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Implementing Peat Accumulation and Methanogenesis into the Earth System Model ECHAM6/MPIOM

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Wetlands of the northern high latitudes provide excellent conditions for peat accumulation and methanogenesis. High moisture and low O2 content in the soils lead to effective preservation of soil organic matter. Boreal Wetlands contain one-third of the global soil carbon (∼450 PgC) and currently constitute a significant natural source of methane (CH4) even though they cover only 3% of the global land surface.
While storing carbon, boreal wetlands have contributed to global cooling on millennial timescales. Undisturbed boreal wetlands are likely to continue functioning as a net carbon sink. On the other hand these carbon pools are sensitive to climate change since the ratio of carbon sequestration and emission is closely dependent on hydrology and temperature. These in turn may be altered significantly in the future. As a result northern wetlands could have a large impact on carbon cycle-climate feedback mechanisms and therefore play an important role when modelling carbon cycle dynamics on a global scale.

The global biogeochemistry models used for simulations of CO2 dynamics in past and future climates usually ignore wetland carbon cycle dynamics, despite their potential for large feedbacks to the climate system. The integration of boreal wetlands in climate models therefore is vital for better predictions of future climate change.

We investigate the potential for positive or negative feedbacks to the climate system through sequestration and emission of greenhouse gases (CO2 and CH4) with the general circulation model ECHAM6/MPIOM. A generic model of peat accumulation and decay, as well as methanogenesis, are at the moment being implemented into the land surface module JSBACH.
Our approach aims at the evaluation of the feedback of boreal wetlands on climate through CO2 and CH4 fluxes on decadal to millennial time scales and at the application of the wetland model to past (time slice experiments) and future (transient runs) climate simulations. As prototypes we use the modelling approaches by Frolking et al. (2001) as well as Walter & Heimann (2001) for the peat dynamics, and the wetland model by Wania (2007) for vegetation cover and methane emissions. An initial distribution of wetlands follows the GLWD-3 map by Lehner and Döll (2004).

This wetlands model is under development at the MPI for Meteorology in close cooperation with the University of Helsinki.
For validation, the modelled peat accumulation, as well as GHGs emissions, will be compared to measurements from oligotrophic mire sites in Western Siberia, North America and Finland.

REFERENCES

S. Frolking et al., Ecosystems 4, 479–498 (2001).
B. Lehner et al., Journal of Hydrology 296, 1–22 (2004).
B. P. Walter et al., Journal of Geophysical Research 106, 34,189–34,206 (2001).
R. Wania, Dissertation University of Bristol, 122 p. (2007).