



Case study: Aircraft-based observation of vertical mixing event in the lower atmosphere during PARADE 2011

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Characterization of the planetary boundary layer (PBL) in complex terrain is a major topic in boundary layer research. Here we discuss a mixing event between the growing PBL and the free troposphere induced by a low-level wind speed maximum (LLWSM) using aircraft measurements of CO, CO₂, O₃ and particle number concentrations, as well as high resolution radio ascents.

Measurements took place in August and September 2011 at the Taunus Observatory on Mount “Kleiner Feldberg”, about 20 km northwest of Frankfurt am Main in Germany during the field campaign PARADE (PARTicles and RADicals: Diel observations of the impact of urban and biogenic Emissions). The PBL was characterized based on 174 radio soundings, complemented by continuous measurement of the boundary layer with a ceilometer, where also ground-based measurements of various reactive tracers (e.g. CO, NO_x, O₃, VOCs) have been performed.

The PBL top height was very variable (1 - 2.5 km ASL) during the measurement period depending on meteorological conditions. We found good agreement for the evolution and the height of the PBL top between the different instruments at fair weather conditions with calm winds and partially also during cloudy and windy days. To identify mixing between the PBL and the FT, we applied the trace gas correlation technique to the airborne observations. On 6th September 2011 we observed a low-level wind speed maximum of approximately 21 ms⁻¹ at 850 hPa. Our results indicate that this LLWSM weakened the transport barrier between the PBL and the FT, which enhanced transport and mixing from the FT into the PBL. High resolution backward trajectories (based on COSMO-EU model data) show that air masses observed at this level were affected by a low pressure system. Our results emphasize the importance of strong low-level wind maxima on chemical compound exchange between the PBL and the air aloft.