

WORLD METEOROLOGICAL ORGANIZATION

**COMMISSION FOR ATMOSPHERIC SCIENCES (CAS)
WORLD WEATHER RESEARCH PROGRAMME (WWRP)**

WWRP POLAR PREDICTION PROJECT

STEERING GROUP – 4TH SESSION

BOULDER, COLORADO, USA

1-3 OCTOBER 2013



FINAL REPORT – 18 OCTOBER 2013



1. OPENING

The fourth session of the Steering Group (SG) for the WWRP-THORPEX Polar Prediction Project (PPP) was opened by the chair, Thomas Jung, at 0830 on 1 October 2013 at the Mesa Lab, National Center for Atmospheric Research (NCAR) in Boulder, Colorado, USA.

Thomas Jung thanked those involved in the local arrangements, and particularly NCAR for hosting the meeting at short notice, given the need to relocate from the NOAA facility in Boulder. He regretted that the US partial government shutdown had meant that many NOAA colleagues were unable to participate as planned in the meeting. He welcomed the newest member of the SG, Phil Reid (Australia), who strengthened Southern Hemisphere involvement in the project.

In his opening remarks, he also emphasised the need during the meeting to prioritise and to ensure accountability for agreed actions.

Randy Dole from NOAA, who was able to participate for the first morning only, extended his welcome to the SG. In his position also as a member of the WWRP Joint Scientific Committee (JSC) he commended the SG for progress to date and their published Science and Implementation Plans. He expressed a wish for close coordination between NOAA and the PPP.

Marika Holland from NCAR also welcomed the group, and thanked her NOAA colleagues for their assistance in organizing and relocating the venue for the meeting.

On behalf of WMO, Tetsuo Nakazawa (Chief, WWRP-THORPEX) extended his own welcome and briefly advised that contributions to the Polar Prediction Trust Fund were gradually coming in, with two WMO member countries having contributed to date, and another expected soon. He looked forward to productive discussions, particularly on YOPP and data sharing.

The list of participants in the meeting is given as Annex 1 to this report.

2. ORGANIZATION OF THE MEETING

The meeting agenda was adopted, and is given as Annex 2 to this report. Working arrangements were agreed for the session.

3. REVIEW ECMWF-WWRP/THORPEX POLAR PREDICTION WORKSHOP

3.1. Recommendations

Peter Bauer outlined the main recommendations from the Polar Prediction Workshop, which had been held at ECMWF in Reading, UK, from 24-27 June 2013.

Three working groups had been established with chair and rapporteurs as listed in parentheses:

1. Physical processes, observations and verification (Ian Renfrew & Gianpaolo Balsamo)
2. Multi-scale modelling and coupling (Dave Bromwich & Sarah Keeley)
3. Data assimilation and ensembles (Florence Rabier & Linus Magnusson)

The main recommendations from these working groups, which had already largely been taken into account in the current draft YOPP Plan, are available at http://www.ecmwf.int/newsevents/meetings/workshops/2013/Polar_prediction/papers_for_proceedings/WG_reports.pdf. They were summarized as:

- Correct interplay between boundary layer, cloud and surface processes for the accurate description of vertical mass and momentum transport, surface radiative and energy budget, and the interaction between the shallow polar lower troposphere and large-scale advection in NWP models.
- Main problem areas are:
 - representation of stable boundary layers and their interaction with stratiform clouds and snow covered surfaces;
 - role of moisture advection and turbulence in cloud formation given very low CCN concentrations;
 - speed of hydrometeor phase transitions in mixed phase clouds;
 - the role of rather heterogeneous sea-ice states through the seasons (thickness, leads, melting ponds, snow on ice) as the lower boundary mediating the fluxes at the interface.
- Processes need to be studied in a concerted way and in communication with existing groups like GASS to enable improvement of parameterizations:
 - revisit existing field campaigns such as SHEBA,
 - define observational requirements for planned activities like MOSAIC (YOPP),
 - revisit reanalyses to assess the role of moisture transport and cloud formation,
 - analyse Cloudsat/Calipso datasets to study mixed phase clouds.
- Invest in coupled modelling of snow, sea-ice, ocean (waves) and the atmosphere, also for short and medium range applications:
 - existing multi-layer snow models can already produce a significant step towards improved atmosphere-surface coupling,
 - sea-ice, types, concentration and thickness,
 - sea-ice interaction with ocean currents and waves, snow and the lower atmosphere,
 - enhanced observational capabilities of ice mass balance over large areas (MOSAIC).
- Dedicated research theme under the Polar Prediction Project (PPP) on teleconnections:
 - sea-ice/ocean state,
 - troposphere-stratosphere interaction,
 - poleward advection of heat, momentum and moisture by synoptic weather patterns,
 - regime dependent (e.g., AO) large-scale connectivity. The working groups concluded that this topic poses the need for collaboration with WCRP's Polar Climate Predictability Initiation (PCPI).
- Data assimilation:
 - coupled sea-ice/ocean/atmosphere: ECMWF experimental system for YOPP,

- diagnostics in areas with large-scale enhanced errors,
- observation operators simulating satellite observations (surface, lower troposphere),
- background error (weight in analysis, spread of ensemble analyses and).
- Observations for both verification and data assimilation:
 - observations of opportunity (commercial, field campaigns),
 - detailed sea-ice observations (mostly concentration, thickness and density; snow on ice),
 - PPP's role in defining observational requirements for future space programmes.
- PPP also has a role in fostering education and training courses aimed at early-career scientists.

Subsequent discussion was primarily on the following points:

1. Whether the proposed ECMWF coupled modelling system for YOPP would include data assimilation of coupled components including sea ice and ocean – yes, but probably weakly coupled.
2. The next meeting of WGNE will be in March 2014, which means that consolidated PPP requirements for WGNE should be drafted by November 2013. Possible topics included resolution studies (critical inter alia for convection, orography, and sea ice); the impact of different model analyses on verification; generally topics where WGNE are “the experts” by comparison with members of the PPP-SG; topics which are “game changers”; stable boundary layers over sloping terrain (of particular importance for Antarctica). There could also be a generic question asked of WGNE: When they look at something such as drag, or surface flux parameterizations, and what different contributions to it are for different locations, could they also please focus explicitly on polar regions in support of PPP.
3. Linkages between high latitudes and lower latitudes (sometimes referred to as teleconnections). Several SG members had taken part in a recent Workshop organised by the US National Academy of Sciences on “*Linkages between Arctic Sea Ice Loss and Mid-Latitude Weather Patterns*”(see <http://dels.nas.edu/Upcoming-Event/Linkages-between-Arctic-Warming/DELS-BASCPR-13-01>). This important matter was further discussed under other agenda items, with an action under item 7.2 (PPP Flagship Themes).
4. The importance of “edges” (including ice edges, coastal margins, the edge of the Antarctic continent) as well as in the interior of polar regions – not only are there important processes at “edges”, but this is where marine and other services are most important.
5. Sea ice issues, including the applicability of current rheologies, given finer resolution and “the new Arctic” with less multi-year ice, and suggested work on the predictability of sea ice.

ACTIONS

4SG-01	Peter Bauer	Draft and convey to WGNE, consolidated PPP requirements for WGNE by November 2013 (high priority)
4SG-02	Paco Doblas-Reyes & Thomas Jung & Brian Mills	Organise an international workshop on polar-mid-latitude connections – including participation by WGNE, WGSIP, S2S, and PCPI. Tentatively early 2015. Ensure it is “on

		the calendar ASAP” to avoid conflict with other scheduled meetings. (high priority)
4SG-03	Neil Gordon & Thomas Jung	Ensure there is sufficient emphasis in YOPP Plan on ice edge issues, orographic influences, and not just confined to stable boundary layers
4SG-04	Neil Gordon & Thomas Jung (with assistance from Gunilla Svensson and Chris Fairall)	Ensure there is more emphasis in YOPP Plan on sea ice rheologies, relation to ice age and resolution, cross-cutting work between PPP and PCPI. Ensure that YOPP Plan recognises that stable PBL over flat or sloping terrain is not just an issue for polar regions but also for many other parts of the globe, so that what can be learned and improved is also relevant elsewhere
4SG-05	Thomas Jung / AWI	Carry out predictability studies on sea ice – one-way coupling

3.2. Special Issue of QJRMS

Peter Bauer presented the following list of papers (subject to further small changes) that will be prepared for a special issue of QJRMS, based on the presentations at the ECMWF-WWRP/THORPEX Polar Prediction Workshop. The submission deadline will be 15 January 2014, with a publication date of boreal autumn 2014.

