



Deep water formation in the North Atlantic Ocean in high resolution global coupled models

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An ensemble of historical and future climate simulations with the global coupled model EC-Earth has been investigated. The results show that the Labrador Sea convection is an important driver of the Atlantic Meridional Overturning Circulation (AMOC) at decadal times scale. Deep convective activity in the Labrador Sea declines throughout the 20th century, with an accompanied decrease of the AMOC, and vanishes in the 21st century. The primary cause for the extinction of deep convection is a decrease of sensible heat loss to the atmosphere in winter, resulting from increasingly warm atmospheric conditions.

In the EU-project PRIMAVERA, sets of high and standard resolution simulations with five global coupled climate models have been analyzed to study the impact of high resolution on the deep oceanic convection and the robustness of the signal across models.

Compared to observations from ARGO-floats, most of the models overestimate the deep water formation in the Labrador Sea. High-resolution increases the deep convection in the Labrador Sea but decreases convection in the GIN-Sea. The convection in the Labrador Sea is largely governed by the ocean heat release to the atmosphere in the convection area. Northwesterly atmospheric flows, which are often connected to a positive state of the North Atlantic Oscillation, increase the ocean heat release and thus the density of the ocean surface. The high-resolution models show stronger surface heat fluxes than the standard resolution models in the convection areas, which agrees with the stronger convection in the Labrador Sea. Also in the GIN-Seas, high resolution leads to an increased ocean heat release to the atmosphere. However, here, the relation between surface heat fluxes and convection is strongly model dependent.

Ongoing work investigates the impact of high resolution on the freshwater transports into the convection regions and on the linkage between deep water convection and the AMOC.