Geophysical Research Abstracts
Vol. 13, EGU2011-5721, 2011
EGU General Assembly 2011

Can eddies affect the freshwater distribution and the reaction of the MOC in Greenland melting scenarios?

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What will be the effects of accelerated melting of the Greenland ice sheet on the global ocean circulation, in particular the Atlantic Meridional Overturning Circulation (AMOC)? Since melt water run-off in the subarctic North Atlantic is primarily entrained in the boundary current system along the continental shelves, its impact on deep water formation by open ocean convection, e.g., in the Labrador Sea, may strongly depend on the effectiveness and location of lateral exchanges with the ocean interior. Here we use a set of global ocean-only model experiments differing in horizontal resolution to study the role of mesocale eddy processes in idealised melting scenarios (continuous run-off of 0.1 Sv equally distributed around Greenland). The models are based on different NEMO-ORCA configurations developed in the European Drakkar collaboration with global grid sizes of 0.5° and 0.25°; in addition, a new model version with a 1/20°-nest for the subarctic Atlantic has been set up to explicitly resolve the major part of the eddy spectrum. Atmospheric forcing builds on the bulk formulations and atmospheric data for 1948-2007 developed by Large and Yeager ("CORE"-forcing), with only a very weak relaxation of sea surface salinity to avoid spurious model drift. Control simulations (hindcasts without additional run-off) show a decadal variability of the MOC of O(2 Sv) associated with NAO-related convection variability. In the melt water runs, the 0.5°-model shows a reduction of the MOC by more than 40% over 40 years, due to a rapid collapse of the deep convection in the Labrador Sea within the first 5 years after the start of the hosing. In the (weakly-eddying) 0.25°-case, the MOC-behaviour is still rather similar; however, a passive tracer introduced to track the spreading of Greenland melt water gives first hints of the importance of eddies: whereas in the coarse model the convective region in the Labrador Sea is rapidly swamped by the Greenland water, in the the eddy-permitting model much of it is remains in the cyclonic boundary current system, delaying the effect on the convection in the Labrador Sea. The preliminary results thus suggest that the convective area may effectively be shielded in the real ocean, in contrast to the behaviour of current climate models; a more quantitative assessment of this effect is expected from the ongoing experiments with the more realistic 1/20°-model.