

WORLD METEOROLOGICAL ORGANIZATION
**World Weather Research Program (WWRP)
Polar Prediction Project (PPP)
Societal and Economic Research and Applications
(SERA) Meeting**

Universidad de Magallanes, Punta Arenas, Chile
(8-12 April 2019)

WWRP-PPP-SERA-Meeting 5-
report
(Finalised 24 May 2019)]

Report summarising the Fifth
PPP-SERA Meeting

This report summarizes the items discussed and progress made during the fifth annual meeting of the Societal and Economic Research and Applications (SERA) Task Group of the Polar Prediction Project (PPP), coordinated and managed through the World Weather Research Programme (WWRP) of the World Meteorological Organization (WMO). The meeting was held at University of Magallanes (UMAG) in Punta Arenas, Chile, from 8 to 12 April 2019. The meeting was hosted and organized by Dr Jorge Carrasco (University of Magallanes), with logistical and technical support of Patricia Jamett of the Antarctic Gaia Research Center. A list of participants can be found in Appendix A.



PPP-SERA Task Group meeting at University of Magallanes (UMAG), Chile (April, 2019)

Organisation and highlights of the meeting

Jorge Carrasco officially opened the meeting at 09:00 CLST on Monday, 8 April 2019 and provided an overview of the organisational framework and support for the meeting. Dr. Juan Carlos Aravena Donaire, Head of Antarctic Gaia Research Center of the University of Magallanes, provided formal welcoming words at 09:30 CLST.

Specific objectives of the meeting included:

1. Identify and discuss key projects relevant for the SERA objectives. Explore opportunities for advancing new research projects on the global networks of researchers and service providers of weather and sea ice services for both the Arctic and the Antarctic. The study will be based on a survey and analysis of key developments and issues in the user-provider interface, including the use, value, financing, governance and co-production of weather and sea ice services. The results will allow us to provide unique insights into the opportunities and challenges of this dynamic field as well as appropriate recommendations for actions. One potential opportunity could be the Belmont Forum call.
2. Plan for a series of proposed Special Services Projects Workshops based on the 'Weather and Society' workshops format, under the banner of Special Services Projects, as a PPP-SERA contribution to the YOPP Consolidation Phase to be held in 2019/2020. At the workshops, we aim to bring together researchers (including relevant endorsed YOPP projects) and service providers working on cutting-edge approaches for understanding and improving the user-provider interface of weather and sea ice services in the Polar Regions, including challenges of value generation, co-design, and governance.
3. Host a PPP-SERA Open Session in Punta Arenas to extend the PPP-SERA network within South America, to showcase current research, to generate awareness of relevant themes and approaches and to engage in discussions with researchers, service providers and end-users.
4. Engage with the WMO-SERA group through the participating co-chair Julia Chasco
5. Work on tasks related to: Special Issue in Polar Geography, reviewing the EC-PHORS Services White Paper

Additional objectives and activities:

6. Provide members with an update from the Steering Group meeting, the International Coordination Office of PPP, related WMO activities, relevant and endorsed PPP projects, events and funding opportunities.
7. Connect virtually with contributors in Norway, Canada and Australia, who are unable to attend the meeting.
8. Review our goals and future as a group and revisit the action plan and timeline, identifying and confirming key activities and milestones for PPP and YOPP, and the resources or inputs necessary to achieve them (i.e., funding, expertise, data, meetings, etc.).
9. Consider participation/activities by PPP-SERA in upcoming YOPP sessions (e.g. Arctic Council meeting, EGU2020) and other meetings (e.g. ,IICWG September 2019)

10. Prepare and submit a report to the PPP Steering Committee on the results of the meeting and recommendations.

Update from the ICO

Kirstin Werner gave an update on behalf of the PPP International Coordination Office (ICO), which covered the following points:

- a) The YOPP-IASC Arctic Science Workshop (14-16 January 2019) was held at the FMI and hosted over 100 participants. A survey offered after the workshop about the workshop organisation and communication within YOPP indicates that the workshop was well-received and that the PPP website is the best avenue for sharing information.
- b) There are also other communication channels such as newsletter *PolarPredictionNews*, a blog entitled Polar Prediction Matters to engage with users for polar forecast services, several mailing lists, social media accounts (Twitter and Instagram) and printed materials.
- c) How can YOPP involve PPP-SERA in YOPP Communication and Outreach?
- d) Task Team activities reviewed at the SG meeting in Helsinki (new task teams include “Evaluation and Measurement of YOPP success” and “Communication, Education and Outreach” => PPP-SERA involvement requested by both of these teams)
- e) The Consolidation Plan is work in progress. PPP-SERA input is needed.

