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CONSISTENCY CHECK OF DROP SIZE DISTRIBUTION IN RAIN RETRIEVALS WITH A COMBINATION OF TRMM MICROWAVE IMAGER AND PRECIPITATION RADAR OBSERVATIONS

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1. INTRODUCTION

While differences in global averaged rainfall between the TRMM Microwave Imager (TMI) and Precipitation Radar (PR) have been reducing, regional and seasonal differences still exist. Possible error sources are static model assumptions involved with individual retrieval algorithm. In this study, the consistency in observed and simulated brightness temperature (TB) is investigated, where the simulated TB is derived from PR precipitation profiles, similar to Viltard et al. (2000), but for the cases over the South China Sea Monsoon Experiment (SCSMEX). We examine whether or not the DSD model assumed by the PR algorithm produces good or poor agreement between observed and simulated TBs.

2. DATA DESCRIPTIONS

We use two of TRMM standard data products, referenced as PR rain rate/PR-corrected reflectivity (2A25) and TMI TB (1B11). Both standard products here are version 5. The results reported in this short paper are based on a subset of orbit 2719 on 19 May 1998 from the SCSMEX region.

Here we introduce a brief summary of Z-R relations, or, equivalently, the drop size distribution (DSD) for 2A25. The "globally" averaged Z-R relation used in version 5 of 2A25 are as follows

$$Z = 185R^{1.43}\text{(convective)}, \quad (1)$$

$$Z = 300R^{1.38}\text{(stratiform)}. \quad (2)$$

The Z-R relations are obtained from a collection of Z-R relations measured near the oceanic from widely distributed locations around the world (Kozu et al., 1999). The same Z translates to R smaller in stratiform compared to convective rainfall.

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3. RESULTS AND DISCUSSIONS

In this study, the radiative transfer model (RTM) developed by Liu (1998) is used to calculate TBs. Because absorption is the dominant effect at lower frequencies, TMI TB at 10.65 GHz is less sensitive to DSD or the effect of ice scattering. Therefore, we focus on TB at 10.65 GHz.

Figure 1 illustrates the brightness temperature simulations that the antenna patterns affects. Although the general spatial patterns are very well reproduced, the lack of emission at 10.65 GHz-V is obvious. This result is consistent with the results of Viltard et al. (2000) for a case in the central Pacific.

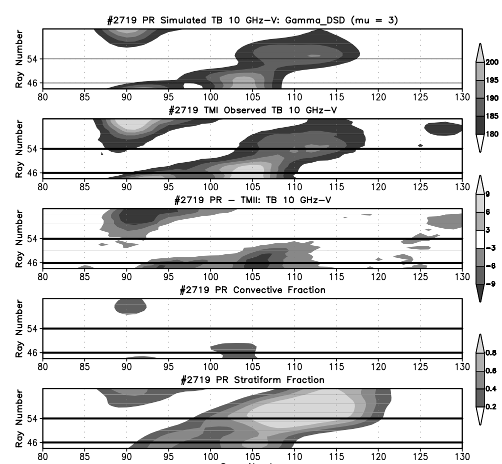

Figure 1: Imagery of mesoscale systems occurring over the SCSMEX region on 19 May 1998, (a) Simulated TBs for 10.65 GHz-V obtained from PR rain profiles, (b) TMI observed TBs for 10.65 GHz-V, (c) simulated TBs minus observed TBs, (d) PR-derived convective area fractions at a resolution comparable to the TMI, and (d) PR-derived stratiform area fractions at a resolution comparable to the TMI. Horizontal lines indicate ray number 46 and 54, respectively

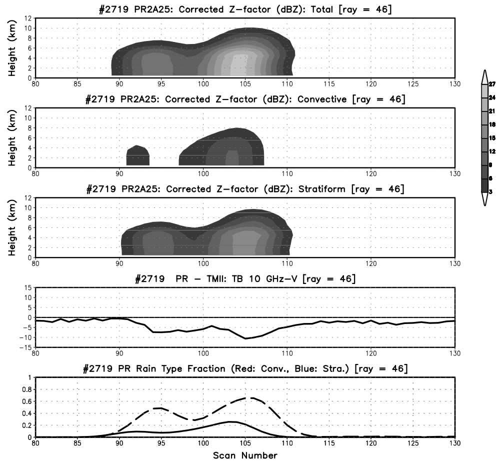

Figure 2: Vertical cross section of PR observed radar reflectivity at a resolution comparable to the TMI for ray number of 46 dor (a) total, (b) convective, and (c) stratiform. (d) Simulated TBs minus observed TBs, and (e) PR-derived convective (solid) and stratiform (dashed) area fractions at a resolution comparable to the TMI.

