

# WWRP POLAR PREDICTION PROJECT (WWRP-PPP)

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## TENTH PPP STEERING GROUP MEETING (PPP-SG10)

16-18 JANUARY 2019

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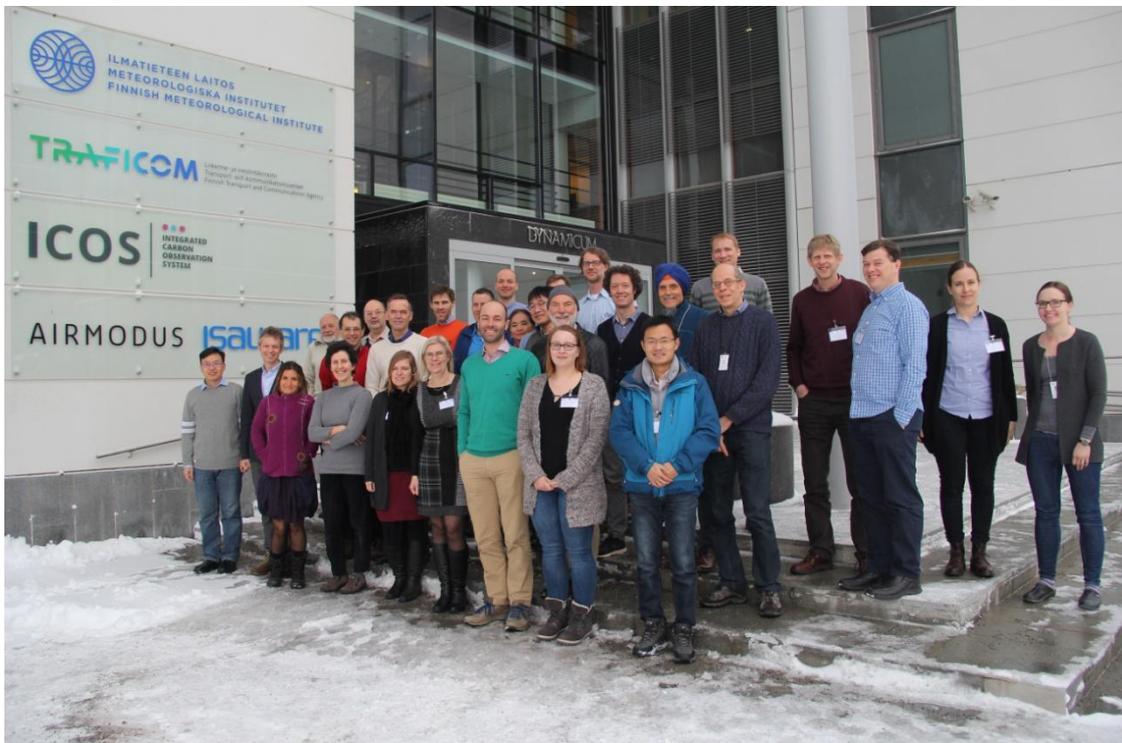


Photo: Kati Johansson (FMI)

**Back row (L-R):** Alexander Makshtas, Mikhail Tolstykh, Jørn Kristiansen, Helge Goessling, Jonny Day, Matt Shupe, Daryl Kleist, John Methven, Irene Suomi, Tiina Nygård

**Middle Row (L-R):** Eric Bazile, Helge Tangen, Steffen M. Olsen, Nanette Lomarda, Jun Inoue, Jeff Wilson, Machiel Lamers, Siri Jodha S. Khalsa, Timo Vihma, Greg Smith

**Front row (L-R):** Qinghua Yang, Ian Renfrew, Irina Sandu, Barbara Casati, Kirstin Werner, Gunilla Svensson, Thomas Spengler, Katharina Kirchhoff, Qizhen Sun



Executive Summary.....	5
1. OPENING OF PPP-SG10.....	7
1.1 Welcome.....	7
1.2 Purpose of the Meeting & Adoption of the Agenda .....	7
1.3 Working Arrangements .....	7
2. WRAP-UP OF YOPP ARCTIC SCIENCE WORKSHOP .....	7
2.1 Review of progress reported at the YOPP Arctic Science Workshop .....	7
3. UPDATE ON WWRP DEVELOPMENTS.....	8
3.1 Recent Developments in WWRP .....	8
3.2 Discussion .....	10
4. INTRODUCTION TO YOPP CONSOLIDATION PHASE PLAN .....	11
4.1 YOPP Consolidation Phase Plan.....	11
4.2 Discussion .....	11
5. CONSOLIDATING YOPP Research - I.....	11
5.1 Observing System Experiments .....	11
5.1.1 Challenges and Design of Future Observing Systems .....	11
5.1.2 General Discussion.....	12
5.2 From Process Understanding to Enhanced Models .....	13
5.2.1 MOSAIC – Understanding Polar Dynamics and Physical Processes .....	13
5.2.2 General Discussion.....	14
5.3 YOPP – SH Special Observing Period .....	14
5.3.1 General Discussion.....	15
6. CONSOLIDATING YOPP RESEARCH – II.....	16
6.1 Forecasting System Development and Merged Observatory Data Files.....	16
6.1.1 The YOPP Supersite Model Intercomparison Project .....	16
6.1.2 Comparison of Observational Data Sets for YOPPSiteMIP .....	17
6.1.3 General Discussions .....	18
6.2 Polar – Lower Latitude Linkages .....	18
6.3 YOPP Reanalysis.....	19
6.4 Verification .....	19
6.4.1 Plans for the YOPP Consolidation Phase.....	19
6.4.2 Discussion .....	21
6.5 SERA – Special Services Period Projects .....	22
6.5.1 Plans for the YOPP Consolidation Phase.....	22
6.5.2 Discussion .....	22
6.6 Data Publishing .....	22
6.7 Conferences and Workshops.....	23
6.8 Scientific Publications.....	23
7. FROM RESEARCH TO OPERATIONS AND SERVICES .....	24
7.1 Community Building .....	24

7.2	Recommendations for Observing Systems.....	24
7.3	Operational Implementation.....	24
7.4	From Operations to Services .....	24
7.5	Conferences and Workshops.....	25
7.6	Publications .....	25
8.	PREPARING THE YOPP LEGACY .....	25
9.	DETERMINING SUCCESS OF YOPP.....	26
9.1	Quantitative Success Measures.....	27
9.2	Qualitative Success Measures .....	27
10.	YOPP EDUCATION, OUTREACH AND COMMUNICATION .....	28
10.1	Education.....	28
10.2	Communication and Outreach .....	29
10.3	General Discussion .....	30
11.	COORDINATION .....	31
11.1	Elements of Coordination.....	31
11.2	Revised Elements.....	31
12.	STEERING GROUP MATTERS (CLOSED).....	32
12.1	Budget .....	32
12.2	Membership .....	32
13.	WRAP UP, NEXT STEPS AND CLOSING.....	32
13.1	Wrap-up and Next Steps .....	32
13.2	Closure.....	32
	Annex I – Meeting Agenda .....	34
	Annex II – PPP-SG10 participants.....	37
	Annex III – Decisions and actions from PPP-SG10.....	39
	Annex IV - Proposed Task Teams .....	44
	Annex V – Recommendations from the YOPP Arctic Science Workshop .....	46
	Annex VI –Glossary.....	48

## Executive Summary

The tenth session of the Polar Prediction Project Steering Group (PPP-SG) took place in Helsinki, Finland, at the headquarters of the Finnish Meteorological Institute (FMI) from Wednesday 16<sup>th</sup> January to Friday 18<sup>th</sup> January 2019. This session specifically focused upon refining the plan for the YOPP Consolidation Phase, developing plans for the third Special Observing Period for the Northern Hemisphere (SOP3-NH) as well as general coordination and administrative matters.

The updated plan for the YOPP Consolidation Phase (1 July 2019 to late 2022) will be subsequently incorporated into a third version of the “*WWRP Polar Prediction Project Implementation Plan for the Year of Polar Prediction (YOPP)*” which is expected to be completed prior to the 18<sup>th</sup> World Meteorological Congress in Geneva in June 2019. The new draft plan for the YOPP Consolidation Phase builds upon the original plan identifying the key research, operations and service activities that will need to be carried out over the four years of consolidation as well as a range of metrics that will be used to determine the success of YOPP prior to, and following, late 2022. The PPP-SG agreed on a new working structure to better fit the activities foreseen for the next four years. This new structure will be reflected in the revised plan.

Noting some of the preliminary outcomes from the first Special Observing Period in the Arctic (SOP1-NH; 1 February to 31 March 2018), the PPP-SG agreed that the focus for SOP3-NH (1 February to 31 March 2020), which is being held in conjunction with the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition, would be different to that of SOP1-NH and SOP2-NH (1 July to 30 September 2018). Whereas SOP1-NH and SOP2-NH focused upon increasing the regular observation and prediction of environmental values over the pan-Arctic domain for a specific period of time, SOP3-NH would focus upon major cold air excursions from the Arctic into the mid latitudes and warm air intrusions (along with their transformation) from the mid latitudes into the Arctic region. The SOP3-NH focus would be on observing and predicting the air mass transformations and better understanding the grid and sub-grid scale processes involved in the transformations. The PPP-SG further agreed that given the focus on transient phenomena, the duration of SOP3-NH may increase, noting that this would not necessarily imply an increase in the overall number of observations as there would be lengthy periods requiring only the standard observation frequency and locations. A new YOPP Processes Task Team was established to oversee the refining and implementation of the SOP3-NH plan as well as continue work with the YOPPsiteMIP data.

The PPP-SG10 session provided an opportunity for coordination with the Chairs of the WWRP Working Groups DAOS (Data Assimilation and Observing Systems) and PDEF (Predictability, Dynamics and Ensemble Forecasting) identifying some common areas of interest that will be further explored during their Joint Session tentatively scheduled for Melbourne, Australia in May 2019. PPP-SG10 also provided an extended opportunity for the PPP-SG to meet with one of the coordinators of the MOSAiC Project and identify the three top YOPP priorities (mixed phase clouds, boundary layer mixing, and surface energy budget) for MOSAiC observations and prediction activities.

In looking forward to the next, and last four, years of the Polar Prediction Project, the PPP-SG noted the uncertainty in the funding base, particularly given the enhanced number of workshops and conferences that will be required to deliver the PPP outcomes. The PPP-SG requested the chair of PPP-SG, Dr Thomas Jung, to bring this matter to the attention of the next EC-PHORS meeting in late March 2019.

The PPP-SG also reviewed and modified its working structure to better meet the needs of the next four years. The following Task Teams were established/confirmed during the meeting with leaders and key activities to be confirmed prior to the March 2019 EC-PHORS meeting: Sea-ice Prediction; Numerical Experimentation; YOPP Verification; Processes; Southern Hemisphere; PPP-SERA; YOPP Data; Communications, Outreach and Education; YOPP Final Summit; and, YOPP Evaluation (see Annex IV for further details). Annex III contains a summary of the key actions identified during the session.

The PPP-SG Chair noted that whilst this session was affected by the absence of some PPP-SG members due to the US Government shutdown, and that he had to chair remotely due to personal circumstances, the meeting had been very productive. Dr Jung thanked the Finnish Meteorological Institute for their excellent support to the logistics and conduct of the meeting.

PPP-SG11: tentatively scheduled for Bremen/Bremerhaven, Germany, 17-21 February 2020.

PPP-SG12: tentatively scheduled for Zhuhai City, China in early 2021.

PPP-SG13: to precede YOPP Final Summit tentatively scheduled for Montréal, Canada in the Northern Hemisphere summer of 2022.

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## **1. OPENING OF PPP-SG10**

### **1.1 Welcome**

Dr Thomas Jung (Chair of the PPP-SG) opened the session at 1400 and welcomed all members and invitees to the tenth meeting of the PPP-SG. Dr Jung thanked the Finnish Meteorological Institute (FMI), Dr Timo Vihma and his colleagues for their kind offer to host this meeting and for their arrangements for this session as well as for the preceding YOPP Arctic Science Workshop.

Dr Vihma welcomed participants to FMI and Finland and hoped that they would enjoy their stay and benefit from the discussions in the meeting.

Mrs Nanette Lomarda from the WMO Secretariat conveyed the best wishes of the WMO Secretary-General to the participants and his wishes for a successful session. Mrs Lomarda also conveyed the wishes from Dr Ruti who supported the PPP-SG for many years. Mrs Lomarda advised the PPP-SG that she was looking forward to working with the PPP-SG and Polar Community in furthering the work of the Polar Prediction Project.

### **1.2 Purpose of the Meeting & Adoption of the Agenda**

The Chair advised the PPP-SG that this session would focus on refining the plan for the YOPP Consolidation Phase and developing the plan for the third Northern Hemisphere Special Observing Period (SOP3-NH) as well as preliminary updates on the outcomes from SOP1-NH and the usual SG administrative matters. The Chair recalled that the draft agenda for this session had been circulated to all members prior to the session. The Chair asked if there were any changes or adjustments to the agenda, receiving no changes he adopted the Agenda as circulated (see Annex I).

### **1.3 Working Arrangements**

The PPP-SG agreed that the usual working arrangements of working in plenary with breaks as per the agenda or as required would apply. Dr Jung apologized that he could not attend in person and hoped that chairing remotely would be practical.

## **2. WRAP-UP OF YOPP ARCTIC SCIENCE WORKSHOP**

### **2.1 Review of progress reported at the YOPP Arctic Science Workshop**

Dr Thomas Spengler (IASC representative) reviewed the outcomes from the YOPP Arctic Science Workshop that preceded this tenth session of the PPP-SG (PPP-SG#10). Dr Spengler advised the PPP-SG that the workshop consisted of presentations, posters and breakout groups. The presentations covered a wide range of topics centered on Arctic meteorological or sea-ice topics including preliminary outcomes from SOP1-NH.

Dr Spengler noted that many of the recommendations from the workshop (Annex V) were relevant to PPP-SG#10. The PPP-SG were surprised by the lack of awareness of YOPP and the YOPP Data Portal by a significant number of the workshop participants despite the excellent work undertaken by the International Coordination Office for Polar Prediction (ICO) and many of the PPP-SG members in promoting YOPP and the YOPP Data Portal. The PPP-SG encouraged the workshop organizers to investigate this further when providing the workshop participants written feedback on the recommendations and actionable items.

The PPP-SG Chair thanked Dr Spengler for his report and encouraged the PPP-SG to consider the YOPP Arctic Science Workshop recommendations under the appropriate agenda items.

### 3. UPDATE ON WWRP DEVELOPMENTS

#### 3.1 Recent Developments in WWRP

Mrs Nanette Lomarda (Senior Scientific Officer WWRP, WMO Secretariat) briefed the PPP-SG on developments within the WWRP and WMO in general. Mrs Lomarda noted that WWRP was structured around the concept of Working Groups and Core Projects.

Mrs Lomarda recalled that the WWRP Working Groups are: Tropical Meteorology; Weather Modification; Nowcasting and Mesoscale; Verification; Numerical Experimentation; Predictability, Dynamics and Ensemble Forecasting; and, Data Assimilation and Observing Systems. She further recalled that the WWRP Core Projects are Polar Prediction, Sub-seasonal To Seasonal Prediction; High Impact Weather; Sand and Dust Storm, with Aviation Research soon to be added as a fifth core project. Mrs Lomarda thanked Dr Daryl Kleist and Dr John Methven, respectively Chairs of the DAOS and PDEF Working Groups, for participating in PPP-SG#10 to ensure coordination between the PPP, as a WWRP Project, and their working groups.

