Geophysical Research Abstracts, Vol. 8, 02920, 2006
SRef-ID:

Modelling carbon cycle-climate feedbacks

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The presently observed and projected future climate change poses a substantial risk to the human society. Response strategies to mitigate greenhouse gas emissions and to adapt to climate change require scientific information based on our best understanding of the Earth System. It is key for climate change projections to understand how the present marine and terrestrial carbon sinks will evolve in the future under rising atmospheric carbon dioxide (CO_2) and climate change, and how climate change itself will affect atmospheric CO_2.

We use the NCAR coupled ocean-atmosphere climate carbon cycle model (CSM1.4-carbon) to study carbon cycle-climate interactions over the industrial period until 2100. The spectral resolution of the model is T31. Representations of terrestrial and oceanic biogeochemical cycles are embedded into CSM1.4-carbon. The biogeochemical models include explicit land water-carbon coupling, dynamic carbon allocation to leaf, root and wood, prognostic leaf phenology, multiple soil detrial carbon pools, oceanic iron limitation, a full ocean iron cycle, and a 3-D atmospheric CO_2 transport. This biogeochemical version of CSM1.4 has been installed on the IBM SP4 at the Swiss National Supercomputer Centre in Manno, where all simulations will be run with 32 processors. The integration time for one model month is approximately 10 minutes.

A scenario with fossil carbon emissions only and a corresponding control simulation is currently running. First results for anthropogenic carbon and marine biogeochemical tracers will be discussed. Other simulations, including forcing from a range of natural and anthropogenic factors (CH_4, N_2O, sulfur, solar, volcanic), will be performed in the coming months and we expect to be able to present first scientific analyses of the results.