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Airborne-Measured Spatially-Averaged Temperature and Moisture Turbulent Structure Parameters Over a Heterogeneous Surface

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Turbulent structure parameters of temperature and humidity can be derived from scintillometer measurements along horizontal paths of several 100 m to several 10 km. These parameters can be very useful to estimate the vertical turbulent heat fluxes at the surface (applying MOST). However, there are many assumptions required by this method which can be checked using in situ data, e.g.

1) Were CT2 and CQ2 correctly derived from the initial CN2 scintillometer data (structure parameter of density fluctuations or refraction index, respectively)?

2) What is the influence of the surround hetereogeneous surface regarding its footprint and the weighted averaging effect of the scintillometer method

3) Does MOST provide the correct turbulent fluxes from scintillometer data.

To check these issues, in situ data from low-level flight measurements are well suited, since research aircraft cover horizontal distances in very short time (Taylor's hypothesis of a frozen turbulence structure can be applyed very likely).
From airborne-measured time series the spatial series are calculated and then their structure functions that finally provide the structure parameters. The influence of the heterogeneous surface can be controlled by the definition of certain moving-average window sizes.

A very useful instrument for this task are UAVs since they can fly very low and maintain altitude very precisely. However, the data base of such unmanned operations is still quite thin. So in this contribution we want to present turbulence data obtained with the Helipod, a turbulence probe hanging below a manned helicopter.

The structure parameters of temperature and moisture, CT2 and CQ2, in the lower convective boundary layer were derived from data measured using the Helipod in 2003. The measurements were carried out during the LITFASS03 campaign over a heterogeneous land surface around the boundary-layer field site of the Lindenberg Meteorological Observatory-Richard-Aßmann-Observatory
(MOL) of the German Meteorological Service during May and June. The synoptic situation of the analyzed days are fair weather conditions with temperature at about 30, sometimes with previous rain events. The spatial series of CT2 and CQ2 showed considerable variability along the flight path that was caused by surface heterogeneity. Measurement flights were performed in the morning and during
noon, allowing for a temporal evaluation of the structure parameters during the day. CT2 indicates a high variability between forest, agricultural landscape and lakes at a flight level of 100 m above ground. CQ2 showed lower variations between the different types of soils. The decrease of CT2 with height as predicted by free-convection scaling was confirmed for the
analyzed flights.