

Polar Prediction Project (PPP)

The Year of Polar Prediction and MOSAiC

Thomas Jung

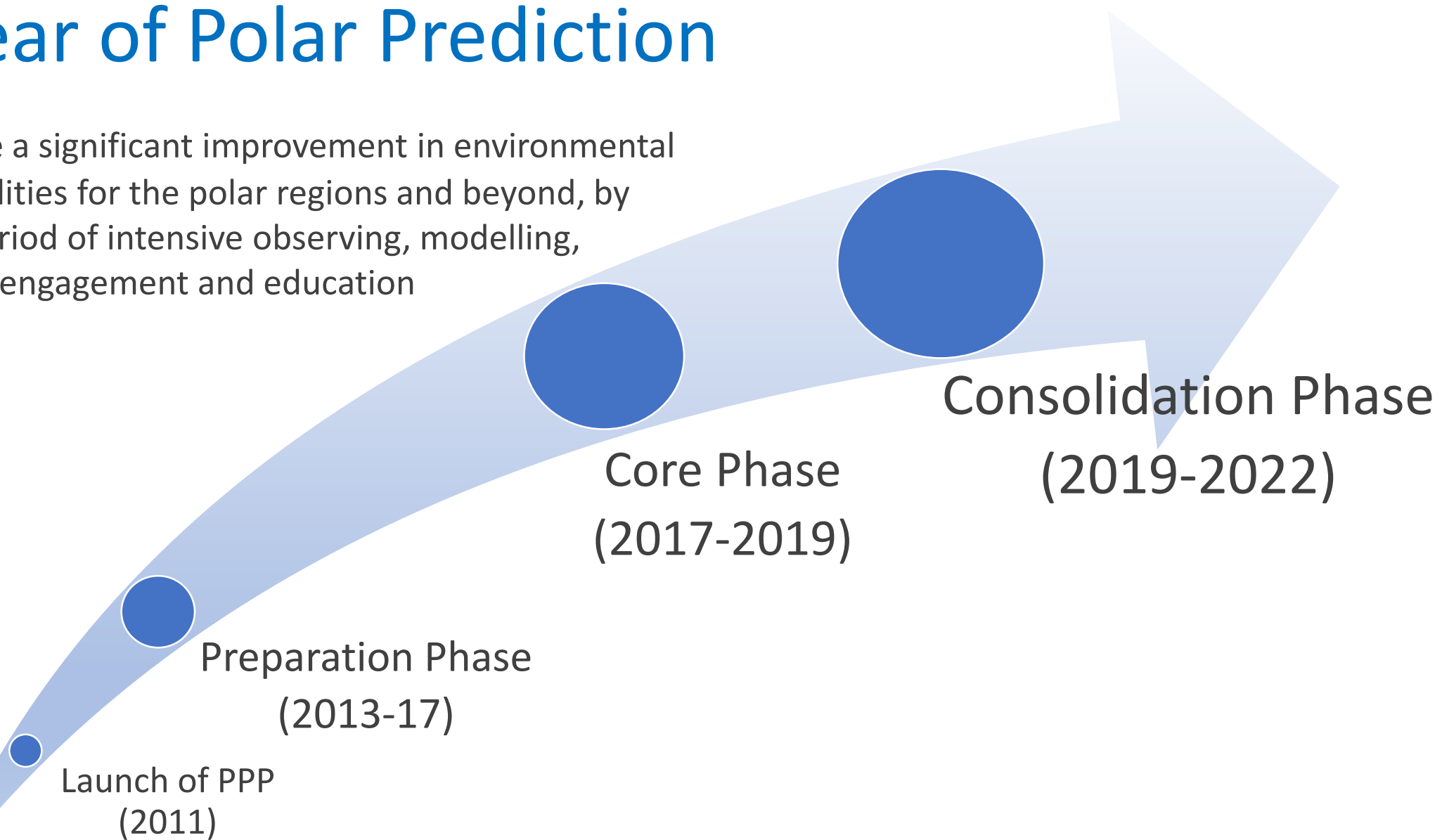
Chair of the WWRP PPP Steering Group

Alfred Wegener Institute | Helmholtz Centre
for Polar and Marine Research



The Year of Polar Prediction

Mission: Enable a significant improvement in environmental prediction capabilities for the polar regions and beyond, by coordinating a period of intensive observing, modelling, verification, user-engagement and education activities.



YOPP Consolidation Phase: Key elements



MOSAiC expedition: Key elements



YOPP and MOSAiC: Collaboration all along



PPP-SG4, Boulder, 2013



PPP-SG11, Bremerhaven, 2020

PolarPredictNews

YOYP
YEAR OF
POLAR
PREDICTION

AWI PPP WORLD METEOROLOGICAL ORGANIZATION

International Coordination Office (ICO) of the Polar Prediction Project

Find more information at www.polarprediction.net

PolarPredictNews

Newsletter #12
Sept. 2019

On 20 September 2019, the MOSAIC expedition starts. The expedition will be the largest MOSAIC observation from the central Arctic since 2007. The MOSAIC expedition will be the largest MOSAIC observation from the central Arctic since 2007. The MOSAIC expedition will be the largest MOSAIC observation from the central Arctic since 2007.

Dear Colleagues,

After years of planning, finally, RV Polarstern is leaving Tromsø on 20 September 2019 to accomplish MOSAIC – the biggest Arctic expedition ever. While drifting for one year through the central Arctic, novel measurements will be taken that will provide the basis for bringing weather and climate models in terms of their ability to represent critical processes in the high north to the next level.

