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Fugitive methane emissions from biogas plants - results of a field experiment

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Precise emissions from a biogas plant are very difficult to determine due to numerous heterogeneous emission sources. In the past years, attempts were undertaken to quantify single emission sources as well as overall emission from biogas plants using direct (on-site) and remote sensing methods. In order to evaluate the accuracy of the various methods intercomparison campaigns are necessary including innovative quantification approaches such as inverse dispersion modelling and dynamic tracer methods.
Here we report on an intercomparison experiment undertaken at a biogas plant in Northern Germany in October 2016. The surrounding landscape was relatively flat and uniform. There were no other methane emitting sources for several kilometres in any direction (except for some small farms 1 – 2 km north of the biogas plant). Different methods including direct (on-site, 2 institutions) and remote sensing approaches (Inverse Dispersion Technique with laser spectrometers, 3 institutions, Tracer Dispersion Method with cavity ring down spectrometer, 1 institution) were applied simultaneously to determine methane emissions from the plant. The three institutions using laser spectrometers measured the meteorological conditions in the vicinity of the plant and provided wind and turbulence information necessary for dispersion modelling with their own three-axis ultrasonic anemometers.
ZAMG did not participate in the experiment but received the results of the measurements and the meteorological data afterwards to re-calculate the overall methane emissions via an inverse dispersion technique. First, the meteorological measurements from the three sites were compared. They showed partly systematic deviations which could be explained by the immediate surroundings. Simulations with the Lagrangian particle diffusion model LASAT based on a harmonized meteorological data set were conducted in order to investigate the influence of the choice of the source configuration (Point-, Volume- and Area Sources) and the influence of the roughness length on the resulting emission rates. Another aspect was the evaluation of the laser measurements from the different teams. The aim was to reveal potential differences between the measurement teams and to give input for an intended harmonization procedure. The results of sensitivity studies, concerning the model setup and the calculation of the emission rates, will be presented.