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Forecasting the weather
- ensemble techniques
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Feasibility study of using an unmanned aerial vehicle to measure entrainment processes

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Entrainment processes between the atmospheric boundary layer and the free atmosphere are important concerning vertical exchange of momentum, energy, water vapor, trace gases and aerosol. Measurement flights of the mini meteorological aerial vehicle (M^2AV) were performed in spring 2011 to study the feasibility of the unmanned aerial vehicle (UAV) to measure the structure of the transition zone between the convectively mixed layer and the stably stratified free atmosphere.

The applied UAV is a self-constructed model plane with two electric engines and a wingspan of two meters. The maximum take-off weight is 6 kg, including 1.5 kg of payload. The meteorological instrumentation of the M^2AV consists of a five-hole probe for measuring the turbulent wind vector, two temperature sensors (thermocouple (fast response) and resistance thermometer (slow response)), and a humidity sensor (humicap). Turbulence measurements are sampled at 100 Hz, resulting in a resolution (after anti-aliasing filters) of about 30 Hz (except for humidity data).

The campaign took place at the Meteorological Observatory Lindenberg–Richard-Aßmann-Observatory of the German Meteorological Service, which is located close to Berlin. Besides the M^2AV flights standard observations were performed by a 10 m and 99 m tower, a sodar, a windprofiler and radiosondes. A tethered balloon with measurement units at six different levels was operated especially for this campaign. The measurements of these systems were used to determine the inversion layer and to capture its diurnal cycle.

The performed flights of the M^2AV included vertical profiles up to the free atmosphere to determine the inversion layer. Horizontal flight legs were performed to measure the vertical sensible heat flux in the boundary layer, in the inversion layer and in the free atmosphere with the aim to expand the knowledge about entrainment. Time series of $w'\theta'$ measured by the M^2AV show turbulent exchange of heat in short turbulent bursts at heights close to the entrainment layer.