Mrs Lomarda advised the PPP-SG that the overall directions and priorities for the WWRP are contained in the 2016 WWRP Implementation Plan which outlines the Key Societal Challenge action areas as:

High Impact Weather with actions to address limitations in the models, ascertain the level of uncertainty in the models, develop and implement fully coupled models, develop applications for utilizing the model output, use verification, and define attribution of high impact weather to climate change;

Water with actions to develop an integrated water cycle, new observation methodologies and techniques, further examine precipitation processes, and quantify hydrological uncertainty;

Urbanization with actions to address understand the needs of society for improved environmental prediction, refine observation and processes and examine options for urban prediction; and,

New Technologies with actions to develop advanced methods for prediction and observation, provide support facilities and improved tools, identify new observations and prepare plans for the future Global Observing System.

The action areas in the WWRP Implementation Plan identify which WWRP Projects should contribute to implementation. PPP/YOPP contributes to key actions such as exploitation of WWRP databases and issues related to scalability and links with external expertise and communication amongst groups and communities. Mrs Lomarda advised the PPP-SG that the WWRP Scientific Steering Committee (WWRP-SSC) had decided that each of the WWRP Working Groups should contribute to at least two action areas over the next two years.

WWRP Implementation is occurring through the efforts of the various WWRP Working Groups and Projects. The WWRP Steering Committee (WWRP-SSC) has developed metrics to measure and monitor effectiveness and enable a culture of continuous innovation and development. The WWRP-SSC is very mindful of the current gender imbalance in WWRP with women representing less than 1/3 of WWRP members.

Mrs Lomarda briefed the PPP-SG on the outcomes from the last session of the WWRP-SSC (October 2018) noting that:

- The membership of the WWRP-SSC continues to evolve as existing members leave and new ones are appointed;
- PPP and the work of the PPP-SG act as a model for all of the core WWRP projects;
- PPP and S2S bridge the weather and climate timescales and contribute to Earth System modeling;

- The WWRP-SSC encouraged closer cooperation between PPP, S2S and IOC on polar matters related to multi-scale interaction using coupled assimilation systems to address social science needs and early warning systems.
- PPP should work with S2S and PDEF to better understand the Polar-Tropic connection; and,
- That PPP and YOPP have well integrated social science and assessment activities through the PPP-SERA and the Verification Task Teams.

In closing, Mrs Lomarda briefly spoke about the WMO Reform activities, particularly the proposed changes to the Technical Commissions which could lead to the Commission for Atmospheric Science (CAS) to change from an intergovernmental entity to become the WMO Research Board.

Dr John Methven, Co-Chair of the Predictability, Dynamics and Ensemble Forecasting (PDEF) Working Group addressed the PPP-SG advising them of the five PDEF challenge topics:

- Construction of ensemble initial conditions;
- Stochastic representation of the effect of unresolved processes in models and model error;
- Coupled modeling and assimilation;
- Role of diabatic processes in weather system dynamics; and,
- Spatio-temporal post-processing for ensemble applications.

Dr Methven reminded the PPP-SG that his working group were responsible for the oversight of the TIGGE data set that is currently due to finish at the end of 2019. They are promoting increased use of this dataset across weather and climate time scales together with the S2S Project. The aim is particularly to expand the use of TIGGE and S2S in ensemble applications research (such as energy, agriculture, water, aviation sectors). This use will be highlighted in April 2019 through a workshop to be held at the ECMWF in Reading, UK, looking at Predictability, Dynamics and Applications Research using the TIGGE and S2S ensembles. The meeting is full with over 120 registrations. WWRP/PDEF will be making the case to contributing global centres that they commit to the continuation of TIGGE until the end of 2023, in line with the current commitment to the S2S database.

PDEF have started a joint activity with the Working Group on Numerical Experimentation (WGNE) using convection-permitting simulations over very large domains (global in some cases) which will be used in “coarse-graining experiments” and the design of stochastic parametrization of sub-grid scale processes in forecast models. A pilot study is being conducted by Judith Berner (NOAA) and Hannah Christensen (Oxford). Four domains are proposed for the experiments (to be conducted by several centres): a pan-Arctic domain (similar to the ECCO CAPS domain), a NAWDEX (North Atlantic) domain, a large tropical domain (Maritime Continent) and a Southern Indian Ocean storm track domain. This could link in with the evaluation of high-resolution models in the Arctic.

There were some lessons learned from the North Atlantic Waveguide and Downstream Impacts Experiment (NAWDEX) in autumn 2016 that are of direct relevance for YOPP and the potential Arctic SOP3 and MOSAIC experiment:

Data denial experiments have been conducted for the NAWDEX period by several groups, including Martin Weissmann (Munich) using the ECMWF ensemble analysis system and ECCO. Most of the additional observations were at high latitudes in the North Atlantic sector spanning from Canada to western Europe and 35-80 N. Impacts have been investigated for several domains. Additional observations are shown to improve the forecasts on average by about 5%. It was discussed that radiosondes in data-sparse regions are important for anchoring the analysis. The additional NAWDEX observations do reduce the spread of the ensemble analysis in the ECMWF system.

Impact has also been shown to be very flow dependent, with greatest impact on days with lowest predictability. In the North Atlantic sector, these situations were associated with poleward extension of warm, moist air masses (ridges ahead of extratropical cyclones) which in some cases results in the onset of Scandinavian blocking. The largest analysis errors are found at tropopause level on the flanks of ridges – affecting Rossby wave development. Therefore, there is scope to deploy additional radiosonde launches in SOP3-NH (from existing stations) targeting such situations when air is extending rapidly into Arctic.

In closing, Dr Methven identified planned field campaigns that would address areas of common interest between PDEF and YOPP, namely THINICE 2021 looking at boundary layer fluxes over sea ice and Arctic cyclones.

Dr Daryl Kleist, Co-Chair of the WWRP Data Assimilation and Observing Systems (DAOS) Working Group, reminded the PPP-SG that the DAOS Working Group had developed out of THORPEX and its role was to provide guidance to WWRP on optimizing the current WMO Global Observing System (GOS). The DAOS Working Group facilitates the development of data assimilation and observing system methodologies from the convective scale to planetary scale and for forecasts with time scales of hours to weeks. They are also to assist WWRP Projects and other WMO working groups in achieving their scientific objectives through provision of advice related to observations and data assimilation techniques.

Dr Kleist recalled that recent DAOS highlights included

The quadrennial Data Assimilation Symposium held in Brazil in September 2017. A summary of the symposium as well as thoughts on future directions are captured in a WWRP summary paper

([http://www.wmo.int/pages/prog/arep/wwrp/new/documents/WWRP\\_2019\\_1\\_DAOs\\_Brazil\\_2017.pdf](http://www.wmo.int/pages/prog/arep/wwrp/new/documents/WWRP_2019_1_DAOs_Brazil_2017.pdf))

The Coupled Data Assimilation Workshop held in Toulouse in 2016 that resulted in a coupled data assimilation white paper

([https://www.wmo.int/pages/prog/arep/wwrp/new/documents/Final\\_WWRP\\_2017\\_3\\_27\\_July.pdf](https://www.wmo.int/pages/prog/arep/wwrp/new/documents/Final_WWRP_2017_3_27_July.pdf))

Sponsorship of a white paper on recommendations for Observing Simulation System Experiments, OSSEs

([https://www.wmo.int/pages/prog/arep/wwrp/new/documents/Final\\_WWRP\\_2018\\_8.pdf](https://www.wmo.int/pages/prog/arep/wwrp/new/documents/Final_WWRP_2018_8.pdf))

DAOS has also facilitated inter-comparison efforts such as a recent Forecast Sensitivity to Observations Impact effort which was led by the JCSDA in the US. DAOS plans to build upon the inter-comparison effort over the next two years as well as further efforts in the area of coupled data assimilation models. Dr Kleist suggested that DAOS could cooperate with PPP through coupled data assimilation research in small self-contained problems, by leveraging YOPP observations and coupled reanalysis. He further suggested cooperation on observation impacts and making recommendations for future observing systems.

### 3.2 Discussion

The PPP-SG thanked Dr Methven and Dr Kleist for their presentations and participation in this session. Dr Jung noted that the PDEF challenge areas had also come up during the YOPP Arctic Science Workshop and that it was hoped a number of the PPP-SG Task Teams would be able to contribute to efforts on the five PDEF challenges. Dr Jung also noted the interest of PPP in the DAOS areas suggested by Dr Kleist. Noting that PDEF and DAOS were planning on a joint working group session in Melbourne, Australia, in May 2019, the PPP-SG requested Dr Jung to work with Dr Methven and Dr Kleist to identify an appropriate PPP representative to participate in the joint working group session to explore options for further collaboration between these Working Groups and PPP.

## 4. INTRODUCTION TO YOPP CONSOLIDATION PHASE PLAN

### 4.1 YOPP Consolidation Phase Plan

Mr Jeff Wilson, WMO Consultant, briefed the PPP-SG on the revision and refinement of the draft plan that has been undertaken by Mr Wilson under the guidance of a small adhoc PPP-SG Task Team composed of Dr Thomas Jung, Dr Jørn Kristiansen, Dr Ian Renfrew and Dr Kirstin Werner.

Dr Jung advised the PPP-SG that their input to the YOPP Consolidation Phase plan would occur through this session as well as review and input into the next draft. Dr Jung further advised the PPP-SG that the revised plan would be incorporated into a third version of the YOPP Implementation Plan to be released prior to the 1<sup>st</sup> of July 2019. Dr Jung noted that the revision of the 2nd version of the YOPP Implementation Plan would be relatively light, focusing on the YOPP Consolidation Phase with only minor updates to the remainder of the publication to accommodate developments that occurred after the publication of the second version.

### 4.2 Discussion

During the discussion on this agenda item, the PPP-SG noted their overall satisfaction with the current draft of the revised YOPP Consolidation Phase. The PPP-SG requested the WMO Consultant and the ad hoc Task Team to take the following into account when preparing the next draft:

- Retain the heading Consolidating Research;
- Where appropriate, change NWP to environmental prediction to better reflect the involvement of the sea-ice and ocean communities in environmental prediction in the polar regions;
- Include sub-sections on Publications, and Workshops and Conferences in each of the sections;
- Continue the use of the dot point format for the major tasks and outcomes rather than create extended text;
- Seek feedback from YOPP-endorsed projects and institutions regarding YOPP Consolidation Phase activities;
- Develop the next draft for review by mid-February for review by the PPP-SG and presentation to the EC-PHORS session in late March 2019;
- Do not finalize the plan until after the PPP-SERA Task Team meet in April 2019; and,
- Incorporate suggestions from the PPP-SG during this session regarding OSEs, Verification, Success Measures and Preparing the YOPP Legacy.

## 5. CONSOLIDATING YOPP Research - I

### 5.1 Observing System Experiments

#### 5.1.1 Challenges and Design of Future Observing Systems

Dr Irina Sandu from ECMWF presented an update on polar Observing System Experiments (OSEs). OSEs evaluate the effect of adding or removing individual components of the observing system on numerical weather prediction (NWP) analysis and forecast quality with the aim to understand the role of the current observing systems and guide the design of future observing systems in polar regions. The polar OSEs work is being carried out by the European Center for Medium-Range Weather Forecast (ECMWF), Environment and Climate Change Canada (ECCC), the German Weather Service (DWD) and the Norwegian Meteorological Institute (Met Norway). In the OSEs done at ECMWF, ECCC and DWD, various components of the observing systems are removed from the global NWP systems both poleward of 60° latitude in both hemispheres. The analysis so far has focused on the Arctic,

but the data is available and could be analyzed for the Antarctic as well in the future. The Met Norway experiments are performed with the AROME-Arctic regional model and explore the impact of Arctic observations both through direct assimilation in the regional model and through the use of observations in the driving model used for lateral boundary conditions (in this case the ECMWF model).

The results from the OSEs indicate:

Current polar observing systems clearly have impacts both in polar regions and mid latitudes; The conventional (surface) observation system is the most influential system during winter (for Arctic and mid latitudes). This is common to all global models;

The importance/ranking of each observing system depends on how the observations are used in the respective NWP system. There are differences in the assimilation systems, e.g. 4D-Var/4d-EnVar/3D-EnVar, and some key differences in satellite data usage over sea-ice/snow, clear-sky vs all-sky, etc. Impacts are always subject to the sophistication/maturity of the data use. Investment in the data use may be at least as important as investment in further observations; thus, good models, comprehensive observations usage and data assimilation techniques are all key for making an effective use of observations in data assimilation;

Some of the results are being written up for publication (ECMWF/APPLICATE - winter vs summer OSEs and Arctic to mid-latitude linkages during SOP1-NH); and, ECMWF will continue OSEs until summer 2018 for at least Microwave (MW), conventional observations, and IR satellite data. A comparison of results obtained with the different global modelling systems for the summer SOP1-NH will be performed, including analysis of the Arctic to mid-latitude linkages.

### 5.1.2 General Discussion

Much of the discussion focused upon the use of radiosondes, particularly whether the OSEs are able to provide information regarding desirable location and frequency. Dr Sandu noted that globally, area averaged RMSEs showed little impact of extra radiosondes, however in particular meteorological situations and geographic areas some radiosondes have a big impact. Dr Sandu also mentioned that the radiosondes have a very big impact in anchoring the base analysis, and that the analysis of the results is not advanced enough yet to be able to derive conclusions about the importance of the frequency of radiosondes. The PPP-SG questioned the ability for the centres running the OSEs to further investigate the impact of additional radiosondes at new locations or the impact of removing current radiosondes where stations have been threatened with closure. Eric Bazile advised the PPP-SG that Météo-France had shown that more frequent radiosondes helped deal with the diurnal cycle which was very important for limited area models but less so for the global models. Dr Svensson questioned whether more frequent radiosondes improved the vertical structure depicted in the models. Dr Day informed Dr Svensson that ECMWF were looking at the bias statistics from the data assimilation scheme to see whether the more frequent ascents helped with the finer detail in the vertical structures.

Noting that regular additional radiosondes from current sites did not necessarily make big improvements to the NWP models in terms of large scale skill, the PPP-SG considered that for SOP3-NH it may make more sense to extend the period of the SOP and request additional radiosondes from particular stations dependent upon atmospheric flow conditions. The PPP-SG tasked the group looking at SOP3-NH to further investigate this aspect.

The importance of further improving the use of satellite data in polar regions is also emerging as a clear conclusion of the OSEs work so far, in particular over snow, sea-ice and in cloudy situations, and was discussed by the PPP-SG. Links with DAOS were also discussed here, in particular in terms of how improvements of data assimilation methods or use of satellite data could help make a more efficient use of observations in polar areas.

