YOPP YEAR OF POLAR PREDICTION

International Coordination Office (ICO) for Polar Prediction

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Issue #15
July 2020

PolarPredictNews

Sea ice scientists Stefanie Arndt (left) and Robert Ricker (right) during their weekly observational walk across the Arctic sea-ice floe to measure sea-ice thickness with the electromagnetic sensor (EM) sled and snow depth with the MagnaProbe during Leg 3 of the MOSAiC expedition where more than 600 international scientists study the central Arctic conditions during an entire year. The sled (to the very right in photo) measures the distance between the snow surface and the underlying ice/water interface, which is the total thickness of both the sea ice and snow. Subtracting the additionally measured snow depth with the MagnaProbe allows to calculate the actual sea-ice thickness (photo: Saga Svavarsdóttir/Alfred Wegener Institute).

Content

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 significatnly advance our environmental prediction capabilities for the polar regions and beyond.
As an internationally coordinated period of intensive observing, modelling, prediction, verfication, 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.

Editorial

Dear Colleagues,

It is time to briefly pause and celebrate the publication of the 15th issue of PolarPredictNews. *Launched in autumn 2016, Kirstin Werner and her team managed to publish one issue about every 3.5 months. Starting in October 2016 as an 8-pager,* PolarPredicNews *has grown continuously in length and quality. Essentially, I consider* PolarPredictNews *one of the key legacy elements that will provide an overview of the accomplishments of PPP and YOPP. And it will do so, in a very accessible and entertaining way (see, for example, the watercolour drawings by Amy Macfarlane that are spread throughout this whole 15th issue).*

This latest issue also highlights exciting recent scientific progress. For example, there is a report describing improvements in snow modelling that could enhance predictive capacity in polar regions and beyond. I am quite optimistic that this work will become a PPP/YOPP success story when it comes to going from research to better predictions and advanced services.

Furthermore, I would like to highlight two special issues. The one on Antarctic Meteorology and Climate: Past, Present and Future presents latest findings from expanded and ongoing research efforts in Antarctic meteorology, weather prediction, climate variability and climate change. The special issue entitled Societal Value of Improved Forecasting, published in Polar Geography, compiles a range of papers detailing work that has been undertaken in conjunction with the PPP's Societal and Economic Research and Applications (PPP-SERA) Task Team.

Finally, you will also find an update on COVID-19 has impacted PPP and YOPP. Looking into the future, it is very likely that most of the activities planned for 2020 and 2021 will be held online. In fact, it may very well be the case that the next and final onsite *meetings of the YOPP Consolidation Phase will the Polar Prediction School in Abisko (March 2022) and the YOPP Final Summit in Montreal (May 2022). However, this should not prevent us from doing exciting research.*

Happy reading,
Thomas Jung

photo: Martina Buchholz/ Alfred Wegener Institute

FEATURED IN THIS ISSUE:

Watercolour Drawings from MOSAiC Leg 3

by Amy Macfarlane, WSL Institute for Snow and Avalanche Research, Switzerland

Good practice on board Polarstern is for the science team to leave an entry in Polarstern's guestbook after each expedition leg. For leg 3 of the MOSAiC campaign, Amy Macfarlane, PhD student at the Snow and Avalanche Research Institute in Switzerland, prepared a watercolour collage that captured many of the events that happened during the 5-month leg and each team member either with their work or expedition hobbies.

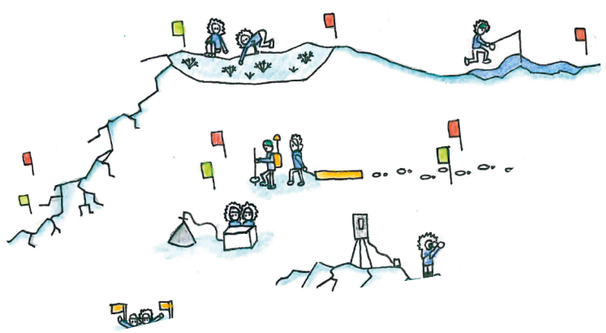
After starting a PhD at the Snow and Avalanche Research Institute in Switzerland, I found myself packing to join MOSAiC leg 3. As I prepared for what was to be a 3- month expedition, my flat mates gifted me with watercolour paints and paintbrushes for my time away. During eventful and demanding times onboard, when ice dynamics destroyed the runway and limited handover plans, working in -40 degree temperatures on the ice and hearing about family and friends at home in quarantine, I turned to drawing.

photo: Delphin Ruché

My work on MOSAiC is researching the snow on the sea ice and understanding how it changes throughout the seasons both physically and chemically. I have no installations on the ice, therefore the number of times I put on my thick snow boots and walked down the gangway directly correlated to the quantity and value of the data. Every evening I was physically exhausted from pulling a sledge over the ice and when I finished with lab work and data entry I often got out my watercolours as it's an easy task with aching muscles.

It's difficult to give gifts whilst onboard as we exhausted the shop's chocolate and sweets supply after a few weeks, I found myself often drawing small birthday cards to give a personal gift to my friends. When we started the journey back to Svalbard I offered to make the expedition's guestbook entry. So many unique events had happened over the leg, it was extremely easy to come up with ideas to incorporate each colleague into the drawing either with their work or expedition hobbies. I could have added to this collage for a long time but after 5 months(!) the leg came to an end as we saw Svalbard.

The same evening, due to a last-minute drop out, I was invited to stay for leg 4. I found myself heading back to the Arctic. A 3-month trip now turning into 8 months. and I couldn't be more grateful for the thoughtful gift of watercolour paints and paintbrushes that I will take back to the ice with me to keep me settled on this (sometimes quite wild) adventure.



Watercolour cartoons by Amy Macfarlane are spread over the entire PolarPredictNews #15 newsletter. Find the drawing as a whole in the middle of the issue – you may want to print it as a poster to decorate your (home) office walls.

01

This Year is Difficult to Predict

by Kirstin Werner, Alfred Wegener Institute and International Coordination Office for Polar Prediction

The World Meteorological Organization is concerned about the decrease of airborne atmospheric observations due to the suspension of commercial air traffic since mid-March. The German Weather Service starts using additional data from radiosondes' sinking to the ground. While many of the research campaigns planned for this and the coming season in the Arctic and Antarctic were cancelled and others are postponed, the one-year ice drift MOSAiC goes on. How does the COVID-19 pandemic affect the polar prediction community?

There are years when the weather can be forecast more easily than in other years. "*The COVID-19 year is one with the summer being more difficult to predict than for example last year's summer*", says Detlev Majewski, head of the German Meteorological Service's department Meteorological Analysis and Numerical Modeling. In March, when the outbreak of COVID-19 in Europe forced people to move their entire lives to home, the weather was still dominated by longer-term stable high-pressure systems enabling nice and sunny conditions. However, "*the current weather in Germany resembles more of a typical mid-European summer*", says Majewski, "*with more instability due to rapidly moving short-term low-pressure areas over Europe, allowing at maximum some three to four days of sunny weather before chilly temperatures are back.*" In Germany, this can be felt in particular at the coasts, for example close to the North Sea.

Missing an Historic Event while MOSAiC Continues

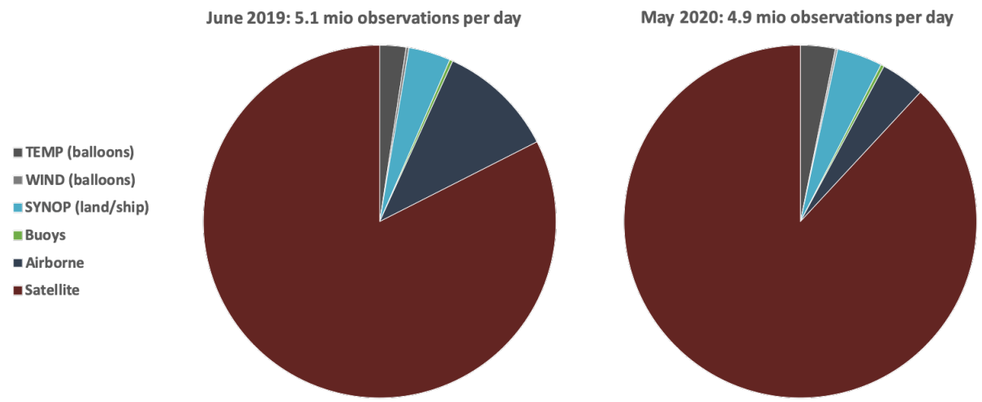
Close to the North Sea is home for Stefanie Arndt, sea-ice scientist at the German Alfred Wegener Institute (AWI). After 145 days being away from Bremerhaven, Arndt returned to Germany only four weeks ago. Together with more than one hundred German and international people, she spent the time when the pandemic peaked in Europe in the central Arctic aboard the German research vessel Polarstern. "*While I definitely missed what can only be considered an historic event with entirely empty streets and people in Germany panic buying pasta and toilet paper, the pandemic had a huge impact to MOSAiC. Instead of three, I have now spent five months in total away from home, and for some*

Stefanie Arndt and her colleague work on the ice during MOSAiC leg 3 (photo: Steven Fons/Alfred Wegener Institute).

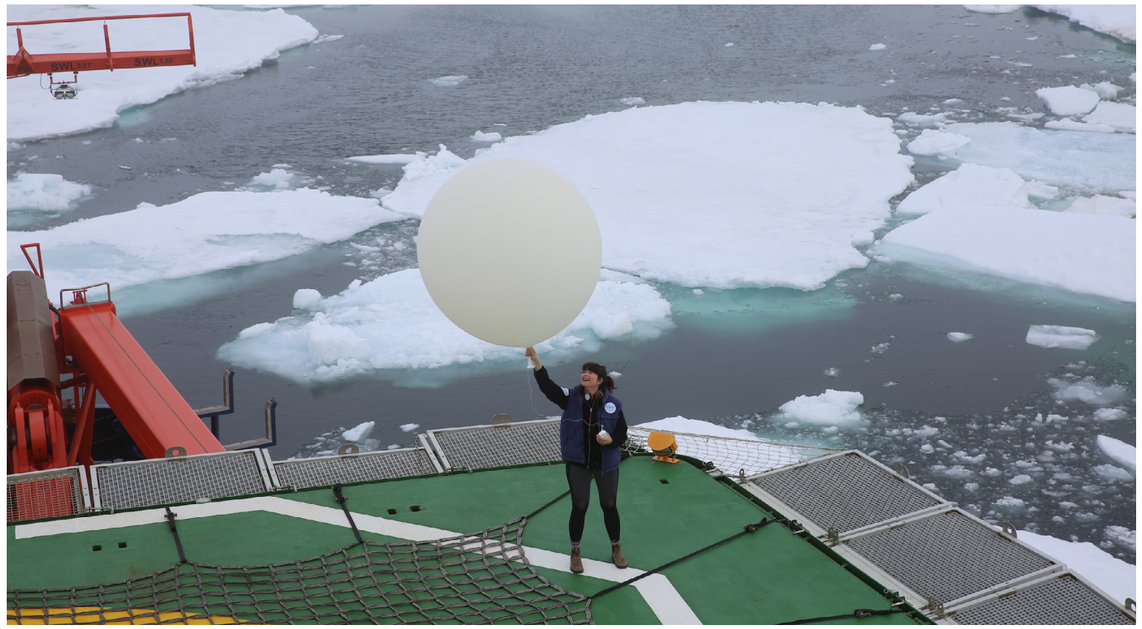
time, there was a huge uncertainty amongst the team about how and when the next exchange of the expedition legs would happen. At the same time, at least I myself have never worried about anything but my family's health." Eventually, the MOSAiC project board and logistic team found a good solution for the teams' exchange. After a number of international requests and negotiations, the two German research vessels *RV Maria S. Merian* and *RV Sonne* were finally able to assist in swapping the science teams, crews and captains. Participants of leg 4 had to stay quarantined in a hotel in Bremerhaven for two weeks in May before boarding the vessels at Bremerhaven port. In a Svalbard fjord, they met with *RV Polarstern* in early June for the transfer. MOSAiC leader and chief scientist of leg 4 Markus Rex is proud of the MOSAiC logistic team who assessed all possible options to make the transfer happen: "*It had been a difficult time for MOSAiC, and sometimes it was not clear at all whether the expedition would go on, but in the end, while most of the international expeditions had to be cancelled due to the Corona virus, MOSAiC continues*". During the time when Polarstern left the central Arctic sea-ice observatory unwatched for some weeks, most of the research camp needed to be packed. However, some of the autonomous instruments left on the ice floe during the vessel's absence continued measurements. "*After our return to the floe, re-building of the research camp happened within just a week*", says Rex who came back to an Arctic Ocean bathed in 24-hour-daylight, much different from what he had experienced during the dark Arctic winter conditions during leg 1. This time it is a light version of the research camp as the ongoing instability of ice floe requires flexibility and the possibility to rapidly pack up instruments. "H*owever, we might also be able to stay on this ice floe until the end of this phase of the expedition*", says Rex in the German podcast 'Arctic Drift – Das Audiologbuch'.

Drastic Decrease in Airborne Atmospheric Observations

One huge impact of COVID-19 the World Meteorological Organization has been concerned about was the number of weather observations going down due to the drastic decrease in flight traffic. "*Overall, the decrease in the number of commercial flights has resulted in a reduction of in certain regions up to ninety percent in observations of meteorological measurements from aircraft platforms*", states the WMO in their press release from 7 May 2020. Typically, commercial airliners of 43 airlines and several thousand aircraft contribute to the WMO Aircraft Meteorological Data Relay (AMDAR) programme with daily over 800,000 high-quality automatic observations of atmospheric temperature, wind speed and direction, and increasingly also adding humidity and turbulence measurements. In June 2019 about ten per cent of the data assimilated into the global DWD ICON model were from airborne observations, reducing to only about four per cent in May 2020. In a test run by the European Centre for Medium-Range Weather Forecasts (ECMWF) all airborne observations were removed from the forecast. "*The sensitivity studies have shown that in particular the short-range wind and temperature forecasts at 11 to 12 kilometers height – which is a typical aircraft cruising altitude – would degrade by up to 15%, with significant degradations at all forecast ranges up to seven days*", states ECMWF on 24 March 2020 in a news article on their website.



