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A TRMM-CALIBRATED INFRARED TECHNIQUE FOR CONVECTIVE AND STRATIFORM RAINFALL: ANALYSIS AND VALIDATION

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1. INTRODUCTION

In this paper, we present results from a combined satellite infrared (IR) and microwave (MW) technique for estimating rainfall over the Amazon Basin. Our objectives are to examine the diurnal variability of rainfall and to investigate the relative contributions from the convective and stratiform components. Anagnostou et al (1999) performed a similar analysis using SSM/I and GOES data. The current technique (designated CST/TMI) and described in Negri et al (2001), is based on the IR estimates from the Convective-Stratiform Technique (Adler and Negri, 1988) calibrated by coincident rain estimates from the TRMM Microwave Imager. This paper extends the results of Negri et al (2001) to examine the inter- and intra-annual variability of the diurnal cycle of rainfall for various periods in 1999-2001.

2. RESULTS

The diurnal cycle of rain over the Amazon Basin (0-10S, 75-50W) was constructed from 30-minute interval CST/TMI estimates. We examined six three-month periods: Jan-Mar, (JFM) 1999, 2000 and 2001 (for interannual variability) and well as Apr-Jun (AMJ), Jul-Sep (JAS) and Oct-Dec (OND) in 2000 for intra-annual variability. The first period coincided with the LBA experiment in Rondonia (southwestern Brazil). *In situ* radar data provided a comparison between the mean radar rain rates and convective/stratiform division with those estimated by the CST/TMI. The phase of the satellite estimates lagged the radar by one hour (Negri et al, 2001).

Buoyed by the success of the technique in an area with ground-truth, we examine the diurnal variation of rainfall in the entire Amazon basin. In such a large region, it is possible to utilize the TRMM PR data as ground truth, despite the limited sampling. In Figure 1, we display a time series of the estimated total, convective and stratiform rain rates (mm/h) for all of 2000 for both the CST/TMI (top) and TRMM PR (bottom). The IR estimates (total and convective) peak at 16 LT, with stratiform trailing 2-3 h later. Phase agreement with the PR is best for the convective portion. The IR estimates missed morning rainfall, which the PR identifies as mostly stratiform. The diurnal cycle of stratiform rain from the PR is essentially constant, unlike the CST/TMI cycle. In the mean, both methods find the convective rain to comprise ~ 60% of the rain volume. At the time of peak rainfall, the percentage is closer to 70% in both methods. Sampling is indicated by the number plotted across the bottom. We plot the number of TRMM orbits (by hour) in which the subpoint crossed the region of interest during 2000. We believe that the limited sampling contributes to the "noise" in the PR diurnal signal. There are obvious differences in the *amplitude* of the diurnal cycle.

Figure 2 shows the interannual variability of the diurnal cycle of rainfall for JFM 1999-2001. The CST estimates display the same pattern in all three periods, with a peak at 16 LT, and an indication of a smaller, early morning maximum at 4 LT. The PR data show a consistent spike between 6-8 LT, mostly stratiform rain, that the IR technique misses. For this period, the PR has the mean percent stratiform rain at ~ 50%, while the IR technique is closer to 66%, a result of underestimating the morning rainfall.

In Figure 3, we present seasonal (three-month) estimates for 2000. PR sampling in this 3-month period is about 16 overpasses at each hour. During the hours 0-10 LT, rainfall is not well represented in the CST/TMI estimates. The PR estimates show the onset of afternoon convection to be 1 h earlier than the IR, and the PR displays a broader afternoon maximum.

Future work will include an investigation of the morning stratiform rainfall missed by the IR technique, and a comparison with the diurnal cycle derived from the TMI retrievals. We hope to use the high-resolution, global IR dataset of Janowiak et al (2001) in conjunction with the PR data to produce global estimates at high spatial and temporal resolution.

