The Transition in Multi-Satellite Products from TRMM to GPM (TMPA to IMERG)

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The transition from the Tropical Rainfall Measuring Mission (TRMM) data products to the Global Precipitation Measurement (GPM) mission products has begun. This document specifically addresses the multi-satellite products, namely the TRMM Multi-satellite Precipitation Analysis (TMPA), the real-time TMPA (TMPA-RT), and the Integrated Multi-satellitE Retrievals for GPM (IMERG).

1. TRMM Status and Future

The TRMM satellite reentered the Earth's atmosphere on 17 June 2015, and whatever debris survived landed in the southern Indian Ocean well west of Australia. The terminal phase began when fuel was exhausted in July 2014. On 7 October 2014 the satellite descended to an altitude that precluded useful TRMM Precipitation Radar data, with a brief revival as TRMM descended past the original altitude of 350 km. Meanwhile, the TRMM Microwave Imager (TMI) continued to function with slowly changing characteristics until it was shut down on 8 April 2015 as part of the decommissioning, or "passivation" of the satellite. The actual demise of TRMM is not the substantive issue for the TMPA and TMPA-RT.

2. TMPA Future

Starting with October 2014, the intercalibration of the passive microwave precipitation estimates had to change for production 3B42, and this created at least a slight inhomogeneity, primarily over the oceans. We already know that calibrations involving PR have a different interannual behavior than calibrations based solely on passive microwave. In addition, as a legacy product, shifts in input data, such as new algorithms, might make continuation of 3B42 problematic faster than we want. The NOAA MSPPS sounder data are a particular flash point. If the character of the 3B42 changes too much, we could face a discussion within the project about whether this "research-quality" product really isn't anymore. Nonetheless, we hope that 3B42 will run in parallel with IMERG until the mid-2018 timeframe. [Note that this is a year later than some early planning called for; see the IMERG timeline, below.] One unavoidable issue is that the loss of TMI data reduces the amount of conical-scan imager data going into the TMPA and TMPA-RT.

3. TMPA-RT Future

Meanwhile, the 3B42RT system was already computed with a climatological intercalibration for the passive microwave precipitation estimates (i.e., they are not calibrated with current data), so 3B40RT, 3B41RT, and 3B42RT continue to function as they have. As with 3B42, 3B42RT's status as a legacy product means that shifts in input data might make continuation problematic faster than we want. One unavoidable issue is that the loss of TMI data reduces the amount of conical-scan imager data going into both the TMPA and TMPA-RT. We recognize the application focus for 3B42RT, and expect to run it until the equivalent IMERG products are satisfactory. We devoutly hope that this will be the case by mid-2018 (again, a year later than

stated in earlier versions of this document). We suppose that some users will want the old product forever, but at some point we have to stop. Even with continuation, note the caveat above that future changes in input data sets for the constellation members could affect the amount of microwave data.

4. IMERG Timeline

- The Day-1 IMERG Final Run data sets (for the GPM era, mid-March 2014 to the present, delayed about 3 months) were released in late December 2014.
- The IMERG Late Run data sets begin 7 March 2015, while the Early Run start 1 April 2015.
- The first retrospectively processed GPM-era IMERG data sets are planned to be released in late Fall 2016 (somewhat later than previously announced). In a change from previous plans, additional work is required to fully calibrate the TMI to the GMI. As a result, it is likely that the extension of IMERG back to the TRMM era will happen in late 2017. The goal is to start at the beginning of 1998, but at the present the appropriate geo-infrared data are not available before mid-February 2000. This issue affects all runs, including the Final, and it's being worked.

Given the sea change in algorithms in GPM, the current plan is to use the retrospective processing for IMERG in place of a final (TRMM Version 8) reprocessing for the TMPA/TMPA-RT.

5. Further Information

The IMERG Algorithm Theoretical Basis Document (ATBD) is currently the best technical reference for IMERG. It is accessible at

http://pmm.nasa.gov/sites/default/files/document_files/IMERG_ATBD_V4.5.pdf

The technical document is located at

http://pmm.nasa.gov/sites/default/files/document_files/IMERG_doc.pdf

The PMM web site

http://pmm.nasa.gov/

is the right general source for news, and its IMERG data access page contains hot links to the latest versions of these documents, as well as release notes. Specific IMERG announcements will be posted to the IMERG mailing list, and you're always free to ask if you think we're too quiet or you hear a rumor. If you wish to be added to the TMPA and/or IMERG mailing lists, please e-mail

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Together with all GPM and TRMM data sets, IMERG data set locations are posted on the consolidated GPM data access pages, available through

http://pmm.nasa.gov/data-access

The best place to ask questions (because they go to more than one person), is the "contact us" link at thee bottom of the GPM web page

http://pmm.nasa.gov/contact?edit[cid]=3

Finally, two GPM Applications Workshop held in November 2013 and June 2015 proved very useful for exchanging information and feedback to users and developers alike. Another workshop is being planned for the future. It will be publicized on the GPM web page as plans develop.

