FLINDERS UNIVERSITY'S RESEARCH AIRCRAFT

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In 1984, F.I.A.M.S. (Flinders Institute for Atmospheric and Marine Sciences) decided to purchase a research aircraft to intensify the Institute's long standing activities in atmospheric boundary layer research. The aircraft, a GROB G109B motorglider, was manufactured by B. Grob, Flugzeugbau GmbH in Mindelheim/W-Germany. During its construction, numerous modifications were included to facilitate the mounting of special equipment in and on the aircraft. The G109B was delivered in May '84 in Germany and the remainder of 1984 was used to install and test its basic set of meteorological instrumentation. This task was carried out by the author in close cooperation with the DFVLR (German Aero-space Agency) and the Meteorological Institute of the University of Bonn. Between November '84 and March '85, the G109B was shipped to Australia, where the author has led F.I.A.M.S.'s activities involving the aircraft since the beginning of 1985.

During the first half of 1985, a data acquisition and logging system was developed, a first version was installed in June and first successful field tests were performed shortly afterwards. Furthermore, a sophisticated attitude and heading reference system and an Ω/VLF navigation system were installed.

The dimensions and performance of the aircraft are:

Aircraft length: 8.10 m
Maximum takeoff weight: 870 kg
Speed range: 40 - 100 kt
Range: > 1000 km
Wingspan: 17.40 m
Crew: 2
Endurance: > 10 h
Ceiling: approx. 5000m

The aircraft's avionics equipment include two VHF-radios for communication, receivers for VOR and ADF navigation, a transponder for secondary surveillance radar, and an emergency location beacon. For flights over water, two single seat liferafts are available. The aircraft can be operated under Visual Flight Rules during day and night. The approximate cost per flying hour is currently $120.

The following scientific sensors and subsystems are installed in the aircraft:

1. a high-resolution static pressure transducer (Rosemount 1201F1)
2. a barometric altitude transducer (Rosemount 1241M)
3. an indicated airspeed transducer (Rosemount 1221D)
4. two fast temperature sensors (Pt100 (DFVLR, thermocouple (meteolab))
5. a relative humidity sensor (Vaisala Humicap)
6. two Lyman-α humidity sensors (ERC BLR and AIR LA-1A)
7. a dew-point mirror system (meteolab TP-3S)
8. a 5-hole-probe for angle of attack and sideslip (DFVLR)
9. two differential pressure transducer for 5-hole-probe (Rosemount 1221F2vL

The following table gives the range, the accuracies and the estimated response times for the various measured parameters:

parameter	units	instruments	range	absolute accuracy	relative accuracy	response time
st.pressure	hPa	1.	1050 - 800	< 0.2	< 0.1	< 0.02 s
press.alt.	ft	2.	-1000 - 15000	10	3	< 0.02 s
airspeed	kts	3.	30 - 130	3	< 0.1	< 0.02 s
temperature	C	4.	-10 - 50	0.5	0.05	0.1 s
rel.humidity	%	5.	0 - 100	5	1	0.3 s
abs.hum.	g/m^{**3}	6.	0 - 40	0.3	0.1	0.05 s
dew point	C	7.	-40 - 50	0.5	0.2	0.5 s
pitch	deg	10.	-90 - 90	1	0.5	< 0.1 s
roll	deg	10.	-180 - 180	1	0.5	< 0.1 s
heading	deg	10.	0 - 360	1	0.5	< 0.1 s
accelerations	g	10.	-5 - 5	0.005	0.005	0.05 s
w(air)	m/s	2.,3.,8.,9.,10.	-10 - 10	< 0.5	< 0.2	0.1 s
surface temp.	C	11.	-25 - 75	2	0.5	0.4 s
radar alt.	ft	12.	0 - 2500	10	3	0.2 s
u,v(air)	m/s	3.,8.,9.,10.,13.	0 - 40	< 3	< 1	< 5 s

10. an attitude and heading reference system, providing aircraft attitude angles (pitch, roll and heading), three-dimensional body accelerations and rates (Rockwell-Collins AHS-85)
11. an infrared radiometer for surface temperature (Heimann KT-15)
12. a radar altimeter (King KRA-10A)
13. an Ω/VLF navigation system, providing aircraft position (latitude, longitude), mean horizontal wind vector and aircraft ground speed (Litton LTN-3000)
14. a video-system (remotely controlled camera and recorder)
15. additional radiometric equipment (under development)

The data acquisition system (based on 80186 and Z80 processors) is capable of logging up to 16 analog channels with sampling rates of up to 52 Hz and a digital resolution of 12 bit. Digital buses connect the attitude and heading reference system and the Ω/VLF navigator to the data acquisition system. Selected data channels can be displayed on-line on a graphics screen in the cockpit. To enable a first evalution of the flight data directly after the flights, a graphics terminal and a printer/plotter can be connected to the aircraft's data acquisition system on the ground. Additionally, two ground-based micro-computers (AMPRO LB-186 and IBM-AT compatible) with approximately 200Mb hard-disk space, 60Mb streaming tape back-up, graphics terminals and printer, and software for accessing, processing and storing of the data are available in the field.

The aircraft has been used successfully during several field studies for measuring vertical energy fluxes in the boundary layer down to about 15m above ground or water using the eddy-correlation method. Other applications were horizontal and vertical soundings of the above mentioned parameters. During the last two years, the aircraft was used for estimating the evaporation from tidal flats in the Upper Spencer Gulf area, from John Brewer Reef off Townsville and from various surfaces in the Murray-Darling Basin and for studying the seabreeze circulation over Adelaide and the structure of convection over northern South Australia and Eyre Peninsula.