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Atmospheric carbon fluxes of a formerly drained fen up to 14 years after rewetting

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Drained and degraded peatlands constitute significant and long-term carbon dioxide sources and thus contribute to climate warming. In the northeast German state of Mecklenburg-Western Pomerania, an estimated 20-30 % of the statewide carbon dioxide emissions are attributed to drained peatlands and one strategy to reduce national greenhouse gas emissions is therefore the re-wetting of peatlands to restore their natural carbon sink capacity. However, the long-term evolution of carbon fluxes of rewetted fens are highly site specific and uncertainty remains with regard to if and when such sites turn into carbon sinks.

Surface-atmosphere fluxes of CO_2 and CH4 were measured at “Polder Zarnekow” (Fluxnet ID: DE-Zrk), a formerly drained and rewetted rich fen located in the Peene River valley. Draining of the fen began in the 18th century and was intensified between 1960 and 1990, when the water table was lowered to > 1 m below the surface. Mineralization of the peat caused the surface to subside to levels below the adjoining Peene River. The site was rewetted by inundation during the winter of 2004/2005 and a shallow lake with a fluctuating water table of up to 1.2 m depth and an area of about 7 ha developed. A layer of organic sediment formed at the bottom of the lake, which originated from the fen’s former vegetation and has since been annually replenished by dying aquatic plants and helophytes.

A first observation period predating the establishment of the current infrastructure covers the years 2007–2009 and continuous monitoring has been ongoing since 2013. Preliminary results suggest that methane emissions are remaining high (28-39 g m-2 y-2) while CO_2 effluxes show a declining trend eventually turning the site from a CO_2 source to a CO_2 sink in 2018.

We present a time series of surface-atmosphere carbon fluxes and annual carbon balances (excluding lateral transport) from 2014 to 2018. Drivers of the turbulent fluxes are analysed on various time scales and the role of observed temporary summertime drying of the lake in the net carbon balance is analyzed.