WORLD METEOROLOGICAL ORGANIZATION

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

WWRP POLAR PREDICTION PROJECT

FIRST YOPP PLANNING MEETING

READING, UNITED KINGDOM

27–28 JUNE 2013

FINAL REPORT – 18 JULY 2013

1.   OPENING

The first planning meeting of the WWRP Polar Prediction Project (PPP) Year of Polar Prediction (YOPP) was opened by the PPP Steering Group Chair, Thomas Jung, at 1400 on Thursday 27 June 2013, at the European Centre for Medium Range Weather Forecasts (ECMWF) in Reading, United Kingdom.

He welcomed the participants, and thanked ECMWF for hosting the meeting, THORPEX for ongoing funding and other support to the project, and the International Arctic Science Committee (IASC) for additional assistance.

He recalled that the preliminary plans for YOPP comprised Chapter 5 of the PPP Implementation Plan (published as **WWRP/PPP-No.2**), which had been distributed to all participants. The plans still largely reflected the views of the PPP Steering Group. This meeting, which immediately followed a very successful ECMWF-WWRP/THORPEX Workshop on Polar Prediction, was therefore the opportunity for wider input to see where the gaps were, what the priorities were, and identify key partners and other issues. Many of previous Workshop presentations and breakout Working Group discussions and recommendations were very relevant to this.

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.   EXISTING YOPP PLANS

A short presentation was given on the existing YOPP Plans. In the ensuing discussion the following points were agreed:

- There should be more emphasis than previously on the YOPP Preparation Phase
- A milestone should be established, such as a pre-operational fully coupled system which could then be run during YOPP
- Prediction of sea ice is a product in itself, and not just a means of improving atmospheric predictions
- Careful attention needs to be paid to establishing databases, and ensuring that observational data can be made available in near-real-time to support operational predictions
- Since the TIGGE database will continue, it is important to review what model data is being archived, and whether any should be added to support PPP and YOPP
- It is also important that model data planned to be archived for the Sub-seasonal to seasonal (S2S) prediction project reflects the needs of PPP and YOPP
- The issue of teleconnections, and particularly the influence of polar regions on mid-latitudes, is broader than YOPP and should be a *separate* "flagship" activity under PPP

ACTIONS:

PPP-SG – 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

PPP-SG – review what model data are being archived in TIGGE datasets, and recommend any future changes to support PPP and YOPP

PPP-SG - review what model data are planned to be archived in S2S datasets and recommend future changes to support PPP and YOPP

PPP-SG – remove Teleconnections from YOPP planning, then put greater emphasis on this in the overall PPP Plan, collaborating closely with other groups such as S2S, WGSIP, IASC/AWG, and various European projects

4. OBSERVATIONS

During extensive discussion, the following points were agreed:

- Commercial shipping is an important potential source of additional observations
- This could include additional Automated Ship Aerological Programme (ASAP) soundings

- More observations are needed in the free troposphere
- The most cost effective way may be additional soundings from existing sites ringing the Arctic and over Antarctica (e.g., four times a day rather than once or twice)
- Additional AMDAR should also be sought from commercial flights over Arctic and logistic flights to Antarctica
- Dropsondes would be expensive as part of routine observing system, but could be useful for Intensive Observing Periods (IOPs) with clear objectives, for coordinated existing planned campaigns

- Sea ice observations will be very important for PPP and YOPP; there is a particular need for more high quality sea ice observations for calibration / validation activities to understand satellite data.
- Spot sea ice measurements include Mass Balance Buoys (with a thermistor string, and acoustic probes looking up and down), and Ice Tethered Platforms (ITP – see *http://www.whoi.edu/page.do?pid=20781*)
- Joint observation of sea ice and salinity are important for coupled data assimilation

- Buoy observations will also be very important
- Contact should be established with the key groups deploying and operating buoys and ice observations
- If not already available, surface pressure and wind observations from buoys should be promoted

- Marine mammal observations are an interesting and potentially valuable source of ocean observations near ice margins, which are otherwise data sparse (no Argo floats – see *http://www-hrx.ucsd.edu/www-argo/statusbig.gif*)
- It will be useful to assess the impact of additional buoys previously deployed during IPY (there is at least one existing study reported at *http://www.jamstec.go.jp/e/about/press_release/20090402/*)

- It is of high priority to obtain proper manual measurements of snow including information on depth, density, grain size (for Microwave retrievals). These are really the only reliable measurements. Should be high priority. This includes snow over sea ice.

