Geophysical Research Abstracts
Vol. 12, EGU2010-15587, 2010
EGU General Assembly 2010

Long term effects of fen restoration: Parameterization of net ecosystem exchange models along a land use-degradation gradient

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In combination with fluctuating water regimes and extreme variations in weather conditions expected through climate change, continual disturbance to the soils through peat use poses a risk to the carbon storage capacities and sequestration potentials of peatlands. Restoration and/ or extensive use of peatlands are strategies to optimize vegetation and hydrological balance within these sensitive ecosystems. Our goal was to determine the long term effects of fen restoration on CO_2 fluxes and to identify the driving parameters causing differential fluxes along a disturbance gradient. This study aimed specifically to provide a CO_2-C flux dataset to determine net ecosystem exchange (NEE) in restored temperate fens ecosystems. A climate controlled chamber system was used for measuring instantaneous NEE over the entire year in the Donauried in 2005 and in the Loisach-Kochelsee fens in 2006, both in southern Germany. The sites were chosen to represent both a management gradient (from intensive grasslands and crops to long-term restored Carex lawns) and a water table gradient (-78 cm below surface to -1 cm below surface). NEE was measured using the closed chamber technique, allowing for separation of NEE into gross ecosystem production (GEP) and ecosystem respiration (Reco). In both study areas, management strongly influenced ecosystem respiration and GPP and thus NEE, where Reco remained a strong determinant of NEE balances. Whereas the managed-degraded sites are acting as sources of CO_2, a positive effect of restoration is seen in terms of NEE exchange. The restored sites are either acting as significant sinks for CO_2 (Donauried old restored sites) or are have significantly lower emissions as the managed-degraded sites. NEE values ranged from 1041 g CO_2-C m^2 a^1source to the atmosphere in a two cut grassland to a -130 g CO_2-C m^2 a^1sinkin the long-term restored unmanaged *Carex paniculata* site. Reco was highest in grassland sites and lowest in the restored Carex sites. A micro-water table gradient in the restored sites offered additional insight to the differential fluxes. An indication of a time effect of restoration on NEE was seen in comparing short-term and long-term restored sites. Our results indicate that shifting management intensities from intensive to extensive, as well as raising the water table to near surface levels are viable options for climate friendly peatland management.