Geophysical Research Abstracts, Vol. 8, 00421, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00421

Applying linear assumptions and Deardorff scaling scheme to the early-morning shallow convective boundary layer using airborne measurements

J. Bange and T. Spieß

Institut für Luft- und Raumfahrtsysteme, Techn. Univ. Braunschweig, Germany
(j.bange@tu-bs.de)

Airborne turbulence measurements in the shallow convective boundary layer (SCBL) during the morning transition were performed using the helicopter probe Helipod. The experiment was carried out during the STINHO-2 summer campaign over heterogeneous land surface near Lindenberg, Germany. On three days low-level flights were analysed in order to identify scales and parameters that simplify the characteristics of the SCBL. Using a constant level flight strategy while the top z_i of the SCBL was rapidly rising, vertical profiles of horizontally averaged boundary-layer properties with respect to z_i were obtained.

Many indications were found that the morning transitions were quasi-stationary and governed by linear processes. During the burn-off process the lapse rate of the residual nocturnal inversion layer remained unchanged. The height of the SCBL, the surface temperature and the surface heat flux increased linearly in time. Due to a very short large eddy overturning time a good vertical mixing of the SCBL was expected. However, the heat flux at about 100 m above the surface exhibited larger deviation from linear temporal behaviour. Applying the Deardorff scaling scheme, large scatter around the classic daytime convective boundary layer (CBL) flux profile was found. This was probably due to the impact of the underlying heterogeneous land surface. Overall, the scatter in the dimensionless flux profile was not substantially larger than what is known from the daytime CBL and rather small compared to other observations during the morning transition. The dimensionless heat flux crossed zero at about 0.55 z_i while the linearised enthalpy equation led to an estimate of 0.4 z_i. Compared to the daytime CBL the zero crossing was found very low. Thus the morning SCBL

was accompanied by an unusual thick entrainment zone.

Significant differences to the daytime CBL were also found in the dimensionless standard deviations. The large eddy overturning time τ_* of the SCBL was much smaller. As in the daytime CBL $\sigma_u \; w_*^{-1}$ and $\sigma_v \; w_*^{-1}$ were height-independent and more or less identical. But the mean values were found to be larger (0.9 instead of 0.6). Unlike in the daytime CBL the variances of vertical wind and temperature were also height-independent. In agreement with experimental observations in the daytime CBL the scatter of all statistical moments of second order increased with height due to entrainment variations. Overall, the study demonstrates that the morning SCBL can be described in terms of the usual CBL parameters but with different characteristics. More *in situ* measurements of this interesting and important section of the daily boundary layer development are necessary.