WORLD METEOROLOGICAL ORGANIZATION

YEAR OF POLAR PREDICTION

ACHIEVEMENTS AND IMPACTS

Photo: Christian Rohleder /AWI

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PREFACES

It is my pleasure to present this booklet on the successes and achievements of the World Weather Research Programme's (WWRP) Polar Prediction Project, a 10-year flagship activity that began with the aim of "enabling a significant improvement in environmental prediction capabilities for the polar regions and beyond, by coordinating a period of intensive observing, modelling, verification, user-engagement and education activities" and of which the Year of Polar Prediction is a key element.

Anthropogenic climate change has amplified and exacerbated environmental changes in the polar regions, including changes such as decreasing sea ice cover and diminishing snow cover. Because of these trends, increased human activity in the polar regions, such as shipping, fisheries, tourism and increasing governmental and socio-economic interests, require new and better weather forecasts and climate services to support decision-making. This includes support to indigenous communities and livelihoods and consideration of traditional knowledge in the decision-making process.

The poles also influence weather and climate conditions in lower latitudes where hundreds of millions of people live. Warming Arctic air masses and declining sea ice are believed to affect ocean circulation and the jet stream, and are potentially linked to extreme phenomena such as cold spells, heat waves and droughts in the northern hemisphere.

Over the last 10 years, the Polar Prediction Project and its leadership have delivered a high calibre research project that has made bounds in the science of polar prediction, including understanding the impact of sea ice decline on mid-latitude extreme events and production of special datasets, which support model forecast evaluation, predictability studies and model error analyses over polar areas, which are strongly affected by climate change.

I would like to thank all contributors to this booklet for their hard work and enthusiasm in progressing the science and communication of polar forecasting. I hope that it provides clear evidence for the outstanding accomplishments achieved so far and evidence for the continued need for enhanced polar observations, numerical modelling and prediction, and systems and services to protect polar communities to ultimately mitigate the economic impacts of severe weather.

Peterri Taalas
WMO Secretary General

The initiation of the Year of Polar Prediction (YOPP) goes back to the 2000s when we saw a recrudescence of attention for Earth's polar regions. Concerns about an amplification of anthropogenic climate change at higher latitudes combined with an increasing interest of many stakeholders throughout the polar regions have required urgently to improve polar Numerical and Environmental Weather Prediction (NEWP) with sea ice forecasts an important motivation. The third International Polar Year in 2007-2008 orchestrated a multitude of research and development initiatives to accelerate the benefit of forecast applications in polar regions like the THORPEX projects cluster. A legacy of the latter was through the establishment in 2012 of the WMO Polar Prediction Project (PPP), led by Thomas Jung, to support the international coordination of polar prediction research activities to allow a significant improvement in NEWP capabilities for the polar regions and beyond, by organising a period of intensive observing, numerical modelling and prediction, verification, user-engagement, and education activities. Following a thorough planning period that was finalised in conjunction with the first World Weather Open Science Conference (Montreal, 2014), the YOPP was established as the flagship of the PPP. After witnessing more than three decades of polar NEWP research and development, I consider YOPP as one of the most significant and integrated R&D contributions. But there is still much to do!

Gilbert Brunet
Chair WWRP Scientific Steering Committee
2007-2014

The implementation of the Polar Prediction Project and the Year of Polar Prediction is a major success story for WWRP and for WMO as a whole. Under the leadership of Prof Thomas Jung, PPP has engaged the weather, climate, ocean, sea ice and social science communities and integrated infrastructure and service elements into the scientific planning. This created a momentum that overcame structural boundaries at all levels and inspired statements and actions at the highest political level of the Arctic Science Ministerial Conferences. PPP fostered the development of an Earth System approach in NWP and improved the understanding of the value of observations in remote regions and of their impact on mid-latitude weather predictions. It contributed to the understanding of sea ice-ocean-atmosphere interactions and improved the simulation and understanding of Arctic weather extremes, providing means to make the Arctic a safer place for indigenous people and for people operating there. PPP was enormously successful in mobilising resources for the successful implementation. Conservative estimates suggest that much more than 20 Mio Swiss Francs can be attributed as third-party funding to the PPP/YOPP. Over 100 projects and institutions have received YOPP endorsement. The observing and modelling communities were brought together efficiently with many institutions around the world involved. The success of YOPP was also based on major outreach events and the use of social media, raising awareness of the scientific and operational constraints in polar regions and bringing the Arctic and Antarctic closer to the interests of many institutions and the general public. PPP/YOPP have demonstrated how a seamless value cycle approach can be achieved in the WMO. It is crucial that the WMO continues to provide an environment in which such initiatives can develop and thrive.

Sarah Jones
Chair WWRP Scientific Steering Committee
2014-2019

The period 2013-2022 has seen remarkable advances in polar research spurred by the Polar Prediction Project and activities connected to the Year of Polar Prediction. With the YOPP Special Observing Periods in 2018 and 2019, and the pioneering MOSAiC Expedition in 2020, rich datasets have been collected. These data are fueling ongoing research into processes within the atmosphere-ocean-ice system in the Arctic, and with attention to land-ice processes over Antarctica. The YOPP Data Portal provides an excellent point of access to these data. The YOPPsiteMIP (YOPP site Model Intercomparison Project) is now focusing on using novel data to improve aspects of our numerical models, including high-latitude mixed-phase clouds, surface energy balance, ocean mixing and boundary-layer structure. Improving our models will be critical to exploring the predictability of the coupled systems in polar regions and how the processes in these regions influence predictability at lower latitudes. In addition to model improvements, the next stage of polar prediction research will lead to applications where we can exploit our technological advances to better anticipate impacts caused by an increasingly ice-free Arctic in late summer, to predict impacts of Arctic storms and changing ocean and land ecosystems on populations within the region, and to better model the processes that contribute to melting Antarctic glaciers that has profound impacts for coastal regions everywhere. In many ways the last decade is just the beginning as polar research continues to break new ice, quite literally, to advance our Earth-system prediction capabilities.

Chris Davis
Chair WWRP Scientific Steering Committee
2019 to present

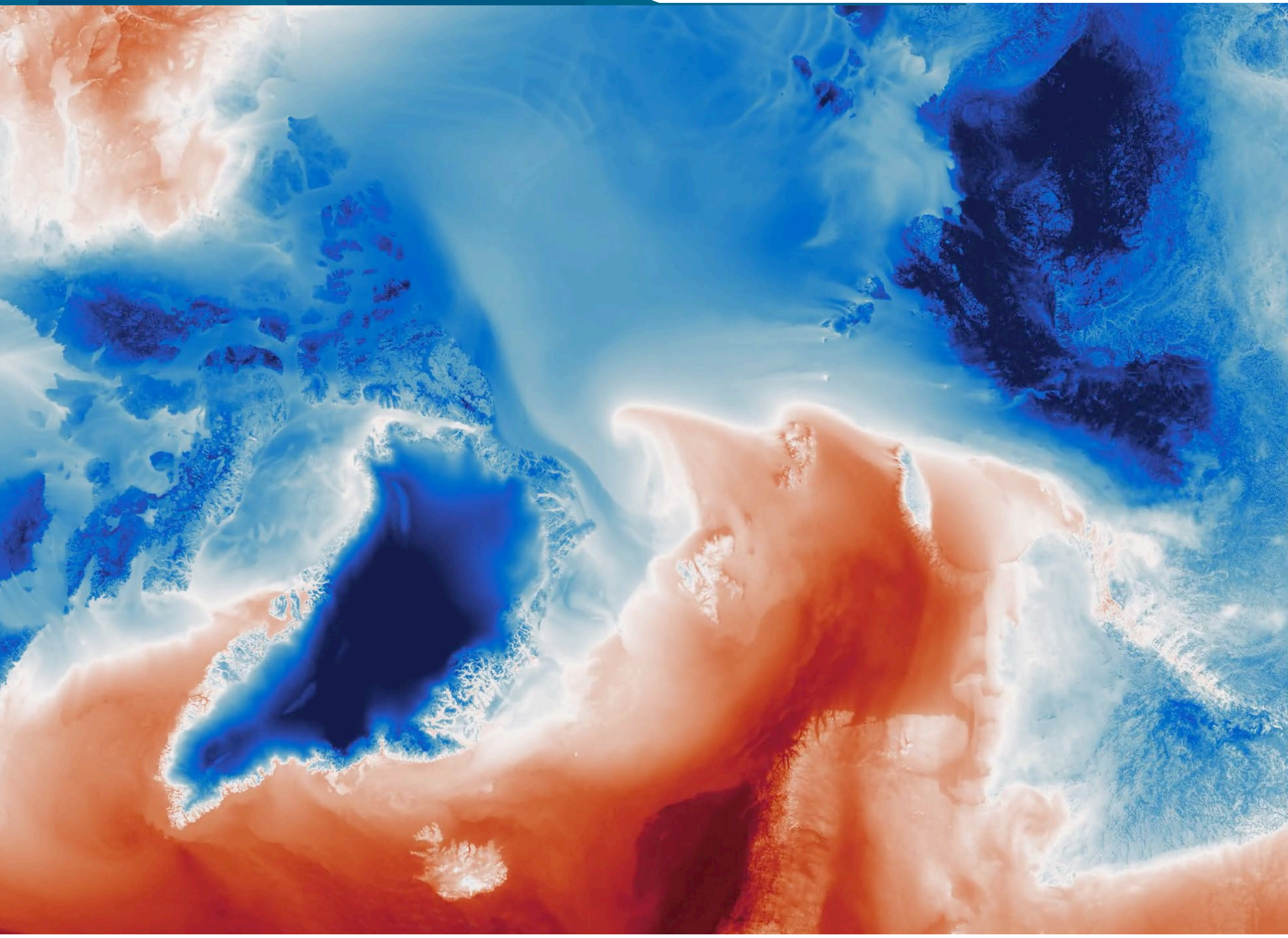
Arctic sea ice as "seen" from space. The visualisation is based on a 1-km simulation with the sea ice-ocean model FESOM2 (Nikolay Koldunov, AWI)

After more than 10 very exciting and productive years, the Polar Prediction Project and its flagship activity the Year of Polar Prediction will be coming to an end in 2022. PPP/YOPP would not have been possible without the enthusiastic and ongoing support from many institutions and individuals. This booklet and the YOPP Final Summit acknowledges this support and provides an overview of the achievements and impacts of PPP/YOPP.

Was YOPP a success? After having looked at this booklet, I anticipate that you will agree with me that the answer is yes! Has YOPP resolved all of the polar prediction puzzles? Clearly not. However, the YOPP legacy, building on from the IPY and earlier projects, has extended and strengthened the earlier foundation. In the next coupled of years YOPP's Model Intercomparison and Improvement Project (MIIP) work will provide novel insights that will help improve our understanding and modelling capabilities of critical processes in polar regions. Furthermore, continued analysis of the targeted observing periods carried out in the Southern Hemisphere in the austral winter of 2022 will shed light on flow-dependent predictability associated with strongly meandering jetstream events. Future polar research will build on the datasets created by YOPP and made accessible via the YOPP Data Portal (https://yopp.met.no); and new polar projects will further use and address the information and challenges identified in the user engagement section, respectively.

In closing this preface, I wish to thank the many people who have contributed to the work of the PPP/YOPP. Without your dedicated support and engagement, particularly during the COVID-19 pandemic, none of this would have been possible. I also need to explicitly thank Environment and Climate Change Canada, the Norwegian Meteorological Institute, the World Meteorological Organisation and the Alfred Wegener Institute for their ongoing financial and administrative support for PPP/YOPP. The "seed" funds provided by these organisations and several others helped to turn PPP/YOPP into highly visible international initiatives that helped leveraging somewhere in excess of twenty times the governance and coordination funds. I look forward to seeing how the legacy of PPP/YOPP will contribute to further improvements of predictive capacity in polar regions and beyond.

Thomas Jung
Chair, Polar Prediction Project Steering Group

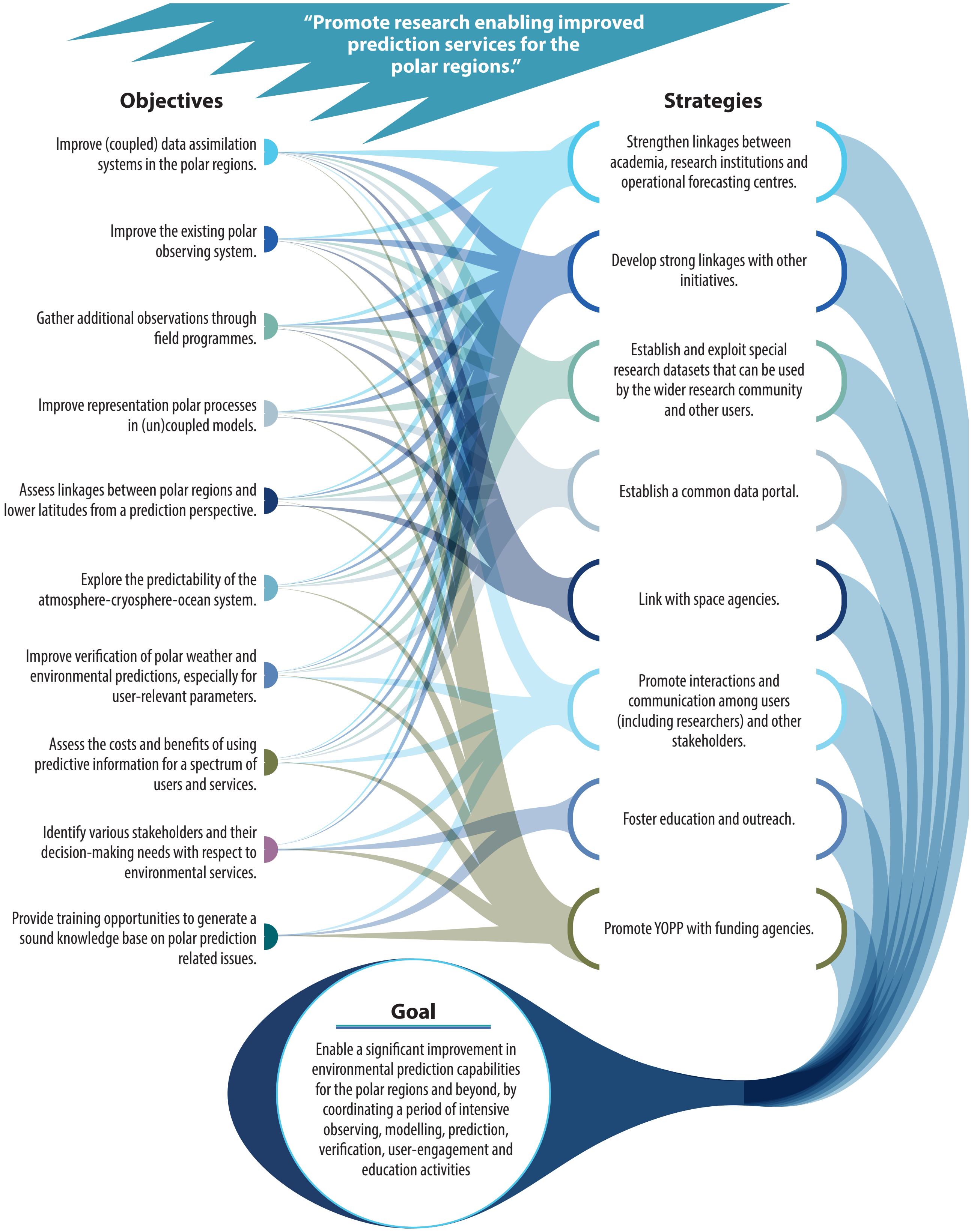


Near-surface temperatures from a simulation with a km-scale climate model carried out in the H2020 project nextGEMS (Thomas Rackow ECMWF and Nikolay Koldunov AWI)

GOALS

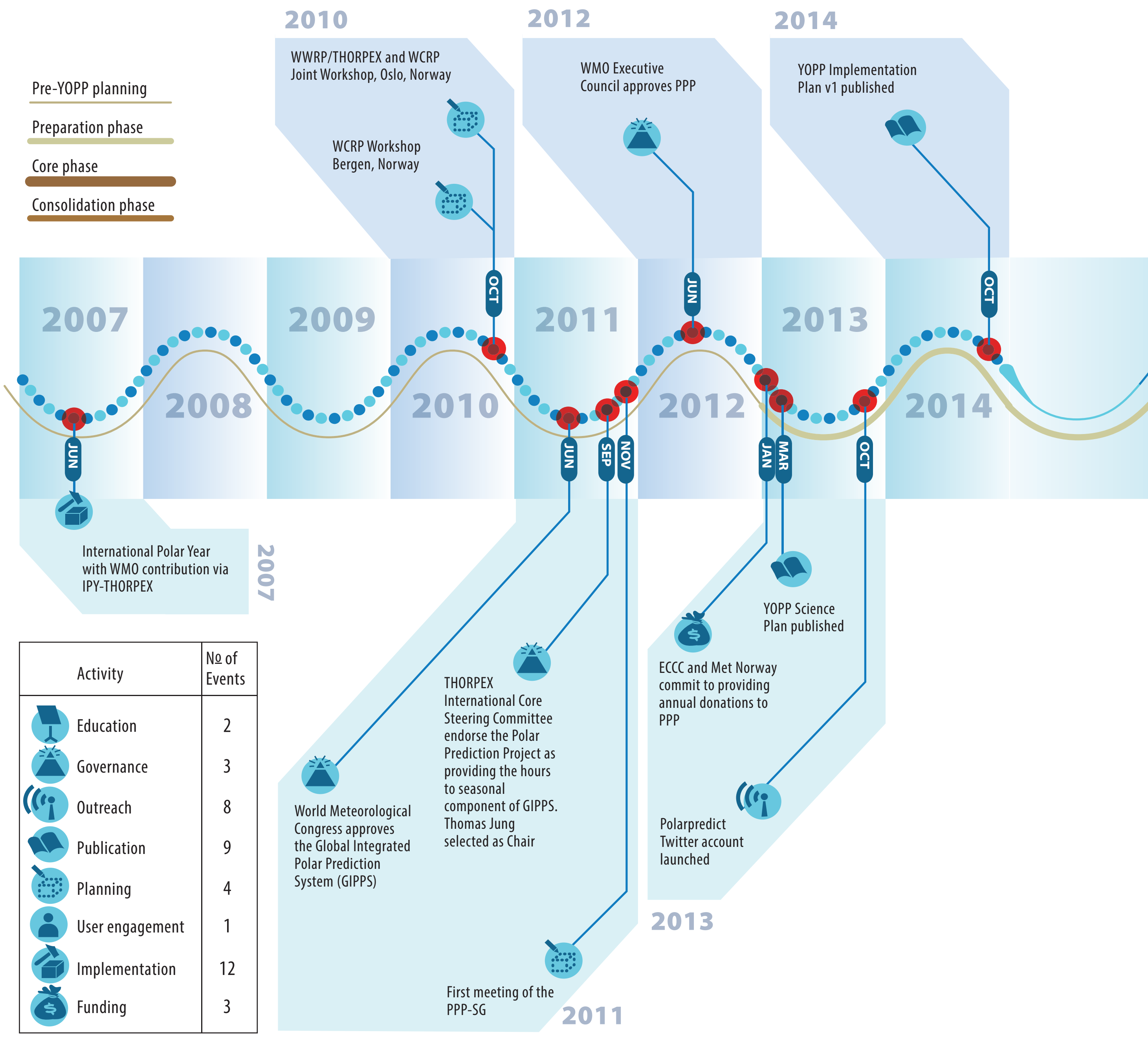
Prompted by evidence of rapid climate change in the polar regions in the 2000s, WMO launched the Polar Prediction Project to close major gaps in our predictive capabilities in polar regions in a coordinated international effort. The Year of Polar Prediction, a flagship activity of PPP, which has its genesis in the initial planning of the Polar Prediction Project, took on the mission or goal to enable a significant improvement in environmental prediction capabilities for the polar regions and beyond, by coordinating a period of intensive observing, modelling, prediction, verification, user-engagement and education activities. The overarching goal was necessarily formulated rather broadly. To add more focus and make the vision more tangible, 10 specific objectives were defined. They were formulated in such a way as to guide activities and allow an assessment of the success, or lack thereof, at the end of the PPP/YOPP. The goals and objectives (”the what”) were underpinned by strategies (”the how”) that provided a focus and clarified how the goal and objectives would be achieved.

