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Recent developments of the wind- and turbulence measurement with the research UAV MASC

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For atmospheric research, boundary-layer meteorology and wind-energy studies, the environmental physics group at the Centre for Applied Geo-Science (ZAG), University of Tübingen, Germany, designed and built a research UAV named MASC (Multi-purpose Airborne Sensor Carrier). MASC is an electrically propelled single engine (pusher) aircraft of 2.7 to 3.5 m wing span. The total weight of the aircraft is 5 to 8 kg, including up to 1.5 kg scientific payload. This UAV is typically operated at an airspeed of 25 m/s, as a trade-off between high spatial resolution of the measured data and gathering a snap-shot of the atmosphere in short time. MASC operates fully automatically (except landing and take-off). Height, flight path and all other parameters of flight guidance are controlled by the autopilot system ROCS (Research Onboard Computer System) developed at at the Institute of Flight Mechanics and Control (iFR) at the University of Stuttgart. The overall endurance of MASC is up to 90 minutes or 135 km. The standard scientific payload carried by MASC consists of several subsystems in order to measure the 3D wind vector, air temperature, water vapour and further parameters. This includes several fast thermometers, a capacitive humidity sensor, a five-hole flow probe, an inertial measurement unit (IMU) and GNSS for position and velocity above ground. The air sensors allow for a real resolution of about 30 Hz (except for air humidity (3 Hz)). Additionally a Fast Response Probe (FRP) will be mounted to resolve turbulence one order of magnitude faster. Preliminary results of wind tunnel measurements and the concept of integration will be presented. Furthermore a concept of calculating the 3D wind vector while flying will be introduced.