Number of observational data per day used in the global DWD model ICON in June 2019 (left) vs. May 2020. A decrease from about 10 to 4 per cent of assimilated data from airborne observations is caused by the reduced



Aikaterini Tavri is launching a weather balloon from Polarstern's helicopter deck during MOSAiC leg 4. Polarstern was the first location where radiosonde descents were recorded. The COVID-19 pandemic caused the German Weather Service to speed up the process to implement meteorological data from all German radiosondes during descent, it has been operational since July 2020 (photo: Lisa Grosfeld/Alfred Wegener Institute).

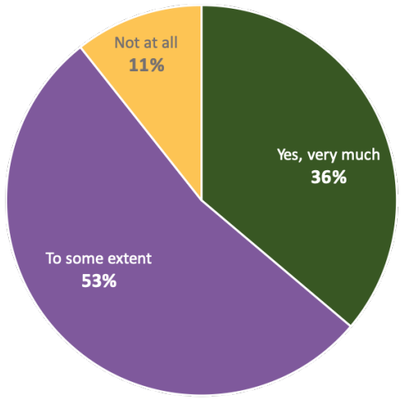
Why not Measure while Radiosonde Sinks

In order to keep up the good quality of forecasts despite the decrease in airborne observations since mid-March, the German Weather Service (DWD) reacted quickly. Not only did they increase the number of weather balloon launches over Germany since early April, they used the humidity data from the Global Navigation Satellite System GNSS as well as radar volume data to measure radial wind and precipitation. The DWD also initiated the use of the radiosondes' descents for obtaining additional atmospheric data. Previously, radiosondes had recorded meteorological data only during ascents. But why not measure atmospheric data also after the weather balloon has burst in the stratosphere, which usually happens around thirty kilometers elevation, and sondes sink to the ground? The radiosonde manufacturer Vaisala had already equipped their radiosonde model 41 with the ability to measure data while the sonde drops down. "*Polarstern was the first location where we tested the data uptake during the radiosondes' descent starting in September 2019*", says Alexander Cress, a senior research scientist in the data assimilation section of the German Weather Service's Meteorological Analysis and Numerical Modeling department. Cress was the one who initiated and supported from Germany this very first test run in the central Arctic. "*It included a little bit of puzzling out how to install the new software to make sure the data is recorded in both the DWD and the Polarstern system and then being fed into the Global Telecommunication System (GTS) of the WMO where it is available for the national weather centers to use the data to initiate their forecasts*". Since May 2020, data from all radiosondes' dives in Germany are recorded and used in the DWD's global and regional forecast models. "*MeteoSwiss, the UK Met Office and other European countries have also prompted to follow us and started to measure atmospheric data during their sondes' descents*", says Cress.

Modest Impact at the Poles?

Recording the radiosondes' drop down over the small research town Ny-Alesund on Svalbard would require both additional personnel to adjust the software and consultation with the Norwegian Meteorological Institute through which the atmospheric data is transmitted to the GTS. "*But since there aren't a lot of commercial overflights in the Arctic, we wouldn't expect a lot of atmospheric data loss across the North Pole*", says Detlev Majewski. Indeed, weather observations have not been strongly impacted so far in the Arctic, confirms Marion Maturilli, head of the Meteorological Observatory of the AWIPEV Research Base in Ny-Alesund, Svalbard. "*For research campaigns in February and March and during the YOPP*

Targeted Observing Period around and after Easter, we launched weather balloons every six hours. Otherwise, we did one radiosonde per day." However, the crisis already had impact on a research campaign using the German Polar 5 and 6 aircraft within the YOPP-endorsed (AC)[3] project.



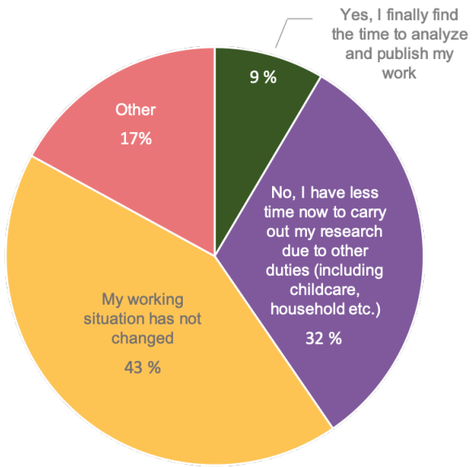
Survey Question 1: The pandemic so far has impacted my daily operations/life/the research I am involved with in the Arctic and/or Antarctica?

"*Our flight campaign to support MOSAiC was supposed to launch in March/April 2020, aligned to the YOPP Targeted Observations. But because during this time there was no way to travel to Svalbard from where we would have departed, the entire activity had to be cancelled*", says Manfred Wendisch who is a meteorology professor at the University of Leipzig and leads (AC)[3]. The second MOSAiC aircraft campaign is, however, scheduled to take place as planned in August/September 2020. Other atmospheric science field work in Greenland, the Canadian Arctic or in Alaska has been either cancelled or postponed. Remote stations such as Summit in Greenland might eventually run out of helium and therefore need to reduce their radiosounding frequency.

At the other side of the world, at the German Antarctic research station Neumayer, the impact of COVID-19 so far seems to be modest. Holger Schmithüsen who leads the meteorological observatory at Neumayer does not expect the pandemic to impact routine atmospheric measurements from the station. However, again, research activities for the next Antarctic summer season have already been cancelled or postponed. "*The exchange of the overwintering team will take place during austral summer as scheduled. Routine meteorological measurements and maintenance of instruments will thus be secured also for the coming year at the Neumayer station*", says Schmithüsen.

"*The COVID-19 pandemic has caused all National Antarctic Programmes to reconsider how they can support the coming field season, with a united focus on keeping Antarctica free from the virus*", is stated by Antarctica News Zealand which is New Zealand's government agency responsible for carrying out activities in Antarctica. Therefore, plans are to only support essential operational activities and planned maintenance in the austral summer season 2020/2021.

"*Regarding ships' operations, to my knowledge all levels of weather forecast communication for merchant ships have been reported as 'regular'*", says Thomas Viguier, a former Safety and Security Officer of Merchant Marine now working as a researcher at the Icelandic Arctic Cooperation Network in Akureyri, Iceland. "*However, maritime traffic reduced drastically mainly due to the impossibility to call at ports, the economic situation and border control.*" The cancellation of shipboard operations also affects this year's research cruises that were already underway but are now cancelled. "*Even for next year, all cruises in the Indian Ocean sector of Southern Ocean were cancelled already so opportunities to deploy buoys or moorings have been changing rapidly, and shipboard support measurements are drastically reduced*", reports Lynne Talley, professor for oceanography at the Scripps Institution of Oceanography, University of California, San Diego.



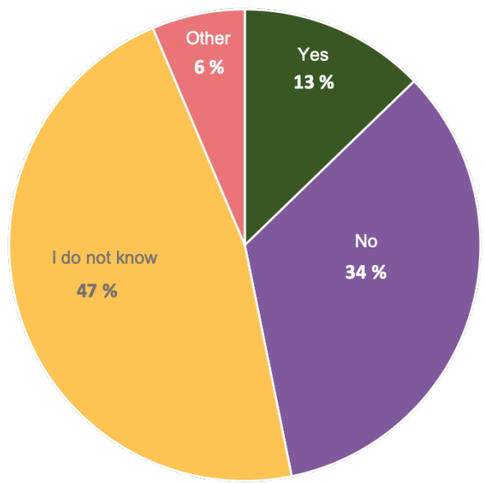
Survey Question 2: The COVID-19 situation has given me more time to work on scientific results.

Impact to Research Operations Strongly Expected

Resulting from a recent, non-representative survey carried out by the YOPP International Coordination Office, there is concern among the polar prediction community regarding a potential gap in the collection of polar data and the subsequent deterioration of observational quality that might reduce the amount of data assimilated into numerical models which eventually could lead to a loss of forecast accuracy. "*Several field campaigns have been cancelled or changed which will affect the availability for observational data to compare with numerical models*", says meteorology professor at Stockholm University Gunilla Svensson who leads the YOPPSiteMIP effort to evaluate model output with polar observations.

If travel restrictions continue and only limited staff is allowed to stay at the polar research stations, maintenance and service requirements for instruments will not be kept at a high level. "*The installation of a new tall tower automatic weather station (AWS) at Byrd Station is now delayed, as is much of the field work to maintain the AWS network*", says Matthew Lazzara, research meteorologist and principal investigator of the United States' Antarctic Automatic Weather Station Program that is maintained by the Antarctic Meteorological Research Center at the University of Wisconsin-Madison.

In the survey that was open from 6 to 20 July 2020, the majority of the 47 respondents indicated that the pandemic so far has impacted their daily operations, life and/or their research in the Arctic or Antarctic very much (37%) or at least to some extent (52%). So far, the working situation of more than 40% of the survey participants has not been impacted by COVID-19 while more than 30% (50% of female respondents) indicated that they would now have less time to carry out research due to additional duties (including childcare, household etc.). Only 13% of the survey participants expect the national lock downs to impact the quality of Arctic or Antarctic forecast while there exists a huge uncertainty (more than 45%). More than 30% do not consider the pandemic to have any impact to forecast quality. However, operations are expected to being impacted "*very much*" (more than 40%) or at least "a little bit" (more than 20%) during the next field seasons in the Arctic and Antarctic.



Survey Question 3: Did/Will the national lock downs impact the quality of weather and sea ice forecasts in/around your area of operations in the Arctic and/or Antarctica?

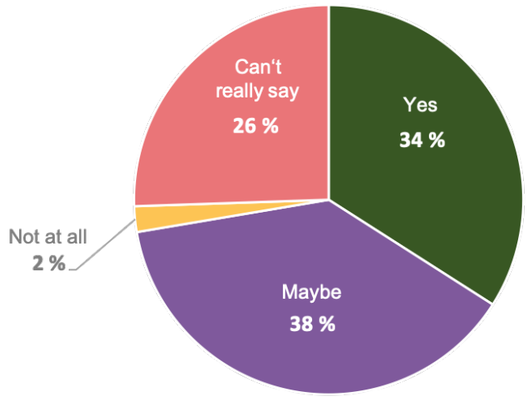
Much of the personal communication and exchange is now being compensated by video conferencing. "*In some cases, this new way of networking might even be an advantage, with new collaborations between far-apart colleagues being established and online conferences being much more accessible to everyone*", says Helge Goessling, climate scientist at the Alfred Wegener Institute. "*The reduced carbon footprint of our research community is also a positive aspect. Some aspects, however, will be difficult to compensate if strong constraints due to the pandemic remain. For example, the establishment of research networks by young scientists and intense workshops where people stick their heads together for a few days to advance the science. This can hardly be done online.*"

Early-career scientists might indeed be seriously affected from the pandemic as field work for PhD projects is getting delayed and networking opportunities shrink to a minimum. Irlanda Mora Rosales did her Master in Antarctic Sciences at the Chilean University of Magallanes. "*Doing*

science in South America is very difficult as education is not a priority. We already have social, economics, ethics, and now also 'pandemic' problems."

Wind Speed Measured from Space

It can be considered pure luck that the Earth observation satellite ADM-Aeolus has been launched by the European Satellite Agency at the right time to compensate for the loss of wind data through the drop in airborne atmospheric observations during the COVID-19 pandemic. Every three seconds, a laser beam is sent from the satellite through the atmosphere where it is reflected by aerosols and other particles. The movements of the particles causes a frequency shift between the laser beam and its reflection, the so-called Doppler effect, which can be translated into a wind speed. Since May 2020, the German Weather Service has added this data to initiate their global forecast model ICON. Considering the positive experience which the national weather services are now gaining from using the laser measurements from space, it has a drop of bitterness when Alex Cress and Detlev Majewski mention that the laser onboard ADM-Aeolus is still a scientific mission: "*After the laser will be down in probably one and a half years, it will take another four to five years to build another laser. But then it will be for operational use of wind data*".



Survey Question 4: I expect the pandemic to impact the future efforts in research and operations in the Arctic and Antarctica with regard to weather and sea-ice forecasts.

The new data sources that have been added during spring and summer this year to initiate DWD's global and regional forecast models will be pursued, even after airborne measurements might be back to a pre-pandemic state. "*In a way, COVID-19 has forced us to speed up enhancements which were planned anyway to improve the quality of forecasts*", says Majewski. "*With the additional data, we do not see any deterioration of the forecasts' quality. However, as I mentioned – in some years, the weather forecast is more easy. This year is difficult anyway.*"

02

Towards Improved Forecasts in Northern Europe with a New Snow Model Forecast Experiment

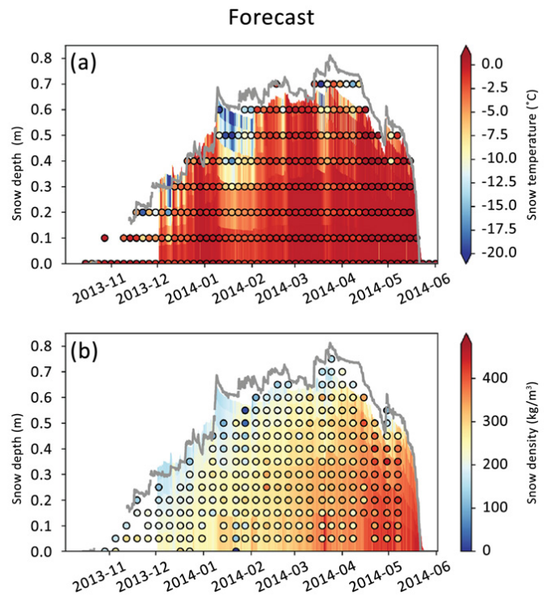
by Jonny Day and Gabriele Arduini, European Centre for Medium-Range Weather Forecasts

The original article has been published at the ECMWF Science Blogs.