While the mission of PPP included a specific statement on time scales (i.e., ”hourly to seasonal”), not explicitly mentioning any time scales for YOPP turned out to be a game changer, for it opened the door to a wider range of people working on climate related issues.

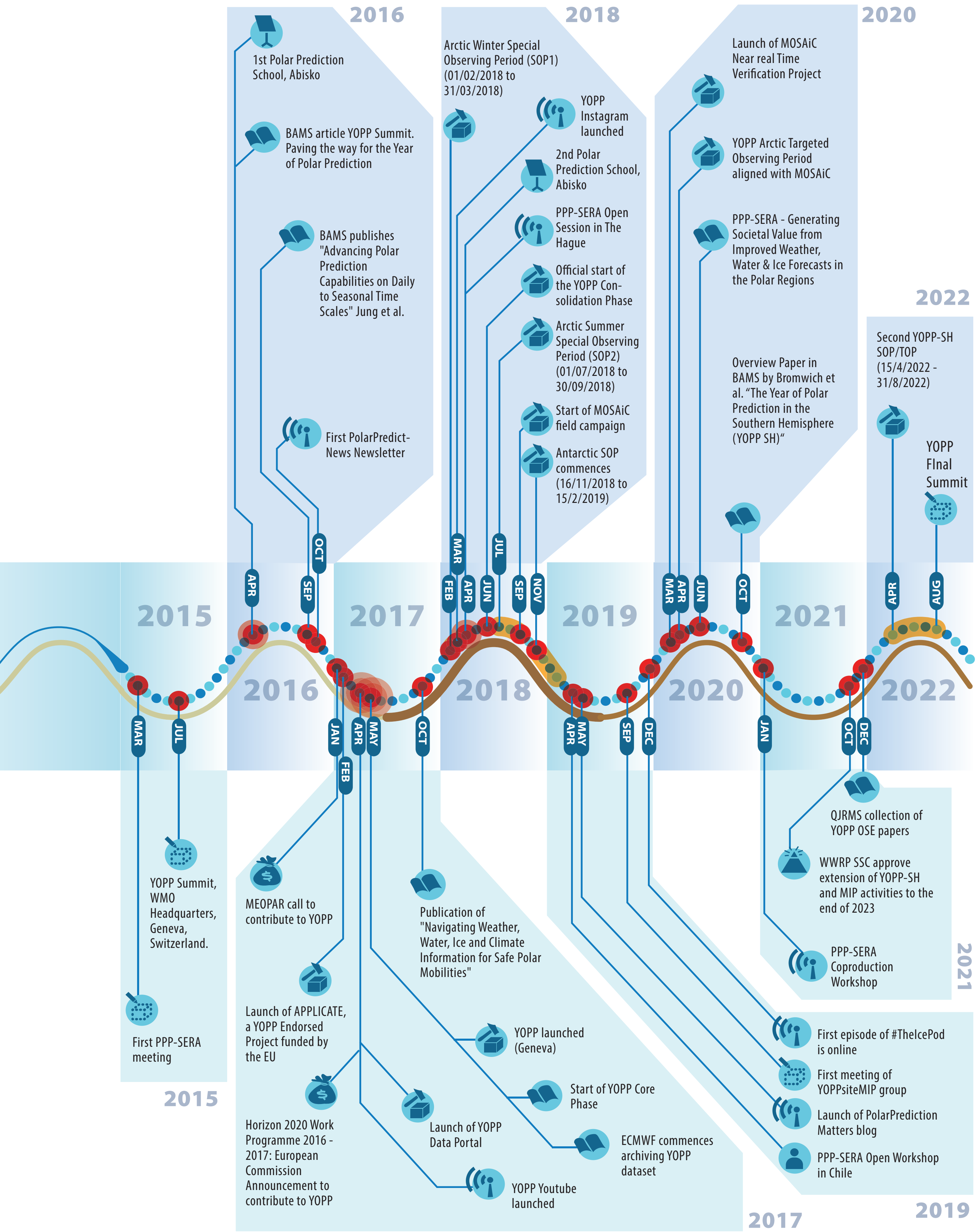

"Promote research enabling improved prediction services for the polar regions."
Objectives
Improve (coupled) data assimilation systems in the polar regions.
Improve the existing polar observing system.
Gather additional observations through field programmes.
Improve representation polar processes in (un)coupled models.
Assess linkages between polar regions and lower latitudes from a prediction perspective.
Explore the predictability of the atmosphere-cryosphere-ocean system.
Improve verification of polar weather and environmental predictions, especially for user-relevant parameters.
Assess the costs and benefits of using predictive information for a spectrum of users and services.
Identify various stakeholders and their decision-making needs with respect to environmental services.
Provide training opportunities to generate a sound knowledge base on polar prediction related issues.
Strategies
Strengthen linkages between academia, research institutions and operational forecasting centres.
Develop strong linkages with other initiatives.
Establish and exploit special research datasets that can be used by the wider research community and other users.
Establish a common data portal.
Link with space agencies.
Promote interactions and communication among users (including researchers) and other stakeholders.
Foster education and outreach.
Promote YOPP with funding agencies.
Goal
Enable a significant improvement in environmental prediction capabilities for the polar regions and beyond, by coordinating a period of intensive observing, modelling, prediction, verification, user-engagement and education activities

SELECTED ACCOMPLISHMENTS AND MILESTONES AT A GLANCE

The Polar Prediction Project is a ten year project that formally commenced on 1 January 2013. However, the foundations for PPP were laid some years earlier in the activities of the 2007–2009 International Polar Year (IPY), particularly the WMO contribution to IPY via Polar THORPEX. PPP/YOPP itself will form part of the foundation for future polar projects within WMO and this is illustrated by the extension of a number of the key activities past the end of 2022. The accompanying graphic provides an overview of PPP/YOPP history and key accomplishments. Some of the key themes are further expanded elsewhere in this publication.



Activity	№ of Events
Education	2
Governance	3
Outreach	8
Publication	9
Planning	4
User engagement	1
Implementation	12
Funding	3


2015
MAR
JUL
YOPP Summit, WMO Headquarters, Geneva, Switzerland.
First PPP-SERA meeting
2015
2016
APR
SEP
OCT
1st Polar Prediction School, Abisko
BAMS article YOPP Summit. Paving the way for the Year of Polar Prediction
BAMS publishes "Advancing Polar Prediction Capabilities on Daily to Seasonal Time Scales" Jung et al.
First PolarPredict-News Newsletter
2016
2017
JAN
FEB
APR
MAY
OCT
MEOPAR call to contribute to YOPP
Launch of APPLICATE, a YOPP Endorsed Project funded by the EU
Horizon 2020 Work Programme 2016 - 2017: European Commission Announcement to contribute to YOPP
Publication of "Navigating Weather, Water, Ice and Climate Information for Safe Polar Mobilities"
YOPP launched (Geneva)
Start of YOPP Core Phase
Launch of YOPP Data Portal
ECMWF commences archiving YOPP dataset
YOPP Youtube launched
2017
2018
FEB
MAR
APR
JUN
JUL
SEP
NOV
Arctic Winter Special Observing Period (SOP1) (01/02/2018 to 31/03/2018)
YOPP Instagram launched
2nd Polar Prediction School, Abisko
PPP-SERA Open Session in The Hague
Official start of the YOPP Con-solidation Phase
Arctic Summer Special Observing Period (SOP2) (01/07/2018 to 30/09/2018)
Start of MOSAiC field campaign
Antarctic SOP commences (16/11/2018 to 15/2/2019)
2018
2019
APR
MAY
SEP
DEC
First episode of #TheIcePod is online
First meeting of YOPPsiteMIP group
Launch of PolarPrediction Matters blog
PPP-SERA Open Workshop in Chile
2019
2020
MAR
APR
JUN
OCT
Launch of MOSAiC Near real Time Verification Project
YOPP Arctic Targeted Observing Period aligned with MOSAiC
PPP-SERA - Generating Societal Value from Improved Weather, Water & Ice Forecasts in the Polar Regions
Overview Paper in BAMS by Bromwich et al. "The Year of Polar Prediction in the Southern Hemisphere (YOPP SH)"
2020
2021
JAN
OCT
DEC
QJRMS collection of YOPP OSE papers
WWRP SSC approve extension of YOPP-SH and MIP activities to the end of 2023
PPP-SERA Coproduction Workshop
2021
2022
APR
AUG
Second YOPP-SH SOP/TOP (15/4/2022 - 31/8/2022)
YOPP FInal Summit
2022

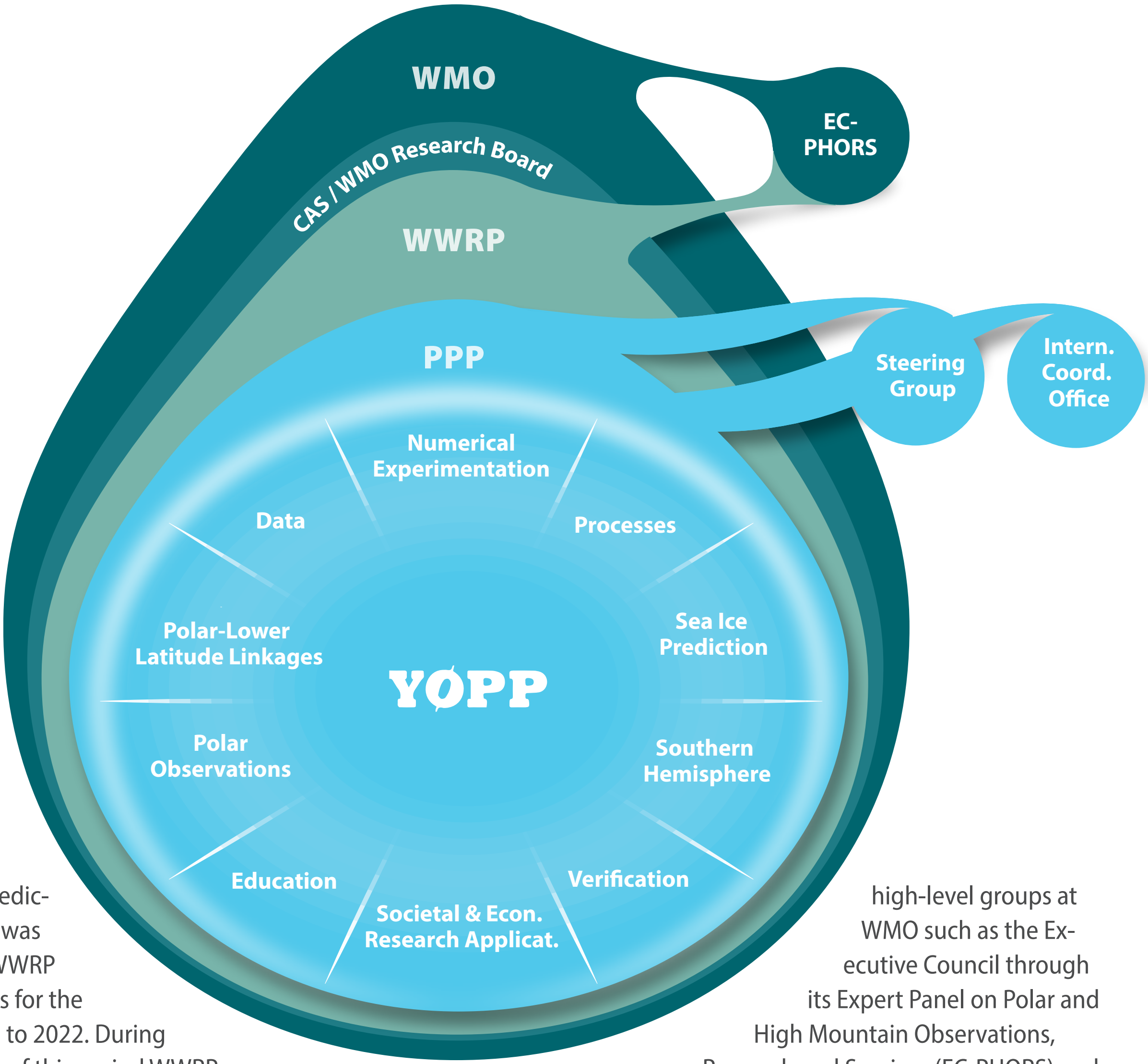
COORDINATION

Participants of the PPP kickoff meeting that took place in November 2011 at WMO in Geneva. Photo: WMO

The meeting noted that in polar regions, perhaps more so than in other parts of the globe, all the processes are highly interactive – so if possible an integrated approach involving all processes was important, ...

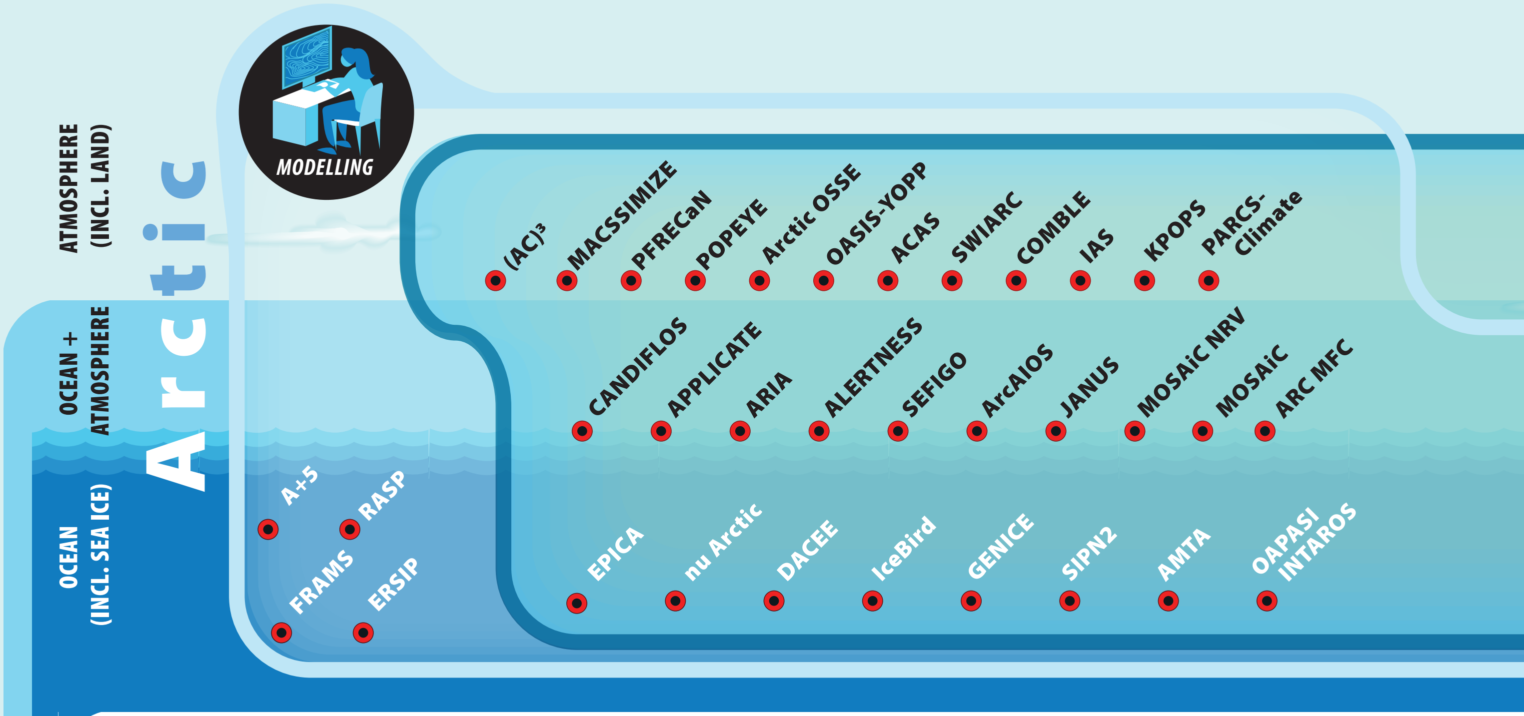
excerpt from WWRP/Thorpex Polar Prediction Project Steering Group Kickoff Meeting, Nov 2011

PPP/YOPP GOVERNANCE STRUCTURE



The Polar Prediction Project was one of the WWRP core projects for the period 2013 to 2022. During the majority of this period WWRP was overseen by the Commission for Atmospheric Sciences (CAS). CAS was replaced by the WMO Research Board in 2019 following a major reform of the WMO governance structure. In 2011 and 2012 WWRP and CAS championed the development of PPP as a legacy project to the International Polar Year (2008-2009) and the WWRP THORPEX activities. In this context, the Steering Group of the Polar Prediction Project, a committee of more than 20 international experts from various backgrounds, took a central role, in terms of planning, carrying out and overseeing coordination. This expert panel was supported by Task Teams and the International Coordination Office (ICO), hosted by the Alfred Wegener Institute. Coordination was also facilitated by reporting to and engaging with high-level groups at WMO such as the Executive Council through its Expert Panel on Polar and High Mountain Observations, Research and Services (EC-PHORS) and the World Weather Research Project (WWRP) Scientific Steering Committee (SSC).

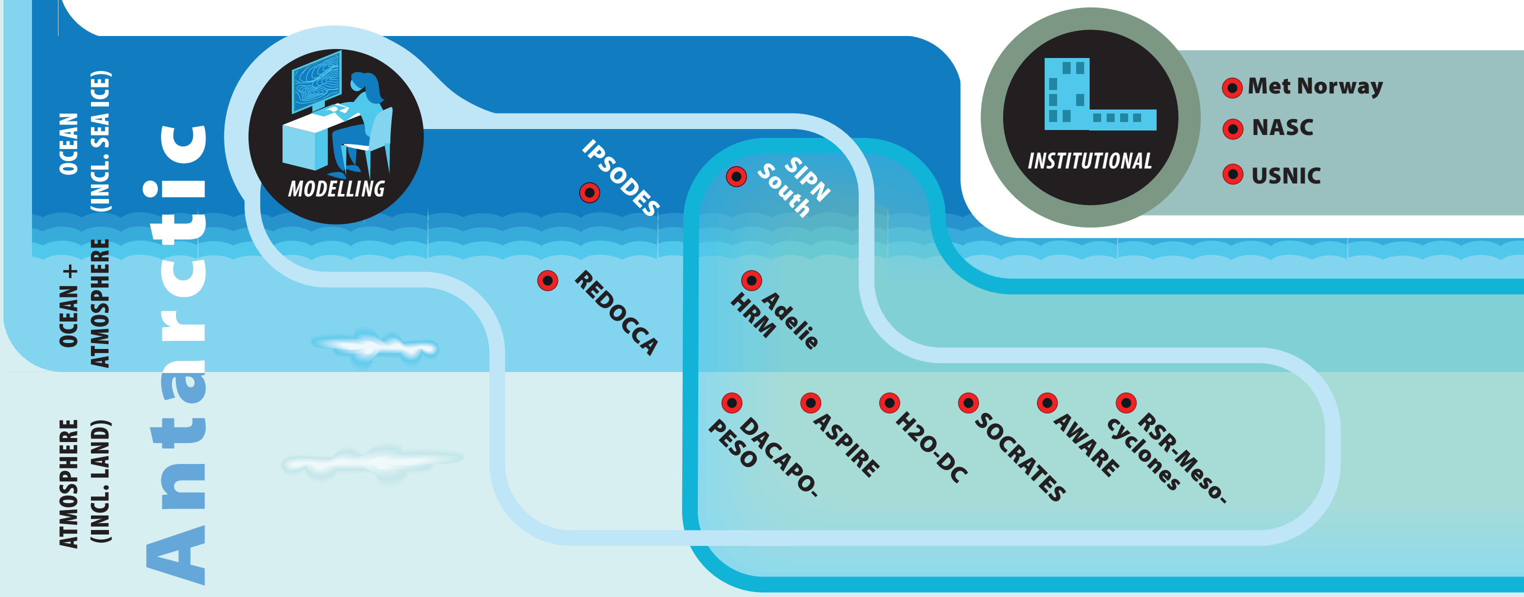
As further outlined in this booklet, other important coordination activities included international meetings (e.g., workshops), special observing periods (e.g., special and targeted observing periods), modelling efforts (e.g., multi-model observing system experiments), overview publications as well as special issues in journals. Furthermore, coordination was facilitated by introducing an endorsement process, developing a proactive communication and outreach strategy, using social media, newsletters, blog posts and email updates all of which kept the community informed of ongoing and upcoming activities.