- Contacts are needed in key Asian countries – China, South Korea, Japan

- Polar prediction needs should be taken into account as part of WMO's CBS Rolling Review of Requirements (see *http://www.wmo.int/pages/prog/www/OSY/GOS-RRR.html*)

ACTIONS

Thomas Jung – contact EC-PORS to ask for their assistance in promoting additional ship-borne observations

Peter Bauer – investigate possibilities for additional polar E-ASAP (and E-AMDAR) observations at EUCOS meeting at ECMWF in week of 1 July 2013

PPP-SG – promote additional radiosonde observations during YOPP from existing sites ringing the Arctic and over Antarctica

PPP-SG – promote additional AMDAR data during YOPP from commercial flights over Arctic and logistic flights to Antarctica

PPP-SG – establish contact with buoy/sea ice measurement and analysis groups including:
- Don Perovitch at US Army's Cold Regions Research and Engineering Laboratory (CRELL)
- Argo Float Programme – Woods Hole
- Beaufort Observatory
- Ignatius Rigor – IABP Coordinator
- iAOOS
- Christian Haas, York University, Toronto
- Ocean and Sea-Ice SAF, Norway *http://osisaf.met.no*
- University of Washington (PIOMAS)
- Simon Prinsenberg – University of Manitoba (EM Measurements)
- Sea ice thickness – passive microwave – University of Colorado
- Ice Charting Working Group – operational ice analyses – work together for automated algorithms using SAR imagery, etc.

Ian Renfrew – find out more about marine mammal observations, and whether data are available for real-time assimilation

Greg Smith – find out more about marine mammal observations, and whether data are available for real-time assimilation

PPP-SG – request 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

PPP-SG – strongly support other groups working on snow observations and initialisation

PPP-SG – establish 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*)

Thomas Jung – identify and nominate someone from the polar prediction community to participate in the planned meeting later in 2013 of CBS's Inter-Programme Expert Team on Observing System Design and Evolution (IPET-OSDE)

Peter Bauer – review and compile observation recommendations for YOPP from the ECMWF/WWRP-THORPEX Polar Prediction Workshop breakout Working Groups and provide to Neil Gordon and Thomas Jung

Neil Gordon/Thomas Jung – incorporate Workshop observation recommendations as appropriate in the updated draft of the YOPP Plan

5. MODELLING

5.1 PRIORITY AREAS

The following seven areas were considered to merit particular attention for YOPP:

1) Boundary Layer Including Mixed Phase Clouds

   This is a very important area for polar regions. Clouds have a strong impact on momentum mixing and moisture fluxes, etc.

2) Sea Ice Modelling

   There are three distinct areas to consider (as well as to what order the modelling is conducted, the resolution and initialization):

   a. Ice rheologies - for example, including a landfast ice component; better bathymetries; interacting with waves; arching.
   b. Thermodynamic elements (constraint with IMBs; better parameterisation of melt ponds; albedo; satellite observations)
   c. Applying stresses to ice – more ridges, form drag – driven both by atmosphere and oceans

3) Upper Ocean Processes

   There are large heat fluxes on a small scale – e.g., ocean leads. This could influence the way some observations are taken, and will be useful to guide how experiments are conducted during YOPP.

4) Physics of Coupling (Including Snow On Sea Ice)

   This also implies the need for joint observations relating to coupled processes (e.g., salinity and sea ice). Often such measurements may be held within research institutions and not made real-time available in operational formats

5) High Resolution Ensembles

   It was recognised that ensembles are very much a part of modern prediction systems. For example, Norway already provides operational ensemble-based strike probabilities for polar lows. But do we know enough about model uncertainties to have reliable probabilities? Can the models generate the mesoscale features (in the central Arctic)?

   Overall, it wasn't clear how much priority should be placed on this area, and into the representation of model uncertainties for high resolution ensembles, as compared to other aspects of YOPP.

6) Chemistry (Aerosols; Ozone)

It was recognised that transport of soot (black carbon) from mid-latitudes to higher latitudes, followed by deposition on snow and ice could have significant impacts. There was discussion on its relevance to climate, but it was unclear what the observation and prediction issues were, including for seasonal prediction. WGNE activities in this area are mostly case study approaches on atmospheric radiative impacts and not the impact on snow and ice. At the moment there is not sufficient evidence for the forecast relevance of black soot on snow and ice to make it a high priority topic during YOPP. Scientific progress in this field will be monitored by the PPP SG.

