YOPP YEAR OF POLAR PREDICTION

AWI PPP WORLD METEOROLOGICAL ORGANIZATION

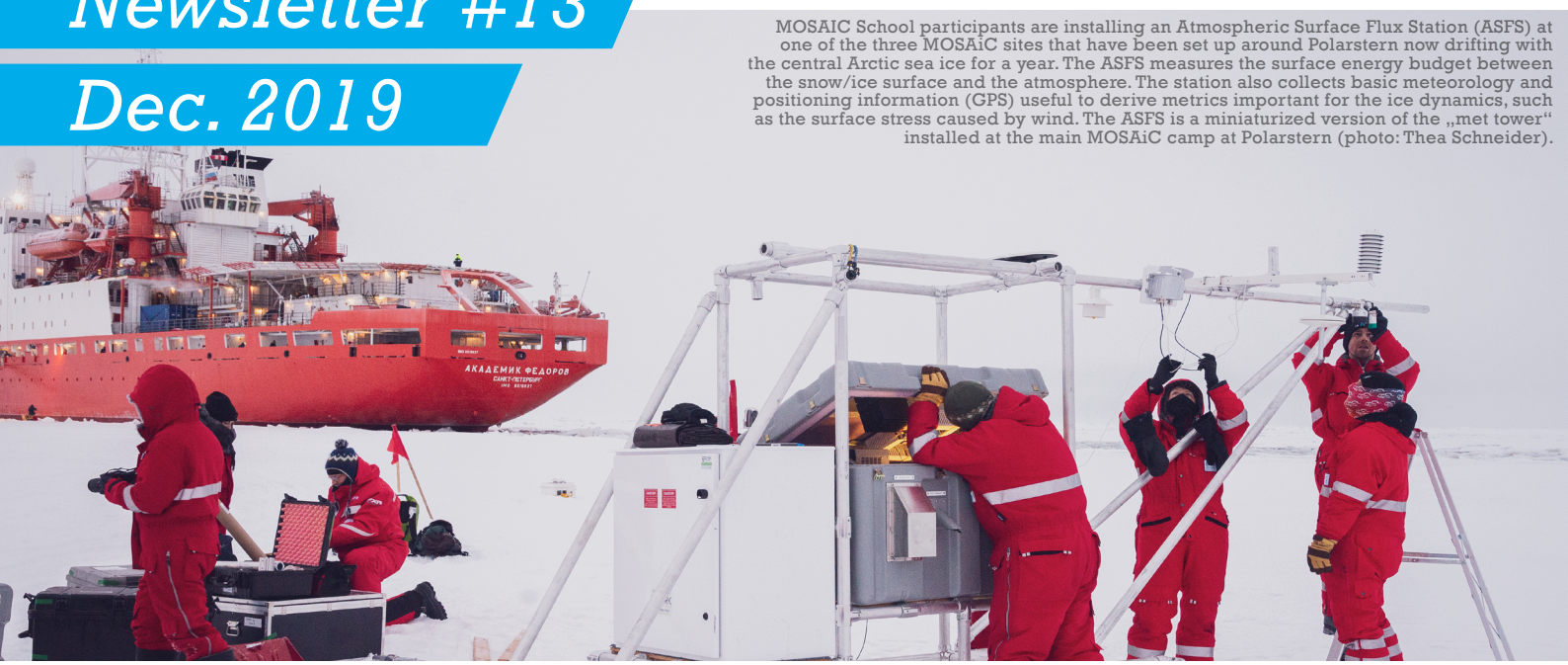
International Coordination Office (ICO)
of the Polar Prediction Project

Find more information at
www.polarprediction.net

PolarPredictNews

Newsletter #13

Dec. 2019



MOSAIC School participants are installing an Atmospheric Surface Flux Station (ASFS) at one of the three MOSAiC sites that have been set up around Polarstern now drifting with the central Arctic sea ice for a year. The ASFS measures the surface energy budget between the snow/ice surface and the atmosphere. The station also collects basic meteorology and positioning information (GPS) useful to derive metrics important for the ice dynamics, such as the surface stress caused by wind. The ASFS is a miniaturized version of the „met tower" installed at the main MOSAiC camp at Polarstern (photo: Thea Schneider).

Dear Colleagues,

After the first six months of the YOPP Consolidation Phase (it will run for another three years), I am excited to see so many outstanding scientific contributions to PPP being published. The results by Heather Lawrence, Jonny Day and colleagues provide an excellent example. Based on so-called observing system experiments (OSEs), these authors explore the impact of certain observation types on prediction skill. They highlight the observations' importance but also indicate issues in their uptake that should be addressed to make best use of data. They also point to a highly flow-dependent link between the Arctic and mid-latitudes, with Scandinavian blocking events playing a criticial role. It will be interesting to see how these results depend on the forecasting system used, utilizing similar experiments carried out by different prediction centres in a coordinated fashion.

With the holiday season just starting, you might look for something interesting and educative to do. This *PolarPredictNews* issue provides some fabulous suggestions. You can check weather forecasts for the *MOSAiC* expedition using the YR.no app; you can build your own *MOSAiC Climate Cube* (perhaps a good idea for an unusual present?); and you can listen to the first episode of *The IcePod*, in which climate modeller Thomas Rackow shares his experience as a MOSAiC School lecturer aboard the Russian research icebreaker Akademic Fedorov. If that's not enough, you will certainly find more exciting information in this issue of *PolarPredictNews*.

Happy reading,
Thomas Jung

The Year of Polar Prediction (YOPP) is a major international activity that has been initiated by the World Meteorological Organization as a key component of the Polar Prediction Project (PPP). The overarching goal of YOPP is to significantly advance our environmental prediction capabilities for the polar regions and beyond. As an internationally coordinated period of intensive observing, modelling, prediction, verification, user-engagement, and education activities which involves various stakeholders, YOPP contributes to the knowledge base needed to manage the opportunities and risks that come with polar climate change.

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Content

01 How Important are Arctic Observations for Global Numerical Weather Prediction? | *(by Jonathan Day, Irina Sandu, Heather Lawrence, and Niels Bormann, ECMWF)* **One of the central aims of the Year of Polar Prediction is to assess how important Arctic and Antarctic observations are for global Numerical Weather Prediction (NWP) to inform the design of future observing systems in polar regions. Two recently published papers directly address these questions in the Arctic using numerical experimentation performed with ECMWF's Integrated Forecasting System.**

Conventional in-situ and satellite observations play a crucial role in determining the initial state of the atmosphere for operational forecasts produced by the European Centre for Medium-Ranged Weather Forecasts (ECMWF). The initial conditions for the forecasts are produced by optimally combining observations with short-range forecasts through the 4D-Variational data assimilation system of ECMWF's Integrated Forecasting System (IFS). This ensures that the forecasts are initialized with the best possible reconstruction of the atmospheric state.

ECMWF

Observing System Experiments

In a paper just published in the Quarterly Journal of the Royal Meteorological Society, ECMWF scientist Heather Lawrence and her colleagues performed a set of comprehensive Observing System Experiments (OSEs) to determine the relative importance of different types of Arctic observations for the skill of short to medium-range weather forecasts performed with ECMWF's IFS. In these experiments, different observation types were removed systematically at latitudes north of 60°N when creating the initial conditions of the weather forecasts. The aim was to assess their impact on forecasts in the Arctic and mid-latitudes. Similar experiments have been run globally before but, to our knowledge, have not been performed for the Arctic region using a state-of-the-art operational global NWP system.

