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INITIAL LAND RAINFALL ESTIMATES FROM THE AQUA AMSR-E

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1. **INTRODUCTION**

The first Advanced Microwave Sounding Radiometer-EOS (AMSR-E) was launched on board the Aqua satellite May 4, 2002. The AMSR-E has better resolution than the Special Sensor Microwave/Imager (SSM/I) and covers most of the earth in comparison with the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI). So it is believed that the AMSR-E estimates will be the best single source of microwave rainfall estimates to date.

2. **PRELIMINARY AMSR-E RESULTS**

The AMSR-E data record begins June 1, 2002. However, for the first several months after launch the data have been available only to investigators within the project so they can look at the data and find problems.

As an example of the types of problems encountered, the initial rainfall estimates were all zeros. This resulted from a surface type database used in the rainfall algorithm but created as a separate product that was missing in the processing. At the time of this writing, the original problem had not yet been corrected.

In the meantime, we analyzed the 89 GHz channel, the most important channel utilized to estimate rainfall rate over land. This channel is the best measure of cloud ice, and the algorithm uses the assumption that larger amounts of cloud ice correspond to stronger convection and more surface rainfall as in Ferraro (1997).

Aqua is near-polar orbiting with local overpass times of 1:30 am/pm +/- 15 minutes. The TRMM orbit was designed to sample the diurnal cycle at all locations, so it occasionally crosses the ground swath of Aqua. We collected the collocated TMI and AMSR-E brightness temperatures for land locations at the times with satellite crossings within 15 minutes of each other. For the first 10 days of AMSR-E data, June 1-10, this resulted in around 350,000 pairs of data for each of the two polarizations (horizontal and vertical). As a reference, the same procedure was done for the same time period for the crossings of the SSM/I on board the F-13 and F-14 Defense Meteorological Satellite Program polar orbiting satellites, which have approximate local overpass times of 6 am/pm and 9 am/pm, respectively. The differences between the 85 GHz channels of SSM/I and TMI and the 89 GHz of AMSR-E are negligible, facilitating these comparisons.

Figure 1 summarizes the results of the 10 days of comparisons. The initial AMSR-E 89 GHz brightness temperatures are significantly higher than the TMI 85 GHz temperatures, especially in the horizontal polarization (286K vs. 275K). Hereafter, we denote horizontal polarization by H, as in 89H for AMSR-E, and vertical polarization by V. These AMSR-E data had not yet been calibrated, so this large difference is not unexpected. It may take some time to calibrate the instrument, but these results give an idea of the types of corrections that may be necessary.

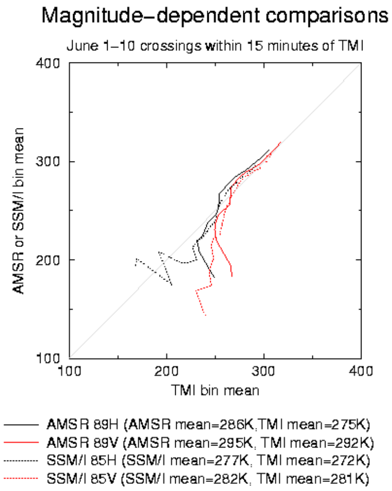

Figure 1. Summary of AMSR-E vs. TMI and SSM/I vs. TMI collocations. The data were binned according to the sum of the two values compared.

The TMI was calibrated with reference to the SSM/I (Kummerow et al. 2000), however, there are different versions of SSM/I data available and the data here do not have the same calibration with TMI, thus there are also biases in these comparisons. For example, the mean SSM/I 85H temperature is 277K, compared to the mean TMI 85H temperature of 272K.

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The brightness temperature histograms (Figure 2) show a clear shift for the horizontal polarization, resulting in the lower TMI mean rainfall.

