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The UAS SUMO: A successful story of an alternative tool for atmospheric boundary layer studies

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During the last decade there has been a rapid development in the field of UAS used as an alternative and, at least in the case of very small and light-weight systems, cost-efficient in-situ measurement tool in atmospheric sciences. The mini UAS SUMO (Small Unmanned Meteorological Observer) has been developed at the Geophysical Institute, University of Bergen in collaboration with Martin Müller engineering. SUMO is probably the smallest, lightest and most cost-efficient UAS used in meteorological field experiments, so far. During the last 4 years, several interesting atmospheric boundary layer (ABL) phenomena, such as inversions, low level jets, boundary layer transitions, mountain waves and diurnally induced circulations such as mountain-valley winds and land-sea breezes, have been investigated with support of the system.

UAS facilitate atmospheric profile measurements with high temporal, and by use of multiple systems also high spatial resolution and therefore represent an ideal tool for ABL process studies. Corresponding atmospheric data sets are a key prerequisite for the validation, evaluation and future improvement of numerical weather prediction models. SUMO profile measurements have been used to evaluate several high-resolution model runs performed with the Weather Research and Forecasting model WRF for Iceland and Spitsbergen.

The system's flexibility allows the operation of several SUMO aircrafts at the same time which will find numerous applications such as operating the system in flocks or swarms. As a first step two SUMOs could be flown simultaneously up to 1500 m in a horizontal distance of 1 km to investigate differences in the structure of the stable polar boundary layer over snow covered land and open ocean on Svalbard.

The SUMO system is under continuous development. Recently it has been equipped with an inertial measurement unit (IMU) to extend its application range for operations in cloudy conditions and even inside clouds. A pitot tube and 5-hole probe are under integration at the moment to enable investigations of the turbulence structure, e.g. for measurements in the wake of wind turbines.