Main authors	Topic
Doug Smith	Seasonal to decadal prediction of the Arctic Oscillation
Virginie Guémas	A review on Arctic sea-ice predictability and predictions on seasonal to multi-decadal timescales
David Bromwich	Regional numerical weather prediction for the Antarctic and Arctic using Polar WRF
Elizabeth Hunke	Weighing the importance of surface forcing on sea ice— A September 2007 CICE modelling study
Florence Rabier	Observation impact over the Antarctic during the Concordiasi field campaign
Andrew Elvidge, Ian Renfrew	What type of föhn event causes the highest melt rates on the Larsen C Ice Shelf, Antarctica?
Linus Magnusson	Ensembles/EDA/Obs
Mark Buehner	Impact of assimilating additional remote sensing data in a sea ice data assimilation system
Peter Bauer	Predictability/global NWP model performance
Thomas Jung	Verification of weather forecasts in polar regions using TIGGE data
Trond Iversen	Predicting weather conditions associated with polar lows
Jonny Day	Ensemble design for the polar regions

ACTIONS

4SG-06	Peter Bauer	Finalise list of proposed papers
4SG-07	Authors	Prepare and submit papers by deadline of 15 January 2014

4. NOAA ACTIVITIES AND INTERESTS

Janet Intriери from NOAA provided a very interesting presentation on NOAA's Arctic activities. The main points were that:

- NOAA has Arctic observing, modelling, and service activities that span across the agency
- NOAA plays a leadership role in U.S. Arctic science and has statutory mandates that extend into the U.S. Arctic & internationally
- A changing Arctic environment expands & elevates NOAA's observing, understanding, & prediction requirements
- Arctic Science & Service is a NOAA priority that are evidenced in their developing plans

She went on to describe NOAA's Arctic Vision & Strategy, which included six identified goals:

1. Forecast Sea Ice
2. Strengthen Foundational Science to Understand and Detect Arctic Climate and Ecosystem Changes
3. Improve Weather and Water Forecasts and Warnings
4. Enhance International and National Partnerships
5. Improve Stewardship and Management of Ocean and Coastal Resources in the Arctic
6. Advance Resilient and Healthy Arctic Communities and Economies

In subsequent discussion, the fact that NOAA has services as well research focus was emphasised.

The SG was pleased to hear about a workshop tentatively planned for mid-March 2014 and titled "*NOAA Science Challenge Workshop: Predicting Arctic Weather and Climate and Their Impacts: Status and Requirements for Progress*". It was expected that PPP Steering Group Members Chris Fairall and Marika Holland would take part; the offer was also extended for the PPP-SG to be involved in planning if that was appropriate.

It was suggested that the recommendations from the workshop at ECMWF and those outlined in the PPP Implementation Plan could provide a good "first guess" for recommendations to be discussed in breakout groups. However, it was also noted that the outcomes of workshop weren't intended to identify "scientific problems". Rather, the outcomes should be to identify where NOAA should be taking specific actions in terms of their own mandates and operational systems, as well as how NOAA could contribute to PPP overall.

The SG noted that there were other meetings around the planned time for the NOAA Workshop that would need to be scheduled around, including a sea ice prediction (CliC International Symposium on Sea Ice) meeting in Tasmania 9-14 March, an International Sea Ice Prediction Research Network meeting in the first week of April; a pan-PCPI workshop of leads and other key people in Boulder from 3-4 April 2014; the Arctic Science Summit Week in Helsinki from 5-11 April 2014.

ACTIONS

4SG-08	All SG Members	Advise Randy Dole of any meetings around March 2014 that could conflict with the workshop planned for Boulder in mid-March 2014, tentatively titled "NOAA Science Challenge Workshop: Predicting Arctic Weather and Climate and Their Impacts: Status and Requirements for Progress"
4SG-09	Thomas Jung	Ensure PPP participation in NOAA March 2014 workshop, including assisting with planning if appropriate

5. YOPP PLANNING SESSION

5.1. Review of YOPP Planning Meeting 1, Including Follow Up on Action Items

The first YOPP Planning Meeting had been held at ECMWF, Reading, UK, on 27 and 28 June 2013. It had agreed on 51 action items. Progress on these was reviewed, and the following items were noted as still requiring action to be completed, or not covered by other agenda items at this PPP-SG4 meeting.

ACTIONS

4SG-10	Thomas Jung	Review what model data are being archived in TIGGE datasets, and recommend any future changes to support PPP and YOPP; Thomas to ask David Richardson/Richard Swinbank to come up with a proposed list - this can then be taken further as appropriate.
4SG-11	Thomas Jung	Review what model data are planned to be archived in S2S datasets and recommend future changes to support PPP and YOPP; Thomas to ask Frederic Vitart what the current list is, so we can check against earlier advice we provided.
4SG-12	Thomas Jung	Contact EC-PORS to ask for their assistance in promoting additional ship-borne observations; will do at EC-PORS meeting in Feb 2014
4SG-13	Neil Gordon	Peter Bauer had raised possibilities for additional polar E-ASAP (and E-AMDAR) observations at EUCOS meeting at ECMWF in week of 1 July 2013; Neil to draft letter from Thomas Jung to EUMETNET
4SG-14	Don Perovich	Assist SG in establishing contact with buoy/sea ice measurement and analysis groups including (see list in report).
4SG-15	Peter Bauer	Arrange for ECMWF to carry out an Observing System Experiment (OSE) to evaluate the impact of additional buoys that were deployed during IPY. Explore the need for similar experiments with other forecasting systems

4SG-16	Thomas Jung	Approach EC-PORS over establishing contact points for YOPP and PPP in China, South Korea, Japan (Jun Inoue perhaps? http://www.jamstec.go.jp/esc/afes/oreda/people/inoue.html.en)
4SG-17	Thomas Jung	Thank Erik Anderson from ECMWF for opportunity to participate in the planned meeting later in 2013 of CBS's Inter-Programme Expert Team on Observing System Design and Evolution (IPET-OSDE), and ask if he can represent polar interests for the next meeting
4SG-18	Thomas Jung	Email Andrew Charlton from SNAP about PPP interest in stratospheric modelling/data assimilation issues, and also raise with new WWRP Predictability Expert Team.
4SG-19	Pertti Nurmi	Working with Laurie Wilson and WGNE, select around six relevant scores, and intercompare models for polar regions.
4SG-20	Pertti Nurmi	Raise PPP verification issues at the next meeting of JWGFVR in Macao, and recommend which could be most relevant for YOPP (noting similar issues also being discussed for S2S)
4SG-21	Pertti Nurmi (and Barbara Brown)	Consider at JWGFVR in Macao, and then report back to the PPPSG, the possibility of a special focus on sea ice verification - perhaps a workshop? This could interest verification experts (as opposed to sea ice experts) in scale-dependent spatial verification techniques. In practice someone should formulate a proposal involving polar experts and verification experts, and ensure that prediction and validation data are provided in appropriate formats.
4SG-22	Neil Gordon	Prepare a short presentation on YOPP to be incorporated on polarprediction.net website when it goes live
4SG-23	David Bromwich & Peter Bauer	Consider writing a paper on reanalysis in the Arctic – either as part of the proposed special issue of QJRM or separately

5.2. Presentation of Latest YOPP Plans

The first draft of the YOPP Plan had been circulated to all meeting participants a week before the meeting. Neil Gordon worked through it to explain the how the draft had been prepared, and highlighted particular points that needed input from the Steering Group.