Update on member activities

Machiel Lamers, co-chair of PPP-SERA and the coordinator of SALIENSEAS-project, from Wageningen University gave an update about the SALIENSEAS activities regarding co-production of climate services in the marine sector. The project is utilizing gaming approaches. He also summarized the YOPP stocktaking work and Master’s thesis conducted by Marijn Hooghiem. One of the key findings of this work is that as YOPP is focussed on science and the academic community, there is no consensus on the different (needed) levels of engagement (e.g. inform, consult, collaborate).

Daniela Liggett, co-chair of PPP-SERA, from the University of Canterbury, has been involved in the Antarctic Platform (Science-Policy Nexus Expert Group). She has given a presentation about the PPP-SERA work on polar mobilities at the SCAR Humanities and Social Sciences conference and will participate in the WAMC and YOPP-SH in Charleston, S.C., in late June 2019. She will offer a PPP-SERA related project for the PCAS course.

Riina Haavisto from the Finnish Meteorological Institute (FMI) updated that TWASE-project successfully ended in 2018, producing meteorological and socio-economic research outputs as well as some support to new service delivery. She has mapped and analysed polar WWIC providers and that work was also submitted to the PPP-SERA Special Issue in Polar Geography. YOPP-IASC workshop was held in Helsinki in January 2019 and it hosted around 100 participants. Unfortunately, FMI’s socio-economic research group does not have polar specific projects at the moment. She will represent PPP-SERA in PARCOF-3 in Rovaniemi, Finland.

Emma Stewart informed the group about new funding opportunities provided by the newly established Centre of Research Excellence in Sustainable Tourism, in Lincoln University, New Zealand. She has also submitted a paper on polar mobilities and information needs to the PPP-SERA Special Issue in Polar Geography. She has also been asked to join to the editorial board of Journal of Sustainable Tourism and will present a poster on the work of the PPP-SERA in New Zealand Antarctic Science conference in June.

Jorge Carrasco from University of Magallanes informed that INACH, National Weather Service and University of Santiago launched radiosondes at Frei Station during the Special Observation Period. National Weather Service is also running PWRP (Polar Weather and Research Forecasting) model for the Antarctic Peninsula at very high resolution and that will be made available to the public in the future. In the process of organising the Open Session, Jorge received feedback from an operator on the issue with accessing weather information on current observations and 24-hour forecasting which is written in code. This is for aviation purposes, but it could also be available in clear text format for other users. This could be of interest for WMO to develop further.

Rick Thoman has retired from US Weather Service and transferred to Alaska Centre for Climate Assessment and Policy (ACCAP), which mission is to improve the climate service delivery and preparedness across rural Alaska. Rick is delivering weekly climate services to the remote communities via traditional media (newspaper, tv and radio) but he is also piloting social media channels (Facebook groups). He has taken part in several funding proposals.

Kirstin Werner from the ICO informed the group about the work in progress regarding the YOPP Consolidation Plan. As PPP is moving to the Consolidation Phase there are also considerations around creating the YOPP legacy. The YOPP-IASC Arctic Science Workshop (14-16 January 2019) at the FMI in Helsinki hosted over 100 participants. The PPP Steering Group has reviewed the Task Team activities, and there is a request to increase PPP-SERA participation in other Task Teams as well. There are several meetings (e.g. SCAR OSC and YOPP meeting; 2020 PPP SG meeting in Bremerhaven, Germany; 2021 PPP SG meeting in Zhuhai, China; 2022 YOPP Summit in Montreal) and Summer Schools (e.g. MOSAiC Summer School in Sep/Oct 2020) and Polar Prediction School #3 probably in April 2021 at Abisko, Sweden) coming.

Gita Ljubicic gave an update about the special sessions on user needs she and Jackie Dawson have organized at the previous ArcticNet conferences, as well as her work in SMART ICE and SIKU projects. These efforts focus on community-based monitoring, community's user needs and service delivery and also sea ice terminology. She stressed that all community members do not understand English, which is why weather information needs to be translated and interpreted.

Julia Chasco from the Argentinian Weather Service introduced herself and gave an introduction about the WMO SERA working group, which she is co-chairing. The WWRP has four priority areas: high-impact weather, water, urbanisation, and evolving technologies. Each WMO SERA member is working in these aspects on their own work, and thus they are contributing to the WWRP task teams that relate to their work. The main research priorities in WMO SERA are: estimation of the economic/social value of weather information,

understanding and improving the use of weather information in decision-making, understanding and improving the communication of weather forecast uncertainty, and development of user verification methods. WMO SERA is now looking for more members.

Paola Uribe from the Chilean Weather Service introduced herself and Chilean Weather Service activities. She also introduced the work of EC-PHORS.

Requests by the SG

A number of requests have been formulated by PPP SG for PPP-SERA to address. These requests were carefully considered and extensively discussed at the meeting in Punta Arenas.

- a) PPP-SERA and YOPP-SH TT to advise PPP-SG of plans for YOPP activities around the SCAR COMNAP conference in Hobart, Australia in August 2020.