TMPA-IMERG Comparison

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algorithm	TRMM Multi-satellite Precipitation Analysis	Integrated Multi-satellitE Retrievals for GPM
basic acronym	TMPA	IMERG
data sets	• 3B42/3B43 production multisatellite-gauge combination • 3B40RT/3B41RT/3B42RT real-time merged microwave, microwave-calibrated IR, multisatellite	• 3IMERGHH/3IMERGM Final Run multisatellite-gauge combination • 3IMERGL Late Run near-real-time • 3IMERGE Early Run near-real-time
spatial grid; coverage	0.25°x0.25° lat/lon; 50°N-S	0.1°x0.1° lat/lon; 60°N-S
current version	7 (7a for parts, but this is a technicality)	3 (4 in development)
time interval; span	• 3 hr centered at 00, 03, …, 21 UTC; 1 Jan 1998-present (production), 15 Feb 2000-present (real-time) • monthly; Jan 1998-present (production) • other value-added products in data centers	• 30 min; 1 Apr 2014-29 Feb 2016 (Final); 10 Mar 2015-present (Late); 1 Apr 2015-present (Early) • monthly; Apr 2014-Feb 2016 (Final) • other value-added products in data centers
latency	• 3B42/3B43 2.5 mo after the month's end • 3B40RT/3B41RT/3B42RT 8 hr after obs. time	• Final 2.5 mo after the month's end • Late 15 hr after obs. time • Early 5 hr after obs. time
native format	• HDF4 (production) • binary (RT) • other value-added products in data centers	• HDF5 • other value-added products in data centers
algorithm summary	• calibrate microwave precip rates to TRMM Combined Instrument • merge microwave (HQ), giving preference to conical-scanners • compute VAR microwave-calibrated IR precip rates • fill holes in HQ merged microwave with IR estimates • include gauge data by - computing monthly satellite-gauge and then scaling 3 hr data to sum to the monthly in each grid box (production) - scaling 3 hr to 3B42 with climatological coefficients (RT)	• calibrate microwave precip rates to GPM Combined Instrument • merge microwave (HQ), giving preference to conical-scanners • compute PERSIANN-CCS microwave-calibrated IR precip rates • use CMORPH-style IR motion vectors to forward/backward propagate microwave maps, then use a Kalman filter to combine these and the IR estimates into a weighted estimate (Early is forward-only) • include gauge data by - computing monthly satellite-gauge and then scaling 30 min data to sum to the monthly in each grid box (Final) - scaling 30 min to Final with climatological coefficients (Late and Early)
Input microwave algorithms	• GPROF versions 2010v2 and 2004v for various conical scanners • NOAA MSPPS for cross-track scanners	• GPROF2014v2
plan	• continue running until IMERG is reprocessing back to 1998 (est. Q2 2018)	• release V04 back to April 2014 (est. Q4 2016) • release V05 back to April 2014 (est. Q2 2017) • extend V05 back to 1998 (est. Q1 2018); this is the TRMM V8 last processing

Data Fields in TMPA (top left), TMPA-RT (top right), and IMERG (bottom)

	3-hourly data file (3B42)
1	*Multi-satellite precipitation*
2	*Multi-satellite precipitation error*
3	Sat. obs. time
4	PMW precipitation
5	IR precipitation
6	Satellite source identifier
	Monthly data file (3B43)
1	*Satellite-Gauge precipitation*
2	*Satellite-Gauge precipitation error*
3	Gauge relative weighting

	Merged microwave data file (3B40RT)
1	*Merged PMW precipitation*
2	*Merged PMW precipitation error*
3	# pixels
4	# ambig. pixels
5	# rain pixels
6	PMW source identifier
	IR data file (3B41RT)
1	*PMW-cal. IR precipitation*
2	*PMW-cal. IR precipitation error*
3	# pixels
	Multi-satellite data file (3B42RT)
1	*Calibrated precipitation*
2	*Calibrated precipitation error*
3	Satellite source identifier
4	Uncalibrated precipitation

	Half-hourly data file (IMERG Early, Late, Final)
1	*Calibrated multi-satellite precipitation*
2	*Uncalibrated multi-satellite precipitation*
3	*Calibrated multi-satellite precipitation error*
4	PMW precipitation
5	PMW source identifier
6	PMW source time
7	IR precipitation
8	IR KF weight
9	*Probability of liquid-phase precipitation*

	Monthly data file (IMERG Final)
1	*Satellite-Gauge precipitation*
2	*Satellite-Gauge precipitation error*
3	Gauge relative weighting
4	*Probability of liquid-phase precipitation*