5.3. Review of Latest YOPP Plans

The meeting concentrated on brainstorming input for two critical components of the YOPP Plan: Model Experiments, and Observations. SG members were also requested to provide comments on the current draft to Neil Gordon by Friday 11 October.

It was also decided that the YOPP Planning Group would include **all** members of the PPP Steering Group, plus invited representatives from partners.

MODEL EXPERIMENTS DISCUSSION

It was agreed that there should be a defined schedule of model experiments during the YOPP Preparation phase. Then, during YOPP itself, new experiments should be run rather than just relying on the standard operational models. Some of the key aspects of model experiments would be:

- High resolution global
- High resolution regional
- Forcing data sets for one-way sea-ice models and predictability experiments

It was suggested that there would be two kinds of experiments:

- (A) Sensitivity studies – understand how the modelling systems work and what is the ‘best’ overall approach and system. Start with perfect predictability approach, and then move to operational type configurations against the “real world”.
- (B) Case studies – how well does the modelling system in various configurations deal with particular extreme events?

The focus of the model experiments could be on the following four aspects:

(1) Coupling (ice)

- Coupled versus uncoupled sea ice predictions (one way experiments valuable, ECMWF could provide forcing data). Compare various different sea ice prediction models from the same forcing. Sensitivity studies that multiple groups could run.
- There could be an ensemble of sea ice predictions based on different atmospheric ensemble members; the spread of the resulting ice predictions based on “pure” atmospheric spread, could be compared with what the spread is from using different ice modelling parameterizations.
- Sensitivity studies – if looking at sea ice predictability on a certain time scale, and at a certain time of year. How important is it to get “right”:
 - Surface state of sea ice?
 - Melt ponds?
 - Snow on ice? Degrade snow on ice and do perfect model studies. How much impact is there on the prediction?
 - Tides?
 - Wave impacts on ice?

(2) Orography

- Both what horizontal and what vertical resolution is required
- Explore the role of resolution and orography
 - Orographic drag
 - Vertical diffusion
 - Land surface coupling

(3) Mesoscale and synoptic scale systems

- Mesoscale systems could include polar lows

(4) Clouds

- Request model centres to compare model predictions with sites (ARM, etc.) where there are high resolution cloud observations
- Clear sky radiances; column liquid water
- For archived model variables – see what was asked for CFMIP (CMIP only saved cloud fraction)

Other brainstorming discussions covered the following points:

- Existing data sets such as SHEBA and Concordiasi should be exploited
- Can experiments explain what Arctic sea ice is decreasing, while Antarctic sea ice is increasing?

In terms of the topic of linkages (which is a flagship theme of PPP, and not just YOPP) it was noted that there is a lot of current attention/interest in extreme events and how they might be related to polar regions (including sea ice changes). Some suggested relevant model experiments

- (1) Remove **all observational data** from polar regions (polewards of say, 60N) and see what happens to weather forecasts in polar regions, and in mid-latitudes
- (2) Relax model in polar regions to re-analysis so it is “perfect” there (the model runs freely in mid and low latitudes). See what is the impact versus letting the polar regions run freely too. (Thomas Jung’s group at AWI has run these experiments, but they have still to be published.)
- (3) Use singular vectors – what is needed in polar regions for maximum growth in lower latitudes?

OBSERVATIONS DISCUSSION

It was noted that, for YOPP, observations will have two purposes – improving initialization, and for model development (improving processes). Most of the subsequent discussion was on initialization, and what additional observations could be provided for YOPP. It was also suggested that model experiments could be used to help optimise station site locations. The DAOS Expert Team could be asked to provide support for an observing system design for polar regions – they are carrying out relevant work on forecast sensitivity to observations.

Points raised were:

- To some extent, what would be useful additional data may be driven by model experiments showing sensitivity to initial values – and then how cost-effective each possible additional source is (e.g., dropsondes versus more routine radiosondes or more surface observations). Data denial experiments are also useful.
- It is important to have free troposphere observations because of decoupling of PBL
- Ice observations will be very important – there are many developments in buoys

- The Antarctic/Southern Hemisphere has its own unique issues – e.g., the “ring of uncertainty” referred to in Florence Rabier’s presentation at the ECMWF Polar Workshop)

ACTIONS

4SG-24	Peter Bauer & Thomas Jung	Develop a coherent list of proposed YOPP model experiments based on the material provided above on the model discussion, and other inputs
4SG-25	Decision	The YOPP Planning Group will be the full SG plus invited representatives from partners
4SG-26	All	Send any comments and suggested edits on the draft YOPP Plan to Neil Gordon by Friday 11 October
4SG-27	Thomas Jung	Ensure a promotional brochure is prepared and approach funding agencies

6. YOPP PLANNING SESSION CONTINUED

6.1. MOSAiC Presentation by Matt Shupe

Matt Shupe covered a lot of detail in his presentation, which will be made available on <http://polarprediction.net>, along with other presentations from the meeting. Further information is also available from the MOSAiC website <http://www.mosaicobservatory.org>

Matt noted that the Arctic sea ice decline was driven by a net radiation change of around 1 W/m², yet the uncertainties and biases from radiative process in the Arctic are quite large.

The leading science question for MOSAiC is: “What are the causes and consequences of an evolving and diminished Arctic sea ice cover?”

This breaks down to areas of:

- Energy budgets, mixing processes, stratification
- Sea ice movement, deformation
- Arctic clouds and interaction with boundary layer
- Biological productivity
- Interfacial exchange rates and elemental cycles
- Large-scale implications for weather, climate, ecosystems

The importance of observing the full annual cycle was emphasized.

Matt specifically covered what, in his view, PPP could do for MOSAiC:

- Promotion & support for MOSAiC effort
- Identifying priority processes and issues
- Specification of measurements: scales, density
- Provide further motivation for additional observational efforts
- Preliminary modelling activities
- Operational model support for field activities
- Specification of needed data products
- Active use of the observations
- Process modelling activities to integrate information

6.2. Discussion of MOSAiC Science Plan

Discussion on the presentation by Matt Shupe, in the context of the preliminary expanded outline of the Science Plan, which had been circulated to meeting participants, was on the following points:

- The question was raised whether the leading science question of “What are the causes and consequences of an evolving and diminished Arctic sea ice cover?” was too broad, and perhaps should be more focussed (e.g., on process understanding). As written, the leading science question could, for example, cover the topic of linkages between polar and lower latitudes, on which a lot of work was being done by other groups including PPP.
- A related discussion was on the requested supporting modelling activities (through the Polar Prediction Project and other groups), and whether any modelling would be an integral part of MOSAiC.
- The purpose of MOSAiC is not just to support improved regional models; it will also support and improve global models; the link to global models should be strengthened in the MOSAiC Science Plan.
- While MOSAiC observations will be extremely useful for PPP and YOPP, YOPP could proceed without MOSAiC (noting the success of YOTC which was a virtual global field experiment)
- The grid box approach was seen as being very important, and should be highlighted in any letter of support from PPP for MOSAiC. It had not been able to be implemented for SHEBA because of a funding shortfall. There was a lot of discussion about the various spatial scales needed – broadly, three – and what the implications were for model processes and resolutions. Something similar to the GASS cold outbreak project modelling approach could be used to assess appropriate scales – run very high resolution models to learn what

scales are. It was also noted that, by the time of MOSAiC, climate models would be running at around 40 km horizontal resolution. In principle it was highlighted that two grid boxes would be needed, a small NWP grid box and a coarser climate grid box.

