Release Notes for TRMM/GPM SLH V07

December 2021

Revised in May 2022

For the GPM SLH V07, the LUTs for great mountain ranges in the tropical precipitation regime (rainTypeSLH>200) is newly developed. The areas of the great mountain ranges in the tropical precipitation regime are shown in Figure 1. The separation among the tropics, the great mountain ranges in the tropical precipitation regime, and midlatitudes should be done referring to the rainTypeSLH values stored in the orbital data, and described in Table 1. Note only latent heating is retrieved for great mountain ranges in the tropical precipitation regime in the GPM SLH V07. TRMM SLH V07 algorithm is the same as the GPM SLH V07 algorithm.

The LUT for mid and higher latitudes was newly developed in the GPM SLH V05. In the TRMM/GPM SLH V06A, the same LUT for mid and higher latitudes is applied and LUT for tropics is the same as TRMM SLH V7A. Some recommendations to users of orbital data are listed below, for TRMM/GPM SLH V06A retrieved as tropical precipitation or those as mid latitude precipitation.

Although the SLH algorithm and Tables are the same as GPM SLH V05 for mid-latitude and TRMM SLH V7A for tropics, respectively, because of the change in input PR/KuPR Level 2 data (2APR/2AKu), TRMM/GPM SLH V06A products differ from TRMM SLH V7A and GPM SLH V05 products, respectively.

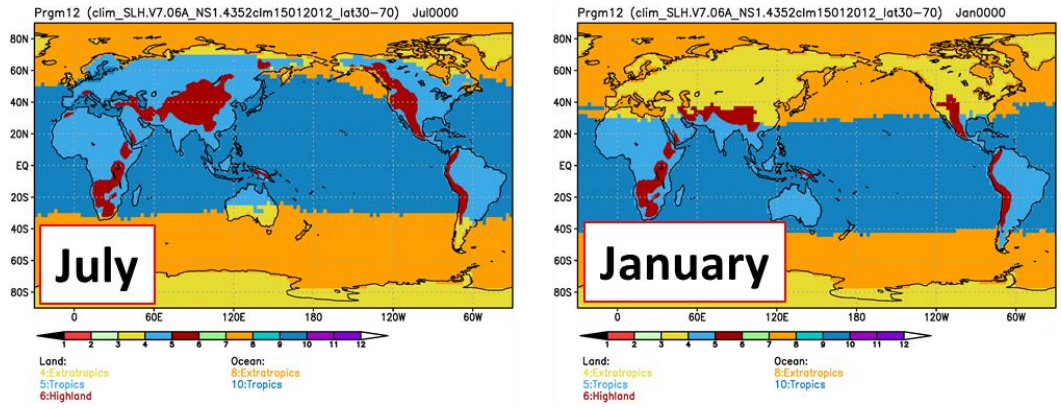


Figure 1 Distribution of the areas (6: Highland) which the LUTs for great mountain ranges in the tropical precipitation regime are applied with the areas (5: Tropics over Land and 10: Tropics over Ocean) where the LUTs for tropics are applied and the areas (4: Extratropics over Land and 8: Extratropics over Ocean) where the LUTs for mid and higher latitudes are applied for July (left) and January (right).

Table 1. Description for rainTypeSLH

(a) Tropics and subtropics	(b) Mid and higher latitudes	(c) Great mountain ranges in the tropical precipitation regime
0: No precipitation	100: No precipitation	200: No precipitation
11: Convective	111: Convective	211: Convective over high-elevation areas 212: Convective over low-elevation areas
21: Shallow stratiform	121: Shallow stratiform	221: Shallow stratiform over high-elevation areas 222: Shallow stratiform over low-elevation areas
31: Deep stratiform 32: Deep stratiform, DI (Intermediary)	131: Deep stratiform, DD, Pmax aloft 132: Deep stratiform, DD, Pmax NS 133: Deep stratiform, DI, Pmax aloft 134: Deep stratiform, DI, Pmax NS 135: Deep stratiform, subzero, Pmax aloft 136: Deep stratiform, subzero, Pmax NS	231: Deep stratiform, DD, Pmax aloft 232: Deep stratiform, DD, Pmax NS 233: Deep stratiform, DI, Pmax aloft 234: Deep stratiform, DI, Pmax NS 235: Deep stratiform, subzero, Pmax aloft 236: Deep stratiform, subzero, Pmax NS
61: Other, Applying table for rainTypeSLH=21	160: Other	261: Other, Applying table for rainTypeSLH=221 262: Other, Applying table for rainTypeSLH=222 263: Other, Applying table for rainTypeSLH=231 264: Other, Applying table for rainTypeSLH=232 265: Other, Applying table for rainTypeSLH=233 266: Other, Applying table for rainTypeSLH=234 267: Other, Applying table for rainTypeSLH=235 268: Other, Applying table for rainTypeSLH=236
Mask		
900: Areas with low melting levels including some mountains except for of great mountain ranges in the tropical precipitation regime 910: Suspicious extreme 920: No precipitation in SLH (precipRate < 0.2 mm/h (0.3 mm/h for tropics) or precipitation depth < 500m) but precipitation exists in 2Aku		

DI: Downward Increasing, DD: Downward Decreasing, NS: Near Surface

It was found that the change of the input KuPR level 2 data from V05 to V06 increased the bias between the KuPR near-surface precipitation and vertically integrated latent heating of SLH V06A. Moreover, some unnatural heating profiles were found associated with precipitation in tropical cyclones. To fix these problems, we revise the algorithm and release the SLH V06B product. Note that the SLH V06B product is available for GPM era since February 2014.