It is with great pleasure, that I look back at years of excellent collaboration with the MOSAIC planning team. In fact, from the outset it was clear that YOYP and MOSAIC would be an excellent fit. MOSAIC was first mentioned at the PFP Steering Group meeting at ECMWF in 2018 ("invite MOSAIC representatives to the first YOYP planning workshop"). One year later, MOSAIC was presented by Matt Shupe, and subsequently it

I wish the MOSAIC endeavor. Be using your predictive capabilities. Happy reading, Thomas Jung

Fall 2019

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PolarPredictNews

Newsletter #13
Dec. 2019

Dear Colleagues,

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

The Year of Polar Prediction (YOYP) is a major international activity that the Meteorological Organization as a key component of the Polar Prediction goal of YOYP is to significantly advance our environmental prediction capability. As an internationally coordinated period of intensive observation, user-engagement, and education activities which involves various stakeholders, knowledge base needed to manage the opportunities and risks that come with

Happy reading, Thomas Jung

Winter 2019/20

Spring 2020

Newsletter #14
Apr. 2020

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PolarPredictNews

Issue #15
July 2020

Six months into the MOSAIC drift of Polarstern and its crew and scientists reach uncharted territory by acquiring six climate data sets during a whorl in the central Arctic. Now up is to cross the Arctic transforms around the of season and into the summer. But the towards Fram Strait, the gate to the and the North Atlantic, has been less than expected. Together with the logistical challenges posed by the COVID-19, this renders the fate of MOSAIC and summer uncertain. In this issue (p. 8), scientists shed light on how a ship is continuously being forecast, rate the forecasts have turned out

Summer 2020

Issue #16
Autumn

YOYP
YEAR OF
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PolarPredictNews

Issue #16
Autumn

Sea ice scientists Stefanie Armit (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 (in the 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).

YOYP
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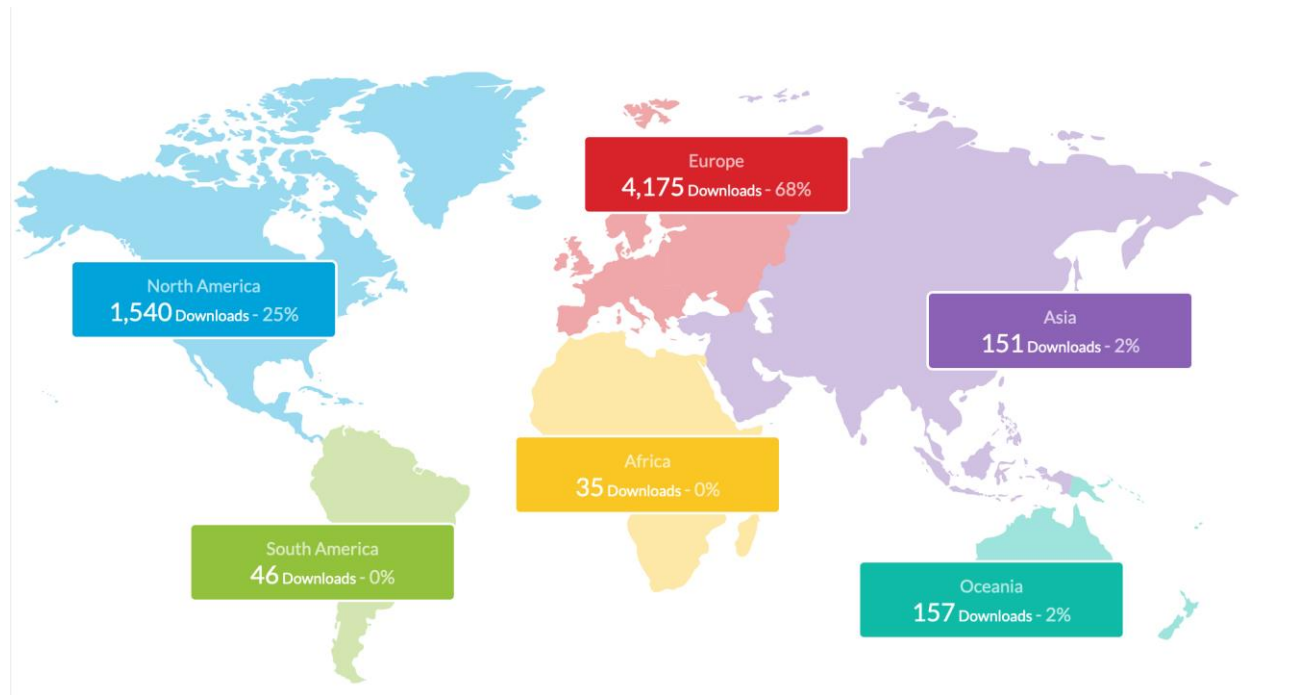
Find more information at www.polarprediction.net

PolarPredictNews

Fall 2020

polarprediction.net

YOPP Podcast *The IcePod*

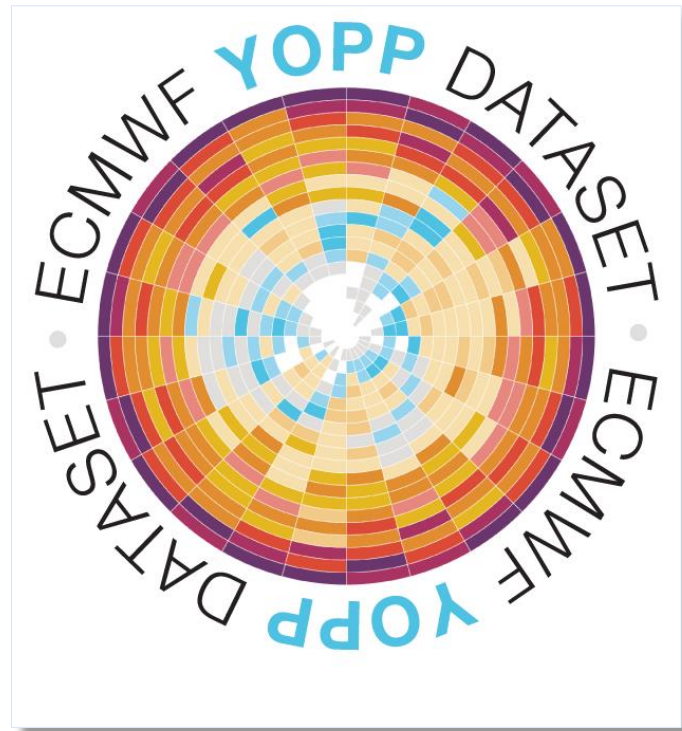


- Strengthen the link between MOSAiC and YOPP
- Enhance communication of the science activities within YOPP during MOSAiC and beyond
- Monthly interviews with scientists involved in MOSAiC and YOPP