Response: There have been in-depth discussions about the type of YOPP activities planned during the SCAR OSC conference in Hobart, Tasmania. We have also consulted Scott Carpentier and David Bromwich in this respect. We have agreement on running a Weather and Society workshop, as part of PPP-SERA's Special Services Projects, in conjunction with the WAMC, shortly before the SCAR OSC. A separate concept note about this workshop will be drafted, together with EC-PHORS representatives, and will be circulated to the PPP Steering Group in due course. At the same time, we are in the process of developing a detailed workshop plan that will be made available to the Steering Group.

- b) PPP-SERA to provide formal feedback on the YOPP Consolidation Plan to ICO immediately after their April 2019 meeting.

Response: The PPP-SERA co-chairs and Jackie Dawson have reviewed the Consolidation Plan and have provided formal feedback to the ICO. If further iterations and feedback are required, PPP-SERA can provide these on request.

- c) PPP-SERA to consider whether to examine socio-economic benefits of impact of Polar Observations in mid latitudes due to the impacts of cold air outbreaks etc on the mid latitudes.

Response: PPP-SERA has discussed this request at the Punta Arenas Meeting and concluded that this topic is too ambitious to be tackled within the YOPP timeframe, especially since the socio-economic data needed to undertake such an assessment are not yet available.

However, it might be feasible to table this topic for discussion with WMO WWRP SERA after the completion of YOPP. Undoubtedly, this is an interesting question, but it would require a concerted effort at an international scale (possibly similar to the identification of sustainable development indicators as done by the UN with its Sustainable Development Goals).

This effort is out-of-scope at the moment, and considering that we do not yet know the impact of improved polar observations for better environmental forecasting for the Polar Regions (which is something the PPP attempts to understand), it would be

too premature to now also focus on assessing the societal benefit of improved observations for the mid-latitudes. There is a lot more work that needs to be done before we can even get to this question as we first of all need to establish whether improved observations actually lead to socio-economic benefits in the Polar Regions and what exactly these benefits entail.

- d) PPP-SERA to invite a representative of WMO-SERA to their next meeting to improve coordination and provide a pathway for the PPP-SERA activities to continue past the end of 2022.

Response: We have had the pleasure of Julia Chasco from WMO WWRP SERA participating in our PPP-SERA meeting and making valuable contributions to our discussions and work. We would like to request WMO support to ensure that the participation of a representative from WMO WWRP SERA can be secured for future PPP-SERA meetings, and vice versa. We are also interested in potentially holding a fully joint WWRP/PPP SERA meeting in the future to ensure optimal cross-pollination of ideas.

- e) ICO/PPP-SERA to coordinate on the need to review the existing list of organisations involved with Polar environmental services and prediction.

Response: Riina Haavisto, on behalf of PPP-SERA, compiled a comprehensive list of polar environmental services providers for both Polar Regions. The landscape of providers is much more diverse and extensive in the Arctic, as compared to the Antarctic, and researchers are, by far, the largest user group of environmental forecasting information. A manuscript that compiles the data of analysis has been submitted for publication in the journal *Polar Geography* and will be made available to the PPP Steering Group once it has been accepted for publication. Concurrently, we are in the process of preparing the submission of this database to the PANGEA database.

PPP-SERA recommends contacting the relevant Arctic Council Working Groups and the Council of Managers of National Antarctic Programs (COMNAP) to explore partnership opportunities.

PPP-SERA also recommends to the ICO to retain a copy of the database on their records and review the database from time to time and update it.

- f) PPP-SERA to update documentation and plans to reflect the change of Special Service Periods to Special Service Projects and the proposal for these to run throughout the YOOP Consolidation Phase period rather than in two short blocks.

Response: PPP-SERA have updated their documentation and plans accordingly and have agreed to hold a series *Weather and Society* workshops (i.e., Special Services Projects) throughout the YOOP Consolidation Phase, up to the YOOP Synthesis Summit.

Special Issue in Polar Geography

Title:

Generating Societal Value from Improved Weather, Water and Ice Forecasts in the Polar Regions

Editors: M. Lamers & D. Liggett

Status of submissions:

Published

Lamers et al. (published 2018). Understanding user needs: A practice-based approach to exploring the role of weather and sea ice services in European Arctic expedition cruising. Article ID: TPOG 1513959

Knol et al. (published 2018). Making the Arctic predictable: The changing information infrastructure of Arctic weather and sea ice services. Article ID: TPOG-2017-0020.R2.

In revision

Stewart et al., Characterising polar mobilities to understand the role of weather, water, ice and climate (WWIC) information

Haavisto et al., Mapping weather, water, ice and climate information providers in Polar Regions: Who are they and who do they serve?