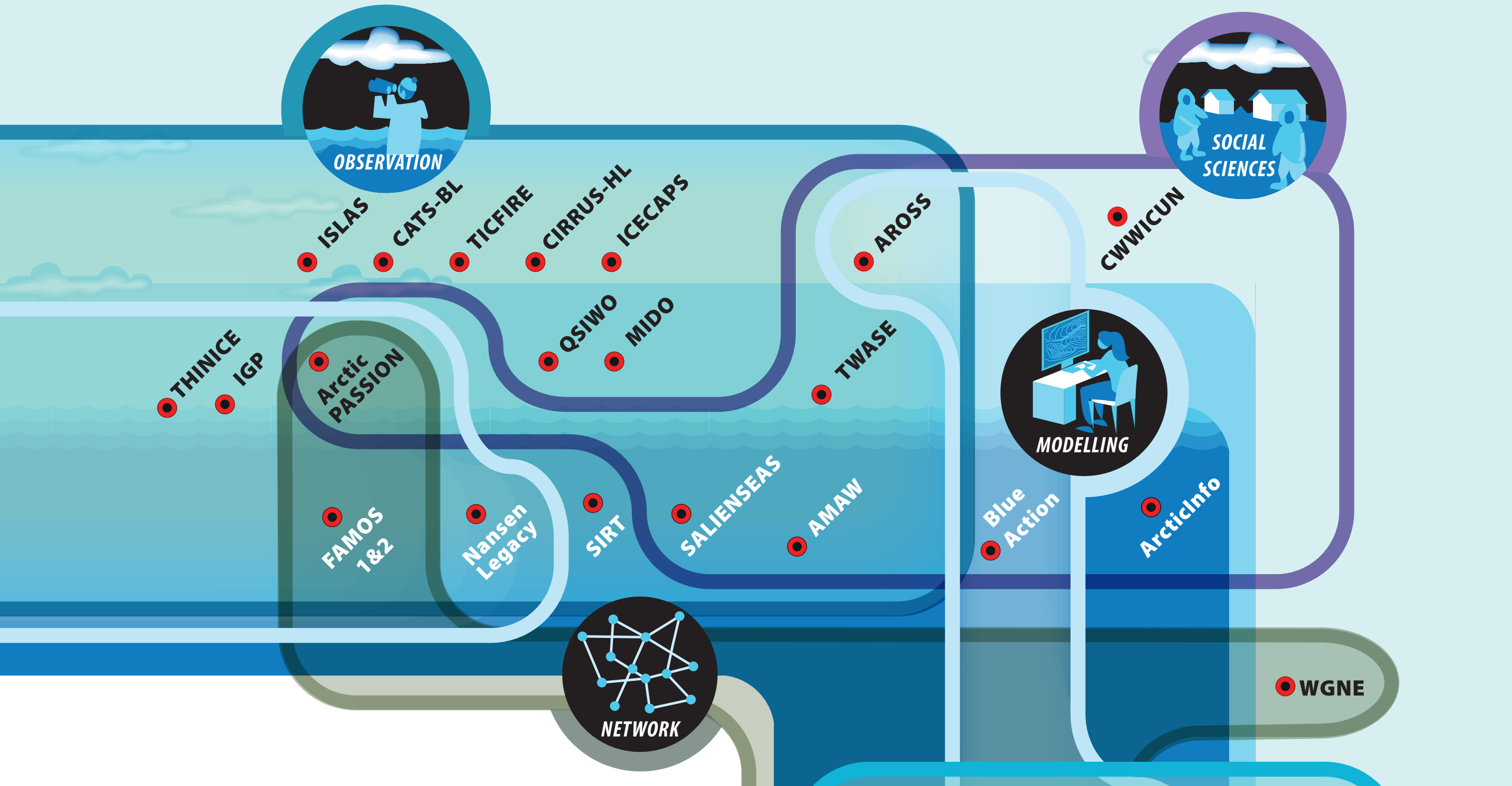


YOPP ENDORSEMENT

During the YOPP Summit in Geneva in 2015 it became clear that there was substantial interest in the Year of Polar Prediction from a very diverse range of researchers, research institutions, operational centres and users. To support the PPP steering group and the ICO in coordinating the various activities an endorsement process was launched. The goal was to gain a better understanding of "who will be doing what by when". This endorsement process also had a second, equally important goal, that is to support potential contributors (projects and institutions) acknowledging their contributions to the goals of PPP/YOPP. This included assisting them with obtaining external funding, demonstrating the increased use of their project and services, and gaining further recognition of their work. From the funding agencies perspective, the endorsement process provided assistance in targetting their funds towards internationally approved research topics. Endorsement was carried out by the PPP-SG.

Since the start of the endorsement activity 130 requests for YOPP endorsement were received of which 102 received endorsement. A prominent example is the APPLICATE project, which received approximately EUR 8,000,000 from the European Commission and involved more than 30 scientists over a 4 ½-year period. In response to a questionnaire sent to more than 90 endorsed projects more than 50% of the projects responded by mid-April 2022. These responses indicate YOPP endorsed projects had more than USD $53 million in funding; more than 950 people were involved; more

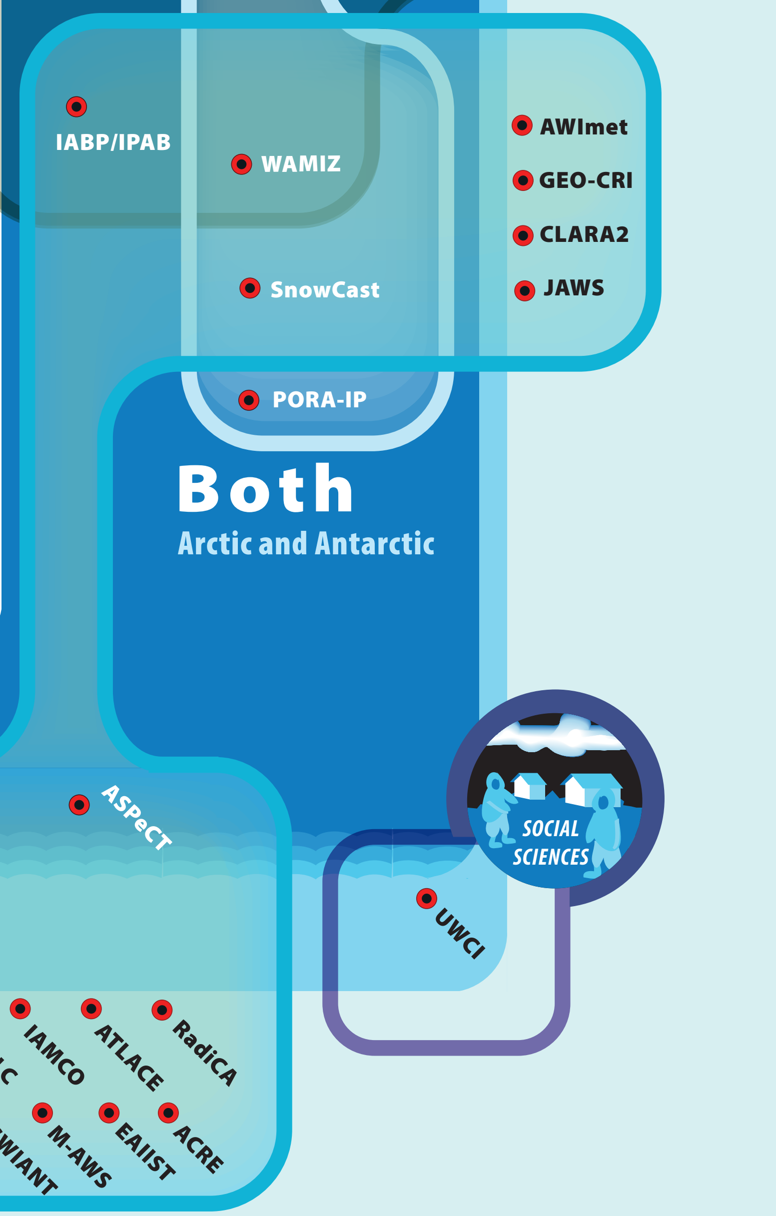


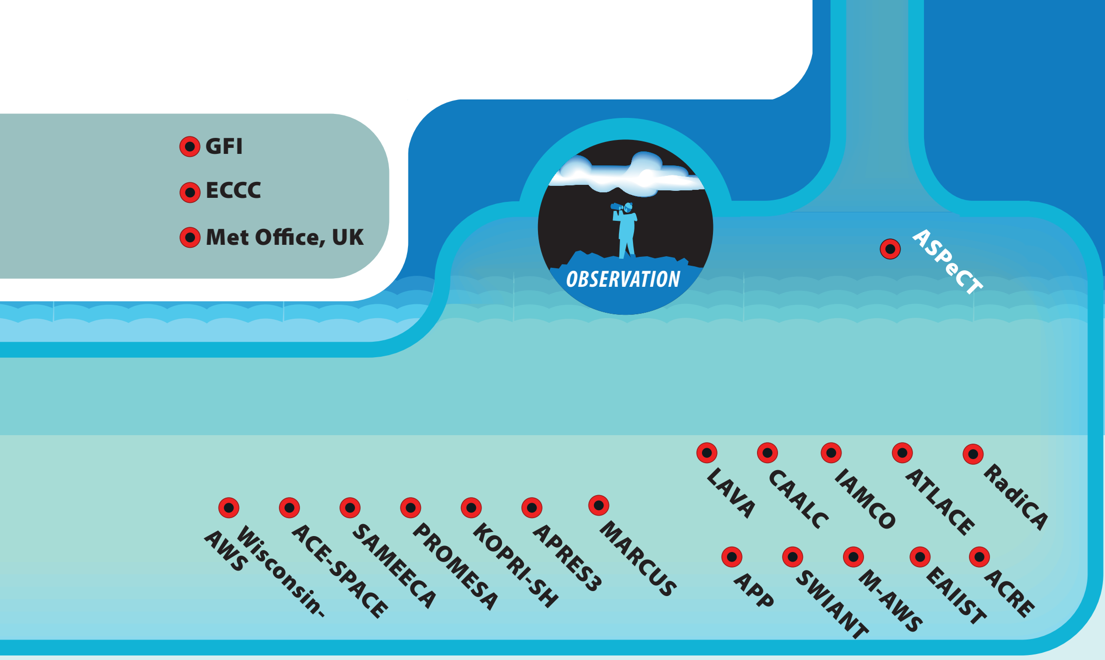


than 200 papers were published at the time of reporting; and more than 150 early career scientists were involved in these projects.

An analysis of the YOPP-endorsed projects demonstrates that PPP/YOPP covered both hemispheres very well. Furthermore, there was a strong involvement of personnel from the observation and modelling communities as well as input from academia, research institutions and operational prediction centres. There were also a number of projects with a clear focus on social science.

The graphic depicts all projects and institutions that have received YOPP endorsement.





COMMUNITY BUILDING – BRINGING PEOPLE TOGETHER

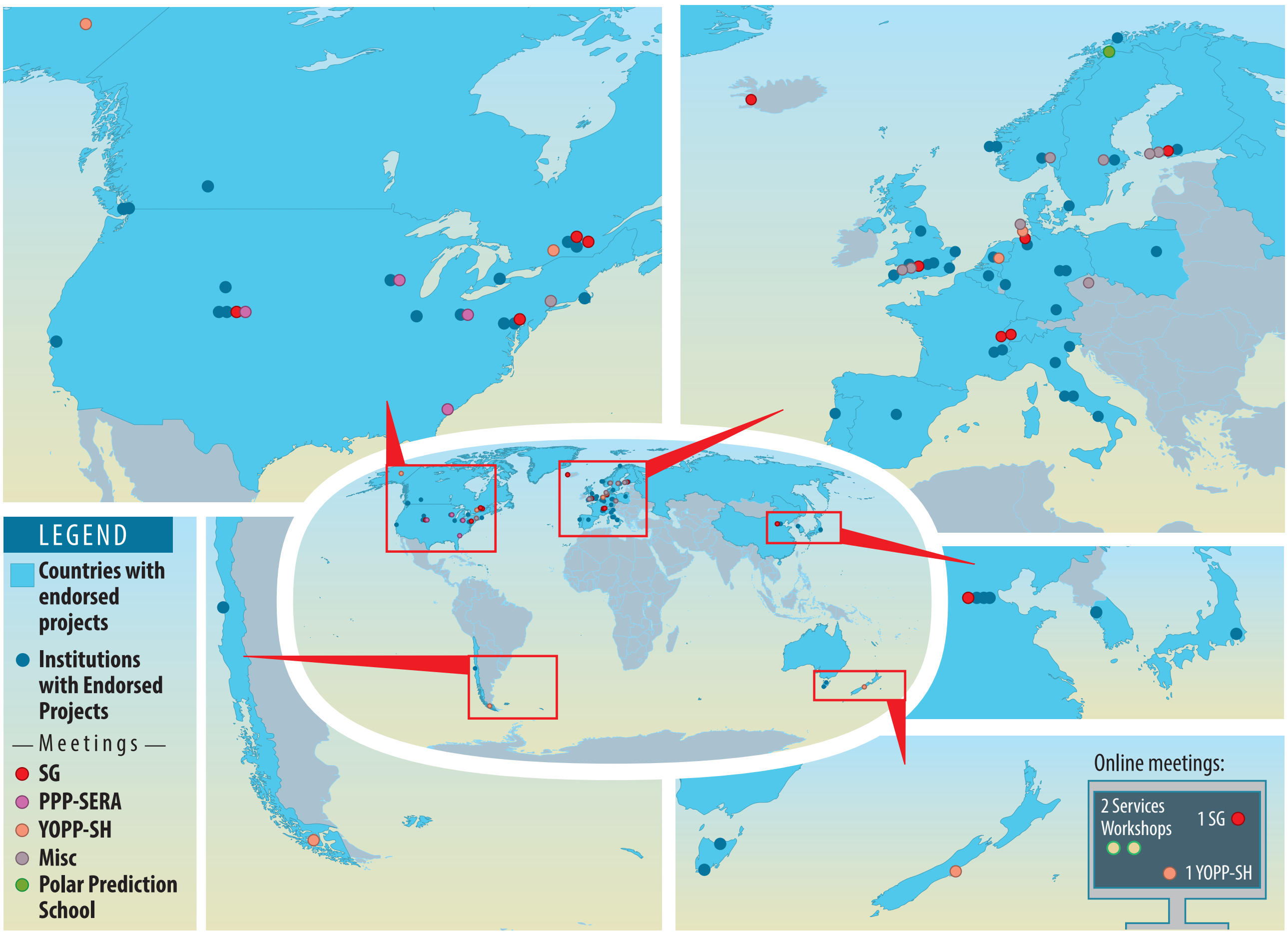
For PPP/YOPP to achieve its goals and objectives, it was clear from the outset that effective community building centred around the theme of environmental prediction in polar regions and beyond would have to be a key element of the strategy. Community building was particularly targeted towards linking (i) weather and climate scientists, (ii) modellers and observationalists, (iii) experts on mid-latitude and polar meteorology and oceanography, (iv) academia, research institutions and operational forecasting centres, and (v) and developers and users of polar environmental services.

PPP/YOPP have been major catalysts for community building. Specific activities included more than ten workshops, nearly twenty face-to-face planning meetings, two polar prediction schools, several information sessions specifically for early career scientists, about 100 endorsed projects, engaging more than 800 personnel via email, more than 2000 tweets and a similar number of followers on Twitter, nearly 1000 followers on Instagram and more than 150 posts, publication of nineteen regular newsletters and more than twenty blog articles under the title of Polar Prediction Matters.

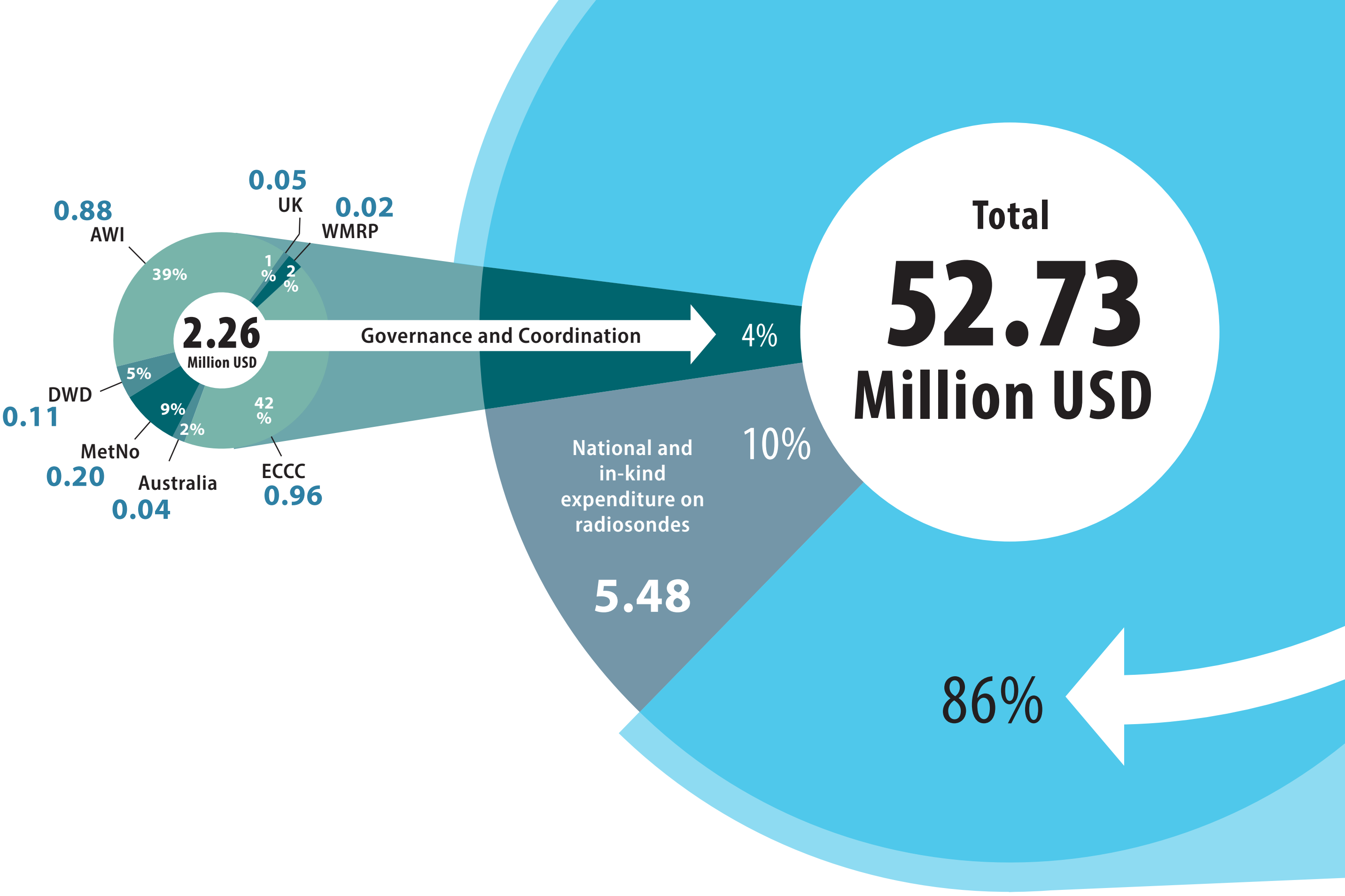
The work done by PPP/YOPP, from communications to networking and more, has been great and can serve as a clear reference for future international projects, including the way of how to manage international coordination offices. The chemistry [between people] is an essential ingredient in making things work perfectly, with everybody feeling they are part of a great endeavour.

