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Vaisala INTERCAP® Humidity and Temperature Probe HMP50 in Airborne Measurements

Figure 1: T200 aircraft (Meteorological-Micro Aerial-Vehicle, M²AV).

The Institute of Aerospace Systems provides, among other things, airborne measurement systems for meteorological applications, field experiments, and atmospheric science. A brand-new system in this field is the M²AV (Meteorological-Micro Aerial-Vehicle). MAVs are aircraft as small as birds, acting as airborne robots that fly completely autonomously using GPS and pre-programmed waypoints.

The T200 aircraft (Figure 1) of the "Carolo" MAV family is used for meteorological measurements. This is a twin-propeller aircraft with a wingspan of 200 cm. It is hand-launched, which makes handling and operating the aircraft very easy. The maximum take-off weight is 4 kg, including 1500 g of payload. The T200 is classified as a "model aircraft", and is therefore less subject to air-safety rules than a heavier aircraft. The payload of the M²AV includes meteorological probes, mounted in the noseboom (Figure 2) outside the influence of the propulsion. The miniature 5-hole-probe is necessary for the determination of the wind vector, which can be calculated from the airspeed, position, and altitude of the aircraft.

Temperature and humidity are measured with the Vaisala INTERCAP® Humidity and Temperature Probe HMP50. The HMP50 is a very user-friendly probe. Thanks to the connections and fixings it can be replaced and integrated easily into the M²AV noseboom. Furthermore, the probe provides an amplified signal, which makes post processing unnecessary. The data is of a very high quality. The probe offers good long-term stability and absolute accuracy of measurements. The measuring range of the HMP50 also allows for measurements in polar and tropical regions. It is also lightweight, which is important for the M²AV. An additional fast temperature sensor provides turbulent fluctuations, while the onboard 3D-GPS system gives the M²AV's accurate position, altitude and attitude. All measurements are stored on a standard flash-card. After the flight, the data is transferred with a card-reader and is ready for analysis.

Cost-effective airborne turbulence probe

When developing the M²AV, the goal was to achieve a cost-effective airborne turbulence probe. The energy transfer of sensible heat from the surface into the atmospheric boundary layer can be determined with the M²AV. It can be used to supplement other measurement systems (e.g. remote sensing, towers, ground stations). Measurements in remote areas and critical situations where manned flights are too risky also become possible - e.g., over an active volcano (performed in April 2005), in the Arctic or Antarctica (scheduled for December 2005), or even in the polar night. The range of applications in clouds is presently being investigated.

M²AV versus helicopter-borne turbulence probes

In spite of their small size, M²AVs carry out high-quality turbulence measurements. Although the absolute measurement accuracy is not on the same level as that of the helicopter-borne turbulence probe Helipod (Figure 3), the M²AV offers a competitive alternative due to its easy handling and versatility. Furthermore, the acquisition and maintenance costs are very low compared to research aircraft or other meteorological instruments.

The Braunschweig Helipod is also operated by the Institute of Aerospace Systems. It, too, benefits from Vaisala technology: the long-term stable humidity measurements are carried out with a Vaisala HUMICAP® sensor. In the future we hope to perform supplementary M²AV measurements during Helipod campaigns to achieve better temporal and spatial coverage and resolution. ●

Further information:
www.m2av.de

Figure 2: Meteorological probes mounted in the noseboom of the T200.

Figure 3: The Braunschweig Helipod.

	data quality	versatility	handling	acquisition cost	maintanance
Research aircraft	++	+	o	- -	- -
M²AV	o	o	++	+	+