Geophysical Research Abstracts
Vol. 14, EGU2012-12872, 2012
EGU General Assembly 2012

The Small Unmanned Meteorological Observer SUMO: Recent developments and applications of a Micro-UAS for atmospheric boundary layer research

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During the last 5 years, the Small Unmanned Meteorological Observer SUMO has been developed as a new and flexible tool for atmospheric boundary layer (ABL) research to be operated as controllable and recoverable atmospheric sounding system for the lowest 4 km above the Earth's surface. In the year 2011 two main technical improvements of the system have been accomplished. The integration of an inertial measurement unit (IMU) into the Paparazzi autopilot system has expanded the environmental conditions for SUMO operation to now even allowing incloud flights. In the field of sensor technology the implementation of a 5-hole probe for the determination of the 3 dimensional flow vector impinging the aircraft with a 100 Hz resolution and of a faster Pt1000 based temperature sensor have distinctly enhanced the meteorological measurement capabilities.

The extended SUMO version has recently been operated during two field campaigns. The first one in a wind farm close to Vindeby on Lolland, Denmark, was dedicated to the investigation of the effects of wind turbines on boundary layer turbulence. In spite of a few pitfalls related to configuration and synchronisation of the corresponding data logging systems, this campaign provided promising results indicating the capability and future potential of small UAS for turbulence characterization in and around wind farms. The second one, the international BLLAST (Boundary Layer Late Afternoon and Sunset Transition) field campaign at the foothills of the Pyrenees in Lannemezan, France was focussing on processes related to the afternoon transition of the convective boundary layer. On a calm sunny day during this experiment, the SUMO soundings revealed an unexpected 2°C cooling in the ABL during morning hours. By a comparison with model simulations this cooling can be associated with thermally-driven upslope winds and the subsequent advection of relatively cool air from the lowlands north of the Pyrenees.