Paolo Ruti
Chief Scientist, EUMETSAT, formerly Chief of the World Weather Research Division at WMO

Participants of the first YOPP Summit that took place in July 2015 at WMO in Geneva, Switzerland. Photo: Neil Gordon



RESOURCE MOBILISATION

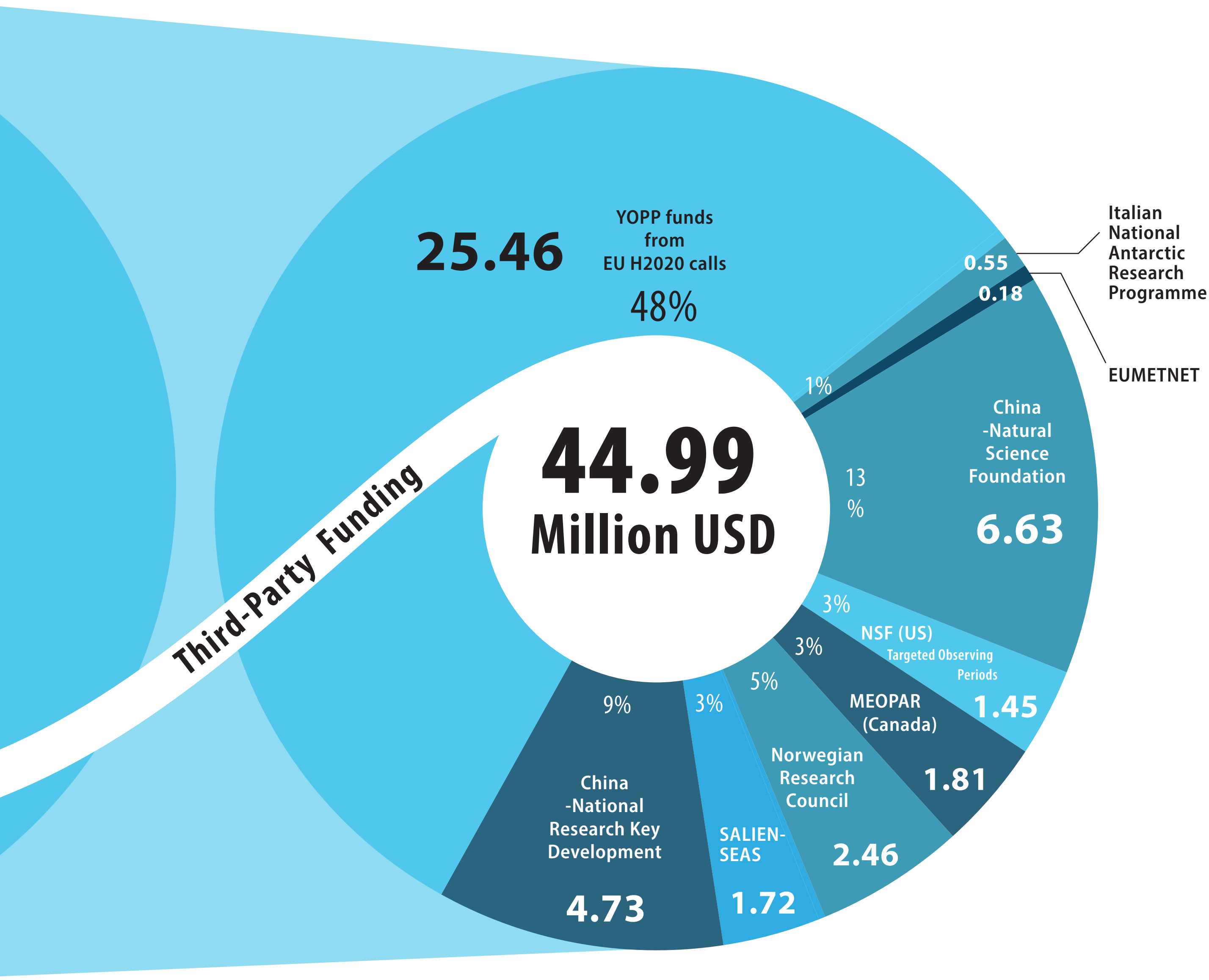


Resource mobilisation had to focus on three different areas: (i) the PPP Trust Fund in support of coordination activities, (ii) in kind contributions, including the establishment of the International Coordination Office (ICO), and (iii) third-party funding, for example through calls for proposals that identify contributions to the goals of PPP/YOPP.

Contributions to the Trust Fund have been substantial, amounting to a total of about 1.388.000 USD through contributions from ECCC, MetNo, DWD, BoM and the Met Office for the period 2011-2022.

In kind contributions have also been outstanding, including support by the Alfred Wegener Institute through the hosting of the ICO, support for time from the many individuals involved in the PPP-SG and its Task Teams, provision of additional staff, equipment and consumables to support the Special Observing Periods and Targeted Observing Periods in the Arctic and Antarctic; and last but no means least the time and support by individuals and institutions to curate and quality control observations and forecasts from the SOP/ TOPs, analyse the data and publish the results.

Moreover, dedicated third-party funding for PPP/YOPP through, for example, the European Commission, the Norwegian Research Council and MEOPAR (Canada) are clear indicators of success, as is the provision of more than 10,000 additional radiosondes and 200 to 250 additional buoys for the targeted observation periods in 2018 and 2019 through many participating countries and organisations such as EUMETNET.



Success story: Contribution of European Commission

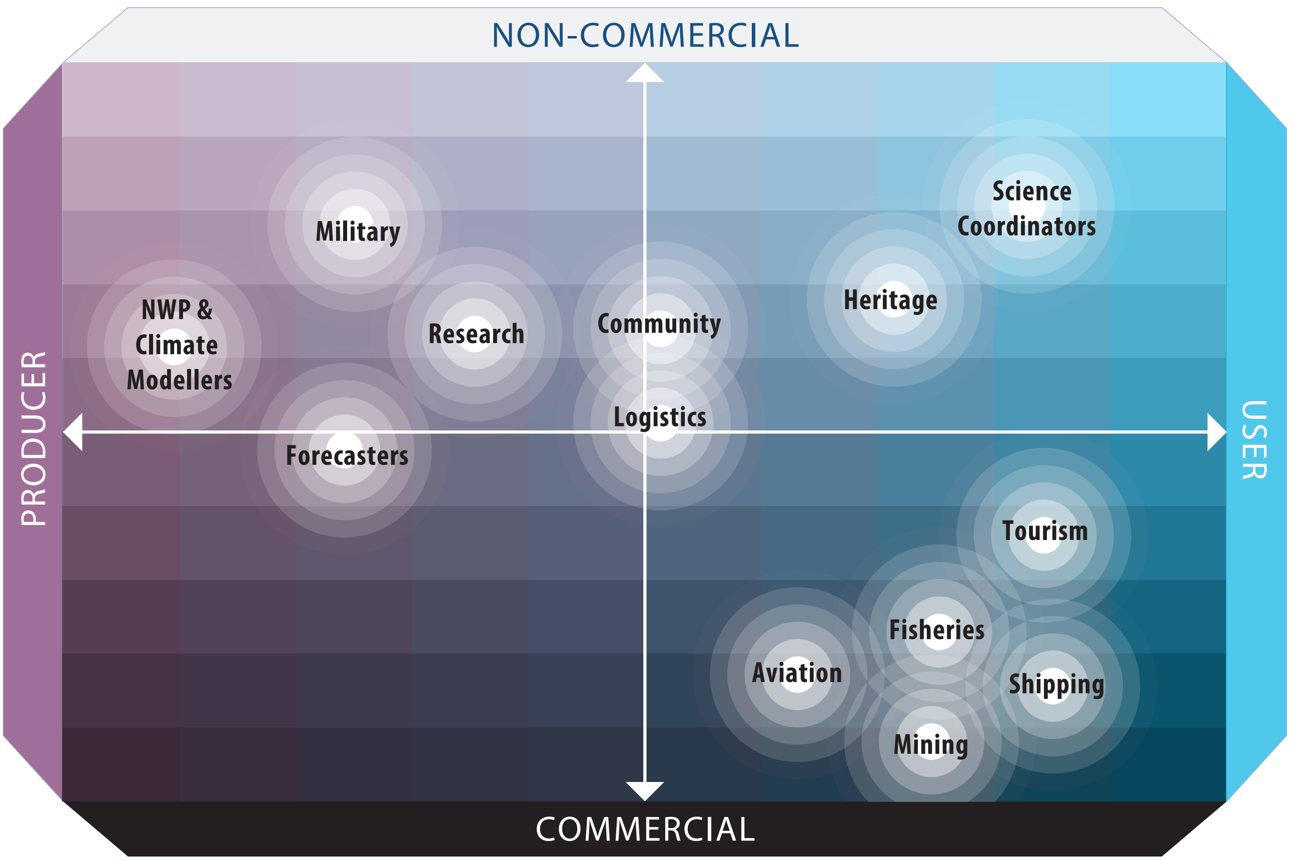
The European Commission made substantial contributions to PPP/YOPP through its research and innovation funding programme Horizon 2020. More specifically, contributions to YOPP were explicitly mentioned in three different calls related to the integrated Arctic observing system (USD 21.9 Mio / 20 Mio. EUR funding in 2016), the impact of Arctic climate change on weather and climate (USD 17.5 Mio / 16 Mio. EUR funding in 2016) and polar climate (USD 17.5 Mio / 16 Mio. EUR in 2019). In these calls, YOPP was mentioned at the same level as IPCC Assessment Reports, Copernicus Services, GEO Cold Region Initiative and the Transatlantic Ocean Research Alliance. One of the funded EU Horizon 2020 projects is APPLICATE (https://applicate-h2020.eu) that had advanced predictive capacity for weather and climate in general and YOPP in particular at its core.

USER ENGAGEMENT

User engagement activities were carried out via workshops, conferences, focus-group discussions, surveys, and interviews. In addition to these face-to-face activities, existing scholarly research was systematically analysed to gain a nuanced understanding of the different user communities, their activities and mobilities, their information needs and how they currently access and wish to access services and products. A key finding was that there are distinct differences between user and producer communities, both within and between the two polar regions, in terms of their roles as producers and users of information and forecasts, and their needs and access to communication channels. For instance, Indigenous communities in the Arctic, shipping and tourism companies in the Arctic and Antarctic, fishing operators and National Antarctic Programme managers of Antarctic stations have very different needs and requirements. A 'one size of service does not fit all'.

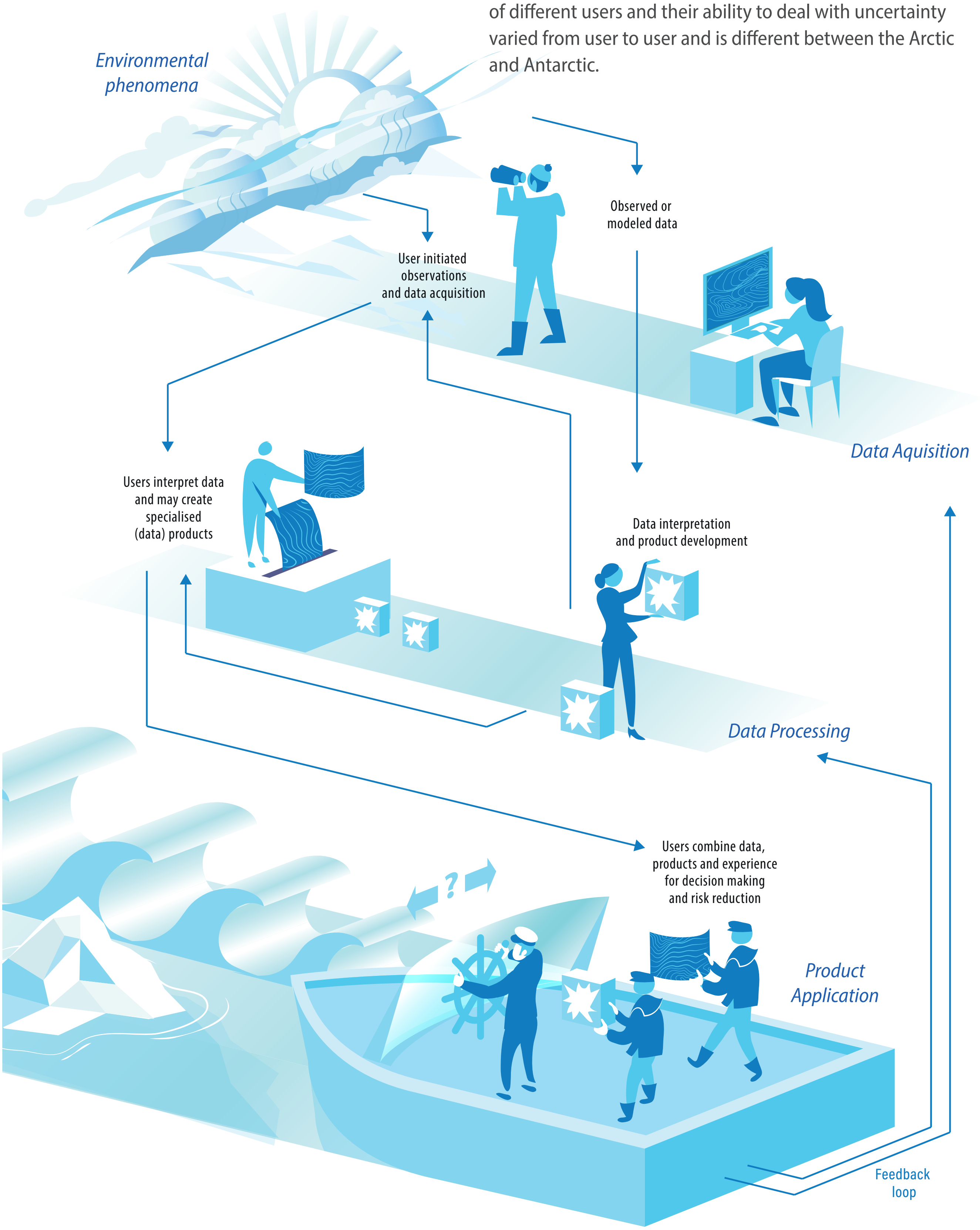
People in polar regions use environmental information (including real-time data and forecasts) for planning and scheduling activities, making operational decisions, and managing risk and human safety. However, due to a mismatch between the services provided and the information users need for their specific decision-making and activities, people face many challenges in accessing and using weather information. In other words, the data available do not necessarily or automatically result in salient products and services for all users. Useability challenges can be addressed by reducing barriers and through coproduction, where users contribute to the design of products and services and providers incorporate an understanding of user needs and continuous feedback to tailor services. The YOPP endorsed SALIENSEAS project is an example of a project that coproduced tailored services for maritime sectors and users in the European Arctic by applying innovative modes of user engagement, such as participatory mapping and serious gaming (salienseas.com).

SPECTRUM OF WEATHER WATER ICE AND CIMATE INFORMATION USE AND CREATION



RENDERING SERVICES – USER VALUE CHAIN

User Engagement within PPP/YOPP reinforced the need for cooperation and collaboration between all parties involved in the development, delivery and application of environmental services in polar regions. The detailed requirements of different users and their ability to deal with uncertainty varied from user to user and is different between the Arctic and Antarctic.

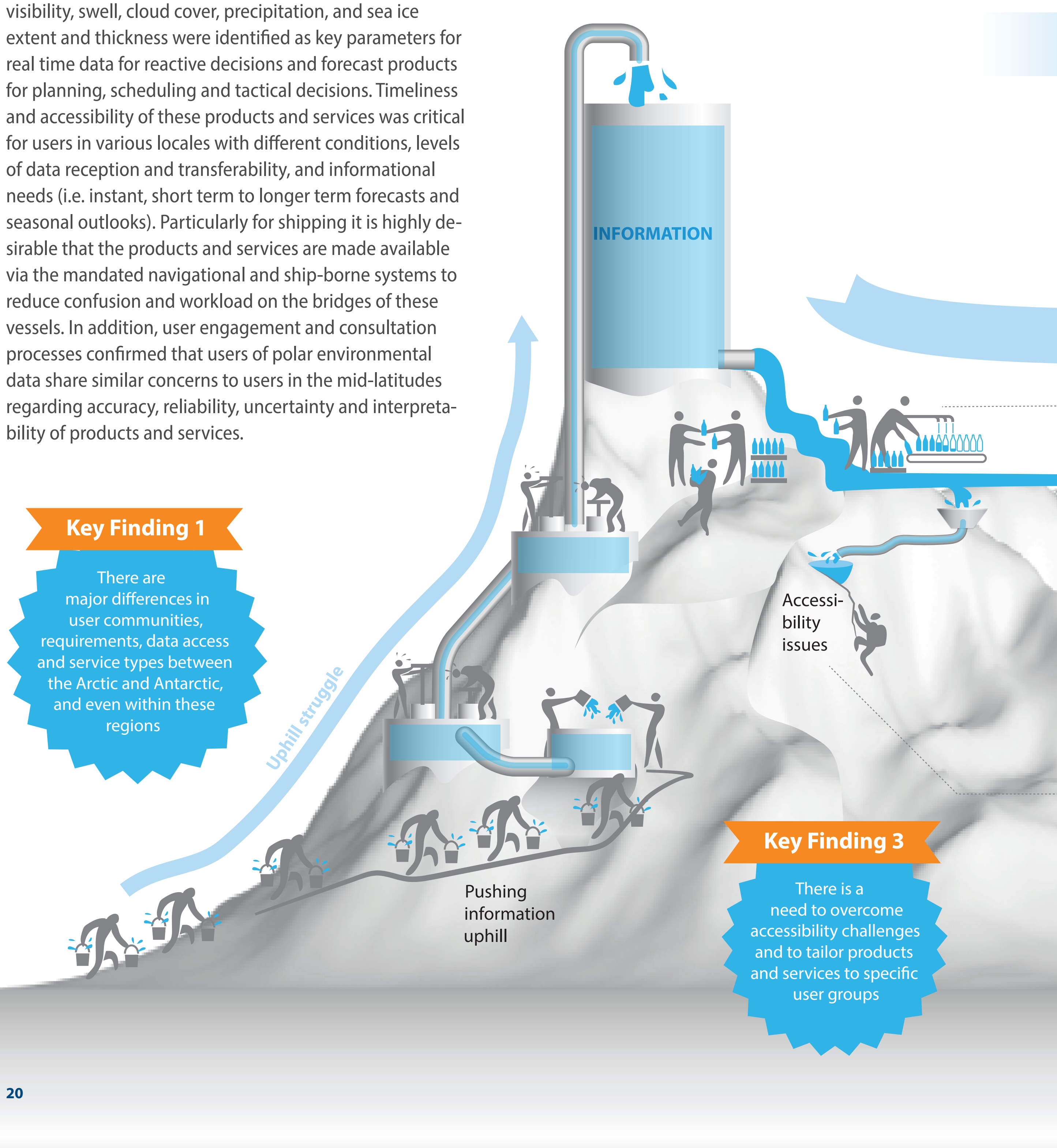


Typical challenges

For both polar regions, surface wind speed and direction, visibility, swell, cloud cover, precipitation, and sea ice extent and thickness were identified as key parameters for real time data for reactive decisions and forecast products for planning, scheduling and tactical decisions. Timeliness and accessibility of these products and services was critical for users in various locales with different conditions, levels of data reception and transferability, and informational needs (i.e. instant, short term to longer term forecasts and seasonal outlooks). Particularly for shipping it is highly desirable that the products and services are made available via the mandated navigational and ship-borne systems to reduce confusion and workload on the bridges of these vessels. In addition, user engagement and consultation processes confirmed that users of polar environmental data share similar concerns to users in the mid-latitudes regarding accuracy, reliability, uncertainty and interpretability of products and services.

