Retrieval of cloud water distribution from an air-borne scanning microwave radiometer: Wakasa Bay field experiment results

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1. A mobile cloud tomography setup has some advantages over a fixed one.

The tomographic method involves scanning clouds from a multiplicity of directions and locations, and inverting the resulting radiometric measurements to obtain 2D/3D cloud water distributions. A fixed ground-based setup will needed more than four microwave radiometers to secure an acceptable retrieval accuracy. With a mobile platform, a single radiometer can collect tomographic data of the same quality (plus some bonus: cloud chasing ability, high efficiency of data collection).

Fig 1. Schematic of two mobile cloud tomography setups. The swath of each radiometer scan cycle is shown in different color.

2. A limited cloud tomography trial was carried during the 2003 AMSR-E validation.

Several microwave instruments were boarded on the NASA P-3 research aircraft and scanned through a system of shallow cloud layers (Fig. 1a).

Instruments	Frequencies	Scan mode
Polarimetric Scanning Radiometer (PSR)	10.7, 18.7, 21.5, 37, and 89 GHz, 0.6-11.5 µ	Along-track, Swath: ±70° off nadir
Millimeter-wave Imaging Radiometer (MIR)	89, 150, 183±1, ±3, ±7, 220, and 340 GHz	Cross-track, Swath: ±53° off nadir
Airborne Cloud Radar (ACR)	94 GHz	Nadir staring

Summary

The cloud tomography field trial during the 2003 AMSR-E validation campaign shows that a single scanning microwave radiometer aboard a moving platform can provide useful data for cloud tomography retrieval.

Observation system simulation experiments show that many conditions during the field trial were not optimal. A slower platform at a lower altitude (e.g., ground-based) can provide better retrievals.

3. Examples of the collected data

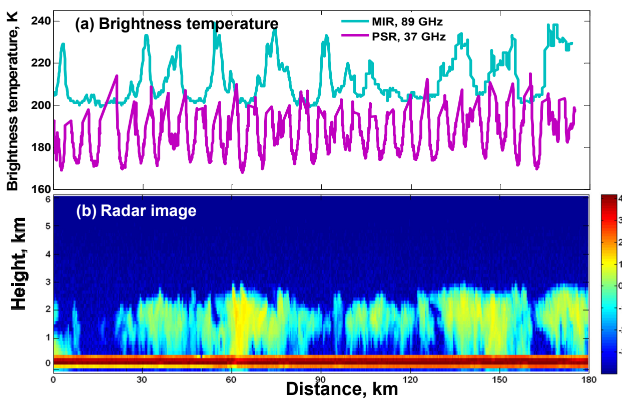

Fig 2. (a): Microwave brightness temperature; and (b): radar reflectivity.

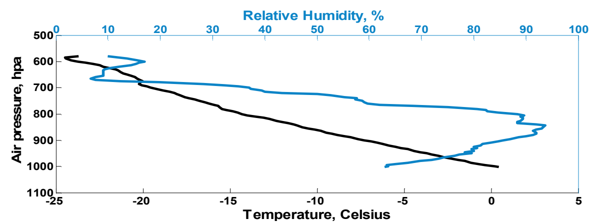

Fig 3. Mean temperature and humidity profiles from several dropsondes.

4. The tomographic retrievals roughly capture the spatial features of clouds.

Three retrieval runs: (1) only MIR nadir data; (2) only PSR data; (3) MIR+PSR.

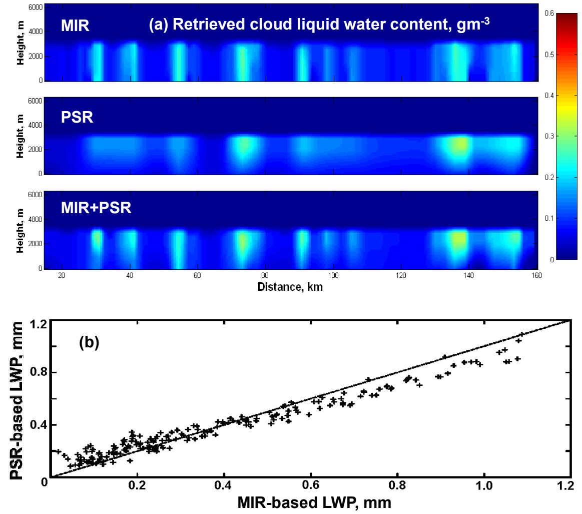

Fig 5. (a) The retrieved cloud fields using the Wakasa Bay data; and (b) the comparison of cloud liquid water path calculated from the different retrieval runs.

5. Observation system simulations (OSSEs) show that many conditions were not optimal.

The aircraft was too fast and too high during the trial.

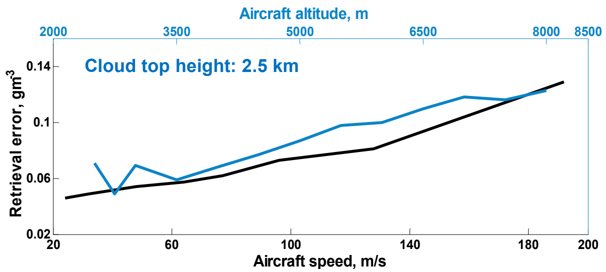

Fig 6. The sensitivity studies are based on OSSEs. The retrieval error increases with aircraft speed and height.

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Reference

Huang, D., A. Gasiewski, and W. Wiscombe (2008a & b), IEEE TGARSS, submitted.

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