Snow plays a crucial role in weather and climate, particularly in high latitude and high altitude regions which are covered in deep snow either permanently or for large parts of the year. It is an important reservoir of fresh water for drinking and agriculture, and dramatically influences surface meteorology. Flooding associated with rapid snow melt also poses significant hazard to human life. It is, therefore, crucial for weather and hydrological forecasting at ECMWF that forecasts of snow and its influence on the weather are well captured in the forecasting system.

Currently, most operational numerical weather prediction (NWP) models use only a single-layer snow scheme, which is thought to contribute to systematic temperature biases in ECMWF forecasts in high latitude regions, including Northern Europe during winter and spring (Arduini et al., 2019). Using a single-layer snow scheme can also lead to errors in the simulation of snow depth and cover. For example, during spring, the single-layer scheme contributes to sluggish snowmelt. This leads to errors in hydrological forecasting but also to errors in temperature, by delaying the transition to snow-free conditions in the forecasts.

A state-of-the-art multi-layer snow scheme has been implemented in an experimental version of the Integrated Forecasting System (IFS) as part of ECMWF's contribution to the WMO's Year of Polar Prediction (YOPP) and the H2020-APPLICATE project which is expected to improve this situation. It is currently under testing within the 4-dimensional variational (4D-Var) data assimilation system and is expected to become operational in a forthcoming operational upgrade. Here, we present some examples of the improvements the new snow model will bring to ECMWF forecasts, focused on Northern Europe. This provides an opportunity to showcase the excellent work done by the Finnish Meteorological Institute (FMI) in collecting rich meteorological data at Sodankylä, a snow covered boreal site in Finnish Lapland (e.g. Essery et al. (2016) and Leppänen et al., (2016)) and highlight their use at ECMWF.



Top: comparison of coupled atmosphere multi-layer snow forecasts (coloured shading) with in-situ snow temperature (a) and snow density (b) measurements (coloured dots) (from Arduini et al. (2019)). The observed snow depth is shown with a grey line. Figures a & b reproduced under Creative Common Licence CC BY 4.0.

Improved 2-Metre Temperature Forecasts in the Medium Range

A warm bias in night-time temperatures and a cold bias during the day is a long-standing error in the IFS in Northern Europe during spring (page 12 Figure a, b and c). Further analysis at Sodankylä reveals that this underestimation of the amplitude of the diurnal cycle of 2 m temperature is due to a lack of sensitivity to changes in radiation in the IFS (page 12 Figure d). This lack of sensitivity is partly due to the use of the single-layer snow model in which the entire snowpack is represented by one layer and so a large thermal inertia can result if the snow pack is deep, as is the case in Scandinavian regions during

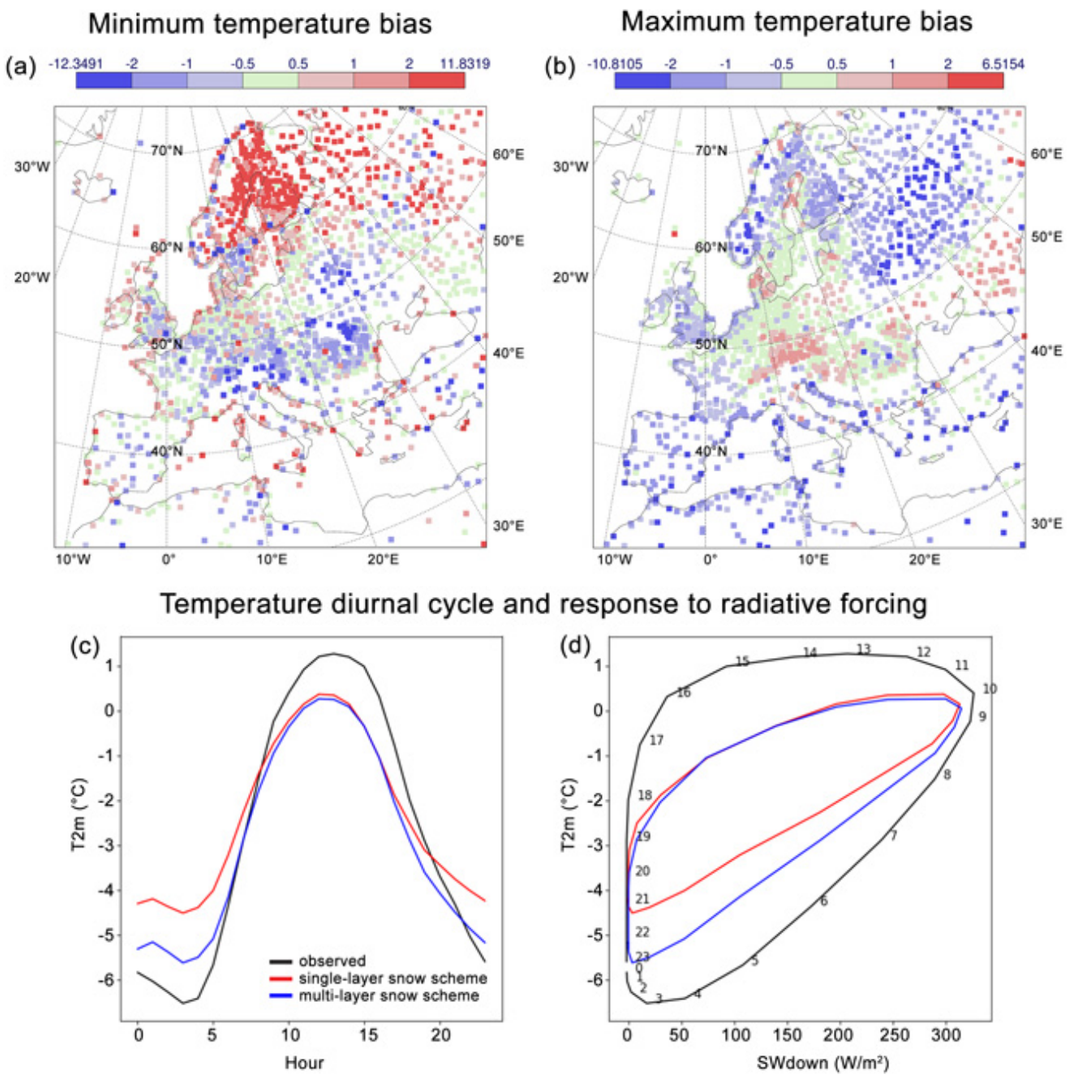
winter and early spring (see ECMWF Newsletter, Haiden et al., 2018).

Introducing the multi-layer scheme reduces these errors by increasing the amplitude of the diurnal cycle of temperature (page 12 Figure c). This is because directly representing a thin top layer of snow, with a lower thermal inertia, makes the surface and near-surface air temperature more sensitive to variations in radiative forcing than is possible with the single-layer scheme, making the simulation more realistic. This increase in sensitivity (leading to more rapid warming in the morning and cooling in the evening) can be seen nicely by looking at how 2 m temperature responds to variations in radiative forcing (Day et al., 2020), such as the diurnal cycle of solar radiation (page 12 Figure d).

Realistic vertical snow structure

When adding a new Earth-system component to the forecasting system, it is also important to understand the changes at the process level. Page 11 figures a and b show time-height plots of snow temperature and density at Sodankylä, from observations and from forecasts coupled to the multi-layer snow model. Snow temperature is measured by an array of thermistors which is covered by the snow during wintertime, while snow density profiles are measured every week or so by digging a pit in the snow and weighing a snow sample of a certain volume at different depths.
The multilayer snow model captures the propagation of hot and cold waves within the snowpack, which is a key feature of deep snowpacks. Comparison of the modelled temperature with observations suggests that the downward propagation of this cold wave through the snowpack is well represented by the model. The temporal evolution of snow density also looks realistic throughout the season (see page 11 Figure b), even though the snow density of the bottom of the snowpack is overestimated by the model, particularly after February.

These results highlight the motivation and the impact that the new snow model is expected to have on ECMWF forecasts. They also provide an excellent example of how process-oriented evaluation of model developments at supersites, such as Sodankylä, helps to ensure that model developments are improving forecasts for the right reasons. However, clearly there is more to do to understand and improve systematic forecast errors at this complex site, where interplay between snow, forest and atmosphere create a complex web of interactions. Work to further understand the sources of error at Sodankylä, and other Arctic sites will be conducted as part of INTERACTIII.



Top: Spatial map of March–April daily minimum (a) and maximum (b) temperature error for the ECMWF operational system at a lead time of 2 days. Bottom: (c) March–April mean diurnal cycle of 2 m temperature at Sodankylä in observations and in the ECMWF forecasting system with single-layer and multi-layer snow. (d) Mean temperature for each hour of the day as a function of downwelling shortwave radiation (numbers on the observed curve represent the hour of the day in UTC).

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03

Combining Modeling and Observations for Improved Sea-Ice Predictions

by Lars Nerger, Alfred Wegener Institute

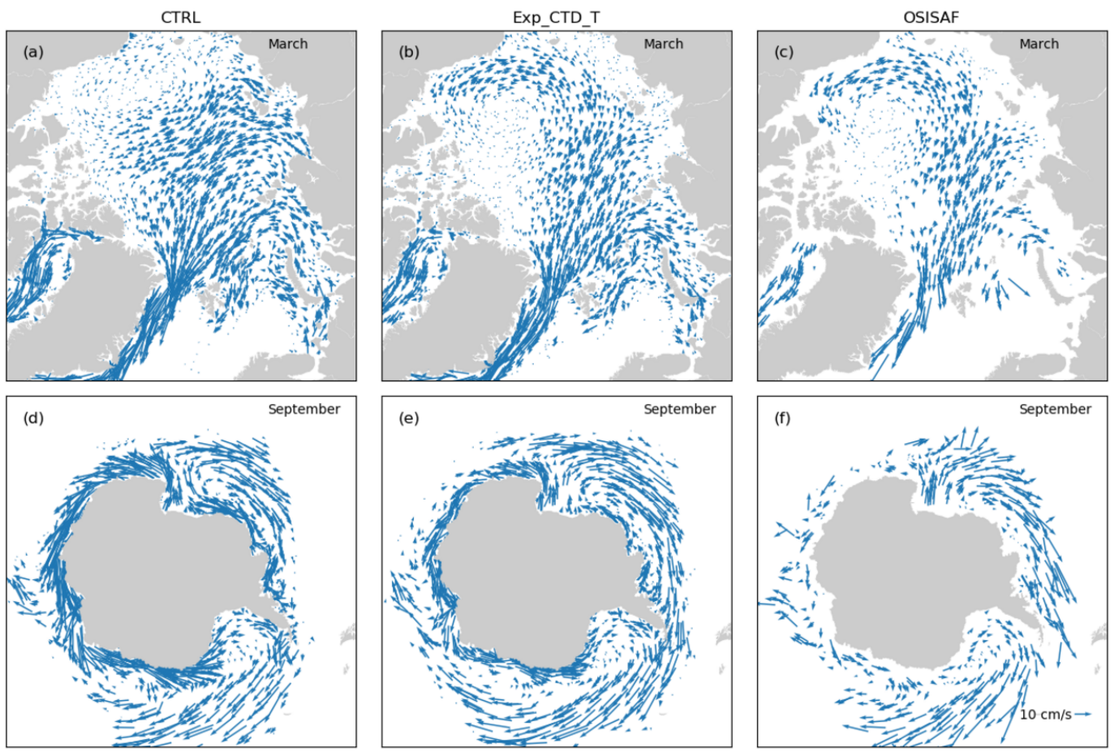
The original article has been published on the Helmholtz ESM webpage.

In a study recently published in the *Journal of Advances in Modelling Earth Systems*, a seamless sea-ice prediction system is introduced with a focus on the data assimilation component.

Sea ice is an important component of the Earth system because it strongly influences heat exchanges between the ocean and the atmosphere. Models are used to predict the state of the sea-ice over time scales from days to years. In a recent study, published in the *Journal of Advances in Modeling Earth Systems*, Longjiang Mu and his colleagues from the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research developed and assessed a seamless sea-ice prediction system with a focus on the data assimilation component.

Data assimilation combines models with real observational data. In the study, this methodology is used to generate improved model fields which are then used to initialize the computation of model predictions. Other applications of data assimilation are the assessment of model error and an optimized representation of model processes.

A particularity of the model and data assimilation system is that a so-called coupled model – the Alfred-Wegener-Institute Climate Model (AWI-CM) – was used. AWI-CM simulates interactions between the ocean and sea ice as well as the atmosphere and land surface. In this study, the data assimilation software Parallel Data Assimilation Framework (PDAF) is directly connected to AWI-CM to provide online data-assimilation functionality. Directly combining the model with the data assimilation as done here reduces the computation time. In the study by Mu et al., the data assimilation focused on ocean and sea ice, by assimilating observations of the sea-surface temperature and sea-ice properties like thickness, concentration and drift velocity. Including the data assimilation, the sea ice and the ocean circulation becomes more realistic, as can be shown when comparing the study with independent, non-assimilated observations. In general, the data-assimilation methodology is configured in a way that each observation type can influence all model variables. These effects can be assessed by studying single data types. For example, the sea-ice drift velocities help to improve the representation of the sea-ice thickness, and the sea-surface temperature observations improve the ocean circulation at mid depth.

