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Application of the Remotely Piloted Aircraft (RPA) 'MASC' in Atmospheric Boundary Layer Research

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The remotely piloted aircraft (RPA) MASC (Multipurpose Airborne Sensor Carrier) was developed at the University of Tübingen in cooperation with the University of Stuttgart, University of Applied Sciences Ostwestfalen-Lippe and 'ROKE-Modelle'. Its purpose is the investigation of thermodynamic processes in the atmospheric boundary layer (ABL), including observations of temperature, humidity and wind profiles, as well as the measurement of turbulent heat, moisture and momentum fluxes. The aircraft is electrically powered, has a maximum wingspan of 3.40 m and a total weight of 5-8 kg, depending on battery- and payload. The standard meteorological payload consists of temperature sensors, a humidity sensor, a flow probe, an inertial measurement unit and a GNSS. In normal operation, the aircraft is automatically controlled by the ROCS (Research Onboard Computer System) autopilot to be able to fly predefined paths at constant altitude and airspeed. Since 2010 the system has been tested and improved intensively. In September 2012 first comparative tests could successfully be performed at the Lindenberg observatory of Germany's National Meteorological Service (DWD). In 2013, several campaigns were done with the system, including fundamental boundary layer research, wind energy meteorology and assistive measurements to aerosol investigations. The results of a series of morning transition experiments in summer 2013 will be presented to demonstrate the capabilities of the measurement system. On several convective days between May and September, vertical soundings were done to record the evolution of the ABL in the early morning, from about one hour after sunrise, until noon. In between the soundings, flight legs of up to 1 km length were performed to measure turbulent statistics and fluxes at a constant altitude. With the help of surface flux measurements of a sonic anemometer, methods of similarity theory could be applied to the RPA flux measurements to compare them to literature. The results show prospects and limitations of boundary layer research with a single RPA at the present state of the art.