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1 Reevaluation of the integrated horizontal flux approach

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The integrated horizontal flux (IHF) method is a simplified mass balance approach frequently used to determine emissions from confined source areas, e.g. NH_3 emissions from slurry spread to a circular plot (Denmead, 2008). With a mast in the center of the circle with radius R, the total flux F of the upwind emitted NH_3 is approximated from the measured vertical (z) profiles of concentration (c) and horizontal wind speed (u) as (Denmead 1983):

$$F = \frac{1}{R} \int_{z=0}^{z=z_{pl}} \overline{u\,(c - c_{bgd})} dz \tag{1}$$

where c_{bgd} is the "background" concentration upwind of the emitting area and z_{pl} is the maximum height of the emission plume (where the concentration c equals c_{bgd}).
The IHF method is a robust approach, as it is independent of surface characteristics and the state of atmospheric diffusion (Denmead, 2008; Laubach,2010). Ryden and McNeill (1984) published guidelines on how to evaluate IHF measurements, which have been used in many investigations that followed. In the following we analyze systematic biases that might occur by applying different recipes to both modelled concentration profiles as well as measured profiles from a recent field experiment in the Netherlands.

Typical differencs using the approach by Ryden et al. (1984) are in the order +10% to +30% compared to the reference values from the model or alternative determination of the emissions based on the experimental values. The positive biases consist of several contributions: horizontal diffusion, logarithmic fit of the concentration profile, displacement height.

References

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