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A sensitivity study of the sea ice simulation in the global coupled climate model, HadGEM3

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We will present some results from the first sea ice sensitivity study to be performed with a fully-coupled global atmosphere-ice-ocean climate model. Results will be presented for sensitivity to a selection of sea ice parameters, varied within the range of observational uncertainty, and additionally for the sensitivity of the sea ice to increased resolution in the atmosphere and ocean-ice models, as well as dynamics and physics changes in the atmosphere.

In the Arctic, the sea ice thickness is most sensitive to the albedo of the overlying snow layer (because of its influence on surface melt) and the thermal conductivities of ice and snow (because of their role in regulating heat flux from the ocean to the atmosphere through the ice). The winter Arctic ice extent is found to be sensitive to an increase in resolution of the ocean-ice model, because of increased sea surface temperatures in the Labrador Sea at higher resolution. In addition, the Arctic ice extent is reduced under increased atmospheric resolution, because better representation of mid-latitude storms leads to increased poleward heat transport.

In the Antarctic, the sensitivity to sea ice parameters is weaker, and atmosphere and ocean forcing dominate; in particular, increased resolution of the atmosphere and ocean-ice models leads to the enhancement of a warm bias in the Southern Ocean, which has a large impact on sea ice thickness and extent. Inclusion of a selection of these parameters in combination, together with changes to the atmosphere and ocean models, leads to significant improvements in depiction of sea ice extent, thickness and volume.