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Point source emission estimation through eddy covariance: validation using an artificial source experiment

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Eddy covariance is increasingly used to monitor cattle emissions. However, these sources are only intermittently present in the footprint area, due to the movement of the source and to wind characteristics variations within one averaging period. The assumption of flux stationarity is thus breached and it is unclear how well the covariance of the scalar concentration and the vertical wind component at the measurement point is representative of the true flux. Moreover, the calculation of the source emission from the measured flux relies on the use of a footprint model and those models are insufficiently validated.
In this study (Dumortier et al., 2019), we used a single known artificial point source placed at cow's muzzle height in order to assess the impact of the flux calculation method (averaging method, averaging period, quality filters) and of the footprint model on the emission estimates. The selected optimal combination (running mean, 15 minute averaging periods, no application of the Foken & Wichura (1996) stationarity filter, and the use of the KM (Kormann and Meixner, 2001) footprint model) led to estimated emissions between 90 and 113% of the true emission, leading to the conclusion that the use of eddy-covariance for point-source emission estimation is feasible provided an adequate calculation method is selected.
However, the two tested footprint models, KM and FFP (Flux Footprint Prediction tool (Kljun et al., 2015)), chosen for their popularity and simplicity of use both force a source at ground level and not at the actual release height of 80 cm. This element is not trivial and might largely influence the choice of the best footprint model. For instance, the better performance of the KM footprint model over FFP might come from the cancellation of two systematic errors associated with the KM footprint model, one intrinsic to the model and the other due to the influence of the source height. As a follow up of the previous study, the impact of the source height will therefore be addressed through the use of a footprint model allowing source height modification, namely the FIDES footprint model (Loubet et al., 2001).

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