## 5.2 From Process Understanding to Enhanced Models

### 5.2.1 MOSAIC – Understanding Polar Dynamics and Physical Processes

Dr Matthew Shupe from the MOSAIC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) Consortium, briefed the PPP-SG on developments with MOSAIC. Dr Shupe recalled that MOSAIC involves drifting the RV Polarstern across the Arctic sea-ice over the period of one year from (Northern Hemisphere) Fall 2019 to Fall 2020. In addition to the RV Polarstern a number of other research vessels will be providing support for logistics and research. There will also be aircraft involved. Overall 17 Nations are supporting MOSAIC, which will aim to improve our understanding of polar dynamics and processes in the coupled atmosphere, sea-ice and ocean.

Dr Shupe reminded the PPP-SG that like PPP, MOSAIC is examining physical processes in the Arctic on a local, regional and Arctic-wide scale, see Figure 1, thus ensuring shared approaches to:

- Assimilation studies and experiments;
- Model assessment;
- Detailed process understanding and assessment;
- Characterizing heterogeneity/sub-grid scale variability;
- Diagnosing atmospheric and sea-ice predictability; and,
- Education and outreach.

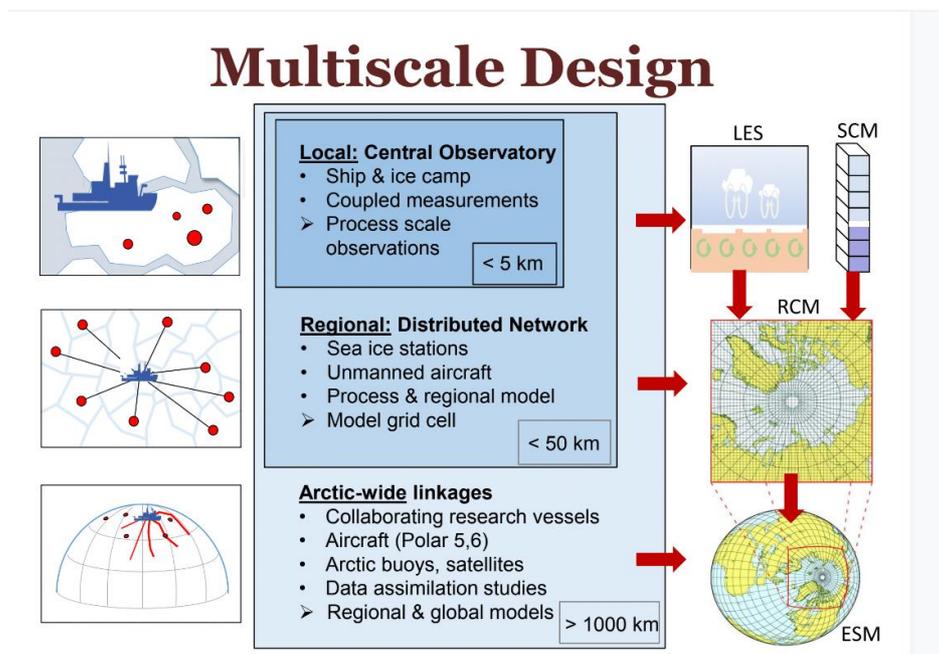


Figure 1. The three-level design approach to MOSAIC

These shared approaches through MOSAIC and the SOP-3 NH will allow coordinated investigation of:

- Energy and momentum budgets;
- Atmospheric Boundary Layer and air mass transformation;
- Cloud composition and processes;
- Precipitation processes;
- Upper ocean processes;
- Sea-ice dynamics; and
- Links to ecological systems and biogeochemical processes.

### 5.2.2 General Discussion

The PPP-SG reiterated their support for cooperation and coordination with MOSAiC and their support for running a third Special Observing Period (SOP3 NH) during the time MOSAiC will be running.

Dr Shupe noted that it would be of great assistance to MOSAiC if the PPP community could nominate the key processes they wished to investigate using MOSAiC data. This would allow MOSAiC to focus on preparing the data associated with these processes for early access. Following an active discussion, the PPP-SG agreed that at this stage the three key PPP processes that the PPP-SG would like MOSAiC to focus upon are:

- Mixed phase clouds;
- Boundary Layer mixing; and,
- Surface Energy Budget.

To enable this link between MOSAiC and PPP/YOPP, it is important that the participating operational model centers output model results at model grid cells that follow the drifting MOSAiC location. This process can follow the YOPPSiteMIP activity that is being implemented at fixed Arctic locations.

### 5.3 YOPP – SH Special Observing Period

Dr Kirstin Werner updated the PPP-SG on the plans and activities of the YOPP-SH group on behalf of the Task Team leader Dr David Bromwich who was unable to attend the session in person but did provide input via teleconference.

Dr Werner advised the PPP-SG that the first SOP for the Southern Hemisphere (SOP1-SH, 16 November 2018 to 15 February 2019) was currently underway with additional radiosonde, surface observations, buoys and NWP predictions being made for the Antarctic region (Figure 2). The observations are being monitored by ECMWF and NCEP. It appears from NCAR monitoring that not all of the additional radiosondes are getting into the NCEP global weather forecasts. Investigations into why this is occurring are underway.

Dr Werner reported that the buoy deployments for 2018/2019 were similar to those for 2017/2018 which had resulted in more than one hundred additional buoys being deployed by the US, Australia, Japan, Germany, New Zealand, and South Africa. In terms of shipboard meteorological and oceanographic measurements, Dr Werner advised the PPP-SG that some of these were available via the GTS but others were only available in non-real time by approaching specific ships or expeditions. The YOPP-SH Task Team had identified key contacts for these measurements.

In terms of sea-ice prediction, the YOPP-endorsed project SIPN South has been collecting operational forecasts of sea-ice and then comparing them with observational data sets. Predicting the Ross Sea sea-ice anomaly has proven to be very challenging.

The YOPP-SH Task Team reported that, in addition to real time weather prediction from the US (the Antarctic Mesoscale Prediction System AMPS) and the ECMWF, India, China, Chile, Météo-France and the Republic of Korea have been running NWP suites in real time or near real time with some of the datasets openly available.

For the Supersites, Météo-France and AMPS are providing data from various parameters and tendencies for future research purposes.

In terms of Southern Hemisphere OSEs, the US has funded a three-year project which commenced on 1 June 2018 to evaluate the impact of Special Observing Period observations on AMPS forecasts. Two data assimilation techniques are being trialed to see which results in the greatest forecast improvement. Japan and France are also developing plans for their own

OSEs.

For the SOP1-SH, at least two education activities have been run, the first by Italy where about four hundred students in 17 classes will explore polar meteorology and climate issues using data from the Italian-French Antarctic station Dome C/Concordia, by attending seminars and visiting operational centres. A second educational activity was initiated by The Ohio State University where approximately twelve undergraduate students who enrolled in Synoptic Meteorology are forecasting maximum and minimum temperatures and average wind speed for the Antarctic stations McMurdo and South Pole.

Dr Werner noted that the YOPP-SH task team requested support from PPP-SG for holding a SH winter (mid-April to mid-July) SOP2-SH during 2020 perhaps focusing on the Ross Sea area. Following a brief discussion, the PPP-SG supported the YOPP-SH proposal and requested that they update the PPP-SG following their June 2019 workshop.

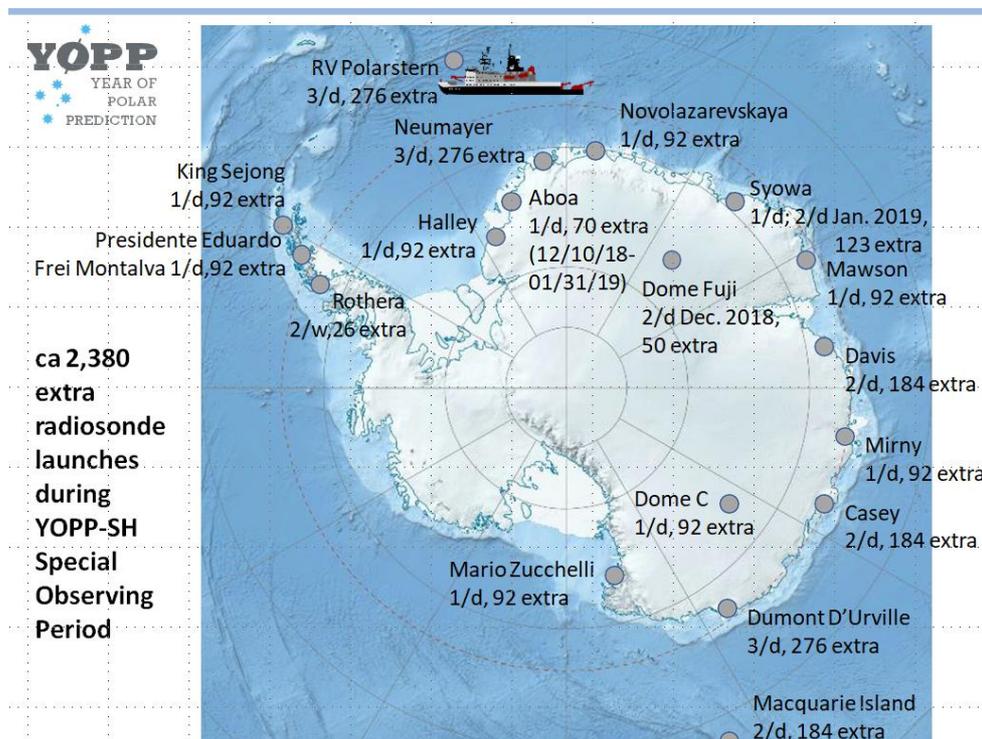


Figure 2. Overview of additional radiosonde launches during SOP1-SH

In closing, Dr Werner advised the PPP-SG that the YOPP-SH task team envisioned the following activities during the YOPP Consolidation Phase:

- Write an early overview paper on YOPP-SH for BAMS;
- Organize a winter SOP in 2020;
- Continue and coordinate data denial experiments;
- Identify improvements to the observing system;
- Enhance operational NWP systems; and,
- Organize conferences and special journal issues devoted to research results.

### 5.3.1 General Discussion

In the ensuing discussion Dr Bromwich informed the PPP-SG that he had recently been advised by Dr Philip Reid from Australia that the Bureau of Meteorology were hoping to increase their efforts in Antarctic research in the next twelve months and that the Bureau would be supporting aspects of the COMNAP/SCAR meeting in Hobart in August 2020.

Dr Lamers advised the session that PPP-SERA would also be holding one of their workshops in Hobart around the SCAR meeting. Dr Bromwich noted that the 2020 YOPP-SH meeting

would most likely be held around the SCAR meeting.

Dr Barbara Casati advised the PPP-SG that members of the YOPP Verification Task Team would be joining the regular YOPP-SH teleconference to report on verification matters. A separate teleconference for the SH on verification was not foreseen.

## 6. CONSOLIDATING YOPP RESEARCH – II

### 6.1 Forecasting System Development and Merged Observatory Data Files

#### 6.1.1 The YOPP Supersite Model Intercomparison Project

Dr Gunilla Svensson briefed the PPP-SG on work related to the YOPP Supersite Model Intercomparison Project (YOPPSiteMIP) where data model output over YOPP Supersites will be verified by observations. The work is the most advanced for the Arctic. Model data is also being archived for Antarctic Supersites but there is no planned coordinated analysis by the YOPPSiteMIP Task Team. However, the YOPP-SH Task Team is advised to plan some activities. Similarly, the global models have been archiving data for nominated supersites in the Third Pole, but there is no planned or coordinated analysis foreseen by the YOPPSiteMIP group. Data is not yet available via the YOPP Data portal but should be in the near future.

Dr Svensson advised the session that the operators of five global models were contributing to the work, namely ECMWF, ECCC, Météo-France, the UK MetOffice and Roshydromet. On a regional scale, Met Norway and Météo-France are running limited area weather models and AWI is running a regional climate model. Some small issues remain with the common data format before the NWP data can be accessed via the YOPP Data Portal. Verification has commenced and is planned for all sites with process evaluation planned for selected sites such as Barrow, Sodankylä, Ny-Alesund and a number of Canadian sites. At this stage more work is needed on the observation files to make that data available via the YOPP Data Portal. Dr Svensson further advised the session that some ocean supersites had been nominated for outputting NWP data to allow process studies but at this stage there was no matching observational data. This activity is in preparation for the MOSAiC year.

The task team had identified the following potential focus areas for process studies based around the Surface Energy budget, constrained by observations with special emphasis on:

- Low level clouds, including phase;
- Calm and clear conditions (i.e. stable boundary layers);
- Atmosphere-snow interactions over land and on sea-ice;
- Coupling procedures, variables and frequencies; and,
- Ocean mixing.

The YOPPSiteMIP team noted the importance of the momentum budget but believed it is more important to tackle the energy budget initially. Focus on the momentum budget might be possible via the ongoing Sea Ice Drift Forecast Experiment (SIDFex, <http://www.polarprediction.net/yopp/sidfex/>) activity.

The YOPPSiteMIP team identified the following activities for action in 2019:

- Continue the initial analysis aiming for a targeted workshop in Northern Hemisphere autumn of 2019 with first results summarized and published by end of 2019;
- Plan for a YOPPSiteMIP session in the SOP workshop in 2020;
- Present results at other conferences to inspire the community to use the dataset; and,
- Advertise the data more widely once they have been uploaded to the YOPP Data

Portal.

The YOPPSiteMIP team emphasised the importance of maintaining close links to MOSAiC and where possible producing YOPPSiteMIP files for the entire period of MOSAiC. The YOPPSiteMIP team also noted the desirability of including IASOA observation sites in the YOPP Data Portal. Dr Svensson further emphasised the importance and efficiencies that would come from YOPP coordinating its modeling plan with that of MOSAiC and analysing model output at the ocean sites, including sea-ice and ocean in preparation for MOSAiC.

Dr Svensson informed the PPP-SG that the breakout groups at the YOPP IASC Arctic Workshop had developed the following recommendations relevant to YOPPSiteMIP activities:

- Organize workshops to work on and advance YOPPSiteMIP process based diagnostics;
- Organize a MIP (arranging case studies and workshop) focusing on ocean mixing and/or interaction with sea-ice processes, with the aim of activating the ocean community that often is outside of the weather services;
- Strengthen the coordination with the MOSAiC efforts;
- The YOPPSiteMIP data should be maintained as it can be used for many years as a benchmark for model improvement;
- Ensure that the code for accessing and analysing the YOPPSiteMIP data is publicly available through e.g. github or YOPP Data Portal; and,
- Future YOPPSiteMIP activities could include: coordinate process groups; support ocean-atmosphere coupling in MOSAiC; process-based metrics could focus on variable inter-relationships/parameterization representation; need of overall assessment at supersites prior specific process analyses.

The PPP-SG took note of these recommendations and requested the YOPPSiteMIP team to consider their inclusion in their future work plans.

In the following discussion the PPP-SG noted that WMO is running a High Mountain Summit in June 2019 which may provide an ideal opportunity to promote the Third Pole data set. The PPP-SG also noted the need to identify a YOPP-SH champion to tighten up the YOPP-SH plans for YOPPSiteMIP activities.

### **6.1.2 Comparison of Observational Data Sets for YOPPSiteMIP**

Dr Matthew Shupe presented this agenda item on behalf of Dr Taneil Uttal. Dr Shupe reported that work advancing standardization of the observation files from the Supersites was progressing well but it was a huge task.