- The three atmospheric scales suggested were as follows (note that scales are also required for sea ice measurements):
 1. Surface – order 100s of meters
 2. PBL order a few km.
 3. Free atmosphere – order 100 km or so.
- Input should be provided from modellers, including those who were working on stochastic parameterization schemes. This was seen as a unique opportunity for modellers to provide input into an observational strategy. Input should come as early as possible – by the end of 2013 would be good – but can be updated as time goes on; nothing is frozen.
- Brian Mills expressed interest in the “societal/economic benefit” of decision-making support to MOSAiC (both through planning advice as well as field support) as a case study.

ACTIONS

4SG-28	Thomas Jung	Delegate a subgroup of the PPP-SG to prepare draft views for MOSAiC on parameters to be measured, as soon as possible
4SG-29	Thomas Jung & Matt Shupe	Maintain close contact between PPP and MOSAiC, at the very least through cross participation in meetings
4SG-30	Thomas Jung (or delegate) & Matt Shupe	Jointly compile and keep updated a list of upcoming polar field campaigns which are relevant and complementary to YOPP and MOSAiC

6.3. Formal Endorsement of MOSAiC by PPP SG

The PPP Steering Group (SG) discussed, in the absence of non-SG participants, whether they should formally endorse MOSAiC. They agreed to do so, with the action as recorded below:

ACTIONS

4SG-31	Thomas Jung, Neil Gordon & Stefanie Klebe	Draft a letter of support from PPP to MOSAiC, highlighting advantages of grid boxes for parameters including sea ice; noting support for model experiments and linkages studies done elsewhere under PPP umbrella; and offering a consolidated PPP review of the Science Plan when the draft is circulated for comment. Circulate to SG members to ensure agreement, and then send to Matt Shupe.
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6.4. YOPP SERA Aspects Presentation by Brian Mills

Brian provided an overview of the aspects of the YOPP for Society component – or YOPP-S.

- Intense observation and research period leads to more rapid and in-depth results and potentially greater understanding
- Practical, well-defined focal period provides certainty for participants and facilitates collaboration, funding, and research efficiencies
- Makes data and methods available and accessible
- Raises visibility and enables mutual learning and exchange of knowledge/practice among R&D, operational forecasting, and user communities

He proposed the following activities for the three stages of YOPP:

YOPP Preparatory Phase:

- Establish YOPP-S subcommittee in consultation with EC-PORS, International Arctic Social Sciences Association (IASSA), WWRP-SERA, JWGFVR, and NMHSs (1 or 2 liaisons with PPP-SG)
- Prepare review paper, inventory and evaluation of current weather-related hazards/impacts, prediction services, information requirements, and user experiences in applying information in decision-making
 - Includes vertical comparison of scientific/R&D, operational forecaster/service provider, and user perspectives
 - Selection of 3-5 key application areas/cases for detailed analysis in YOPP-S
- Stakeholder engagement/interdisciplinary science workshop(s) to review and verify application area selection, identify expected forecast/prediction improvements, and develop specific social science proposals (new or extensions/collaborations)

YOPP Phase

- Establish repository for YOPP-S primary and secondary data, including survey instruments, interview protocols, and experimental designs
- Conduct research (variety of methods/designs will likely be employed) to characterize and evaluate the use and benefit of improved predictions (various attributes) for each application area/case

YOPP Consolidation Phase

- Publication of societal benefit assessment, experiences and best practices
- Development of a capacity-building initiative targeted to NMHSs and groups of users (e.g., training, workshops)

- Conduct longer-term evaluations where demonstration applications have been operationalized

6.5. Discussion of YOPP SERA Aspects

Discussion covered the following points:

- Can there be education and outreach components for SERA?
- A comprehensive example of a YOPP activity through all three stages of YOPP for one user community – e.g., shipping – would be useful. This could cover statistics of activity (probably isolated to a region), understanding existing decision making processes, what information is used, needs assessment for services, understanding constraints, and the impact of changing some of the inputs (e.g., improved services)
- Other application examples discussed were native communities, oil spill emergencies, fisheries, scientific logistics, tourism, and economic benefit analysis of polar activities.
- It was suggested that application areas chosen should be those with the highest “signal to noise ratio” – where recognizable benefits would be expected. However, a comprehensive benefits analysis might be difficult – illustrative cases may be the preferred route.
- Analysis of decision processes was seen as critical. They would vary with time and space scales
- The concept of setting up a YOPP-S subcommittee could also be usefully applied to modelling and observations

ACTIONS

4SG-32	Brian Mills	Provide updated text for YOPP Plan SERA aspects, including an example (perhaps shipping)
4SG-33	Brian Mills	Establish YOPP-S subcommittee in consultation with EC-PORS, International Arctic Social Sciences Association (IASSA), WWRP-SERA, JWGFVR, and NMHSs (1 or 2 liaisons with PPP-SC)
4SG-34	Thomas Jung	Form subgroups within PPP for (a) modelling and (b) observations
4SG-35	Brian Mills	Prepare review paper, inventory and evaluation of current weather-related hazards/impacts, prediction services, information requirements, and user experiences in applying information in decision-making

7. IDENTIFICATION OF PPP FLAGSHIP THEMES

Thomas Jung reminded the meeting that PPP Flagship themes were areas where we wanted to make progress alongside YOPP; and where PPP can add value; and which could be seen as legacies of the project overall, which had a lasting impact. Identifying these was also one way of answering the question “Is PPP providing something beyond YOPP?”

7.1. YOPP

This is the major PPP flagship theme.

7.2. Polar-lower Latitude Linkages

This topic had arisen at other times during the meeting. There was particular discussion on a recent Workshop (which several PPP-SG members had taken part in) organised by the US National Academy of Sciences on “*Linkages between Arctic Sea Ice Loss and Mid-Latitude Weather Patterns*” (see <http://dels.nas.edu/Upcoming-Event/Linkages-between-Arctic-Warming/DELS-BASCPR-13-01>, and presentations at <http://dels.nas.edu/global/basc/all-presentations>. The report from this workshop should be available around end of 2013.

One of the SG attendees at the Workshop, David Bromwich, reported that it was his impression that there was very strong disagreement between attendees over whether recent Arctic warming has influenced mid-latitude weather patterns, and that research on the Arctic influence on mid-latitudes was still at an early stage.

It was pointed out that the topic of linkages was two-way – it also included lower latitude influences on polar latitudes, since this could affect the quality of polar predictions.

Another relevant upcoming meeting was noted: “The Northern Hemisphere Polar Jet Stream and Links with Arctic Climate Change Workshop” which will be held at the Icelandic Met Office from 13 - 15 November 2013. It is sponsored by the [International Arctic Science Committee \(IASC\)](#), the [Climate and Cryosphere Project \(CliC\)](#) and the [Icelandic Met Office](#). Further details are at <http://www.climate-cryosphere.org/meetings/polar-jet-stream-13>

ACTIONS

4SG-36	Paco Doblado-Reyes & Thomas Jung & David Bromwich & Brian Mills	Organise an international workshop on polar-mid-latitude connections – including participation by WGNE, WGSIP, S2S, and PCPI. Tentatively early 2015. Ensure it is “on the calendar ASAP” to avoid conflict with other scheduled meetings. Open invitation – not a closed workshop. (Brian for possible inclusion of societal benefits and influences) (high priority)
4SG-37	Peter Bauer	Arrange for ECMWF data denial experiments – impact on mid-latitude forecast skill of polar data denial (see earlier action about this).
4SG-38	Thomas Jung	Write up experiments on impact on mid-latitude forecast skill of “perfect” polar knowledge (relax to reanalysis in polar regions)

4SG-39	Jonny Day	Write up study on impact of sea ice on model mid-latitude forecast skill
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7.3. Others

Two additional PPP Flagship Themes were agreed:

(1) Sea ice prediction, including data assimilation, verification, predictability studies, and observational network design. Greg Smith will be one of leaders of this. He will float the idea of more work in existing meetings, and perhaps raise enough interest for a targeted workshop in 2015. Greg has a list of developments and issues (including ensembles)

(2) Improved operational availability of research datasets from polar regions. This had been discussed at YPM-1, with an action item to “Further consider the issue of improved near-real-time access to research observational data in polar regions for operational prediction, including the necessity for metadata, provision of guidance to research groups, and finding an operational centre which could convert data to standard codes.” Cecilia Bitz noted that the Sea Ice Prediction Network also had a strong interest in getting sea ice data into operational systems (primarily from a seasonal prediction perspective). Overall agreed actions to pursue this matter are below.

