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Atmospheric Measurement Techniques Discussions

Interactive comment on "Areal-averaged trace gas emission rates from long-range open-path measurements in stable boundary layer conditions" *by* K. Schäfer et al.

Anonymous Referee #2

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General comments

The manuscript addresses the important question how to quantify emission rates of trace gases like NH3 or N2O as spatial averages over areas of one ha or more. The authors state that this can be more readily done using spatial-integrating micro-meteorological methods than the widely-utilized small chamber measurements. This statement, for which they do not come up with a justification from their own original research, forms their motivation to evaluate several micro-meteorological flux-gradient methods utilizing non-intrusive path-averaging measurement methods for determining land-surface emission rates of trace gases under stable boundary layers. The au-

thors correctly state that successful application of a flux-gradient method requires confidence in the gradients of trace gas concentration and wind and in the applicability of boundary-layer turbulence theory, which is especially challenging for stable stratification.

The study is based on two experiments in Indiana (USA) and Fuhrberg (Germany). Concentration differences of N2O were measured during the Fuhrberg experiment by two bi-static open-path FTIR spectrometers applying a correction of the bias between the FTIR spectrometers. 3-D sonic anemometers were installed at the same heights as the FTIR open paths. Concentration gradients of NH3 were determined during the Indiana experiment from scanning TDLAS measurements. 3-D sonic anemometers were installed at 2.5 m, 4.4 m and 16.2 m height. The authors employ two flux-gradient methods based on Monin-Obukhov similarity theory (MOST), which assume a log-linear profile of the wind speed and concentration gradient. In addition they use a more generic flux-gradient method, which they call 'similarity' method, using turbulent diffusivity as exchange coefficient. Finally, they utilize a so-called integrated horizontal flux (IHF) method based on the product of an interpolated mass concentration distribution and interpolated wind speed normal to the measurement plane. The authors assume that the flux determined from the IHF method was closest to the actual flux.

The micro-meteorological measurements are complemented by small chamber measurements. From their quality-assured measurements the authors conclude that applying flux-gradient methods based on MOST results in incorrect vertical profiles and thus fluxes in the stable boundary layer.

In general. the manuscript should be shortened where the topics are well described in the scientific literature. The manuscript is partly confusing since the two experiments are rather different with respect to scientific objectives, study designs, instrumentations and environmental boundary conditions. I have the impression that the way in which the two experiments have been put together has to be optimized such that the reader is able to see how the authors come to their general conclusions, and which of the

results are depending on the specific site. My major concern is, however, that the manuscript is not able to prove which of the methods is most appropriate to quantify the actual fluxes. It mostly shows the similarities and dissimilarities of the different methods, and it argues on the reasons behind the findings using general statements from the scientific literature, which may probably be true, but this has not been tested by their own analyses. I therefore recommend to completely revise the manuscript not only to make it more compact and readable but to come up with scientific analyses that are, at least, clearly showing the strengths and weaknesses of the different methods.

Specific comments

Since I recommend a major revision I will not go into the details of the manuscript in its current form. Nevertheless, the authors should take the following points into consideration when revising the manuscript:

a) The English language needs improvement. b) The layout of the manuscript should be modified such that related infomation is not spread over different sections. c) The figures are partly incomplete and difficult to read.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 1459, 2012.