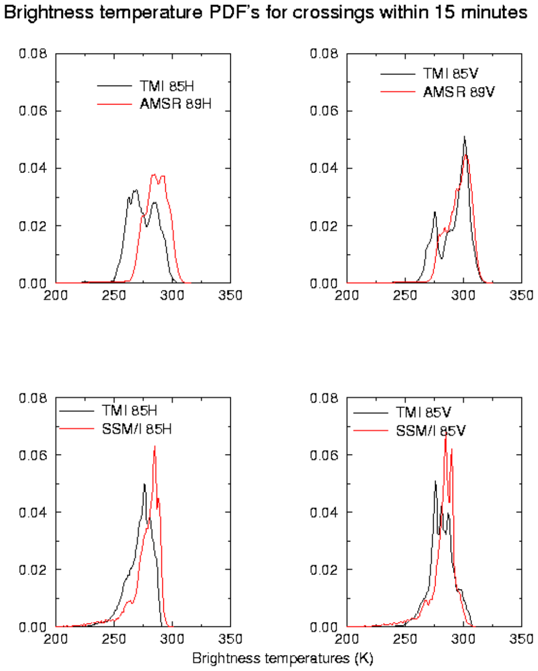

Figure 2. Brightness temperature histograms for the collocated data.

The global view of the brightness temperatures is shown in the remaining figures. The higher brightness temperatures with respect to the TMI can also be seen on the global maps of Figures 3-6. The largest discrepancy between the upper and lower panels is in Figure 3, AMSR-E 89H vs. TMI 85H.

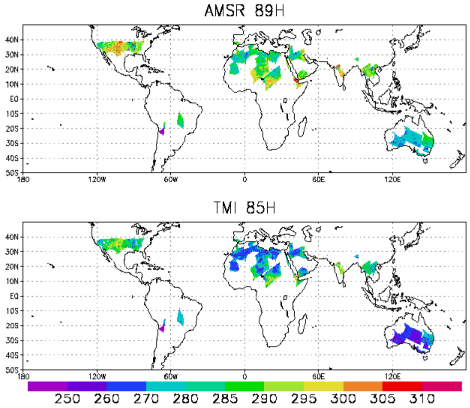

Figure 3. Overlaps of AMSR-E 89H and TMI 85H for June 1-10, 2002.

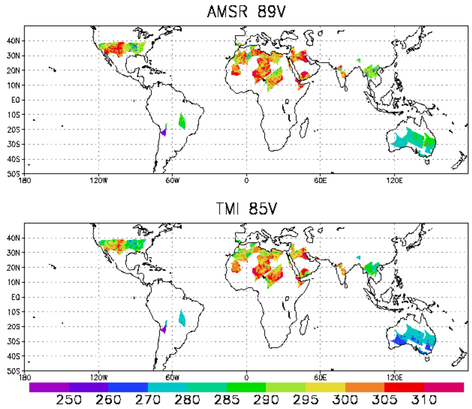

Figure 4. Overlaps of AMSR-E 89V and TMI 85V for June 1-10, 2002.

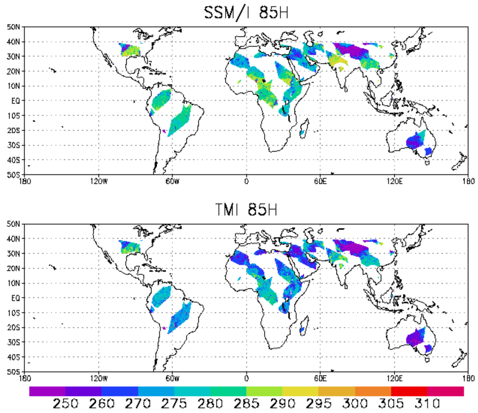

Figure 5. Overlaps of SSM/I 85H and TMI 85H for June 1-10, 2002.

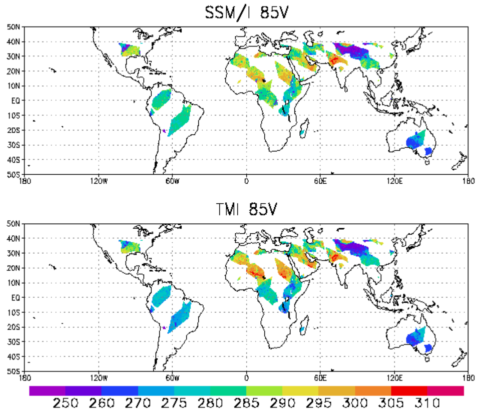

Figure 6. Overlaps of SSM/I 85V and TMI 85V for June 1-10, 2002.