ACTIONS

4SG-40	Greg Smith	Lead “Sea Ice Prediction” as a new PPP Flagship Theme
4SG-41	Peter Bauer	Request Erik Anderson to find out whether there are ice datasets (e.g., from NSIDC) which are not being made available operationally for potential data assimilation
4SG-42	Phil Reid	Establish whether the Australian Bureau of Meteorology could take on an operational role of recoding and feeding in field and research data sets in proper WMO formats and codes
4SG-43	Greg Smith	Establish whether Environment Canada could take on an operational role of recoding and feeding in field and research data sets in proper WMO formats and codes
4SG-44	Chris Fairall	Establish whether NCAR (UCAR) could take on an operational role of recoding and feeding in field and research data sets in proper WMO formats and codes
4SG-45	Thomas Jung	Write a letter to an appropriate CBS body raising the issue of facilitating getting research data into the operational WMO systems, and asking for assistance and a “how to” guide that could be provided to research groups.

8. SCIENCE SESSION

Following an introduction and welcome from James Hurrell, the Director of NCAR, the following talks were presented to a wider audience than the SG4 participants, and resulted in useful questions and discussion.

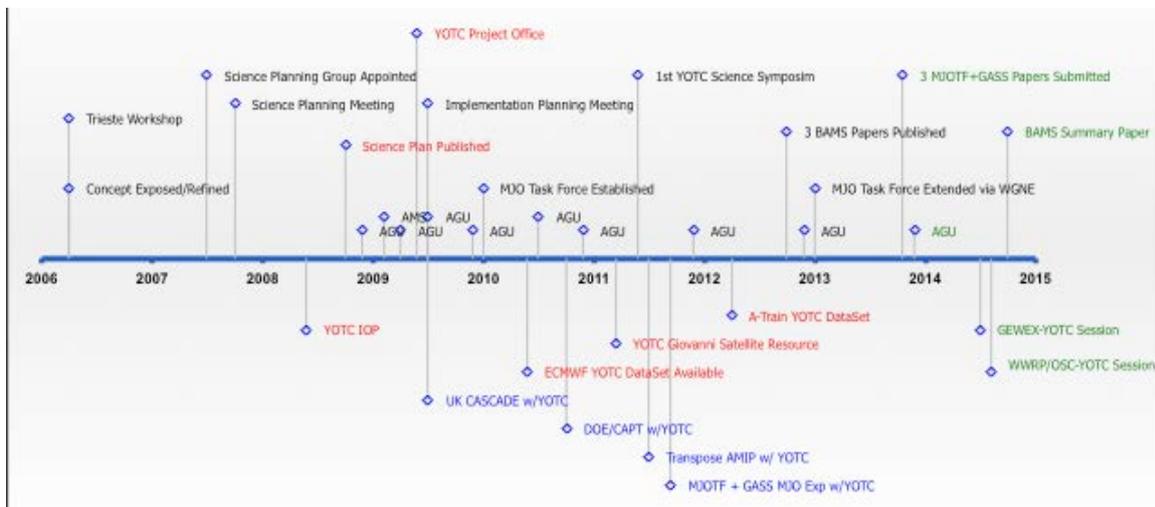
- The Polar Prediction Project, Thomas Jung
- Global Polar Weather Prediction, Peter Bauer
- Meso-scale Polar Weather Prediction over Antarctica, Jordan Powers
- Polar Observations, Donald Perovich
- Seasonal Sea Ice Prediction & Sea Ice Prediction Network, Cecilia Bitz
- Science Challenges for MOSAiC, Matthew Shupe

9. LESSONS FROM YOTC FOR YOPP

Mitch Moncrieff, the co-chair of the Scientific Steering Group for YOTC, gave a presentation to the meeting on YOTC. Some of the main points he made were:

- YOTC is collaborative between WCRP and WWRP-THORPEX; at the weather-climate intersection, a bit like S2S
- YOTC will formally finish at the end of 2014, but will collaborate with S2S and other projects. It was intentionally set up to last for a few years, and then conclude..
- YOTC is not just about the tropics, although organized tropical convection and its physical-dynamical interactions on scales up to global are primary focal areas.
- It is beneficial to have co-chairs to spread the workload and broaden the perspective.
- It is important to have a website and keep it up to date (see <http://yotc.ucar.edu>)
- There are three main components:
 - (1) A “virtual global field campaign”, with data from May 2008-April 2010. This composes a global analysis, 10 day forecasts, and subgrid tendencies, on a 25 km / 16 km mesh supplied by the ECMWF IFS. The global analysis is taken as equivalent to observations on a 25 km scale. Subgrid tendencies are a unique aspect of the YOTC database.
 - (2) YOTC-Giovanni Satellite Data; YOTC A-train database.
 - (3) Research – diagnostic studies, etc.
- Some motivators for YOTC:
 - Understanding & predicting weather extremes in varying climate states as a formidable unprecedented challenge
 - For the first time, the spatial resolution of climate models is such that mesoscale physical & dynamical processes at the weather-climate intersection (weeks-to-months) can be comprehensively addressed

- Accelerate progress via a unified approach to weather & climate research and involving a novel model development framework – virtual global field campaign for climate research using high-resolution weather models that assimilate vast amounts of data,
 - New thinking on convective parametrization needed for representing multiscale organized tropical convection and its scale interactions in global models (weather and climate)
- Precipitation biases occur within a few days in weather forecast models, and appear as climate biases in longer term model runs. Many are related to organized convection, e.g., Mesoscale Convective Systems.
 - MJO research is a very important component. The next generation of high resolution climate models should deal with MJO much better. There are about 50 contributing groups to an MJO Task Force/ YOTC/GASS Model Evaluation Project.
 - A timeline was developed and updated (see below; green to be completed yet) which included a deliberate strategy to make sure that YOTC was visible at AGU sessions



Discussion following the presentation covered the following points:

- YOTC data was archived on pressure levels. It would be useful to archive on model levels, but because this is very expensive, perhaps just for the first day or two.
- Data from a “virtual global field campaign” needs to be usable for research purposes for high resolution climate models as well as “NWP” models
- A YOTC-like YOPP data archive will be useful for purposes other than polar prediction, since it is global; this should be considered during YOPP planning.
- Visualization of data is an important and growing issue ; NCAR is developing a YOTC data visualization framework with the help of in-house CISL and Unidata expertise
- YOTC has helped to catalyse other efforts such as DYNAMO <http://www.eol.ucar.edu/projects/dynamo/>, with which there is substantial research collaboration.

- YOTC datasets could be used to quantify polar biases in short-range predictions, and compare these with climate model biases in polar regions. Since it includes a prominent Arctic Oscillation, the YOTC database could be useful for YOPP research purposes, and as a testbed for the future YOPP database.
- It was noted that YOTC included a goal of “improving climate models”, and the question was raised whether PPP should also have a similar more explicit goal; however, this was seen as where PPP intersects and collaborates with PCPI. In fact, an important outcome of PPP is that it feeds into improvement of climate models, which supports the climate community and GFCS.
- It was suggested to analyse the Transpose-AMIP dataset in the polar regions to see whether climate biases in the high-latitude show also up in short-range forecasts.

10. LINKS WITH WWRP EXPERT TEAMS

It was agreed that, where the PPP Steering Group does not already include representatives from other teams, a formal liaison person should be established.