7) The Stratosphere

As one of the main sources of predictive skill for S2S scales, this is an area with many initiatives already taking place – e.g., through SPARC, and S2S. The S2S project will be archiving high resolution climate forecasts.

So while this is a high priority issue for PPP and YOPP, it was agreed that it should primarily be carried out by and in collaboration with other groups such as the Stratospheric Network for the Assessment of Predictability (SNAP). Andrew Charlton from Reading University could be an appropriate contact.

However, it was agreed that one area where PPP/YOPP could play a larger part is in data assimilation, and initialization of the stratosphere, including assimilation of ozone measurements. PPP/YOPP could suggest to WGNE that they carry out experiments on improved data assimilation in the stratosphere, with the assistance of the WWRP/THORPEX DAOS group. This could also be an area of collaboration between PPP and PCPI.

ACTIONS

Peter Bauer – review and compile modelling recommendations for YOPP from the ECMWF/WWRP-THORPEX Polar Prediction Workshop breakout Working Groups and provide to Neil Gordon and Thomas Jung

Neil Gordon/Thomas Jung – incorporate Workshop modelling recommendations as appropriate in the updated draft of the YOPP Plan

Neil Gordon/Thomas Jung – incorporate the above priority modelling areas as appropriate in the updated draft of the YOPP Plan

Thomas Jung – raise stratospheric modelling/data assimilation issues at THORPEX ICSC meeting in Geneva in July 2013

5.2 MOSAiC

The meeting was informed about plans for the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC; www.mosaicobservatory.org) by Matt Shupe, one of three meeting participants from the MOSAiC Ad Hoc Organizing Committee. It will be based around a polar research vessel (options are AWI's *Polarstern* or Canada's *Amundsen*) starting in newly formed Arctic sea ice around September 2018 and drifting with the ice over the course of at least a year, to study a full annual cycle. The project is specifically designed to study interdisciplinary process

interactions linking the central Arctic sea-ice, atmosphere, ocean, and biosphere. There will also be a number of Intensive Observing Periods (IOPs) – for example, when the light returns. Such IOPs are likely to include contributions from aircraft flights, as well as complementary drifting vessels.

It was noted that, unlike the previous SHEBA experiment in 1998, MOSAiC would be conducted in first-year sea ice, and modelling links would be built in from the start – which is where collaboration and involvement of YOPP was particularly important. There was much discussion about additional observations which would be taken at points around the central site – to sample mesoscale variability, which would aid in modelling subgridscale processes. Scales involved were likely to be on the order of tens of km, but MOSAiC was very interested in input from YOPP on this matter. Small scales were likely to be sampled more frequently near the surface, while the free troposphere would be sampled less frequently and on larger scales.

MOSAiC would also benefit from new technology, and lessons learned since SHEBA about Arctic clouds and the boundary layer structure. Aerosols were not touched at all during SHEBA; MOSAiC would involve a whole new level of multi-disciplinary processes including biology and broader environmental monitoring.

The YOPP Planning Meeting expressed strong support for MOSAiC, which was complementary, supportive, and potentially a significant component of the overall YOPP plans. They decided that it was important that YOPP be timed to allow for an appropriate lead in and overlap with MOSAiC. The decision on YOPP timing was recorded under Agenda Item 8 (General Issues).

In discussions on how YOPP could best support MOSAiC, as well as working closely together, the following points were agreed upon:

- Formal letters of support for MOSAiC should be sent, at a high level, emphasising the alignment with YOPP objectives

- There should be cross representation in PPP/YOPP and MOSAiC meetings, and cross comment and input into plans

- YOPP should in particular provide their views to MOSAiC on what should be measured both at the site and nearby, and at what spatial scales around the central site. The following could be a structure for formulating these views, and includes some preliminary ideas:

    o What measurements are absolutely crucial, and what is a wish list?
    o What parameters?
        ▪ How is ice distributed when under stress; fails; - internal measurements of stresses in the ice
    o What scales and density of measurements?
        ▪ Measurements of sub-grid scale variability
    o What supporting satellite observations should be made?
        ▪ e.g., extra high resolution imagery over MOSAiC area; SAR

- Model experiments should be carried out as part of the Preparation Phase of YOPP to assist MOSAiC planning – in particular, relating to subgrid parameterization and Large Eddy Simulations (LES)

- SHEBA data should be used for model experiments as part of the YOPP Preparation Phase, which can also assist MOSAiC planning

- It was suggested that some of the proposed measurement strategies for MOSAiC could be tested effectively in advance by exploiting land-based polar supersites

- A range of model experiments should be carried out during YOPP, to take advantage of MOSAiC data for model calibration and validation. In particular, this should include sea ice modelling.

    o The meeting participants expected that sea ice modelling for prediction purposes would become "mainstream" by the time of MOSAiC. Sea ice models are currently validated for the most part using satellite imagery/SAR; MOSAiC could provide additional detailed sea ice measurements, including imagery from UAVs. During IOPs, there could be expanded surface observations and IOP aircraft flights (e.g., by the Met Office UK and/or AWI aircraft) measuring Microwave Brightness, with a goal of making better use of satellite observations in future, having calibrated it from both MOSAiC obs and associated aircraft passes.

