Geophysical Research Abstracts
Vol. 19, EGU2017-8334, 2017
EGU General Assembly 2017

The interplay between eddies, deep convection and sinking of dense water in an idealized model study of the Labrador Sea

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The Atlantic Meridional Overturning Circulation (AMOC) is of paramount importance for climate. Open ocean convection in the Labrador Sea plays a major role in the functioning of the AMOC. Historically, the connection between the formation of dense water in the interior of the Labrador Sea and its sinking was thought to be direct. However, recent studies indicate that this connection may not be straightforward and that the eddies play an important role. In particular, eddies transfer heat between the boundary current and the cooling region by lateral turbulent buoyancy fluxes. The aim of this study is to address the impact of the eddies on deep convection and sinking in the North Atlantic with a focus on the Labrador Sea where strong mesoscale activity occurs. For that, an idealized eddy-resolving configuration (MITgcm) is employed for the Labrador Sea region. The model output demonstrates a good agreement with observations and provides an excellent platform to examine the interplay between eddies, ocean convection and sinking of dense water masses in the Labrador Sea. The sensitivity of the characteristics of the deep convection and the sinking of the dense water with respect to surface fluxes and lateral heat fluxes is examined. It is shown that the presence of eddies limits the mixed layer deepening, reduces the convection volume and affects the magnitude and location of the sinking. In addition, it is shown that the sinking of dense water occurs near the boundaries and it is investigated to which extent it is governed by the alongshore density differences. To estimate the influence of climate change, we perform sensitivity simulations with altered surface fluxes according to future projections. Our results are relevant to the general understanding of the dynamics that are involved in the deep convection and the sinking in the Labrador Sea, especially in a changing environment.