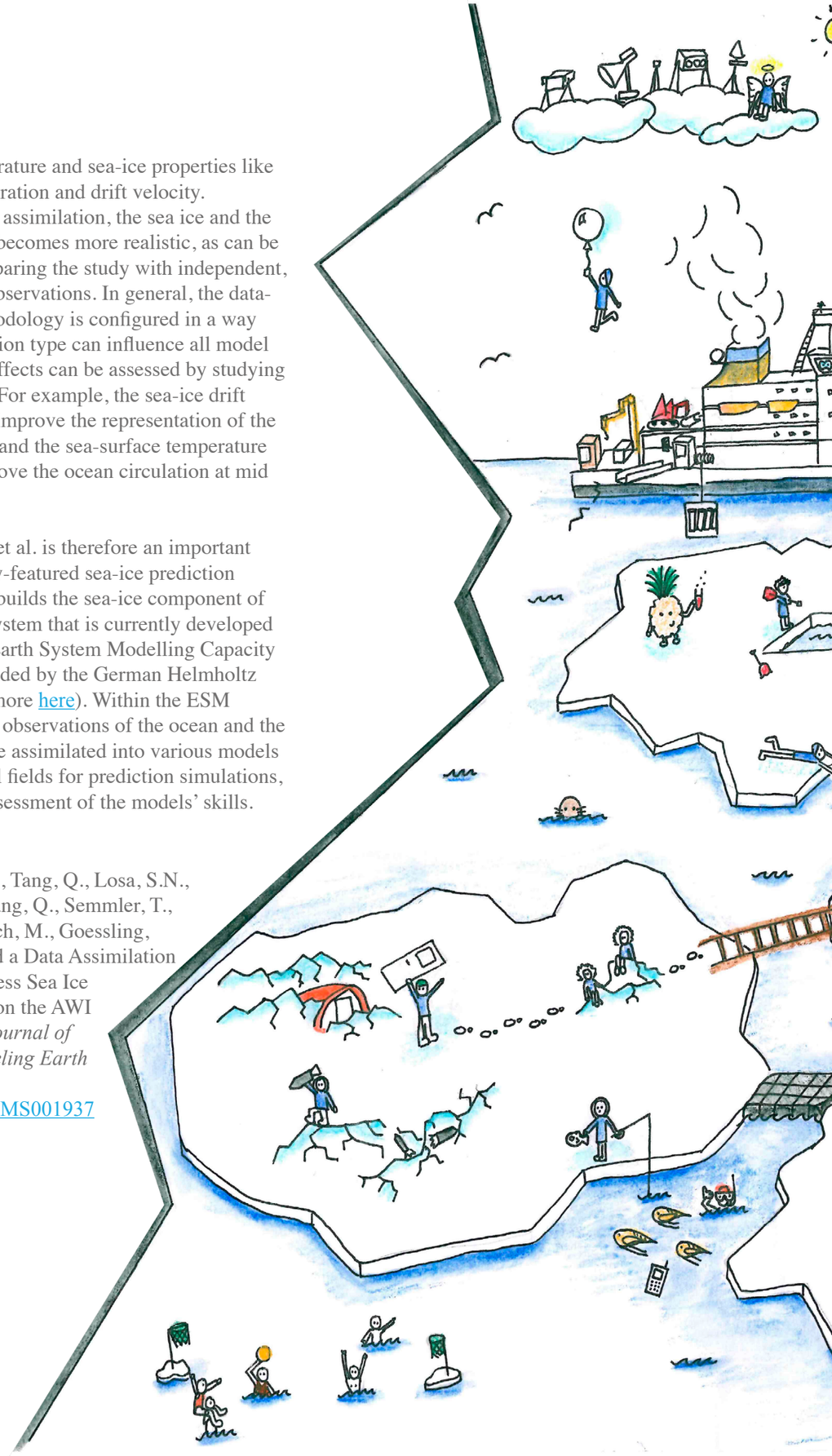


Sea-ice drift velocity averaged over the years 2008-2018 in the Arctic and Antarctic. Left column: the experiment without data assimilation, middle column: the experiment with data assimilation with improved drift, right column: comparison data from the Ocean and Sea Ice Satellite Application Facility (OSISAF) (source: Mu et al., for details see text).

The study by Mu et al. is therefore an important step toward a fully-featured sea-ice prediction system. It further builds the sea-ice component of the assimilation system that is currently developed in the Advanced Earth System Modelling Capacity (ESM) project funded by the German Helmholtz Association (see more here). Within the ESM project, also other observations of the ocean and the atmosphere will be assimilated into various models to find good initial fields for prediction simulations, but also for the assessment of the models' skills.

Reference

Mu, L., Nerger, L., Tang, Q., Losa, S.N., Sidorenko, D., Wang, Q., Semmler, T., Zampieri, L., Losch, M., Goessling, H.F. 2020: Toward a Data Assimilation System for Seamless Sea Ice Prediction Based on the AWI Climate Model. *Journal of Advances in Modeling Earth Systems* 12. doi: 10.1029/2019MS001937



04

Improving Weather Forecasts in the Arctic

by Anna Kathinka Dalland Evans, Norwegian Meteorological Institute

Special conditions and few available observations provide extra challenges when forecasting weather in the northern regions. How do researchers work with improving weather forecasts in the Arctic?

Close to a hundred viewers followed the open live streaming event when researchers from the YOPP-endorsed Alertness project invited everyone interested to join them in a set of open lectures on this subject on May 27, 2020.

The event was supposed to have taken place in Longyearbyen at Svalbard but was moved to an online platform due to the current COVID-19 situation.

"*People in the north naturally have an extra interest in the weather and in precise weather forecasting*", says Marius Jonassen, who lives in Longyearbyen and works at the University Centre in Svalbard (UNIS). Jonassen is co-lead for the Alertness research project. "*We have a lot of field activities with our students and staff*", he explains. "*And in this context, precise weather forecasting is extremely important for safety reasons.*"

The primary objective of the Alertness project is to improve Arctic weather forecasts and warnings, for the benefit of maritime operations, business and society.

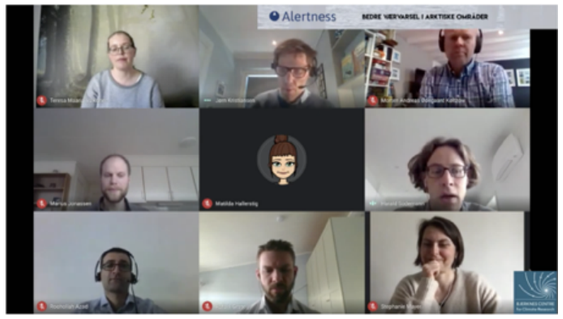
Talking about Weather Forecasting: the Online Event

The event, which was broadcasted on Youtube, included four short popular science talks, as well as a session where a panel of researchers from The Norwegian Meteorological Institute, The University Centre in Svalbard (UNIS) and the Bjerknes Centre for Climate Research, answered questions from the audience.

Matilda Hallerstig is currently working on a Ph.D. thesis within the Alertness project at NORCE/ Bjerknes Centre for Climate Research. She kicked off the online event with her story about how she moved from working as a weather forecaster in the city of Tromsø in the north of Norway, to working with research on improving weather models. A text version of this story is available at Science Norway. Hallerstig had also contributed an an article to *Polar Prediction Matters* dialogue platform maintained by the PPP International Coordination Office.

Marius Jonassen talked about the importance of accurate weather forecasts for students and staff at UNIS and gave examples from field work conducted in Svalbard. Morten Køltzow, researcher from The Norwegian Meteorological Institute, explained how a weather forecast is made, and why it does not always correspond to the actual weather that people experience.

Students from the University Centre in Svalbard (UNIS) on a field trip in Isfjorden, Svalbard (photo: Nils Roar Sælthun/ UNIS).



After the talks, a panel of researchers from The Norwegian Meteorological Institute, The University Centre in Svalbard (UNIS) and the Bjerknes Centre for Climate Research, answered questions from the audience (screenshot: Matilda Hallerstig).

Finally, project lead for Alertness Jørn Kristiansen from The Norwegian Meteorological Institute explained how the people involved in Alertness work with improving weather forecasts in the north. They work with developing the AROME Arctic model in ways related to data assimilation, sub-grid scale parameterisations and the generation of ensembles. "*I would like to thank everyone who contributed into making this open event a success*", Kristiansen says. "*An important aspect of Alertness is that academic researchers collaborate directly with operational forecasting centres, and this was presented very nicely.*"

Thanks to everyone who gave talks and were part of the discussion panel, and to those who watched the event live online and asked great questions. Also our thanks to the communication department at the Bjerknes Centre for Climate Research for running the technical part of the event smoothly, and to the communication department at the Norwegian Meteorological Institute for help in forming the content of the event.

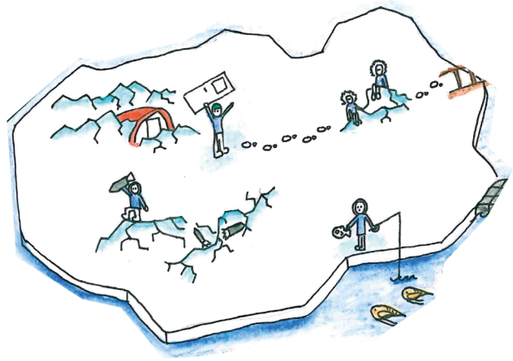
The lectures and discussion are available online here (in Norwegian).

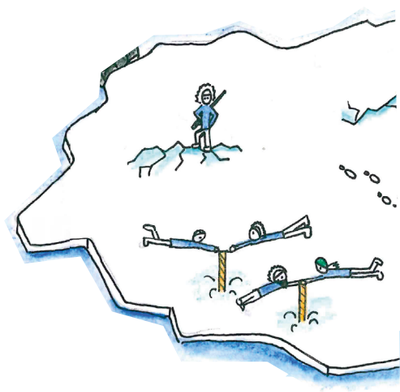
About: Alertness

Alertness (Advanced models and weather prediction in the Arctic) is a 4-year (2018–2021) research project about Arctic weather prediction financed by the Norwegian Research Council. The aim is to develop world leading capacity for the delivery of reliable and accurate Arctic weather forecasts and warnings for the benefit of maritime operations, business and society. Alertness is led by the Meteorological Institute of Norway (MET Norway) and is a cooperation between MET Norway, the University of Bergen (UiB), the Norwegian Research Centre (NORCE), the University of Tromsø (UiT), The Royal Netherlands Meteorological Institute (KNMI), the Nansen Environmental and Remote Sensing Center (NERSC) and The University Centre in Svalbard (UNIS).

Alertness home page:
https://www.alertness.no/en/home

Alertness is endorsed by the Year of Polar Prediction (YOPP).





05

Third Coordinated Sea-Ice Forecast Experiment in the Southern Ocean

by François Massonnet, Université Catholique de Louvain, Belgium

The Sea Ice Prediction Network South (SIPN South) just issued its third post-season report evaluating forecasts of sea-ice conditions around Antarctica for the austral sea-ice minimum season 2019/2020.

Operations in the Southern Ocean are intensifying, both as a result of increased scientific interest for this remote region and a growing interest from stakeholders. Navigating Antarctic waters is not without risk though. The presence of sea ice, even in summer months, can hinder the progression of vessels and, in the worst case, become a real danger. In recent years, the study of sea-ice predictability in the Southern Ocean has progressed and several potential mechanisms have been identified that bear promise for skillful predictions.

SIPN South is an international initiative endorsed by the Year of Polar Prediction (YOPP), that aims at coordinating realistic seasonal summer sea-ice forecasts in the Southern Ocean. SIPN South has just issued its third post-season report evaluating forecasts submitted in late November 2019 and targeting the three-month period December 2019-February 2020 (report available here).

One of the key findings, already hinted at last year, is that forecasts based on statistical approaches seem more skillful than forecasts based on fully coupled dynamical models. This indicates a large potential for improvement in our physical understanding of the Southern Ocean sea ice using process-based models. Key regions like the Ross Sea appear to be intrinsically difficult to predict and strongly influenced by unpredictable weather events.

SIPN South will continue to collect forecast for the coming years, including for the winter YOPP-SH Special Observing Period that is scheduled for mid-April to mid-July 2022.

Find the SIPN South website here.

Antarctic sea ice (photo: Thomas Ronge/Alfred Wegener Institute).

06

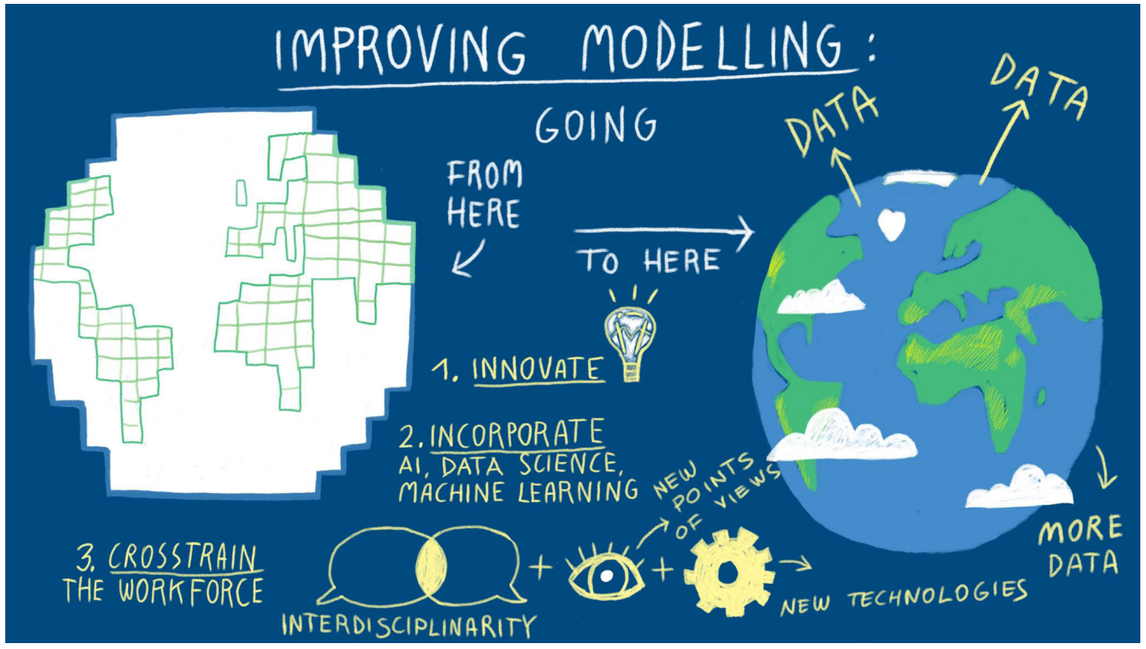
Background Story – Tell it with a Comic

by Sara Pasqualetto, Alfred Wegener Institute and International Coordination Office for Polar Prediction

Thinking of alternative ideas to get scientific results across is becoming a greater part of the science process. Not only for peer-reviewed publications but also when writing research proposals and managing science projects, communication plays a crucial and ever increasing role. The question often is: how to deliver my message to a larger audience, without losing important pieces in the process?

