# GPM SLH V04 evaluation

Yukari N. Takayabu, Shoichi Shige, Atsushi Hamada,
Misako Kachi, and Takuji Kubota

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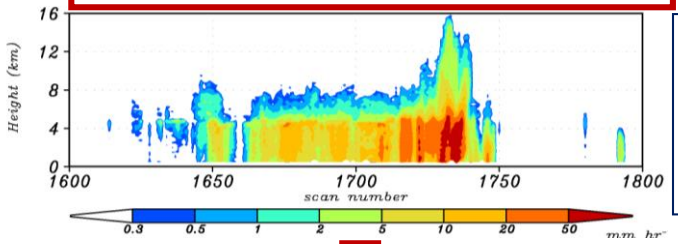
# SLH L2/L3 V04 Product Outlines

- Agreements on DPR SLH V4 product
  - Process on both sides (PPS and EOC)
  - DPR SLH V4 is based on the TRMM PR SLH V7 product algorithm (V3.97), and applied to DPR to estimate the latent heating over the tropics and the subtropical regions.
  - Latent heating of mid-latitude type precipitation will be produced in the next product version.
- Products
  - Level2: Latent heating orbital data (Quasi-standard)
  - Level3: Latent heating 0.5 degree gridded, Orbital
  - Level3: Latent heating 0.5 degree gridded, Monthly
- Resolutions
  - Level2: 5km horizontal, 80levels vertical (same as PR SLH L2)
  - Level3: 0.5degree horizontal, 19 levels vertical (as PR SLH L3)

# SLH Algorithm

TRMM PR2A25 orbital data

GPM DPR KuPR orbital data

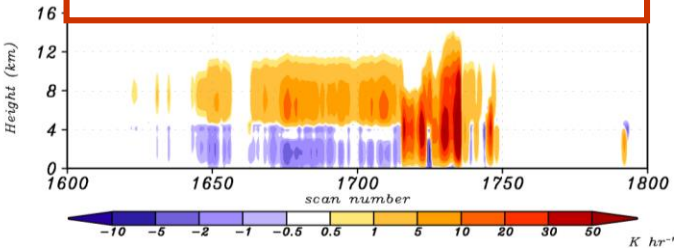


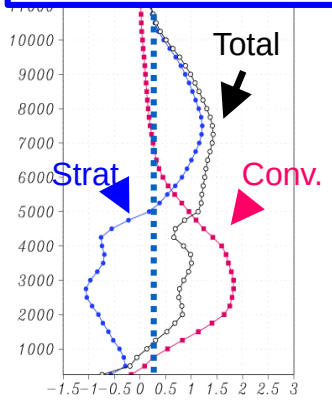

Rain Type
Precip. Top Height
Melt-Lvl Precip.
Sfc Precip.

Goddard Cumulus Ensemble Model (GCEM)

Rain-LH tables

Estimate LH Data

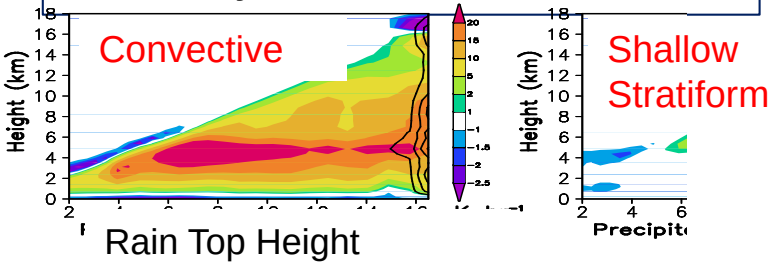


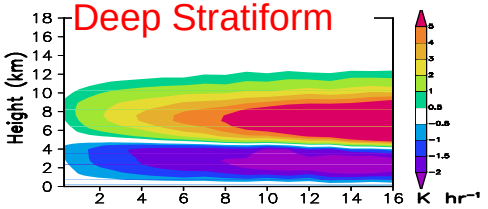

(Shige et al. 2004, JAMC)

Rain-LH tables

Rain-LH tables, for convective, deep and shallow stratiform rain, are constructed from cloud ensemble model simulations forced by TOGA-COARE data.