Jeuring et al., Toward valuable weather and sea ice services for the marine Arctic: exploring met-service perspectives on the user-producer interface

De Silva et al., Medium range sea ice prediction for support the Japanese research vessel MIRAI's expedition cruise in 2018

Wagner et al., Sea-ice Information and Forecast Needs for Industry Maritime Stakeholders

Wagner et al., Evolving Polar Tourism Requirements and the Need for Environmental Data

Kettle et al., Opportunities and challenges for co-producing sea ice decision support tools in the Arctic

Bronen, Co-Production on Knowledge: The Foundation for Transformational Climate Adaptation in the Arctic

Belmont Forum Call

The Belmont Forum Call and preliminary ideas for participating in the call were presented by co-chair Machiel Lamers. The recommended budget is up to EUR1.5 Million over 3-4 years per project and eligible countries include Canada, Denmark, France, Japan, Iceland, Netherlands, Norway, Russia, Sweden and the US (project teams must be international and

include a minimum of 3 organisations from three different countries). Thus, eligible PPP-SERA members are only Machiel Lamers, Gita Ljubicic, Rick Thoman and Jackie Dawson. The submission deadline for the proposal is 14 June 2019.

It was discussed whether it was feasible for PPP-SERA members to put in a proposal on “Resilience in a Rapidly Changing Arctic”, which would involve integrated projects with researchers and stakeholders in the format of consortia. It was discussed that the focus could be on community users and in articulating weather and climate services based on their needs, with the aim to investigate further what those needs are. The focus could also be in unifying concepts rather than user groups, e.g. in mobilities. It was also discussed how this proposal could distinguish itself from the more natural-science specific projects that are anticipated to participate in the call. It was agreed that the discussions about participating to the call would continue after the meeting.

EC-PHORS

- (Executive Council Panel of Experts on Polar and High-Mountain Observations, Research and Services) feedback and funding requests
 - EC-PHORS is a WMO council of different experts in polar high-mountain regions research => meeting every year to discuss progress in working groups (three working groups: Research; High-Mountain Issues/Problems; Services – including for glaciers, oceans, climate/climate change)
 - The WWRP’s PPP was born out of EC-PHORS, and EC-PHORS wants to be kept informed about the PPP.
 - Scott Carpentier is one of the co-leaders of the Services WG (Helge Tangen from MetNorway is the leader of the Services WG, which is a new group that was created a couple of years ago, based on a White Paper submitted to EC-PHORS: “*EC-PHORS Services Task Team – Services Requirements Paper*” [updated 8 September 2015], with co-authors: Aimee Devaris, Helge TAngen, Scott Carpentier, Johanna Ikävalko, Anette Jönsson, James Renwick, Vasily Smolyanitsky, Johan Stander, Renee Tausko, Cunde Xiao)
 - The Services WG is still looking for input and focus
 - Email from **Scott Carpentier** was discussed in the meeting in preparation for a teleconference call with Scott that was scheduled for later in the day (see notes from two teleconferences below). This email outlined the following points:
 1. Relevant EC-PHORS requests to PPP SERA
 - a. input on Services Task Team White Paper;
 - a. Improved characterization of societal risks and opportunities in polar and high mountain regions, where WMO can add value;
 2. For Your Information: EC PHORS recommendations to relevant Antarctic National Meteorological and Hydrological Services (NMHSs):
 - b. NMHSs to seek efficient use of resources in service provision by working on synergies, coordination and co-design, towards common goals;
 - c. NMHSs to consider coordinating the products and services they provide to Antarctic operators, build interoperability into existing systems and, where feasible, provide integrated products and services

to improve service delivery capabilities of (WMO) Members to meet end-user needs in the Antarctic.

3. Ideas for a Special Services Period (as part of the Special Services Project)

d. In July-Aug 2020 SCAR will be meeting in Hobart, as will be COMNAP and PPP SERA. The Australian Bureau of Meteorology is also considering hosting the Workshop on Antarctic Meteorology and Climate (WAMC) in Hobart just ahead of SCAR 2020. This would present an outstanding opportunity to run a focused workshop with PPP SERA engaging users and service providers to define a YOPP Special Services Period (SSP) that could be run in Austral Summer 2020-21. Topics to be addressed:

1. End user requirements, including from National, private and commercial actors;
2. Impact of Observations on services;
3. Transition from Research to Operations;
4. Linkages with development of WMO Antarctic Regional Climate Centre Network;
5. Harmonization of services across the Antarctic.