ACTIONS

4SG-46	Thomas Jung	Propose a liaison person from each relevant WWRP Expert team (and also the other THORPEX legacy projects S2S and HIW), and then work through Tetsuo Nakazawa for those to be agreed and formally designated.
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11. RELATED INITIATIVES

11.1. Link With PCPI

The two co-leads of the Polar Climate Predictability Initiative (PCPI) are Cecilia Bitz (CliC) and Ted Shepherd (SPARC). Cecilia Bitz was able to participate in the SG-4 meeting, and gave a presentation on PCPI to the meeting. As with other presentations, this will be made available on <http://polarprediction.net>.

PCPI is working on six initiatives. There are two co-leads for each initiatives or sub-initiative.

- (1) Improve knowledge and understanding of past polar climate variations (up to 100 years).
- (2) Assess reanalyses in polar regions (joint with PPP)
- (3) Improve understanding of polar climate predictability on seasonal to decadal timescales (joint with PPP)
- (4) Assess performance of CMIP5 models in polar regions
- (5) Model error (joint with PPP)

- (6) Improve understanding of how jets and non-zonal circulation couple to the rest of the system in the Southern Hemisphere

The view is that polar regions are important to global climate, and not just “canaries in the coal mine” for global climate change. Cecilia said that PCPI cuts across all elements of WCRP, but tends to fall between the cracks.

PCPI is at early planning stages – with a good team of co-leads with plenty of enthusiasm. There are lots of model intercomparisons and gathering of datasets that can inform the questions; the intention is to see new initiatives and not just a relabeling of existing programmes to fit PCPI. Collaboration with PPP is important – including a strong relationship with the ICO in Bremerhaven. There will be a pan-PCPI workshop of leads and other key people from 3-4 April 2014 in Boulder.

Cecilia reported that the project scientist Diane Pendlebury is funded until the end of 2013, and has been developing a PCPI web site (funded by CliC).

Discussion following the presentation included the following points:

- The sixth initiative on “how jets and non-zonal circulation couple to the rest of the system” could be tackled using YOTC dataset, supplemented when available by the YOPP dataset. Exploring the uses of such datasets for this purpose would expose their strengths and weaknesses
- Methods for scientific discussion amongst small or large groups on specific topics. Those involving a wider audience tended to use social media tools such as Facebook, blogs and online forums. (An example is the Arctic Sea Ice Forum at <http://forum.arctic-sea-ice.net>). Interaction amongst a more restricted group of scientists could use similar tools for a closed discussion, or virtual meeting tools for either synchronous or asynchronous (over a few days) discussion

A major part of the discussion was on identifying elements of cooperation between PPP and PCPI, since this would be discussed at the EC-PORS meeting in Wellington, New Zealand in February 2014. These elements were identified:

- Co-leads of two of the PCPI initiatives are PPP-SG members, and therefore provide a direct link between PCPI and PPP
- Cross-participation in steering group meetings should continue
- Joint workshops – e.g., the planned polar-lower latitudes linkages workshop such linkages are also a clear point of cooperation
- The PPP flagship theme of sea-ice prediction is strongly related to the Sea Ice Prediction Research Network and PCPI
- Potential PCPI involvement in YOPP (pending the views of PCPI initiative co-leads regarding this)
- High resolution re-analysis
- Model error (PPP is primarily involved with operational centres, and PCPI with climate models, but PPP studies could be done with climate models). The proposed list of model experiments for YOPP should be shared with PCPI.

- Societal issues and services – there is interest and GCFS-related funding for establishing an Arctic Climate Outlook Forum; PPP and PCPI overlap on the important seasonal time scale for this
- Closer involvement by PCPI in the website <http://polarprediction.net>
- Establishing regular teleconferences between PCPI and PPP leaders

ACTIONS

4SG-47	Stefanie Klebe	Send draft YOPP Plan, once new draft available at end of October 2013, to Cecilia Bitz and ask to forward on to co-leads of PCPI initiatives
4SG-48	Cecilia Bitz & Ted Shepherd	Ask co-leads of the six initiatives whether and how they would see involvement in YOPP, and what they see as priority areas
4SG-49	Thomas Jung & Cecilia Bitz & Ted Shepherd	Arrange a regular teleconference with a clear agenda to coordinate common projects (this can be the mechanism for exchanging and discussing information such as PCPI views on YOPP; planned YOPP model experiments, etc.)

11.2. International Sea Ice Prediction Research Network

Cecilia Bitz also gave a presentation on the International Sea Ice Prediction Research Network – a largely virtual collaboration among a dozen core scientists with dozens of other international collaborators. Some key aspects are:

- Evolve the SEARCH Arctic Sea Ice Outlook to an International Sea Ice Prediction Network
- Prediction at seasonal to interannual timescale, synergy with climate projections
- Collaboration of observers, modellers, physicists, and social scientists
- Focus on public engagement and advancing the science of sea ice prediction

There are specific goals for modelling and observational data. No meetings are planned, expect perhaps a kickoff meeting in April 2014 to progress the goals and virtual mechanisms for operation of the network.

11.3. Global Cryosphere Watch (GCW)

Tetsuo Nakazawa gave a presentation on this, based on input from Jeff Key and Barry Goodison. It was recalled that the 16th WMO Congress (2011) agreed that “WMO needs to have a focus on global cryosphere issues to be able to provide authoritative information to meet Members’ responsibilities on regional and global weather, climate, water and related environmental matters, and decided to embark on the development of the Global Cryosphere Watch (GCW), **as an IPY Legacy**, with a view of an operational GCW”. EC-PORS guides GWC development.

GCW includes a web portal, which is intended to provide the ability to exchange cryosphere data, metadata, information and analyses among a distributed network of providers and users in support of informed decision making. This had been suggested as a potential mechanism or model for a portal for YOPP data, although this is not clear.

ACTIONS

4SG-50	Thomas Jung	Continue to investigate options for the YOPP data archive, that builds on existing systems if appropriate
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12. INTERNATIONAL COORDINATION OFFICE

Thomas Jung updated the meeting on progress with the International Coordination Office (ICO). The ICO was formally established when the MOU between AWI and WMO was signed on 26 September 2013. Links with PCPI need strengthening; a Project Scientist has yet to be hired.

The meeting reviewed the website <http://polarprediction.net>; this has been password protected, to allow SG members and PCPI to have a chance to review it and provide input.

It was agreed to make the following improvements to the site:

- Add links to key polar prediction-related publications
- Provide a facility so that users of the site can register to receive an email when the site is updated or a news item is added; alternatively or as well, use a twitter account (perhaps @polarprediction) for the same purpose

ACTIONS

4SG-51	All SG members	Each provide links to a maximum of two papers that could be included on the linked list of publications
4SG-52	All SG members	Review table of upcoming meetings at http://polarprediction.net/en/meetings/calendar_of_related_meetings/ and advise Stefanie Klebe of any that should be added
4SG-53	Stefanie Klebe	Remove password from polarprediction.net as soon as possible
4SG-54	Stefanie Klebe	Email speakers at PPP-SG4 Science Session and ask them if they are happy for their presentations to go on the site, then add to the site
4SG-55	Stefanie Klebe	Add tab on "Education" to the site, which could provide a place for summer school material
4SG-56	Stefanie Klebe	Implement mechanism for tweeting (grab twitter account of @polarprediction) and/or emailing (mechanism needed for visitors to site to provide their email address) when there are updates to the site or news items
4SG-57	All meeting participants	Advise Stefanie Klebe of good contacts/lists to advise that the site is online and live
4SG-58	Stefanie Klebe	Email various partners to advise (including Arctic Info, Cryolist, Climlist)

13. PPP SUMMER SCHOOL

Jonny Day gave a presentation to the meeting on idea for Summer Schools in association with PPP/YOPP. The presentation included the suggestion of doing webinars as well – not just summer schools. The following points were discussed, largely as a result of questions he raised in the presentation.