Positive Impact on Forecast Skill

As the main finding, Lawrence et al. (2019) show that all observation types have a positive impact on forecast skill in the Arctic region. The paper highlights the microwave (satellite) and conventional (in-situ, including radiosonde) observations as being the most important observation types in summer and winter, respectively. Removing these observations significantly degrades the skill of medium-range forecasts not only in the Arctic, but also in northern-hemisphere mid-latitudes. Striking differences in the relative impact of Arctic observations for the summer and winter seasons are partly due to the suboptimal assimilation of microwave sounding data (such as from the satellite instruments AMSU-A, MHS, or ATMS) over snow and sea-ice into the forecasting system. Improving the use of this data over snow and sea ice is likely to prove very beneficial to forecasts in the Arctic and mid-latitudes, but also for future ECMWF reanalyses for time periods as far back as 1979 when the first microwave sounding unit (MSU) was launched.

Large Short-Range Error Growth during Scandinavian Blocking

Another paper, published by the ECMWF scientist Jonathan Day and his colleagues looks into further analysis of these Observing System Experiments (OSEs). This paper, also published in the Quarterly Journal of the Royal Meteorological Society, demonstrates that short-range error growth in forecasts for the European-Arctic is larger than average during Scandinavian Blocking episodes. These blocking episodes are characterized by warm-moist intrusions into the Arctic.

Influence of the Arctic on Mid-Latitudes

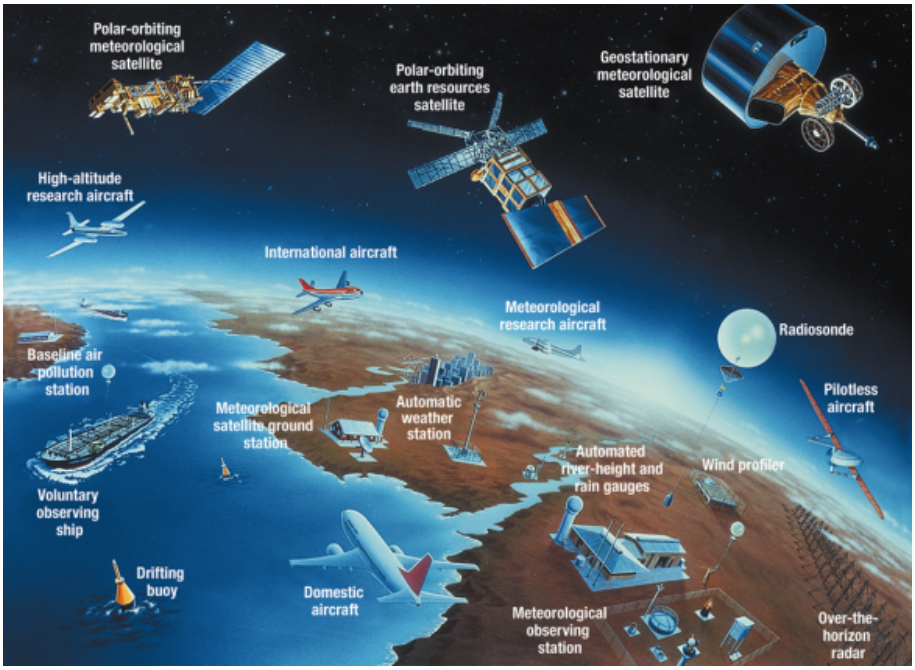
Jonathan Day et al. (2019) also found that the potential for forecast errors to propagate to mid-latitudes, particularly over northern Asia, at longer forecast ranges is larger than average during these blocking episodes. Accordingly, removal of in-situ or satellite Arctic observations from the data assimilation system, used to create the initial conditions for the forecasts, deteriorates the mid-latitude synoptic forecast skill in the medium-range over northern Asia, particularly during the Scandinavian Blocking episodes. This important role the Scandinavian Blocking plays in modulating the influence of the Arctic on mid-latitudes was also corroborated in relaxation experiments, and through a diagnostic analysis of the ERA5 reanalysis and reforecasts.

OSEs Coordinated through YOPP Task Team

The two papers are part of ECMWF's contribution to the Year of Polar Prediction and to the EU funded APPLICATE project. Similar numerical experimentation is now performed at Environment and Climate Change Canada (ECCC), the German Weather Service (DWD), the Norwegian Meteorological Institute (Met Norway) and the Finnish Meteorological Institute (FMI). The analysis of the results is coordinated in the framework of YOPP's Task Team on Numerical Experimentation. This coordinating effort is crucial to consolidate these results and to further guide the design of future observing systems in the Arctic.

Lawrence, H, Bormann, N, Sandu, I, Day, J, Farnan, J, Bauer, P., 2019: Use and impact of Arctic observations in the ECMWF Numerical Weather Prediction system. Q J R Meteorol Soc., 1– 23. https://doi.org/10.1002/qj.3628

Day. JJ, Sandu, I, Magnusson, L, Rodwell, MJ, Lawrence, H, Bormann, N, Jung, T., 2019: Increased Arctic Influence on the midlatitude flow during Scandinavian Blocking episodes. Q J R Meteorol Soc., 1– 17. https://doi.org/10.1002/qj.3673



WIGOS is the WMO Integrated Global Observing System. It provides a framework for the integration and sharing of observational data from National Meteorological and Hydrological Services (NMHSs) and other sources. This graphic illustrates the different observational components that feed into the Observing System Experiments carried out for the Year of Polar Prediction (graphic: WMO).

02 Ambitious North Pole Expedition will Help Improve Weather Forecasts at Yr.No | *(originally published by MET Norway)* **A search for "Polarstern" at Yr.no will give you weather observations from the research vessel currently deployed in the Arctic Ocean. This ambitious expedition will help improve weather forecasts from the weather service Yr.**

Temperature, precipitation and wind observations from the German icebreaker RV Polarstern are updated hourly on *Yr's new website* and app. During the entire year Polarstern spends drifting with the ice near the North Pole, Yr will also present the weather forecast for the ship's current location.

"Yr is eager to be at the forefront and wants to help publicize this project that means so much for society. It is more important than ever to understand the ongoing changes in the Arctic Ocean", says Ingrid Støver Jensen, Yr's product manager at the Norwegian broadcasting company (NRK).

Polarstern left Tromsø on 20 September 2019 as part of the MOSAiC expedition, which is the largest Arctic research cruise ever. Over one year, six hundred scientists from 19 countries will be aboard the research vessel, which is being frozen into the ice for a full year to figure out what is happening in the Arctic. The data they collect will be used by scientists all over the world and give climate research new wind in its sails.

Closing Knowledge Gaps

The goal is to fill knowledge gaps concerning the central Arctic Ocean, where wintertime observations are particularly scarce. Global warming is leading to a gradual disappearance of sea ice, and in a few years the ice may be gone. The expedition will try to determine if and when this might happen.

Like Fridtjof Nansen's vessel during the Fram expedition of 1893-1896, RV Polarstern will be frozen into the ice. From Siberia in the east, the ship will drift at an average speed of seven kilometres per day. A network of observation posts have been set up as far as fifty kilometres from the ship, and data will be collected from 4,000 meters depth to 35,000 meters up in the air. Both the ship and the surrounding observation network will drift with the ice towards the Atlantic.

Weather forecast at RV Polarstern's location in the central Arctic from 21 November 2019 on the Yr.no weather app maintained by MET Norway.

Better Models for Weather and Climate

These observations will lift weather and climate models to a new level and help improve weather forecasts for Arctic areas.

"MOSAiC will increase our knowledge about interactions between atmosphere, sea ice, and the sea in the Arctic, so that the physical processes can be better represented in our weather forecasting models", explains Jørn Kristiansen, director of the centre for the Development Centre for Weather Forecasting at the Norwegian Meteorological Institute (MET Norway).

Systematic and comprehensive understanding of the scientific fundamentals, obtained in part through the YOPP-endorsed *Alertness* research project, enables MET Norway to meet the operational needs of the weather forecasting service.

Much of the Norwegian Meteorological Institute's contribution will come through the major research effort during The Year of Polar Prediction, which will make use of the observations from MOSAiC. In order to forecast weather into the future, we need highly accurate observations of current weather conditions. The global weather observation network is sparse in the Arctic and Antarctic. The sparseness of these observations, combined with our limited knowledge about the physical processes in polar regions, means that weather forecasts are less accurate in polar areas than, for example, in Norway or the rest of Europe. Studies show that these limitations also affect the quality of the weather forecasts for areas far from the poles.