- On Spotify, Apple Podcast etc,
- Also on local community radio station Radio Weser.TV



ECMWF YOPP Dataset



Operational ensemble forecasts

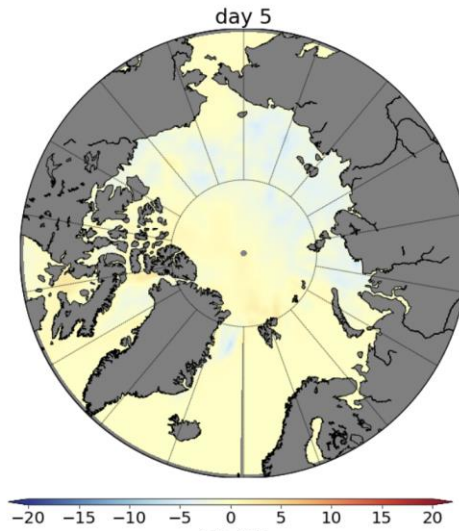
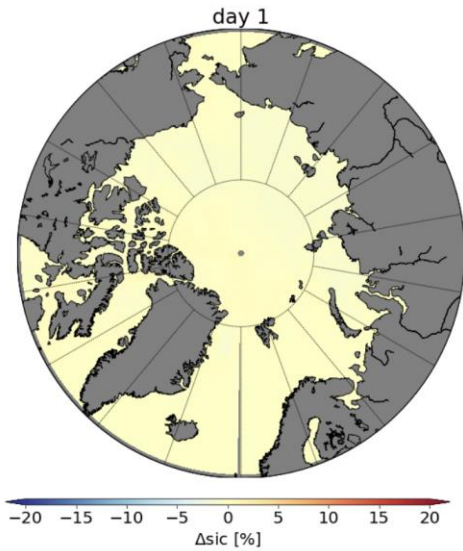
- Period: July 2017 to October 2020
- Analysis fields (fc step 0)
- Coupled forecasts out to day 15
- Tco639 ($\approx 18\text{km}$) + 91 levels
- Data available on native mesh

Dedicated research experiments

- Same period, system and resolution
- Coupled forecasts out to day 2
- Availability of process tendencies

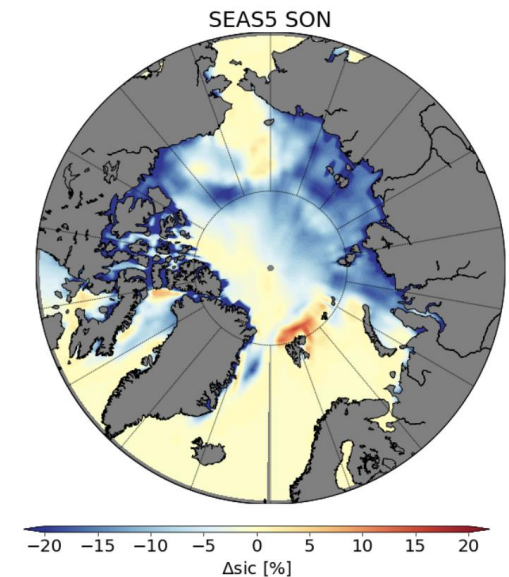
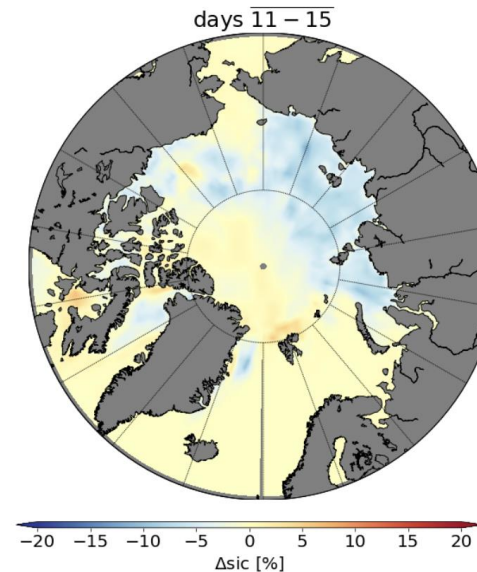
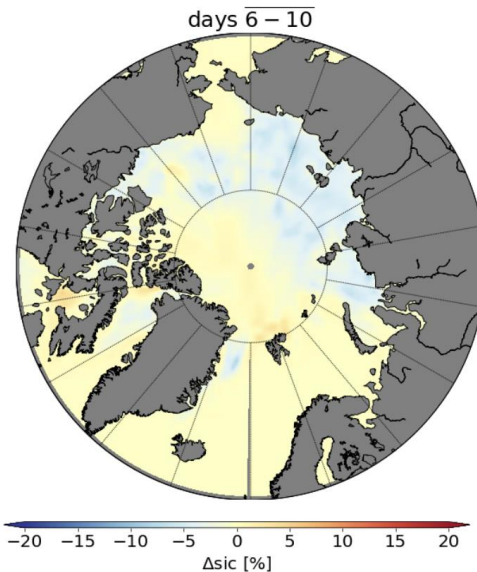
Bauer et al., in preparation, Scientific Data