A team of researchers and artists thought about this and came up with a brilliant solution to make science fun and more accessible: On the occasion of the AAAS Annual Meeting in Seattle (see also PPP news item from 10 February 2020), artists from the RIVA Illustrations start-up company created amazing pieces of art, inspired by the scientific presentations at the meeting. APPLICATE coordinator and PPP Steering Group chair Thomas Jung was among the presenters of the session on *The Future of Earth's Climate: A World of Extremes?*, organized by the European Commission and the Executive Agency for Small and Medium-sized Enterprises (EASME). While Jung was discussing the APPLICATE project and its objectives and results, among the audience, the artist Fiammetta Ghedini transformed his words and science graphs into a drawing.

In an interview with Fiammetta Ghedini, who founded RIVA Illustration, we discuss with her what is behind this and many other illustrations created by her start-up, we talk about visual storytelling and the relation between science and art. Read the full article in the YOPP Background Stories.



Live drawing by Fiammetta Ghedini from the presentation "Frontiers in Earth System Modeling: Where Do We Go From Here?" at AAAS 2020.

07

Antarctic Meteorology and Climate Special Issue

by Jenny Lin, Advances in Atmospheric Sciences

The original article was published in Eurek Alert!

The Advances in Atmospheric Sciences special issue entitled, *Antarctic Meteorology and Climate: Past, Present and Future* presents latest findings from expanded and ongoing research efforts in Antarctic meteorology, weather prediction, climate variability and climate change.

The issue presents research conducted during the Year of Polar Prediction – an international effort by the World Meteorological Organization to improve predictions of weather, climate and sea-ice conditions in the Arctic and Antarctic. This collection of peer-reviewed papers provides evidence of variability and change in Antarctic environmental conditions, mostly based on enhanced observations carried out during the YOPP Special Observing Period in the Southern Ocean, the most extensive period of observations ever conducted in and around Antarctica.

More Reliable Weather Forecasts and Climate Predictions

YOPP efforts in the Southern Hemisphere stimulated additional research in Antarctic meteorology and climate by enabling increased data collection and enhanced computing power for modeling. The AAS special issue suggests that future Antarctic weather forecasts and climate predictions will be more reliable based on the combined new insights into the atmosphere, land surface, ocean conditions and sea-ice variability – ultimately making operations in Antarctica and the Southern Ocean safer.

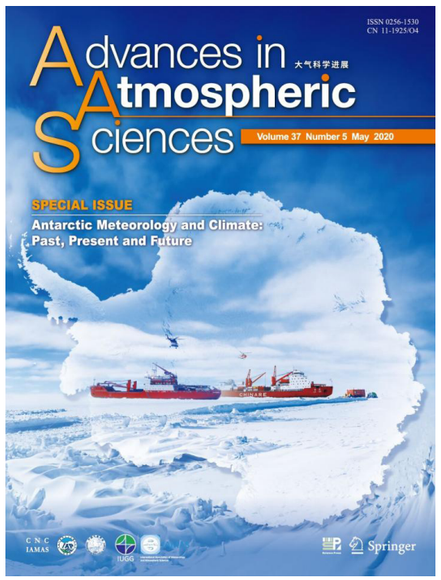
"*These studies make important contributions to our understanding of the weather and climate systems in the polar regions and can improve future climate projections while producing important information for policymakers*", said Ming Xue, an AAS editor-in-chief, and professor and director of the Center for Analysis and Prediction of Storms at the University of Oklahoma in Norman, Oklahoma.

The special issue also indicates that long-term weather and climate changes are already underway across Antarctica and the Southern Ocean with potentially far-reaching consequences, which will be the object of future research.

Predict the Future Antarctic Climate more Accurate

"*Climate change research in the Antarctic is relatively neglected compared to the Arctic*," said Jiping Liu, the issue's lead editor and associate professor at the University at Albany in Albany, New York. "*However, it's clear that climate change is already impacting the Antarctic and that studying the changes is vital, because it enables us to predict the future climate more accurately.*"

Signs of climate change in the Antarctic, added Liu, include a strong warming over the Antarctic Peninsula, a deepening of the Amundsen Sea low, rapid warming of the upper ocean north of the circumpolar current, an increase of sea ice since the late 1970s followed by a recent rapid decrease and accelerated ice loss from ice shelf/sheet during the same period



"*This is the second special issue published by AAS highlighting scientific progress in important areas addressed by the YOPP*", said Thomas Jung, professor at the Alfred Wegener Institute in Bremerhaven, Germany, and YOPP coordinator. "*In 2018, AAS also published a special issue focusing on the impact of Arctic change on Eurasian climate and weather.*"

08

Special Issue on the Societal Value of Improved Forecasting

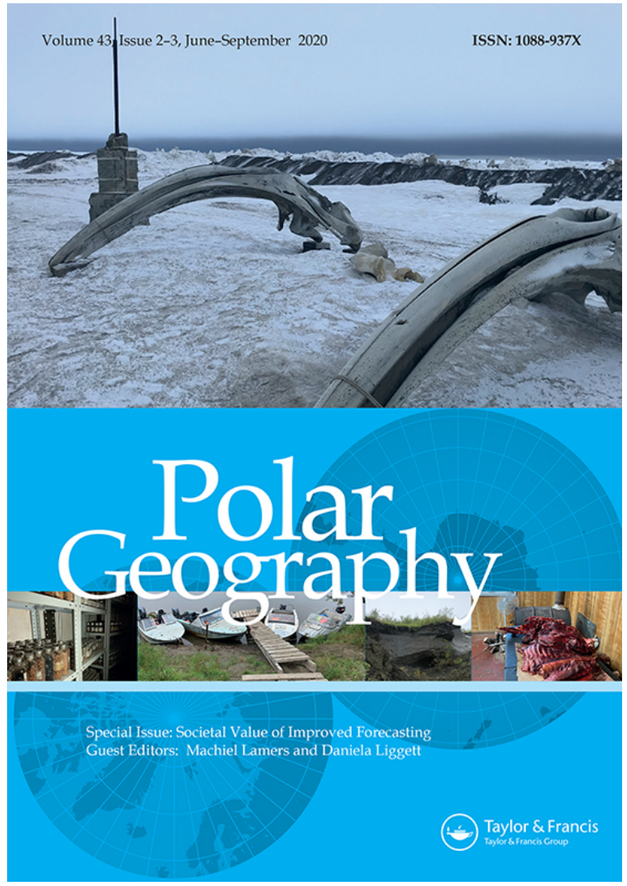
by Daniela Liggett, University of Christchurch, New Zealand

The academic journal Polar Geography has just published a special issue *Societal Value of Improved Forecasting* that compiles a range of papers detailing work that has been undertaken in conjunction with the PPP's Societal and Economic Research and Applications (PPP-SERA) Task Team.

PPP-SERA championed this special issue as a community-building effort that also aims at reaching out to stakeholders world-wide. The publications featured in this special issue showcase research results and perspectives on "*the use and potential improvement of WWIC [weather, water, ice and climate] services for the polar regions in an effort to translate scientific and technological advances into societal value*" (Lamers & Liggett, 2020). The authors examine the multiple and complex ways of producing and using WWIC information in the polar regions and shed light on who is involved in this process, what their information needs are, what kind of information systems and infrastructures are being utilized, how data is being managed, and how WWIC services are funded. To this end, regional case studies are included in this special issue and highlight how diverse the WWIC 'actorscape' is, and what current capabilities and constraints frame WWIC information provision and use.

There is increasing erosion of the duality of WWIC information users versus providers and an increase in users also producing weather and climate information and vice versa. This development seems to go hand in hand with a move away from nation states and the public sector as the main providers of WWIC service towards a more prominent role for the private sector in this space. Overall, the articles in this special issue address some important questions regarding the use of WWIC and user needs as well as provider priorities. But they also raise further questions that serve as a timely reminder that further work is needed on the effects shifts in the WWIC actorscape, infrastructure and funding landscape have for the continued and reliable provision of WWIC services, ideally with the aim of reducing risks and improving operational (and environmental) health and safety in the polar regions.

The Special Issue in Polar Geography, Volume 43 (2–3), 2020 can be found here.



09

Improving Weather, Water, Ice and Climate Information in the Canadian Arctic

The Canadian project *Community WWIC Uses and Needs* (CWWICUN) recently received YOPP Endorsement. CWWICUN looks at improving the weather, water, ice and climate information and services available to Canadian Inuit communities.

For people living in the Canadian Arctic, information on weather and ice conditions are crucial for planning their daily life and work. However, with the ongoing changes in climate and industrial development, weather, water, ice and climate (WWIC) information and services have become less unpredictable, posing a risk for Inuit and other northern residents. The CWWICUN project led by Gita Ljubicic, an Associate Professor in the School of Earth, Environment and Society at McMaster University (Hamilton, Canada), aims to better understand what Canadian Arctic communities need to inform safe travel and how the required information can be better accessed and communicated. Local research coordinators are facilitating surveys in their home communities, and responses will inform service providers and policy makers with the ultimate goal of improving WWIC information and service delivery from local to international scales.

More information on CWWICUN can be found on the project's website.

CWWICUN and other YOPP-endorsed projects can be found at the data base https://apps3.awi.de/YPP/endorsed/projects. *(kw/nm)*

Boats navigating sea ice during June break-up in Pangnirtung Fiord, Nunavut (photo: Gita Ljubicic).

10

YOPP Endorsement Open until 2021

Projects, initiatives and institutions that contribute to the aims of the Year of Polar Prediction are invited to request YOPP endorsement until the end of 2021. A 'blind' YOPP-endorsement process is now also available on request for competitive funding situations.

The Polar Prediction Project (PPP) and its flagship Year of Polar Prediction (YOPP) initiative provide a unique collaboration and coordination opportunity for researchers involved in increasing the understanding and improvement of polar environmental prediction. Projects, initiatives and institutions may seek endorsement from the PPP Steering Group. Benefits of YOPP endorsement include increased visibility of research activities (e.g., listing on the PPP website, featuring in *PolarPredictNews* newsletter); an international framework for research to help leverage support and funding; improved coordination between different activities; and enhanced networking and communication within the PPP/YOPP community. The opportunity for receiving YOPP endorsement has been extended until the end of 2021.

Blind YOPP Endorsement

A blind YOPP endorsement process has now been introduced. This new mechanism will allow people to request YOPP endorsement for competitive projects for which a funding decision is still outstanding. As for the regular YOPP endorsement, activities that request blind endorsement will receive a YOPP endorsement letter. However, to treat certain activities more confidentially, they will not be listed on the YOPP-endorsement page until funding is secured. Through the blind YOPP endorsement, it is also possible to preclude particular reviewers.

Institutional Endorsement

Institutional YOPP endorsement is also still available. Research institutes and operational forecasting centers whose activities contribute to the success of YOPP are invited to request institutional YOPP endorsement. This differs from the project YOPP endorsement in the way that it addresses general contributions to improving polar predictive skill rather than individual academic projects or programmes often sponsored through third-party funding. With the institutional endorsement, the PPP Steering Group provides the possibility for research consortia such as operational weather forecasting centres and academic institutions to link with the Year of Polar Prediction. *(kw/tj/jw)*

Further information can be found https://www.polarprediction.net/key-yopp-activities/yopp-endorsement/ or via email to office@polarprediction.net.

11

Two New Contributions to *Polar Prediction Matters*

Two new contributions to *Polar Prediction Matters* – the dialogue platform for users and providers of forecast in the polar regions – have been published. In *Risk and Reward*, Jennifer Ross summarizes on the risks of the currently ongoing Greenland ice sheet melting, and the rewards to reliably predict and prevent harmful conditions. As an expert in Arctic shipping and maritime industries, Thomas Viguier provides insights on why it is so important to have accurate ice and weather predictions on board and what challenges the currently available forecast software on the bridge are facing.

Risk and Reward

Today, the Earth's ice sheets are constantly losing mass because of climate change. With about 79% ice-covered surface, Greenland has the second-largest ice sheet worldwide, after Antarctica. Ongoing melting of the Greenland Ice Sheet strongly affects the Atlantic and Arctic oceans, through sea-level rise and iceberg release. This not only causes the global ocean circulation to destabilize, but the water masses and numbers of icebergs released into the sea also bear a number of risks for human and environment.