(i) No precipitation or Masked out pixels (rainTypeSLH=0, 100, 200, 300, 900, 910, or 920)

SLH values are not estimated (missing) for raintypeSLH=900 or 910.
SLH values are not estimated (0) for raintypeSLH=0, 100, 200, 300, 920.

(ii) Release note for tropical algorithm (0≦rainTypeSLH <100)

Analysis showed consistency among GPM SLH V04, V05, V06 and TRMM SLH V7A, V07 estimates over the coverage of TRMM/PR during a GPM and TRMM overlapping

observation period (April-June 2014). Note that:

0. Vertical levels are 80 levels.
1. In the V06B SLH, there was a shallow stratiform type (raintypeSLH=21). In V07 SLH this type is no longer used. Heating in all shallow pixels with their precipitation top heights (threshold 0.3mm/hr) lower than the melting level is estimated as convective type (raintypeSLH=11).
2. Differences of sampling between TRMM/PR and GPM/KuPR affect SLH estimates. The greater global coverage of the GPM Core Observatory (65°N/S) compared to the TRMM coverage (35°N/S) decreases sampling of GPM/DPR over the coverage of TRMM/PR, especially at around the satellite inclination latitudes of 35°N/S, affecting SLH estimates there.
3. Retrieval for tropical cyclones and high mountains/winter mid-latitudes pixels will be developed.
4. For tropical latent heating provided in 80 levels, users are recommended to smooth the profile vertical for a few levels to avoid the spurious peak at around 0degC level.
5. The tropical algorithm is sometimes applied at high latitudes in summer. In such cases, pixels to which the tropical algorithm are applied and those to which the mid-latitude algorithm are applied are distributed disorderly. This problem will be fixed in future version.

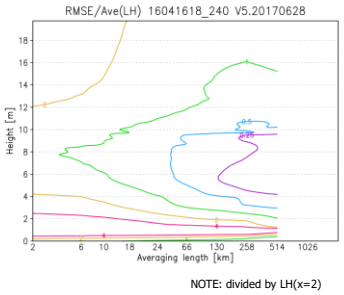
(iii) Release Note for Mid-latitude algorithm (100≦rainTypeSLH<200)

A. In look up table ranges where sampling numbers did not satisfy the criteria, values are discarded or extrapolated from nearest neighbor bins, depending on the precipitation type. Sampling number criterion is basically 30, but 60 is chosen for deep stratiform LUT with precipitation maximum at the near surface level. Corresponding range for the convective LUT is PTH>11km. Note that in case that a latent heating profile at the candidate bin used for extrapolation has cooling around the middle (or 0.35-0.45) of relative altitudes, for deep stratiform LUT with precipitation maximum at the near surface level, values at the bin are not used for extrapolation and those at its next bin are utilized.

B. Recommendation for horizontal averaging at the utilization of pixel products calculated with the mid-latitude algorithm for SLP or SLG.

B1. Eddy flux convergence in Q1R and Q2 are estimated assuming that the size of "large-scale grids" is 100kmx100km. Therefore, it is recommended to average horizontally in this spatial scale to utilize Q1R or Q2.

B2. Horizontal averaging of about 50km x 50km, or 100 pixels with GPM DPR sampling, is recommended, in order to reduce root mean square errors (RMSE) calculated between estimated LH from LFM-simulated precipitation, to less than a half of the mean value at the LH peak height of ~5.5km (for Case 1).



C. CorrectionFactorMidlatType is introduced in the SLH V06B algorithm to consider LH associated with small hydrometeors condensed outside of the precipitating area, transported some distance into the precipitating area, and precipitate. However, the application of this factor in the L2 product is inconsistent in terms of pixel-by-pixel estimation. In the SLH V07 algorithm, this factor is not applied to SLP and SLG products but applied to SLM products. The specific value of the correctionFactorMidlatType is stored in the AlgorithmRuntimeInfo in the L2 product and correctionFactorMidlatType in the L3 product.

(v) Release Note for L3 (gridded; SLG and Monthly; SLM) product

From the TRMM/GPM SLH V06A product, we added the unconditional variables (UnCnd) for all rain type, and modified their variable names to include conditional variables (Cnd). Please refer to the ATBD.

[Note about the missing value for conditional mean]

Note that there are two reasons for missing values for conditional mean (LHCndMean, Q1RCndMean, Q2CndMean), which can be discriminated by 'allPix' values as follows.

1. conditional mean is not defined because there is no precipitation in the grid (precipPix=0), when allPix≠0.
2. missing value is given because the grid value is masked out related to the topography, when and allPix = 0.

[Note about CorrectionFactorMidlatType in SLM]

After the SLH V06B algorithm, heating (LH, Q1R, Q2) has been corrected by the CorrectionFactorMidlatType=0.88 in the area where the midlatitude algorithm is applied. In V07, because this factor is changed to be applied to only the SLM product, but not to the SLP product, the monthly mean of the L2 heating divided by the factor corresponds to the SLM product in the midlatitude area.