Dr Shupe and Dr Uttal recommended that some priority parameters/processes and groups are developed to allow the standardization work to proceed at a faster rate. The prioritization would help focus the efforts on the key parameters. Dr Shupe further emphasized that while Dr Uttal's group was developing the standard processes and methodologies for dealing with the data, they were not responsible for getting all of the YOPP Supersite data ready for publication on the YOPP Data Portal. In this regard, it will be important to engage additional representatives from specific supersites.

Dr Shupe noted the high level of importance of consistency in formatting and quality control in the YOPP Supersite data to allow the same algorithms to be run across all sites. The YOPP data would be a key part of the YOPP legacy as would the documentation of the methodologies for model assessment and standards used to create and share the data.

In summary, Dr Shupe indicated that the work was on course but coordination across the observation sites will be very important, as will identification of key parameters or processes to allow some high-priority data to be made available early.

### 6.1.3 General Discussions

The PPP-SG thanked Dr Shupe and Dr Uttal for the update on YOPP Supersite observational data. The PPP-SG actively discussed the next steps for this key work on YOPP Data noting the following:

- One of the biggest challenges is trying to map the various observations to the same time frame (i.e., consistent with the 7.5 min output from the NWP models) when they have different frequencies of observation, different heights etc. The degree of difficulty depends upon the amount of experience the groups from each Supersite have in working with data. In addition, the recorded data is often in terms of raw voltages rather than physical parameters and thus needs to be turned into level 3 data (i.e., sensible parameters) with metadata showing the processing trail;
- For widespread use, the data needs to be quality controlled and formatted and where possible matched to the NWP output;
- The observations will be part of the YOPP legacy as will the NWP output as this will establish benchmarks to test future models against. Thus it is very important for the observations and the NWP output to be archived and remain available for use well past the end of 2022;
- Some priority processes/parameters should be agreed so we can decide what types of analyses are highest priority. This will assist in developing methodologies that can then be easily applied to all sites. Start simple but with smart stratification;
- The verification of YOPP Supersite data can be carried out by the YOPPsiteMIP team which should also have at least one person from the Verification Task Team involved to ensure coordination across the teams;
- It would be highly desirable to conduct a YOPPsiteMIP workshop in late 2019 to highlight progress, promote the use of the YOPPsiteMIP data and decide next steps;
- A significant part of the YOPP legacy will be documenting and publicizing the methodologies used to process and publish the YOPPsiteMIP Data; and,
- It is very important to acknowledge and thank the countries, institutions, and agencies supporting the Supersites and provide them feedback on how it is being utilized. The ICO will investigate the option for Dr Svensson to address the next meeting of the WWRP - WGNE as part of this process.

### 6.2 Polar - Lower Latitude Linkages

The PPP-SG noted that the draft YOPP Consolidation Phase plan covering Polar-Lower Latitude Linkages was not well developed but the initial results of the OSEs from SOP1-NH were providing some insight into possible linkages between the polar regions and the lower latitudes. The PPP-SG further noted that teleconnections are two-way and the mid latitudes have a big impact on the polar regions in the winter period but less so in the summer.

The PPP-SG recalled that the WWRP-SSC were keen for teleconnections between the poles and the tropics to be considered by the PDEF and S2S Working Groups and that the Polar Amplification Model Intercomparison Project (PAMIP) which was part of the sixth Coupled Model Intercomparison Project (CMIP) would also shed some light on the processes involved.

The PPP-SG made the following observations on this agenda item:

- The current and future OSEs will provide further insight into these connections;
- OSEs are computationally expensive so it may be useful to carryout relaxation experiments so that teleconnections outside of the SOPs can also be examined;
- The weather during the winter SOP was quite unusual and indicated that the Atlantic and Pacific sectors were both important. Linkages (cold air intrusions into the mid latitudes and warm air incursions into the polar latitudes) should both be considered;
- It would be important to have flow-dependent verification;
- Blocking situations had a big impact over the land in the Arctic. The models generally do not pick the onset of blocking very well so OSEs that can identify key observation

sites could be very useful; and,

- The PPP-SERA task team may consider including impacts of polar weather on the mid latitudes (particularly North America and Europe) in their work.

### 6.3 YOPP Reanalysis

The PPP-SG recalled that a number of countries were undertaking reanalysis projects linked to YOPP:

- MET Norway is leading the Copernicus Arctic Regional Reanalysis (part of Copernicus Climate Change Service), where a 24-year reanalysis with the same regional (convection-permitting) model setup as AROME Arctic will be implemented and run on two complementary domains to cover the European sector of the Arctic. The work also includes a proof-of-concept Pan-Arctic reanalysis to be run for one-year duration, probably covering part of YOPP. The reanalysis should be completed by 2021;
- The research group at the Byrd Polar and Climate Research Center, The Ohio State University (<http://polarmet.osu.edu/ASR/>) have obtained funding to update the Arctic System Reanalysis from a 15-km grid spacing to a 10-m grid spacing. The new model will be known as ASRv2.5;
- ECCC has a proposal for a sea-ice reanalysis of the Arctic; and,
- China has plans for some reanalysis activities in the Arctic and Antarctic.

In addition to the reanalysis work, the PPP-SG also noted that Met Norway and ECCC are undertaking hindcasting activities: Met Norway has plans in place for ocean hindcasting whilst ECCC has an atmospheric 33-km reforecast product that focuses on land surface parameters such as soil moisture and snow depth.

Noting that the teams either undertaking or planning reanalysis work were already communicating with each other, the PPP-SG decided that it was not necessary to create a specific Task Team on reanalysis. The PPP-SG encouraged Met Norway and the other reanalysis centres to:

- Document the uncertainty associated with each of the reanalysis parameters;
- Ensure that the reanalysis data sets are made available via the YOPP Data Portal; and,
- Use the additional YOPP observations to check the reanalysis fields rather than incorporate them into the reanalysis due to the transient nature.

The PPP-SG suggested that an appropriate person from the CARRA project may wish to participate in the YOPP Special Observation Period workshop planned for February 2020 and requested Eric Bazile to coordinate with the ICO on this matter.

## 6.4 Verification

### 6.4.1 Plans for the YOPP Consolidation Phase

Dr Barbara Casati led the discussions on this agenda item. She thanked the Verification Task Team members for their active participation in the work of the team which had produced a number of key documents as well as ongoing activities (full details on the verification task team can be found at <http://www.polarprediction.net/yopp-activities/yopp-task-teams/verification/>).

Prior to discussing verification plans for the YOPP Consolidation Phase Dr Casati recalled that the primary overall goals of YOPP Verification were to:

- Demonstrate the added value of enhanced observations in
- data assimilation (data denial, x-validation, standard scores);
- prediction (data denial, x-validation, standard scores, DA);
- verification practices (thinning, spatial representativeness);

- Exploit verification research opportunities such as
- verification in data-sparse regions; explore observation uncertainty;
- verification against analysis; synergies with Data Assimilation (DA);
- 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 through
- 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;
- Analyze the performance of dynamical sea-ice models for sea-ice concentration, thickness, drift, extent, edge, pressure;
- Demonstrate advancements associated with the YOPP modelling effort: pre-YOPP versus post-YOPP; and
- Linkages: demonstrate that improvements in the forecast accuracy in polar regions transfer to improvements in the predictability at mid-latitudes.

Dr Casati further recalled that the second order priorities for YOPP verification were:

- Representation of snow cover and depth;
- Representation of solid precipitation types, including freezing rain;
- Fog/horizontal visibility; cloud ceiling/base height (user oriented);
- Representation of low-level mixed phase clouds;
- Representation of stable boundary layer; and,
- The effects of steep orography: orographically enhanced precipitation, katabatic winds, hydraulic shocks.

For the YOPP Core Phase Dr Casati recalled that the main verification activities that were underway included:

- NWP process-based evaluation against high frequency multivariate observations at the YOPP Supersites. Research teams involved: Gunilla Svensson (U. Stockholm); Barbara Casati, Stella Melo, Zen Mariani (all ECCC); Jonny Day, Linus Magnusson (both ECMWF); Morten Koltzow (Met Norway); Matthew Shupe (NOAA, Mosaic); Taneil Uttal (IASOA - NOAA);
- Operational summary verification scores:
- pre-YOPP NWP system performance;
- operational verification practices in the Polar Regions
- objective verification exchange during the SOPs; (involving Tom Robinson, Barbara Casati, Gabrielle Gascon (all ECCC); Thomas Haiden, Martin Janousek (both ECMWF); Morten Koltzow, Teresa Valkonen (both Met Norway); Eric Bazile (Météo France));
- Verification of sea-ice prediction (led by the Sea Ice Prediction Task Team) during YOPP involving Barbara Casati, Jean-François Lemieux, Ji Lei, Greg Smith (all ECCC); Pam Posey, Julie Crout, Rick Allard (all U.S. Naval Research Laboratory NRL); Bob Grumbine (NOAA); Malte Müller, Arne Melsom (both MET Norway); Helge Goessling, Lorenzo Zampieri (both AWI); Bill Merryfield (ECCC); Steffen Tietsche, Sarah Keeley, Jonny Day (all ECMWF).

Dr Casati remarked that the Verification Task Team anticipates undertaking the majority of the work early in the YOPP Consolidation Phase. The verification plans for the YOPP Consolidation Phase include:

- Complete operational summary verification scores:
- complete Arctic SOP verification activities (e.g. global models);
- participate in YOPP-SH Antarctic SOP verification activities;
- Synthesize and publish major verification results: summary verification studies

- characterizing the overall performance of prediction systems during YOPP; comparison of the Pre-YOPP versus post-YOPP performance (uncoupled versus coupled models; effect of dynamic sea-ice models on weather prediction);
- Assist the Numerical Experimentation Task Team in the assessment of the added value of the assimilated additional polar observation for the initialization of prediction systems for an enhanced predictability in mid-latitudes (e.g. statistical significance, causality);
- Collaborate with the modelling community in the development of process-based diagnostics (in alignment with WGNE) (e.g., involving multiple variables collaboration with Thomas Haiden); design specific diagnostics for exploiting the YOPPsiteMIP and MOSAIC datasets (multi-variate profile time-series);
- In the verification context for model development: promote aggregation (or other statistical approaches) to infer model behaviour from single case studies to a generalized result on process representation. Promote more strongly inference/statistical significance, in all verification studies.

Sea-ice verification (to be led by the Sea Ice Prediction Task Team):

- Currently: the focus is on ice concentration, ice edge, ice drift Investigate: ice thickness, ice pressure, stage of development, Marginal Ice Zone (MIZ);
- Challenge:
- how to further exploit/improve the use of satellite data and products;
- analyze Canadian Archipelago (not only main ice pack);
- Aim: sea-ice model intercomparison;
- Challenge: prediction systems span all time scales (48h, medium long- and extended-range, sub-seasonal and seasonal), and encompass deterministic and ensembles. Several ongoing parallel model intercomparison (GODAE, FRAMS, ...); and,
- Currently: evaluation by using traditional categorical scores (correct ice, correct water) + user-informative distance metrics.

In addition to the above activities, the Verification Task Team also anticipates providing feedback to Environmental Prediction Centres and the WMO Commission for Basic Systems for improved operational verification practices in areas such as the under catchment of solid precipitation, the use of findings from the WMO Solid Precipitation Comparison Experiment SPICE, weighted verification results with respect to surface observation networks, representativeness of surface station observations and matching most suitable model outputs. The Verification Task Team anticipate collaborating with WMO on projects such as the station representativeness with CBS and JWGFVR.

#### 6.4.2 Discussion

The PPP-SG noted that the WCRP and Climate community need to be made aware of the verification results regarding biases of the weather models in the polar regions for potential incorporation into the climate scale models.

Regarding the activities related to sea ice the PPP-SG agreed that a new Sea-Ice Prediction Task Team should be formed with strong links to the verification task team and other YOPP teams. The Sea-Ice Prediction Task Team should bring together the work of GODAE and the Ice Charting Groups and support the PARCOF.

The PPP-SG encouraged the Verification Task Team to promote their work by linking publications and conference papers from the Verification website (<https://www.polarprediction.net/yopp-activities/yopp-task-teams/verification/>) to more visible sections within the YOPP Website ([www.polarprediction.net](http://www.polarprediction.net)). The ICO were also requested to investigate adding another section to the newsletter to promote new findings from the Task Teams that had not yet been formally published.

## 6.5 SERA – Special Services Period Projects

### 6.5.1 Plans for the YOPP Consolidation Phase

Dr Machiel Lamers briefed the PPP-SG on the proposed activities of the PPP-SERA for the YOPP Consolidation Phase. During the YOPP Consolidation Phase, PPP-SERA would like to draw more attention to services development, use/uptake of environmental services and their impact by organizing a series of workshops. During the YOPP Consolidation Phase, these workshops will bring relevant expertise and experiences together from various parts of the world, including Europe, Canada, Alaska and Tasmania (focusing on the Antarctic).

### 6.5.2 Discussion

During the discussion on PPP-SERA activities it became clear that there was some potential for confusion regarding the use of the term ‘Special Services Periods’ as there were no special services planned, rather ongoing interactions between users and producers of environmental services for polar regions. The PPP-SG decided it would be more appropriate for the proposed activities to be grouped under the term ‘Special Services Projects’ and for them to be carried out over the entire duration of the YOPP Consolidation Phase. Dr Lamers confirmed that PPP-SERA was involved in PARCOF activities, which provided a good opportunity to promote discussions between producers and users of polar environmental services.

Dr Jung requested Dr Lamers to refine the PPP-SERA budget estimates for the remainder of the YOPP Consolidation Phase so he could raise the issue of budget at the EC-PHORS meeting at the end of March 2019.

Noting that WMO also had a SERA working group, it was agreed that PPP-SERA should invite a representative from the WMO SERA group to the PPP-SERA meeting scheduled for April 2019.

## 6.6 Data Publishing

Dr Thomas Jung led the discussion regarding data publishing and the YOPP Data Portal. Dr Jung noted that the YOPP Data Portal Task Team had been inactive for some time and needed to be re-activated. Dr Jung further noted that Met Norway continued to support the YOPP Data Portal on a best effort basis. Dr Siri Jodha Khalsa informed the session that he has done some spot checks on the Portal and encountered problems which Met Norway had been able to resolve with time.

The PPP-SG considered that as the YOPP Core Phase was nearly over, it was very important for the YOPP Data Portal to become fully operational as soon as possible. The PPP-SG suggested that the YOPP Data Task Team members:

- Clarify their responsibilities and the timeline for development of the YOPP Data Component;
- Develop options to assist institutions and observation sites to register their data on the portal;
- Develop options for users to show the YOPP data in a variety of “views”, including separating model data from observational data;
- Track who is accessing and downloading YOPP data through the portal;
- Work with the ICO to promote the use of the YOPP Data Portal and DOI’s with YOPP endorsed projects;
- Develop guidelines on how to make data publicly available for projects where data is not available through the YOPP Data Portal;
- Promote YOPP data publications;
- Document and advertise success stories showcasing instances where YOPP data was discovered, where it would not have been without the portal;
- Develop a standard disclaimer for access and use of the data. It should also include a

non-redistribution clause;

- Explore options for maintaining modeling data until at least the end of 2022; and,
- Arrange a webinar to promote YOPP data and the YOPP data portal.