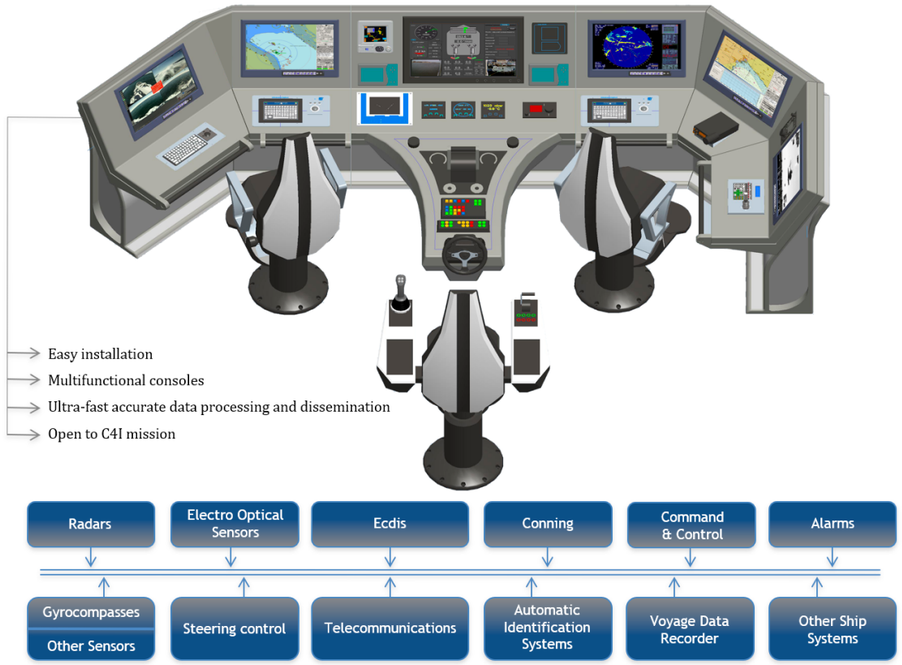
In this contribution to Polar Prediction Matters, Jennifer Ross, PhD student at the University of Sheffield, describes the risks of sea-level rise and iceberg abundance in the Nordic Seas caused by the ongoing Greenland Ice Sheet melt. While there are fluctuations between seasons, the general trend of increased numbers of icebergs and meltwater input over the years is likely to further rise. There is thus a need to better understand and predict the risks that are associated with both, enhanced flooding and potential impacts to coastal areas, as well as hazards for ships and offshore platforms in the open ocean. To reliably forecast risks and thus help prevent hazards in the open ocean will be most rewarding to scientists and forecasters able to support environmentally safe operations in the northern regions. *(kw/nm)*

Find Jennifer Ross' Polar Prediction Matters article here.

Ice and Weather Forecast Software on board Merchant Vessels

Shipping in polar regions is challenged by extreme ice and weather conditions. Over the past years, electronic ice and weather forecast software has been introduced and is nowadays the preferred tool for navigation from the bridge. It not only provides information about the current weather and ice situation but displays forecasts to support officers in their decision-making process.

In her new contribution to Polar Prediction Matters, Jennifer Ross writes: „Icebergs have been of public interest since the sinking of the RMS Titanic in 1912, off the coast of Newfoundland, Canada. While few ships sink from collisions with icebergs in this region nowadays, due mainly to daily forecasts of iceberg activity, icebergs still pose a direct risk to shipping and stationary platforms in the North-West Atlantic." (Photo: Darrel Swift, University of Sheffield)



Example of an Integrated Bridge System (IBS) (source: http://www.gemrad.com/integrated-bridge-solutions/).

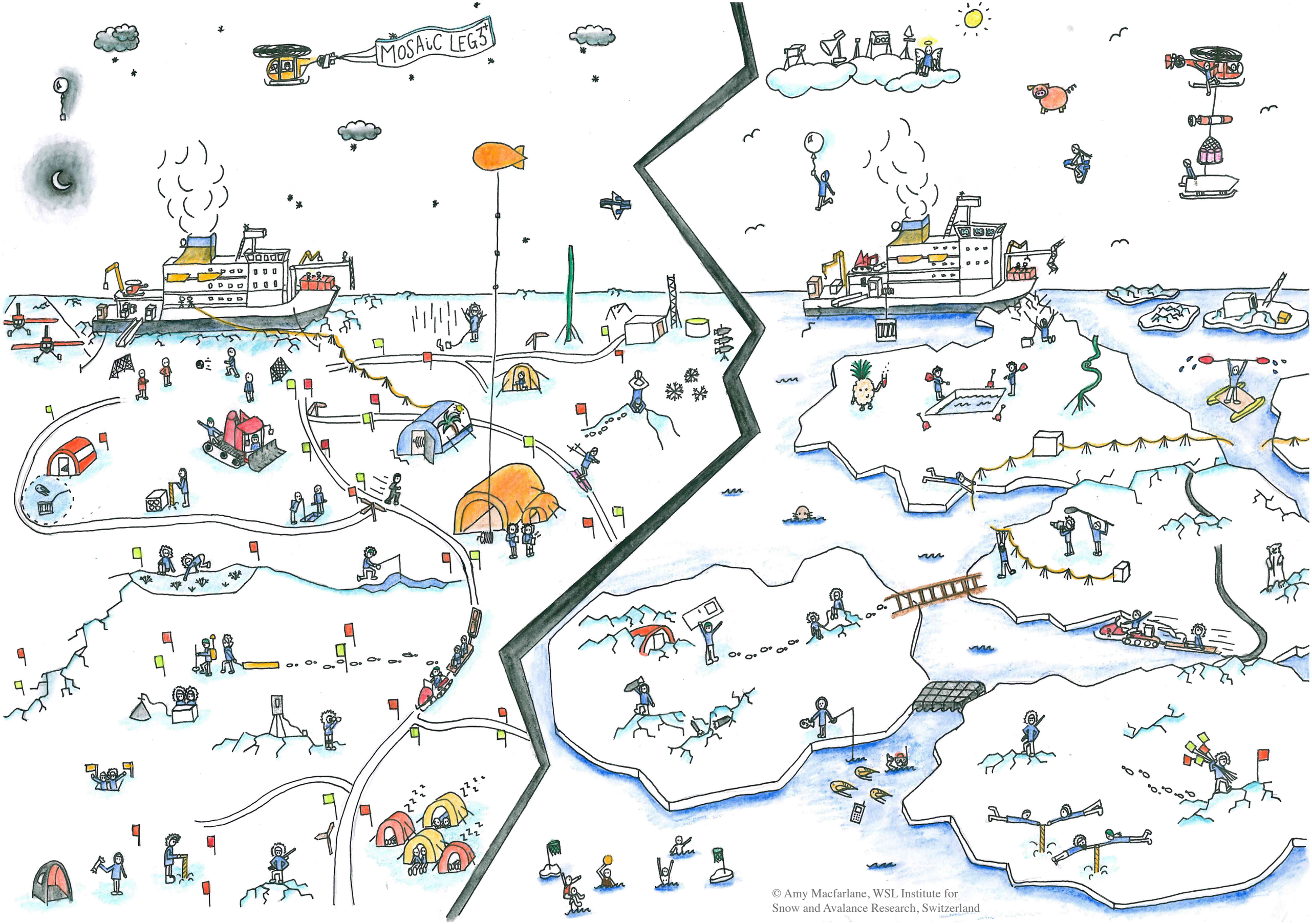
Focused on the interactions between the final users and the software application, Thomas Viguier, an Arctic researcher working at the Icelandic Arctic Cooperation Network in Akureyri, Iceland, explains the concept, benefits and challenges of the Integrated Bridge System (IBS). "*In the IBS approach, there is a clear tendency in making data more accessible through software applications to maritime and shipping professionals, aiming to reduce risk related to navigation in polar regions.*" Yet, often the available software to display weather and ice forecasts appears complex, lacking user friendliness. Involving maritime end users to develop future on-board systems will be crucial to rapidly integrate new tools for successful use by the shipping industry. *(kw/tv)*

Find Thomas Viguier's Polar Prediction Matters article here.

About: Polar Prediction Matters

Polar Prediction Matters is a non-peer reviewed forum initiated as a means 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. It is hosted by the Helmholtz Association of German Research Center's blog portal and maintained by the International Coordination Office for Polar Prediction.

Polar Prediction Matters home page:
https://blogs.helmholtz.de/polarpredictionmatters/



12

The IcePod – Three New Bonus Episodes

by Kirstin Werner and Sara Pasqualetto, Alfred Wegener Institute and International Coordination Office for Polar Prediction

Three more bonus episodes of *The IcePod*, the official podcast for the Year of Polar Prediction to support the MOSAiC one-year ice drift, are available through various podcast platforms. In the bonus episode published in May 2020, YOPP podcasters Kirstin Werner and Sara Pasqualetto met with leader of the MOSAiC ice drift Markus Rex to talk about his impressions during leg 1.

In a series of two episodes about the YOPP Targeted Observing Periods, or TOPs, published in June 2020, Gunilla Svensson and Thomas Jung reveal insights on how the Polar Prediction Project came into life, about the YOPP Targeted Observing Periods and the YOPPSiteMIP effort as one of the major current activities of PPP, and about the challenges that still lay ahead of YOPP.

Bonus Episode Two – Markus Rex

When the world was still in order and people were allowed to hang out in cosy offices, we met with Markus Rex, leader of the MOSAiC ice drift, who came to Bremerhaven for two days in February to join the YOPP Science Workshop at the Alfred Wegener Institute.

Markus Rex is one of those people who always manage to sleep well, even when the stress level is high. In his interview with us, he talks about the greatest challenges, nicest moments and biggest surprises during leg 1 of the MOSAiC expedition. Luckily, coordinating MOSAiC means not only work to him: Finding those rare moments of solitude skiing on the ice floe, with the full moon enlightening the out-of-the-world Arctic landscape gives him reward and energy. At the moment, Markus is preparing for his return to the Arctic with leg 4. As excited as he is to see the ice camp in daylight, we wonder: will he be able to sleep even during polar day?

Photos of this and next page:
Markus Rex – Esther Horvath/Alfred Wegener Institute
Gunilla Svensson – Eva Dalin/Stockholm University
Thomas Jung – Martina Buchholz/Alfred Wegener Institute

About: The IcePod

The IcePod is the podcast about polar science and the people. We'll talk to scientists who went on board Polarstern, the German research icebreaker, for the biggest research expedition in the Arctic. The podcast is produced in collaboration with the Alfred Wegener Institute and Radio Weser.TV. **The IcePod** is the official podcast of the Year of Polar Prediction www.polarprediction.net

Editorial responsibility: Kirstin Werner and Sara Pasqualetto

Where to find *The Icepod*:
The IcePod webpage https://theicepodcast.home.blog/ and on various podcast platforms, e.g., Spotify, Apple Podcasts, or Castbox (no sign up needed).

Bonus Episode Three - Gunilla Svensson

Gunilla Svensson is a meteorology professor at Stockholm University, Sweden. She is also member of the Polar Prediction Project's Steering Group and leads the YOPP Processes Task Team. Within her role, she coordinates the YOPPSiteMIP project and the currently ongoing YOPP Targeted Observing Periods, or TOPs, aligned with MOSAiC.

Wait a minute – what is YOPPSiteMIP? And what is a Targeted Observing Period? Well, listen to our new bonus episode of *The IcePod* where we speak with Gunilla about one of the key activities for the Year of Polar Prediction.

In our first episode of what we call the TOP series of *The IcePod*, Gunilla explains not only what these pan-Arctic campaigns of enhanced observations are meant for. She also talks about how the TOP studies of warm air intrusions from the mid-latitudes to the central Arctic are impacted by COVID-19. And: why Polarstern's current location in the Arctic is a paradise for every Arctic scientist.

Observations are just one part of the puzzle, and so is modelling. But blending the two allows to see the bigger picture. This is done within the YOPP Supersite Model Intercomparison activity – which is a long title so we just call it YOPPSiteMIP. Here, atmospheric and sea-ice data from across the Arctic including MOSAiC, and respective modelling output are currently simultaneously examined.

Bonus Episode Four – PPP Captain Thomas Jung

Here is the second episode on the YOPP Targeted Observing Periods, or TOPs. We speak to Thomas Jung, head of the section Climate Dynamics at the German Alfred Wegener Institute and professor for Physics of the Climate System at the University of Bremen. Even more important, as the chair of the Polar Prediction Project's Steering Group, he is the captain and structured mind behind YOPP and PPP.

His ability to chair a meeting even with fever from his bed not only provides him with all the skills needed to steer the Polar Prediction Project during a pandemic, but has been the ultimate test of his leadership skills. Keeping a healthy balance between management and science is probably his secret to success, in addition to creating extensive but ultrapractical mindmaps and building an international network across the academic community and forecasting experts.

Thomas was also the winner of our YOPP TOP Twitter challenge. How did he overcome the jumpiness of forecast? Here, he unveils his secret: Well, it's just like planning your next barbecue weekend (something we all look forward to during this COVID-19 summer).

Take your time between an ice cream and a cold drink and listen to this episode for a look behind the scenes of YOPP, how the project came to life and how it still surprises its master of mind maps and virtual meetings.

13

YOPP Sea-Ice Experts: Farewell and Welcome

by Kirstin Werner and Helge Goessling, both Alfred Wegener Institute

For over eight years, Greg Smith has supported the Polar Prediction Project with his knowledge and expertise to move forward capabilities in sea-ice prediction. Moving on to other duties within Environment and Climate Change Canada (ECCC), he recently decided to step down from the PPP Steering Group. His co-lead in the YOPP Sea Ice Task Team is taken over by Amy Solomon from the University of Colorado and U.S. National Oceanic and Atmospheric Administration (NOAA).

As a research scientist in ECCC's Environmental Numerical Prediction Research department, Greg Smith was ideally suited to provide his profound expertise on high-resolution ice-ocean modelling and forecasting to the PPP Steering Group. In collaboration with the Canadian Ice Service, he has helped much in fostering the transfer of new model sea-ice forecast products into operations. Due to new duties within ECCC, Greg Smith has now stepped down from PPP SG as well as from co-leading the YOPP Task Team on Sea-Ice Prediction and Verification.

For the remainder of the Polar Prediction Project until end of 2022, Amy Solomon will lead the task team together with Helge Goessling from the German Alfred Wegener Institute. Amy is a senior research scientist at the Coorperative Institute for Research in the Environmental Sciences (CIRES) at the University of Colorado in Boulder, Colorado, and the NOAA Earth System Research Laboratory (ESRL). Her interest is in Arctic short-term forecasting, meteorology and climate, with a special focus on cloud properties and processes and interactions of clouds with the boundary layer and surface.

