3rd International Conference on Earth System Modelling
Vol. , 3ICESM-298, 2012
3rd International Conference on Earth System Modelling

Trends in the North Atlantic CO_2 uptake and their correlation to ocean circulation and stratification as simulated by the Bergen Climate Model

N. Goris (1,2), C. Heinze (1,2), J. Tjiputra (1,2), J. Schwinger (1,2)

(1) University of Bergen, Geophysical Institute, Bergen, Norway (nadine.goris@gfi.uib.no), (2) Bjerknes Centre for Climate Research, Bergen, Norway

Most of the Earth System Models as employed for the IPCC Fourth Assessment Report simulate a decreasing Atlantic Meridional Overturning Circulation (AMOC) during the course of the 21st century. While a few of these simulations show a reduction in the AMOC of up to 50%, the majority of the models predicts a relatively small reduction. Yet this reduction is of high importance, since the AMOC is a crucial component of global climate change. A decreasing AMOC is accompanied by a decreasing vertical ocean circulation and an increasing ocean stratification in the North Atlantic. As parts of the physical pump of carbon dioxide both vertical ocean circulation and ocean stratification affect the oceanic CO_2-uptake. Further, the effectiveness of the oceanic CO_2-uptake is regulated by biologically mediated processes. Quantifying the relation between CO_2-uptake and ocean circulation and stratification therefore is of high relevance for predicting future climate developments. Here, the North Atlantic as one of the most important carbon sinks is of special interest.

In order to verify and moreover quantify the above mentioned relationships, our presented study analyses the outcome of two simulations with the Bergen Climate Model (BCM-C). Both simulations are operated for the period of 1850-2099 and apply only anthropogenic CO_2 emissions as forcing. While the first simulation applies a constant forcing of 284.7ppm CO_2 for the period of 1850-2099, the second simulation utilizes varying carbon emissions based on observed records for the period of 1850-1999 as well as the IPCC SRES-A2-emission scenario for the period of 2000-2099. The outcome of both simulations is analysed with the help of Singular Value Decomposition and Empirical Orthogonal Functions. Shared spatial correlations and correlated trends are identified for vertical oceanic circulation, stratification, pCO_2 and CO_2-flux. In this manner, the long-term relationships between the analysed variables are quantified. The discovered spatial and temporal correlations verify the importance of the AMOC for the oceanic CO_2 uptake.