Geophysical Research Abstracts
Vol. 12, EGU2010-11531, 2010
EGU General Assembly 2010

The role of peatlands in interglacial Carbon cycle dynamics – a modelling perspective

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Arctic and Boreal peatlands cover about 3% of the Earth's land surface area only, but they contain substantial amounts of carbon. Estimates of peat accumulated during the Holocene reach up to 450 GtC. On longer timescales the carbon uptake by peatlands therefore becomes a cumulative flux of substantial magnitude, though it is rather small if one considers the short timescales only. We will present results showing the influence of the carbon uptake by peatlands on Holocene CO_2 concentrations.

Using the coupled climate carbon cycle model CLIMBER2-LPJ we are considering all natural factors influencing the atmospheric CO_2 concentration, including carbon uptake by peatlands. CLIMBER2 is a climate model of intermediate complexity, containing a dynamic atmosphere and ocean, as well as sea ice and land surface modules. Its coarse spatial resolution leads to a high computational efficiency, which allows long-term transient integrations of the coupled model. Land carbon dynamics are computed using the dynamic global vegetation model LPJ. LPJ is run at a high spatial resolution of 0.5° and coupled to CLIMBER2 using the climate anomalies approach. Changes in land carbon storage as a response to changes in climate or atmospheric CO_2 are therefore taken into account interactively at high spatial resolution.

While it is easily possible to consider the influence of peat formation on the carbon cycle during the Holocene by using external scenarios of peat accumulation, this approach is not viable for previous interglacials. Most peat deposits accumulated during previous interglacials were removed in the course of glaciation, and we therefore have no estimates to base external scenarios on. In order to consider this forcing in models, it is therefore necessary to incorporate peat formation into global models dynamically.

Integrating peatland dynamics into dynamic global vegetation models is a non-trivial problem due to the coarse representation of the land surface. Since wetland and therefore peatland size often is substantially smaller than the model grid cells, the dynamic representation of wetland extent can only be accomplished by incorporating sub-gridcell information on hydrological properties of the land surface. We will present the approach we have taken for integrating peat dynamics into the DGVM LPJ, consisting of a scheme for the dynamical determination of wetland extent based on high resolution topographical data, and the carbon dynamics occurring in peatlands.

We will finish the presentation by showing model results for peat dynamics during the previous interglacial, the Eemian.