Using Monte Carlo simulations to estimate model bias of flux calculation from static chamber measurements

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Currently, there is no accepted international standard for flux calculations from closed static chamber measurements. When evaluating flux measurements, one has to choose a model for the time dependence of trace gas concentration. The main choice is between a linear and a non-linear approach. Although it is known that the linear model potentially underestimates absolute fluxes and several non-linear models have been available for some years, up to now the majority of research studies used the linear model. Use of linear model is often justified by the danger of overestimation of absolute fluxes, if a non-linear model is used.

The Monte Carlo method was employed to create artificial data sets with fluxes and corresponding concentration-time points exhibiting different degrees of non-linearity. Subsequently, both the linear model and the semi-empiric non-linear HMR model were applied to estimate fluxes from these concentration-time points. These estimates were then compared with the given fluxes and model bias was calculated. The results confirm that depending on the degree of non-linearity the linear model can cause a severe underestimation of mean flux values. The HMR model overestimated mean flux values. Thus, a recommendation is given how to minimize bias by choosing the model best suited for an individual flux measurement.