from the observation system background.

8.1 Decision: The Chair of the PPP-SG to advise the editor of Tellus A (open access) that in principle the PPP-SG is interested in a special Tellus A edition summarising YOPP and its outcomes.

8.1 Decision: The PPP-SG are appreciative and supportive of Greg Smith, Matthieu Chevallier and Steffen Olsen offering to submit a YOPP proposal to OCEANOBS'19 conference.

10.2 Action: Take the list of variable names and keywords that the modeling centres are developing for the verification work, some will be standard and the ones that are not standard. Dr Barbara Casati, Dr Irina Sandu, Dr. Vasily Smolyanitsky and Dr Jørn Kristiansen to provide the variable names and keywords to Dr Godøy and to Dr Siri Jodha S. Khalsa who will then consider making a submission to the NetCDF/CF to create new standard for those not covered in the existing NetCDF/CF standard.

10.2 Action: Dr Godoy to provide ICO with the "how to" documentation on metadata and data encoding.

10.2 Action: ICO to advise the YOPP endorsed projects of the developments with the YOPP data portal, including page of keywords and other information from Oystein regarding use of NetCDF/CF etc.

11.2 Recommendation: The PPP-SG recommended to focus on the YOPP Core Phase, the SOPs and address the SERA issues. The following PPP-SG members offered to assist in the development of the program and themes for the Arctic YOPP Science Workshop: Dr Jonathan Day, Dr Machiel Lamers.

11.2 Action: PPP-SG members to contribute to the development of the second brochure for the YOPP Arctic Science Workshop that will include some Human and Social impacts.

12.1 Decision: The PPP-SG considered whether the PSTG should be approached to fill in the SAR hole around the South Pole during the SOP for the Southern Hemisphere and decided no. As SAR is primarily for ice sheet dynamics, the PPP-SG considered that the aims of the YOPP would not be compromised by the SAR hole.

12.1 Observation: The organizers of the Oden expedition are interested in holding discussions with DLR on the availability of TerraSAR-X for the cruise.

12.1 Request: Greg Smith/Paul Pestieau (ECCC) to provide the PPP-SG with the URL of the high-resolution SAR data that could be used to initialize sea-ice movement predictions.

12.1 Decision: ICO to contact the YOPP-endorsed projects to advise them that there is the potential for space-based data for their projects and that they should advise the ICO of their needs. The ICO to include information about the opportunities provided by the micro-satellites.

12.1 Decision: The ICO to provide the PSTG a list of YOPP supersites including location, instruments, data types and contact information for possible ground-truthing of the remotely sensed data.

14.1 Decision: PPP-SG decides that the endorsement process can continue past the YOPP Core Phase but results need to be included in the Consolidation Phase. Potentially conclude endorsements up to the end of 2021.

14.1 Decision: add a miscellaneous section to the webpage (check)

14.1 Decision: Modelling plan table to be updated to include links to the observation data and additional modelling experiments.

14.2 Decision: Accept, adopt and implement the WMO Gender Action Plan

15.1 Recommendation: For the Polar Prediction School and other upcoming PPP activities, PPP-SERA recommends to put increased focus on social science aspects within YOPP/PPP, e.g., initiatives in Canada to involve first-nation people in schools and early career indigenous scientists.

16.2 Decision:

- Jackie Dawson from PPP-SERA would like to step down due to other duties. PPP-SG recommended that Machiel Lamers takes over from Jackie Dawson.
- Peter Bauer (ECMWF) wants to step down and suggested that Irina Sandu takes over from him. PPP-SG recommended that Irina Sandu takes over from Peter Bauer.
- Chris Fairall from NOAA research has stepped down. PPP-SG recommended Janet Intriери takes over providing a good interface into MOSAiC.