We also looked at case studies for low brightness temperatures, as these are often cases involving heavy rainfall. These cases are labeled by the number of seconds from the first AMSR-E data on June 1.

Fig. 1 indicates that the TMI may sometimes miss the extreme low values estimated by AMSR-E and SSM/I, particularly AMSR-E. For example, Figure 7 shows AMSR-E values below 200K, whereas TMI doesn't measure anything below 250K for the same area. Also note that the higher brightness temperatures are much warmer for AMSR-E. The vertically polarized channels show similar behavior in Figure 8.

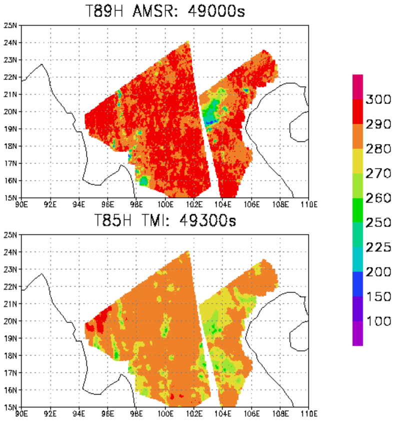

Figure 7. Overlaps of AMSR-E 89H and TMI 85V for a case study.

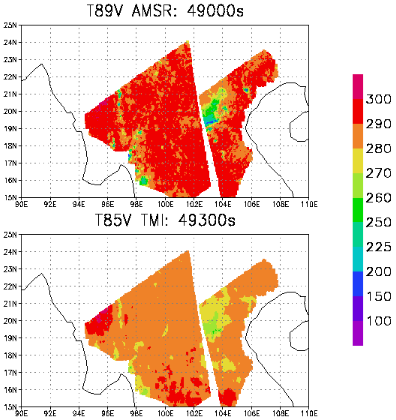

Figure 8. Overlaps of AMSR-E 89V and TMI 85V for the case study of Fig. 7.

Case studies for the SSM/I overlaps including sub-200K brightness temperatures show similar results, an example overpass in shown in Figures 9 and 10.

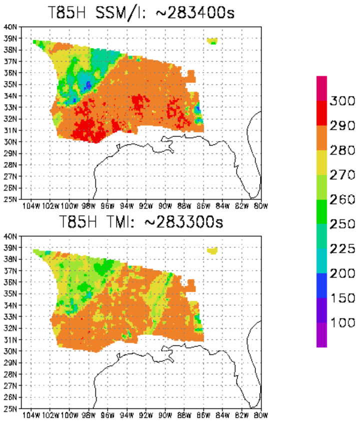

Figure 9. Overlaps of SSM/I 85H and TMI 85H for a case study.

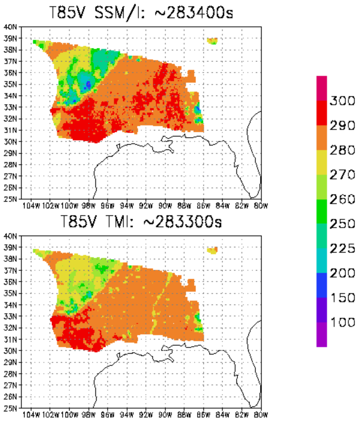

Figure 10. Overlaps of SSM/I 85V and TMI 85V for the case study of Fig. 9.

3. SUMMARY

The initial post-launch AMSR-E data are being investigated. As an important input product to the rainfall algorithm has not been generated, we looked at the 89 GHz brightness temperatures used to estimate rainfall rate. The initial data show the lack of calibration; the AMSR-E 89H channel is in general around 10K higher than TMI 85H for the higher brightness temperatures.

4. REFERENCES

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