Geophysical Research Abstracts, Vol. 9, 01123, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01123

Variability of the Atlantic meridional overturning circulation in a global atmosphere-ocean global coupled model

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A number of preindustrial, transient and stabilisation climate experiments were conducted with the third version of the CNRM global atmosphere-ocean-sea ice coupled model (CNRM-CM3) for the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4). Among these simulations, we first focus on the CNRM-CM3 preindustrial experiment, in order to investigate the physical processes involved in the variability of the Atlantic Meridional Overturning Circulation (MOC). Three ocean convection sites are simulated, in the Labrador, Irminger and Greenland-Iceland-Norwegian (GIN) Seas, and a further analysis highlights an atmosphere-ice-ocean coupled mechanism involving the variability of oceanic convection, consistently with available observational data. Convection interacts with the thermohaline circulation on a timescale of 5 to 10 years, which translates into meridional overturning circulation anomalies propagating southward from the convection sites. Then, in order to assess to what extent this simulated variability and the mean climate may be affected in a warmer climate, we focused on the CNRM-CM3 SRES-A1B stabilisation experiment (years 2100-2299). In our model, global warming implies a reduction in the rate of deepwater formation (essentially due to a shutdown of convection in the Labrador Sea), and subsequently a slowdown of the thermohaline circulation. This can be explained by a positive feedback involving a strong increase of the freshwater outflow through Fram Strait. However, even though the MOC is significantly weaker in the

A1B stabilisation than in the preindustrial experiment, the mechanism controlling its variability is robust.