Rain Top Height




Melting Level Precipitation Rate

# SLH L2/L3 V4 Data Release Criteria

- In comparison with the TRMM PR LH heating products, no significant inconsistency (*1) should be found for the 3 months averaged Q1R (=Q1-QR) for April-June 2014, in terms of horizontal distribution, zonal mean profiles, and profiles in representative regions (*2), except for shallow heating (*3)

(*1) Agreements in horizontal distribution and in zonal mean profiles. Reasonable agreements in average Q1R profiles in most of representative regions, with differences of peak values above 3km altitudes are less than about 20%, with some exceptions where future issues are specified.

(*2) Six selected regions: West Pacific, Central Pacific, East Pacific, Indian Ocean, Atlantic, and South Pacific, and 3 regions of past field experiments: TOGA-COARE, GATE, and DYNAMO

(*3) In addition to higher sensitivity of GPM Ku band radar compared to TRMM PR, a dominance of mesoscale systems in TOGA-COARE possibly affects the table for shallow rainfall anomalously rich in developing convection. (This point should be improved in the future version)

# Differences from the TRMM PR LH V7 and their evaluations

- Major differences
  - Using the KuPR L2 data as an input.
  - Based on PR 2A23 precipitation type classification giving priority in consistency between DPR SLH and PR SLH.
    - ✓Definition of shallow precipitation in the convective/stratiform precipitation type classification is different between DPR and PR.
  - Introducing climatological database of precipitation type to exclude mid-and-high latitude's type precipitation.
    - ✓Database is produced in monthly basis using monthly data of PR L2, KuPR L2 and Japanese 55-year Reanalysis (JRA55) data from January 1998 to December 2014 (17-years).
- Validation results
  - Comparison of DPR SLH and PR SLH products for the 3-month overlap period from April to June 2014.
  - There is reasonable agreement between two products and DPR SLH product satisfied its data release criteria.

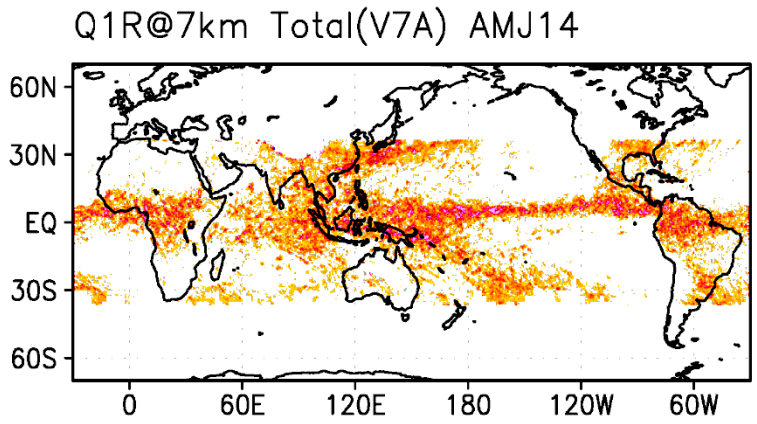
# SLH L2/L3 V04 Evaluations

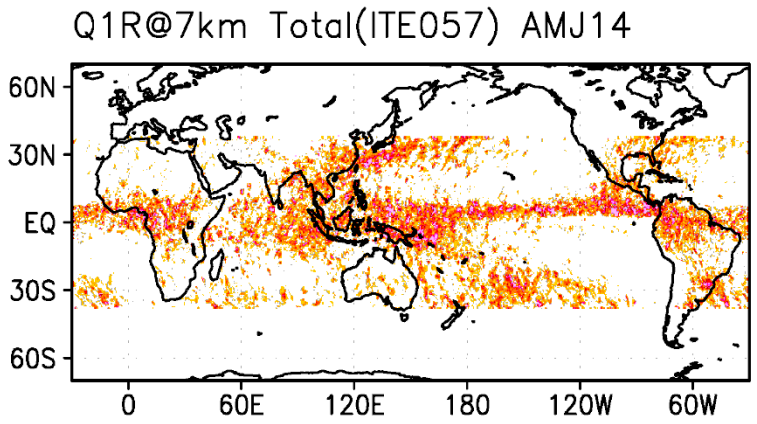
## Horizontal distributions of three-month mean Q1R