The PPP-SG requested Dr Jung to bring the issue of retention of YOPP Modeling data until at least the end of 2022 to the attention of EC-PHORS. In response to questions related to the archiving of model data in the period between the end of SOP2-NH and the commencement of MOSAiC, it was agreed that, ideally, there would be no break in the archive record.

## 6.7 Conferences and Workshops

The PPP-SG reaffirmed the discussions from earlier PPP-SG sessions about the importance of presenting YOPP studies in sessions at major workshops and to hold a YOPP Summit Workshop in 2022 that would highlight YOPP achievements as well as outline the challenges ahead of the post-YOPP period. The PPP-SG discussed that YOPP sessions would feature at:

- IUGG in Montreal in July 2019;
- EMS in September 2019 (two sessions, one on the atmosphere and one on the cryosphere);
- SCAR Conference 2020 in Hobart, Tasmania; and,
- The Arctic Science Summit Week 2020 in Iceland.

The PPP-SG were further advised that it may be possible to include YOPP related sessions at:

- Polar Prediction Workshop in Oklahoma in 2019;
- IICWG at the end of 2020; and
- Use the World Meteorological Congress in Geneva in June 2019 to mark the start of the YOPP Consolidation Phase and provide the National Meteorological and Hydrological Service (NMHS) stakeholders feedback on YOPP activities to date.

The PPP-SG noted that one of the weaker parts of YOPP to date was the engagement of the satellite community in YOPP activities. To at least partially address this, it was suggested that efforts are made to include appropriate individuals and groups from the satellite community into future YOPP workshops and conferences such as the proposed YOPPsiteMIP workshop(s), the YOPP SOP workshop(s), sea-ice workshops and workshops related to MOSAiC.

The PPP-SG further noted the benefits of having the IASC/YOPP Arctic Science Workshop preceding the PPP-SG#10 meeting as this was a good method for early career scientists to meet the YOPP science leaders and get to know more about YOPP, the YOPP data sets and YOPP related research.

Regarding the proposal for a YOPP Summit in 2022, the PPP-SG recalled that the Government of Canada had been a major supporter for PPP and that it would be appropriate to see if they wished to host the YOPP Summit. Dr Greg Smith and Dr Barbara Casati from ECCC were requested to advise PPP-SG whether Canada is willing to commit to hosting the final summit in 2022. For planning purposes, the PPP-SG suggested five days with 300 to 500 participants. It would be mainly science focused but with services themes as well and the option to include education events either prior to or in parallel with the Final Summit. The PPP-SG decided to create a Final Summit Task Team to plan and coordinate the event.

## 6.8 Scientific Publications

The PPP-SG noted the recent call for papers for a special issue in *Advances in Atmospheric Science* <<https://link.springer.com/journal/volumesAndIssues/376>> that will showcase recent and ongoing research progresses in Antarctic meteorology and numerical weather prediction, and Climate variability and change in the Antarctic. The PPP-SG further noted that this compilation of research papers is expected to contribute to a more thorough

understanding of issues in Antarctic meteorology and climate in the past, present and future. The dates for this special issue manuscript submission open: March 1, 2019 with deadline for submission of August 31, 2019. The estimated publication date is January 2020.

As with the agenda item on Conferences and Workshops the PPP-SG reaffirmed the importance of promoting YOPP through publications using the DOIs and including YOPP in keywords etc. Apart from the wide range of publications on particular aspects of YOPP that are expected over the coming years, the PPP-SG discussed the option of a final YOPP overview paper, or potentially a book, being published after the Final Summit in 2020. Prior to this publication, the PPP-SG anticipated that there would also be publications on YOPP SH and further publications from PPP-SERA. No decision was taken regarding a final publication, this would be further considered by the Final Summit Task Team and the ICO.

In terms of the YOPP data portal and YOPP Data sets the PPP-SG encouraged the ICO and the new YOPP Data Task Team to consider options to publish an overview paper on YOPP data, for example in a special issue of a journal such as Earth System Science Data but this should not restrict others from publishing papers in the meantime.

The PPP-SG requested the ICO to encourage the YOPP Endorsed Projects to include YOPP references or DOIs in their publications.

## **7. FROM RESEARCH TO OPERATIONS AND SERVICES**

The PPP-SG10 discussions on agenda item 7 centered around the draft text of the plan that was circulated to members prior to the session. In considering the draft text for the YOPP Consolidation Phase the PPP-SG decided:

### **7.1 Community Building**

This section entitled community building was somewhat confusing and should be incorporated in the Outreach Section of the draft Plan;

The ICO and PPP-SERA should consult with the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP) to ensure closer cooperation and potential collaboration in areas of mutual interest such as observation networks and their maintenance as well as products and services related to climate change and the Arctic; and,

The ICO and PPP-SERA to review the list the ICO developed some years ago regarding institutions and organizations involved in Arctic research and services.

### **7.2 Recommendations for Observing Systems**

To underline the goal of YOPP in improving environmental prediction in the polar regions, review the use of the term NWP and replace it with environmental prediction where appropriate; and,

Remove the phrase "how to restructure" from the first bullet point as it is too strong.

### **7.3 Operational Implementation**

Clarify that the phrase "Operational Implementation" could mean either implementing new products and services or improving the capacity of institutions to deliver products and services;

Add climate monitoring to "enhanced environmental prediction"; and,

ICO to consider if the newsletter should feature stories on from research to operations and services.

### **7.4 From Operations to Services**

An example of a new service is predictions on freeze and thaw dates that are discussed at the PARCOF and expected to be operationalized before the end of YOPP;

Improvements in forecast quality or domain may be another measure; and, Perhaps we can create a table showing the new services or parameters that have developed during the life of YOPP, i.e., surface visibility is now forecast.

## 7.5 Conferences and Workshops

The main workshops for this agenda item will be the PPP-SERA Society and Service workshops.

## 7.6 Publications

The following journals were identified as potential targets for publications on Research to Operations and Services:

Meteorological Applications;

Weather and Forecasting;

Bulletin of the American Meteorological Society (BAMS);

WMO Bulletin;

Polar Geographics are currently calling for papers with a deadline at the end of February 2019;

“Witness the Arctic” (<https://www.arcus.org/>);

The Canadian Journal “Atmosphere-Ocean” (<https://www.cmos.ca/site/ao>) has approached Dr Greg Smith about doing a special issue around Canadian YOPP activities.

## 8. PREPARING THE YOPP LEGACY

The PPP-SG undertook a brainstorming exercise to identify what may be seen as YOPP legacy elements in say 2030. These were done independently from the draft text in the YOPP Consolidation Phase plan as a means of cross checking. The key legacy elements identified by the PPP-SG were:

- Providing a strong education platform to train successive generations of polar scientists;
- Creating a demand for increased use of environmental prediction services in the polar regions;
- Operationalization of YOPP research to produce new services and increase the quality and quantity of current services; and,
- Improved understanding of environmental processes in the polar regions.

The following table records the key points for each of these legacy elements.

<b>Providing a strong education platform to train polar scientists</b>	
Next generation of scientists trained	
A range of education and training material produced and made widely available	Assign editor for papers from YOPP Final Summit to create a publication
	Develop a lecture series based upon the YOPP Summer School
	The YOPP video updated
<b>Creating a demand for environmental prediction services in the polar regions</b>	
Improve the polar prediction products for the shipping community	
Indigenous people are more involved and using products	
Increased use of polar environmental prediction services	
Increased understanding of the benefit of environmental services in polar regions	Establishment of the societal and economic value of environmental prediction services for the wide range of the users
Communities are more resilient due to the use of environmental products	
Provide guidance for improved environmental safety in polar regions	

Improved services for benefits of users	
Better understanding of coproduction methodologies	A core of people capable of coproduction
Weather services transitioned to environmental services in polar regions	
Improved understanding of environmental processes in the polar regions.	
Forecast community are easily able to use YOPP data	Detailed observation data from the SOPs are readily availability
	Consolidated observatory files are widely available and the process of creating them is documented
	The scripts used to process the data is documented and widely available
Areas of future work and priorities to tackle it are identified	
Advancement in the understanding of polar processes	Method(s) of evaluating the environmental processes is/are documented and widely available
	Examples are provided of the approach and methods to develop a better understanding of processes
Improved understanding of how the polar weather effects the mid latitudes	Increased awareness of the challenges of the polar systems and the importance to non-polar regions
Main scientific progress is documented in peer-reviewed literature	
Greater interest in the application of social science in the topics of polar issues	
Better utilization of satellite products to understand the model biases	
Operationalization of YOPP research	
Improved verification techniques of sea ice and processes	Improved metrics for verification of sea ice
	Establishing the prediction skill or benchmarking the skill and verification statistics
Global forecasting systems now include polar region processes	
Better understanding of the importance of the polar observation system components	Observing systems design improved
Better connection to the climate community	YOPP products and services are carried on by groups such as AMAP and areas beyond the typical NMHSs <ul style="list-style-type: none"> <li>• AMAP includes YOPP products in the ongoing assessment reports;</li> <li>• AMAP focusing on linkages between Arctic and mid latitudes</li> </ul>
	YOPP input used to revise the AMAP Climate monitoring guidelines
Better systems to cope with the changing climate in the Arctic due to better understanding of the processes so the models are better constructed	

Dr Jung thanked the PPP-SG for their contributions and advised them that their input would be included in the next version of the draft YOPP Consolidation Phase plan.

## 9. DETERMINING SUCCESS OF YOPP

To start the discussion, the PPP-SG Chair invited the PPP-SG members to reflect on the range

of YOPP Stakeholders as different stakeholders may have different success measure metrics. The PPP-SG identified the following incomplete list as major YOPP Stakeholders:

- WWRP-SSC;
- WMO Members;
- PPP-SG members;
- Operational environmental prediction centres (atmosphere, ocean and sea ice);
- YOPP endorsed institutions and institutions undertaking YOPP endorsed projects;
- Direct donors to the YOPP Trust Fund;
- Arctic communities (indigenous and other) and Arctic organizations;
- Arctic and Antarctic transport, fishing, industrial and tourism operators;
- The general public; and,
- Future generation of scientists.

Following the identification of these stakeholders the PPP-SG then suggested a range of success measures under the terms of quantitative and qualitative success measures.

Noting the importance of this issue the PPP-SG decided to create an Evaluation Task Team to further refine the suggested success measures and ensure that the measures can be undertaken in the time available and with limited resources.

### 9.1 Quantitative Success Measures

The PPP-SG suggested the following quantitative success measures for consideration in the next draft of the YOPP Consolidation Phase plan.

- Number of YOPP referenced publications
  - peer-reviewed
  - non-peer-reviewed
- Number of YOPP related meetings (workshops, conferences etc.)
- Number of YOPP projects/extra third party funding
- YOPP Training activities
  - number of research students trained
  - individual interviews of students to record cases
  - attended schools
  - participated in endorsed projects
- Leveraging of efforts
- Mapping of changes in polar research network (before and after) - for example using LinkedIn
- International collaboration
- Cooperation between WMO committees
- YOPP Data access and uptake
- Access and downloads to polarprediction.net
- Communication
  - social media
  - news items
  - media articles
- YOPP Impacts (beyond the academic world)
  - could be under success stories (qualitative)
  - input to policies and standards
  - parameterization taken up by agencies
  - improvement in NWP skill scores

### 9.2 Qualitative Success Measures

The PPP-SG suggested the following qualitative success measures and areas that did not work as well as expected for consideration in the next draft of the YOPP Consolidation Phase plan.

**Qualitative success measures**

YOPP Endorsement

Third-party funding/dedicated calls

Recommendation of Observing System

Nomination of YOPP as a deliverable of the Arctic Science Ministerial (ASM)

Opportunities (e.g., third pole)

New services (e.g., sea-ice products etc.)

Better understanding user needs (e.g., Polar Prediction Matters (PPM))

<https://blogs.helmholtz.de/polarpredictionmatters/>

Policy briefings

What was done beyond the original planning

**Which areas did not work as well as anticipated compared to original plans?**

What did we manage to do?

What didn't we manage to do?

The PPP-SG Chair thanked the PPP-SG for the ideas and suggestions and confirmed that they would be considered when updating the draft YOPP Consolidation Phase plan.

**10. YOPP EDUCATION, OUTREACH AND COMMUNICATION****10.1 Education**

Dr Jonathan Day updated the PPP-SG on the work of the Education Task Team since the last PPP-SG session. The main activity was the Abisko-Polar Prediction School held in Northern Sweden in April 2018. Supported by H2020, APPLICATE, WWRP-PPP, IASC, CLiC and SCAR, the school was attended by thirty students and consisted of field work as well as lectures ranging from observations to longer-term prediction. There were many students applying for this school who were unable to attend because of limited spaces.

In closing Dr Day advised the PPP-SG that the Education Task Team had identified the following activities as worthwhile running but due to changes in the Task Team they need help to organize and run such sessions.

- MOSAiC field school in September 2019;
- Abisko-Polar Prediction School in 2020;
- Side events for European early career researchers at major conferences during the YOPP Consolidation Period;
- Webinars; and,
- Linking with funded initiatives such as APPLICATE and the EU Arctic Cluster to develop and deliver joint education activities.

The PPP-SG thanked Dr Day for his work on the Education Task Team of YOPP noting that due to a change in his role at ECMWF he would need to move from this Task Team in the near future. Dr Mikhail Tolstykh advised the session that an International Arctic Climate and Environment Young Scientists School in the Russian Arctic was held from 4-16 September 2016.

Regarding the proposal for a further Polar Prediction School in Abisko, the PPP-SG noted the high demand for such a school and the opportunity it provided to promote the use of YOPP data and products during the YOPP Consolidation Phase. Provided, funds of around 50,000 Euros can be identified and a small support group can be established to deal with the logistics, the PPP-SG agreed that a third school in early 2020 would be desirable. Dr Lamers suggested that a services component could be introduced into another Polar Prediction

School or a specific school on services may be considered. Dr Jung suggested that the Education Task Team and the YOPP Final Summit Task Team could investigate the options for holding a “hackathon”-type event immediately prior to the YOPP Final Summit to further promote the YOPP data legacy. The PPP-SG requested the Education Task Team and the ICO to investigate options to hold a third Polar Prediction School in early 2020.

Following on from the education agenda item, Dr Werner advised PPP-SG that MOSAiC had offered YOPP berths for a lecturer on modelling and for an early career scientist (ECS; subject to a review process) during the MOSAiC Summer School. The summer school will take place in September/October 2019 aboard the RV Akademik Federov which accompanies RV Polarstern on her trip from Tromsø into the central Arctic. During the cruise, ECS will have lectures aboard RV Akademik Federov and, once reached the final destination, help setting up the MOSAiC Distributed Network on the ice before returning to Tromsø. There will be a significant media group aboard RV Akademik Federov which will set up media projects with ECS on the return trip to Tromsø and could provide a good opportunity to further promote YOPP and its findings. The ICO were inviting PPP-SG members to nominate people to assist MOSAiC to review the student applications as a next step. MOSAiC had requested that the YOPP lecturer covers environmental modelling during the summer school. The student and the lecturer needed to be available for six weeks commencing in mid-September 2019 for the school. The ICO agreed to work with Mrs Lomarda to refine the estimated costs so WMO could assess whether there would be sufficient budget to cover the student and the lecturer. Initial estimates for both were of the order of 5,000 Euros.