- There should be operational model support for MOSAiC during the field campaign
- It was pointed out that the post-processing and archiving of physical model tendencies planned for YOPP should be extended to make sure that the full period of MOSAiC will be covered by the dataset

ACTIONS

PPP-SG – formally approve a letter of support at the next PPP Steering Group meeting (PPP-SG-4) planned for Boulder from 1-3 October 2013, and then send under signature of the PPP-SG Chair, as well as from other key people such as the EC-PORS co-chairs and the WMO Secretary General

Peter Bauer – arrange if possible for a formal letter of support for MOSAiC from the Director General of ECMWF

Thomas Jung – Formally invite MOSAiC representative to the PPP-SG-4 meeting

Neil Gordon – ensure that the updated draft YOPP plan includes text on the MOSAiC contribution, and on actions related to support of and interaction with MOSAiC, including operational model support during the field campaign

Matt Shupe – ensure that the updated draft MOSAiC plan(s) includes reference to YOPP

Matt Shupe – send draft MOSAiC plan(s) to Neil Gordon by 15 September for onward distribution to participants at the PPP-SG-4 meeting from 1-3 October

Thomas Jung – delegate a subgroup of the PPP-SG to prepare draft views for MOSAiC on parameters to be measured, to be discussed at PPP-SG-4

Peter Bauer – formulate a request on behalf of ECMWF saying what the key polar prediction parameterization problems are, which could be provided to LES groups to carry out experiments in support of MOSAiC (and YOPP) as part of the YOPP Preparation Phase. (For example, how does entrainment scale with cloud top cooling – LES studies can be helpful both to improve parameterization schemes and also to inform what observational studies should be made.)

Chawn Harlow – similarly brief the Met Office on the parameterization/LES issues in support of MOSAiC as part of the YOPP Preparation Phase, and explore how they could contribute to the effort.

5.3 YOPP Archived Model Dataset

The meeting considered that archiving of operational model datasets for the Year of Tropical Convection (YOTC) – see *http://yotc.ucar.edu* – was successful, and a "first guess" for what could be similarly done for YOPP.

The meeting decided that a small Working Group should be established to consider this issue. It should review the experiences of archiving was for YOTC, while recognising that YOPP is a different project. Some differences included that the archive would need to include not just atmospheric model data. The review could look at data downloads and reported uses of the YOTC data, although such information needed to be interpreted with care.

As input to the Working Group, the meeting considered:
- It was important to archive tendencies on model grids (nor pressure levels).
- Ideally more than one model should be archived - ECMWF plus other(s)
- Coupled models included sea ice should be in place by the YOPP Phase, which should for the possibility of model intercomparisons in the dataset of fully coupled versus atmospherically driven sea ice predictions
- Since YOTC archived data is global, it could be used as the basis for polar LES modelling now

ACTIONS

Thomas Jung – establish a small Working Group (including an archiving specialist from ECMWF such as Baudoin Raoult) to review the YOTC experience and develop requirements for a YOPP Archived Model Dataset

Peter Bauer – discuss related ocean/sea ice issues at the ECMWF Ocean Reanalysis Meeting to be held shortly at ECMWF

5.4 Other Key Partners and Datasets

While noting that the current PPP Implementation Plan already included a number of key partners and lists of relevant datasets, the meeting requested that the following should definitely be included:

Key Partners
- *GODAE OceanView*
- *FAMOS (Forum for Arctic Ocean Modeling and Observation Synthesis)*
- *WWRP-HIW (High Impact Weather)*
- *CLIVAR-GSOP*
- *SNAP (SPARC Stratospheric Network for the Assessment of Predictability)*
- *WGSIP – multimodel experiments*

Observational Data
- *SHEBA*
- *ASCOS (http://ascos.se)*
- *Networks of supersites (IASOA, www.iasoa.org)*
- *Overwintering ice islands (Russian)*

