Arctic sea-ice reduction: gaining new knowledge from data assimilation

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The strong decline of Arctic sea ice is a conspicuous indicator of climate change: the last 13 years (2005-2017) have seen the 13 lowest September Arctic ice extents in the satellite record. The dramatic reduction in extent has been accompanied by an even stronger decrease in volume, as measured by satellite altimetry and field observations.

Arctic sea ice is an important component of the global climate system: its high albedo (reflectivity) relative to ocean water significantly affects the surface radiative budget; it forms a mechanical barrier to transports of heat, moisture and momentum between the atmosphere and ocean; and the formation and melt of sea ice acts as a buoyancy forcing to the ocean, affecting deep-water formation and the thermohaline circulation.

The mechanisms responsible for changes in Arctic sea-ice volume and its distribution are complex, involving both thermodynamic changes and dynamics of motion and deformation. Understanding the local causes of past sea-ice loss is crucial to developing the ability to predict the future of Arctic sea ice, and its impacts on the broader climate system.

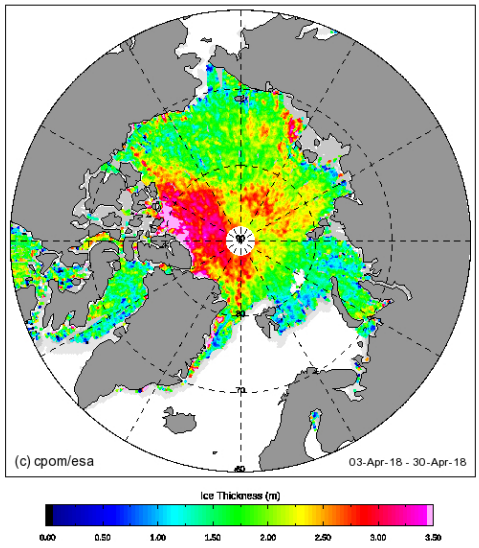

Figure 1: Arctic sea-ice thickness (April, 2018) obtained by CPOM using radar altimetry from CryoSat2.

This project will combine new and emerging satellite estimates of sea ice thickness (see figure 1) with a state-of-the-art sea ice model using data assimilation. Data assimilation is a tool that uses observations to improve the model estimate of the sea-ice state, which can in turn be seen as a way of filling in the gaps in the observational record. Using these tools, we will develop a sea ice reanalysis (spatio-temporal description of the sea-ice state) that will be analysed to identify the proximate causes of sea-ice change over the satellite era, giving us new physical insight.

The successful applicant will:

(i) Work with other researchers to set up a new Arctic sea ice data-assimilation system;
(ii) Develop an observational operator that maps model variables onto the satellite data products;
(iii) Process existing satellite data into a form that can be used for data assimilation;
(iv) Produce a sea ice reanalysis over the satellite era (1979+);
(v) Analyse the sea ice reanalysis to understand the proximate causes of sea ice change; and
(vi) (If time permits) examine the potential to use the sea-ice data-assimilation system to produce a sub-seasonal sea-ice prediction capability.

Student profile:
The position is based in the Department of Meteorology, University of Reading. A successful candidate will have a degree (2(i) minimum) in applied mathematics, physics, engineering, or a similar numerate subject, along with an aptitude for applying physical and mathematical principles with computer programming to solve real-world problems. Specialist sea-ice knowledge is not expected.