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High Heat Flux events and the role of sea ice in the Iceland Greenland Seas

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The Iceland Greenland seas Project (IGP) represents a coordinated meteorological and oceanographic study of the Iceland and southern Greenland Seas. The aim being to characterise the atmospheric forcing and the ocean response of coupled atmosphere-ocean processes; in particular cold-air outbreaks in the vicinity of the marginal-ice-zone and their triggering of oceanic heat loss and the generation of dense water masses. Within the project a climatological assessment using regional climate modelling tools of changes in the distribution late winter/early spring (January-February-March-April) sea ice concentration was undertaken.

Here we present the results of this regional modelling study. Four simulations were produced using a regional free running nest within the global version of the UK Met Office Unified Model (MetUM). Each simulation ran for 20 extended winter periods (November to April) for the years 1990/91 to 2009/10. The only changes between each simulation was in the choice of sea ice and sea surface temperature (SST) lower boundary conditions. Firstly, a baseline simulation was undertaken using time varying sea ice and SSTs concomitant with the date of the simulation, before three simulations utilised three different annually repeating sea ice and SSTs representative of the maximum (1987/88), median (2003/04) and minimum (2015/16) sea ice conditions in the Iceland-Greenland seas. After evaluating our model performance by using the baseline simulation compared to ERA-Interim and the experimental design using monthly mean climate responses to changes in sea ice concentration, we focussed on analysing the occurrence of individual heat flux events.

We focussed on two specific regions, previously identified as important locations for open ocean convection, the first in the Iceland Sea and the second in the Greenland Sea. For the Iceland Sea, the magnitude of high heat flux events decreased as sea ice concentrations reduced from the maximum to the minimum simulation. Conversely for the Greenland Sea, the magnitude of high heat flux events increased as the sea ice concentration was reduced.

Through case study and composite analysis we will demonstrate in this presentation: 1) Why we have simulated a different response of high heat flux events to reductions in sea ice between the Iceland and the Greenland Seas and 2) What implications this might have for the future of high heat flux events and open ocean convection in this region.