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Using "snapshot" measurements of CH4 fluxes from peatlands to estimate annual budgets: interpolation vs. modelling.

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There is growing interest in estimating annual budgets of peatland-atmosphere carbon dioxide (CO_2) and methane (CH_4) exchanges. Such budgeting is required for calculating peatland carbon balance and the radiative forcing impact of peatlands on climate. There have been multiple approaches used to estimate CO_2 budgets; however, there is a limited literature regarding the modelling of annual CH_4 budgets. Using data collected from flux chamber tests in an area of blanket peatland in North Wales, we compared annual estimates of peatland-atmosphere CH_4 emissions using an interpolation approach and an additive and multiplicative modelling approach.
Flux-chamber measurements represent a snapshot of the conditions on a particular site. In contrast to CO_2, most studies that have estimated the time-integrated flux of CH_4 have not used models. Typically, linear interpolation is used to estimate CH_4 fluxes during the time periods between flux-chamber measurements. It is unclear how much error is involved with such a simple integration method. CH_4 fluxes generally show a rise followed by a fall through the growing season that may be captured reasonably well by interpolation, provided there are sufficiently frequent measurements. However, day-to-day and week-to-week variability is also often evident in CH_4 flux data, and will not necessarily be properly represented by interpolation. Our fits of the CH_4 flux models yielded $r^2 > 0.5$ in 38 of the 48 models constructed, with 55% of these having a weighted $r_w^2 > 0.4$. Comparison of annualised CH_4 fluxes estimated by interpolation and modelling reveals no correlation between the two data sets; indeed, in some cases even the sign of the flux differs. The difference between the methods seems also to be related to the size of the flux - for modest annual fluxes there is a fairly even scatter of points around the 1:1 line, whereas when the modelled fluxes are high, the corresponding interpolated fluxes tend to be low. We consider the implications of these results for the calculation of the radiative forcing effect of peatlands.