ECMWF YOPP Dataset: Example application



Growth of sea ice concentration in autumn across time scales

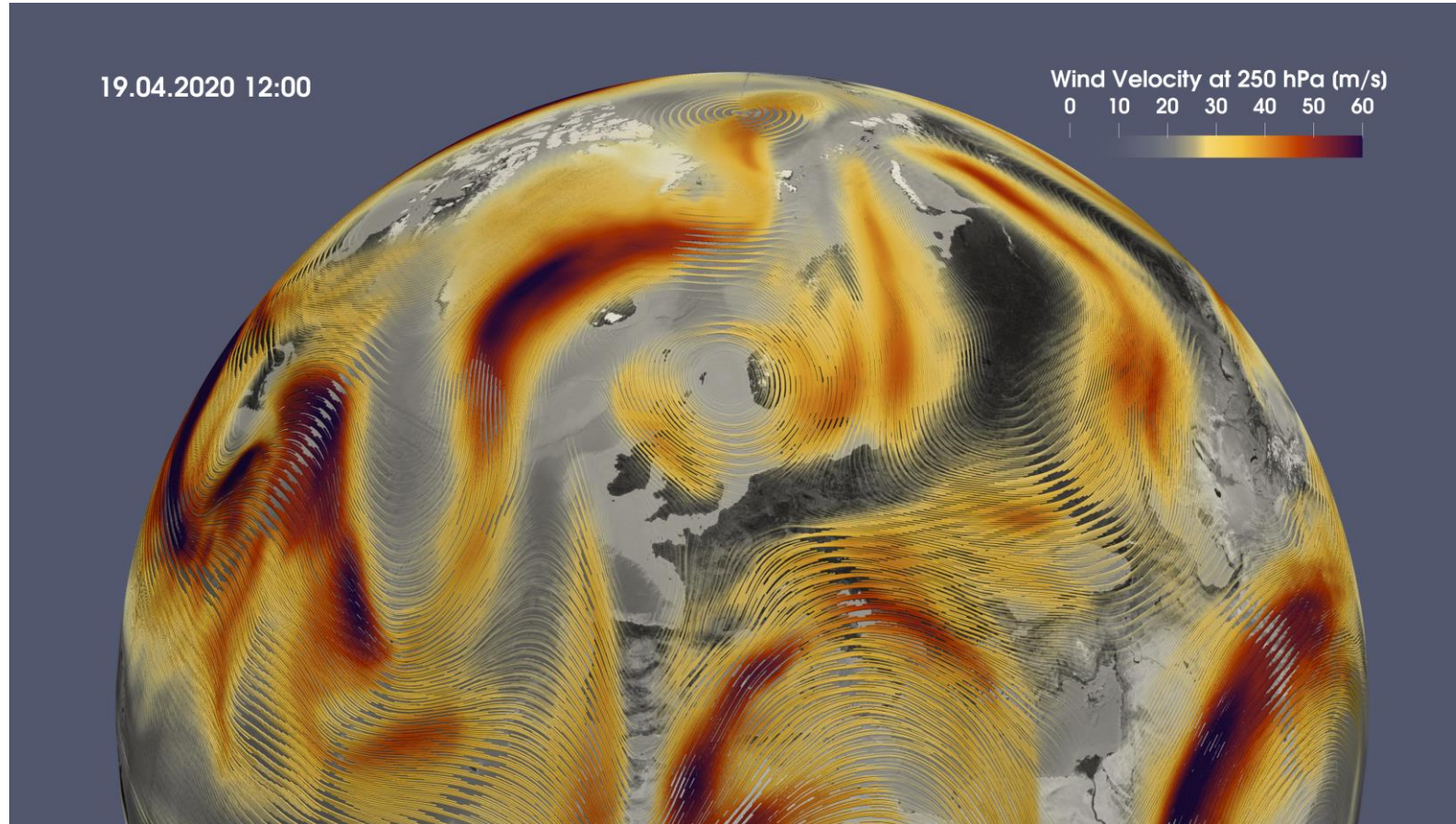
APPLICATE.eu 
Advanced prediction in
polar regions and beyond



YOPP-MOSAiC Observations: Targeted Observing Period

12–21 April 2020

Jetstream during MOSAiC-YOPP TOP



YOPP-MOSAiC Observations: Targeted Observing Period

12–21 April 2020

Extra radiosondes from AWI,
DMI, ECCO, FMI, IMO, MET
Norway, and SMHI



Photo: Lisa Grosfeld

Well-observed warm air
intrusion on its way
towards MOSAiC!



YOPPSiteMIP: Process-based model evaluation

Mission: Coordinate process-based model evaluation based on high-frequency multi-variate observations at some selected Arctic and Antarctic supersites, during YOPP, with the aim to deepen our understanding of the representation of the role of polar processes on environmental predictions.

