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Changes of the Atlantic Thermohaline Circulation under different atmospheric CO_2 scenarios in a climate model

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Changes of the thermohaline circulation (THC) due to increased CO_2 in the atmosphere play an important role in the future climate. A coupled climate model developed at Max-Planck Institute for Meteorology is used to study the variation of THC strength, the changes of North Atlantic Deep Water (NADW) formation and the regional responses of the THC in the North Atlantic to increased Atmospheric $CO_{2.}$From 2000 to 2100, under increased CO_2 scenarios (B1, A1B and A2), the strength of THC decreases by 4Sv, 5.1Sv and 5.2Sv respectively, or equivalently by 20%, 25% and 25.1% of the present THC strength. Analyses show that oceanic deep convective activity strengthens significantly in the Greenland–Iceland–Norway (GIN) Seas owing to saltier (denser) upper oceans, but weakens in the Labrador Sea and the Irminger Sea because of surface warming and freshening due to global warming. The relatively high salinity of the GIN Seas is mainly caused by the increase of the saline North Atlantic inflow through Faro-Bank (FB) Channel. Deep water is formed from three sources in North Atlantic, which are convection in Labrador Sea, two outflows (of Denmark Strait and FB Channel) and entrainment in the Irminger Sea. In the 20th century, in total approximate 16.2Sv deep water are formed in the Labrador sea (8.2Sv)by convection, both outflows(5.9Sv),and entrainment (2.1Sv) in the Irminger Sea. In the 21st century under the A1B scenario, approximate 13.7Sv deep water are formed in the Labrador sea (5.2Sv) by convection, both outflow (7.1Sv), and entrainment (1.6Sv) in the Irminger Sea.