

A+5

Arctic Earth Observation Impact Assessment



Principal investigator

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Areas of contribution

Oceanic processes

Modelling and forecasting

Sea ice processes

Data assimilation

Summary

The project addresses the combination of earth observation (EO) data streams with a numerical model of the Arctic ocean sea-ice system using advanced data assimilation techniques. The team proposes to construct a highly flexible system for Arctic Mission Benefit Analysis (ArcMBA) that evaluates in a mathematically rigorous fashion the observational constraints through individual and groups of EO (and in situ) data products in an advanced data assimilation system. A+5 fits to the YIOO objective on the improvement of polar prediction capabilities on daily to seasonal time scales.

Description

First, we will set up NAOSIM in $\frac{1}{4}$ degree resolution, Arctic wide. Second, we will implement a mathematically rigorous procedure for assessment of the reduction in uncertainty in simulated/predicted quantities, which

allows an assessment of the observation impact. The approach is called quantitative network design (QND), and aims at designing an observational net work with optimal performance. The approach is based on work by Hardt and Scherbaum (1994) who optimised the station locations for a seismographic network. It was first applied to the climate system by Rayner et al. (1996), who optimised the spatial distribution of atmospheric measurements of carbon dioxide.

For the Arctic domain, the QND approach was successfully demonstrated through the evaluation of the combination of hypothetical airborne altimeter/radar observations of ice thickness/snow depth (Kaminski et al., 2015). The study evaluates two idealised flight transects derived from NASA's Operation IceBridge airborne ice surveys in terms of their potential to improve ten-day to five-month sea-ice forecasts. Target regions for the forecasts were the Chukchi Sea, an area particularly relevant for maritime traffic and offshore resource exploration, as well as two areas related to the Barnett Ice Severity Index (BSI), a standard measure of shipping conditions along the Alaskan coast that is routinely issued by ice services. This study quantifies the added value in reducing observational uncertainty and the complementarity of sensors. These proofs of concept demonstrate that the QND approach is ideal to address the requirements of the present theme. In A+5 we propose to set up the Arctic Mission Benefit Analysis (ArcMBA) system around the ¼ resolution version of NAOSIM. This will allow us to evaluate the added value of

- real data products from archived or ongoing missions (e.g.ERS, ENVISAT, and Cryosat-2 ice thickness)
- planned hypothetical products to be expected from future missions (e.g. snow depth on MY ice, summer ice thickness)
- planned novel data products from existing missions (e.g. Ice Surface Temperature from DMI))

The added value will be assessed through the reduction in uncertainty (with respect to the prior uncertainty, i.e. the case without observations) in target quantities. Suggested target quantities are:

- predictions of sea ice covered area, regionally (e.g. Northern Sea Routes) and Arctic wide for forecast times of a few days to a season.
- predictions of sea ice volume, regionally (e.g. Northern Sea Routes) and Arctic wide for forecast times of a few days to a season.
- predictions of snow volume, regionally (e.g. Northern Sea Routes) and Arctic wide for forecast times of a few days to a season.
- simulation of solid/liquid freshwater export through Fram Strait.

The proposed project is scheduled to end in autumn 2017 and will thus overlap with the YOPP core phase only by a few months. The project is, however, part of a longer-term effort that foresees followup activities (described in a scientific roadmap of which a first iteration is part of the tender) which would cover the core phase of YOPP.

The project output data will be made publicly available on the A+5 project web page for the YOPP community, and the transfer of important data to a data centre linked to YOPP, e.g., PANGAEA, will be considered.

Timeline

2016-04-01 - 2017-09-25

Regional emphasis

Northern hemisphere: Yes

Southern hemisphere: No

Key project deliverables

Executive summary progress report

Website

Communications material

Publications

Presentations

Requirement baseline

Dataset

Dataset user manual

Algorithm theoretical basis documents

Product validation report

Experimental dataset

Update of dataset user manual

Impact Assessment report

Scientific roadmap

Final report

Executive summary

Data management

Will be made available on project website, PANGAEA considered

Is data provided to WMO Global Telecommunication System

No

Real-time provision

The data are real time available via GTS.