- MODFs (Merged Observational Data Files)
- MMDFs (Merged Model Data Files)

YOPPsiteMIP meeting summary, outcomes and actions

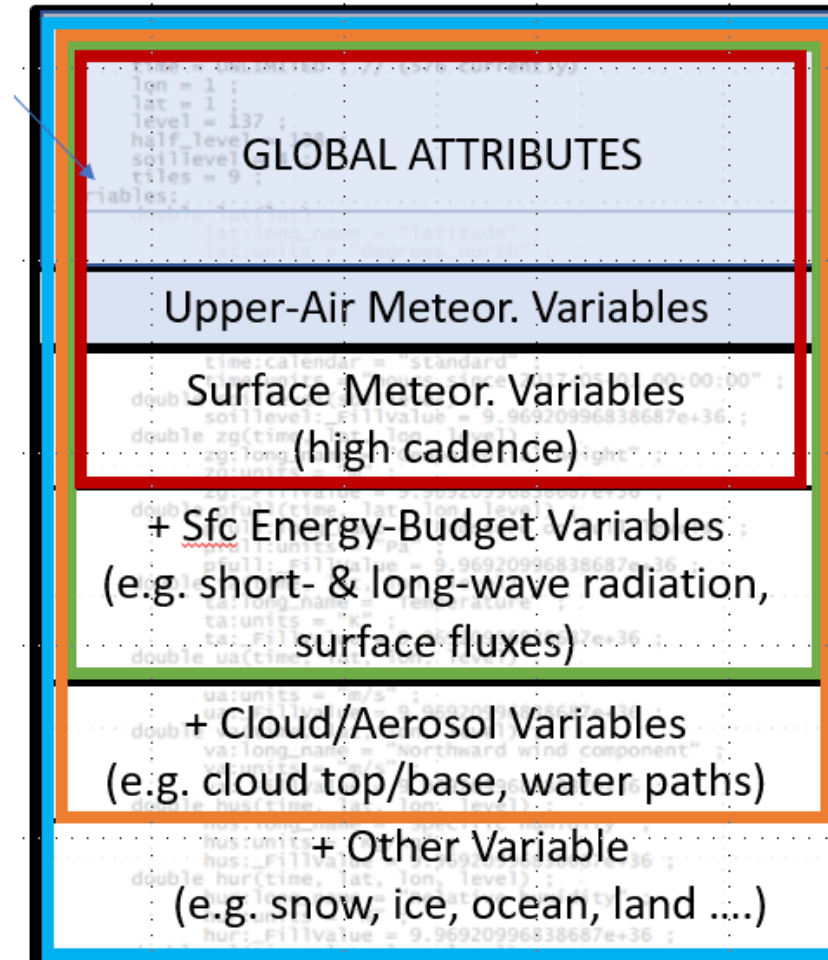
17 to 19 September
Department of Meteorology, Stockholm University
Stockholm, Sweden



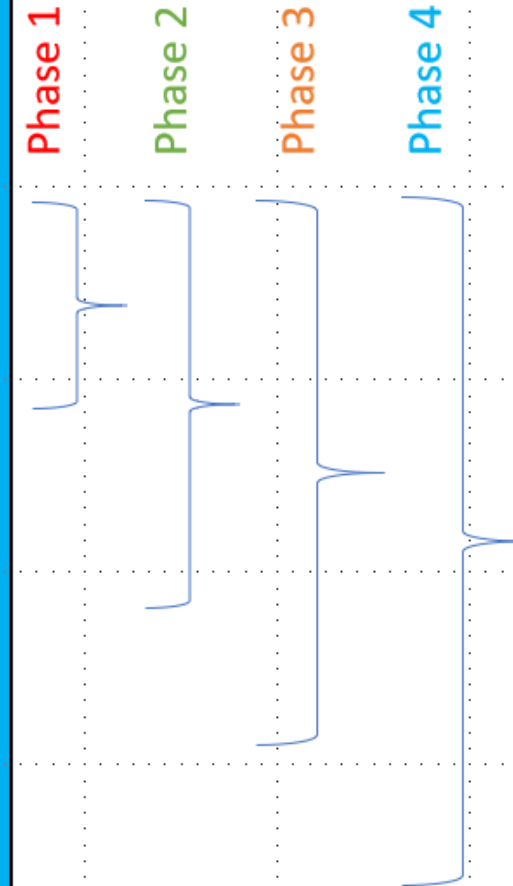
YOPPSiteMIP: Timeline

- SOP1 and SOP2
 - Most modelling centres have contributed their data (MMDFs)
 - Work in progress with observations: Nov 2020 → first Phase I data for selected Arctic supersites
- MOSAiC
 - Work in progress (first model data in available leg 1)
- Coding Workshops planned for autumn 2020
- Newsletter article by Gunilla Svensson in progress
- Data available through the YOPP Data Portal

YOPPSiteMIP: Observational data



Development Phases
(meant as prioritizing guides to
speed production)



RMetS Quarterly Journal: Special Issue on Observing System Experiments (OSEs)

RESEARCH ARTICLE

Quarterly Journal of the
Royal Meteorological Society 

Use and impact of Arctic observations in the ECMWF Numerical Weather Prediction system

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Abstract

This paper presents an assessment of the usage of Arctic atmospheric observations in the Numerical Weather Prediction (NWP) system of the European Centre for Medium-Range Weather Forecasts, and of their impact on the quality of short- to medium-range forecasts. The Arctic has low coverage of conventional data north of 70°N but one of the highest levels of coverage of satellite sounding data on Earth. The impact of Arctic observations on forecast skill was assessed by performing Observing System Experiments, in which different observation types were removed from the full observing system. This assessment was complemented by an analysis of Forecast Sensitivity to Observation Impact diagnostics. To our knowledge it is the first time that comprehensive numerical experimentation has been carried out to explore the role of different Arctic observations in a state-of-the-art global operational NWP system. All Arctic observations were found to have a positive impact on forecast skill in the Arctic region, with the greatest tropospheric impacts on both short- and medium-range forecasts due to microwave, conventional and infrared sounding observations. Results indicate the great importance of microwave sounding data and conventional data, which are found to be the key observing systems in the summer and winter seasons, respectively. These observations were found to have positive and statistically significant impacts on forecasts not only in the Arctic but also in the midlatitude regions at longer lead times. Differences between the seasons are most likely due to problems assimilating microwave sounding observations over snow and sea ice, leading to a reduced impact in winter. There is also the suggestion of increased importance of conventional data in winter, and other factors may also play a role.