## 10.2 Communication and Outreach

With regard to YOPP Communication and Outreach activities, Dr Kirstin Werner (ICO Director) recalled that since early 2018 the YOPP website, Twitter feed, Instagram and newsletters had featured articles and images from the two Northern Hemisphere SOPs and the SOP currently underway in the Antarctic. The field staff involved very much appreciated seeing their efforts publicized.

In terms of statistics: the website was generally getting 50 hits a day (increasing to more than 150 when the IASC/YOPP Arctic Science Workshop was promoted); five editions of PolarPredictNews were produced; mail lists were slowly growing (general mail – 626 subscribers, YOPP endorsed projects – 121 subscribers, YOPP SH – 55 subscribers and PPP-SERA – 18 inactive subscribers); Twitter had 1,260 posts and 1,126 followers; Instagram had 245 followers and 53 posts; and, Polar Prediction Matters blog site had 7 entries in 2018.

Dr Werner presented initial ideas for communication and outreach in the Consolidation Phase of YOPP. Two target audiences had been identified: the YOPP Community including researchers, operational centres, forecast users, and groups such as WWRP-SSC and the WMO Member States; and, the general public.

Dr Werner further advised the PPP-SG that the ICO was planning to use the already established YOPP communication channels (following an evaluation of effectiveness) and do more cross posting to other associated groups such as (Arcticinfo, Cryolist, APECs, etc) as well as review the list of relevant YOPP organizations that was established early in YOPP. The proposed outcomes for the Outreach and Communication activities are: increased engagement of YOPP community within a diversity of activities related to the YOPP Consolidation Phase and the post-YOPP period; and, increased awareness amongst stakeholders and the general public of YOPP and its findings.

In terms of workshops and conferences activities would include:

- Identify key workshops and conferences to target for annual YOPP sessions, i.e. EGU,

AMS;

- Plan for major Synthesis Summit in 2022, notionally to be hosted in Canada;
- Promote the synthesis workshop to the major operational centres directly through WWRP/WMO;
- Involve the major operational centres as much as possible for workshops and conferences to increase “buy in”;
- PPP-SERA will run a series of Weather and Society workshops to:
- create dialogue between environmental forecasters, researchers and end-users from relevant projects and processes;
- understand the role and relevance of Weather, Water, Ice and Climate (WWIC) services in decision-making of diverse end-user groups operating in the Polar Regions;
- engage and learn from various YOPP-endorsed and other projects regarding the tailoring or co-production of services; and
- assess the societal effects and implications of contributions made by PPP.

With outcomes:

- YOPP synthesis workshop(s) is/are expected to synthesize scientific progress to contribute to the operational implementation of YOPP findings.
- Weather and Society Workshops are expected to bring users and providers closer together, establish user-provider networks and enable learning on both sides.

In terms of scientific publications:

- Ensure publications from core and endorsed projects include YOPP hashtags and/or YOPP DOI;
- Prepare YOPP overview papers including one on YOPP Outreach and Communications dealing with user numbers and involvement of stakeholders in media efforts;
- Develop plans for a special issue or multiple issues on YOPP in the peer-reviewed literature;
- Ensure open access to YOPP Data; and,
- Ensure acknowledgements to YOPP and WWRP are included to the publications (see here: <https://www.polarprediction.net/documents-publications/yopp-acknowledgement/>).

With outcomes:

- YOPP findings are widely publicized and support from YOPP sponsors acknowledged.

In closing Dr Werner recommended the formal establishment of a Communications and Outreach Task Team and involvement in the MOSAiC School to provide access to media to further promote YOPP. Dr Werner also raised the issue of what would happen with the PPP website after the end of PPP.

### 10.3 General Discussion

The PPP-SG thanked Dr Werner for the presentation on communication and outreach and for highlighting the proposed activities and outcomes for the YOPP Consolidation Phase. Noting comments from the SG, Dr Jung recommended that each section of the YOPP Consolidation Phase have subsections for Workshops and Conferences, and Publications with the Communication and Outreach section including an overview table bringing together all of the subsection material. Dr Jung also advised the PPP-SG that AWI may be able to continue supporting the PPP website post 2022 but at a reduced level.

## 11. COORDINATION

### 11.1 Elements of Coordination

The PPP-SG reviewed the Task Team structure that was developed before and for the YOPP Core Phase, noting that it may need to be modified as YOPP moves into the Consolidation Phase. The PPP-SG Chair reminded the PPP-SG that Steering Group members would be expected to actively participate in at least two YOPP Task Teams also ensuring at least some coordination across the Task Teams.

### 11.2 Revised Elements

The PPP-SG Chair recalled that earlier in this session, the PPP-SG had already identified the need to create a Task Team on sea-ice prediction, create a Task Team to plan and coordinate SOP3-NH, reinvigorate the YOPP Data Portal Task Team and discontinue the Satellite Task Team (with satellites being addressed in all new Task Teams).

The following revised structure (see Annex V for further details) was agreed with the details to be completed following the next PPP-SG teleconference in mid-February 2019. The PPP-SG agreed that membership of the TT's should include PPP-SG members as well as invited experts.

Revised Task Team	Comment
<b>Sea ice prediction</b> Leader Greg Smith	(Including sea-ice verification) – new TT
Numerical experimentation Leader Irina Sandu	Expansion of YOPP Modeling TT
YOPP verification Leader Barbara Casati	Continuation of existing TT with updated tasks
<b>Processes</b> Leader Gunilla Svensson	
Southern Hemisphere Leader David Bromwich	Continuation of existing TT
<b>PPP-SERA</b> Leader Machiel Lamers & Daniela Liggett	Continuation of existing TT
<b>YOPP Data</b> Leader	Reinvigoration of existing YOPP Data Portal TT and extension of role to include promotion and utilization of YOPP Data
<b>Communication, outreach and education</b> Leader Kirstin Werner	Scope and membership of older Education TT extended
<b>YOPP Final Summit</b> Leader Thomas Jung	New TT to plan and coordinate the Final Summit
<b>YOPP Evaluation</b> Leader	New TT to develop and implement success measures
<b>Discontinued Task Teams</b>	
<b>Airborne Platforms</b>	Processes TT to include use of airborne data and coordinate with MOSAiC on airborne operations during SOP-3 NH
<b>Buoys</b>	Actions to be coordinated with the IABP
<b>Education</b>	Included in the Communication, outreach and education TT
<b>Satellite</b>	Satellite experts to be addressed by all new TTs
<b>Special Observing Periods</b>	To be included in the Processes TT

<b>YOPP Communication</b>	Included in the Communication, outreach and education TT
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## 12. STEERING GROUP MATTERS (CLOSED)

### 12.1 Budget

Mrs Lomarda briefed the session on the overall budget situation. The exact figures for 2019 were not yet available but typically the PPP budget is of the order of 60,000 CHF comprising 35,000 CHF from the Canadian Trust Fund and ad hoc support from other WMO Member States of 25,000 CHF. In regard to the PPP-SERA session scheduled for Chile in April 2019, Mrs Lomarda advised Dr Lamers that the current estimates for the session were approximately 10,000 CHF over budget and cost saving measures would need to be found to bring the overall workshop costs down to approximately 25,000 CHF.

Dr Jung asked Mrs Lomarda if there was a longer-term outlook for the PPP budget that could be used for planning purposes for the remainder of PPP (end of 2022). Noting the activities planned during the YOPP Consolidation Phase, Dr Jung wished to advise the March 2019 EC-PHORS meeting of the likely budget scenario and impacts on the YOPP Consolidation Phase if there were shortfalls in the budget. Mrs Lomarda agreed to work with the ICO to draft a budget outlook for the period 2019 to the end of 2022.

### 12.2 Membership

Noting that a number of the PPP-SG members were not able to attend this session due to the US Government shutdown and that Dr Jung was also not physically present, the PPP-SG briefly considered the PPP-SG membership and provided suggestions to Dr Jung to follow up offline. The PPP-SG requested Dr Jung to report back to the PPP-SG via teleconference or email. The PPP-SG membership would need to account for the reconfiguration of the PPP-SG Tasks Teams elaborated in Agenda Item 11.

## 13. WRAP UP, NEXT STEPS AND CLOSING

### 13.1 Wrap-up and Next Steps

The PPP-SG noted and thanked the offers from Australia and China to host the next meeting of the PPP-SG. The PPP-SG considered the timing and location for the following PPP-SG meetings and, taking into account costs and, the opportunity to link PPP-SG meetings with YOPP and YOPP-associated workshops, it was decided that PPP-SG 11 would be in Bremerhaven/Bremen, Germany in late 2019 or early 2020, PPP-SG 12 would be in Zhuhai, China, in early 2021 and the final PPP-SG session would precede the YOPP Final Summit in Canada in 2022.

The PPP-SG Chair requested that the action items and a short summary of the meeting be prepared for circulation to all PPP-SG members within two weeks of the meeting and that the final minutes be made available prior to the EC-PHORS meeting in late March 2019. The PPP-SG Chair further requested that the current draft of the YOPP Consolidation Phase plan is updated as soon as possible based upon feedback from the session and circulated to the PPP-SG for review and comment prior to the EC-PHORS meeting and the PPP-SERA meeting in April 2019.

### 13.2 Closure

Dr Jung thanked FMI for their support to the session and to the PPP-SG members for their contributions during the session. Dr Jung wished everyone a safe trip home and closed the session at 1214 pm on Friday 18 January 2019.



## Annex I – Meeting Agenda

<b>WORLD METEOROLOGICAL ORGANIZATION</b>	Agenda WWRP/PPP/YOPP SG-10
<b>WWRP Polar PREDICTION PROJECT (WWRP- PPP)</b>	(08-Jan-2019)
<b>TENTH PPP STEERING GROUP MEETING (PPP- SG10)</b>	_____
16 -18 JANUARY 2018	Agenda Item: 1.2
FINNISH METEOROLOGICAL INSTITUTE (FMI)	
<b>VENUE: ERIK PALMÉNIN AUKIO 1</b>	ENGLISH ONLY
00560 HELSINKI, FINLAND	

### *Agenda*

<b>WEDNESDAY, 16 JANUARY</b>	[1400-1800]
SESSION 1: OPENING OF PPP-SG10 [1400-1415]	
1.1 Welcome (Thomas Jung and Timo Vihma)	[1400-1405]
1.2 Purpose of the meeting & Adoption of the Agenda (Thomas Jung)	[1405-1410]
1.3 Working Arrangements (Timo Vihma)	[1410-1415]
SESSION 2: WRAP-UP OF YOPP ARCTIC SCIENCE WORKSHOP	[1415-1515]
Review of progress reported at the Arctic Science Workshop (Thomas Jung)	[1415-1515]
SESSION 3: UPDATE ON WWRP DEVELOPMENTS [1515-1530]	
3.1 Recent Developments in WWRP (Nanette Lomarda)	[1515-1525]
3.2 Discussion	[1525-1530]
SESSION 4: INTRODUCTION TO THE YOPP CONSOLIDATION PHASE PLAN [1530-1600]	
4.1 Plan (Jeff Wilson)	[1530-1540]
4.2 Discussion (chair: Thomas Jung)	[1540-1600]
COFFEE BREAK AND NETWORKING	[1600-1620]
SESSION 5: CONSOLIDATING YOPP RESEARCH I [1620-1800]	
5.1 Observing System Experiments	[1620-1650]
5.1.1 Challenges and Design of Future Observing Systems (Irina Sandu)	[1620-1630]
5.1.2 General discussion	[1630-1650]
5.2 From Process-Understanding to Enhanced Models	[1650-1720]
5.2.1 MOSAiC – Understanding Polar Dynamics and Physical Processes (Matthew Shupe)	[1650-1700]
5.2.2 General Discussion	[1700-1720]
5.3 YOPP-SH Special Observing Period	[1720-1800]

THURSDAY, 17 JANUARY	[0830-1730]
SESSION 6: CONSOLIDATING YOPP RESEARCH II	[0830-1230]
6.1 Forecasting System Development and Merged Observatory Data Files	[0830-0930]
6.1.1 The YOPP Supersite Model Inter-Comparison Project (Gunilla Svensson)	[0830-0840]
6.1.2 Comparison of Observational Data Sets for YOPPsiteMIP (Taneil Uttal)	[0840-0850]
6.1.3 General Discussion	[0850-0920]
6.2 Polar Lower Latitude Linkages	[0920-0940]
6.3 YOPP Reanalysis	[0940-1000]
6.4 Verification	[1000-1030]
6.4.1 Plans for the YOPP Consolidation Phase (Barbara Casati)	[1000-1010]
6.4.2 Discussion	[1010-1030]
GROUP PHOTO & COFFEE BREAK	[1030-1100]
6.5 SERA – Special Services Period	[1100-1130]
6.5.1 Plans for the Consolidation Phase (Machiel Lamers)	[1100-1110]
6.5.2 Discussion	[1110-1130]
6.6 Data Publishing	[1130-1200]
6.7 Workshops	[1200-1215]
6.8 Scientific Publications	[1215-1230]
LUNCH	[1230-1330]
SESSION 7: FROM RESEARCH TO OPERATIONS AND SERVICES (DISCUSSION ONLY)	[1330-1530]
7.1 Community Building	[1330-1350]
7.2 Recommendations for Observing Systems	[1350-1410]
7.3 Operational Implementation	[1410-1430]
7.4 From Operations to Services	[1430-1450]
7.5 Workshops	[1450-1510]
7.6 Publications	[1510-1530]
COFFEE BREAK	[1530-1600]
SESSION 8: Preparing the YOPP LEGACY	[1600-1730]
Key Questions: What would we like to have as important legacy elements in 10 years from now? How can we ensure a strong data legacy? How do we go from a project to sustained activities? How can we obtain specific commitments beyond 2022?	
NO-HOST DINNER	[1900]

FRIDAY, 18 JANUARY

[0830-1215]

## SESSION 9: Determining Success of YOPP

[0830-0930]

9.1 Quantitative Success Measures

[0830-0900]

9.2 Qualitative Success

[0900-0930]

YOPP Endorsement, Success stories, also failures

## SESSION 10: YOPP OUTREACH &amp; COMMUNICATION

[0930-1015]

10.1 Education and Outreach (Jonathan Day)

[0930-0940]

10.2 Communication (Kirstin Werner)

[0940-0950]

10.3 General Discussion

[0950-1015]

## COFFEE BREAK

[1015-1030]

## SESSION 11: Coordination

[1030-1130]

11.1 Elements of Continuation

[1030-1100]

PPP Steering Group, International Coordination Office,  
YOPP Task Teams, YOPP Endorsement

11.2 New Elements

[1100-1130]

Identify and establish new Task Teams

## SESSION 12: STEERING GROUP MATTERS (CLOSED)

[1130-1145]

12.1 Budget

[1130-1135]

12.2 Membership

[1135-1145]

## SESSION 13: WRAP-UP, NEXT STEPS AND CLOSING

[1145-1215]

13.1 Wrap-up and Next Steps

[1145-1210]

13.2 Closure

[1210-1215]

