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Towards a validation of scintillometer measurements: The LITFASS-2009 and LITFASS-2012 experiments

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Scintillometry has been increasingly used over the last decade for the experimental determination of area-averaged turbulent fluxes needed to validate the results obtained with regional atmospheric models or derived from satellite images at a horizontal scale of a few kilometres. Although the successful application seems to justify the broad use of this technique, a number of assumptions in the scintillometer data processing still call for a thorough evaluation of the scintillometer principle, in particular over heterogeneous terrain. These open issues include the spatial variability and corresponding aggregation rules for structure parameters. Moreover, a validation of the path-averaged structure parameters of temperature and humidity derived from scintillometer data by independent measurements is still missing.

A joint project coupling field measurements using eddy-covariance techniques, scintillometers and an unmanned aircraft with numerical modelling using a large-eddy simulation (LES) model has been started to treat these open questions. This combination of experimental and modelling techniques represents a unique attempt both to measure the statistics of the turbulent temperature and humidity field along a scintillometer path by airborne techniques, and to simulate the pattern of the structure parameters along this path by LES thus providing an independent evaluation of the scintillometer principle.

A first field experiment (LITFASS-2009) was performed within this project around the Meteorological Observatory Lindenberg – Richard-Aßmann-Observatory (MOL-RAO) of the German Meteorological Service (DWD) in July 2009. The experiment made use of five micrometeorological field stations (equipped i.a. with eddy-covariance systems and SLS-20/40 laser scintillometers), two large-aperture scintillometer (LAS) systems and the M2AV unmanned aircraft. Additional flights along the LAS path were performed in summer 2010. The measurements and data analysis were focused on the behaviour of the temperature structure parameter over moderately heterogeneous terrain represented by different types of agricultural farmland. A second field experiment is planned to be performed in 2012 with the focus shifted towards increased terrain heterogeneity (including patches of forest and open water) and also considering the humidity structure parameter and the relation between the turbulent temperature and humidity fields.

The presentation will give an overview on the project strategy and on the design of the field experiments. Exemplary results from the 2009 and 2010 field campaigns will be shown. These include the variability of the temperature structure parameter in the study area and the intercomparison of the different measurement techniques. An outlook will be given at the LITFASS-2012 experiment.