Ultimately, we want to address/explore "points 1 and 2" so as to better inform appropriate investment into Antarctic Service delivery by governments. I.e. where do we get best "Impact and value" from government investment into Antarctic services. So, Scott Carpentier proposed:

- a. EC PHORS STT and PPP SERA to prepare a **Concept Note by September 2019 for a weather and society workshop to be run just before SCAR 2020 in Hobart (Note: Action required);**
- b. Run a SERA Weather and Society Workshop on the last day of the WAMC meeting (just before SCAR 2020) in Hobart, to gain buy-in by the research, service provision and operational community; and
- c. Undertake an Antarctic "Special Service Period" as part of PPP-YOPP in austral summer 2020-21.
- d. (Added by Helge Tangen): also add an SSP for the Arctic and look at obtaining funding proposals

- Many of the points above and information requests are already included in the PPP-SERA Scoping Document but PPP-SERA has to make the document more visible and ensure that it is being read and accessed by the relevant groups => **Action Point: produce a short overview of our main lessons (maybe from the Executive Summary) for the PPM Blog and then a smaller piece for the newsletter**

EC-PHORS objectives cover six activities, with the second one addressing polar predictions and services and the others all addressing the effectiveness of service delivery; the fourth objective focusses specifically product and service delivery in the Antarctic (as the assumption is that this is already a bit better organised for the Arctic, although service delivery might not as well coordinated as it could be) => Kirstin arranged for the respective document to be shared with us for

information only, which happened in the latter part of the meeting. PPP-SERA members have consequently commented on the White Paper.

Notes from two teleconference calls (with Scott Carpentier and Dave Bromwich)

- Teleconference call with Scott Carpentier:
 - Scott manages the delivery of the Australian Antarctic Weather Services (at BoM)
 - Also part of the WMO's EC-PHORS group and co-chairs the Services Task Team at EC-PHORS together with Helge Tangen (who has an Arctic focus)
 - Focus on cross-cutting partnerships between EC-PHORS and PPP-SERA
 - WMO EC-PHORS:
 - WMO New Technical Commissions ⇔ WMO Reform Mapping to develop efficiencies in governance and reflect a shift in strategic priorities
 - Regional Associations (RAs) are playing an enhanced role and work with Technical Commissions => the regional associations are tasked with implementing the weather forecasting recommendations coming from the Technical Commissions
 - Regional Associations for the Arctic are three Regions (North America, Europe and Asia) => this creates some challenges as these RAs have to work together to coordinate Arctic issues
 - Antarctica lies outside any WMO RA => this has led to some challenges regarding some of the good work of the WMO being carried across to the Antarctic
 - ToRs of EC-PHORS include the recognition that the cryosphere (encompassing ca. 100 countries) is one of the most under-sampled domain in the climate system => important gaps => the Polar Regions, the Third Pole and other high mountain areas are extremely important in terms of their impacts on weather, climate and water, and the functioning of the Earth System, etc. => consequently, the WMO established the EC-PHORS with the goal of tackling those gaps
 - EC-PHORS is tasked with engaging across all WMO Members, Technical Commissions and Regional Association as well as relevant research and international organisations and bodies (e.g. COMNAP, SCAR, Arctic Council, etc.) in improving predictive capability and services in Polar Regions on timescales from hours to centuries
 - How can EC-PHORS work with PPP-SERA:
 - Looking at the YOPP schedule, we are now moving into the Consolidation Phase of the PPP => some of the key themes and more extended verification efforts are coming through after the intensive observing period
 - Learnings and discoveries from YOPP will (hopefully) be implemented over the coming years as organisations see fit
 - A bit of a gap exists with regard to how we focus on what we continue working on => How do we know what services to improve and how? (this is from a MetService perspective)
 - Antarctic contribution to YOPP-SH saw nearly a doubling of the number of radiosondes launched (this was very expensive and a lot of work; monies

had to be shifted from other tasks to YOPP efforts) => hope that it was worth it (this very much depends on the work during the verification process)

- Some of the verification work coming out (some models from Japan, Europe, etc.) shows that during the SH SOP not much of an improvement was seen in the 500hPA Geopotential RMSE against observation => a lot more work is required there => key question really is whether the outcome will be better services (this is still a very open questions)
- Paper recently published by Sato & Inoue et al. (2019, Adv. Atm. Science) on additional RAOP at Dome Fuji showed that increased observations had an improved prediction outcome near Syowa Station and could better pick up an extreme wind event
- Remaining questions:
 - What is the value and impact?
 - Are better decisions being made?
 - Are we saving money and lives?
 - Are we mitigating risks and impacts?
 - **How does this inform investment into Services?**
 - **What are the Socioeconomic outcomes?**
 - MetServices are funded by tax payers, and they will ask whether a positive impact results for them in Australia, or elsewhere. => what is the added value from investing in Antarctic work (e.g. for insurance companies w.r.t. extra hours of warning => some well-established techniques from an economics perspective with MetServices, but not much experience with evaluating the societal aspects)
- Improved characterisation of risks and opportunities in polar and high mountain regions, where WMO can add value, via:
 - PPP-SERA to provide input on the EC PHORS Services Task Team White Paper => the 2015 paper needs to be reshaped as it is a bit of a flat paper at the moment that only articulated initial thoughts about gaps in service provision in the polar regions
 - Characterisation of risks and opportunities in the polar and high-mountain regions (for decision makers)
 - **Action Point: PPP-SERA to provide feedback on the 2015 EC PHORS Services Task Team White Paper**
 - PPP-SERA and EC PHORS to coordinate Special Services Periods
 - Aware that our group is thinking about Special Services Projects but would like to stimulate Special Services Periods as part of the Special Services Project
 - Idea to better inform appropriate investment into Polar Service delivery by governments, i.e. where do we get back “impact and value” from government investment into services?
 - Propose an Antarctic Regional Coordination Centre to ensure the same standards in observation parameters across different nations operating in the Antarctic