3. REFERENCES

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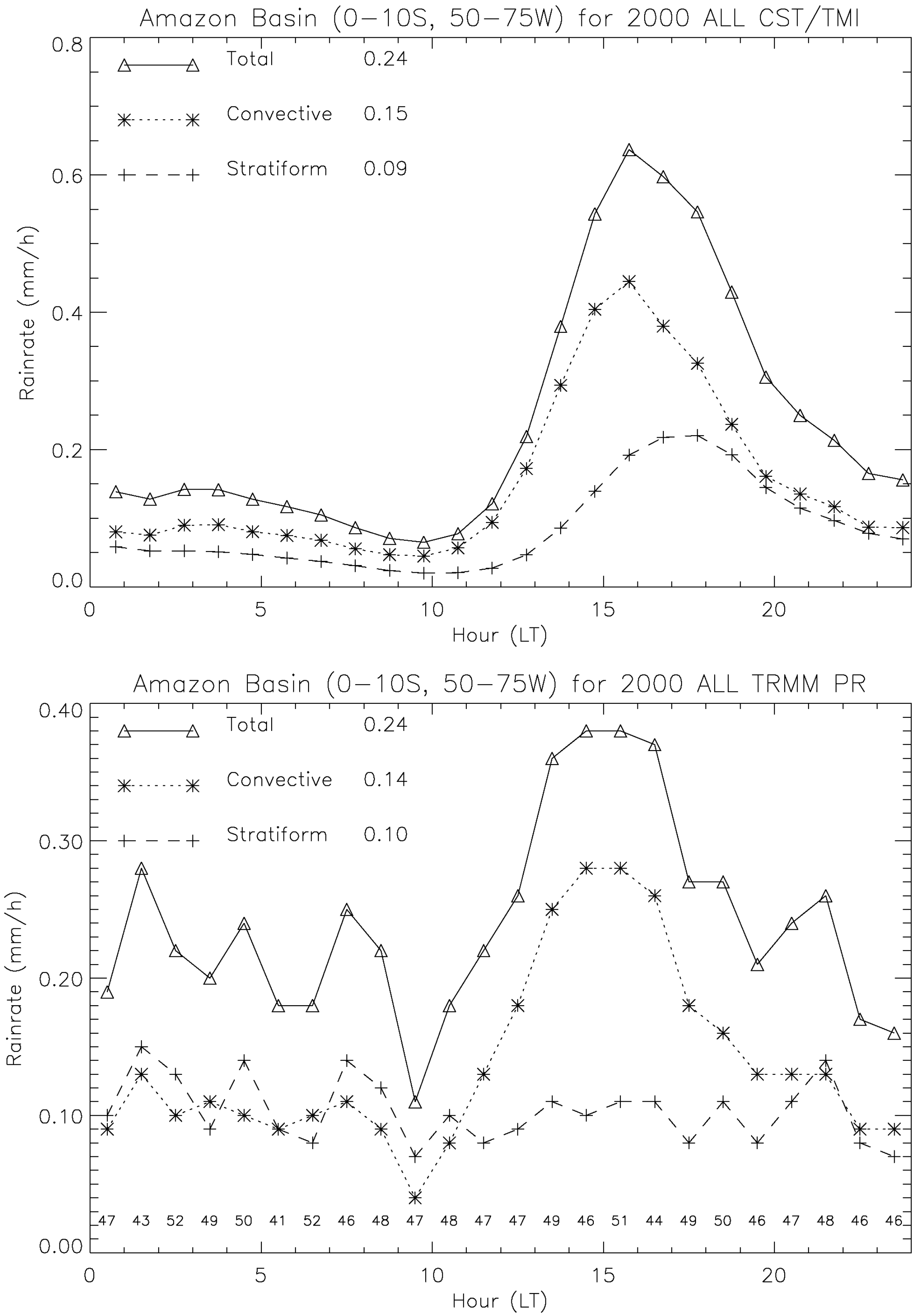

Figure 1. Diurnal cycle for the Amazon Basin estimated from the CST/TMI (top) and TRMM PR (bottom) for 2000. Total, convective and stratiform rain rates are plotted. Mean values for each are shown in the legend. Numbers along the bottom indicate the number of TRMM orbits in which the satellite subpoint intersected the region.