[K/day]

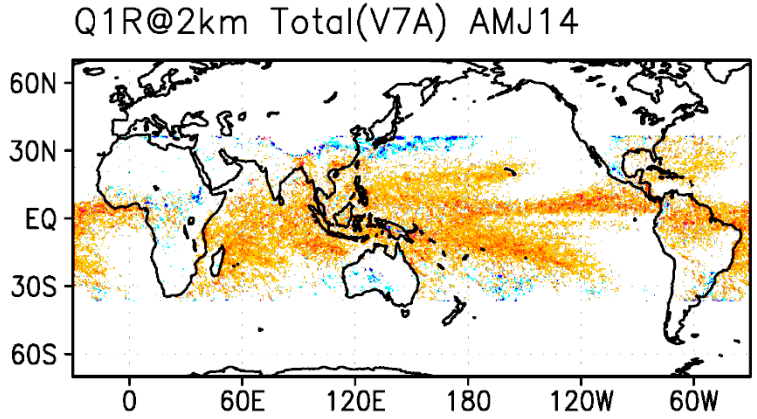
**TRMM PR V7A** | **GPM DPR ITE057**

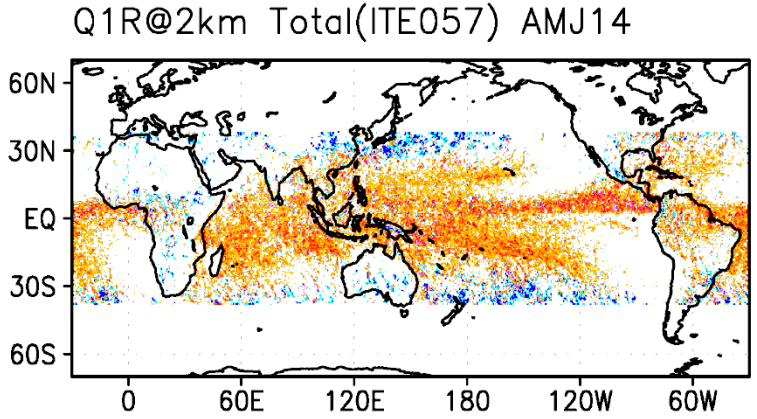
**7km**




**2km**



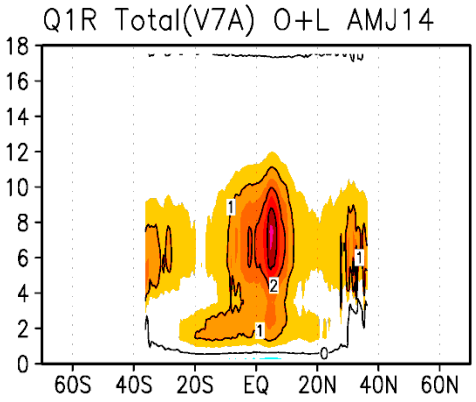

Good agreements in horizontal distributions between PR-SLH and DPR-SLH are found in the TRMM region

