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Ocean response to natural and anthropogenic forcings in an ensemble of 1500 to 2100 AD simulations

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The climatic response to greenhouse gases (GHGs), solar and volcanic forcing has been intensively investigated in the last decades. Since anthropogenic emissions of GHGs are still increasing, a deeper understanding of the impacts for the different forcing sources – especially GHGs - is even more essential. So far, most studies have investigated the climatic response over the late Holocene from an atmospheric perspective. In this work, we will concentrate our analysis on the ocean and its response.
The model used is the NCAR community climate system model (CCSM, version 3) in its lowest resolution (T31, gx3v5). The CCSM3 is a fully coupled model and consists of atmosphere, ocean, land, and sea ice components. There are three different forcing types implemented, namely solar, volcanic and GHGs. An ensemble of four 1500 to 2100 AD simulations and one 1000 to 2100 AD simulation were conducted, using the SRES scenario A2 in the 21th century. To remove a small longterm trend in the transient simulations, two control simulations with constant 1500 AD resp. 1000 AD forcing are used. Preliminary results show the most pronounced responses in the A2 scenario part, e.g. a strong increase of the global mean sea surface temperature and a weakening of the ensemble mean meridional overturning circulation (MOC). Up to the end of the 20th century, the strength of the MOC remains within a band of 16 to 18 Sverdrup, whereas in the 21th century it continually decreases to 14 Sverdrup. The goals of this study are to investigate the forcing impact on the ocean, and to find the response pattern and the corresponding time scales for each of the three forcing types.