## LUNCH BREAK (optional)

## Annex II – PPP-SG10 participants

<b>PPP-SG Members</b>
Thomas Jung (Chair) Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI), remote participation
David Bromwich University of Ohio, remote participation
Barbara Casati Environment and Climate Change Canada (ECCC), Canada
Jonathan Day European Centre for Medium-Range Weather Forecasts (ECMWF), UK
Jun Inoue National Institute of Polar Research, Japan
Siri Jodha S. Khalsa National Snow & Ice Data Center, USA
Jørn Kristiansen Norwegian Meteorological Institute, Norway
Machiel Lamers Wageningen University and Research, The Netherlands
Steffen M. Olsen Danish Meteorological Institute, Denmark
Ian Renfrew University of East Anglia, UK
Irina Sandu European Centre for Medium-Range Weather Forecasts (ECMWF), UK
Gregory Smith Environment and Climate Change Canada (ECCC), Canada
Gunilla Svensson Stockholm University, Department of Meteorology, Sweden
Mikhail Tolstykh Institute of Numerical Mathematics, Russia
Qinghua Yang Sun Yat-sen University, School of Atmospheric Sciences, P.R. China
<b>ICO and WMO Secretariat</b>
Helge Goessling Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI), Germany
Katharina Kirchhoff Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI), Germany
Nanette Lomarda World Meteorological Organization (WMO), Switzerland
Kirstin Werner Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI), Germany
Jeffrey Wilson World Meteorological Organization (WMO), Switzerland
<b>Invited Experts</b>
Eric Bazile

Meteo-France, CNRM/GMAP, France
Bin Cheng Finnish Meteorological Institute, Finland
Martin Forsius Finnish Environment Institute (SYKE), Arctic Council AMAP, Finland
Alexey Karpechko Finnish Meteorological Institute, Finland
Daryl Kleist University of Maryland, Department of Atmospheric & Ocean, USA
Alexander Makshtas Arctic and Antarctic Research Institute (AARI), Russia
Terhikki Manninen Finnish Meteorological Institute, Finland
John Methven University of Reading, Department of Meteorology, UK
Tuomas Naakka Finnish Meteorological Institute, Finland
Tiina Nygard Finnish Meteorological Institute, Finland
Adriaan Perrels Finnish Meteorological Institute, Finland
Matthew Shupe University of Colorado & NOAA, USA; MOSAiC
Qizhen Sun National Marine Environmental Forecasting Center, P.R. China
Thomas Spengler University of Bergen, Geophysical Institute, Norway; IASC
Irene Suomi Finnish Meteorological Institute, Finland
Helge Tangen Norwegian Meteorological Institute, Norway
Timo Vihma Finnish Meteorological Institute, Finland

**Annex III – Decisions and actions from PPP-SG10**

<b>Action #</b>	<b>Agenda Item</b>	<b>Action</b>	<b>Who</b>	<b>When</b>
1	1.2	Investigate EU Project "European Polar Climate" for funding opportunities and establish whether YOPP is explicitly mentioned	ICO	End of Feb 2019
2	2	Request YOPP endorsed projects to use the YOPP logo to improve YOPP visibility and remind them to use the correct acknowledgements to facilitate project evaluation	ICO	End of Feb 2019
3	2	Increase YOPP visibility at major conferences and workshops	PPP-SG members	Ongoing
4	2	Request the organizers of the YOPP Arctic Science Workshop to seek further information regarding where workshop participants get information on research questions and data to enable the ICO to consider including these channels in their YOPP promotion activities	ICO	End of March 2019
5	3	Coordinate with WWRP WGs DAOS and PDEF regarding possible joint projects on data assimilation and defining the uncertainty in forecasts and observations through a PPP-SG member with modelling background potentially attending DAOS/PDEF joint working group meeting in Melbourne Australia in May 2019	Chair PPP-SG to coordinate with DAOS and PDEF Chairs	By end of March 2019
6	3.1	Advertise the Judith Berner/Hannah Christensen pan-Arctic domain dataset when it becomes available		
7	3.1	Invite DAOS representatives to international workshop on observing system design in polar regions		
8	4	PPP-SERA to provide formal feedback on YOPP Consolidation Plan to ICO immediately after their April 2019 meeting	PPP-SERA Chair	mid April 2019
9	4	Consider how to engage YOPP endorsed projects and institutions in reviewing the YOPP Consolidation Phase plan	ICO	End of Feb 2019

10	4	Finalise the YOPP Consolidation Phase plan by end of April 2019	ICO/WMO	End of April 2019
11	5.2	Advise MOSAiC of the key YOPP processes for MOSAiC to consider in their work (Mixed phase clouds, boundary layer mixing, surface energy budget)	Matt Shupe	Prior to MOSAiC workshop in March 2019
12	5.3	Data task team to investigate the possibility of making the non-real time shipboard meteorological and oceanographic observations available via the YOPP Data Portal		
13	5.3	YOPP-SH Task Team to identify who is carrying out OSEs for the Southern Hemisphere and advise the PPP-SG		
14	5.3	YOPP-SH TT to advise PPP-SG of further details and plans for the proposed additional YOPP SH SOP (tentatively 1 April to 31 July 2020 but could be delayed 12 months for logistic reasons). This new SOP to be included in the YOPP Consolidation Plan (Jeff Wilson)	David Bromwich	End of June 2019
15	5.3	PPP-SERA and YOPP-SH TT to advise PPP-SG of plans for YOPP activities around the SCAR COMNAP conference in Hobart, Australia in August 2020	PPP-SERA Chair & David Bromwich	End of June 2019
16	6.1	YOPP-SH TT to identify a "champion" who will participate in the YOPPsiteMIP meetings (Process TT) and guide SH work on YOPPsiteMIP data	David Bromwich	End of June 2019
17	6.1	YOPPsiteMIP Task Team to advise the YOPP Data task team as supersite data becomes available to add to the data portal		
18	6.1	Processes TT Chair to advise ICO when data for the Third Pole stations will be available for promoting. WMO running a High Mountain meeting in June 2019 which would be a good place to promote the data set	Gunilla Svensson/ Irina Sandu	End of March 2019
19	6.1	Processes TT to develop documentation showing how to access and use the YOPPsiteMIP data. Document could include "case studies" and suggestions for areas of research	Process TT	End of July 2019
20	6.1	ICO to contact WCRP Chair to see if Gunilla Svensson could address their next meeting to promote	ICO	End of Feb 2019

		the YOPPSiteMIP data		
21	6.2	PPP-SERA TT to consider whether to examine socio economic benefits of impact of Polar Obs in mid latitudes due to the impacts of cold air outbreaks etc on the mid latitudes	PPP-SERA with input from Jonny Day (?)	April 2019
22	6.3	Eric Bazile to raise possibility of cooperation between YOPP and CARRA Development Team on reanalysis. If yes then invite CARRA Rep to the SOP workshop scheduled for 2020 regarding reanalysis work they are doing with Met Norway	Eric Bazile/ICO	January 2019 for Eric to speak to the CARRA people
23	6.4	Sea-ice TT to investigate options for producing a benchmark data set of sea-ice forecasts so institutions can try out new schemes and processes against an ongoing operational data set	Sea-ice TT	End of December 2019
24	6.5	PPP-SERA to invite a representative of WMO-SERA to their next meeting to improve coordination and provide pathway for the PPP-SERA activities to continue past the end of 2022	PPP-SERA Chair/ICO	End of Feb 2019
25	6.6	PPP-SG Chair to advise EC PHORS of the need for the operational centres to retain the full YOPP model archive until at least the end of 2022 if not beyond. If at all possible the model data for the full year of MOSAiC should also be kept. The model data for the YOPPSiteMIP files to be held by Met Norway	PPP-SG Chair	End of March 2019
26	6.7	PPP-SG TT leads to advise ICO of their need for satellite experts in their TT so ICO can look for potential members	PPP-SG TT Leads and PPP-SG Chair	End of March 2019
27	6.7	Greg Smith and Barbara Casati to advise PPP-SG of whether Canada is willing to commit to hosting final summit in 2022. Five days with 300 to 500 participants. Mainly science focus	Greg Smith/Barbara Casati	End of June 2019
28	6.7	ICO, Process TT and Sea-ice TT to identify possible speakers from the satellite community for appropriate workshops	ICO/Process TT/Sea-Ice TT	End of June 2019

29	6.7	ICO to coordinate with Nanette Lomarda and Paolo Ruti regarding dates for possible YOPP side event during the 18th World Meteorological Congress in Geneva in June 2019	ICO/Nanette Lomarda	End of Feb 2019
30	6.8	YOPP Summit TT to consider options for YOPP overview papers and publications as part of the Summit planning	YOPP Summit TT/ICO	End of December 2019
31	7.1	ICO/PPP-SERA to coordinate on the need to review the existing list of organisations involved with Polar environmental services and prediction	PPP-SERA Chair and ICO	End of Feb 2019
32	7.3	ICO to investigate the possibility of adding a new section to the newsletter to cover examples of research to operations and services (success stories)	ICO	End of Feb 2019
33	7.5	PPP-SERA to update documentation and plans to reflect the change of Special Service Periods to Special Service Projects and the proposal for these to run throughout the YOPP Consolidation Phase period rather than in two short blocks	PPP-SERA Chair	April 2019
34	7.6	Continue investigations into options for journals to publish overview or specific YOPP publications and opportunities	PPP-SG	Ongoing
35	9	Evaluation TT to further develop the tentative evaluation metrics included in the YOPP Consolidation Phase plan and brainstormed in the PPP-SG10 session	Evaluation TT	End of December 2019
36	10	ICO to investigate options for maintenance of the polarprediction.net website past the end of 2022	ICO	End of December 2019
37	10.1	ICO to provide WMO with estimate for costs of YOPP supporting a lecturer and student on the MOSAiC summer school	ICO	End of January 2019
38	11	PPP-SG Chair to continue developing the TT membership and key tasks with the proposed TT leads	PPP-SG Chair/PPP-SG TT leads	End of February 2019
39	12	PPP-SG Chair and WMO to develop budget outlook for the remainder of PPP with PPP-SG Chair to present to EC PHORS	PPP-SG Chair/ICO/Nanette	End of March 2019

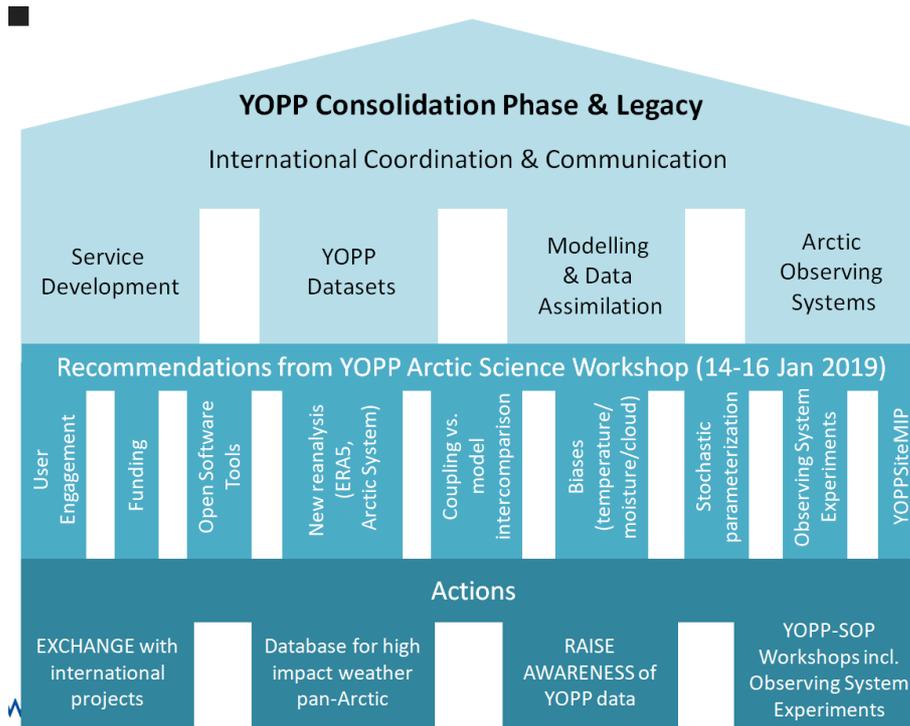
40	12	PPP-SG Chair to work with current PPP-SG members and potential new members regarding membership. PPP-SG Chair to bring back to PPP-SG either via email or during teleconference	PPP-SG Chair	End of Feb 2019
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## Annex IV - Proposed Task Teams

<b>Task Team</b>	<b>Purpose</b>	<b>Deliverables</b>	<b>Members</b>
<b>Sea ice prediction</b>			<ul style="list-style-type: none"> <li>• Greg Smith</li> <li>• Helge Goessling</li> <li>• Qinghua Yang</li> <li>• Francois Massonnet</li> </ul>
<b>Numerical experimentation</b>	<ul style="list-style-type: none"> <li>• Arctic</li> <li>• OSE</li> <li>• Linkages</li> <li>• Satellite</li> </ul>		<ul style="list-style-type: none"> <li>• Irina Sandu</li> <li>• Thomas Jung</li> <li>• Jørn Kristiansen</li> <li>• Jonny Day</li> <li>• Jun Inoue</li> </ul>
<b>YOPP verification</b>	<ul style="list-style-type: none"> <li>• Outline a YOPP verification strategy,</li> <li>• Develop and support a YOPP verification effort</li> </ul>	<ul style="list-style-type: none"> <li>• YOPP Verification plan</li> </ul>	<ul style="list-style-type: none"> <li>• Barbara Casati</li> <li>• Qizhen Sun</li> </ul>
<b>Processes</b>	<ul style="list-style-type: none"> <li>• SOP3</li> <li>• Aircraft</li> <li>• YOPPSiteMIP</li> <li>• Satellite</li> </ul>		<ul style="list-style-type: none"> <li>• Gunilla Svensson</li> <li>• Jonny Day</li> <li>• Ian Renfrew</li> <li>• Taneil Uttal</li> <li>• Timo Vihma</li> <li>• Manfred Wendisch</li> <li>• Barbara Casati</li> <li>• Jun Inoue</li> <li>• Jim Doyle</li> <li>• Steffen M. Olsen</li> </ul>
<b>Southern Hemisphere</b>	<ul style="list-style-type: none"> <li>• Coordination of Southern Ocean observations and modelling activities</li> </ul>		<ul style="list-style-type: none"> <li>• David Bromwich</li> <li>• Kirstin Werner</li> <li>• YOPP-SH group</li> </ul>
<b>PPP-SERA</b>	<ul style="list-style-type: none"> <li>• Develop a strong YOPP SERA component</li> </ul>	<ul style="list-style-type: none"> <li>• YOPPP SERA Plan</li> </ul>	<ul style="list-style-type: none"> <li>• Daniela Liggett</li> <li>• Jackie Dawson</li> <li>• Machiel Lamers</li> <li>• Brian Mills</li> <li>• Rick Thoman</li> <li>• Emma Stewart</li> <li>• Gita Ljubicic</li> <li>• Maaïke Knol</li> <li>• Winfried Hoke</li> <li>• Kirstin Werner</li> </ul>

