Geophysical Research Abstracts
Vol. 21, EGU2019-3120-1, 2019
EGU General Assembly 2019

Impact of Atmospheric resolution on ocean heat transport into the Arctic

Sally Woodhouse (1), Len Shaffrey (2), Reinhard Schiemann (2), and Sheldon Bacon (3)

(1) Reading, Meteorology, Reading, United Kingdom (sally.woodhouse@pgr.reading.ac.uk), (2) National Centre for Atmospheric Science, Department of Meteorology, University of Reading, Reading, United Kingdom, (3) National Oceanography Centre, Southampton, United Kingdom

Recent trends in the Arctic show that this region is extremely sensitive to climate change with surface temperatures increasing at 2-4 times the global average and a corresponding large decrease in sea ice extent. However, CMIP5 models have a large uncertainty in their representation of the current Arctic climate, such as sea-ice extent, and thus, in the projected decrease of sea-ice.

In this study the impact of atmospheric resolution on the Arctic climate and energy transports into the Arctic is evaluated in a coupled climate model (HadGEM3-GC2) using three different atmospheric resolutions (N96: 140km, N216: 60km, and N512: 25km). The ocean model is kept at the same resolution, $\frac{1}{4}$ degree NEMO, a state-of-the art model that will be used within the CMIP6 program.
It is found that in the higher resolution experiment (N512) the Arctic is warmer and has a correspondingly smaller sea ice extent. This is linked to a substantial increase (e.g. 0.045PW at 65N) in the total energy being transported into the Arctic, between the N96 and N512 experiments. This increase is dominated by an increase in the energy transported by the ocean. The ocean heat transport through the four ocean gateways (Davis, Fram, Barents Sea Opening and Bering Straits) in the high resolution atmosphere experiment gives a better agreement with recent observational estimates than the lower resolution experiments (N96: 0.09PW, N512:0.15PW).

Different mechanism are responsible for the differences in heat transport though each of the gateways. The drivers of the differences in OHT through the Davis Strait are complex, with changes in wind stress forcing over the strait appearing to drive differences in the ocean circulation. Changes in the wind stress are thought to be linked to better resolved orography in the higher resolution atmospheric experiments and a reduction in the areas covered by coastal grid cells. In the Bering Strait the change in OHT is dominated by warmer waters throughout the North Pacific. A discussion of the impact of atmospheric resolution on the Fram Strait and Barents Sea Opening will also be presented.

The large changes in the OHT show that the ocean model is highly sensitive to the applied atmospheric forcing and therefore sensitive to the resolution of the atmospheric model. This sensitivity could lead to important feedbacks on the atmospheric model. Therefore changes in resolution of components of a coupled climate model should also be evaluated in the full coupled model to understand their impacts on the whole system.