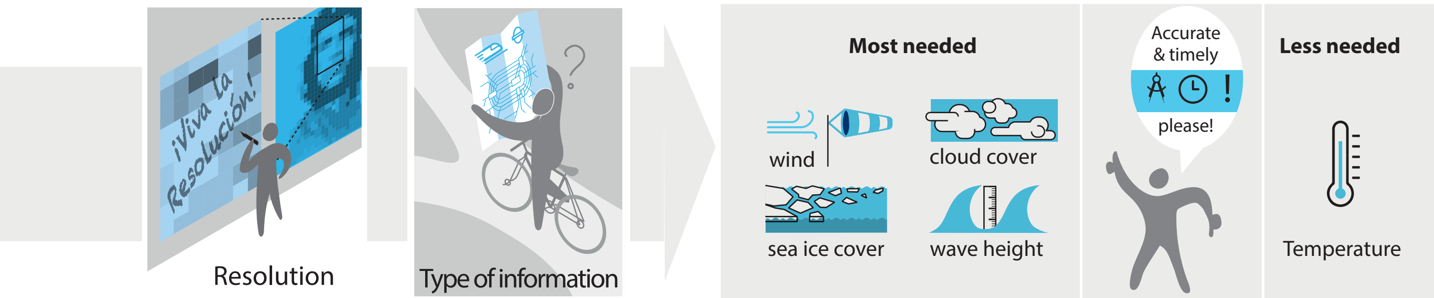
Key Finding 1

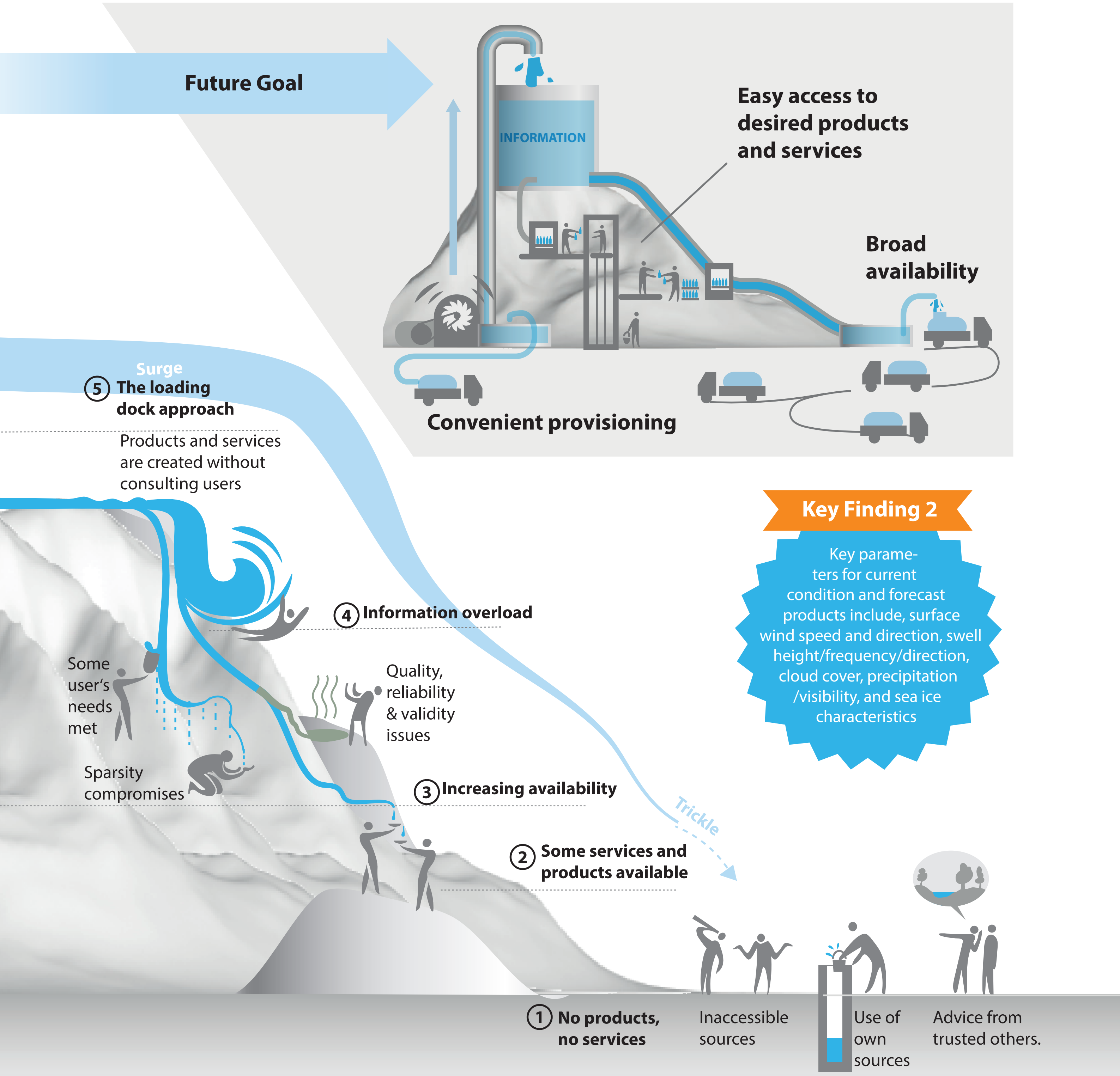
There are major differences in user communities, requirements, data access and service types between the Arctic and Antarctic, and even within these regions



Key Finding 3

There is a need to overcome accessibility challenges and to tailor products and services to specific user groups





Key Finding 2

Key parameters for current condition and forecast products include, surface wind speed and direction, swell height/frequency/direction, cloud cover, precipitation /visibility, and sea ice characteristics

PUBLICATIONS

Publishing plans and outcomes of PPP/YOPP has been one of the key elements of the strategy to maximize impact. Prominent examples:

In support of the planning and resource mobilisation, a Science Plan (2013) and 4 versions of the PPP/YOPP Implementation Plans have been published (2013, 2014, 2016, 2019).

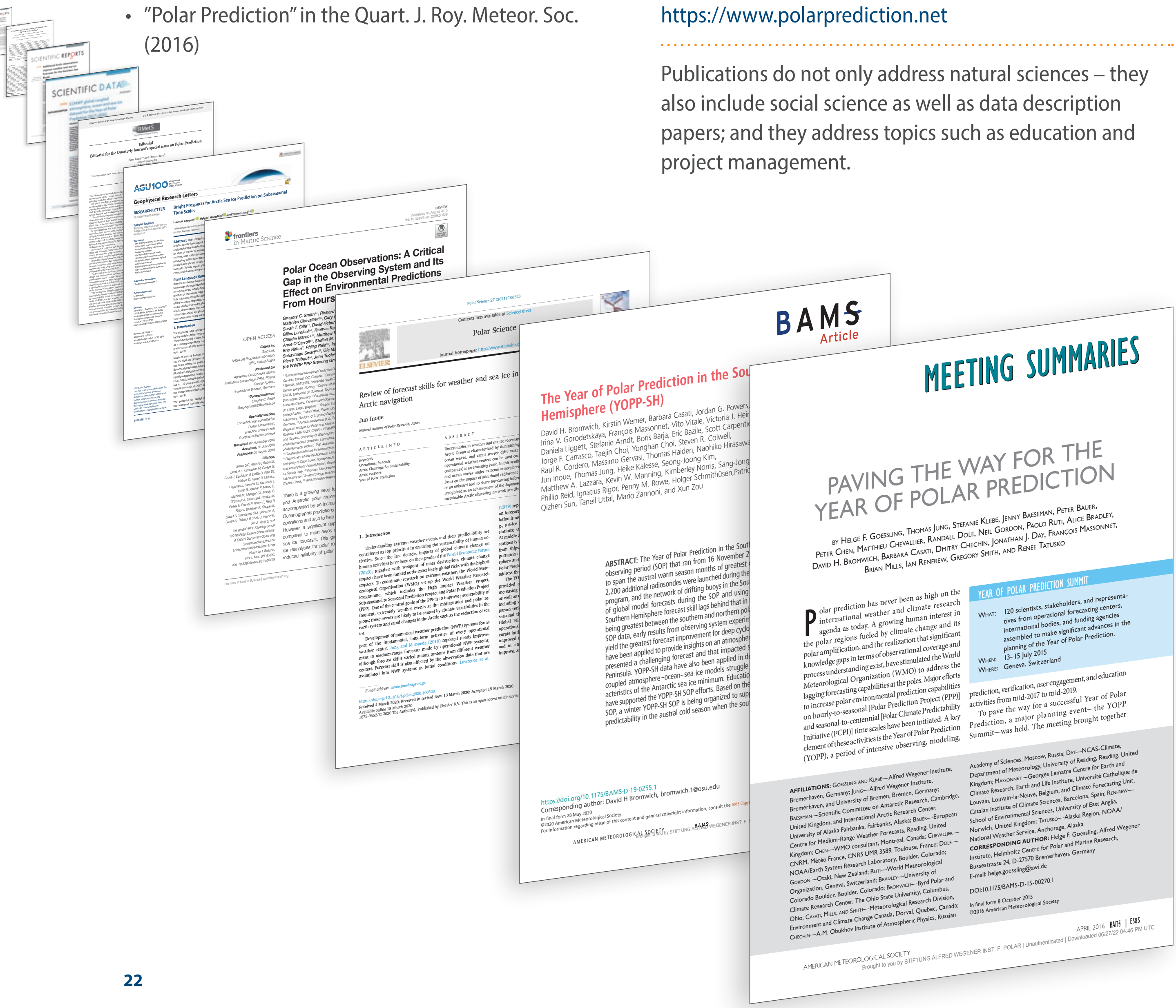
The number of peer-reviewed publications exceeds 216; and the h-index of PPP/YOPP publications amounts to 43, with the number of citations growing exponentially.

A total of 5 special issues containing peer-reviewed publications have been produced:

- "Polar Prediction" in the Quart. J. Roy. Meteor. Soc. (2016)
- "Impact of a Rapidly Changing Arctic on Eurasian Climate and Weather" in Advances in Atmospheric Sciences (2017)
- "Societal Values of Improved Forecasting" in Polar Geography (2020)
- "Impacts of Polar Observations on Predictive Skill" in the Quart. J. Roy. Meteor. Soc. (2020)
- "Antarctic Meteorology and Climate: Past, Present and Future" in Advances in Atmospheric Sciences (2020)

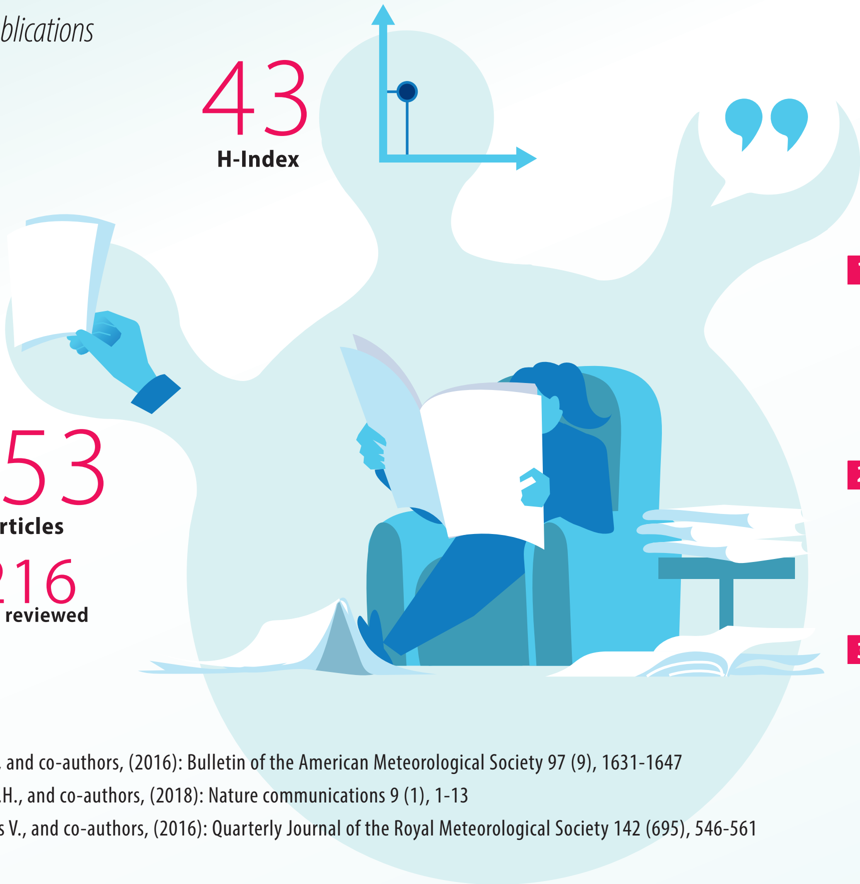
Publications can be tracked through a dedicated PPP/YOPP Google Scholar account. At the time of publication there are 216 peer reviewed publications and another 37 conference publications listed in the Google Scholar account; key publications are also available through https://www.polarprediction.net

Publications do not only address natural sciences – they also include social science as well as data description papers; and they address topics such as education and project management.



Publications

43
H-Index



Top 3 most cited articles:

564
Citations

253
Articles

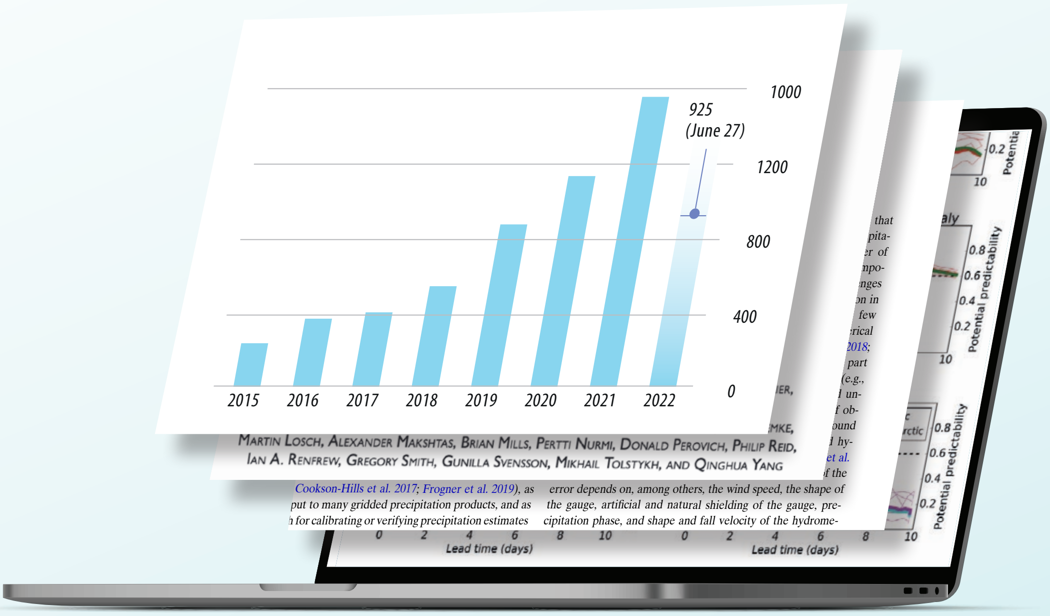
216
Peer reviewed

1 Advancing polar prediction capabilities on daily to seasonal time scales*
202 **Citations**

2 Quantifying climate feed-backs in polar regions**
202 **Citations**

3 A review on Arctic sea-ice predictability and pre-diction on seasonal to decadal time-scales***
160 **Citations**

* Jung T., and co-authors, (2016): Bulletin of the American Meteorological Society 97 (9), 1631-1647
** Goosse.H., and co-authors, (2018): Nature communications 9 (1), 1-13
*** Guemas V., and co-authors, (2016): Quarterly Journal of the Royal Meteorological Society 142 (695), 546-561



Google Scholar / Exponential growth in the number of citations of YOPP peer-reviewed publications

POLAR-LOWER LATITUDE LINKAGES

Understanding the two-way linkages between the polar regions and lower latitudes has been a priority theme in PPP/YOPP:

On climate timescales PPP/YOPP contributed to understanding the impact of sea ice decline on mid-latitude extreme events through contributions to designing and applying the Polar Model Intercomparision Project (PAMIP), see Smith and co-authors, 2022. Results suggest that there is a link; however this link does not appear to be sufficently strong to fullly explain recent extreme events in mid-latitudes.

The dynamics of linkages on daily to seasonal timescales related to the prediction problem was shown to be fundamentally different compared to climate timescales. Linkages are strongly associated with the meandering jet stream, with regions of southerly (northerly) flow being characterized by mid-latitude (Arctic) weather influencing the Arctic (mid-latitudes). This link turns out to be strongly flow-dependent, with episodes of Europe-Atlantic blocking giving rise to North Atlantic air masses influencing the Arctic, while undergoing transformation, and subsequently impacting weather further downstream over Eurasia.