- (establish best practice and share information across national borders)
- Opportunity through the PPP to attempt to harmonise the delivery of services in the Antarctic (but also in the Arctic => see “Arctic Regional Climate Centres”)
- Objectives would be to evaluate the impact of service changes on end-user decision making => as services improve, are we seeing safer, more confident and more efficient decisions being made?
 - Improved observations?
 - Reduced risk and reduced loss of life?
 - Are decision-makers more confident in MetService products with better articulations and communication?
 - How can we achieve quality assurance (especially considering that it is currently a bit of a “Wild West” as Antarctic weather forecasting services are concerned)
 - Harmonisation of services across the Antarctic (for efficiency, establish best practice and ultimately better meet user needs)
- Evaluate the impact of service changes on NMHSs risk profiles => how does this improve an NMHS in delivering on its mandate to mitigate national weather-related risks?
- Risk matrix (Description of risk – Potential impacts – Existing controls (description and adequacy; i.e. existing investments in risk management) – Risk analysis (likelihood, consequence, risk level) – Is the risk tolerable? – Proposed risk treatments – Resources required to implement – Residual risk estimate)
 - Example of Antarctic aircraft crash due to inaccurate forecast => will have a real impact on an operator
 - Functioning AWS network is important to treat the risk
- Using risk matrix scenarios as a method to investigate what a MetService should invest more in and possibly also what current investments can be scaled back => informing effective investments based on a range of case studies
- Suggested pathway to an Antarctic Special Services Period/Project
 - **EC PHORS STT and PPP-SERA to prepare an SSP Concept Note by September 2019 (Action Point but waiting to hear back from Scott)**
 - Run a PPP-SERA Weather and Society Workshop on the last day of the WAMC meeting (just before SCAR 2020) in Hobart, to gain buy-in by the research service provision and operational community; and

provision [formats, models, scope, spatial coverage, temporal cover, etc.] – there may not be time though; we wouldn't want to do it in the evenings (Dave's hesitation is with regard to the time that is available but he does think that this is a good idea) => **Action Point: Daniela to draft for a proposal for such a workshop/discussion to be sent to Dave and Kirstin**

- One of the main goals of the YOPP-SH meeting will be whether to go ahead with the SOP in 2021 => the SSP at the SCAR OSC will be instrumental in aiding a decision in this regard (the SSP and the SOP will make a nice package)
- Input on the importance of a winter season

Special Services Projects and Weather and Society workshops

(The PPP-SERA meeting in 2021 would be a forum to work on writing deliverables but then possibly a separate meeting is needed)

- Special Services Projects (SSPs):
 - Have a theme running through all SSPs
 - Think about ethics proposal and create a research project (template)
- Breakout group discussion on the Special Services Project for the Northern Hemisphere:
 - 1 workshop in Alaska (lead: Rick Thoman)
 - 1 workshop in Europe (lead: Machiel Lamers and Riina Haavisto)
 - 1 workshop in Russia (possible lead: Yulia Zaika and one other); aligned with the IASSA conference in Arkhangelsk
 - 1 workshop in Canada (lead: Gita Ljubicic and Jackie Dawson) => linked to ArcticNet conferences but ArcticNet is already a full week with lots of side meetings, and it may be difficult to get people to come to another meeting (benefit: low cost as most participants would have funding already to go to the ArcticNet conference); so, the other option would be to partner with Environment Canada to set up a separate workshop, which could be longer (a couple of days) but it would be much more expensive, and Environment Canada might not be willing to fund it (some WMO funding might be necessary)
- Breakout group discussion on the Special Services Project for the Southern Hemisphere:
 - PPP Workshop on WWIC service provision and use in the Antarctic (combine YOPP-SH and WAMC with PPP-SERA's activities)
 - The question is when the best time for the workshop (maybe have the workshop just before the SCAR Business Meetings and then the WAMC and YOPP-SH meeting during the Business Meetings)
 - Keep in mind that we are operating within the framework of the Antarctic Treaty System
 - Invited group of speakers and contributors and a few separate slots for other attendees. These could include:
 - COMNAP (Executive Secretary and Executive Committee members as well as Operations Working Group)
 - IAATO likely to attend the SCAR OSC
 - Scientists