Predecessor RV Lance Improved Yr
Four years ago, the research vessel Lance was also frozen into the ice; the observations made at that time were used to improve weather models for Arctic areas – *models now in use at Yr*. Met Norway researchers Malte Müller and Yurii Batrak did the work of improving the weather model and *published their findings in the journal Nature Communications*, as part of the YOPP-endorsed research project *The Nansen Legacy*.

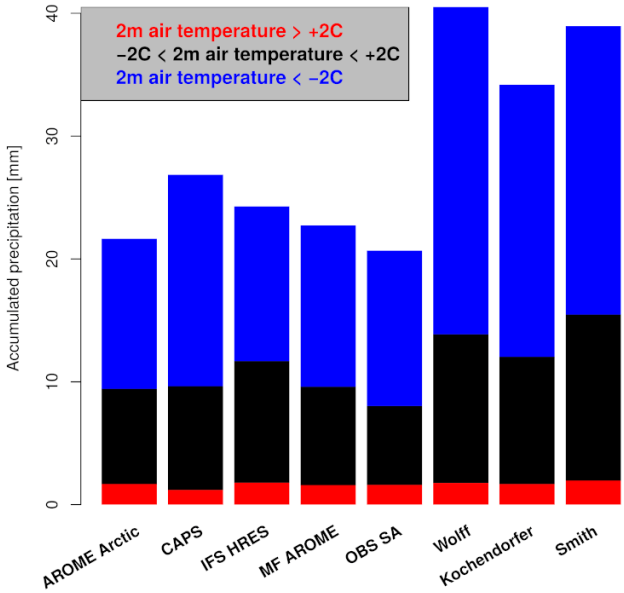
Team YOPP: Master student Thea Schneider (University of Potsdam) and climate scientist Thomas Rackow (Alfred Wegener Institute) joined the MOSAiC School (photo: Neil Aellen, ETH Zurich).

03 MOSAiC School – The Importance of Being the Support | **Thea Schneider was one of the twenty early career scientists who participated in the MOSAIC School – a floating university aboard the Russian research icebreaker Akademik Fedorov, in support of RV Polarstern's transit into the Arctic. In her very personal report now published on the Polar Prediction website, the Master student in Physics shares insights from her time aboard and on the sea ice.**

Master student Thea Schneider and climate modelling lecturer Thomas Rackow were supported through the WMO Polar Prediction Project to join the MOSAiC School. For six weeks in September and October 2019, the Russian research icebreaker Akademik Fedorov accompanied RV Polarstern, the German research icebreaker, on her transit into the central Arctic sea ice. In her report, Thea tells from the preparational days in Tromsø and from the collective search for an appropriate sea ice floe to be home for Polarstern for a year. She writes about the MOSAiC School participants' support to install a comprehensive Distributed Network of instruments in a 50 km radius around Polarstern and the manifold topics covered in the MOSAiC School lectures.

Read Thea Schneider's report *here*.

04 Model Intercomparison over European Arctic – Accurate Numerical Weather Prediction Remains A Challenge | (originally published by *APPLICATE*) **Despite important progress in prediction skills over the last decade, current Numerical Weather Prediction (NWP) systems still fail to meet user requirements with larger forecast errors in the Arctic than for the mid-latitudes. A new model intercomparison carried out in the YOPP-endorsed APPLICATE project contributes to establishing a baseline for Arctic short-range forecast capabilities.**



Averaged accumulated precipitation (estimated by temperature thresholds). Four columns left: in NWP systems for YOPP-SOP-NH1; fifth column from left: from observations (SA obs); right three columns: after the observations have been corrected for observation errors with three different methods (Wolff et al., 2015; Kochendorfer et al., 2017; and Smith, 2007) (source: Koltzøw et al. (2019, BAMS).

A sparse conventional observation network remains one of the main reasons for errors in Arctic NWP systems. In addition, weather forecast models are developed on mid- and lower-latitude weather leading to deficiencies in the representation of small-scale Arctic weather phenomena. As human activities in the Arctic region increase, accurate weather forecast predictions become more and more important. Therefore, the Year of Polar Prediction (YOPP), the flagship activity of the Polar Prediction Project (PPP), is an opportunity to gain extra observation and model simulation data that the scientists working within the APPLICATE project can use to improve NWP systems.

Arctic Short-Range Forecast Capabilities

Based on model simulations from the YOPP Special Observing Period Northern Hemisphere 1 (SOP-NH1, 1 February–31 March 2018), an international group of scientists took the opportunity to learn more about present Arctic short-range forecast capabilities. The scientists compared the ECMWF Integrated Forecasting System (IFS-HRES) and three high-resolution regional models: a version of the ECMWF Integrated Forecasting System (IFS-HRES), and four regional models – the AROME-Arctic employed at MET-Norway, the Canadian Arctic Prediction System (CAPS), and AROME with Météo-France for a part of the European Arctic.

"*The results of the intercomparison show that the forecast systems differ in their spatial details and forecast accuracy varies between systems and with a number of factors, such as region, parameter, weather type and lead time*", explains Morten Køltzow from MET Norway who led the study. Despite some unique errors which occurred in different models, authors also found several common model deficiencies related to for example forecasting temperature during cloud- free, calm weather; cold biases in windy conditions; and the distinction between freezing and melting conditions, underestimation of solid precipitation; less skillful wind speed forecasts over land than over ocean; and difficulties with small-scale spatial variability. The Figure to the left shows how the skill can vary according to a 2-meter air temperature (Y-axis: systematic error, X-axis: unsystematic error).

Local Variability Smaller than Model Resolution

Another interesting result is the case study showing that as much as twenty to forty per cent of the difference between the forecasted and observed weather parameters (e.g., wind speed, temperature and precipitation) can be attributed to representativity issues. This means that the actual weather shows large local variability at spatial and temporal scales smaller than the resolution in the NWP systems. This difference between forecasts and observations can therefore not be expected to be captured by the state-of-the-art forecasting systems. Furthermore, the study also shows that large observation errors for solid precipitation hide the real skill of the precipitation forecasts.The study concludes that no NWP system is superior to the other systems in all aspects. However, the importance of high resolution, surface and upper-air assimilation of observations and adaptations to the region of interest is demonstrated.

Køltzow, M, Casati, B, Haiden, T, Valkonen, T., 2019: An NWP Model Intercomparison of Surface Weather Parameters in the European Arctic during the Year of Polar Prediction Special Observing Period Northern Hemisphere 1. Weather and Forecasting, 959–983.https://journals.ametsoc.org/doi/full/10.1175/WAF-D-19-0003.1

See a summary of the paper also in PolarPredictNews #12, page 20 (New Publications).

05 Call for Contributions – Sea Ice Prediction Network South (SIPN South) | **For the third time, the Sea Ice Prediction Network South (SIPN South) had invited contributions to participate in the coordinated sea ice prediction experiment in the Southern Ocean, targeting the period December 2019 to February 2020.** SIPN South is an international YOPP-endorsed effort to collect seasonal forecasts of Antarctic sea ice with the purpose to make an initial assessment of the ability of forecasting systems to predict circumpolar-average, regional-average, and local Antarctic sea ice conditions. With the latest call for contributions with a focus on the austral summer season targeting December 2019 to February 2020, the SIPN South Leadership team around François Massonnet had invited the international community to participate in the third coordinated sea-ice prediction experiment in the Southern Ocean. Deadline for submission of the forecasts had been open until 8th December 2019.