The PPP Steering Group and International Coordination Office are grateful for Greg's invaluable contributions to move forward various PPP and YOPP activities and thank him for his continuous support to improve Arctic predictions.

Photos of this page:
(upper) For over eight years, Greg Smith has supported PPP and YOPP. Due to other duties within Environment and Climate Change Canada, he recently stepped down from the PPP Steering Group (photo: Greg Smith).

(bottom) Amy Solomon from the University of Colorado and the U.S. National Oceanic and Atmospheric Administration (NOAA) takes over Greg's co-lead in the YOPP Sea Ice Task Team (photo: Amy Solomon).

Fortunately, Greg will continue his activities in another task team that is currently preparing the YOPP Final Summit that will take place from 2 to 6 May 2022 in Montréal, Canada.

A warm welcome to Amy Solomon, who has been part of the PPP community for a long time and brings broad and deep knowledge and experience to the Sea Ice Task Team. We are very much looking forward to working with her on polar prediction science.

14

Sharing Geoscience Online – Joint YOPP-APPLICATE Session at EGU2020

by Kirstin Werner, Alfred Wegener Institute and International Coordination Office for Polar Prediction

In response to the COVID-19 pandemic, a joint YOPP-APPLICATE live text chat took place on 8 May 2020, as part of this year's European Geosciences Union (EGU) General Assembly #shareEGU20 online experiment.

Europe's largest and most prominent geosciences conference, the EGU General Assembly, had to explore new grounds this year. Due to the COVID-19 pandemic, the Vienna happening which usually attracts more than 16,000 scientists from all over the globe had to be moved online. A week-long series of live text chats, closely aligned to the originally planned physical science sessions, symposia, debates and Townhall events, was held from 4 to 8 May 2020.

Joint YOPP-APPLICATE Session

To exchange knowledge and share results, a joint YOPP-APPLICATE session *Exploiting Polar Observations to Improve Weather and Climate Predictions* was scheduled in the form of a #stayathome live chat on 8 May 2020. Presenters had the chance to upload their material two weeks prior to the event to give the community a chance to look at in preparation of the chat. The live text exchange was organized by Luisa Cristini, APPLICATE project manager and convener of the session, in the way that three presenters at a time were asked to provide main outcomes of their research in the chat window. Followers of the chat could then type their questions and remarks. Fourteen presenters were available for the discussions with, in total, more than sixty people following the session. Presentations resembled a manifold mixture of activities and scientific results from the YOPP and APPLICATE projects, in addition to contributions from other projects and institutes, with a focus on how to best capitalize on existing and additional Arctic and Antarctic observations to improve forecast initial states, verification, and model physics, and to optimize the future polar observing system.

Silent but Busy

Compared to the usual noise level, it was a silent EGU2020 this year – except one would turn on the radio while actively discussing or shyly following the soundless text chat conversation. Nevertheless, according to the EGU2020's website, the experimental format turned out to be a great success throughout the week, with more than 18,000 abstracts presented in about 700 scientific sessions. 26,219 individual users joined the 721 live text chats and posted 200,400 messages. The EGU Programme Committee and the organizing team are more than satisfied: "*We are very grateful and proud to see how our community has turned the challenges of the pandemic into opportunities and we are sure that part of these achievements will continue and contribute to greener events in the future.*"

The material of the YOPP-APPLICATE session can still be viewed and downloaded at https://meetingorganizer.copernicus.org/EGU2020/session/36745.

15

YOPP at APECS Workshop *Antarctic Science: Global Connections*

by Clare Eayrs, New York University Abu Dhabi

YOPP in the Southern Hemisphere (YOPP-SH) researchers will be contributing to an APECS Online Workshop *Antarctic Science: Global Connections* taking place from 11 to 13 August 2020 alongside the online events for the in-person cancelled Scientific Committee on Antarctic Research biennial Open Science Conference and Delegates Meeting (SCARCOMNAP2020). A live session of the YOPP Podcast *The IcePod* will be broadcasted on 11 August, 10:30 GMT.

The APECS workshop aims to bring together polar Early Career Researchers (ECRs) from around the globe to network, engage with topics presented at the workshop through a series of plenary and workshop sessions, and to potentially develop new research ideas and collaborations to take forward into their careers in the future.

YOPP Session (11 August 15:00 GMT)

The YOPP-SH session on **11 August at 15:00 GMT** offers an overview of some of the key activities associated with the YOPP in the Southern Hemisphere (YOPP-SH) efforts. The presenters will introduce a variety of YOPP-SH activities and provide an opportunity for ECRs to find out how they can use weather and ice forecasts for their research, what kind of meteorological data are available, and ways to contribute to YOPP and PPP.

1. YOPP-SH Overview: ***David Bromwich***, the YOPP-SH Task Team leader, will kick-off the session with an overview of YOPP-SH and the Polar Prediction Project.

2. YOPP Communications: ***Sara Pasqualetto*** will describe how the International Coordination Office works together with the participating members of the Polar Prediction Project and other international programs to disseminate Polar Prediction stories and activities.

3. SIPN South: ***François Massonnet*** will provide an update on sea-ice prediction in the Southern Ocean and how realistic prediction exercises are being aligned with YOPP's Special Observing Periods. François leads the Sea Ice Prediction Network South (SIPN South) initiative.

4. ANTCLIMNOW: ***Tom Bracegirdle*** will describe a new group, the Near-term Variability and Prediction of the Antarctic Climate System (ANTCLIMNOW) that aims to answer fundamental science questions (as identified by the SCAR Horizon Scan), relating to Antarctic Climate variability.

5. Antarctic AWS System: ***Taylor Norton***, ***Sophie Orendorf***, and ***Matthew Lazzara*** will report on the annual activities and status of the Antarctic Meteorological Research Center (AMRC), Automatic Weather Station (AWS), and Antarctic Mesoscale Prediction System (AMPS) and how these contribute to the YOPP Special Observing Period in the Southern Hemisphere.

6. Gone with the Wind – Providing Forecasts to the Polar Windsled Expeditions: ***Sergi Gonzalez*** will describe the atmospheric observations he took across the data-poor Antarctic Plateau using a zero-emissions windsled.

7. ASPeCT observations: ***Marilyn Raphael*** will describe the ASPeCT sea-ice program and how this program complements and contributes to YOPP and other international science programs.

8. YOPP Data Portal: ***Siri Jodha Khalsa*** will close the session with an introduction to the YOPP Data Portal and information on how to link and access data sets collected across the YOPP projects.

Live Session of *The IcePod* (11 August, 10:30 GMT)

In addition, Kirstin Werner and Sara Pasqualetto from the YOPP International Coordination Office will interview Vicki Heinrich, a psychology PhD candidate at the University of Tasmania, Hobart, Australia, in a live broadcast of *The IcePod* on 11 August at 10:30 GMT. Through surveys, interviews and experiments, Vicki's PhD project examines how, when, and why people use weather and climate information in and around Antarctica.

Weather observer and psychology PhD student Vicki Heinrich will be on the live broadcast of *The IcePod* on 11 August 2020 (photo: Peter Hargreaves)

Vicki is interested in how we may apply metacognition, social, and behavioural theories to better understand people's weather-related risk perception and decision-making and ultimately assist people in making safer weather decisions. This research is endorsed by YOPP (@UWCIAntarctica).

Further details on the schedule, a list of presenters, and information on how to register for the event will be available from the APECS website.

16

This Year A Virtual AGU Fall Meeting

This year's AGU Fall Meeting will mostly be a virtual event held from 7 to 11 December 2020.

Meeting organizers state on their website that even though mostly virtual, the AGU Fall Meeting 2020 "*remains the global convening meeting for the Earth and space sciences community*". Featured meeting content will be held during the original 7 to 11 December dates, with additional content scheduled to best meet the needs of international attendees around the world. The meeting will include real-time sessions, networking opportunities and poster hall time. As a special offer, there will be recorded sessions that can be watched, or even 'binge-watched', at anyone's convenient time. Convergent themes including global science policy, data, natural hazards and climate science will be prominently featured.

There are quite a number of sessions that are relevant to the Year of Polar Prediction. A list of interesting sessions can be found here.

To submit an abstract, you need to be an AGU member. A non-refundable abstract processing fee will be charged, which is separate from the registration fee, this year reduced by about fifty per cent from the usual in-person fee, with particularly lowered rates for graduate students. *(kw)*

Abstracts can be submitted by 29 July 2020 at the following link: https://www.agu.org/Fall-Meeting/2020/Present/Abstracts.

17

2021 Arctic Frontiers – Building Bridges on Arctic Weather and Climate Prediction

During the 2021 Arctic Frontiers Science Conference, the Year of Polar Prediction and partners will hold a session entitled *Advanced Prediction Capabilities for the Arctic and Beyond*.

Since Arctic Frontiers started out in 2006, this northernmost Nordic winter conference has steadily grown to what is now 'the event' when it comes to a pan-Arctic forum for dialogue and exchange between science, government and industry. Escorted by beautiful northern lights, Tromsø in February is usually the place where new partnerships across nations, generations and ethnic groups are being built. And so is the title of the 2021 Arctic Frontiers Science conference – *Building Bridges* – which is scheduled from 1 to 4 February 2021.

Session by YOPP and Partners

The session on *Advanced Prediction Capabilities for the Arctic Region and Beyond* organized by YOPP, WMO, MET Norway, ECCC, and DMI capitalizes on and consolidates recent scientific accomplishments for advanced probabilistic climate, weather and Arctic sea-ice forecast information, tailored to key social, environmental and economic needs. Welcome are any presentations on activities and results from YOPP-endorsed projects as well as contributions from other projects that focus on Arctic environmental monitoring, prediction and services for safe and sustainable Arctic operations as well as on basic science, observations, model development and implementation. For further information on the session organized by YOPP and partners, please check the session proposal site.

Abstracts can be sumitted here. The Arctic Frontiers secretariat will closely monitor the situation with COVID-19 and develop an optimal technical solution and format for the conference. As of now, the meeting will likely combine elements of a traditional in-person and digital conferences, with a possibility to participate online. *(kw)*

Further information and updates on https://www.arcticfrontiers.com/pillar/science/.

Since 2006, the Arctic Frontiers Conference takes place in Tromsø, Norway (photo: Kirstin Werner/Alfred Wegener Institute).

18

10th International Workshop on Sea-Ice Modelling, Assimilation, Observations, Predictions and Verification

by the International Ice Charting Working Group (IICWG)

The *10th International Workshop on Sea-Ice Modelling, Assimilation, Observations, Predictions and Verification* will be held from 20 to 22 October 2020 simultaneously in Toulouse, France, and Montréal, Canada. The workshop is supported by the Year of Polar Prediction.

This workshop aims to build on a series of successful workshops by the IICWG Data Assimilation Working Group to advance international capabilities for sea-ice prediction on timescales from hours to a season. Cross-cutting issues in sea-ice modelling and assimilation and how deficiencies of current systems can be more efficiently diagnosed and addressed will be discussed. General topics considered appropriate for this workshop include:

- Sea-ice observations and uncertainties;
- Sea-ice data assimilation (methods and results);
- Sea-ice model parameterizations and coupling to ocean and atmosphere models;
- Verification approaches for sea-ice analyses and forecasts;
- Recent research to sea ice operation transfer; and
- Automated prediction systems.

The workshop is jointly organized by the International Ice Charting Working Group (IICWG), the Copernicus Marine Environment Monitoring Service (CMEMS), OceanPredict (former GODAE OceanView, GOV) and the Coordination & Support Action KEPLER by the European Commission. It will be arranged around a few keynote and contributed presentations with ample time for discussion.

The workshop will be held simultaneously in Toulouse and Montréal via video conference facilities. Participants are asked to mention in which place they will physically attend the workshop.

More information is available at https://nsidc.org/noaa/iicwg.

19
NEW PUBLICATIONS

More Sounding Data to Help Improving Forecasts over the Southern Ocean

In a study by Qizhen Sun et al., Southern Ocean radiosonde and unmanned aerial vehicle sonde observations have been assimilated to improve the Polar WRF Model.

Weather forecasting in the Southern Ocean and Antarctica is a challenge due to the lack of observations that can be assimilated in numerical weather prediction (NWP) models. As observations are expensive and logistically challenging, it is important to evaluate the benefit that additional observations could bring to NWP. Atmospheric soundings applying unmanned aerial vehicles (UAVs) have the potential to supplement conventional weather balloon radiosonde observations. Authors of this paper used UAV and radiosonde observations from an *RV Polarstern* cruise in the ice-covered Weddell Sea in austral winter 2013 to evaluate the impact of their assimilation in the Polar version of the Weather Research and Forecasting (Polar WRF) model. The study indicated that assimilation of sounding data from both radiosondes and UAVs improves the analyses of air temperature, wind speed, and humidity at the observation site for most of the time. Further, the impact on the results of five-day long Polar WRF experiments was often felt over distances of at least three hundred kilometers from the observation site. Due to the limited vertical extent of UAV observations, the impact of their assimilation was limited to the lowermost one-to-two kilometer layer, and assimilation of radiosonde data was more beneficial for modeled sea-level pressure and near-surface wind speed. *(kw)*

Sun, Q., Vihma, T., Jonassen, M.O., Zhang, Zh. 2020: Impact of Assimilation of Radiosonde and UAV Observations from the Southern Ocean in the Polar WRF Model. Advances in Atmospheric Sciences, doi: 10.1007/s00376-020-9213-8

Review of Forecast Skills for Weather and Sea Ice in Supporting Arctic Navigation

In this review paper associated with the Japanese Arctic project (ArCS), Jun Inoue describes the current state of knowledge to predict weather, sea ice, and ocean waves under extreme atmospheric conditions the changing Arctic Ocean is currently facing.