- Bureau of Meteorology of Australia (Scott Carpentier, Phil Reed and others)
- Australian Antarctic Division
- Local tour operators (Aurora Expeditions, Heritage Expeditions, Orion Cruises, Croyden Travel and others)
- Qantas is providing AMDAR data (temperature, wind, etc . from the aircraft) to support weather forecasting services
- R/V *Aurora Australis* captain and crew
- Australian Navy and Air Force
- Fisheries operators (in Australia and New Zealand)
- University of Tasmania (look for local contacts)
- Antarctica Tasmania
- Hobart City Council
- CCAMLR Secretariat
- UNCLOS and IMO might be relevant contributors
- Yacht owners and operators
- Providers of WWIC services other than the MetServices (maybe the IHO, Marine Services)
- Rescue Coordination Centres for the Southern Ocean
- COPERNICUS
- World Café Style Focus Group Discussion (have a night in between => maybe have a day and a half, or even a two-day workshop)
 - Introductory presentations to set the framework
 - Share background material before the meeting (4-5 pages of material)
 - Run a survey before and after
 - *Delphi-style inquiry* with moderators and note takers at each table
 - *Fishbowl approach* (used at AWI; different, previously assigned, groups discussing different topics; chairs in the middle that had the group members discuss an issue for 20 min and other participants as observers that then gave feedback after the discussion) ⇔ good moderator is needed
 - IPTRN meeting in Dawson City used a fishbowl approach to discuss creativity in tourism => experts presenting their views, and the wider community (people outside the fishbowl) then invited to ask questions and offer viewpoints
 - Maybe adopt this approach and have users in the fishbowl discussing their needs and then have providers ask questions and reflect on it
- Funding: we need sponsors for catering as this is not going to be reimbursed by the WMO (possible sponsors could be CCAMLR, IAATO, Antarctica Tasmania, AWI, AAD, other institutions)

Selected new PPP-SERA publications

Dawson, J., Johnston, M. E., Stewart, E. J., & Têtu, P. (2018). Cruise ship passenger experiences of shore visits along the Northwest Passage, Arctic Canada. In *Creative Forces in the Polar Regions: Cultures, Economies, Innovation, and Change in Tourism*, Book of Abstracts, 6th Conference of the International Polar Tourism Research Network (pp. 19).

Yukon, Canada: IPTRN. Retrieved from <https://sites.google.com/view/polartourismresearch/6th-iptrn-yukon-2018/conference-info>

Riina Haavisto, Machiel Lamers, Jorge Carrasco, Jackie Dawson, Daniela Liggett, Gita Ljubicic, Emma Stewart, & Rick Thoman: Mapping weather, water, ice and climate information providers in Polar Regions: Who are they and who do they serve? (submitted to Polar Geography in March 2019)

Liggett, Stewart, Lamers & Dawson (2019) "Understanding the role of climate services for safe Antarctic tourism: A mobilities approach" (oral presentation at the SC-HASS Conference (Ushuaia, 3-5 April, 2019).

Emma J. Stewart, Daniela Liggett, Machiel Lamers, Gita Ljubicic, Jackie Dawson, Rick Thoman, Riina Haavisto, & Jorge Carrasco: Characterising polar mobilities to understand the role of weather, water, ice and climate (WWIC) information. (submitted to Polar Geography in March 2019; accepted with minor revisions, May 2019)

Stewart, E., & Liggett, D. (2018). Polar tourism: Status, trends, futures. In M. Nuttall, T. R. Christensen, & M. J. Siegert (Eds.) *The Routledge Handbook of the Polar Regions* (First ed., pp. 357-370). Routledge. Retrieved from <https://www.routledge.com/The-Routledge-Handbook-of-the-Polar-Regions/Nuttall-Christensen-Siegert/p/book/9781138843998>

Stewart, E. (2018). Stakeholder perspectives on Antarctic tourism. In *Creative Forces in the Polar Regions: Cultures, Economies, Innovation, and Change in Tourism*, Book of Abstracts, 6th International Polar Tourism Research Network (IPTRN) Conference and Community Tour (pp. 17). Yukon, Canada: IPTRN. Retrieved from <https://drive.google.com/file/d/0B1ifaQKqE9Rrd3dOZno1Q2V3cmQxSXhiTnZjRExjTlppS1ZR/view>

Weber, M., Dawson, J., & Stewart, E. (2018) Marine Tourism trends in the Canadian Arctic: Risks and Opportunities. ArcticNet Annual Meeting, Ottawa, Canada. Retrieved from <http://www.arcticnetmeetings.ca/asm2018/pages/program.php>

Review of PPP SERA Action Plan (see also WMO, 2015, 2016, 2017)

a) **Short-term** (by June 2019):

