Oceanic and atmospheric response to Western Antarctic Ice Sheet Collapse during Last Interglacial

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Abstract

Proxy evidence suggests global mean sea levels (GMSL) during the Last Interglacial (LIG, ~130-115kyr B.P.) about 6-9 m higher than present day, of which melting of the Greenland Ice Sheet might have contributed only 1.5-2m and both ocean steric effects and melting of land based glaciers around 1.5m respectively. The source of the remaining sea level rise would be any additional contribution from the Antarctic Ice Sheet (AIS). Observations and model simulations indicate that strong subsurface oceanic warming is essential to destabilize the West Antarctic Ice Sheet (WAIS). A WAIS retreat/collapse could account for the majority of sea level rise during the LIG. In order to investigate the oceanic and atmospheric response to a potential WAIS collapse during the LIG, we conduct sensitivity simulations with the unstructured climate model ECHAM6-FESOM deriving the AIS boundary condition from the output of 3-D thermomechanical ice sheet model, which exhibits LIG WAIS collapse due to oceanic warming. The 3-D ISM boundary conditions include an oceanic gateway which formed between the Ross Sea and Weddell Sea due to the WAIS collapse, connecting the southern Pacific and Atlantic oceans. Our sensitivity simulations indicate that the formation of this oceanic gateway enhances the bottom water formation processes due to direct atmospheric cooling in the respective region. Therefore, the lower cell of Global Meridional Overturning Circulation (GMOC) near the Antarctic enhances by more than 5Sv. Changes in the Antarctic bottom water formation sites also impact on the circulation patterns in the North Atlantic by atmospheric and oceanic pathways, the upper cell of GMOC increases about 3Sv.

Keywords: WAIS collapse, opened new ocean gateway, enhanced GMOC

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