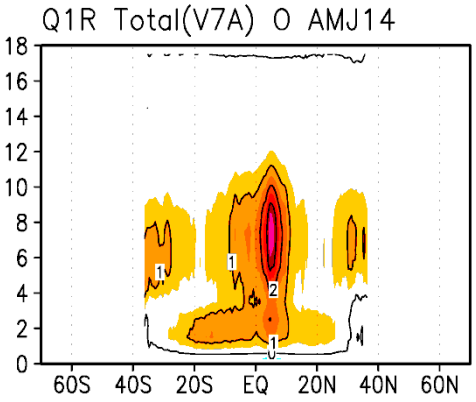
# SLH L2/L3 V04 Evaluations

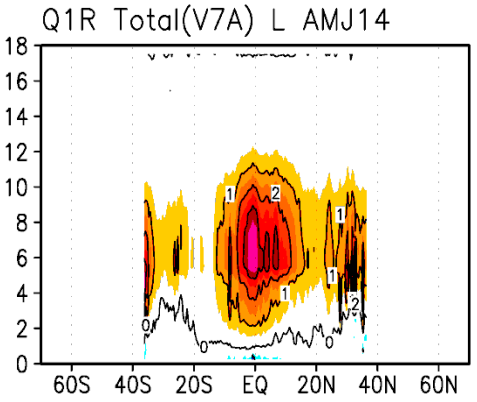
## Zonal mean latitude-height sections of 3mo-mean Q1R