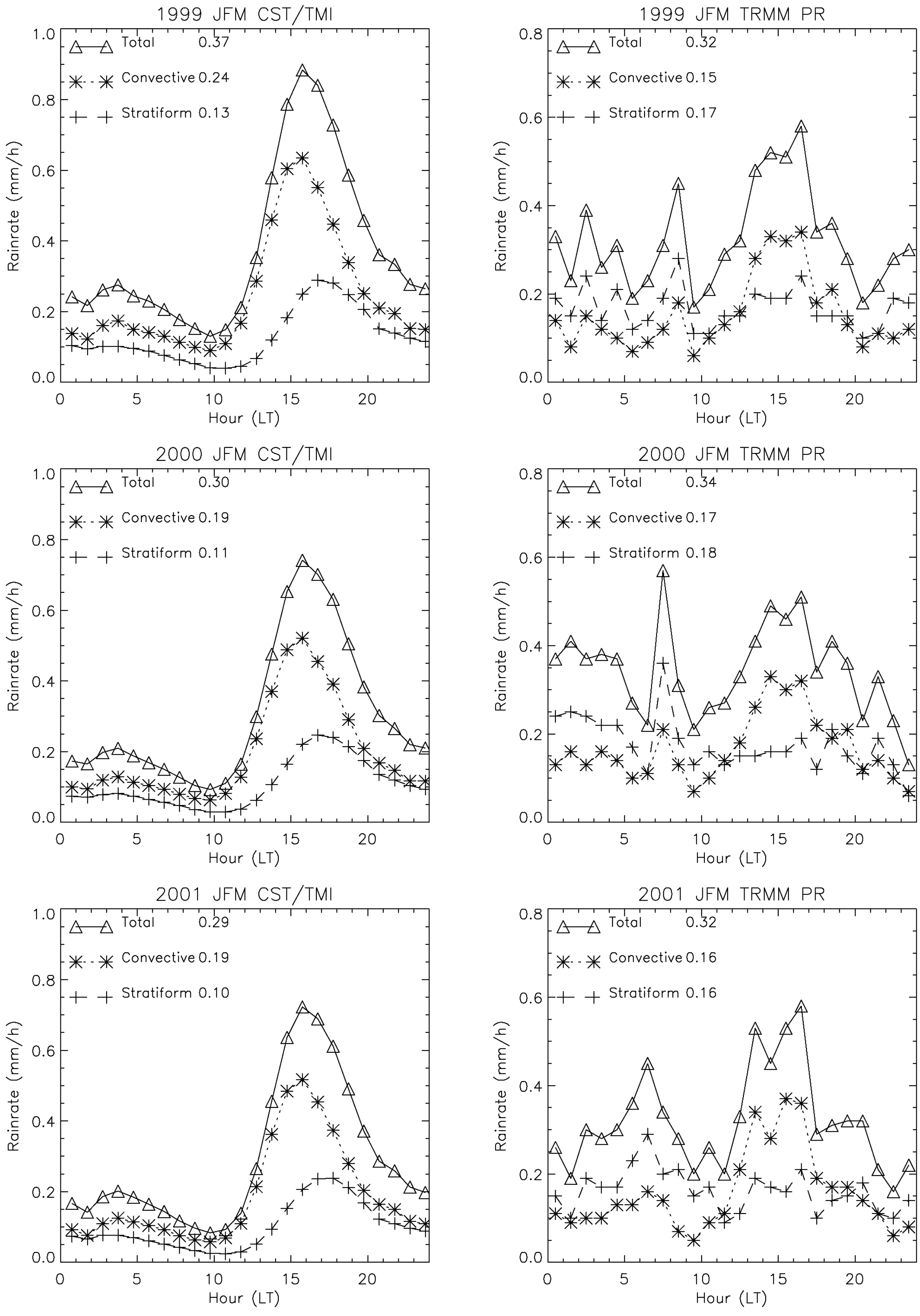

Figure 2. Same as Fig. 1 except for Jan-Mar 1999 (top), 2000 (middle) and 2001 (bottom). IR-based estimates are on the left, TRMM radar on the right.

