
ABSTRACTS (MASTER THESIS)

Study on atmospheric structure based on simultaneous observations with UAV and the MU Radar

(Graduate School of Informatics,
Laboratory of Radar Atmospheric Science, RISH, Kyoto University)

Takashi Mori

Over the past few years, an Unmanned Aerial Vehicle (UAV) has increasingly attracted attention as a new instrument for atmospheric measurements. Radiosonde balloons, which have been often used for atmospheric observations in the troposphere and lower stratosphere, move due to background winds and cannot measure at an aimed place. Therefore, autonomous UAV is being developed and operated to overcome this problem.

Observation field campaigns called the Shigaraki UAV-Radar Experiment (ShUREX) were carried out in 2015 and 2016, in which the UAVs developed by the University of Colorado were flown near and over the MU radar to simultaneously observe the atmospheric column over the radar [1, 2].

This thesis presents considerations of atmospheric structure by using observation data obtained during the ShUREX campaign for mainly two subjects.

As subject 1, simulations for large temperature variations measured by the UAV flying horizontally in strong echo layer were performed. The temperature variation over 20 minutes could be reproduced supposing the vertical profile of temperature and the vertical wind estimated from displacement of the echo layer. As a result, the large difference in temperature was caused by air parcel with adiabatic temperature change entering the oscillating inversion layer due to vertical wind.

As subject 2, comparisons between vertical profiles of squared refractive index gradient estimated from the observation data with UAV and the MU radar were performed. In the stratified layers, the profiles estimated from UAV and the MU radar agreed well except in some regions, which was caused by small inversion layers. On the other hand, the profile estimated from the MU radar was overall larger than that estimated from UAV in turbulent layers, which was probably caused by not distinguishing backscatter models. It was confirmed that other factors except for refractive index gradient contributed to the radar echo power when turbulent scatter is expected.

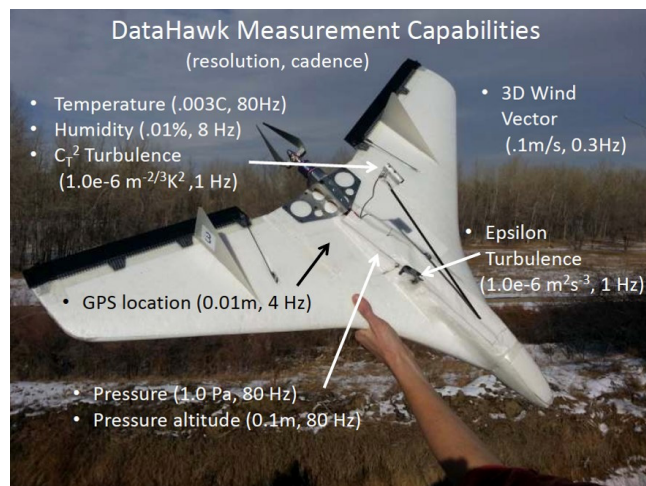


Figure 1. The University of Colorado DataHawk UAV [1].

References

- [1] Lawrence, D. A. and Balsley, B. B., High-resolution atmospheric sensing of multiple atmospheric variables using the DataHawk small airborne measurement system, *Journal of Atmospheric and Oceanic Technology*, 30 (10), 2352-2366, 2013.
- [2] Lakshmi Kantha, Dale Lawrence, Hubert Luce, Hiroyuki Hashiguchi, Toshitaka Tsuda, Richard Wilson, Tyler Mixa, and Masanori Yabuki, Shigaraki UAV-Radar Experiment (ShUREX2015): An Overview with Preliminary Results, *Progress in Earth and Planetary Science*, doi:10.1186/s40645-017-0133-x, 2017.