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Turn on, fade out – methane exchange in a coastal fen over a period of six years after rewetting

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The rewetting of drained peatlands is widely regarded as an adequate measure for the mitigation of greenhouse gas emissions. Therefore, especially in NE Germany, many peatlands are being rewetted. Our knowledge about greenhouse gas exchange associated with rewetting is mainly based on short-term experiments or space-for-time substitutions. These approaches do not consider the transient character of ecosystem acclimatization to flooding by rewetting. Moreover data in this regard on coastal peatland ecosystems are sparse.

Here, we present 7 years of data on CH_4-exchange in a coastal fen after rewetting by flooding. On the site „Rodewiese“, which is located within the NSG "Hütelmoor und Heiligensee" in the Northeast of Rostock, NE Germany, we have established a long term research observatory addressing atmospheric C-exchange. The site is part of the TERENO network. Since summer 2009 we determine CH_4 fluxes with closed chambers distributed widely across the study site and CO_2-exchange with eddy covariance as well as ancillary data on vegetation, hydrology, and biogeochemistry. This talk addresses the CH_4-exchange over time whereas CO_2-exchange data are presented by Koebsch et al. in the same session.

Rewetting turned the site from a summer dry fen with mean annual water levels of around -0.08m into a shallow lake with water levels up to 0.60m. In the first year after flooding, we observed a substantial die-back of vegetation, especially in stands of *Carex acutiformis*. Flooding increased methane release rates to extremely high levels of up to 4.3 t ha^{-1} a^{-1} for sedge stands and 2.7 t ha^{-1} a^{-1} on average, which amounts to 75.6 t ha^{-1} a^{-1} in CO_2-equivalents. Thereafter, the averaged annual CH_4 emissions decreased asymptotically and where at an average of 0.5 t ha^{-1} a^{-1} (14 t ha^{-1} a^{-1} in CO_2-equivalents) in 2015. Factoring in the NEE of the growing season (from Eddy measurements) suggests that the system may be slightly above neutral with respect to the greenhouse warming potential of its atmospheric C-exchange 7 years after flooding. Analyses of peat and water biochemistry showed that the system had been destabilized in the first year following flooding and repeated vegetation analysis combined with remote sensing reveal strong and directed change in vegetation patterns.

The successional development in atmospheric C-exchange in the 6 years after flooding hint at an adaptation of ecosystem functioning to the flooded conditions associated with reaching desirable annual rates of C-exchange and vegetation development during an acceptable time frame. However, high CH_4 emissions and a slow recovery to lower CH_4 emissions that likely occur directly after rewetting by flooding should be considered when forecasting the overall effect of rewetting on GHG exchange of a particular site.