For more information about the project see here. Find more on SIPN South also on the YOPP YouTube Channel (instagram story, presentation)

Who is part of the SIPN south Leadership team?
François Massonnet (UC Louvain, Belgium)
Phil Reid (BoM, Australia)
Jan Lieser (ACE CRC, Tasmania, Australia)
John Fyfe (ECCC, Canada)
Cecilia Bitz (U Washington, Seattle, US)
Will Hobbs (ACE CRC, Tasmania, Australia)

Congratulations!
François Massonnet will receive the 2020 European Union of Geosciences' *Arne Richter Outstanding Early Career Scientist Award* for his contributions in the field of Earth sciences.

Contact: François Massonnet francois.massonnet@uclouvain.be

06 Squaring the Circle – a Do-It-Yourself MOSAiC ClimateCube to Explore the Hotspot of Climate Change | *(by Sara Pasqualetto, Helge Goessling, and Kirstin Werner, Alfred Wegener Institute)* **Big topics need big ideas to come across and be understood: a team of scientists from the Alfred Wegener Institute has come up with an exotic way to visualize the expected drift path of the MOSAiC campaign through the hotspot of climate change.**

Climate change visualization projects have become an increasingly bigger part of today's scientific outreach activities. The warming stripes by scientist Ed Hawkins are a prominent example. At the German Alfred Wegener Institute (AWI), Helge Goessling, a physicist specialized in climate modelling and polar prediction, and his colleagues are now "squaring the circle" of climate visualization. The MOSAiC ClimateCube is set to be a playful means to bring the MOSAiC one-year ice drift campaign as well as climate change into school classes and living rooms.

On the occasion of the official start of the MOSAiC expedition on 20 September 20 2019 (see here for more information), the cube that anyone with the use of some paper and a printer, scissors and glue stick can now DIY (do-it-yourself) features the drift projections of RV Polarstern locations during MOSAiC. Lines in the magnified Arctic show possible year-long drift paths of the MOSAiC ice floe and the frozen-into research icebreaker Polarstern, overlaid on the sea-ice distribution at the beginning of the sea-ice drift in September 2019.

Moreover, the MOSAiC ClimateCube portrays our planet by highlighting the temperature alterations and the patterns of warming that the Earth has experienced over the course of past climate changes, amplified in the Arctic. Holding a self-made cubed Earth in your hands is a truly tangible way to grasp the changes our planet has undergone from pre-industrial times to present days. The MOSAiC ClimateCube has been produced with the open source R package spheRlab which is an advanced toolbox for geophysical data visualization developed at AWI.

DIY your own MOSAiC Climate Cube! Check out the YOPP YouTube Channel to see how (photo: Sara Pasqualetto).

The ClimateCubes came into action for the first time during a creative workshop with school kids which was organized at the Bremerhaven Klimahaus a day before the international Climate Strike on Friday, 20 September 2019. AWI colleagues presented different variations of the ClimateCubes showing how climate is expected to change according to future projections simulated with the AWI Climate Model.
You can download your MOSAiC ClimateCube here: ENGLISH/GERMAN.

Need guidance to build your MOSAiC ClimateCube? Watch our video here for instructions.

07 Gone with the Wind – New Contribution to Polar Prediction Matters | In the new contribution to Polar Prediction Matters, the Spanish weather forecaster Sergi Gonzalez and the polar explorer Hilo Moreno explain what it took to plan and carry out an Antarctic expedition with a non-emission vehicle to measure weather conditions during the YOPP Southern Hemipshere Special Observing Period.

A windsled is a vehicle that has no engine but is only moved by wind through a 150 m^2 kite that moves at about 100 to 200 m elevation above surface. It took the project team around the weather forecaster Sergi Gonzalez from the Spanish State Meteorological Agency AEMET quite a while to prepare for this windsled which was used in an Antarctic expedition during the YOPP Special Observing Period in the Southern Hemisphere. With a Mobile Automatic Weather Station (the YOPP-endorsed M-AWS) installed atop the windsled, the team was able to obtain data of Antarctic weather conditions from the Eastern Antarctic Plateau. The track with the windsled covered more than 2,500 km.

In their contribution to the Polar Prediction Matters dialogue platform for users and providers of polar forecasts, Sergi Gonzalez and his colleague Hilo Moreno share exciting insights on preparing and carrying out this Antarctic zero-emissions campaign.

Assembling the windsled in the blizzard (photo: Windsled team)

Find the new Polar Prediction Matters article here.

See also the interview with Sergi Gonzalez in this issue at **#16 YOPP-endorsed!**

An article on the windsled expedition that employed the YOPP-endorsed M-AWS has also been published in BAMS:
Gonzalez, S., Bañon, M., Albero, J.V., Larramendi, R., Moreno, H., et al. 2019. Weather Observations

of Remote Polar Areas Using an AWS Onboard a Unique Zero-Emissions Polar Vehicle. Bulletin of the American Meteorological Society (BAMS). doi:10.1175/BAMS-D-19-0110.1.

08 Saving Even One Life Is Worth Every Single Effort | The Norwegian project Alertness aims to develop world-leading, reliable and accurate Arctic weather forecasts in support of maritime operations, business and society. PhD student Matilda Hallerstig is one of the researchers in the YOPP-endorsed project Alertness. In her article published on the Alertness project website, the scientist explains what is driving her to contribute to improving Arctic weather predictions.
Long time ago, Matilda Hallerstig had realized how much the daily activities and critical decisions in areas close to the Arctic depend on reliable weather forecasts. During summer, it is the fog slowly moving from the ocean into the fjords and across land which causes airplanes to stay on the ground. In winter, strong winds and heavy snow showers can risk a fisherman's life. In polar regions, a good forecast can make a huge and sometimes even life-saving difference. However, sparse observations in the Arctic make it still difficult to densely monitor the weather situation.

Matilda Hallerstig has been working for several years as a weather forecaster in Norway. During her daily work with users of forecasts she found out more and more what is "under the hood" of numerical weather prediction models.

In particular, she learned how weather conditions in the Arctic such as the small-scaled frequent polar lows, which are the Arctic answer to tropical hurricanes, but also shallow stable boundary layers, and the marginal ice zone with a mix of ice-covered and open ocean, need to be tackled to provide more accurate forecasts. From 2017 to 2018, Hallerstig had the opportunity to work in Reading, United Kingdom, to compare the Arome Arctic model used by MET Norway with the Integrated Forecasting System (IFS) model used at the European Centre for Medium-Range Forecasts (ECMWF). Her current PhD work at the Norwegian Research Center NORCE and the Bjerknes Center for Climate Research is a continuation of this study to better understand how well models perform during historical weather events and during large observational campaigns such as the Year of Polar Prediction.

Matilda Hallerstig is a PhD candidate in meteorology at the Norwegian Research Center NORCE and the Bjerknes Center for Climate Research in Bergen, Norway (photo: Anna Kathinka Dalland Evans).

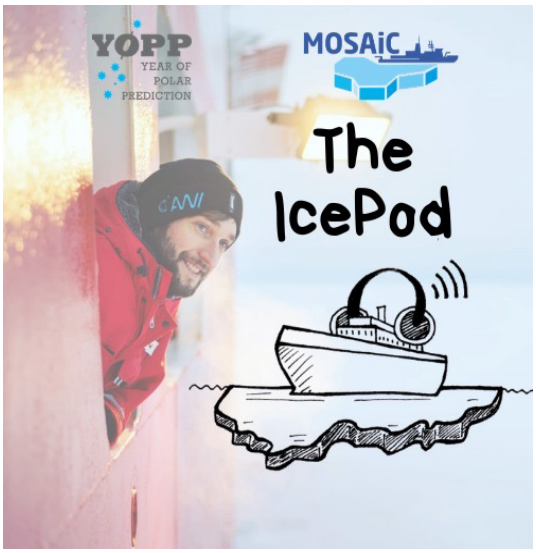
Alertness which stands for 'Advanced models and weather prediction in the Arctic' is led by the Director of the Development Centre for Weather Forecasting at MET Norway Jørn Kristiansen who supports YOPP as a member of the PPP Steering Group. The Alertness project is a 4-year (2018-2021) project funded by the Norwegian Research Council with the goal to provide better weather warnings up to three days in the future. During her PhD project, Hallerstig focuses on polar low events and maritime icing. She hopes that her work "*will lead to better forecasts to assist those who live in the Arctic and Northern Norway, and if even one life is saved by that, it will be worth every single effort.*"

Read Matilda Hallerstig's full article *Improving weather forecasts in the Arctic* on the *Alertness* project website. Her article has also been published as a contribution to the *Polar Prediction Matters Helmholtz dialogue blog*.

