Geophysical Research Abstracts
Vol. 16, EGU2014-14450, 2014
EGU General Assembly 2014

Difference in explanations of CO_2 flux and ecosystem dynamics between five European open peatlands – Merging data and process oriented modelling

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Five different open peatland systems across Europe with a wide gradient in landuse intensity, water table depth, soil fertility and climate were simulated with the process oriented CoupModel. The aim of the study was to find out to what extent the sites differ in respect to carbon dioxide (CO_2) fluxes and related processes. Therefore the model was calibrated to fit to measured CO_2 fluxes, soil temperature, snow depth and leaf area index (LAI) and differences in model parameters were analysed. Finding a site independent configuration would mean that the differences in the measurements can be solely explained by the model input parameters: water table, metrological data, management and soil inventory data. In general a good explanation to the seasonality of various major fluxes was obtained. Differences between sites were found for parameters related to photosynthetic efficiency, the rate of soil organic decomposition and the regulation of mobile carbon (C) pool from senescence to shooting in the next year.

The largest difference between the sites was the high rate of heterotrophic respiration from the managed grassland sites that were both strong source for CO_2 emissions. All unmanaged and abandoned sites showed a tendency to be sinks for carbon because of the high water level and low decomposition rates. A common model for the timing of emergence and senescence and minimum temperature for photosynthesis could be applied even though the gradient in site latitude ranged from northern Finland to South-Germany. Also a common water and temperature response for decomposition could be used for all sites. However the possibility to constrain parameters in respect to water response was limited due to either very low water table fluctuation on some sites or low measurement frequency on others.

The model had limitations in explaining the very high respiration losses in summer and corresponding low respiration in winter for the managed grassland sites.

At the Dutch site, the high LAI values in combination with low GPP could not be described by the model.

A new model configuration using more than one plant layer and more than one active organic substrate will be required for a more detailed description of the differences between the sites.