- *THORPEX-IPY datasets*
- *AOE-2001*
- *CFL*
- *Concordiasi*

Model Data
- *YOTC*
- *ERA-x*
- *TIGGE*
- *APPOSITE*
- *ICE-HFP*
- *NCEP Coupled Model with routine sea ice forecasts (CFS)*
- *Canadian Global Reforecast – downscaled with updated model physics*
- *ASR Reanalysis (15 km) – OSU*
- *S2S dataset – includes sea ice cover and snow (most models not fully coupled; Met Office and NCEP are) – ¼ degree resolution; available in about 3 years*
- *AMPS*
- *PIOMASS*
- *TIGGE-like experiment with GODAE OceanView*
- *MyOcean*

ACTIONS

Neil Gordon – review and update the existing lists of partners and data sources from the PPP Implementation Plan as an ongoing "live document"

6.   VERIFICATION

In discussion on verification, the following points were agreed:

- There should be special emphasis on sea ice verification for YOPP. This would be aided by the trend to automated rather than manual ice analysis, and the planned launch of the RADARSAT Constellation in 2018 (***http://www.asc-csa.gc.ca/eng/satellites/radarsat***) which was very timely for YOPP.
- User-relevant parameters should definitely be verified. This should include the traditional basic elements such as temperature, wind, precipitation and visibility, using available observations since these tend to be located where people are anyway
- Surface currents could be verified – these are relevant to users, and also advect sea ice
- Given the special circumstances in both the Arctic and Antarctic, verification of products for shipping would be of interest
- Of the various purposes and users of verification, diagnostic verification (e.g., scale-dependent verification) is of special value and also provides a link between the verification community and modellers
- Verification of radiation would be an especially interesting diagnostic measure because of its relevance to many processes
- WGNE carries out many verification activities, and has started to look at polar regions, based on standard verification packages; this should be encouraged.
- Awareness of tools and benefits of verification should be raised both for early career scientists at summer school and for others (workshop). Attendance by polar scientists at regular tutorials run by JWGFVR could also be encouraged.

ACTIONS

Pertti Nurmi – continue to generally progress these verification proposals for PPP and YOPP

Pertti Nurmi – continue to promote the importance and challenges of verification in polar regions with a view to enhance polar verification efforts

Pertti Nurmi – working with Laurie Wilson and WGNE, select around six relevant scores, and intercompare models for polar regions.

Pertti Nurmi – discuss the outcome of intercomparison of new techniques by JWGFVR, and recommend which could be most relevant for YOPP

7.   EDUCATION

The concept of a YOPP summer school was fully supported, and it was agreed it should be earlier rather than later. It would provide an excellent opportunity, consistent with the design of YOPP, for productive interaction between observationalists and modellers. It would provide an excellent opportunity to motivate and enthuse early career scientists to be involved in polar prediction.

Sources of funding in addition to university support would likely be needed.

More general outreach and promotion of YOPP was also discussed. It was noted that information provided on the Polar Prediction Project key WMO decision makers during the recent WMO Executive Council session had been well received. However, it was agreed that ongoing efforts to maintain and raise awareness of PPP and YOPP would be necessary, including the planned special issue of QJRMS, brochures, and information on the new polarprediction.net website.

It was noted that MOSAiC will also have an education and outreach component and that it may be useful to coordinate the YOPP and MOSAiC efforts as possible.

Coordination with other polar activities would also be a critical activity; related research activities would continue with or without PPP and YOPP, but it would be to mutual benefit to ensure such activities were harmonised and contributed to YOPP, and YOPP contributed to them.

ACTIONS

Thomas Jung – Explore with AWI the possibility of holding a summer school on Polarstern during its regular transits between hemispheres (through the tropics) for about 10 days

Greg Smith – Explore alternative or additional venue through ArcticNet

Jonny Day – Check through APECS on likely funding sources, including what support would typically be available through universities

Thomas Jung – Check through AWI on likely funding sources

Neil Gordon – prepare a short presentation on YOPP to be incorporated on polarprediction.net website when it goes live

PPP-SG – continue general promotion and raising awareness of PPP and YOPP

PPP-SG – ensure we have good contact and are well connected with all potential groups involved in polar field programmes and observations

8. GENERAL ISSUES

It was decided that YOPP should now extend for a two year period from mid-2017 to mid-2019. This would allow for a bedding in of modelling experiments and other systems for around a year before MOSAiC commenced in September 2018, and then a large overlap with MOSAiC.