09 First Time The IcePod – A Podcast for the MOSAiC Year of Polar Prediction | The IcePod is the podcast about *polar science and the people*. As a contribution to the YOPP-endorsed MOSAiC ice drift campaign, the International

Coordination Office for Polar Prediction (ICO) has launched a series of podcasts entitled The IcePod.

The IcePod is the official podcast of the Year of Polar Prediction initiative to improve weather and sea-ice forecast in the Arctic and Antarctic. Monthly episodes will feature a scientist involved with both the Year of Polar Prediction and MOSAiC. After two short trailers released in September and October, the first episode of The Icepod, entitled "The First Time" is now available. In an interview with Kirstin Werner and Sara Pasqualetto from the ICO, climate scientist Thomas Rackow talks about his duties as a YOPP modelling lecturer for the MOSAiC school aboard the Russian research icebreaker Akademik Fedorov that accompanied RV Polarstern on her transit into the central Arctic sea ice in September and October 2019. Hear more from Thomas Rackow talking about his support of setting up the distributed instrument network on the sea ice around RV Polarstern and how this unique experience will likely impact his future life of a scientist on 'The Icepod'.



In the first episode of The Icepod it's all about first times: the climate scientist and modeller Thomas Rackow talks about his first glimpse of northern lights, his first step onto the Arctic sea ice and how he got the polar virus (photo: Sam Cornish).

The IcePod is produced in collaboration with the community radio station *Radio Weser.TV* and will be available on all common podcast platforms (e.g. *Spotify*, *Apple Podcast*, *Castbox*).

10 New Home for IceWatch | After being hosted by the University of Alaska Fairbanks for seven years, Ice Watch – a joint effort to collect visual Arctic sea-ice observations recorded on ships – has found a new home at the Norwegian Meteorological Institute.

Ice Watch is a program to coordinate the collection and archival of visual sea-ice observations recorded on ships in the Northern Hemisphere. An ice watch is often performed on research cruises in regions infested with sea ice, where the ice morphology is characterized by a set of visual observations.

Since 2012, Ice Watch had been coordinated and hosted by the Geographic Information Network of Alaska and the University of Alaska Fairbanks. In November 2019, the website has been moved to the Norwegian Meteorological Institute. The Ice Watch data base can now be accessed at *https://icewatch.met.no/*
Ice Watch provides open source software for recording and sharing shipborne Arctic sea ice observation data. The program is coordinated by the Norwegian Meteorological Institute, the University of Alaska Fairbanks, the International Arctic Research Center, and the Geographic Information Network of Alaska. Further support for international collaboration and networking is being provided by the Climate of the Cryosphere (CliC) office.

As the new host, MET Norway aims to further develop the Ice Watch system with regard to a continued development of the ASSIST (Arctic Shipborne Sea Ice Standardization Tool) software that is used by observers to record the sea-ice conditions throughout the Arctic Ocean. There are also plans to develop a citizen science app allowing a simple interface for users to submit their observations. Updates on these and other future developments can also be found on the Norway Ice Service's website *https://cryo.met.no/* and their twitter accounts *@istjenesten* and *@IceWatchASSIST* as well as on facebook *https://www.facebook.com/icewatchassist/*,

11 Report of the Fourth YOPP in Southern Hemisphere Meeting | **The fourth meeting of the Year of Polar Prediction Task Team active in the Southern Hemisphere (YOPP-SH) took place from 27 to 28 June 2019 in Charleston, South Carolina, USA. As in previous years, it was preceded by the annual Workshop on Antarctic Meteorology and Climate (*WAMC*), this year organized by *NAVWAR*, the Naval Information Warfare Systems Command.** YOPP-SH#04 aimed at bringing together all parties involved in Antarctic meteorology and the advancement of this discipline through scientific research and improving operational support during the Year of Polar Prediction. In particular, the efforts on extra observations made during the YOPP-SH Special Observing Period (SOP) from 16 November 2018 to 15 February 2019 were reported during this meeting. Also, updates on various modelling, verification, observing system experiments (OSE), and user engagement efforts were presented in Charleston.

During the meeting, it was agreed to hold a second Special Observing Period in the Southern Hemisphere (YOPP-SH SOP2) but this time during Antarctic winter. In order to cover the sea-ice growth in early winter, the current intent is to schedule it between mid-April to mid-July 2021. The meeting report can now be downloaded from *here*.

The fifth YOPP-SH meeting will take place on 31 July 2020, in conjunction with WAMC, preceding the Ninth SCAR Open Science Conference in Hobart, Tasmania, 31 July to 11 August 2020.

A joint report on last two years' WAMC and YOPP-SH meetings will be published in the Special Issue of the Advances in Atmospheric Sciences journal.

12 In Whose Service? A World-Café Focus-Group Discussion | *(by Daniela Liggett, University of Canterbury, New Zealand)* **During a focus-group discussion organized at the 14th Workshop on Antarctic Meteorology and Climate (WAMC) in June 2019, questions on weather, water, ice and climate (WWIC) services were raised and discussed with meteorologists, forecasters, and operators in the Antarctic.** The focus-group discussion aimed at beta-testing the envisioned series of the Weather and Society Workshops that PPP's Task Team on Societal and Economic Research and Applications (PPP-SERA) has planned for the coming year. A world-café approach was chosen to facilitate targeted smaller-group conversations in four different round tables. Antarctic meteorologists, forecasters, and operators were provided with four questions to move from one to another table.

The four questions addressed (1) the biggest inadequacies of WWIC services for the Antarctic community, (2) the transition of PPP outcomes into better WWIC user experiences, as well as the (3) personal relevance of particular Antarctic WWIC information and (4) projected most meaningful contributions resulting from PPP and translated into services for individual WWIC user groups and the society.

World-café approach: Participants had ten minutes to discuss each question at the table, after which the groups rotated to the next round table to ensure that all participants contributed input to each of the questions (photo: Daniela Liggett).

It was agreed by all participants that a better understanding of the users' specific needs was necessary, not just in the transition to better services but also in the production of outcomes. Similarly, communication with users should be carefully planned and thought-through. Read the full report on the *PPP-SERA website*.

13 Polar Meteorology at the European Meteorology Society Annual Meeting 2019

| *(by Jonathan Day, ECMWF)*

The European Meteorology Society Annual Meeting 2019 was held at the Technical University of Denmark (DTU) from 9 to 13 September.

PPP Steering Group chair Thomas Jung gave a strategic lecture at the EMS Annual Meeting in September in Copenhagen, Denmark (photo: Technical University of Denmark).

The theme at this year's EMS was 'The Arctic: the new frontier for weather, ice and climate research, forecasting, and services'. As well as the excellent science presented at the meeting, this meeting's theme helped to highlight the importance of polar environmental prediction to the scientific and operational institutions that were represented at EMS.

International scientific and technical cooperation were covered in some depth, including the Year of Polar Prediction as a major initiative by the World Meteorological Organization to improve predictive skill in the Arctic and Antarctic. Thomas Jung, the chair of the Polar Prediction Project's Steering Group, provided an overview of the current state of polar predictive capacity during his strategic lecture which was part of the meeting's opening session. Many of the scientific outcomes resulting from YOPP were also presented including polar mid-latitude linkages (Tido Semmler, Alfred Wegener Institute), boundary layer meteorology (Michael Tjernstrom, Stockholm University), observing system experiments (Jonathan Day, ECMWF), sea-ice prediction (Ilona Välisuo, University of Helsinki), and operational forecasting (Linus Magnusson, ECMWF).