KEYWORDS

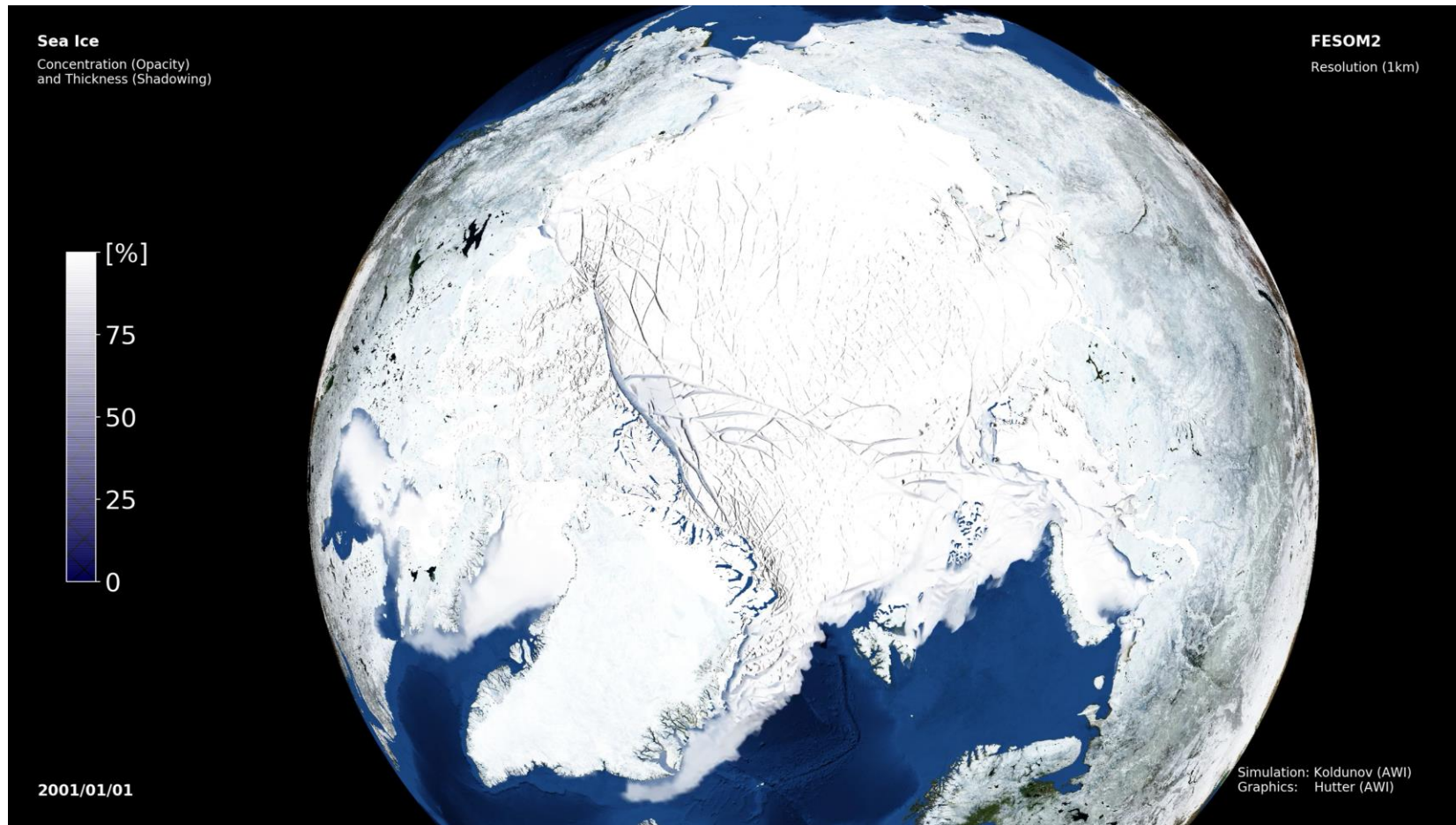
atmosphere, data assimilation, numerical methods and NWP, observations, polar regions, Year of Polar Prediction

Aim: Understand the impacts of different observation types on forecast skill and guide the design of future observing systems in polar regions.

Edited by Irina Sandu, Francois Massonnet and Thomas Jung



High-resolution sea ice modelling



High-resolution sea ice modelling

How realistic are linear kinematic features?

Total deformation rate:



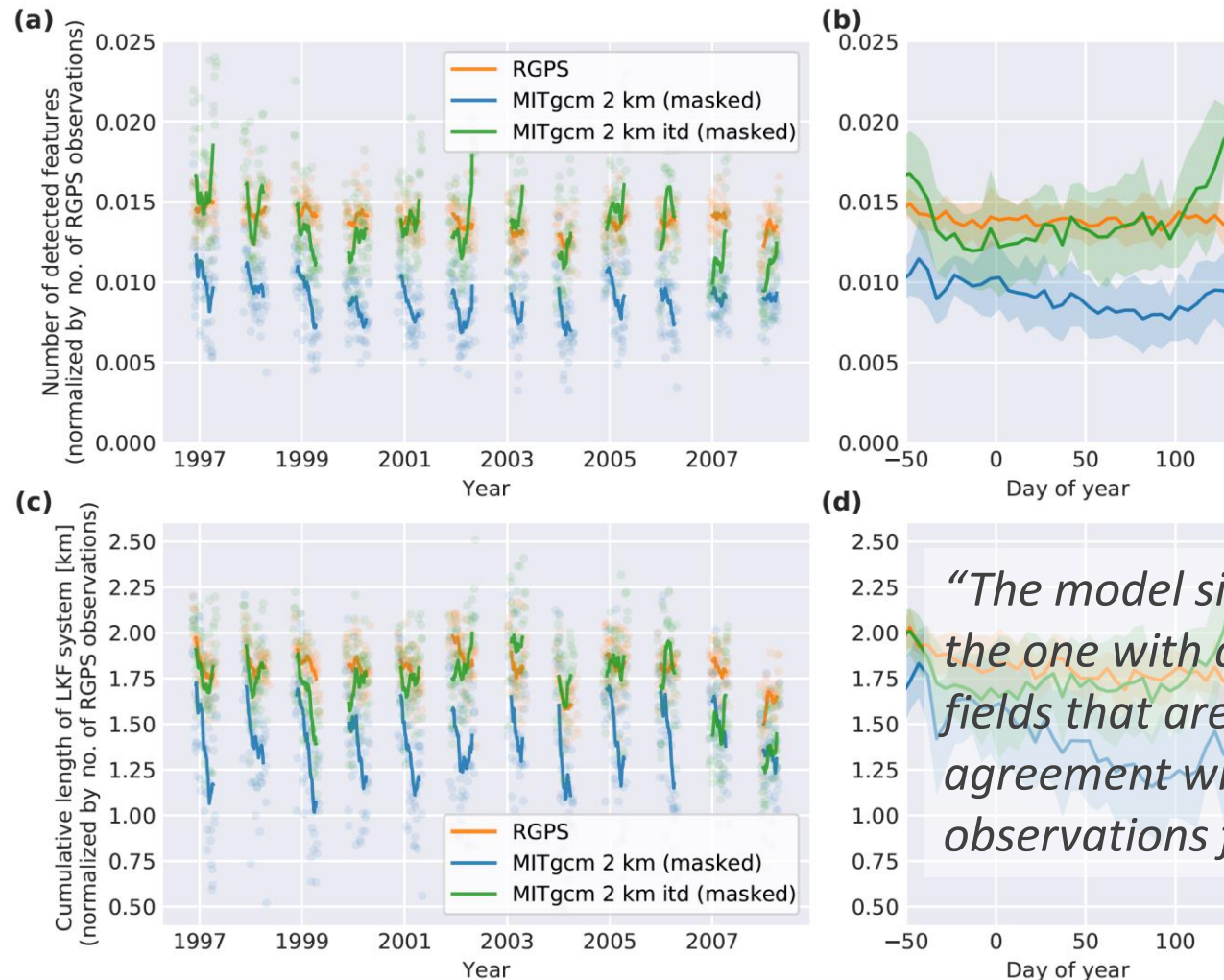
LKFs:



Statistics:

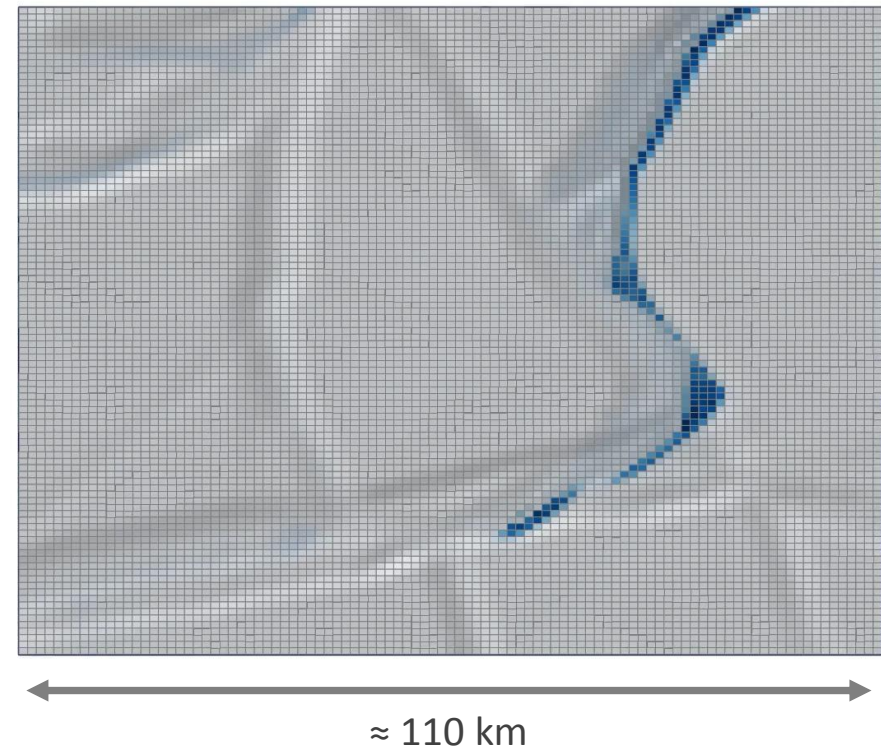
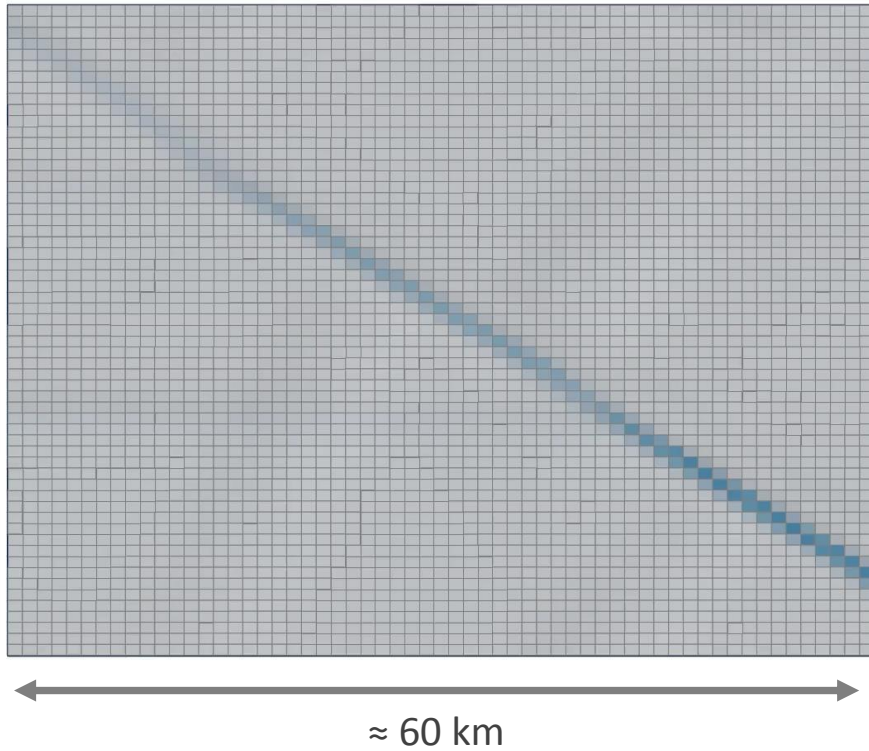
- Number / length of LKF network
- Density
- Length
- Intersection angles
- Lifetime
- Growth rates

