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A simple calculation algorithm to separate high-resolution CH4 flux measurements into ebullition and diffusion-derived components

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Processes driving methane (CH4) emissions in wetland ecosystems are highly complex. Especially, the separation of CH4 emissions into ebullition and diffusion derived flux components, a perquisite for the mechanistic process understanding and identification of potential environmental driver is rather challenging.

We present a simple calculation algorithm, based on an adaptive R-script, which separates open-water, closed chamber CH4 flux measurements into diffusion- and ebullition-derived components. Hence, flux component specific dynamics are revealed and potential environmental driver identified.

Flux separation is based on a statistical approach, using ebullition related sudden concentration changes obtained during high resolution CH4 concentration measurements. By applying the lower and upper quartile $\pm$ the interquartile range (IQR) as a variable threshold, diffusion dominated periods of the flux measurement are filtered. Subsequently, flux calculation and separation is performed. The algorithm was verified in a laboratory experiment and tested under field conditions, using flux measurement data (July to September 2013) from a flooded, former fen grassland site.

Erratic ebullition events contributed 46% to total CH4 emissions, which is comparable to values reported by literature. Additionally, a shift in the diurnal trend of diffusive fluxes throughout the measurement period, driven by the water temperature gradient, was revealed.