Antarctic issues and challenges were also on the menu as the topics including monitoring systems, process understanding, climate forcing agents, and socio-economic changes in polar regions were all covered in a wide ranging scientific program.

Impressions from the 2019 EMS can be found *here*.

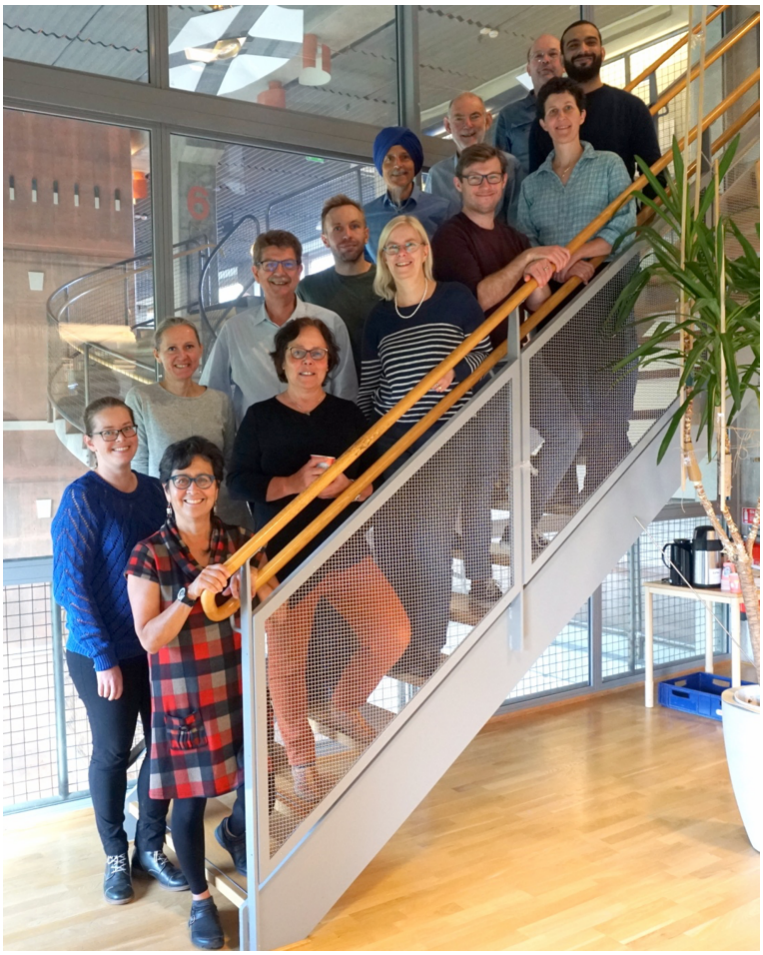
14 First Meeting of YOPPsiteMIP Group in Sweden

| **The first meeting of the YOPPsiteMIP team took place from 17 to 19 September 2019 at Stockholm University, Sweden. Amongst others, it has been agreed to hold on-demand Targeted Observing Periods (TOPs) when air mass transformations during MOSAiC occur.**

YOPPsiteMIP stands for the Year of Polar Prediction Supersite Model Intercomparison Project. As one of the key activities of the YOPP Task Team on Processes, YOPPSiteMIP aims to support detailed evaluation of the model representation of a range of physical processes, including the energy budget at the surface, momentum transfer and clouds and vertical profiles of a number of parameters. A workshop organized by YOPPSiteMIP leader Gunilla Svensson from the Department of Meteorology at Stockholm University brought together practitioners from the modelling and observational communities to discuss first results of the YOPPsiteMIP projects, future analysis and planned activities in connection to the MOSAiC ice drift campaign.

On-demand Targeted Observing Periods (TOPs)

The YOPPsiteMIP activities overlap the work of at least three YOPP Task Teams, namely the Process Task Team, the Verification Task Team and the Data Task Team. This first meeting on YOPPsiteMIP



The first meeting of the YOPPSiteMIP group took place from 17 to 19 September in Stockholm, Sweden (photo: Thorsten Mauritsen/Stockholm University).

therefore resulted in a number of strategic as well as tactical decisions. Strategically big steps were made in refining the contents, processes, semantics and procedures for creating and supporting the schemes to be used for holding the model and observational intercomparison data in NetCDF format. Recalling the decision by the PPP Steering Group to focus any additional YOPP observation and modelling campaign associated with the MOSAiC project on processes occurring during air mass transformations, it has been proposed to use on-demand Targeted Observing Periods (TOPs). TOPs will preferably based around other intensive observation campaigns during MOSAiC such as the aircraft deployments during March/April 2020. Similar to the previous Special Observing Periods, the short on-demand TOPs will benefit additional radiosonde releases during the events in the path of the air mass transformations.

Merged Data File Specification (MDFS) Scheme

Notional dates for having some observational and model data in the new Merged Data File Specification (MDFS) scheme were set for the first quarter of 2020. The semantics for the various schemes were agreed on: MDFS is the generic parent scheme with the Merged Observatory Data Files (MODF) and Merged Model Data Files (MMDF) being its children. A common open toolbox of Python code to assist in the creation of the model and observational MDFS NetCDF files was agreed to be developed with a workshop proposed for late April 2020 in Boulder that would bring together the key data managers to create the MODF files.

For more information on the YOPPSiteMIP meeting in Stockholm, please see the *Meeting Report*.

15 MOSAiC Endorsement for YOPPSiteMIP | In October 2019, the YOPPSiteMIP initiative has been endorsed by the MOSAiC Project Board as an important scientific contribution to the MOSAiC ice drift campaign.

The intercomparison between high-frequency observations and model output from YOPP Supersites has been endorsed as an important contribution to the one-year ice drift around the German research icebreaker Polarstern. The MOSAiC location itself will serve as one of the various YOPP Supersites from where the output of different models will be compared with atmospheric and sea ice observations. YOPPSiteMIP will be fully coordinated with the international scientific MOSAiC modelling efforts.

16 EGU Call for Abstracts – Joint YOPP-APPLICATE Session | The Call for Abstracts is now open until 15 January 2020 for next year's European Geosciences Union (EGU) General Assembly to be held from 3 to 8 May 2020 in Vienna, Austria. A joint YOPP-APPLICATE session on "Exploiting Polar Observations to Improve Weather and Climate Predictions" will take place at this anually largest and most

prominent European geosciences event. To enhance the models' predictive skills, more and better use of observation systems of the polar atmosphere, sea ice, and ocean are needed. It is on these premises that the World Meteorological Organization's project Year of Polar Prediction (YOPP) and the European Horizon2020 APPLICATE project are carrying out their activities, initiating and promoting collaboration among international institutes, operational forecasting centers and stakeholders in an effort to bring together scientific expertise and know-how to work on better polar predictive skill.

To exchange knowledge and share results, the joint APPLICATE-YOPP session "CL2.12 Exploiting Polar Observations to Improve Weather and Climate Predictions" will be held at the upcoming EGU 2020 (Vienna | Austria | 3–8 May 2020).

Welcome are presentations on activities and results from the YOPP and APPLICATE projects as well as contributions from other projects and institutes that focus on how to best capitalise on existing and additional Arctic and Antarctic observations such as Copernicus to improve forecast initial states, verification, and model physics, and to optimise the future polar observing system. Topics include, but are not limited to: Arctic and Antarctic observations, modelling, prediction, data assimilation, verification, linkages to mid-latitudes, user engagement, and governance. New results, contributions from international projects with a focus in the polar regions, and cross-disciplinary approaches that involve natural and social sciences are particularly appreciated.

The call for abstracts is now open and will close on the **15 Jan 2020, 13:00 CET**.

For more details on the session and how to submit your abstract, please visit: *https://meetingorganizer.copernicus.org/EGU2020/session/36745*.