High-resolution sea ice modelling



“The model simulations, especially the one with an ITD, have LKF fields that are in remarkable agreement with satellite observations from RGPS.”

High-resolution sea ice modelling



Color map shows concentration (+slight shadow from thickness)

Creating YOPP Legacy: for discussion



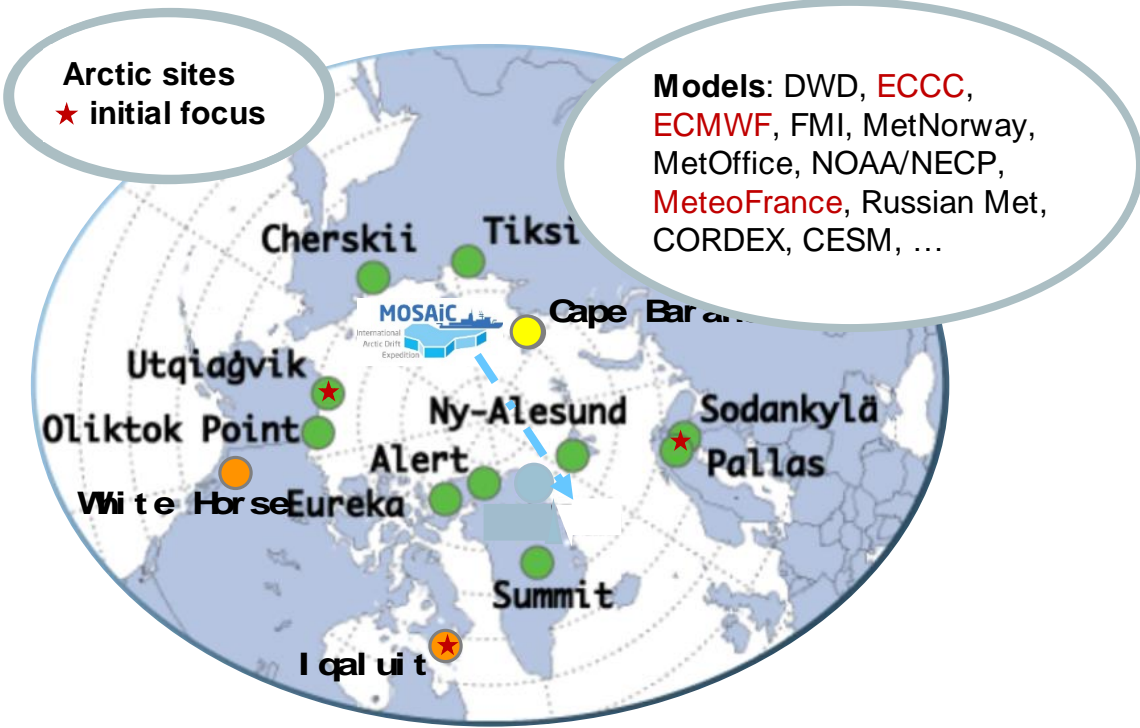
- Create a legacy beyond 2022
- Identify key partners that can carry on some of the work (coordination, science etc.)
- Ensure availability of key infrastructures beyond 2022 (e.g. polarprediction website and YOPP Data Portal)
- Discuss possible legacy activities → Who is going to lead this discussion?

Summary

- YOPP on a very good track with two more years to go!
- Strong links between YOPP and MOSAiC (ECMWF YOPP dataset, YOPPSiteMIP, SidFEx, Targeted observing period, ...)
- Promising → growth sea ice biases across time scales
- Nice insights through OSEs (special issue in QJ)
- Emerging field: Modelling of sea ice leads
- What will be “the next big thing” after YOPP?

YOPPsiteMIP

Team contact: Gunilla Svensson, Stockholm University, gunilla@misu.su.se



Arctic sites
★ initial focus

Models: DWD, ECCC, ECMWF, FMI, MetNorway, MetOffice, NOAA/NECP, MeteoFrance, Russian Met, CORDEX, CESM, ...

- IASOA (International Arctic Systems for Observing the Atmosphere)
- ECCC supersites – soon members of IASOA
- Cape Baranovo – soon member of IASOA
- MOSAiC drifting station

In addition, Antarctic and Third Pole sites

Supersites: Suites of instruments measuring variables that lead to *process understanding*

Models: *High frequency* column output on *model levels* at supersites

MIP: Developed *Format and Semantics* used for both models and observations promoting *multimodel* and *multisite* verification and *process evaluation*

Data: Available through the *YOPP Data Portal* (yopp.met.no)

Targeted processes: Low level clouds (including phase), Stable boundary layers, Atmosphere-snow interactions over land and sea-ice, Coupling procedures (variables and frequencies), Ocean mixing, ...