Exploring the role of sea ice physics in Arctic climate variability and predictability

Principal investigator

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Areas of contribution

Modelling and forecasting
Sea ice processes

Summary

Including the physics of melt ponds in forced sea ice models has been shown to lead to real seasonal predictability of the Arctic summer sea ice minimum, through the impact of ponds on the albedo feedback mechanism. We shall investigate more advanced models of melt ponds and explore their role in variability and predictability of Arctic sea ice in climate models.

Description

Recent observed changes in the Arctic have become a 'poster child' for global climatic changes, particularly because the summer sea ice extent has shrunk rapidly over the past 35 years. This retreat of sea ice has led to plans to extract minerals and fossil fuels from the ocean floor and interest in new Arctic shipping routes. Observations of the Arctic have also improved in recent years with new satellites measuring sea ice properties from space. In particular, these satellites now provide estimates of the sea ice thickness across the Arctic during the winter months. This development allows better monitoring of the state of the sea ice, provides an enhanced ability to assess our physical understanding of the Arctic system and offers a more stringent test of the latest climate model simulations.
However, global climate model (GCM) simulations often fail to realistically capture large scale properties of the Arctic sea ice, such as the mean extent, inter-annual variability and recent trends. Therefore, there is need to improve simulations of Arctic sea ice to provide better understanding of recent changes and credible projections of the future to help assess risks and opportunities and inform important policy decisions about adaptation and mitigation. In addition, there is a growing desire for shorter term sea ice forecast5, such as a few weeks or months ahead, to help inform communities and industry stakeholders.

One essential ingredient for improving the GCM simulations is to better represent the missing relevant physical processes in the latest sea ice models. This proposal will develop and implement improved physics schemes for the CICE sea ice model, which is used by many international groups, including the UK Met Office. The enhanced CICE will be further developed to improve its simulation of Arctic climate and its ability to provide more reliable sea ice predictions will be tested. In addition, the role of natural climate fluctuations in producing recent Arctic sea ice changes on annual to decadal timescales will be better determined by analysing the physical mechanisms responsible.

Connection of this project to YOPP

This proposal directly addresses the following YOPP objectives:
- develop improved representation of polar key processes in uncoupled and coupled models used for prediction, including those which are a particular hindrance to high-quality prediction for the polar regions
- explore the predictability of sea ice on time scales from days to a season

Timeline

2016-10-01 - 2019-09-25

Regional emphasis

Northern hemisphere: Yes

Southern hemisphere: No

Key project deliverables

(i) Improved sea ice model, which can be used within the UK and internationally;
(ii) Production of a sea ice-ocean model that reliably represents observed sea ice trends and variability;
(iii) More sophisticated representation of key physical sea ice processes within UK Met Office climate model;
(iv) Improved understanding of observed and simulated decadal variability of sea ice;
(v) An indication of whether the observed hiatus in sea ice extent trend will continue; and
(vi) Improved understanding of physical processes responsible for Arctic sea ice predictability, with relevance to operational forecasts and end users.
Data management

No data produced. Model output available upon request.

Is data provided to WMO Global Telecommunication System

No

Real-time provision

No data produced.

Timelines

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<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Start date</th>
<th>End date</th>
<th>Activity</th>
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<tbody>
<tr>
<td>-</td>
<td></td>
<td></td>
<td>2016-10-01</td>
<td>2019-09-25</td>
<td>Model development, numerical simulations, analysis of model results.</td>
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