ArcAIOS

Arctic Atmosphere-Ice-Ocean interactions at small and large Scales

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Areas of contribution

Polar atmospheric processes

Oceanic processes

Modelling and forecasting

Observations

Sea ice processes

Data archiving

Outreach

Summary

Interactions in the Arctic atmosphere-sea-ice-ocean system change the circulation/dynamics/heat in the ocean and lower atmosphere, and the thickness/distribution of sea-ice and snow. Autonomous, integrated atmosphere-ice-ocean buoy systems have been developed to provide year-round observations from the harsh and hard to access Arctic Ocean. In addition to giving a quasi-synoptic view on regional scales, these systems allow an in-

depth study of local processes. Satellite observations allow additional synoptic insight and need to connect observational scales. Building on our expertise we propose to study key local processes involving sea-ice-atmosphere-ocean interaction in a large-scale context. In addition to synthesising existing autonomous observations and satellite data products in scientific analyses, the work will feedback with buoy-related programmes and support the upcoming international drift campaign MOSAiC. This project will support YOPP by evaluation of near-real-time observational systems in a long-term context.

Description

The project „Arctic Atmosphere-Ice-Ocean interactions at small and large Scales“ (ArcAIOS) will help to better understand the Arctic climate system. The Arctic has warmed two to three times faster than the rest of the Earth during recent decades. This phenomenon is known as Arctic amplification. By impacting weather patterns, these changes in the Arctic also have consequences for mid-latitude regions, such as Europe. More and improved observations covering a range of horizontal scales, from individual sea-ice floes to the complete Arctic Basin, are needed to better understand the changes in the Arctic.
Interactions in the Arctic atmosphere-sea-ice-ocean system change the circulation, dynamics and heat in the ocean and the lower atmosphere. These feedbacks further influence the thickness and distribution of sea ice and snow. Autonomous, integrated atmosphere-ice-ocean buoy systems (IT buoys) have been developed to provide year-round observations from the harsh and hard to access Arctic Ocean. In addition to giving a quasi-synoptic view on regional scales, these systems allow an in-depth study of local processes. Satellite observations allow additional synoptic insight and are needed to connect observational scales.
Building on the expertise of the consortium, we propose to study key local processes involving sea-ice-atmosphere-ocean interaction in a large-scale context. The work will synthesize existing IT buoy observations, satellite data and reanalysis products in scientific analyses and evaluate near real-time observations in a long-term context. The project will support the international Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC; www.mosaicobservatory.org). By system evaluation we will improve the effective use of IT buoy observations in conjunction with other data. The upcoming Year of Polar Prediction (YOPP) is an important partner for feedback, not just of the evaluation of results but also by using new, high-resolution reanalysis products planned within YOPP to put the IT buoy observations in a large-scale, quasi-synopic context.
Our proposed work builds on the long-standing expertise at UPMC (France) and AWI (Germany), who have several years of experience in developing, operating and scientifically analysing autonomous buoy observations. The group at the University of Bremen (Germany) will contribute with expertise in developing products from satellite observations of the sea-ice and the ocean surface as well as scientific knowledge of how to interpret such data. Some data products from satellites and buoys have already been developed and would be available at the start of the project.

ArcAIOS will consist of four scientific work packages:
1. Data processing, feedback with other projects that focus on technical improvements and operational use of IT buoys;
data processing to obtain composite datasets; feedback with on-going IT buoy projects/programmes that focus on development and use of IT buoys in the field.
2. Analysis of satellite products, reanalysis output and up-scaling of IT buoy results
Develop different high-resolution satellite products and combined products in relation to IT buoys (e.g. history of sea-ice conditions before deployment; lead and flow-size distribution along IT buoy track); relation of point IT buoys observations with large-scale conditions.
3. Use multi-disciplinary IT buoy deployments to analyse local 1-D processes involving the ocean, sea-ice, snow and atmosphere

Local processes around each set of IT buoys: contrast seasonal conditions and atmosphere-ice-snow-ocean feedbacks (e.g. high melt in summer vs. low melt in winter); sensitivity studies using 1-D modelling, evaluation of operational reanalyses/models (e.g. ECMWF for atmosphere, ocean for MERCATOR).
4. Basin-scale analysis of coherent variability in historical and current IT buoy datasets
Statistical and physical analysis of spatial and temporal patterns in ocean-ice-snow-atmosphere behaviours using a basic set of parameters; categorisation of feedback behaviour associated with seasonal preconditioning and regional forcing.

The project duration is planned for 36 months. The project will closely interlink with several other projects by the PIs, for example: (AC)3 (DFG, Germany), MOSAiC (AWI/Helmholtz Foundation/Germany; various national funding agencies), IAOOS (EQUIPEX ANR, France), FRAM (AWI/Helmholtz Foundation/Germany), MIDO (AWI/Helmholtz Foundation/Germany), N-ICE2015 (NPI, Norway), ICE-ARC (European Union, FP7), NABOS (NFS/USA, AARI/Russia, AWI/Helmholtz Foundation/Germany).

A pre-proposal has been submitted in Oct 2016, and the full proposal will be submitted in April 2017 to ANR as part of a joint French-German (DFG-ANR) call.

Timeline

2018-01-01 - 2020-12-31

Regional emphasis

Northern hemisphere: Yes

Southern hemisphere: No

Further specification

Arctic Ocean basins; atmosphere, sea-ice, snow and ocean

Key project deliverables

Objectives / deliverables:
? Building on our joint French-German expertise, we will study key local processes involving sea-ice-atmosphere-ocean interaction in a large-scale context.
? Synthesising existing autonomous ice-tethered observations (IT buoys) and satellite data products in scientific analyses.
? Enhancing our understanding of regional key processes from combined analysis.
? Benefiting from feedback with other projects dealing with IT buoys, this work will support and feedback with

the upcoming YOPP and MOSAiC.
Hypotheses:
1. There are regional differences in the ice-snow-ocean-atmosphere processes that can be identified in observations by networks of IT buoys.
2. Satellite observations can be used to put the localized information of such platforms in an Arctic-wide context on longer time scales.
3. The ice evolution can be categorized by distinct regional conditions and temporal preconditioning based on different ice-snow-ocean-atmosphere feedback processes.
4. There is a statistical predictability of seasonal ice evolution in certain regions by categories obtained in 1.

Data management

Synthesised datasets and data products will be archived in PANGAEA or other publicly accessible data archives as supplements to scientific publications.

Is data provided to WMO Global Telecommunication System

No

Other information

final proposal to be submitted in April

Timelines

Location	Latitude	Longitude	Start date	End date	Activity
Central Arctic			2019-10-01	2020-09-30	MOSAiC
near north pole			2018-04-01	2018-04-30	BARNEO drifting ice camp / buoy deployments