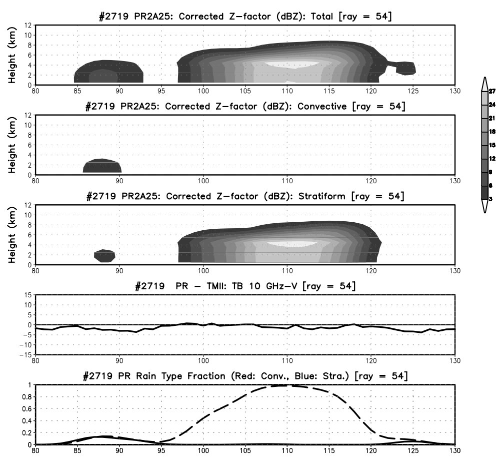

Figure 3: Same as Fig. 2, but for ray number of 54.

Figure 2 illustrates the height-zonal cross sections of PR observed radar reflectivities for ray number of 46 where the lack of emission is noticed in Fig. 1. For more direct comparison, a weighted average of the PR radar reflectivities in the neighborhood of a given TMI footprint is performed. The region with lack of emission roughly corresponds to those of large PR-derived stratiform area fractions. These region of large stratiform area fractions is very close to the region with large convective area fractions.

In contrast, the region of large PR-derived stratiform area fractions in ray number of 54 shows very good agreement between simulated and observed TBs (Fig. 3). The radar reflectivities in this region has typical stratiform characteristics because they still shows the bright band even if a weighted average is performed.

Part of poor agreement between simulated and observed TBs in the stratiform region near the convective region may be due to selection of the Z-R relation in 2A25. In convective-stratiform classification, the same Z translates to R smaller in stratiform compared to convective rainfall (Eqs. (1), (2)). This is based on the presence of a few large drops in the stratiform drop spectra. The dominant growth processes of stratiform precipitation are vapor deposition onto existing ice particles and the collection of snow generated by the mesoscale updraft that develops in the upper levels in the stratiform regions. The passage of the particles through the region of mesoscale updraft may be not enough for the growth of large drops in the stratiform region near the convective region. Hence, the selection of the Z-R relation, or, equivalently the DSD for stratiform (Eq. (2)) may be not appropriate.

Finally, it should be noted conclusions are tentative. As mean size distributions of raindrops are measured in SCSMEX by dual-polarized radar (Bringi et al., 2003), conclusions might be verified more directly.

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REFERENCES

Bringi, V. N., V. Chandrasekar, H. Hubbert, E. Gorgucci, W. L. Randeu, and M. Schoenhuber: 2003, Rindrop size distribution in different climate regimes from disdrometer and dual-polarized radar analysis. *J. Atmos. Sci.*, **60**, 354–365.

Kozu, T., T. Iguchi, K. Shimizu, and N. Kawagishi: 1999, Estimation of rain drop size distribution parameters using statistical relations between multi-parameter rainfall remote sensing data. *Preprints, 29th Int. Conf. on Radar Meteorology*, Amer. Meteor. Soc., Montreal, Quebec, Canada, 689–692.

Liu, G.: 1998, A fast and accurate model for microwave radiance calculations. *J. Meteor. Soc. Japan*, **76**, 335–343.

Viltard, N., C. Kummerow, W. S. Olson, and Y. Hong: 2000, Combined use of the radar and radiometer of trmm to estimate the influence of drop size distibution on rain retrievals. *J. Appl. Meteor.*, **39**, 2103–2114.