17 Tailoring Environmental Forecasting Information to Diverse Polar Needs | PPP-SERA co-chairs Machiel Lamers and Daniela Liggett will co-convene a session on "Tailoring Environmental Forecasting Information and Services to Diverse Polar Needs" at the Tenth International Congress of Arctic Social Sciences (ICASS X) which will take place in Arkhangelsk, Russia, from 15 to 19 June 2020.

To facilitate human safety, community well-being and environmental security in the changing polar regions, more and more specialized environmental forecasting services, based on weather, water, ice and climate (WWIC) information, are being made available by a growing range of providers, including national meteorological services, for-profit and non-profit organizations, and community-based organizations. The session aims to encourage a discussion of both research and practical cases addressing WWIC information requirements and services in terms of operational decision-making and user needs in various sectors, including, but not limited to shipping, tourism, science, government operations, search and rescue, fisheries, aviation, education, and subsistence hunting and harvesting. More on the session and conference can be found *here*.

Abstract submission is open until 31 December 2019 via *https://icass.uni.edu/abstract-submission*.

18 YOPP-endorsed! – A Mobile Automatic Weather Station | YOPP endorsement is available for projects, programmes and initiatives but also for institutions and operational centers that contribute to making the Year of Polar Prediction successful. More than eighty projects, programmes and initiatives already received project endorsement from YOPP.

The YOPP-endorsed **Mobile Automatic Weather Station (M-AWS)** is a part of the MICROAIRPOLAR project and has been initiated by three co-PIs from the Spanish State Meteorological Agency. A mobile Automatic Weather Station called M-AWS has been installed atop of a windsled to measure weather conditions during a 2,500 km route through Eastern Antarctica. Initiated in 2017, the M-AWS has been in operation during

The three co-PIs of the YOPP-endorsed M-AWS project (from left to right): Antonio Quesada, Ana Justel and Sergi Gonzalez (photo: M-AWS team).

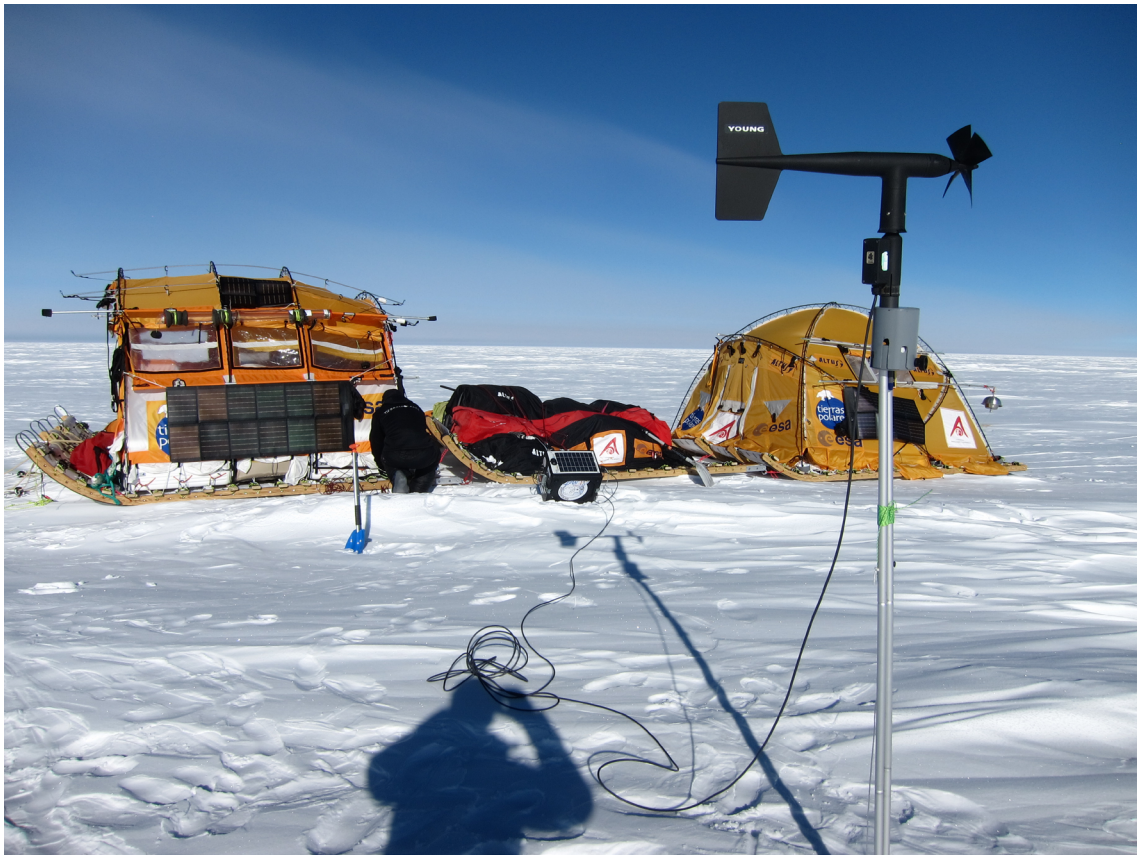
the YOPP Special Observing Period in the Southern Hemisphere from 16 November 2018 to 15 February 2019. In this interview, weather forecaster Sergi Gonzalez provides insights on this exciting Antarctic campaign.

Dr. Gonzalez, what was the YOPP-endorsed M-AWS project about?
The M-AWS project has been initiated to add meteorological observations to the biological data generated within the multidisciplinary MICROAIRPOLAR project carried out during the 2018-2019 Antarctic Campaign on board the windsled. The lack of commercial solutions that fulfill the requirements of the windsled forced us to produce a custom-made Automatic Weather Station with low power consumption which was capable of withstanding low temperatures and the shocks of the vehicle crossing over the wind-built sastrugi snow ridges. We finally designed a prototype that accomplished those requirements with high-performing instruments that could also be used to obtain extra observations for the Year of Polar Prediction.

How long did it take to prepare the expedition and set-up of the Mobile Automatic Weather Station on the windsled?
After an unsuccessful campaign in Greenland in 2017 we realized that installing an Automatic Weather Station on a vehicle like the windsled was not straightforward. During one year, our team, composed of scientists and technicians, designed the station and sought the proper high-performance components to be assembled into a paddle box. Some of the elements were not easy to find; it took us months to get the ideal material. The final assembling was made by engineers of the Autonomous University of Madrid.

How does the windsled work, and how did the weather station do its job on the Antarctic route? *The windsled is a zero-emission vehicle able to navigate over the ice sheet taking advantage of the wind force by using a set of enormous kites. It allows us to make observations and get samples of remote polar areas with a low carbon footprint. The core of the weather station is a "black box" where the most sensible elements, including the datalogger, are stored. This part of the station performed very well: the elements were protected from the shocks, and the inner temperature was about ten degrees higher than the outside. However, the aerovane broke during the movement across the sastrugi, so, unfortunately, no wind data could be collected.*

How does the M-AWS project contribute to the Year of Polar Prediction?
M-AWS provided an extra set of surface data in an Antarctic area where there are not a lot of meteorological stations to evaluate the model performance during the YOPP Southern Hemisphere Special Observation Period. Furthermore, the project demonstrates that atmospheric scientists can carry out extra observations at remote locations of the poles in a sustainable way.



On its route through the East Antarctic Plateau, the windsled had an automatic weather station assembled (photo: Windsled Team).

What was most challenging for you personally during and in preparation of the expedition? *Maybe the most challenging for me was participating in the design from afar. The members of the M-AWS team live in different parts of Spain and sometimes it was thus difficult to participate properly in the construction. Finally, the burden of the construction fell on my colleagues in Madrid. Furthermore, at that time, I was finishing my PhD which added to my workload.*

Any future plans with the M-AWS?
In the short-term, we want to fix the problems we had and improve the station with new instruments. In the long-term, M-AWS could include a device to send the data to the WMO's Global Telecommunication System. Indeed, the windsled could be an inexpensive platform to obtain extra observations and launch extra radiosoundings where they are most needed.