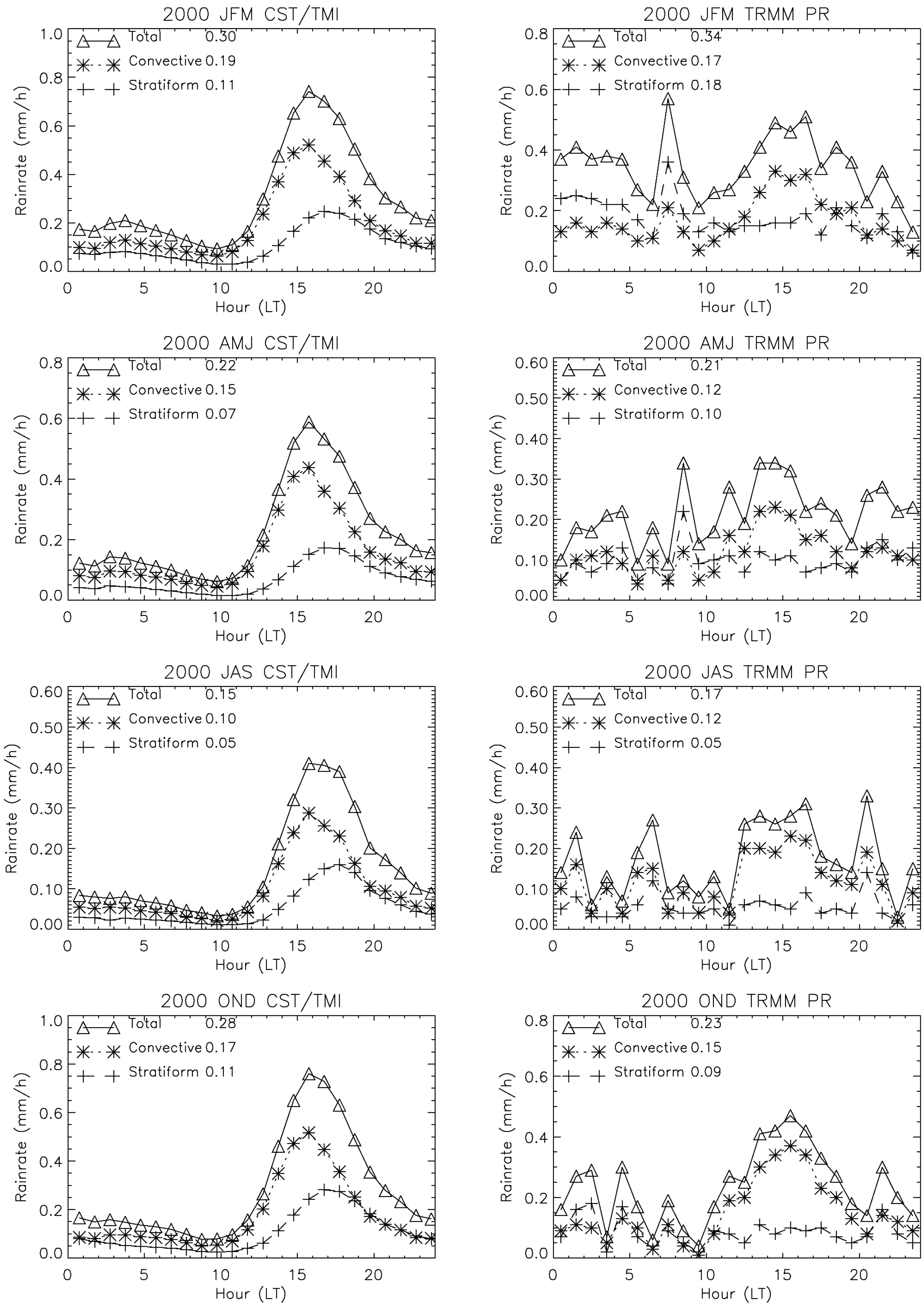

Figure 3. Same as Fig. 2 except for seasonal (three-month) periods in 2000.