Caveats for IMERG in the TRMM Era

George Huffman

3 May 2019

Significant effort has gone into ensuring that there is reasonable homogeneity in the IMERG record given the constantly evolving satellite constellation. This includes ensuring that the Level 1 (brightness temperature) and Level 2 (precipitation) data are as consistent as possible with the GMI across the constellation of passive microwave radiometers during the GPM era, and correspondingly TMI in the TRMM era. Then IMERG enforces calibration to the perceived "best" core satellite estimate, which is the combined radar-radiometer algorithm (CORRA), as well as selective climatological calibration to a recognized standard (the Global Precipitation Climatology Project monthly satellite-gauge combined product) where the combined product is known to be low (high-latitude oceans) or high (tropical and mid-latitude land). Despite this intercalibration, users should note that variations remain across sensors and between the TRMM and GPM eras. Specifically:

- Version 06 is the first time that CORRA and IMERG have been computed for both the TRMM and GPM era. As such, we expect to learn a great deal about how the detailed behavior of the IMERG estimates differs between the two eras.
- The TRMM CORRA is based on fewer channels of microwave and radar data than for the GPM CORRA, so one would expect the underlying calibrations to shift across the transition boundary (May/June 2014). This could affect the histogram of precipitation rates and/or the mean rates.
- The TRMM CORRA only covers the latitude band 35°N-S, while it is 65°N-S for GPM. Thus, calibrations to TRMM CORRA outside 35°N-S are necessarily approximate, based on the (monthly climatological) "shape" of the GPM CORRA calibration field, scaled to match the precipitation volume for each month of TRMM-era calibration for northern and southern hemisphere ocean and land separately in the region 33°N-S.
- The early TRMM era contains estimates from SSMI and AMSU-B sensors, which are less capable than the subsequent SSMIS and MHS sensors that were phased in starting in 2005. This implies that a shift in estimation skill is likely.
- The early TRMM era lacked microwave observations for several hours around the 0/12 and 04/16 UTC orbital times. As a result, there is more use of IR-based estimates in the first few years. IR estimates are generally of lower quality and potentially introduce a systematic regional offset in the timing of precipitation systems. [IR Tb's tend to lag precipitation occurrence, but IMERG uses the PERSIANN-CCS algorithm, which considers other factors, such as spatial texture in the IR Tb's.]
- "Rippling" in the animation of IMERG data in the GPM era has been reduced somewhat from V05 to V06, but continues to be visible. This indicates that the different sensors continue to have different depictions of the same precipitation features due to each sensor type's unique combination of resolution and channel selection.
- We see similar fluctuations in early animations of the TRMM era as well. In addition, the early TRMM era lacked microwave observations for several hours around the 0/12 and 04/16 UTC orbital times. As a result, there is more use of IR-based estimates in the first few years. IR estimates are generally of lower quality and potentially introduce a systematic regional offset in the timing of precipitation systems. [IR Tb's tend to lag precipitation occurrence, but IMERG uses the PERSIANN-CCS algorithm, which considers other factors, such as spatial texture in the IR Tb's.] Furthermore, the Japanese GMS observations only provide hourly data for certain periods of the day, and in the missing half-hours the adjacent METEOSAT and

GOES-W IR values are used to the extent possible, but in some cases the necessary zenith-angle parallax corrections apparently yield very different IR values, leading to dithering between two precipitation estimate scenes in successive half hours. Before 2005 there are large gaps in the available microwave data, which makes the behavior of the IR estimates more important. In addition, there is apparently a somewhat complicated interaction between the morphed microwave and available IR data.

- There is an extended data dropout in the presently available IR dataset for Japanese sector from late on 17 November 2005 to the middle of 22 March 2006 due to issues in NOAA coping with the format of the then-newly introduced MTSat-1. Consequently, during that period a small sector over Japan lacks all data, and the adjacent IR are entirely based on high-zenith-angle data from the METEOSAT to the west and GOES-W to the east.

Additional information is available in the Release Notes (*https://pmm.nasa.gov/sites/default/files/document_files/IMERG_doc.pdf*) and the IMERG Technical Document (*https://pmm.nasa.gov/sites/default/files/document_files/IMERG_doc.pdf*).