How can the polar prediction community follow your project? *Everybody interested can follow the two partners of this project on Twitter at @microairpolar and @aemet_antartida.*

New Publications I

19 The Record Low Bering Sea Ice Extent in 2018 | Record low Bering Sea sea ice in 2018 had profound regional impacts. According to climate models, human-caused warming was an overwhelmingly likely contributor, and such low levels will likely be typical by the 2040s. The 2018 January to April sea-ice extent in the Bering Sea was far lower than any previous winter in the reconstructed or observed past since 1850. This had ramifications for the weather and climate system, economic impacts, and long-lasting ecosystem impacts. Ocean warmth, late ice development, and frequent atmospheric storminess were important factors. Authors find that the observed 2018 January to April mean sea-ice extent has been extremely rare in the pre-industrial control simulation but becomes much more frequent in the current era. With ongoing Earth system warming, the 2018 extent could potentially be typical by the 2040s.

Thoman Jr., R.L., Bhatt, U.S., Bieniek, P.A., Brettschneider, B.P. et al. 2020. *The Record Low Bering Sea Ice Extent in 2018: Context, Impacts, and an Assessment of the Role of Anthropogenic Climate Change*. BAMS, S15-S19. https://doi.org/10.1175/BAMS-D-19-0175.1

20 West Antarctic Surface Melt triggered by Atmospheric Rivers | A large percentage of surface melt events in West Antarctica are caused by atmospheric rivers - long narrow bands of enhanced poleward moisture and heat transport associated with extratropical cyclones. Major melt events in the West Antarctic Ice Sheet only occur a couple times per decade, but a 1–2 °C warming and continued increase in atmospheric river activity could increase the melt frequency with consequences for ice shelf stability. Recent major melting events in West Antarctica have raised concerns about a potential hydrofracturing and ice shelf instability. Using an atmospheric river detection algorithm developed for Antarctica together with surface melt datasets, the authors produced a climatology of atmospheric river-related surface melting around Antarctica and show that atmospheric rivers are associated with a large percentage of these surface melt events. The studied events were all related to high-pressure blocking ridges that directed anomalous poleward moisture transport towards the continent.

Wille, J., Favier, V.., Dufour, A., Gorodetskaya, I. et al. 2019: *West Antarctic Surface Meld triggered by Atmospheric Rivers*. Nature Geoscience, 12, 911-916. https://doi.org/10.1038/s41561-019-0460-1

21 Antarctic Radiosonde Observations Reduce Uncertainties in Forecasts | Observational data from radiosondes deployed in Antarctica improve the forecasting accuracy for severe cyclones. Cyclones with strong winds can make the Southern Ocean and the Antarctic a dangerous environment. Accurate weather forecasts are essential for safe shipping in the Southern Ocean and observational and logistical operations at Antarctic research stations. The study investigated the impact of additional radiosonde observations from Research Vessel "Shirase" over the Southern Ocean and Dome Fuji Station in Antarctica on reanalysis data and forecast experiments A 63-member ensemble forecast experiment was conducted focusing on an unusually strong Antarctic cyclonic event. Reanalysis data with (observing system experiment) and without (control) additional radiosonde data were used as initial values. The observing system experiment correctly captured the central pressure of the cyclone, which led to the reliable prediction of the strong winds and moisture transport near the coast.

Sato, K., Inoue, J., Yamazaki, A., Hirasawa, N. et al. 2020: *Antarctic radiosonde observations reduce uncertainties and errors in reanalyses and forecasts over the southern ocean: an extreme cyclone case*. Adv. Atmos. Sci. , 37(4), doi: 10.1007/s00376-019-8231-x.

New Publications II

22 Advancing Arctic Weather Prediction and Reanalyses | *(modified from ScienceNorway.no, Anna Kathinka Dalland Evans)* **By taking into consideration the insulating effect of snow on top of sea ice, researchers improve our weather forecasting capabilities in the Arctic.** Researchers Yurii Batrak and Malte Müller from the Norwegian Meteorological Institute have examined various weather models currently in use around the world – models that form the basis for weather forecasting and reanalyses production. None of the models had fully taken into consideration the fact that sea ice often has a layer of snow on top. Therefore, Batrak and Müller strived to improve their operational model to represent the snow layer in a more realistic way. In their study, the authors compared forecasts from different weather models and reanalyses products with the temperatures actually measured on the surface of the ice. This temperature is closely related to the air temperature just above the ice. The improved weather model that takes into account the presence of snow on the ice was the only model that accurately predicted air temperature over the ice. All the other models that the researchers examined indicated temperatures higher than measured, between 5 and 15 degrees too high. As a result of this study, an improved weather model that takes the snow layer on the ice into consideration has now been adopted by *Yr.no* for use in Arctic areas.

Batrak, Y., Müller, M. 2019. *On the warm bias in atmospheric reanalyses induced by the missing snow over Arctic sea-ice*, Nature Communications, 10, 4170. doi:*10.1038/s41467-019-11975-3*

23 The Iceland Greenland Seas Project | **The YOPP-endorsed Iceland Greenland Seas Project (IGP) is a coordinated atmosphere–ocean research program investigating climate processes in the source region of the densest waters of the Atlantic meridional overturning circulation. A report by the IGP consortium has now been published in BAMS.** The scientific aims of the project are to characterize the atmospheric forcing and the ocean response of coupled processes; in particular, cold-air outbreaks in the vicinity of the marginal ice zone and their triggering of oceanic heat loss. A field campaign in early 2018, aligned with the YOPP Arctic winter Special Observing Period, utilized a range of observing platforms over the Iceland and southern Greenland Seas to investigate critical processes in the region. Deployment of the observing platforms, including a research vessel, a research aircraft, moorings, sea gliders, floats, and a meteorological buoy, was well coordinated to allow simultaneous sampling of the atmosphere, the ocean, and their interactions. This joint planning was supported by tailor-made convection-permitting weather forecasts and novel diagnostics from an ensemble prediction system. The campaign observed the life cycle of a long-lasting cold-air outbreak over the Iceland Sea and the development of a cold-air outbreak over the Greenland Sea. Repeated profiling revealed the immediate impact on the ocean, while a comprehensive hydrographic survey provided a rare picture of these subpolar seas in winter.

Renfrew, I.A., Pickart, R. S., Våge, K., Moore, G. W. K., Bracegirdle, T. J., et al. 2019. *The Iceland Greenland Seas Project*, Bulletin of the American Meteorological Society, 100, 1795–1817. doi:*10.1175/BAMS-D-18-0217.1*

24 Upcoming Events

12-16 January 2020
100th AMS Annual Meeting
Denver, USA

17-19 February 2020
YOPP Science Workshop
Bremerhaven, Germany

19-21 February 2020
PPP Steering Group meeting #11
Bremerhaven, Germany

27 March – 02 April 2020
Arctic Science Summit Week and
Arctic Observing Summit
Akureyri, Iceland

20-24 April 2020
PPP-SERA Annual Meeting
Bremerhaven, Germany

03-08 May 2020
EGU General Assembly 2020
*with YOPP-APPLICATE Session (see **#16**)*
Arkhangelsk, Russia

15-19 June 2020
*International Congress of Arctic Social Sciences (ICASS X) with PPP-SERA Session (see **#17**)*
Arkhangelsk, Russia

29 July -01 August 2020
15th Workshop on Antarctic Meteorology and Climate
YOPP-SH meeting #5
PPP-SERA Weather and Society Workshop
Hobart, Tasmania

31 July – 11 August 2020
SCAR 2020: 'Antarctic Science - Global Connections'
Hobart, Tasmania

Any news or upcoming events to be announced to the community? Send an email to *office@polarprediction.net*.

The next issue of *PolarPredictNews* is expected to be out in March 2020.

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