Integrated Water Vapor and Cloud Liquid Water at MCTEX

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Introduction

Integrated water vapor and cloud liquid water measurements were obtained during the Maritime Continent Thunderstorm Experiment (MCTEX) by Eugene Clothiaux and Tom Ackerman of Pennsylvania State University using an Atmospheric Radiation Measurement (ARM) Program microwave radiometer. The radiometer was deployed at Pularumpi, Melville Island (11.55 S, 130.56 E) off the north coast of Australia from November-December 1995. Time series of these results are shown in Figure 1.

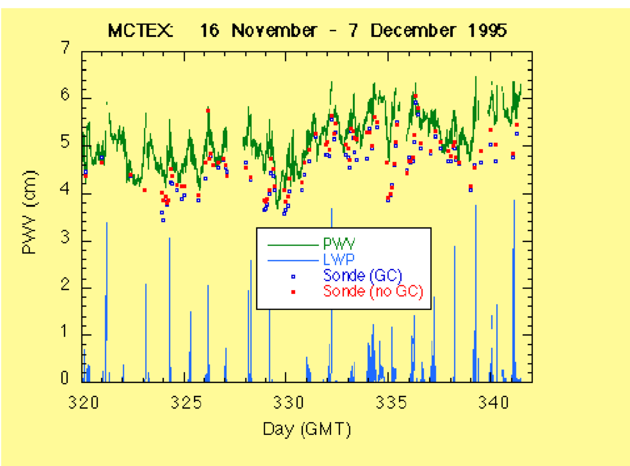

Figure 1. Time series of integrated or "precipitable" water vapor (PWV) and liquid water path (LWP) from the microwave radiometer. Periods of precipitation have been eliminated. The circles are PWV derived by integrating radiosonde soundings, with and without the effect of the calibration ground check. (See text for explanation of the ground check.)

Discussion

The probability distributions of PWV and LWP are presented in Figure 2. The PWV was approximately normally distributed with a mean value of about 5 cm. The LWP was approximately log-normally distributed with a geometric mean value of about 0.02 mm (20 g/m^2).

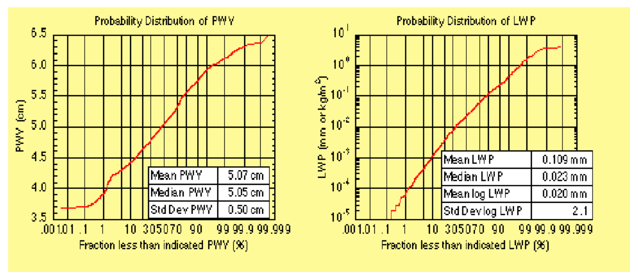

Figure 2. Probability distributions of PWV and LWP.

We compared these measurements with model-calculated brightness temperatures and integrated water vapor derived from Vaisala RS-80 radiosondes launched approximately 10 km away at Maxwell Creek, near the center of Melville Island. Systematic errors were introduced in the soundings through the 1-point calibration "ground check" applied prior to launch. In this procedure the sonde's relative humidity (RH) sensor is placed into a desiccated chamber assumed to be at 0% RH; the value reported by the sonde while in the chamber is subsequently subtracted from the sounding as a "correction." The time series of RH corrections coded by sonde calibration date in Figure 3 shows that very old sondes were used during MCTEX and that the correction does not correlate with sonde calibration lot; that is, the ground check correction does not account for any sonde calibration errors. The net result is a bias of -0.15 cm of integrated water vapor and increased scatter, as shown in Figure 4.

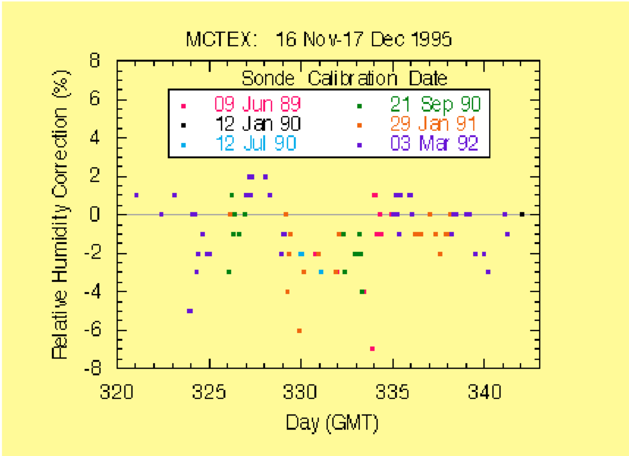

Figure 3. The time series of relative humidity corrections coded by sonde calibration date.

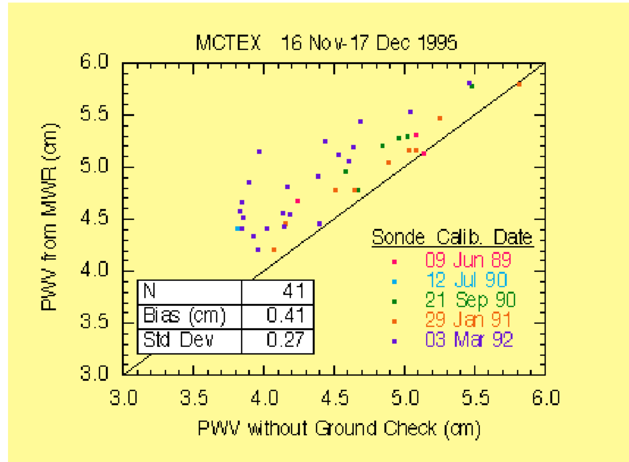

Figure 5. Scatter plot of PWV from the microwave radiometer compared with integrated soundings after removing the ground check corrections.

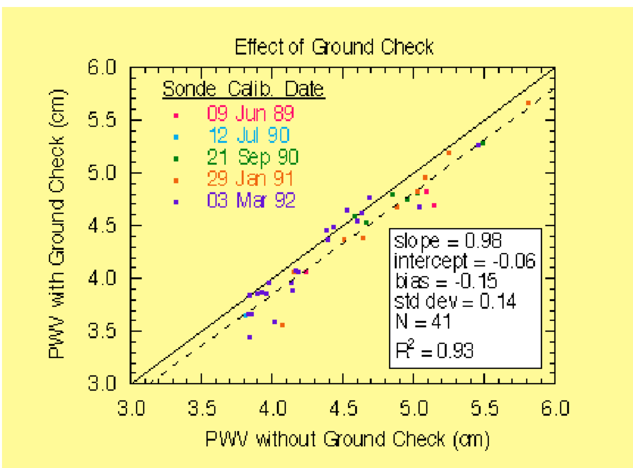

Figure 4. Scatter plot of integrated water vapor from soundings with and without the effect of the calibration ground check.

Even after removing the effects of the ground check, the soundings reported about 10% less water vapor than the microwave radiometer, as shown in Figure 5. This is consistent with similar comparisons conducted at the ARM SGP CART for sondes calibrated during the same time period. The large amount of scatter may be attributable to the distance between the radiometer and sonde launch location.

Conclusions

High-quality measurements of integrated water vapor and cloud liquid water were made in a tropical environment at MCTEX using an ARM microwave radiometer.

The one-point calibration ground check introduced more error into the soundings than it removed.

The sondes reported approximately 10% less water vapor than the microwave radiometer, a fact that is consistent with comparisons at the ARM Southern Great Plains (SGP) Cloud and Radiation Testbed (CART).