Featured publications

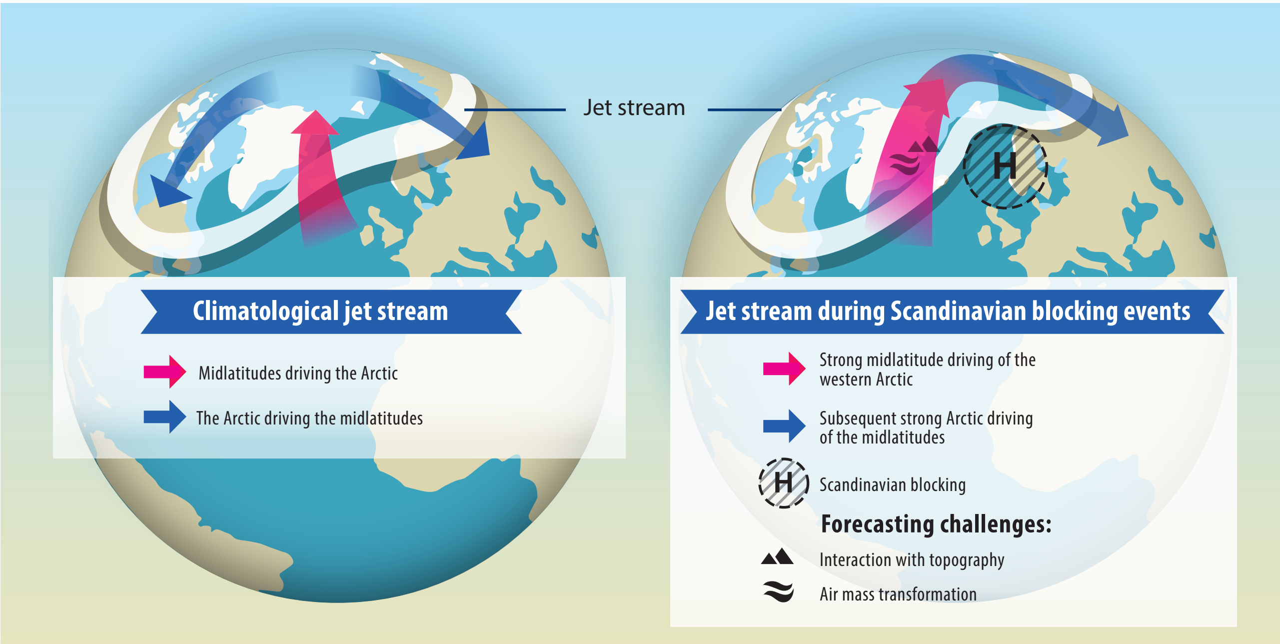
Smith, D., and co-authors, (2022): Robust but weak winter atmospheric circulation response to future Arctic sea ice loss. Nature Comm., 13, 727.

Day, J. and co-authors, (2019): Increased Arctic influence on the mid-latitude flow during Scandinavian Blocking episodes. Quart. J. Roy. Meteor. Soc., 145, 3846–3862.

Semmler, T., and co-authors, (2016): Remote impact of the Antarctic atmosphere on the southern mid-latitudes. Meteorologische Zeitschrift, 25, 71–77.

Jung, T., and co-authors, (2014): Arctic influence on subseasonal midlatitude prediction. Geophys. Res. Lett., 41.

Atmospheric teleconnections – their role in prediction on daily to seasonal time scales
Synthesis from the EU project APPLICATE



VERIFICATION

Helge Goessling, winner of the "Best new user-oriented forecast verification" challenge 2017, awarded for the development of novel sea ice verification methods by the Joint Working Group for Forecast Verification Research (JWGFVR).

During the planning of PPP/YOPP it was recognized that verification is critical for providing users with information about forecast quality to guide their decision making procedure, and for providing feedback to the forecasting community to improve their own processes. Furthermore, it was recognized that verification in polar regions poses specific challenges (e.g, sea ice); and a headline score – like 500 hPa geopotential height was missing.

Solid precipitation measurements are affected by undercatch in windy conditions. The WMO SPICE project developed a number of adjustment functions. The NWP systems artificial overforecast of solid precipitation reduces to a neutral bias after the adjustment.

Development of novel scores for verifying prediction skill of the sea ice edge through the Integrated Ice Edge Error (IIEE) and the Spatial Probability Score (SPS).

IIEE and SPS have become widely used headline scores for sea ice forecast verification.

Featured publications

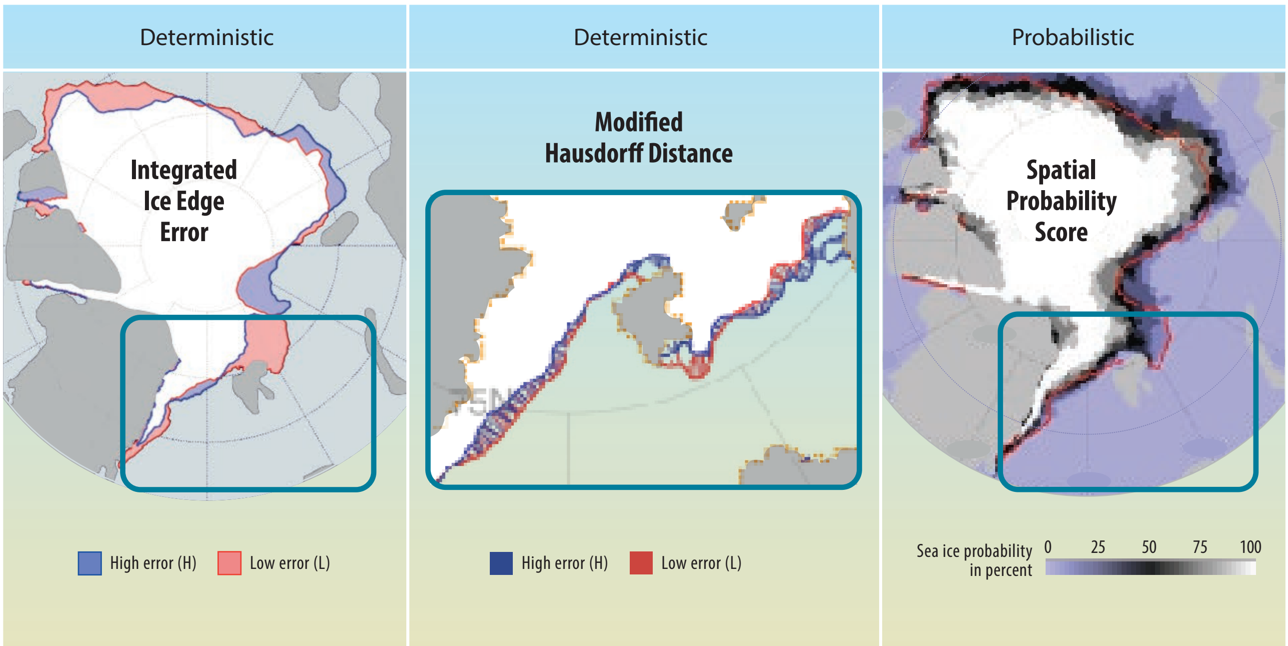
Køltzow, M., and co-authors, (2020): Verification of Solid Precipitation Forecasts from NWP Models in Norway. Weather and Forecasting, 35, 2279–2292.

Goessling, H. F. and T. Jung, (2018): A probabilistic verification score for contours: Methodology and application to Arctic ice-edge forecasts. Quart. J. Roy. Meteor. Soc., 144, 735–743.

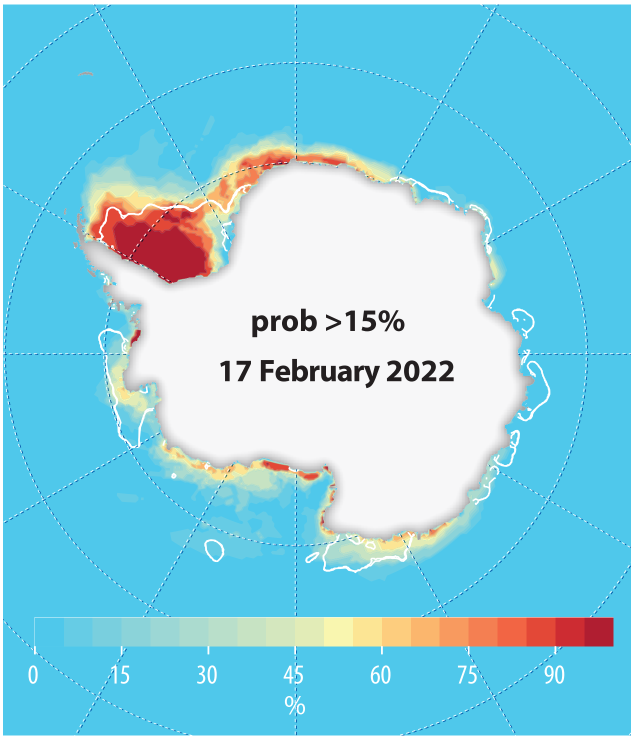
Goessling, H. F., and co-authors, (2016): Predictability of the Arctic Sea Ice Edge. Geophys. Res. Lett., 43, 1642–1650.

Dukhovskoy D.S. and co-authors, (2015): Skill metric for evaluation and comparison of sea ice models. J. Geophy. Res. Oceans, 120, 5910–5931.

How to measure sea ice forecast skill beyond "extent"?
Focus on ice-edge position



SEA ICE PREDICTION NETWORK (SIPN) SOUTH



Featured publications

Abrahamsen, E. P., and co-authors, (2020): Antarctica and the Southern Ocean. Bull. Amer. Meteor. Soc., 101(8), S287–S320.

Bromwich, D. H., and co-authors, (2020): The Year of Polar Prediction in the Southern Hemisphere (YOPP-SH). Bull. Amer. Meteor. Soc., 101(10), E1653-E1676.

The accompanying map (left) illustrates one among many forecasts delivered by SIPN South for austral summer 2022. It shows the probability to observe sea ice presence (more than 15% concentration) at a given location for the 17th of February 2022. The white line illustrates the observed ice edge on that day. Output shown from UCLouvain model. Further information: https://fmassonn.github.io/sipn-south.github.io/

Francois Massonnet is the coordinator of SIPN South. He was a CliC YOPP fellow of the World Climate Research Programme (WCRP).

Due to its unique geographical setting, Antarctica has remained for centuries one of the most remote and least studied places on Earth. Long thought to be immune to global climate changes, Antarctica is now clearly emerging as a climatic hotspot.

Access to the Antarctic continent is hampered by the presence of sea ice, which has long been deemed unpredictable. Recent studies, however, have challenged this idea by demonstrating the existence of physical mechanisms of predictability at sub-seasonal to interannual time scales.

The goal of the SIPN South project is to coordinate existing efforts toward seasonal sea ice prediction in the Southern Hemisphere. The project focuses on the austral summer season, when the probability of sea ice presence near the coastal margins is lowest and access to them easiest. Seasonal predictions are made possible by the existence of slow components in the climate system like the oceans. These slow components can impart predictability to faster components like the atmosphere and sea ice. However, there will always be some degree of uncertainty in seasonal predictions due to the chaotic nature of the atmosphere, hence the forecasts are always communicated with probabilities.

IMPROVING PROCESS REPRESENTATION

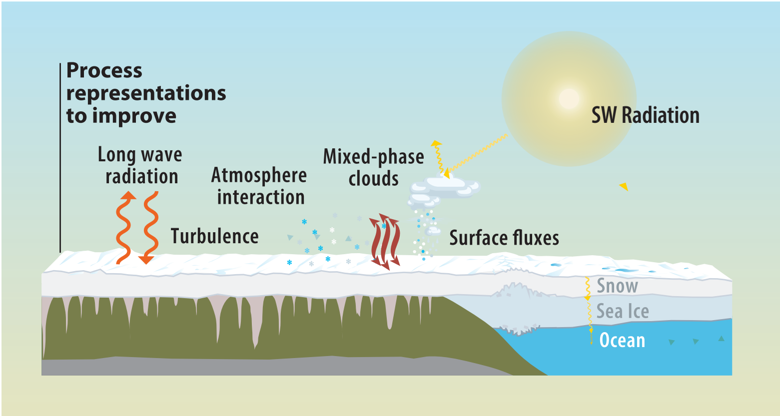
To improve the capabilities of environmental prediction models in polar regions it is necessary to increase our understanding – and model representation – of the complex processes and interactions in the coupled atmosphere-ocean-sea ice-land system. The YOPP Model Intercomparison and Improvement Project (MIIP) has coordinated the activities to improve process representation, involving observational groups and modellers, including scientists from operational forecast centres.

An important element of MIIP is the MOSAiC Near Real-time Verification (NRV) Project, which is focused on evaluating the simulation of the Arctic atmospheric boundary layer and surface energy budget in short-term forecasts of the coupled ocean-atmosphere-sea ice system from state-of-the-art operational and experimental forecast systems using observations taken during the MOSAiC campaign.

Much of the progress on process representation resulted from coordinated efforts during a few specific time periods: the two Northern Hemisphere Special Observing Periods (SOPs), and the MOSAiC year (October 2019 to October 2020) that includes the YOPP Targeted Observing Period (TOP) (mid-April 2020).

Another important aspect underpinning success was the focus on several 'supersite observatories' – well instrumented locations on land or at sea with sustained observations that were matched by corresponding high-resolution, high-frequency model output (see the Section on YOPPsiteMIP). This included novel model experimentation, for example with coupled single column models.

Parameterisation of physical processes that have seen substantial improvements during YOPP include the representation of snow on land and over sea, and surface-atmosphere exchange over sea ice.



Featured publications

Arduini, G., and co-authors, (2019): Impact of a multi-layer snow scheme on near-surface weather forecasts. J. Adv. Model. Earth Syst., 11, 4687-4710.

Batrak, Y., Müller, M., (2019): On the warm bias in atmospheric reanalyses induced by the missing snow over Arctic sea-ice. Nat Comm 10, 4170.

Elvidge, A. D., and co-authors, (2021): Surface heat and moisture exchange in the marginal ice zone: Observations and a new parameterization scheme for weather and climate models, J. Geophy. Res.: Atmospheres, 126.

Hartung, K. and co-authors, (2022): Exploring the dynamics of an Arctic sea ice melt event using a coupled Atmosphere-Ocean Single-Column Model, J. Adv. Model. Earth Syst., 14(6).

Tjernström, M., and co-authors, (2020): Central Arctic Weather Forecasting: Confronting the ECMWF IFS with observations from the Arctic Ocean 2018 expedition. Quart. J. Roy. Meteor. Soc., 147,1278-1299.

SPECIAL OBSERVING PERIODS (SOPs) AND OBSERVING SYSTEM EXPERIMENTS (OSEs)

During the planning of PPP/YOPP it was quickly realized that addressing the following 4 central questions would be critical to accomplishing advanced predictive capacity in polar region and beyond:

- How much do current polar observations contribute to predictive skill from hours to years ahead?
- What new observations would we need to further enhance predictive skill in polar regions and beyond?
- What should future polar observing systems look like?
- Do we make the best use of the current observations in polar regions?

To address these questions, 2 SOPs in the Arctic, 1 SOP in the Antarctic and 2 Targeted Observing Periods (TOPs), one in each of the hemispheres, along with a set of coordinated OSEs, using global and limited area NWP systems, were central to the approach employed in YOPP. In total, more than 10,000 extra radiosondes were launched, and more than an additional 250 buoys deployed in both hemispheres.

Key outcomes include:

While conventional observations are sparse in the polar regions compared to the wealth of data from polar-orbiting satellites, their impact on forecast skill is high.

In global NWP systems, all current Arctic atmospheric observing systems increase short- and medium-range predictive skill both in polar regions and mid-latitudes.

In regional NWP systems, like AROME-Arctic, there is a clear benefit in terms of short-range forecast skill from the assimilation of Arctic atmospheric observations both in the global models used to create their lateral boundary conditions, and in regional NWP systems themselves.

The impact of polar observations on mid-latitudes, and vice versa, is strongly dependent on the large-scale circulation, with a strongly meandering (zonal) jet stream favouring (inhibiting) strong linkages. This finding along with results from OSEs denying additional observation call for targeted observing periods for maximizing and investigating the impact of extra observations.

The use of microwave sounder observations is sub-optimal during winter, particularly over snow and ice. In the lower troposphere, for example, far fewer microwave observations are assimilated during winter than during summer in the ECMWF system.

Assimilating sea ice thickness information significantly improves the skill of sea ice forecasts on subseasonal to seasonal timescales.

Featured publications

Randriamampianina, R., and co-authors, (2021): Relative impact of observations on a regional Arctic numerical weather prediction system. Quart. J. Roy. Meteor. Soc., 147, 2212–2232.

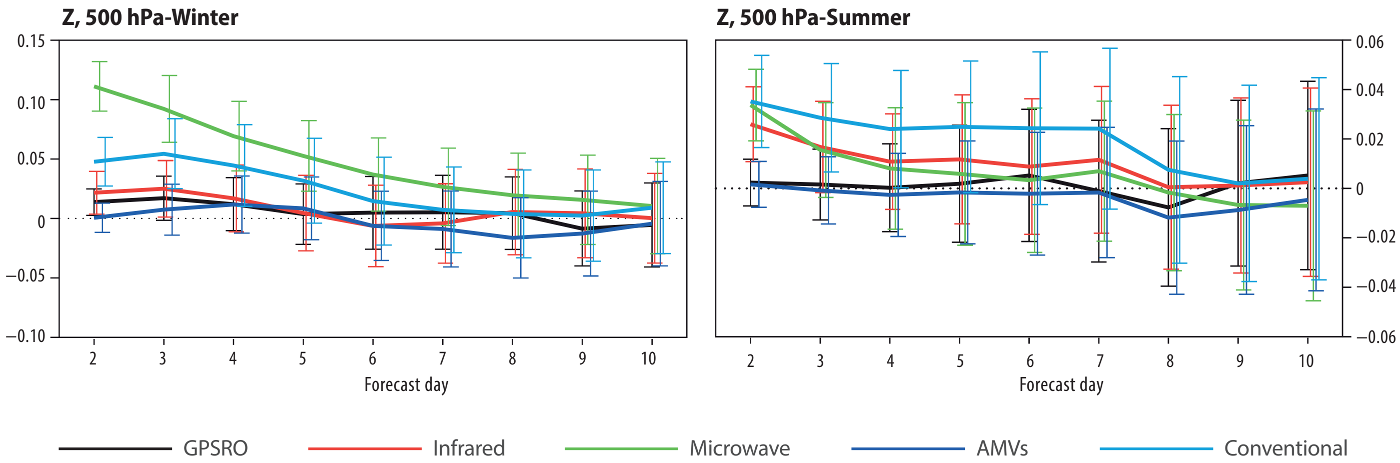
Bromwich, D., and co-authors, (2020): The Year of Polar Prediction in the Southern Hemisphere (YOPP-SH), Bull. Amer. Meteor. Soc., 101, E165–E1676.

Lawrence, H., and co-authors, (2019): Use and impact of Arctic observations in the ECMWF Numerical Weather Prediction system Quart. J. Roy. Meteor. Soc., 145, 3432–3454.

Blockley, E. and K.A. Peterson, (2018): Improving MetOffice seasonal predictions of Arctic sea ice using assimilation of CryoSat-2 thickness. The Cryosphere, 12, 3419–3438.

Sandu, I., and co-authors, (2021): The potential of numerical predication systems to support the design of Arctic observing systems: Insights from the APPLICATE and YOPP projects. Quart. J. Roy. Meteor. Soc., 147, 3863-3877.

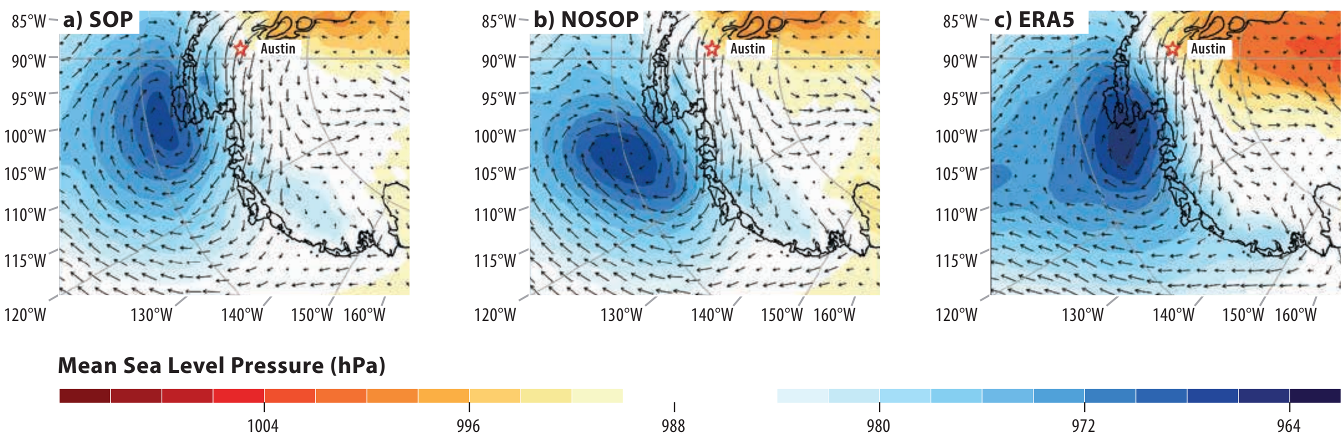
ARCTIC



Impact of different components of the observing system on forecasts in the Arctic.