**Ocean+land** | **Ocean** | **Land**

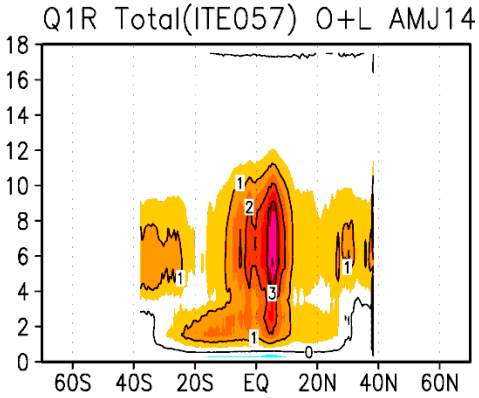
**TRMM PR V7A**

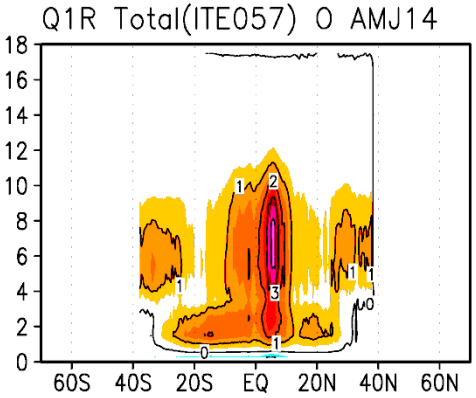


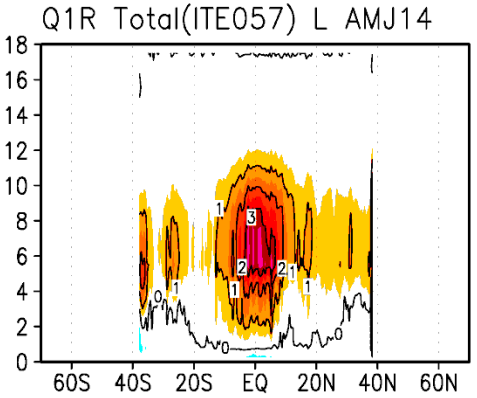




**GPM DPR ITE057**



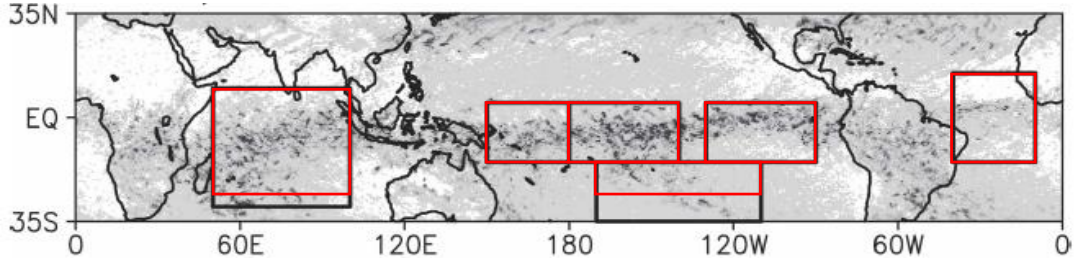



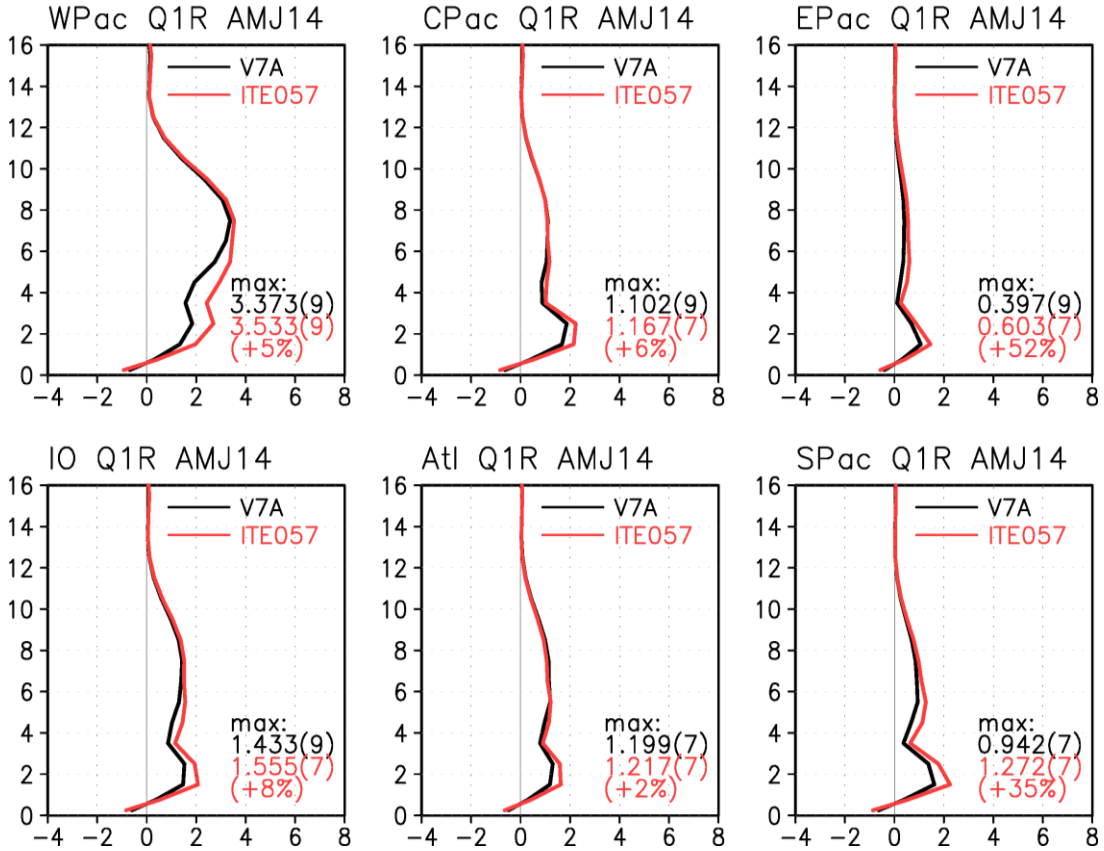




Except for slightly stronger shallow heating of GPM-SLH, good agreements are found in zonal mean lat-height sections of Q1R between TRMM-SLH and GPM-SLH. Higher altitude heating distribution at the northern and southern fringes may be affected by the filtering of mid-latitude type rainfall for this product and will be examined further.

# SLH L2/L3 V04 Evaluations

## Average vertical profiles of Q1R in 6 representative regions



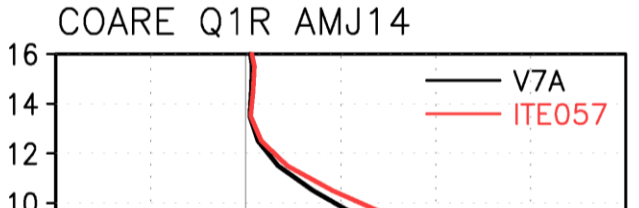



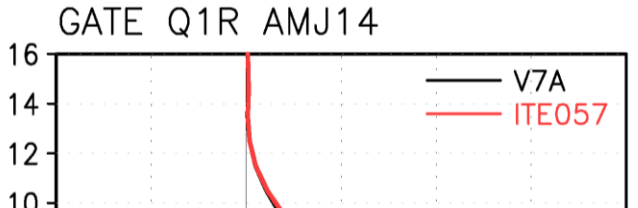

- ✓ Good agreements in profiles of TRMM and GPM SLH in all regions are confirmed.
- ✓ Except for the EPAC and SPAC, where shallow heating is dominant, peak values show sufficient consistency (<20%) among the two.