<b>YOPP Data</b>	<ul style="list-style-type: none"> <li>• Ensure usability</li> <li>• Linkages</li> <li>• Maximize visibility</li> </ul>		<ul style="list-style-type: none"> <li>• Thomas Jung</li> <li>• Richard Swinbank</li> <li>• Kirstin Werner</li> <li>• Barbara Casati</li> <li>• Manuel Fuentes</li> <li>• Machiel Lamers</li> <li>• Torill Hamre</li> <li>• Hironori Yabuki</li> <li>• Siri Jodha S. Khalsa</li> <li>• Thomas Spengler?</li> <li>• Taneil Uttal</li> <li>• Oystein Godoy</li> <li>• NN</li> </ul>
<b>Communication, outreach and education</b>			<ul style="list-style-type: none"> <li>• Kirstin Werner</li> <li>• Jonny Day</li> <li>• Gunilla Svensson</li> <li>• APECS</li> <li>• PPP-SERA member</li> </ul>
<b>YOPP Final Summit</b>			<ul style="list-style-type: none"> <li>• SERA member (Canadian)</li> <li>• Greg Smith</li> <li>• Barbara Casati</li> <li>• Thomas Jung</li> <li>• Kirstin Werner</li> <li>• Irina Sandu</li> <li>• Paolo Ruti / Nanette Lomarda</li> </ul>
<b>YOPP Evaluation</b>	<ul style="list-style-type: none"> <li>• Determine success</li> </ul>		<ul style="list-style-type: none"> <li>• SERA member</li> <li>• Thomas Jung</li> <li>• Kirstin Werner</li> <li>• Paolo Ruti / Nanette Lomarda</li> <li>• stakeholders?</li> </ul>

## Annex V – Recommendations from the YOPP Arctic Science Workshop



### Recommendations

Promote and maintain YOPP data (model and observations), new reanalysis (ERA5, Arctic System)

Case studies: Process focus as well as user engagement

Prioritize coupling vs. inter-comparison: modeling and data assimilation

Mapping of existing models and development plans

Identify minimum complexity of model systems to be able to predict parameter X on timescale Y? (i.e., deal with time scales from nowcasting to decadal climate projections)

Connect oceanographers, hydrologists, and meteorologists to ensure hydrological cycle is better represented

Highlight prioritized problems (biases temperature/moisture/cloud, etc)

YOPP-legacy: Recommendation for Arctic observing system (frequency, distribution)

Inspire stochastic parameterization development

Secure funding for service development

Promote open software tools to exploit YOPPsiteMIP data

### Actionable Items

Establish a database for high impact pan-Arctic weather events (observations, satellite, model data)

Identify, liaise, and communicate with international projects (MOSAIC, APPLICATE, etc.)

Organize a YOPP-SOP Workshop to discuss OSE work

Raise awareness of YOPP data (communication via projects /conferences /workshops /webinars/early career fellowships)

Explore options for workshops on

Applications for satellite data (clouds, vertical profiles, snow depth algorithms, fog, icing, wind, sea ice, floe size/distribution)

Ocean MIP for Arctic: mixing and interaction with sea-ice processes

YOPPsiteMIP: prioritised processes (e.g., phase partitioning in clouds, surface energy budget, snow); process based diagnostics; assessment at supersites

Further encourage exchange between projects: data, model, verification, user engagement, services.

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## Annex VI –Glossary

- 3D-EnVar: A form of data assimilation used in NWP models.
- 4d-EnVar: A form of data assimilation used in NWP models.
- 4D-Var: A form of data assimilation used in NWP models.
- AMAP: Arctic Council’s Arctic Monitoring and Assessment Programme.  
<https://www.amap.no/>
- AMPS: The US Antarctic Mesoscale Prediction System.  
<http://www2.mmm.ucar.edu/rt/amps/>
- AMS: American Meteorological Society. <https://www.ametsoc.org/index.cfm/ams/>
- APECS: Association of Polar Early Career Scientists. <https://www.apecs.is/>
- APPLICATE: Advanced Prediction in Polar regions and beyond: Modelling, observing system design, and Linkages associated with a Changing Arctic climaTE (EU Horizon2020 project). <https://applicat.eu/>
- AROME: AROME is a small scale numerical prediction model, operational at Meteo-France since December 2008. <https://www.umr-cnrm.fr/spip.php?article120&lang=en>
- ASM: Arctic Science Ministerial.  
<https://www.arcticsscienceministerial.org/en/conference-1706.html>
- AWI: Alfred Wegner Institute Helmholtz Centre for Polar and Marine Research.  
<https://www.awi.de/en.html>
- BAMS: The Bulletin of the American Meteorological Society.  
<https://www.ametsoc.org/index.cfm/ams/publications/bulletin-of-the-american-meteorological-society-bams/>
- CAS: The WMO Commission for Atmospheric Science.  
[http://www.wmo.int/pages/prog/arep/cas/index\\_en.html](http://www.wmo.int/pages/prog/arep/cas/index_en.html)
- CBS: The WMO Commission for Basic Systems.  
<http://www.wmo.int/pages/prog/www/BAS/CBS-info.html>
- CLiC: A WMO initiative on Climate and the Cryosphere. <http://www.climate-cryosphere.org/>
- CMIP: Coupled Model Intercomparison Project. <https://www.wcrp-climate.org/wgcm-cmip>
- COMNAP: The Council of Managers of National Antarctic Programs.  
<https://www.comnap.aq/>
- DA: Data Assimilation.
- DAOS: WWRP Working Group on Data Assimilation and Observing Systems.  
[https://www.wmo.int/pages/prog/arep/wwrp/new/daos\\_wg\\_2015\\_main\\_web\\_page.html](https://www.wmo.int/pages/prog/arep/wwrp/new/daos_wg_2015_main_web_page.html)
- DOI: Digital Object Identifier. <https://www.doi.org/>
- DWD: Deutscher Wetterdienst (The German Weather Service).  
[https://www.dwd.de/EN/Home/home\\_node.html](https://www.dwd.de/EN/Home/home_node.html)
- ECCC: Environment and Climate Change Canada. <https://www.ec.gc.ca/?lang=en>
- ECMWF: European Centre for Medium-Range Weather Forecasts. <https://www.ecmwf.int/>
- EC-PHORS: The World Meteorological Executive Council Panel of Experts on Polar and High Mountain Observations, Research and Services.  
<https://www.wmo.int/pages/polar/>
- EGU: European Geosciences Union. <https://www.egu.eu/>
- EMS: European Meteorological Society. <https://www.emetsoc.org/>
- EU Arctic Cluster: Nine currently funded Horizon 2020 Arctic projects and a FP7 funded project together build the EU Arctic Cluster – a network, which merges the most up-to-date findings on Arctic change and its global implications. <https://www.eu-polarnet.eu/eu-arctic-cluster/>
- FMI: Finnish Meteorological Institute. <https://en.ilmatietaenlaitos.fi/>
- github: GitHub Inc. is a web-based hosting service for version control of data and computer code. <https://github.com/>

- GODAE: The Global Ocean Data Assimilation Experiment. <https://www.godae-oceanview.org/>
- GOS: WMO Global Observing System.  
<http://www.wmo.int/pages/prog/www/OSY/GOS.html>
- GTS: The WMO Global Telecommunication System.  
[http://www.wmo.int/pages/prog/www/TEM/GTS/index\\_en.html](http://www.wmo.int/pages/prog/www/TEM/GTS/index_en.html)
- H2020: European Union Research and Innovation Programme.  
<https://ec.europa.eu/programmes/horizon2020/>
- IABP: International Arctic Buoy Programme. <http://iabp.apl.washington.edu/>
- IASC: International Arctic Science Committee. <https://iasc.info/>
- IASOA: International Arctic Systems for Observing the Atmosphere.  
<https://arctic.noaa.gov/Arctic-News/ArtMID/5556/ArticleID/384/International-Arctic-Systems-for-Observing-the-Atmosphere>
- ICO: International Coordination Office for Polar Prediction.  
<https://www.polarprediction.net/background/ico/>
- IICWG: International Ice Charting Working Group.  
<https://nsidc.org/noaa/iicwg>
- IOC: Intergovernmental Oceanographic Commission.  
<http://www.unesco.org/new/en/natural-sciences/ioc-oceans/>
- IUGG: International Union of Geodesy and Geophysics. <http://www.iugg.org/>
- JCSDA: Joint Center for Satellite Data Assimilation in the United States of America.  
<https://www.jcsda.noaa.gov/index.php>
- JWGFVR: WWRP Joint Working Group on Forecast Verification Research.  
[https://www.wmo.int/pages/prog/arep/wwrp/new/Forecast\\_Verification.html](https://www.wmo.int/pages/prog/arep/wwrp/new/Forecast_Verification.html)
- Met Norway: The Norwegian Meteorological Institute. <https://www.met.no/en>
- Météo-France: The French Weather Service. <http://www.meteofrance.fr/>
- MOSAiC: Multidisciplinary drifting Observatory for the Study of Arctic Climate.  
<https://www.mosaic-expedition.org/>
- NAWDEX: The North Atlantic Waveguide and Downstream Impact Experiment.  
<http://www.pa.op.dlr.de/nawdex/>
- NCAR: National Center for Atmospheric Research in the United States of America.  
<https://ncar.ucar.edu/>
- NCEP: National Centers for Environmental Prediction in the United States of America.  
<https://www.ncep.noaa.gov/>
- NMHS: National Meteorological and Hydrological Services. Generic WMO term for weather and hydrology services.
- NOAA: National Oceanographic and Atmosphere Administration, United States of America. <https://www.noaa.gov/>
- NWP: Numerical Weather Prediction.
- OSes: Observing System Experiments. <https://www.wmo.int/pages/prog/www/WIGOS-WIS/reports/6NWP...3/3.10.pdf>
- OSSEs: Observing Simulation System Experiments.  
<http://www.met.reading.ac.uk/~stefano/research/osse/index.html>
- PAMIP: Polar Amplification Model Intercomparison Project. <https://www.wcrp-climate.org/modelling-wgcm-mip-catalogue/cmip6-endorsed-mips-article/1303-modelling-cmip6-pamip>
- PARCOF: Pan-Arctic Regional Climate Outlook Forum. <https://www.arctic-rcc.org/taxonomy/term/4>
- PDEF: WWRP Working Group on Predictability, Dynamics and Ensemble Forecasting.  
[https://www.wmo.int/pages/prog/arep/wwrp/new/pdef\\_wg\\_2015\\_main\\_web\\_page.html](https://www.wmo.int/pages/prog/arep/wwrp/new/pdef_wg_2015_main_web_page.html)
- PPM: Polar Prediction Matters, a YOPP initiated dialogue platform to engage with users of polar weather and sea-ice forecasts. <https://www.polarprediction.net/yopp-activities/polar-prediction-matters/>
- PPP: Polar Prediction Project. <https://www.polarprediction.net/>

- PPP-SERA: Polar Prediction Project Task Team on Societal and Economic Research and Applications. <https://www.polarprediction.net/yopp-activities/yopp-task-teams/ppp-sera/>
- PPP-SG: Polar Prediction Project Steering Group. <https://www.polarprediction.net/steering-group/>
- RMSEs: Root Mean Square Error is the standard deviation of the residuals (prediction errors).....
- Roshydromet: The national weather service of Russia. <http://government.ru/en/department/49/>
- RV Polarstern: German Icebreaking Research Vessel Polarstern. <https://www.awi.de/en/expedition/ships/polarstern.html>
- S2S: Sub-seasonal to seasonal. S2S is a joint initiative of the World Weather Research Programme (WWRP) and the World Climate Research Programme (WCRP). <http://s2sprediction.net/>
- SCAR: Scientific Committee on Antarctic Research. <https://www.scar.org/>
- SH: Southern Hemisphere.
- SIDFex: Sea Ice Drift Forecast Experiment. <https://www.polarprediction.net/yopp-activities/sidfex/>
- SIPN: The Sea Ice Prediction Network. <https://nsidc.org/data/sipn>
- SOP: Special Observing Period.
- SOP1-NH: First Special Observing Period in the Arctic, 1 February to 31 March 2018.
- SOP1-SH: First SOP for the Southern Hemisphere, 16 November 2018 to 15 February 2019.
- SOP2-NH: Second Special Observing Period in the Arctic. 1 July to 30 September 2018.
- SOP3-NH: Third Special Observing Period for the Arctic. 1 February to 31 March 2020.
- SPICE: WMO Solid Precipitation Intercomparison Project. <https://public.wmo.int/en/resources/meteoworld/spice-%E2%80%93improving-snowfall-measurements>
- Supersites: Locations where additional observations or model data has been produced for YOPP, particularly during the Special Observing Periods.
- THINICE 2021: A conference to be organized by AMAP in 2021
- Third Pole: The region that encompasses the Himalaya-Hindu Kush mountain range and the Tibetan Plateau. <http://www.icimod.org/?q=3487>
- THORPEX: The Observing system Research and Predictability Experiment) is an international research programme established in 2003 by the World Meteorological Organization to accelerate improvements in the utility and accuracy of weather forecasts up to two weeks ahead. It is part of the World Weather Research Programme. [https://www.wmo.int/pages/prog/arep/wwrp/new/thorpex\\_new.html](https://www.wmo.int/pages/prog/arep/wwrp/new/thorpex_new.html)
- TIGGE: THORPEX Interactive Grand Global Ensemble. [https://www.wmo.int/pages/prog/arep/wwrp/new/documents/TIGGE\\_brochure.pdf](https://www.wmo.int/pages/prog/arep/wwrp/new/documents/TIGGE_brochure.pdf)
- UK MetOffice: The Weather Service of the United Kingdom of Great Britain and Northern Ireland. <https://www.metoffice.gov.uk/>
- UK: United Kingdom of Great Britain and Northern Ireland.
- US: The United States of America.
- WCRP: The World Climate Research Programme. <https://www.wcrp-climate.org/>
- WGNE: The Working Group on Numerical Experimentation (WGNE), jointly established by the WCRP Joint Scientific Committee (WCRP-JSC) and the WMO Commission for Atmospheric Sciences (CAS), which is responsible for WWRP. <http://wgne.meteoinfo.ru/>
- WMO: World Meteorological Organisation. <https://public.wmo.int/en>
- WWIC: Weather, Water, Ice and Climate. <https://www.polarprediction.net/yopp-activities/yopp-task-teams/ppp-sera/>
- WWRP: World Weather Research Project. [https://www.wmo.int/pages/prog/arep/wwrp/new/wwrp\\_new\\_en.html](https://www.wmo.int/pages/prog/arep/wwrp/new/wwrp_new_en.html)

WWRP-SSC: WWRP Scientific Steering Committee.

[https://www.wmo.int/pages/prog/arep/wwrp/new/main\\_page\\_wwrp\\_ssc.html](https://www.wmo.int/pages/prog/arep/wwrp/new/main_page_wwrp_ssc.html)

x-validation: is a statistical method for assessing how the results of a statistical analysis will generalize to an independent data set.

YOPP Core Phase: From mid 2017 to mid 2019.

YOPP Data Portal: Website providing information and access to data collected during YOPP (<https://yopp.met.no/>).

YOPP: Year Of Polar Prediction. <https://www.polarprediction.net/>

YOPP-SH: The Year of Polar Prediction in the Southern Hemisphere.

YOPPsiteMIP: Year of Polar Prediction Numerical Model Intercomparison Project.

[https://www.polarprediction.net/.../YOPP\\_Supersite\\_common\\_model\\_output.pdf](https://www.polarprediction.net/.../YOPP_Supersite_common_model_output.pdf)

