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The variability of the North Atlantic deep water formation and the Atlantic meridional overturning circulation during the last millennium

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The main modes of variability of North Atlantic convection and of the Atlantic Meridional Overturning Circulation (AMOC) are analyzed in two climate simulations of the last millennium and two IPCC scenarios (A2 and B2) performed with the Atmosphere Ocean General Circulation Model (AOGCM) ECHO-G. In agreement with the observations, the mean convection pattern shows three main areas: the Greenland-Iceland-Norway (GIN) seas, the Irminger sea, and the Labrador sea. Their associated time series indicate a reduction of 20-30% in GIN seas convection in the climate change simulations, but no clear trend in the Labrador and the Irminger regions. A Principal Components Analysis (PCA) supports the weakening of the GIN seas convection, and suggests shared variability between the Labrador and the Irminger regions. The mechanisms behind the main modes of convection obtained through the PCA are investigated. The mean AMOC streamfunction shows a realistic circulation, in accordance with estimates. A weakening in North Atlantic Deep Water (NADW) formation is found in future simulations, in agreement with the weakening of convection in the GIN seas. PCA of the AMOC streamfunction suggests the existence of different mechanisms operating in the NADW formation variability at low and high frequencies. An attempt to understand this issue will be made in future work. In general, both convection and the AMOC strength show a weak response to the forcing during last millennium, and a larger response in future scenarios.