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# On the reduced sensitivity of the Atlantic overturning to Greenland ice sheet melting in projections: a multi-model assessment

Didier Swingedouw (1), Christian Rodehacke (2), Steffen Olsen (2), Matthew Menary (3), Yongqi Gao (4), Uwe Mikolajewicz (5), and Juliette Mignot (6)

(1) EPOC - University of Bordeaux (didier.swingedouw@u-bordeaux1.fr), (2) DMI, Copenhagen, Denmark, (3) Hadley Centre, Exeter, UK, (4) NERSC, Bergen, Norway, (5) Max-Planck-Institut für Meteorologie, Hamburg, Germany, (6) LOCEAN/IPSL, UPMC/CNRS/IRD, Paris, France

Large uncertainties exist concerning the impact of Greenland ice sheet melting on the Atlantic meridional overturning circulation (AMOC) in the future, partly due to different sensitivity of the AMOC to freshwater input in the North Atlantic among climate models. Here we analyse five projections from different coupled ocean-atmosphere models with an additional 0.1 Sv of freshwater released around Greenland between 2050 and 2089. We find on average a further weakening of the AMOC at 26°N of 1.1 $\pm$ 0.6 Sv representing a 27 $\pm$ 14% supplementary weakening in 2080-2089, as compared to the weakening relative to 2006-2015 due to the effect of the external forcing only. This weakening is lower than what has been found with the same ensemble of models in an identical experimental set-up but under recent historical conditions. This lower sensitivity in a warmer world is explained by two main factors. First, a tendency of decoupling is observed between the surface and the deep ocean caused by an increased thermal stratification in the North Atlantic under the effect of global warming. This induces a shoaling of ocean deep ventilation through convection hence ventilating only intermediate levels. The second important effect concerns the so-called Canary Current freshwater leakage; a process by which additionally released freshwater in the North Atlantic leaks along the Canary Current and escapes the convection zones towards the subtropical area. This leakage is increasing in a warming climate, which is a consequence of decreasing gyres asymmetry due to changes in Ekman pumping. We propose that these changes are related with the northward shift of the jet stream in a warmer world. For these two reasons the AMOC is less susceptible to freshwater perturbations (near the deep water formation sides) in the North Atlantic as compared to the recent historical climate conditions. Finally, we propose a bilinear model that accounts for the two former processes to explain the decrease in AMOC sensitivity to freshwater input. From this model, we find that 60% of the reduction in sensitivity of the AMOC is related with the change in gyre asymmetry and freshwater leakage and 40% is due to the reduction in deep ocean ventilation associated with the increased stratification in the North Atlantic.