RECENT RESEARCH ACTIVITIES

Shigaraki UAV-Radar Experiment (ShUREX)

(Laboratory of Radar Atmospheric Science, RISH, Kyoto University)

Hiroyuki Hashiguchi and Mamoru Yamamoto

The Shigaraki UAV-Radar Experiment (ShUREX) is an international US-Japan-France observation field campaign (PI: Prof. L. Kantha of University of Colorado), aimed at measuring and obtaining a better understanding of turbulent mixing and structures in the lower atmosphere. ShUREX 2015 and 2016 campaigns were carried out at the Shigaraki MU Observatory in June 1-14, 2015 and May 26-June 13, 2016, respectively. During the campaign, the unmanned aerial vehicle (UAV) DataHawk, which was developed at the University of Colorado, Boulder, and equipped with a high-resolution cold wire and a high-resolution pitot tube, along with an IMET sonde, was flown near and over the MU radar to obtain simultaneous measurements of the atmospheric column over the radar. It enabled the comparison of radar-inferred refractive index structure function parameter C_n^2 with that obtained from measurements by the cold wire and the humidity sensor on the UAV. It also permitted comparison of TKE dissipation rates in the turbulent structures inferred from the radar spectral broadening with those measured directly by the UAV velocity sensor.

Figure 1 shows the DataHawk UAV which has been developed at the University of Colorado. The wingspan and mass are about 1 m and 1 kg, respectively. It is propelled by a pusher prop in the rear powered by an electric motor running on LiPo batteries. It could be catapult (bungee-cord) launched or taken aloft by a standard meteorological balloon and deployed from a height to conserve battery power. It has an endurance of 60-90 minutes depending on the climb rate. Airspeed ranges from 10 to 25 m/s. The UAV equipped with autopilots can be pre-programmed to execute a preplanned trajectory, and the sensors on board can make atmospheric measurements (pressure, temperature, winds, etc.) along the trajectory. This trajectory can be a spiraling ascent and descent to a prescribed altitude over a particular spot. It can also be a racetrack type trajectory. The range is around 20 to 40 km, determined by the uplink/downlink antenna gain. The DataHawk is well suited to making atmospheric measurements up to altitudes of 4 km (bungee launch) and 7 km (balloon launch). It uses GPS for navigation. The design of the DataHawk, the characteristics of ground support components and some data collected from these systems are described by Lawrence and Balsley (2013) and Balsley et al. (2013). High-resolution (100 Hz) velocity and temperature sensors, capable of yielding information on turbulence, in addition to mean quantities can be deployed.

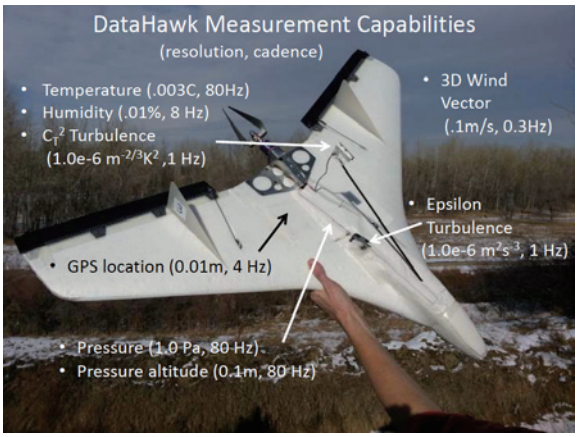

Figure 1. UAV developed by the University of Colorado. [Lawrence and Balsley, 2013]

References

[1] D. A. Lawrence and B. B. Balsley, High-resolution atmospheric sensing of multiple atmospheric variables using the DataHawk small airborne measurement system, *J. Atmos. Oceanic Technol.*, **30**, 2352-2366, 2013.

[2] B. B. Balsley, D. A. Lawrence, R. F. Woodman, and D. C. Fritts, Fine-scale characteristics of temperature, wind, and turbulence in the lower atmosphere (0-1,300 m) over the south Peruvian coast, *Bound.-Layer Meteor.*, **147**, 165-178, 2013.