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Oral

In this paper, airborne radio occultation (ARO) measurements collected during a ferry flight at the end of the PRE-Depression Investigation of Cloud-systems in the Tropics (PREDICT) field campaign from Virgin Islands to Colorado were analyzed. The long flight at ~13 km altitude provided intercomparisons of bending angle retrieval techniques over a range of environments that may have different levels of atmospheric multipath propagation interference. Two especially well-adapted radio-holographic bending angle retrieval methods, full-spectrum-inversion (FSI), and phase-matching (PM), were compared with the standard geometric-optics (GO) retrieval method. Comparison of the ARO retrievals with the near-coincident ECMWF reanalysis-interim (ERA-I) profiles shows only a small root-mean-square (RMS) refractivity difference of ~0.3 % in the drier upper troposphere from ~5 km to 13 km over both land and ocean. Both the FSI and PM methods improve the ARO retrievals in the moist lower troposphere and reduce the negative bias found in the GO retrieval due to the multipath problem. In the lowest layer of the troposphere, the ARO refractivity using FSI shows a negative bias of about -2 %. The increase of the refractivity bias occurs below 5 km over the ocean and below 3.5 km over land, corresponding to the approximate altitude of large vertical moisture gradients above the ocean and land surface, respectively. In comparisons with radiosondes, the FSI ARO soundings capture well the height of layers with sharp refractivity gradients but display a negative refractivity bias inside the boundary layer. Three spaceborne radio occultation profiles within 300 km of the flight track shows a slightly larger RMS refractivity difference of ~2 %. Analysis of the 12 ARO events that were simultaneously recorded from both the top and side-looking antennas, indicates that high precision of the ARO measurements can be achieved corresponding to an RMS difference better than 0.2 % in refractivity (or ~0.4 K). The surprisingly good quality of recordings from a very simple antenna on top of an aircraft increases the feasibility of developing an operational tropospheric sounding system.

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