

# Development of small unmanned aerial vehicles for Antarctic Research

Minoru Funaki, Nahiko Hirasawa and Ant-Plane Group  
*National Institute of Polar Research, Tokyo*

As part of the Ant-Plane project for summertime scientific research and logistics in the coastal region of Antarctica, we developed six types of small autonomous UAVs (we term these vehicles 'Ant-Planes') based on four types of airframe. Ant-Plane 4-1 (Fig. 1) achieved a continuous flight of 1108 km, and a maximum flight altitude of 5700 m.

During Flights of Ant-Plane 4-1, the temperature, humidity, and aerosol particle number measured in Hokkaido, the northern part of Japan are shown up to 4000m. In the flight, a cloud layers were encountered between 200 and 500 m in altitude, where was surmounted by a temperature inversion layer between around 500 to 650m in altitude. The plane passed through the clouds without any problem as to operation. Though the temperature gradually decreased with height up to the bottom of the inversion layer, the potential temperature (not shown) slightly increased with height due to latent heat release by condensation. The humidity reached almost 100% at the levels of 200m and 500m, indicating cloud formation. The humidity fell rapidly to around 50% above the inversion layer.

The number concentrations of particles of 0.3, 0.7, and 2.0  $\mu\text{m}$  in diameter started to decrease at 500m upward, where the bottom of the inversion was, and the values at around 700m in altitude, almost the top of the inversion, indicated one tenth or less than those under the inversion layer. If we see the lowermost layer under the inversion, the variance in the number concentration was the largest in 2.0 $\mu\text{m}$ -particle and the smallest in 0.3 $\mu\text{m}$ - particle (Fig 2).

An onboard 3-axis magneto-resistant magnetometer (400 g) recorded variations in the magnetic field at Western Australia. The data revealed a pattern of the magnetic anomaly that was almost consistent with the pattern published by Geosciences Australia.

The Ant-Plane can be used for various types of Antarctic research as a basic platform for airborne surveys, but further development of the techniques employed in takeoff and landing are required, as well as ready adjustment of the engine and the development of small onboard instruments with greater reliability.



Fig 1 Ant-Plane 4-1 with a magnetometer at Australia

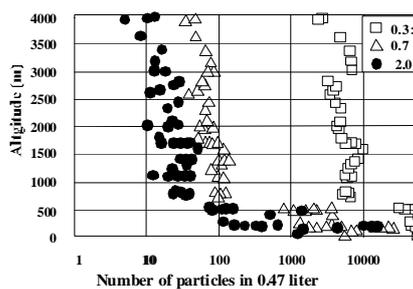


Fig. 2 Distribution of the particle size up to 4000m in altitude

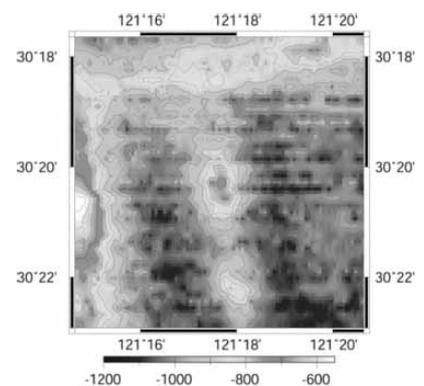


Fig. 3 Magnetic anomaly measured by Ant-Plane 4-1