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# Water table depth regulates evapotranspiration and methane flux of a near-pristine temperate lowland fen measured by eddy covariance and static chambers

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Methane is the second most important greenhouse gas after carbon dioxide, although the current atmospheric concentration is only about two parts per million. This results from a radiative forcing of 0.48 +/-0.05 $Wm^{-2}$, about 26 times that of carbon dioxide. Atmospheric concentrations as well as emissions to the atmosphere have been increasing strongly over the last decades. Emissions are to a large extent biogenic where the largest biogenic source, wetlands, has the largest uncertainty. This precludes the construction of a reliable global methane budget, as well as meaningful predictions, as results from wetland models are uncertain and there are insufficient data for model improvement. We measured evapotranspiration and methane flux of a near-pristine temperate lowland fen in East Anglia in the United Kingdom from July 2013 to June 2014 by eddy covariance, which represents the first annual cycle of eddy covariance measurements of methane flux in this category of wetland. Methane fluxes from vegetation and ditches were additionally measured separately with static chambers. Annual evapotranspiration was 720.4 to 732.6 mm $yr^{-1}$. Annual methane release was 3.77 to 4.03 g $CH_4$ $m^{-2}$ $yr^{-1}$. Water table and methane fluxes were very different in the two half years: an average of -0.63 nmol $CH_4$ $m^{-2}s^{-1}$ (a net uptake) for July-December 2013 and 16.2 nmol $CH_4$ $m^{-2}s^{-1}$ (a net release) for January-June 2014 with a data range of -99 to 410 nmol $CH_4$ $m^{-2}s^{-1}$ over the full year. Water table has the dominant role in determining methane flux and, under a very low water table, methane uptake was observed. Temperature has a clear impact on fluxes at high water tables. Eddy covariance and chamber measurements show the same annual pattern flux magnitude throughout the year. The fen can switch from being a source to a sink if the water table changes over a small critical depth range. Our measurements have implications for large scale wetland restoration plans in the eastern UK and potential options for the management of methane emissions from wetlands.