The changing Arctic Ocean is characterized by diminishing sea-ice extent. Uncertainties in weather and sea-ice forecasts must be taken into consideration in Arctic shipping. Extremely developed cyclones, unexpectedly high ocean waves, and rapid sea-ice drift make navigation difficult. How state-of-the-art forecasts produced by operational weather centers can be used correctly and effectively by end users (e.g., ship crews and operation companies) is an emerging issue. In this synthesis paper, characteristics of the predictabilities of weather, sea ice, and ocean waves under extreme atmospheric conditions over the Arctic Ocean are presented, with particular focus on the impact of additional radiosonde observations on reducing uncertainties in forecasts. The usefulness of an on-board tool to share forecasting information with the ship crew and researchers is also demonstrated, and is recognized as an achievement of the Japanese Arctic research project. Finally, remaining issues with respect to a sustainable Arctic observing network are discussed. *(kw)*

Inoue, J. 2020: Review of Forecast Skills for Weather and Sea Ice in Supporting Arctic Navigation. Polar Science, doi: 10.1016/j.polar.2020.100523

Sea-Ice Information and Forecast Needs of Maritime Industry

The paper by Penelope Wagner et al. summarizes sea-ice information and potential forecast needs and challenges for polar regions stakeholders.

Profound changes in Arctic sea ice, a growing desire to utilize the Arctic's abundant natural resources, and the potential competitiveness of Arctic shipping routes, all provide for increased industry marine activity throughout the Arctic Ocean. This is anticipated to result in further challenges for maritime safety. Those operating in ice-infested waters require various types of information for sea ice and iceberg hazards. Ice information requirements depend on regional needs and whether the stakeholder wants to avoid ice all together, operate near or in the Marginal Ice Zone, or in areas within the ice pack. An insight into user needs demonstrates how multiple spatial and temporal resolutions for sea-ice information and forecasts are necessary to provide information to the marine operating community for safety, planning, and situational awareness. Although ship operators depend on sea-ice information for tactical navigation, stakeholders working in route and capacity planning can benefit from climatological and long-range forecast information at lower spatial and temporal resolutions where the interest is focused on open-water season. The advent of the Polar Code has brought with it additional information requirements, and exposed gaps in capacity and knowledge. Thus, future satellite data sources should be at resolutions that support both tactical and planning activities. *(kw)*

Wagner, P.M., Hughes, N., Bourbonnais, O., Stroeve, J., Rabenstein, L., Bhatt, U., Little, J., Wiggins, H., Fleming, A. 2020: Sea-ice information and forecast needs for industry maritime stakeholders. Polar Geography, doi: 10.1080/1088937X.2020.1766592

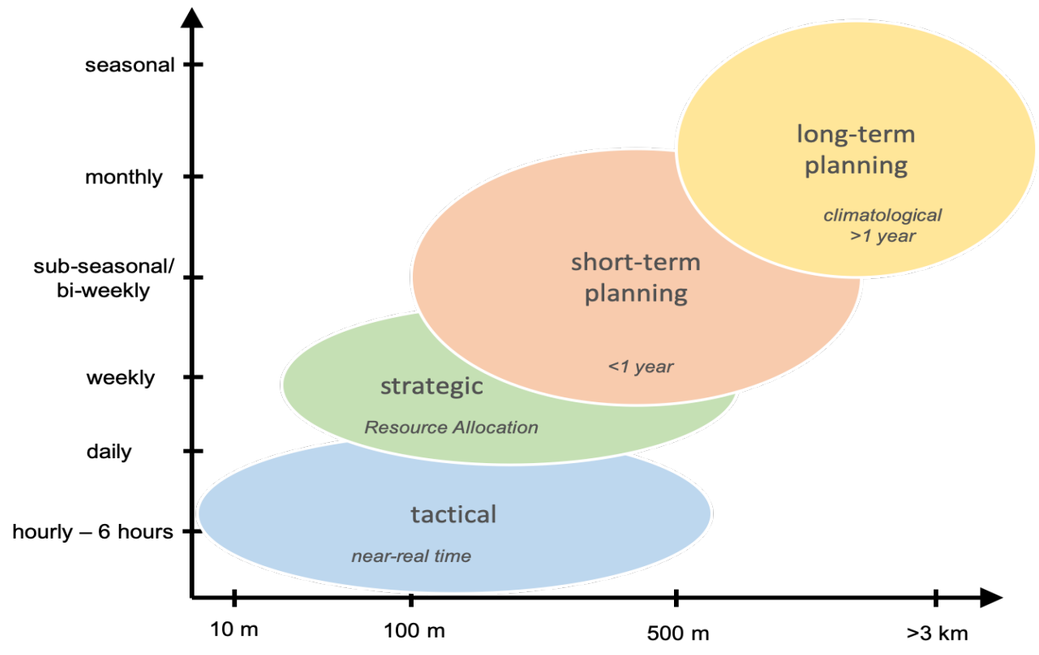


Figure after Wagner et al. (2020) illustrates the range of typical spatial and temporal scales of information required by users (source: re-drawn after Wagner et al., 2020, figure 3, by YOPP International Coordination Office).

20

YOPP-*endorsed*! – the *DACAPO-PESO* project

Interivew: Kirstin Werner, Alfred Wegener Institute and International Coordination Office for Polar Prediction

YOPP endorsement is available for projects, programmes and initiatives and also for institutions and operational centers that contribute to the Year of Polar Prediction's goals to improve weather and sea-ice forecasts in polar regions. More than eighty projects, programmes and initiatives already received project endorsement from YOPP.

The YOPP-endorsed *DACAPO-PESO* project stands for *Dynamics, Aerosol, Cloud and Precipitation Observations in the Pristine Environment of the Southern Ocean*. It is a long-term deployment of a suite of ground-based remote-sensing instruments: the Leipzig Aerosol and Clouds Remote Observations System (LACROS) which is operated by the Leibniz Institute for Tropospheric Research (TROPOS) in Leipzig, Germany. DACAPO-PESO is part of a series of LACROS measurement campaigns. With the same suite of instruments, a continuous dataset of more than one and a half years was obtained from the anthropogenically characterized, northern-hemispheric midlatitude site in Leipzig, Germany, and from a dust-laden, northern-hemispheric subtropical site in Limassol, Cyprus. Based on these two and another dataset from Punta Arenas,Chile, the TROPOS team investigates the relevance of aerosol-cloud-dynamics interaction on the characteristics of clouds and precipitation. We spoke to DACAPO-PESO project PI and meteorologist Patric Seifert.

Dr. Seifert, what is the *DACAPO-PESO* project about?

With *DACAPO-PESO*, we study the relevance of aerosol-cloud-dynamics interaction on the characteristics of clouds and precipitation in the Southern Hemisphere, in Chile. The Leipzig Aerosol and Clouds Remote Observations System (LACROS) is deployed on the campus of the University of Magallanes (UMAG) in Punta Arenas. LACROS comprises active remote sensing with different lidar, radar and radiation sensors. Local partners of UMAG contribute with additional lidar and radiation observations and radiosonde launches. In addition, the University of Leipzig contributed, until September 2019, with a 94-GHz cloud radar. Furthermore, ten kilometers west of the LACROS field site, on the nearby 623-m high peak of the Cerro Mirador mountain, we have installed an aerosol in-situ site, where cloud-relevant aerosol parameters, such as the concentration of cloud-condensation nuclei (CCN) and ice-nucleating particles (INP) are recorded.

Our measurements are accompanied by meso-scale numerical model simulations of the ICON model, the Icosahedral Nonhydrostatic model operated by the German Weather Service which includes aerosol-cloud interaction and sophisticated microphysics.

When did *DACAPO-PESO* start and where are you right now in the project's duration?

Our measurements in Chile launched on 27 November 2018 aligned with the YOPP Special Observing Period in the Southern Hemisphere, but preparations for the project already started back in June 2017. Since the start of the observations, our instruments have worked continuously, which will hopefully be the case until the yet open end of the campaign – depending on the further development of the COVID-19 crisis that determines the date we can travel to Punta Arenas to conclude the measurements and return LACROS back to its hometown of Leipzig.

Southward view of the LACROS site on the premises of UMAG in Punta Arenas. In the white container to the left of the two fenced LACROS containers the lidar of UMAG is operated (photo: Martin Radenz, page 38 photo credit: Patric Seifert).

What kind of measurements and investigations have been carried out?

The continuous measurements of LACROS and the ones from our partners are dedicated to the observation of aerosol, clouds, precipitation and the inter-connecting atmospheric dynamics. We are aiming to collect an as-complete-as-possible continuous time series of these parameters for the pristine region of the southern-hemispheric midlatitudes, which is known to be characterized by very low aerosol load in the free troposphere. The results will be evaluated against LACROS datasets from Leipzig and Cyprus in order to obtain a statement on the role of aerosol perturbations for cloud and precipitation processes.

Who is the *DACAPO-PESO* team?

The central team around *DACAPO-PESO* is from TROPOS, but it consists also of local partners from UMAG and from the University of Leipzig. Since the beginning, we have been experiencing great logistical and scientific support from UMAG, in particular by Felix Zamorano and Boris Barja, both are researchers at the UMAG Atmospheric Physics Laboratory. At the University of Leipzig, the team around Prof. Heike Kalesse (Arctic Science Division) is investigating aerosol-cloud interaction processes from both the observational and the modeling perspective.

Where did the funding come from?

The expenses for the infrastructure and operation of the instruments are entirely covered by internal funds within TROPOS. UMAG gratefully contributed a lot of administrative efforts and on-site support to realize this project. Some involved PhD students are funded internally by TROPOS, but we also receive considerable funding for research staff from research foundations.

How does *DACAPO-PESO* contribute to improve the polar prediction system?

Punta Arenas is at the gateway to the Antarctic vortex; it is one of the few places in the southern hemispheric midlatitudes where meridional transport of air masses to and from Antarctica can be documented with reasonable logistical efforts. The polar system of the Southern Hemisphere and especially the clouds therein are still puzzling to researchers. The radiative budget simulated by models differs strongly from the one measured by satellites. Clouds are suspected to explain a considerable part of this difference.

DACAPO-PESO will help to clarify the contribution of aerosols and dynamics on the cloud properties, in particular the phase partitioning in clouds. Having available LACROS datasets from different locations to compare to, we will be able to show that it is of relevance to include aerosol-cloud interaction in model simulations in order to accurately reproduce local cloud and precipitation conditions.

What are the most exciting results from your study? And what is the most exciting part in the project for you personally?

The observations document events of atmospheric rivers of moisture toward the Antarctic as well as polar-air outbreaks towards the midlatitudes. Down to temperatures of slightly above -40°C, we see the extraordinarily high amount of supercooled liquid water that makes the atmosphere over Punta Arenas so unique compared to northern-hemispheric midlatitude sites. We see that ice is formed by interaction with local aerosols already at temperatures close to 0°C when the clouds are connected to the planetary boundary layer. In free-tropospheric clouds, ice formation is much weaker.

For us, it has been very astonishing how the intensive Australian forest fire season from end of 2019 to beginning of 2020 turned the clean, pristine atmosphere over Punta Arenas into an aerosol burdened environment, and this continues to be the case.

Can interested people freely access the data now?

We are right now working on a first publicly available version of a synergistic product from our observations, which will become accessible by August 2020 via the European Union Aerosol, Clouds, and Trace Gases Research Infrastructure (ACTRIS) subproject Cloudnet (https://cloudnet.fmi.fi/). The LACROS datasets from Leipzig and Cyprus are already available there.

What are next steps within *DACAPO-PESO*? Will there be another LACROS field campaign?

Currently, we are in the final phase of the comparative study of the datasets from Leipzig, Cyprus and Punta Arenas – which is one of the main goals of the project. Also, we need to return LACROS back home to Leipzig as soon as COVID-19 allows. In spring 2021, the LACROS lidar system is scheduled to be deployed for observations of aerosol and clouds at the southern tip of New Zealand. There, we will document differences in the aerosol and cloud conditions between air masses coming from the dust-laden Australian continent and from the clean, pristine polar region of the western Southern Ocean.

How to follow the project and what else should the polar prediction community know about *DACAPO-PESO*?

We are running a web page https://dacapo.tropos.de where the most relevant information is provided and regular updates are given. And people should keep an eye open for *DACAPO-PESO* related research articles which will show up in the not-too-far future.

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Upcoming Online Events

31 July – 11 August 2020
SCAR COMNAP 2020

11 – 13 August 2020
APECS Workshop *Antarctic Science: Global Connections*

21 August 2020
National Weather Service Alaska Climate Outlook Briefing

1st week of September 2020
Convection-Permitting Modeling for Climate Research: Current and Future Challenges

07 – 11 September 2020
6th World Multidisciplinary Earth Sciences Symposium – WMESS 2020
Online & Prague, Czech Republic

27 – 30 October 2020
Arctic Shipping Forum 2020

28 – 30 October 2020
EO for Polar Science Workshop – Virtual Event

9 – 13 November & 16 – 20 November 2020
Around-the-Clock International Verification Methods Workshop Online (2020-IVMW-O)

7 – 11 December 2020
American Geophysical Union (AGU) 2020 Fall Meetings

1 – 2 February 2021
Arctic Frontiers Science 2021
Online & Tromsø, Norway

In-Person Meetings
(planned as of 27 July 2020, check websites for updates)

31 August – 4 September 2020
11th European Conference on Radar in Meteorology and Hydrology (ERAD) 2020
Locarno, Switzerland

10 – 11 September 2020
International Conference on Global Warming & Climate Change 2020
Bangkok, Thailand

14 – 16 September 2020
PalSea Meeting: Improving Understanding of Ice Sheet and Solid Earth Processes Driving Paleo Sea Level Change
New York, USA

8 – 11 October 2020
2020 Arctic Circle Assembly
Reykjavík, Iceland

15 – 17 October 2020
38th International Polar Symposium "Environmental Changes in Polar Regions: New Problems - New Solutions"
Toruń, Poland

20 – 22 October 2020
10th International Workshop on Sea Ice Modelling, Assimilation, Observations, Predictions and Verification
Toulouse, France & Montréal, Canada

International Coordination Office
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