- APECS and the YOPP Planning Group will co-lead in organisation of workshops/virtual training sessions? It will be particularly important to get APECS involvement in-country where the summer school(s) are held
- One potential host institution is UNIS (<http://www.unis.no>) for the Svalbard summer schools. These are usually held every second autumn, with the next in 2015. UNIS do a lot of the organizing; at least partly funded by one of the Norwegian funding agencies.
- The Abisko Research Station on Lake Tornatrask, Sweden, is a location for existing climate-related summer schools
- The Volkswagen foundation is a potential source of money; but any summer school must be held in Germany.
- It should be possible to get *some* direct WMO funding support for summer schools

ACTIONS

4SG-59	Jonny Day	Provide one page document (actually, the section in the YOPP Plan) to Tetsuo Nakazawa as background
4SG-60	Tetsuo Nakazawa	Investigate and advise on the possibilities for WMO support under Education and Training programme for PPP summer schools
4SG-61	Jonny Day	Follow up with Gunilla Svensson, Cecilia Bitz, Tetsuo Nakazawa and Greg Smith and develop ideas for summer schools (probably best to build on existing activities that have a good overlap, rather than “separate” – and may have different focus for each)

14. WORKSHOPS AND CONFERENCES

14.1. World Weather Open Science Conference (August 2014)

This is planned for 16-21 August 2014 in Montréal (see http://wwosc2014.org/welcome_e.shtml). There will be a special slot for PPP, which was promised visibility as one of the three THORPEX legacy projects; a programme committee should be established.

It could be appropriate to have a one day PPP Steering Group meeting in association with it, although it was noted that this is a difficult time, being “holiday season” for many from the northern hemisphere.

In terms of other opportunities to meet, it was also noted that a second YOPP Planning meeting could be held in association with the Arctic Science Summit Week (see <http://www.assw2014.fi>). This could be a good opportunity to interact with stakeholders about YOPP.

ACTIONS

4SG-62	Thomas Jung	Establish a programme committee from among SG members for the PPP session at the World Weather Open Science Conference in Montréal, 16-21 August 2014
4SG-63	Pertti Nurmi	Help facilitate participation of PPP for a YOPP Planning Meeting in association with ASSW in Helsinki, 5-11 April 2014

14.2. EGU Session

ACTIONS

4SG-64	All SG Members	Advise Thomas Jung if you are able to take the lead on organising a PPP session at EGU – perhaps in 2015.
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14.3. Joint workshop with ICDM-ICPM (2014)

PPP has been approached by the IAMAS commissions on dynamical meteorology (ICDM) and polar meteorology (ICPM), suggesting PPP involvement in a joint workshop on “Dynamic Meteorology in High Latitudes and Atmosphere-Ocean-Ice Interactions”. This is tentatively planned for March 2015 in Bergen, Norway.

There was agreement in principle that it would be good to be involved with this, although some uncertainty about the timing, given that IUGG was planned for Prague in June/July 2015.

ACTIONS

4SG-65	Thomas Jung	Find out more from Thomas Spengler and Richard Swinbank, and whether this conflicts and/or is too close to IUGG in Prague in June/July 2015 and how the cycle with IAMAS works; then progress this if all ok
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14.4. Linkages Workshop

Paco Doblás-Reyes had suggested having a workshop in Europe 2014-2015 with WGSIP involvement as well as S2S and PCPI. This was discussed earlier under several items – see in particular Agenda Item 7.2.

14.5. WCRP/WWRP/WCSP Planning Workshop for Arctic Polar Climate Outlook Forums (2015/2016)

As well as noting that such a meeting was likely, it was considered that PPP representation at two other much earlier meetings organised by other groups would be desirable.

ACTIONS

4SG-66	Thomas Jung	Continue to work with the WMO Secretariat on advance planning for a possible WCRP/WWRP/WCSP Planning Workshop for Arctic Polar Climate Outlook Forums in 2015/2016
4SG-67	All SG members	Each member to consider whether they could represent PPP at (a) an S2S meeting plan for 10-13 February 2014 at NCEP (most relevant for North American SG members), and (b) a JWGFVR scientific workshop in New Delhi on 17-19 March 2014; then advise Thomas Jung

15. TRUST FUND

The meeting was updated on the status of contributions to the Polar Prediction Project Trust Fund. They expressed gratitude for contributions of CAD50k from Environment Canada, and GBP15k from the United Kingdom, as well as the in-kind support on the order of \$90k annually by the Alfred-Wegener Institute for Polar and Marine Research for operations and staffing support for the International Coordination office.

The meeting had also been informed earlier, on the first morning of the meeting, that further contributions were to be expected from the United States, with details and amounts yet to be finalised. This included support from both weather and climate parts of NOAA; in doing so, it was noted that close collaboration between WWRP and WCRP (PPP and PCPI) was seen as an essential element of the Project in order for ongoing support. It was also important that the US, and especially the NOAA Climate Programme Office, be well informed of plans for PPP and YOPP, given the long lead times required for overall coordination of activities.

In terms of other financial support for the programme, Thomas Jung informed the meeting that a portion of the Environment Canada funding provided for the Global Framework for Climate Services (GFCS) was likely to be available for PPP and PCPI jointly, in the 2014-2016 timeframe.

ACTIONS

4SG-68	Thomas Jung	As funding sources are confirmed, write to express gratitude, on behalf of PPP, to the Permanent Representatives of the WMO Members who have contributed
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16. MISCELLANEOUS AND CLOSING

16.1. BAMS Paper on Polar Prediction/AOS paper

Following discussion, it was agreed that it would be timely to prepare a summary paper on the Polar Prediction project for the Bulletin of the American Meteorological Society's (BAMS). This could refer and follow on from a series of papers in 2010 on future modelling strategies, and earth system modelling. Such a paper could also highlight how the various structures, including WGNE, would work together on the PPP.

The meeting was also informed there had been a Call for papers to the proceedings of the Arctic Observing Summit (AOS) 2013 to be published as a thematic cluster of peer-review articles in Polar Research. The deadline for paper submission was 30 October 2013. Given that Chris Fairall had taken the lead on a white paper to the AOS, he was asked to pursue this opportunity.

ACTIONS

4SG-69	Thomas Jung	Write to BAMS editor to propose a PPP summary paper
4SG-70	SG Members	Contribute to the BAMS PPP summary paper when it is written
4SG-71	Chris Fairall	Review requirements for a paper based on the AOS 013 white paper to be submitted to "Polar Research", and if appropriate deliver the paper by the deadline of 30 October 2013.

16.2. YOPP Planning Group Formation

It was agreed that, for the interim, the YOPP Planning Group is effectively the PPP Steering Group with other invited participation as appropriate. This may be further formalised by the time of the second YOPP Planning Meeting, tentatively in April 2014.

16.3. PPP-SG Membership

Given that the SG was still somewhat lacking in terms of observational expertise, especially ice/ocean, all agreed that Don Perovich would be an excellent addition to the Steering Group; he expressed willingness to be involved.

ACTIONS

4SG-72	Thomas Jung	Formally propose to WMO that Don Perovich be added as an additional member of the PPP Steering Group
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16.4. Summary

No major points of discussion were raised.

16.5. Next Steps, Including Meetings

A second planning meeting for YOPP was likely to be in association with the Arctic Science Summit Week in Helsinki, Finland, from 5-11 April 2014, and the fifth session of the PPP Steering Group in association with the World Weather Open Science Conference in Montréal from 16-21 August 2014 (http://wwosc2014.org/welcome_e.shtml). Actions relating to the report and an updated draft of the YOPP Plan are given below.

ACTIONS

4SG-73	Neil Gordon	Prepare v1 draft of SG4 meeting report within next few days
4SG-74	Thomas Jung	Review v1 draft of SG4 meeting report, and provide v2 draft to all SG members
4SG-75	Meeting Participants	Review v2 draft of SG4 meeting report, and provide comments/edits back to Neil Gordon by Wednesday 16 October
4SG-76	Neil Gordon	Finalise SG4 meeting report based on comments, and disseminate
4SG-77	Meeting Participants	Review current draft of YOPP plan as provided prior to SG4 meeting, and provide comments/edits back to Neil Gordon by Friday 11 October
4SG-78	Neil Gordon	Finalise the version of the YOPP Plan by the end of October 2013

16.6. Acknowledgements and Closing

Thomas Jung expressed his thanks to NCAR for providing the venue and catering for the meeting, to NCAR and NOAA for the excellent local arrangements, all SG members and other participants for their productive participation in the meeting, Environment Canada for funding support, and the WMO Consultant Neil Gordon for his assistance to the Polar Prediction Project to date.

