A detailed analysis of steep humidity gradients above a turbulent cloud top using MU radar, UAV and balloon measurements.

H. Luce[1], L. Kantha[2,] H. Hashiguchi[3], N. Nishi[4], D. Lawrence[2], T. Tsuda[3], M. Yabuki[3]

[1] Université de Toulon, Mediterranean Institute of Oceanography, La Garde, France.
[2] Research Institute for Sustainable Humanosphere, Kyoto University, Uji, Japan.
[3] Department of Aerospace Engineering Sciences, University of Colorado Boulder, Boulder, Colorado, USA
[4] Faculty of Science, Department of Earth Science system, Fukuoky University, Fukuoka, Japan.

During the ShUREX campaigns (Kantha et al. 2017, this issue), unmanned aerial vehicles (UAVs) equipped with various pressure, temperature, humidity and wind sensors were flown in the vicinity of the MU radar (< 1 km distance). During FLT 15, the UAV moved up and down along helical paths and crossed twice two steep humidity gradients separated by about 300 m in altitude at the interface between cloudy and dry layers around the altitude of 3.0 km (see Figure 1). The MU radar was operating continuously in range imaging mode and monitored the double layer structure for more than 16 hours. The UAV and radar data analyses showed that turbulence due to convective instability, possibly triggered by cloud top radiative cooling, occurred just below the cloud top, at the bottom of the double layer structure. Data obtained from a Vaisala radiosonde launched at the same time, permitted us to get complementary information on the prevailing stability in the form of the gradient Richardson number. The characteristics of the echo layers, the dynamic conditions during which they occurred and turbulence parameters (TKE dissipation rate ε and temperature structure parameter C_T^2) are used to interpret the observational data. Despite their close resemblance, the two radar echo layers may have resulted from different radar backscatter mechanisms.

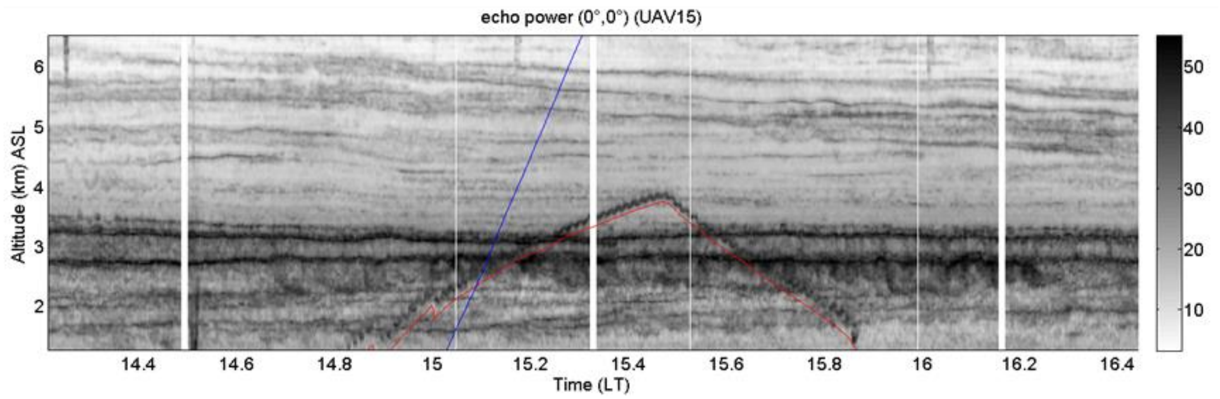

Figure 1: Time-height cross-section of radar echo power at vertical incidence from MU radar on 11 June 2016. Blue line: balloon altitude vs. time. Red line: UAV altitude vs. time.

References

Kantha et al, this issue, 2017