Response of oceanic CO_2-uptake to climate change

T. CRUEGER[1], E. ROECKNER [1], T. RADDATZ [2], R. SCHNUR[1] AND P. WETZEL[1]

[1] Max Planck Institute for Meteorology, Hamburg, Germany, crueger@dkrz.de, roeckner@dkrz.de, schnur@dkrz.de, wetzel@dkrz.de

[2] Max Planck Institute for Biogeochemistry, Jena, Germany, raddatz@dkrz.de

The increase of atmospheric CO_2 due to anthropogenic activity is substantially damped by CO_2 fluxes into the ocean. Besides the atmospheric CO_2 concentration, the uptake depends on the state of the ocean, which in turn is influenced by climate change.

Here, we assess the response of future oceanic CO_2 uptake to climate change. For that reason we evaluate two simulations of a version of the Max Planck Institute Earth System Model (MPI-ESM), consisting of the atmosphere, the ocean with biogeochemistry and land surface performed from 1860 until 2100. Both simulations are driven with observed CO_2 emissions between 1860 until 2000. Afterwards the CO_2 emissions of the IPCC scenario A2 are assumed. Whereas one simulation allows the feedback between atmospheric CO_2 concentration and climate, the other artificially surpresses it.

Both simulations show a nearly linearly increased CO_2 uptake of the oceans from 1960 until around 2070 to about 4.5 GT/yr. From then on, the rise of the globally integrated uptake in the climate change run strongly weakens, leading to a difference uptake rate between the two runs of about 10% at the end of the 21st century. The spatial distribution of the uptake difference between the two runs shows a pronounced pattern: In the North Atlantic and south of South America the ocean CO_2 uptake is clearly reduced in the climate change run. Smaller decreases are found in the tropical oceans. However, there are some parts of the oceans, e.g. the polar areas, where the flux into the ocean is further increased.

The potential reasons for the spatially different CO_2-flux responses to climate change are discussed.

References

[1] Maier-Reimer, E., I. Kriest, J. Segschneider, P. Wetzel (2005): *Reports on Earth System Science*, available from http://www.mpimet.mpg.de.

[2] Marsland, S. J., H. Haak, J.H. Jungclaus, M. Latif, and F. Röske (2003): *Ocean Modelling*, **5**, 91-127.

[3] Roeckner, E., G. Baeuml, L. Bonaventura, R. Brokopf, M. Esch, M. Giorgetta, S Hagemann, I. Kirchner, L. Kornblueh, E. Manzini, A. Rhodin, U. Schleese, U. Schulzweida, and A. Tompkins (2003): *Max-Planck-Institute for Meteorology, Hamburg, Germany, Report* **349**, available from http: //www.mpimet.mpg.de.