The meeting closed at 1230 on 3 October 2013.

ANNEX 1: LIST OF PARTICIPANTS

Name	Email Address	Affiliation	Connections
Thomas JUNG (Chair)	<i>Thomas.Jung@awi.de</i>	Alfred Wegener Institute, GER	PPP-SG EC-PORS Arctic ECRA
Peter BAUER	<i>Peter.Bauer@ecmwf.int</i>	ECMWF, UK	PPP-SG THORPEX
Cecilia BITZ	<i>bitz@atmos.washington.edu</i>	University of Washington, US	WCRP-PCPI
David BROMWICH	<i>Bromwich.1@osu.edu</i>	The Ohio State University, US	PPP-SG PCPI
Barbara BROWN*	<i>bgb@ucar.edu</i>	Research Applications Laboratory NCAR, US	JWGFVR
John CASSANO*	<i>john.cassano@colorado.edu</i>	University of Colorado/CIRES, US	
Jonny DAY	<i>J.J.Day@reading.ac.uk</i>	National Centre for Atmospheric Science, UK	PPP-SG APECS
Randall DOLE*	<i>randall.m.dole@noaa.gov</i>	NOAA Earth System Research Laboratory, US	WWRP JSC
Chris FAIRALL*	<i>chris.fairall@noaa.gov</i>	NOAA, US	PPP-SG
Neil GORDON	<i>Neil.D.Gordon@gmail.com</i>	WMO Consultant, NZ	PPP-SG
Marika HOLLAND	<i>mholland@ucar.edu</i>	Earth System Laboratory (ESL) NCAR, US	PPP-SG
Jennifer KAY*	<i>jenkay@ucar.edu</i>	NCAR, US	
Stefanie KLEBE	<i>stefanie.klebe@awi.de</i>	Alfred Wegener Institute, GER	Admin
Brian MILLS	<i>bmills@uwaterloo.ca</i>	Environment Canada	PPP-SG
Mitchell MONCRIEFF*	<i>moncrief@ucar.edu</i>	ESL NCAR	YOTC
Tetsuo NAKAZAWA	<i>tnakazawa@wmo.int</i>	Chief, WWRP, WMO	
Pertti NURMI	<i>Pertti.Nurmi@fmi.fi</i>	Finnish Meteorological Institute	PPP-SG JWGFVR
Donald PEROVICH	<i>Donald.K.Perovich@erdc.dren.mil</i>	ERDC-RDE- CRREL-NH	MOSAIC
Ola PERSSON*	<i>Ola.Persson@colorado.edu</i>	University of Colorado, USA NOAA/ERSL	MOSAIC

Jordan POWERS*	<i>powers@ucar.edu</i>	ESL, NCAR	
Phillip REID	<i>p.reid@bom.gov.au</i>	Bureau of Meteorology (CAWCR), Australia	PPP-SG
Mark SERREZE*	<i>serreze@kryos.colorado.edu</i>	University of Colorado/CIRES	
Mel SHAPIRO*	<i>mshapiro@ucar.edu</i>	NCAR	
Matthew SHUPE	<i>Matthew.Shupe@noaa.gov</i>	University of Colorado, USA NOAA/ERSL	MOSAIC US DOE
Greg SMITH	<i>Gregory.Smith@ec.gc.ca</i>	Environment Canada	PPP-SG GODAE OceanView
Gunilla SVENSSON	<i>gunilla@misu.su.se</i>	Stockholm University, Sweden	PPP-SG, PCPI
* participation restricted to parts of the meeting			

ANNEX 2: AGENDA

DAY 1, 1 OCTOBER 2013, Venue: NCAR Mesa Lab, Damon Room

1. OPENING [0830-0850]

1.1 Welcome and Introductions

2. ORGANIZATION OF THE MEETING [0850-0900]

2.1 Adoption of the Agenda

2.2 Working Arrangements

**3. REVIEW ECMWF-WWRP/THORPEX POLAR PREDICTION WORKSHOP
[0900-1100, with coffee at 1015-1030]**

3.1 Recommendations

3.2 Proceedings

3.3 Special issue of QJRMS

4. NOAA ACTIVITIES AND INTERESTS [1100-1200]

4.1 Presentation by Janet Intrieri

4.2 Discussion

[Lunch 1200-1300]

5. YOPP PLANNING SESSION [1300-1730]

5.1 Review of YOPP Planning Meeting 1, Including Follow Up on Action Items

5.2 Presentation of Latest YOPP Plans

5.3 Review of Latest YOPP Plans

[Evening – 1900] Joint dinner (own expense) at “The Boulder Dushanbe Tea House”
<http://www.boulderteahouse.com>

DAY TWO, 2 OCTOBER 2013, Venue: NCAR Mesa Lab, Damon Room

6. YOPP PLANNING SESSION CONTINUED

[0830-1130, with coffee at 1030-1045]

6.1 MOSAiC Presentation by Matt Shupe

6.2 Discussion of MOSAiC Science Plan

6.3 Formal Endorsement of MOSAiC by PPP SG

6.4 YOPP SERA Aspects Presentation by Brian Mills

6.5 Discussion of YOPP SERA Aspects

7. IDENTIFICATION OF PPP FLAGSHIP THEMES [1130-1230]

7.1 YOPP

7.2 Polar-lower Latitude Linkages

7.3 Others

[Lunch 1230-1330]

8. SCIENCE SESSION [1330-1730] Venue: NCAR Mesa Lab Seminar Room (20 min presentations plus 15 min discussion each)

- Welcome by James Hurrell, Director of NCAR
- The Polar Prediction Project, Thomas Jung
- Global Polar Weather Prediction, Peter Bauer
- Meso-scale Polar Weather Prediction over Antarctica, Jordan Powers
- Polar Observations, Donald Perovich
- Seasonal Sea Ice Prediction & Sea Ice Prediction Network, Cecilia Bitz
- Science Challenges for MOSAiC, Matthew Shupe

DAY THREE, 3 OCTOBER 2013, Venue: NCAR Mesa Lab, Damon Room

9. LESSONS FROM YOTC FOR YOPP [0830-0900]

- 9.1 Presentation by Mitch Moncrieff
- 9.2 Discussion

10. LINKS WITH WWRP EXPERT TEAMS [0900-0915]

11. RELATED INITIATIVES [0915-1015]

- 11.1 Link With PCPI
- 11.2 International Sea Ice Prediction Research Network
- 11.3 Global Cryosphere Watch (GCW)

[Coffee 1015-1030]

12. INTERNATIONAL COORDINATION OFFICE [1030-1100]

13. PPP SUMMER SCHOOL [1100-1115]

14. WORKSHOPS AND CONFERENCES [1115-1145]

- 14.1 WWRP Open Science Conference (August 2014)
- 14.2 EGU Session (Spring 2015)
- 14.3 Joint workshop with ICDM-ICPM (2014)
- 14.4 Teleconnection Workshop (To Be Decided)
- 14.5 WCRP/WWRP/WCSP Planning Workshop for Arctic Polar Climate Outlook Forums (2015/2016)

15. TRUST FUND [1145-1200]

16. MISCELLANEOUS AND CLOSING [1200-1300]

- 16.1 BAMS Paper on Polar Prediction/AOS Paper
- 16.2 YOPP Planning Group Formation
- 16.3 PPP–SG Membership
- 16.4 Summary
- 16.5 Next Steps, Including Meetings
- 16.6 Acknowledgements and Closing