



Understanding multi-millennial variability in the Southern Ocean

Anna Höse^{1,2,3}, Matteo Willeit³, Georg Feulner^{3,2}, and Alexander Robinson¹

¹Alfred Wegener Institute, Polar Terrestrial Environmental Systems, Potsdam, Germany

²Institute of Physics and Astronomy, University of Potsdam, Potsdam, Germany

³Potsdam-Institute for Climate Impact Research (PIK), Member of the Leibniz Association, Potsdam, Germany

Temperature reconstructions from Greenland and Antarctica during glacial times show anti-phased oscillations which are assumed to be connected to changes in ocean circulation patterns. However, the research focus of most studies is set to the Northern Hemisphere, connecting Dansgaard-Oeschger (DO) events to changes of the Atlantic Meridional Overturning Circulation (AMOC). Meanwhile, in the Southern Ocean (SO), millennial-scale oscillations, driven by changes in the formation of deep water, have been found in different climate model simulations, yet the exact mechanism leading to these changes is still not fully understood. These oscillations, diagnosed by the strength of Antarctic Bottom Water (AABW) formation, have been simulated under warmer climate conditions and also in experiments with additional freshwater input to the North Atlantic. Here we present results of multi-millennial experiments with the fast Earth system model CLIMBER-X and the coarse resolution General Circulation Model (GCM) CM2Mc in which the AMOC is collapsed by freshwater forcing in the north Atlantic and convection is eventually triggered in the SO. We aim to find the drivers of convection onset in the SO and the subsequent strengthening of AABW by analysing the changes of temperature and salinities in both models. Between the two models, we compare how the dynamics of features such as sea-ice, wind stress and thermodynamic ocean variables contribute to changes of SO convection and AABW formation. We also analyze additional sensitivity experiments with CLIMBER-X to explore which conditions lead to oscillations.