Shown is the normalised change in the standard deviation of forecast error for geopotential height at 500 hPa over the Arctic region (north of 60°N) during (a) winter and (b) summer. Different lines give results from different observing system experiments in which certain observation types are removed when creating the initial conditions for the forecasts. From Lawrence et al. (2019).

ANTARCTICA



Impact of extra observations during the SOP around Antarctica on a 2-day forecast of a low-pressure system along the data-sparse coast of West Antarctica during the summer

Shown is sea level pressure (shaded, hPa, scale below figures) and surface winds (vectors) from 48-h (a) forecast using all available observations, (b) forecast with all observations, except for the additional YOPP SOP radiosondes, and from (c) the ERA5 global reanalysis (”truth”), valid 0000 UTC 18 Jan 2019. Having the extra radiosondes included in the forecast clearly leads to a better prediction of the low pressure system. Austin automatic weather station (AWS) is marked. Adapted from Bromwich et al. (2020).

SCIENCE FOR SERVICES

The ambition of PPP/YOPP was to enable the polar research community to carry out excellent science with the outcomes being published in prestigeous peer-reviewed journals. However, rather than stopping at publishing, where possible, PPP/YOPP strived to turn science into operations and services in support of decision-making.

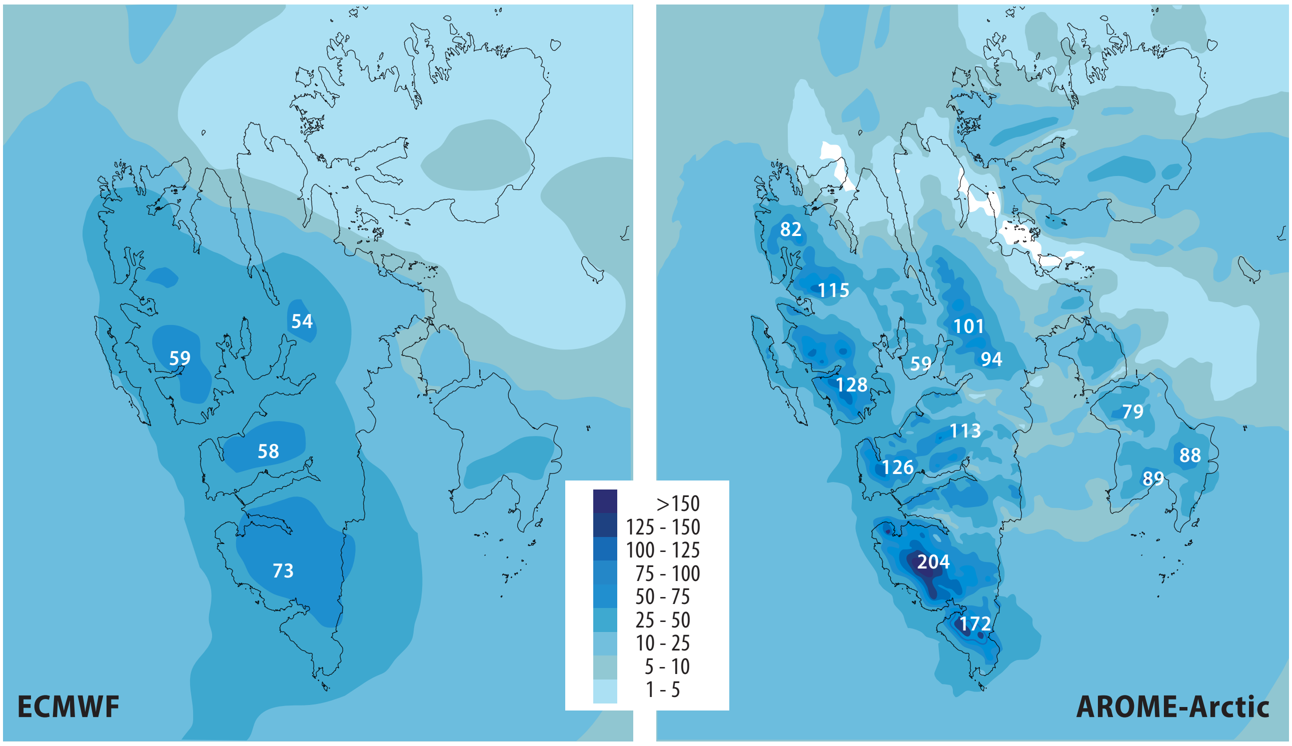
Prominent examples include:

The development of the novel, regional AROME-Arctic system at Met Norway, supported by the YOPP-endorsed projects APPLICATE, ALERTNESS and Nansen Legacy. This system, which led for example to much improved precipitation forecasts and temperatures over sea ice, is now used operationally; and it provides the backbone of the Copernicus Arctic Regional ReAnalysis.

At ECMWF a new multi-level snow scheme has been developed, that shows a much improved representation of critical processes in polar regions and that leads to improved prediction skill of snow-related parameters. Operational implementation is envisaged for 2022/23 (lower right opposite page).

Arctic sea ice drift forecast at lead times from days to years were developed in the context of the Sea Ice Drift Forecast Experiment (SIDFEx). They were extensively used for tactical decision making during the MOSAiC campaign (upper figure opposite page) and during the search for the Endurance in the Weddell Sea.

DEVELOPMENT OF THE AROME-ARCTIC CONFIGURATION AT MET NORWAY



Medium-range (left) and short-range (right) precipitation forecast (mm/24h) for 7 November 2016.

The main benefit from PPP/YOPP is that AROME-Arctic has become an operational short-range weather prediction model for the European Arctic. Without PPP/YOPP AROME-Arctic would not have happened.

Jørn Kristiansen, *Director Development Centre for Weather Forecasting, Norwegian Meteorological Institute*

THE SEA ICE DRIFT FORECAST EXPERIMENT (SIDFEx) IN ACTION DURING MOSAiC

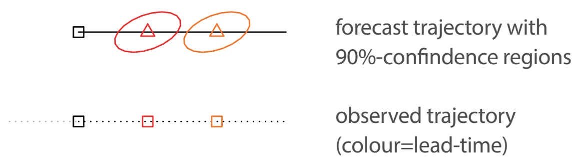
Probabilistic drift forecasts along with verifying observations for the icebreaker Polarstern in support of the operational planning during MOSAiC.
SIDFEx is a community effort to collect and analyse Arctic sea ice drift forecasts at lead times from days to a year. The forecasts are made with various methods for drifting sea ice buoys and, ultimately, MOSAiC.

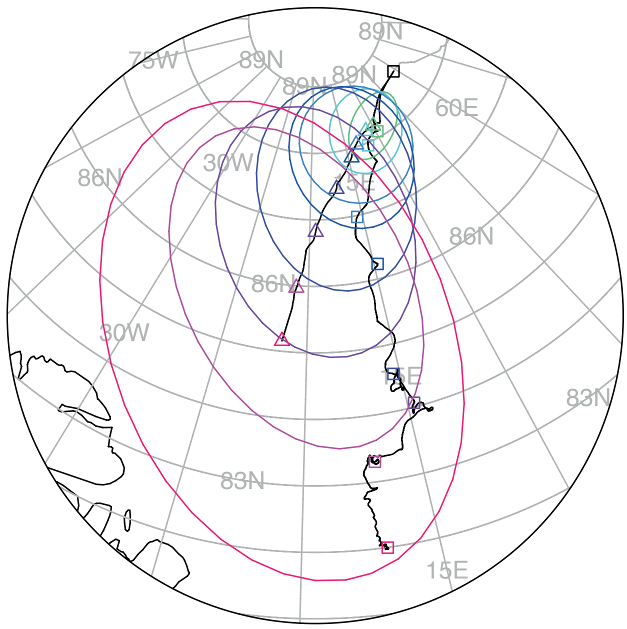
Because of SIDFEx, our hit rate during MOSAiC was about 80–85%. Without SIDFEx my expectations (of Polarstern being in the ordered imagery scene) was below 50%.

Suman Singha
German Aerospace Center, responsible for the daily advance ordering of satellite imagery for the MOSAiC expedition

During Endurance 22 the SIDFEx ice drift forecasts enabled informed decision making for tactical placement of the vessel relative to the planned AUV deep-sea surveys. Without operational ice drift forecasts the outcome of the AUV surveys depended to a larger degree on luck.

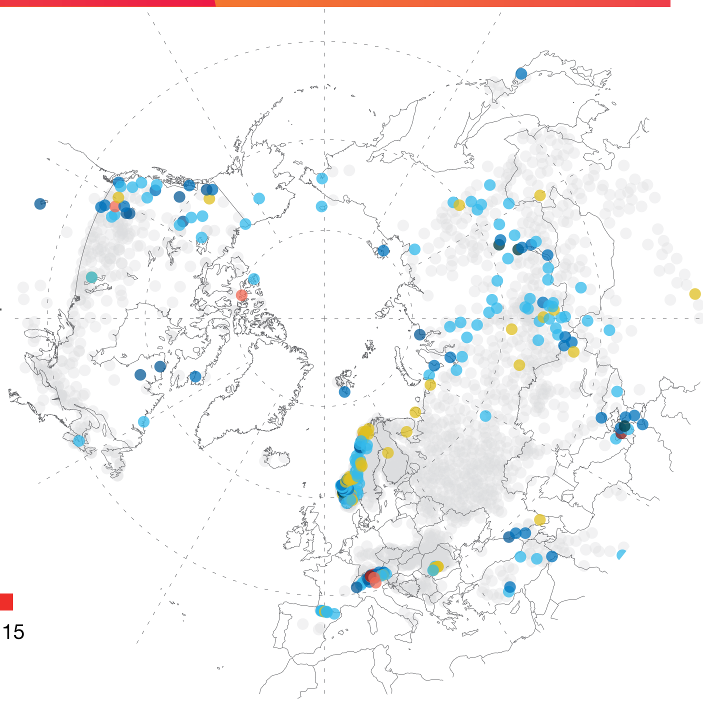
Lasse Rabeinstein
CEO, Drift & Noise Polar Services GmbH

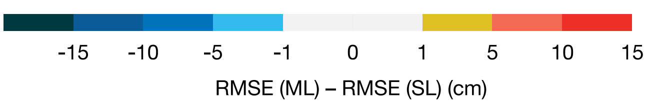




TOWARDS AN IMPROVED OPERATIONAL FORCAST MODEL AT ECMWF

Changes in forecast error for snow depth that came with the introduction of a new multi-layer snow scheme at ECMWF.
Shown is the difference between the root-mean-square error (RMSE) of snow depth between coupled forecasts at a lead time of t+12 hours using the multi-layer (ML) and single-layer (SL) snow schemes and initialised from a consistent analysis using a multi-layer and single-layer snow scheme, respectively, from December 2019 to January 2020. Blue represents an improvements of forecast skill.



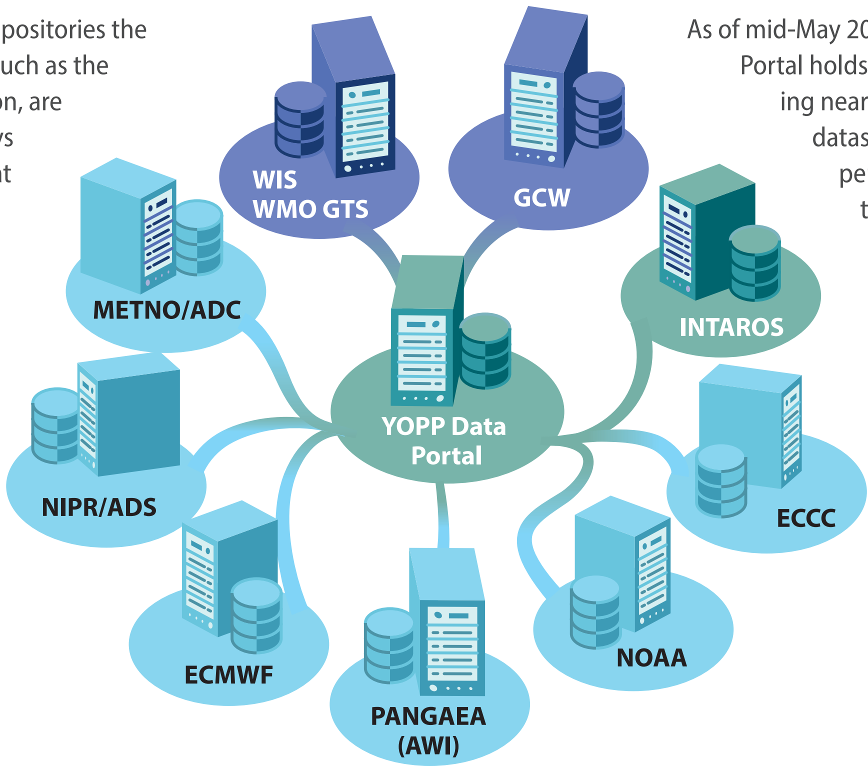


YOPP DATA PORTAL

Numerous countries, institutions and individuals have produced and collected petabytes of data during YOPP to assist in the advancement of polar prediction. Recognizing the need for both open access to data and proper recognition of data providers, and taking advantage of recent technological developments, the Norwegian Meteorological Institute (MetNo) has developed and is hosting a data portal providing a single entry point for users to discover and, depending upon access and copyright requirements of the data owner, to display, compare and download data. This service is called the YOPP Data Portal and is available at https://yopp.met.no/. for data across many different repositories from the one search location. Individuals and institutions can also manually upload the metadata for their observations and forecasts in the event that the metadata from their data depositories cannot be automatically harvested by the YOPP data servers.

MetNo anticipate operating the YOPP Data Portal until at least the end of 2025. When the current hardware configuration needs to be updated it is envisaged transferring the YOPP Data Portal Catalogue to the wider Arctic Data Centre (ADC) system also operated by MetNo.

Some of the data depositories the Portal connects to, such as the WMO WIS connection, are themselves gateways to other systems that exchange metadata whilst others such as the MetNo/ADC are data holdings for the wider Arctic region. This master metadata catalogue allows users to search

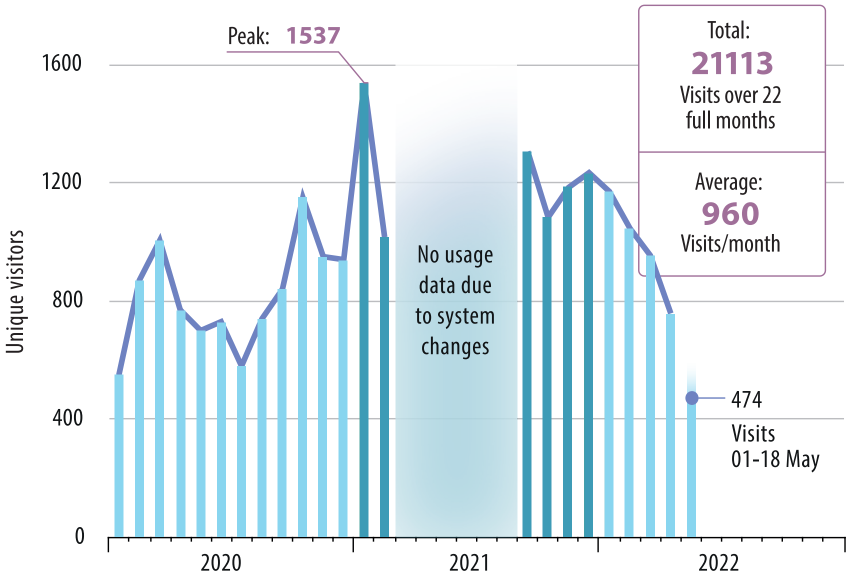


As of mid-May 2022 the YOPP Data Portal holds metadata describing nearly 1100 parent datasets. Over the period January 2020 to May 2022 the YOPP Data Poral recorded more than 21,000 visitors, with peak values for one month exceeding 1500 unique visits.

THE YOPP DATA PORTAL

- Gateways to other networks or networks themselves (WMO)
- Metadata collections that hold the descriptions from all of the other places
- Data centres with working interfaces for metadata harvesting

YOPP DATA PORTAL USAGE

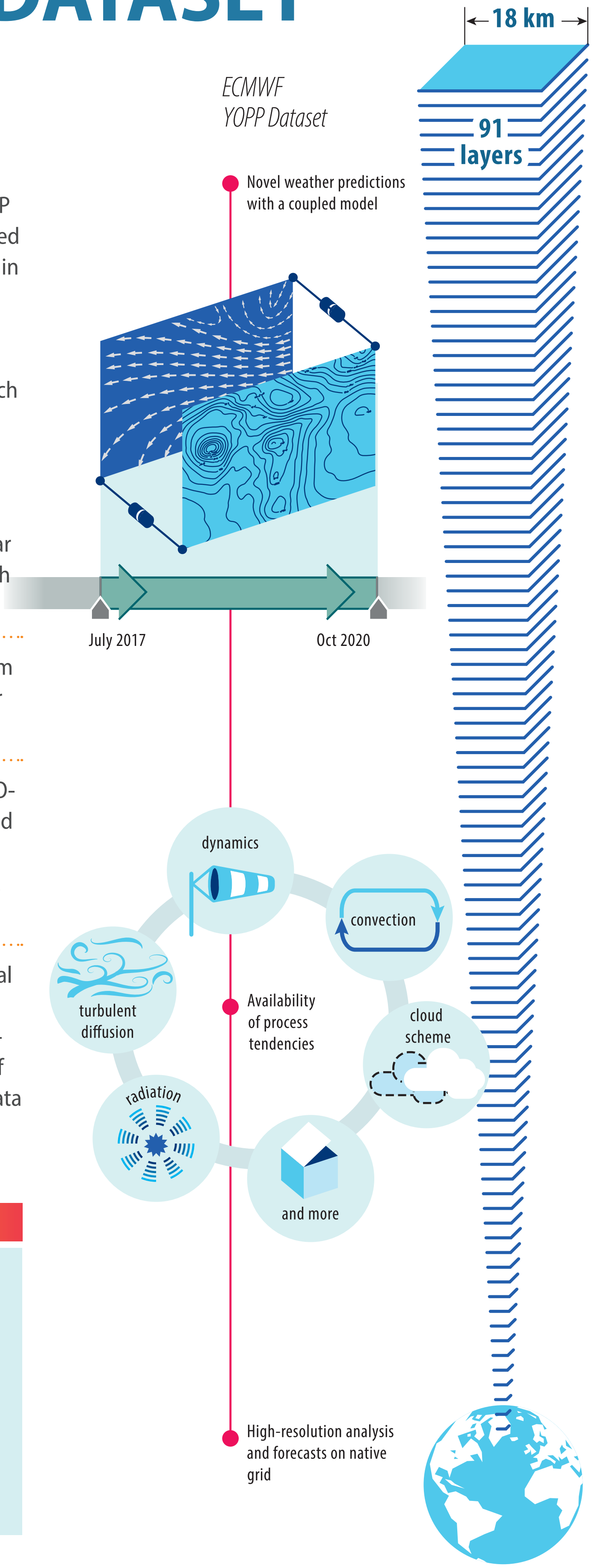


Participants of the planning meeting for the YOPP Data Component hosted by Met Norway in November 2016 in Oslo, Norway.