Earlier discussions in the meeting had covered key partners. Representatives of these should be included in the YOPP Planning Group.

ACTIONS

Neil Gordon – update YOPP Plan to reflect dates of mid-2017 to mid-2019.

Thomas Jung – propose YOPP Planning Group composition for discussion and approval at PPP-SG-4 in Boulder, 1-3 October 2013

9. PREPARATION PHASE

The following points were agreed:

- It would be essential to establish a baseline for polar prediction performance
- A review paper on the quality of reanalysis in the Arctic would be very useful
- A meta-review of model performance in the Arctic based on previously published studies would also be very useful
- There were many suggested actions for the YOPP Preparation Phase from the breakout Working Groups that should be reviewed and incorporated as appropriate in plans

ACTIONS

David Bromwich – team up with Data Assimilation expert(s) from ECMWF to write a paper on reanalysis in the Arctic – either as part of the proposed special issue of QJRMS or separately

Ola Persson – write a paper reviewing model performance in the Arctic based on previously published studies

Peter Bauer – review and compile recommendations for YOPP from the ECMWF/WWRP-THORPEX Polar Prediction Workshop breakout Working Groups and provide to Neil Gordon and Thomas Jung

Neil Gordon/Thomas Jung – incorporate Workshop recommendations as appropriate in the updated draft of the YOPP Plan

10. CONSOLIDATION PHASE

It was agreed that;

- "Establishment of the YOPP Data Centre" should be brought forward from the Consolidation Phase to the Preparation Phase
- Such a "Data Centre" was more likely to be a portal with consistent metadata and pointers to other online locations where data could be retrieved
- A registration system for users of YOPP data would allow better tracking of downloading and usage of data, and facilitate attribution and acknowledgement of data sources in research papers
- Improvement of models and running of reanalyses would be an interactive process rather than serial
- In general, the Consolidation Phase should be more interactive in terms of stakeholder discussions, and the benefits of new products and demonstrated improvements should be highlighted
- There should be some kind of clear "end" to the YOPP Consolidation Phase in 2022 (aligned with the completion of PPP) which could include a YOPP Symposium or perhaps a special session at the AMS Annual Meeting

ACTIONS

Neil Gordon/Thomas Jung – make appropriate amendments to the YOPP Plan to cover the points raised about the Consolidation Phase

11. WRAP-UP AND CLOSING

In closing, the Chair expressed his appreciation to ECMWF for hosting the meeting, to THORPEX for their support, and to all present for their participation in what had been a very productive session. In particular, the presence of representatives from the MOSAiC project, and discussions about the collaboration between YOPP and MOSAiC had been very useful.

It was agreed that next steps would include revision and expansion of the YOPP section of the Implementation Plan, and the production of a brochure and presentation material on YOPP. The PPP Steering Group meeting planned for 1-3 October 2013 in Boulder, USA would provide an ideal opportunity for review of both the YOPP and MOSAiC plans to ensure alignment.

The meeting closed at 1520 on 28 June 2013.

ANNEX 1: LIST OF PARTICIPANTS

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ANNEX 2: AGENDA

1. OPENING

    1.1   **Welcome from PPP-SG Chair, Thomas Jung**
    1.2   **Purpose of the Meeting**

2. ORGANIZATION OF THE MEETING

2.1   **Adoption of the Agenda**
2.2   **Working Arrangements**

3. EXISTING YOPP PLANS

    3.1   **Review existing proposals from PPP Implementation Plan**
    3.2   **Summarise outcome of Polar Prediction Workshop Discussions**
    3.3   **Discussion**

4. OBSERVATIONS

- **What do we need observations for?**
- **Initialization**
- **Model development**
- **Verification**

5. MODELLING

- **What is holding us back and where should the focus of YOPP lie?**
- **What kind of simulations are needed?**
- **How can the research community be involved?**
- **Do we have a reasonable data inventory?**

6. VERIFICATION

- **Observational requirements**
- **Modelling requirements**
- **User aspects**

7. EDUCATION

- **Summer School**
- **Other suggestions**

8. GENERAL ISSUES

- **Project scale (YOPP costs)**
- **Project dates (is 2017 - 2018 still reasonable?)**
- **Who should be involved?**

- **YOPP core planning group composition**

9. PREPARATION PHASE

- **What kind of preparatory research is urgently needed?**

10. CONSOLIDATION PHASE

- **High level brainstorm of key issues**

11. WRAP-UP AND CLOSING

- **Wrap-up**
- **Next steps**
- **Meeting closure**