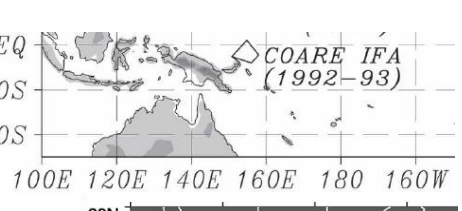
(Note) Regions southward of 25S are excluded in order to avoid the effect of a filter to exclude the mid-lat rainfall cases where 0degree heights are close to the sfc.

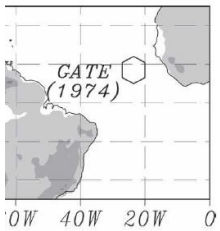
# SLH L2/L3 V04 Evaluations

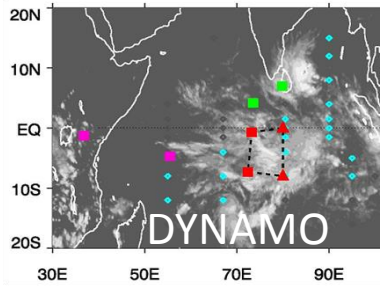
Average vertical profiles of Q1R in 3 representative field experiment regions

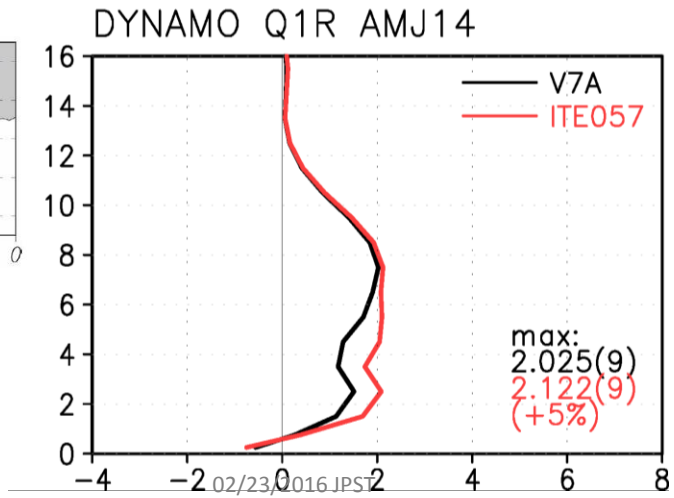



- ✓ Good agreements are found in all experiment regions.
- ✓ Increment of peak values above 3km altitudes are almost as small as 20% except for the 25% in COARE region.
- ✓ Considering the differences in sampling cases by two separate satellites, the consistency can be evaluated as sufficient.

# Summary

- GPM SLH V4 algorithm is the same as TRMM SLH V7A except for using GPM/KuPR information instead of TRMM/PR information.
- Consistency between GPM SLH V4 and TRMM SLH V7A estimates, over the coverage of TRMM/PR during the GPM and TRMM overlapping observation period (April-June 2014) is confirmed.
- A new algorithm to retrieve latent heating in mid-latitudes will be developed for the next version.
- LH table for shallow convection will be examined in order to avoid the possible effect of more-than-average developing shallow convection in TOGA-COARE.

Notes

- For a consistency with SLH estimates from TRMM/PR, shallow non-isolated echo is classified as stratiform for GPM SLH V4, although it is originally assigned convective in GPM/KuPR algorithm.
- A mask for high mountains/winter mid-latitudes pixels has been applied as to TRMM SLH V7A.
- In order to remove suspicious extreme rainfall profiles, a filter developed by Hamada and Takayabu (2014) has been applied.