

P2.7 CHARACTERIZATION OF AIRS TEMPERATURE AND WATER VAPOR MEASUREMENT CAPABILITY USING CORRELATIVE OBSERVATIONS

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1. INTRODUCTION

The Atmospheric Infrared Sounder (AIRS) system on NASA's Aqua spacecraft is an important new source of information about weather and climate processes. We use correlative observations to show that AIRS total water vapor estimates have no cloud-dependent biases. We also demonstrate that AIRS is meeting its fundamental measurement requirements of 20% absolute humidity uncertainty in 2 km layers, and 1 K temperature uncertainty in 1 km layers for infrared cloud fraction up to 70%. AIRS has provided over 300,000 globally distributed retrievals per day since September 2002, and has a five-year planned lifetime. Each retrieval includes profiles of temperature and water vapor, plus characteristics of clouds, the surface and minor gases. Higher information content retrievals –at infrared cloud fractions up to about 70%-- result from a combination of infrared and microwave measurements; lower information content retrievals are obtained from the microwave for higher cloud fractions. In this presentation we address several fundamental issues in the measurement of temperature and water vapor by AIRS: accuracy, precision, vertical resolution and biases as a function of cloud amount. We use two correlative data sources. First we compare AIRS total water vapor with that from the Advanced Microwave Sounding Radiometer for EOS (AMSR-E) instrument, also onboard the Aqua spacecraft. AMSR-E uses a mature methodology with a heritage including the operational Special Sensor Microwave Imager (SSM/I) instruments. AIRS and AMSR-E observations are collocated and simultaneous, providing a very large data set for comparison: about 200,000 over-ocean matches daily. We show small cloud-dependent biases between AIRS and AMSR-E total water vapor for several oceanic regions. Our second correlative data source is several hundred dedicated radiosondes launched during AIRS overpasses. Closely matched in space and time with AIRS retrievals, these sondes provide information about the vertical structure of temperature and water vapor. We present height-dependent AIRS-sonde differences at several locations around the globe, and show that AIRS is meeting its fundamental measurement requirements for temperature and water vapor profiles. We also show where AIRS exceeds its vertical resolution requirements. These results demonstrate that AIRS temperature and water vapor retrievals are suitable for the study of a wide variety of weather and climate phenomena.

Validation of data over regions between 50°S-50°N have shown that temperature in the troposphere has

accuracies of 1K over 1 km-thick layers under both clear and cloudy (up to 70% cloud cover) conditions compared to the matching radiosonde observations, while the accuracy of moisture profiles exceed that obtained by radiosondes (Fetzer et al. 2003; Fishbein et al. 2003).

3. THE AIRS EXPERIMENT

AIRS is a 2378 channel grating spectrometer. It includes the companion HSB and AMSR-E microwave instruments.

3. COMPARISONS WITH AMSR-E

Figure 1 shows AMSR-E and AIRS total water and also as a function of retrieved AIRS cloud amount.

Figure 2 shows summaries for the descending nodes.

Figure 3 shows summaries for the ascending nodes.

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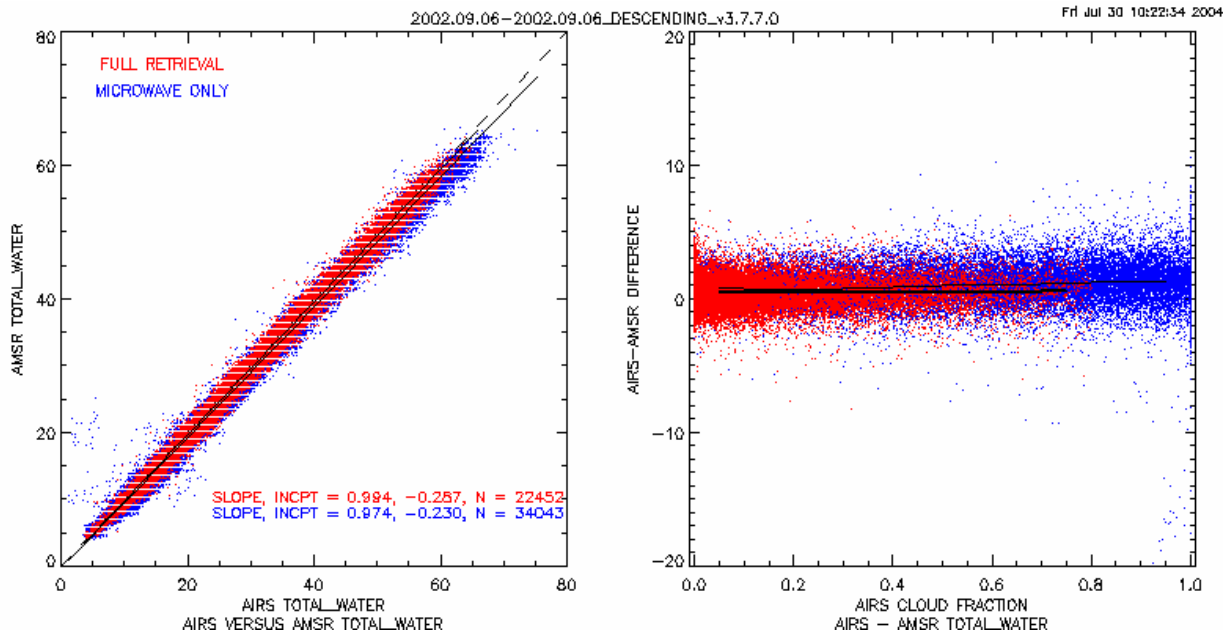


