PAIOArC

Processes governing Atmosphere-Ice-Ocean interaction in a changing Arctic Climate

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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. In addition to synthesising existing autonomous observations and satellite data products in scientific analyses, the work will feedback with buoy-related programmes and participate in 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 „Processes governing Atmosphere-Ice-Ocean interaction in a changing Arctic Climate“ (PAIOArC) will help to better understand local interaction in the Arctic climate system. The Arctic has warmed nearly three times faster than the global average in 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. 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. More and improved observations covering a range of horizontal scales are needed to better understand the changes. Autonomous, integrated atmosphere-ice-ocean buoy systems (IT buoys) have been developed to provide year-round observations from the 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 will study key local processes involving sea-ice-atmosphere-ocean interaction. The work will synthesise existing and new IT buoy observations (metres to hundred metres), satellite data (metres to tens of kilometres) and reanalysis (tens of kilometres) products in scientific analyses and evaluate near real-time observations in a long-term context. The main objective of the project is to analyse extensive datasets from the international Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC). The Year of Polar Prediction (YOPP) and EU projects such as APPLICATE are important partners for connecting our results to large scale modelling applications.

Our proposed IT buoy work builds on the long-standing expertise at UPMC (FR) and AWI (GER), who have several years of experience in developing, operating and scientifically analysing IT buoy observations. The group at the University of Bremen (GER) will add to that with spatial information from newly developed and existing satellite products of the sea-ice, atmosphere, and the ocean surface. This unique expertise will allow an integrated analysis of the ocean-sea ice-atmosphere system on regional scales.

PAIOArC has four work packages:

WP 1. Data processing of IT buoys to obtain composite data syntheses; benefits from on-going IT buoy projects/programmes to optimize use and data analysis of IT buoys within MOSAiC. This will enable a strong participation in MOSAiC field work.

WP 2. Satellite products will be used to connect the IT buoy observations and analyse atmosphere-ice-ocean interactions on a regional scale with additional help from atmospheric reanalysis. At the heart will be the development and interpretation of high-resolution and combined satellite products for the MOSAiC and previous campaigns. Analysed quantities include lead fraction, ice drift, floe size distribution, history of sea-ice conditions, albedo, melt pond fraction, and surface temperature to relate to local IT drifting buoys measurements in a regional-scale and extended temporal context.

WP 3. Use multi-disciplinary IT buoy data and 1-D/single column modelling to analyse the sensitivity of 1-D processes to ocean, sea-ice, snow and atmosphere parameters like estimating ice and snow melt rates, ice and snow-ice formation rates, vertical heat fluxes, vertical salt and freshwater fluxes, and energy budgets at
interfases. Categorisation of feedback behaviour associated with seasonal preconditioning and regional forcing (e.g. high melt in summer vs. freezing or low melt in winter). Evaluation of operational reanalysis products/models (e.g. ECMWF and CARRA for atmosphere, MERCATOR for ocean).

WP 4. Analysis of the multi-scale MOSAiC year-round dataset related to WP1, 2, 3. Statistical and physical analysis of spatial and temporal patterns in ocean-ice-snow-atmosphere within the MOSAiC observatory network using parameters as in WP3. Collaboration with APPLICATE, MERCATOR and the MOSAiC modelling team to test new model parameterizations.

WP 5. Coordination and Outreach: coordination of PAIOArC; liaising with YOPP, MOSAIC, IABP, APPLICATE; public outreach.

A full proposal will be submitted on 10th January, 2018 to the DFG as part of a joint French-German (DFG-ANR NLE 2018) call.

**Timeline**

2019-01-01 - 2021-12-31

**Regional emphasis**

Northern hemisphere: Yes

Southern hemisphere: No

**Further specification**

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

**Key project deliverables**

Objectives:
1. Data processing of IT buoys to obtain composite data syntheses; benefits from on-going IT buoy projects/programmes to optimize use and data analysis of IT buoys within MOSAiC. This will enable a strong participation in MOSAiC field work.
2. Satellite products will be used to connect the IT buoy observations and analyse atmosphere-ice-ocean interactions on a regional scale with additional help from atmospheric reanalysis. At the heart will be the development and interpretation of high-resolution and combined satellite products for the MOSAiC and previous campaigns. Analysed quantities include lead fraction, ice drift, floe size distribution, history of sea-ice conditions, albedo, melt pond fraction, and surface temperature to relate to local IT drifting buoys measurements in a regional-scale and extended temporal context.
3. Use multi-disciplinary IT buoy data to analyse the sensitivity of 1-D processes to ocean, sea-ice, snow and
atmosphere parameters. Categorisation of feedback behaviour associated with seasonal preconditioning and regional forcing around each set of IT buoys: contrast seasonal conditions and atmosphere-ice-snow-ocean feedbacks (e.g. high melt in summer vs. freezing or low melt in winter); sensitivity studies using 1-D/single column modelling, evaluation of operational reanalysis products/models (e.g. ECMWF for atmosphere, MERCATOR for ocean).

4. Analysis of the multi-scale MOSAiC year-round dataset related to WP1, 2, 3. Statistical and physical analysis of spatial and temporal patterns in ocean-ice-snow-atmosphere within the MOSAiC observatory network using parameters as in WP3. Collaboration with APPLICATE, MERCATOR and the MOSAiC modelling team to test new model parameterizations. Liaison with YOPP and IABP.

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

Real-time provision

Near-real time provision of data is partly planned in the framework of MOSAiC data management (AWI data portal).

Other information

Proposal due on 10th January, 2018 -- sorry for the short notice!

Timelines

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