- Finalise and submit PPP-SERA responses to PPP SG requests (**Co-chairs**)
- Submit a report on the PPP-SERA meeting and Open Session to the Polar Journal (Jorge Carrasco, Paola Uribe, Daniela Liggett)
- Prepare a PPM blog post (Gita Ljubicic, Rick Thoman)

b) **Medium-term** (till the end of the YOPP Core Phase, 2019):

- Review the PPP-SERA website (All)
- Ensure a contribution to the PPP Summer School (**Machiel Lamers, Emma Stewart**)
- Formulate plan for W&S workshop at the SCAR OSC together with EC-PHORS (Daniela Liggett, Emma Stewart and Scott Carpentier)
- Present an update on PPP-SERA at the YOPP-SH Meeting (Daniela Liggett)

c) **Long-term** (2019-YOPP Summit in 2022): [these are from last year's report]

- A broad analysis of PPP-SERA-related research (synthesis of research undertaken under the PPP-SERA umbrella) should be aligned with the research agenda of the Scoping Document.
- PPP-SERA to run YOPP *Special Services Projects* (SSPs) and the PPP Weather & Society Workshops.
- PPP-SERA to assist the WMO during the PPP *Evaluation and Services Phase*.

d) **Continuous** [these are from last year's report]

- Continue to raise the profile of PPP-SERA-related research and enhance connections with modelling and forecasting research (**Action: All**).
- As feasible, develop focused collaborative projects within the committee, based on existing data and information (e.g. contribution to the Arctic resilience call through the Belmont Forum; shipping in Arctic Canada, international surveys of sea ice information providers, remote community and urban mobilities, all in relation to how they use weather and sea ice information in support of making decisions) and new projects within or outside of PPP-SERA (e.g. the SALIENSEAS project, see Lamers, 2017).
- Participate in YOPP meetings and continue having annual PPP-SERA meetings. The next PPP-SERA meeting is already in the early planning phase,

to be hosted by Kirstin Werner in Bremerhaven, Germany, in April 2020
(Action: Co-chairs and Kirstin Werner).

- As appropriate, contribute to YOPP education and outreach activities, especially the next PPP Summer School, which goes in hand with capacity building. PPP-SERA offers to provide input and feedback to the PPP community via the SG.
- Continue to contribute and collaborate in the user feedback forum of the PPP ('Polar Prediction Matters').

Members, committee decisions and next steps

Julia Chasco will serve as a point of contact regarding WWRP-SERA activities.

External Activities

A PPP-SERA Open Session has been held at the premises of the University of Magallanes, Punta Arenas.

References

Lamers, M. (2017). SALIENSEAS. Retrieved 20.4.2017 from <http://jpi-climate.eu/nl/25223451-SALIENSEAS.html>

WMO (World Meteorological Organization). (2015). World Weather Research Program (WWRP) Polar Prediction Project (PPP): Societal and Economic Research and Applications Meeting: Report. Ottawa, Canada. Retrieved 19 May 2017 from http://www.polarprediction.net/fileadmin/user_upload/www.polarprediction.net/Home/Meetings/SERA/WWRP-PPP-SERA-Mtg1-Ottawa_report_DRAFT-final_9-Apr-2015.pdf.

WMO (World Meteorological Organization). (2016). World Weather Research Program (WWRP) Polar Prediction Project (PPP): Societal and Economic Research and Applications Meeting: Report. Christchurch, New Zealand. Retrieved 8 April 2017 from http://www.polarprediction.net/fileadmin/user_upload/www.polarprediction.net/Home/Meetings/SERA/WWRP-PPP-SERA-Mtg2-Christchurch_report.pdf.

WMO (World Meteorological Organization). (2017). World Weather Research Program (WWRP) Polar Prediction Project (PPP): Societal and Economic Research and Applications Meeting: Report. Fairbanks, Alaska, USA. Retrieved 8 May 2018 from http://www.polarprediction.net/fileadmin/user_upload/www.polarprediction.net/Home/Meetings/SERA/2017-PPP-SERA-Mt3.pdf.

List of Abbreviations

AWI	Alfred Wegener Institute for Marine and Polar Research
EPB	European Polar Board
FMI	Finnish Meteorological Institute
NOAA	National Oceanic and Atmospheric Administration (USA)
PI	Principal Investigator
PPM	Polar Prediction Matters
PPP	Polar Prediction Project
PPS	Polar Prediction School
SERA	Societal and Economic Research and Applications
SG	Steering Group (of the Polar Prediction Project)
SOP	Special Observation Period
SSP	Special Service Period
WMO	World Meteorological Organisation
WWIC	Weather, water, ice and climate
WWRP	World Weather Research Programme (WMO)
YOPP	Year of Polar Prediction

Appendix A — Participants

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