Figure 1. AIRS versus AMSR-E.

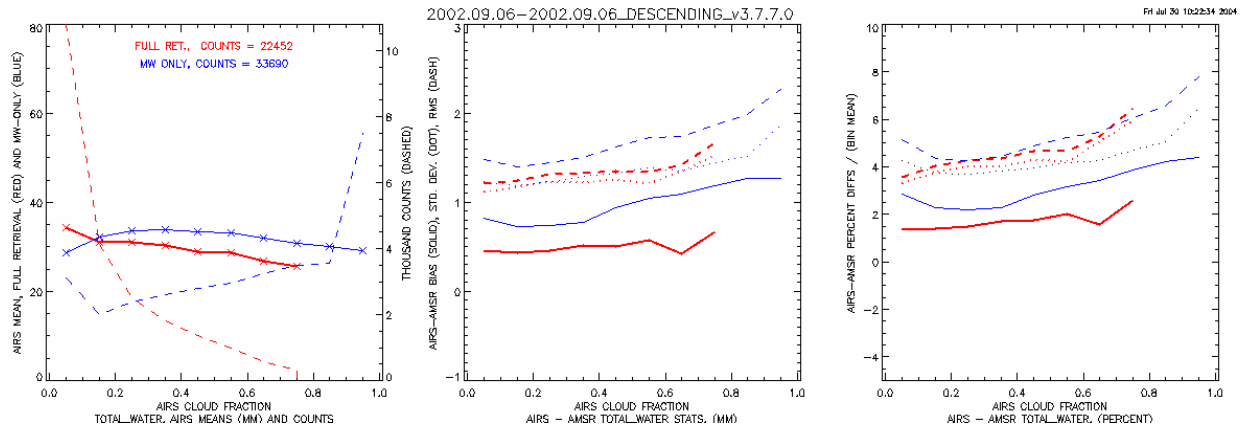


Figure 2. AIRS versus AMSR-E for descending nodes.