Photo: Victoria Heinrich

Photo: Christoph Ritter / AWI

ECMWF YOPP DATASET



Based on the success of the Year of Tropical Convection (YOTC) dataset, produced by ECMWF during THORPEX, early on during the planning it was decided that for YOPP a comparable global dataset was needed that was tailored to the meet the needs for advancing predictive capacity in polar regions and beyond.

ECMWF, supported by the APPLICATE project funded through the EU's Horizon 2020 programme, provided such a dataset covering the period 2017–2020.

The dataset:

Has been created to support model forecast evaluation, predictability studies and model error analyses over polar areas, which are strongly affected by climate change with yet unknown feedbacks on global circulation.

Contains initial condition and forecast model output from ECMWF's operational global, coupled numerical weather prediction system.

Covers the period from mid-2017 until the end of the MOSAiC field campaign (autumn 2020). Initial conditions and forecasts up to day 15 are included for the atmosphere and land surface for the entire period, and for ocean and sea ice model components after June 2019.

Contains tendencies from model dynamics and individual physical parametrizations for the first two forecast days. These fields are essential for characterizing the contribution of individual processes to the predicted evolution of the system. The dataset is available through the YOPP Data Portal.

Featured publications

Bauer, P., and co-authors, (2020): ECMWF Global Coupled Atmosphere, Ocean, Sea ice Dataset for the Year of Polar Prediction (2017–2020). Nature Scientific Data, 7.

Jung, T., and co-authors, (2016): Advancing Polar Prediction Capabilities on Daily to Seasonal Time Scales. Bull. Amer. Meteor. Soc., 97, 1631–1647.

YOPP SITE MODEL INTERCOMPARISON PROJECT (YOPPsiteMIP)

Improving the understanding and model representation of critical processes – in polar regions and beyond – requires confronting our latest models with the best available observations. However, this is a challenging task as data are distributed across multiple archives, using different file formats and many different attributes.

As part of the Model Intercomparision and Improvement Project (MIIP), YOPP has pioneered the YOPPsiteMIP concept, which is a game changer in terms of the ease of use – and hence uptake – of observational and modelling data from different sources. The aim is to enable efficient evaluation of process representation in models and speed up model improvement.

YOPPsiteMIP provides high-frequency multi-variate observations taken from supersite observatories in combination with timestep model output at co-located grid points from the native model grid.

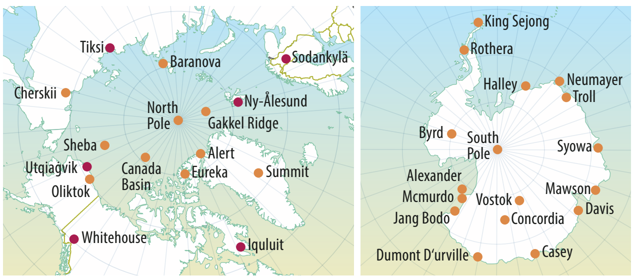
Eight Arctic sites and the MOSAiC expedition have already contributed observational data to the MIIP. The sites are key polar observatories and many of them host multiple systems deployed for long-term monitoring and suites of instruments (such as lidars, radars, ceilometers, radiometers), that provide detailed measurements characterising the vertical column of the atmosphere as well as the surface and subsurface conditions.

Many major NWP centres provided column model output at the selected sites, including the MOSAiC drift site,

Micrometeorological flux tower in Eureka, Canada.
Photo: Robert Albee

in order to contribute to the YOPPsiteMIP sister project MOSAIC-Near Realtime Verification Project. This dataset provides a unique opportunity for in-depth process evaluation of the representation of small-scale parameterised processes important for atmosphere-sea ice interactions.

The key to this activity is the common file format and semantics (netCDF with CF naming convention) for both models and observations that has been established. FAIR principles are followed resulting in Merged Data Files (MDFs) with the two subgroups Merged Model Data Files (MMDF) and Merged Observatory Data Files (MODF) as well as tools to create and analyse them. Both MMDFs and MODFs can be accessed via the YOPP Data Portal.

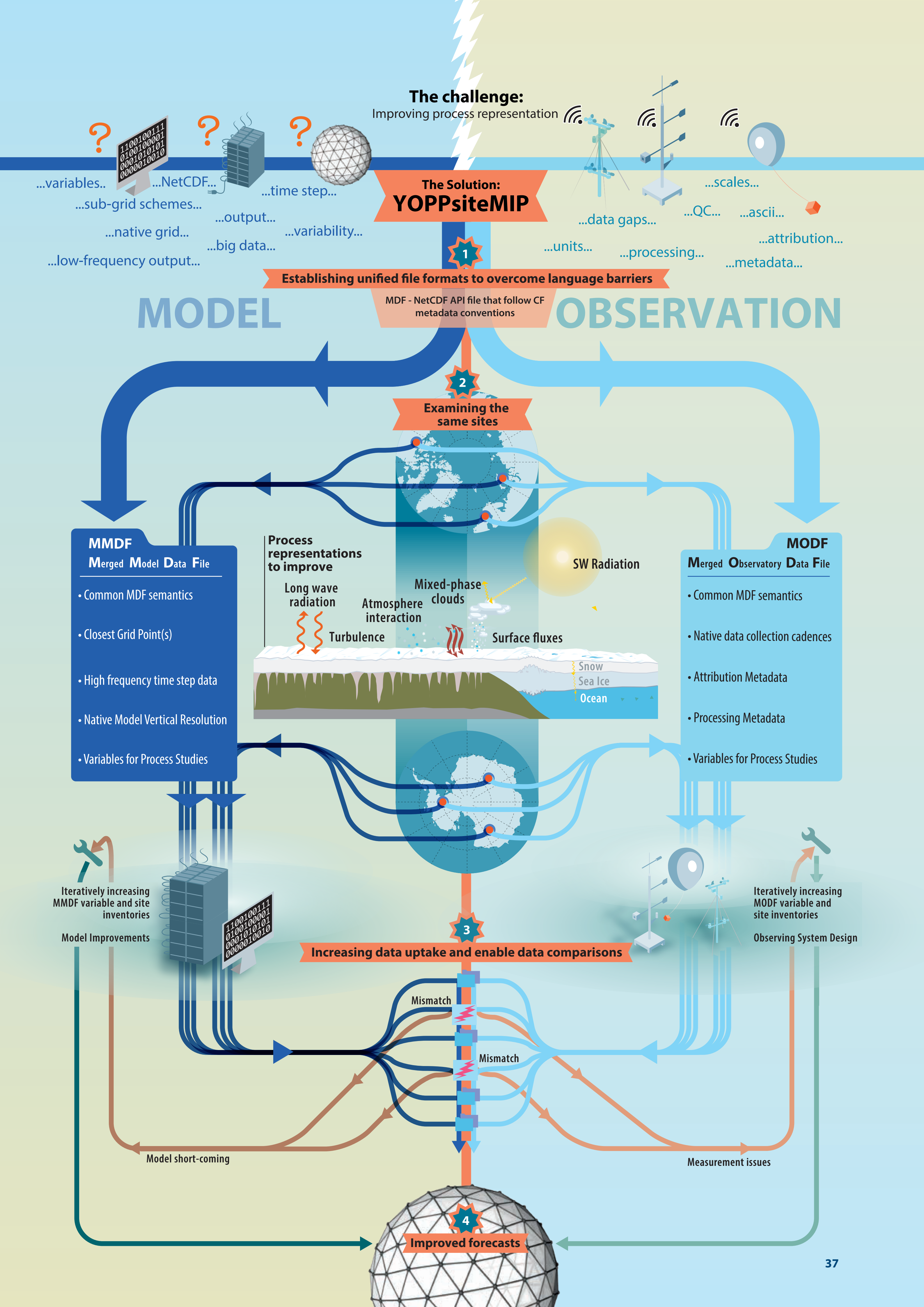


YOPP Arctic and Antarctic (super)sites and field campaigns.

- sites with MODF and MMDF data
- sites with only MMDF data at the date of publication

Featured publications

Uttal, T,. and co-authors, (2016): International Arctic systems for observing the atmosphere: an international polar year legacy consortium. Bull. Amer. Meteor. Soc., 97(6), 1033-1056.


The challenge:
Improving process representation
...variables..
...NetCDF...
...time step...
...sub-grid schemes...
...output...
...native grid...
...variability...
...big data...
...low-frequency output...
The Solution:
YOPPsiteMIP
...scales...
...data gaps...
...QC...
...ascii...
...attribution...
...units...
...processing...
...metadata...
1
Establishing unified file formats to overcome language barriers
MDF - NetCDF API file that follow CF metadata conventions
MODEL
OBSERVATION
2
Examining the same sites
MMDF
Merged Model Data File
• Common MDF semantics
• Closest Grid Point(s)
• High frequency time step data
• Native Model Vertical Resolution
• Variables for Process Studies
Process representations to improve
Long wave radiation
Turbulence
Atmosphere interaction
Mixed-phase clouds
SW Radiation
Surface fluxes
Snow
Sea Ice
Ocean
MODF
Merged Observatory Data File
• Common MDF semantics
• Native data collection cadences
• Attribution Metadata
• Processing Metadata
• Variables for Process Studies
Iteratively increasing MMDF variable and site inventories
Model Improvements
Iteratively increasing MODF variable and site inventories
Observing System Design
3
Increasing data uptake and enable data comparisons
Mismatch
Mismatch
Model short-coming
Measurement issues
4
Improved forecasts

EDUCATION

The provision of training opportunities was one of the central objectives of PPP/YOPP. The YOPP schools were a key component of the education component and aimed to train the next generation of polar scientists. The schools allowed students to discuss key findings in the framework of polar prediction and enable the possibility of networking with senior polar scientists.

Attendees of the Polar Prediction schools were introduced to environmental prediction in polar regions through a mix of lectures and modelling assignments as well as the collection and analysis of field observations. Since the beginning of PPP/YOPP, two summer schools have been held at the Abisko Scientific Research Station in northern Sweden in 2016 and 2018 with nearly 60 PhD and Early Career Scientists taking part.

In addition to the Polar Prediction schools the YOPP Education, Communication and Outreach Task Team has lead and participated in a number of workshops linked to conferences such as the Artic Summit Science Week in March 2021, the Association of Polar Early Career Scientists (APECS) Oceania in August 2020.

Polar prediction affects the lives of people living and working in polar regions. Better forecasts of weather and sea ice conditions will reduce risks and enable safety management in the polar regions and lead to improved forecasts in lower latitudes, where most people live.

ECRs represent a transitional stage between PhD and senior academic roles. By providing educational activities and opportunities, we can help to develop future leaders in polar prediction. Polar prediction is inherently a multi-disciplinary problem, and the Year of Polar Prediction is in the unique situation of being able to draw on researchers working across the disciplines to introduce ECRs to the melange of observing, modelling, verification and user-engagement that comprise the research being undertaken. We hope that by strengthening training opportunities and broadening networks for ECRs, we can provide a strong basis for the development of future polar prediction research.

Extract from an interview with Clare Eayrs on the importance of training ECRS

2016 YOPP School at Abisko, Sweden. Photo Lina Broman

Further reading

Day, JJ., and co-authors, (2017): The Abisko Polar Prediction School. Bull. Amer. Meteor. Soc., 98 (3), 445-447

Tummon, F., and co-authors, (2018): Training Early-Career Polar Weather and Climate Researchers, Eos Transactions American Geophysical Union 99

2018 Abisko Polar Prediction School. Photo: Jonathan Day

COMMUNICATION AND OUTREACH

Outreach and communication played a central role within the Year of Polar Prediction to connect the many people within the polar prediction community, to inform them about PPP/YOPP activities and research findings, to support networking within the community and foster dialogue on ongoing research and advances in predictive skill within and beyond the polar prediction community. Communication was undertaken using a variety of channels including one-on-one email, email lists, the PPP website, social media and newsletters.

The polar prediction mailing list of almost 700 subscribers was a key communication channel with the PPP/YOPP community. Regular updates were forwarded to the mailing list with requests to be added to the list still occurring. Nineteen editions of the PolarPredictNews newsletter were produced over a five year period from October 2016 to October 2021. This newsletter covered research results as well as articles about the scientists, major activities, and engagement with stakeholder groups involved in PPP/YOPP. Later editions of PolarPredictNews expanded to over 25 pages and included an "Art and Science" section.

The Polar Prediction Matters (PPM) activity had been initiated as a non-peer reviewed forum to foster the dialogue between those that research, develop, and provide polar environmental forecasts and those that use (or could use) polar environmental forecasts to guide socio-economic decisions. The German Helmholtz Association hosted PPM as one of their Helmholtz science blog websites. An electronic booklet is being developed from the PPM material.

Example of Art and Science by Amy Macfarlane in PolarPredictNews #15.

The communication around PPP/YOPP has been sensational and created many features that will be copied by other projects.

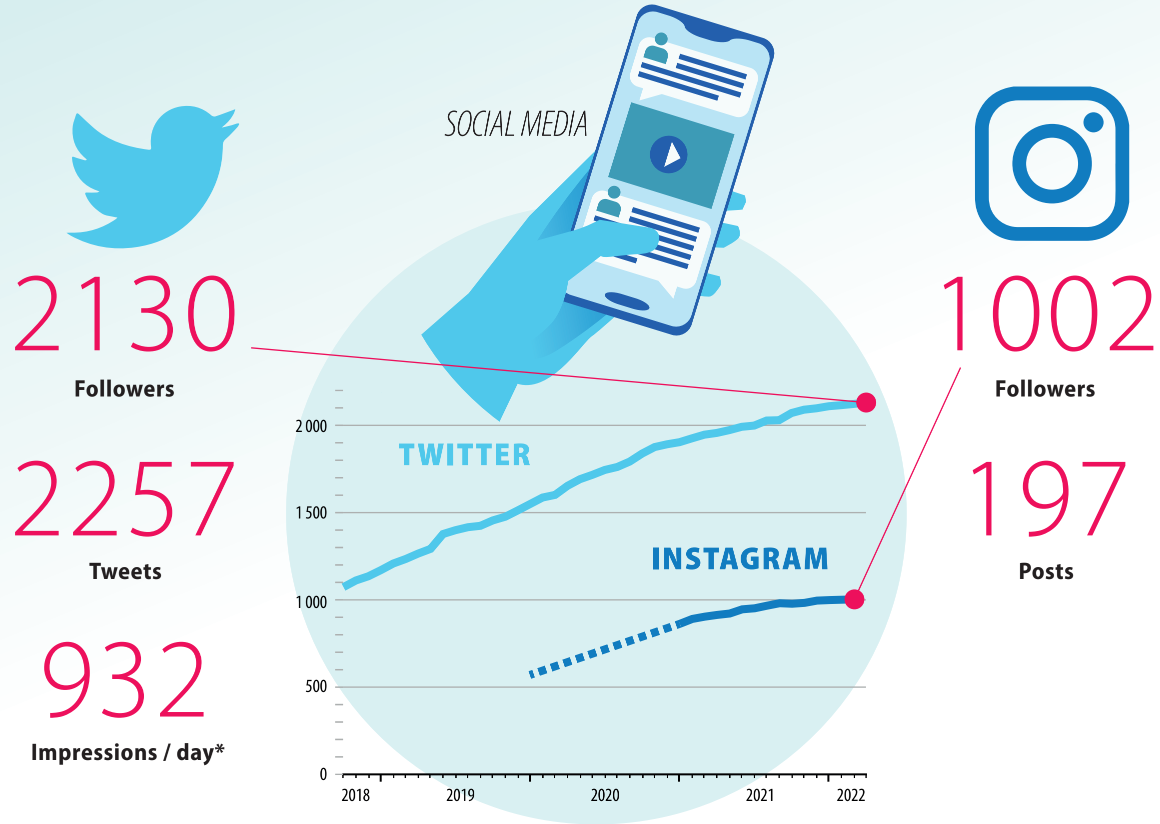
Peter Bauer
Director Destination Earth, ECMWF

Thomas Jung (AWI), Paolo Ruti (then WMO) and Celeste Saulo (Argentinean NMS) at the press conference of the YOPP launch event on 15 May 2017 in Geneva.

PPP/YOPP were also active in social media in order to connect with researchers, polar prediction users and enthusiasts beyond the traditional communication platforms and channels. PPP/YOPP have over 2000 followers on Twitter with an average of around 900 impressions/day for the period January 2020 to April 2022 when a staff departure in the ICO reduced the ability of the office to regularly service the social media accounts. PPP/YOPP have over 1,000 followers on Instagram. Use of social media enabled PPP/YOPP to reach a wider and arguably younger audience than email lists. With these platforms the ICO were able to strengthen the communication with and within polar prediction users and providers.

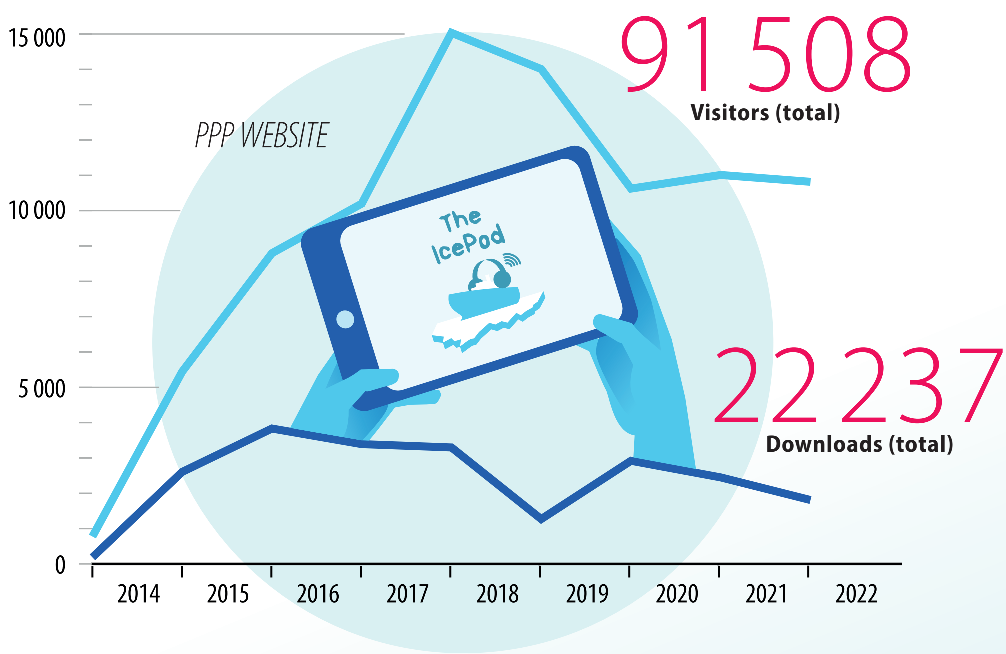
The IcePod

One of the PPP/YOPP outreach highlights is The IcePod ”The Podcast about Polar Science and the People” which started in September 2019. The IcePod ran for two seasons with Season 1 focusing on MOSAiC the first year-round expedition into the central Arctic and Season 2 focusing on the users of polar environmental services. A special episode was the live IcePod session which Kirstin Werner and Sara Pasqualetto, the organizers of the IcePod, produced during the APECS workshop ”Antarctic Science: Global connections” in August 2020. Kirstin and Sara, in Germany, interviewed the Australian weather observer and Ph.D. candidate Vicki Heinrich from the University of Tasmania, Hobart, Australia where she was in front of a live audience. There have been over 11,000 downloads of The IcePod episodes and it has rated in the top 30 Apple Podcasts for Earth Sciences in Germany, Great Britain, Canada and Australia.



*Jan 2020 – April 2022 average

Last updated 02.05.2022



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WWRP WORLD WEATHER RESEARCH PROGRAMME

YOPP YEAR OF POLAR PREDICTION

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