Spectral retrieval of latent heating profiles from TRMM PR data

Shoichi Shige[1], Yukari N. Takayabu[2] and Wei-Kuo Tao[3]
[1]Graduate School of Science, Kyoto University, Japan
[2]Atmospheres and Ocean Research Institute, University of Tokyo, Japan
[3]NASA/Goddard Space Flight Center, USA
(Shoichi Shige, shige@kugi.kyoto-u.ac.jp)

1. Introduction

The Spectral Latent Heating (SLH) algorithm has been developed for the TRMM precipitation radar (PR) in Shige *et al.* (2009, and references therein). In this paper, the status and future plan of SLH algorithm will be discussed.

2. Algorithm

Heating profile lookup tables (LUTs) for the three rain types—convective, shallow stratiform, and anvil rain (deep stratiform with a melting level)—were produced from the cloud resolving model (CRM) simulations from TOGA COARE. For convective and shallow stratiform regions, the LUT is based on the precipitation top height (PTH). Considering the sensitivity of the PR, we used a threshold of 0.3 mm h^{-1} to determine the PTH. Properties (i.e., shape and magnitude) of the convective and shallow stratiform heating profiles show near-monotonic change with the PTH, suggesting that the distribution of latent heating is a strong function of the PTH. On the other hand, the PR cannot observe the PTH with sufficient accuracy for anvil regions because of its insensitivity to the small ice-phase hydrometeors. The anvil heating profile shape is much more uniform in time and space than the convective heating profile, such that the height of maximum anvil heating is not overly sensitive to the storm-height observation. Thus, for an anvil region, the LUT is based on the precipitation rate at the melting level P_m instead of the PTH. The SLH estimates from PR data were in good agreement with rawinsonde estimates averaged over the SCSMEX NESA.

The vertical distribution of the apparent moisture sink (Q_2) is also estimated by the SLH algorithm. Although discrepancies between the SLH-retrieved and sounding-based profiles of Q_2 the apparent moisture sink for the SCSMEX NESA were larger than those for heating, key features of the vertical profiles agreed well.

3. Status and future plan

The latent heat research product based on the SLH algorithm is available on the Internet at http://www.eorc.jaxa.jp/TRMM/lh/index.html and it has been used for scientific studies (Hagos *et al.* 2010, Takayabu *et al.* 2010, Elsaesser *et al.* 2010). The updated version of the SLH estimates will be published as the TRMM standard product.

Currently, only the LUTs produced from two-dimensional CRM simulations from TOGA COARE is used. Significant differences in precipitation features between ocean and land have been shown by TRMM observations. We will perform simulations of other field experiments to produce LUTs for precipitation over land. The turbulent process in the planetary boundary layer is 3D in nature, and it is very important for Q_2 retrieval using the SLH. However, using the LUTs produced from the 3D CRM leads to less agreement between the SLH heating estimates and rawinsonde heating estimates averaged over the SCSMEX NESA (Shige *et al.*, 2009). The horizontal grid spacing was chosen as 2 km for the 3D simulations. Coarser-resolution simulation produces wider clouds, and this has a direct impact on cloud entrainment, leading to fewer, more-concentrated convective cores that ascend higher into the troposphere. More-concentrated convective cores produce more ice-phase condensates, which are generated in and carried from the convective region to the stratiform region, and there is less condensate produced by the stratiform region's own upward motion. In the future, we will conduct the 3D simulations with finer resolution.

References

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