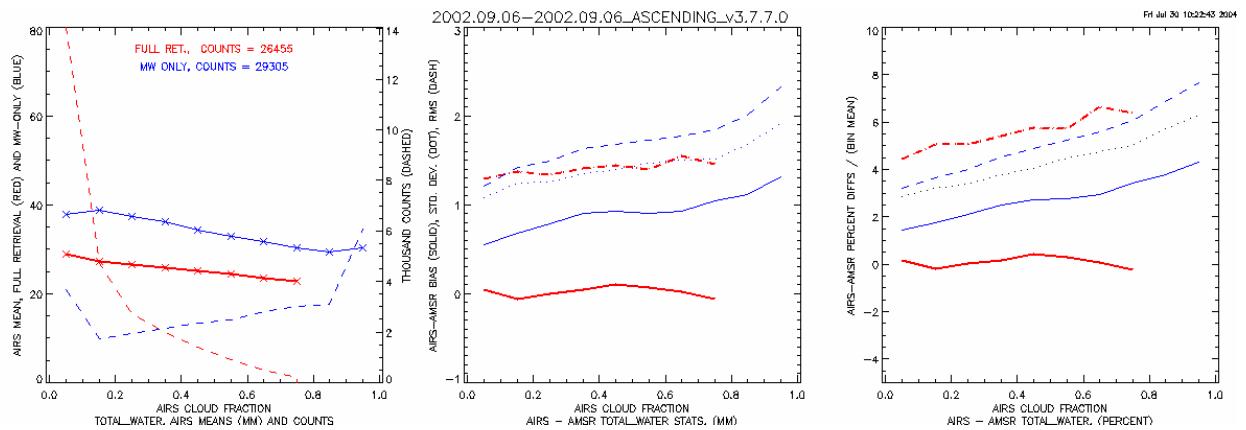


Figure 3. AIRS versus AMSR-E for descending nodes

4.2 Comparison with Radiosondes

Figure 4 shows AIRS versus radiosondes at the Tropical Western Pacific site.

5. SUMMARY

The comparisons shown here demonstrate the following:

- Biases of <2% in total water for all cloud conditions.
- Temperature uncertainties of <1 K averaged into 1 km layers in the troposphere.
- Humidity errors of ~15% in 2 km layers in the troposphere.

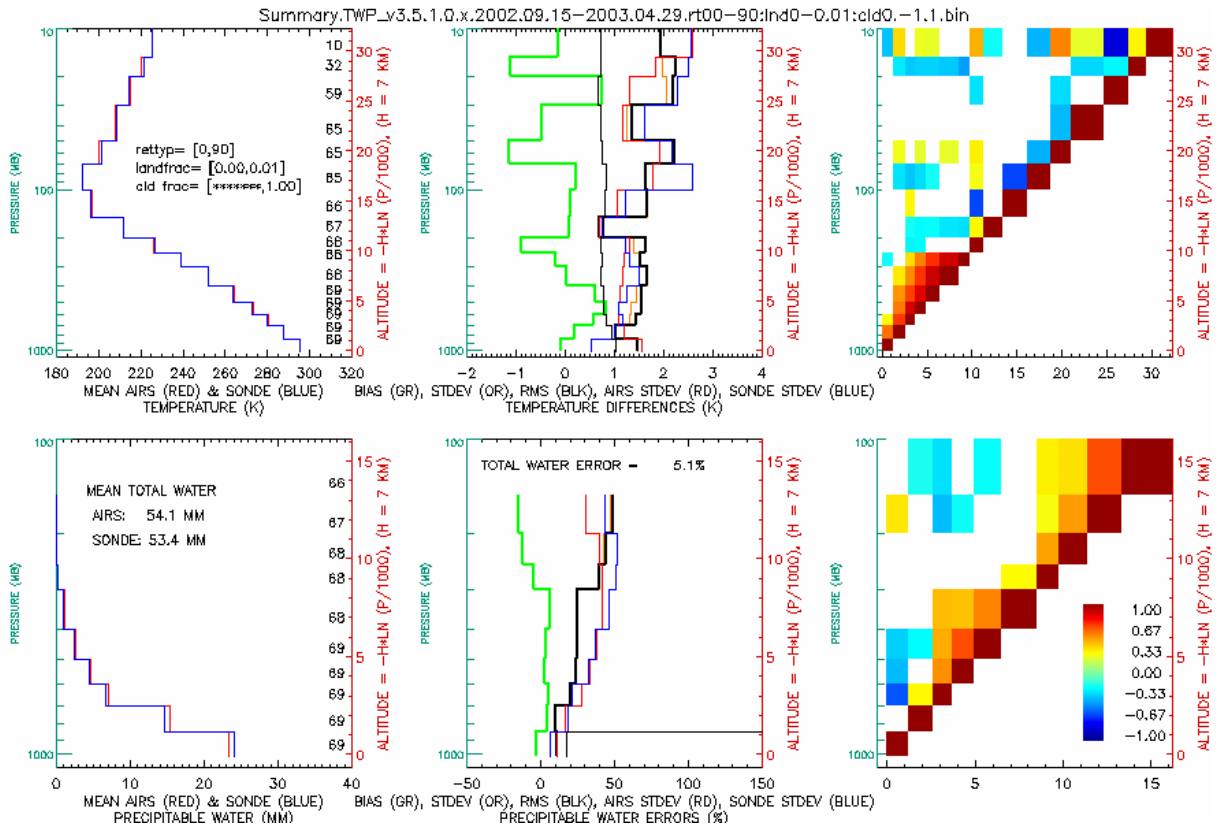


Figure 4. AIRS-sonde statistics at ARM Tropical Western Pacific site.

7. REFERENCES

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