TMPA Version 7 Results

G.J. Huffman[1], D.T. Bolvin[1,2], EJ. Nelkin[1,2], R.F. Adler[3]
1: NASA/GSFC MAPL
2: Science Systems and Applications, Inc.
3: Univ. of Maryland College Park/ESSIC
http://precip.gsfc.nasa.gov

BACKGROUND

How best to use precipitation estimates from a diverse, changing, uncoordinated set of satellites with various
- Periods of record
- Regions of coverage
- Sensor-specific strengths and weaknesses?

We seek the longest-possible relatively homogeneous record of "global" precipitation
- TRMM Multi-satellite Precipitation Analysis (TMPA)
  - High-Resolution Precipitation Product (HRPP) approach
  - emphasize fine-scale accuracy over homogeneity
- Less-emphasized goal also important, of course

Both the RT and production datasets were upgraded in 2012
- Production
  - additional periods of data (boxes on diagram below)
  - improved IR record for 1998 – February 2000
  - updated algorithms (GPROF, in particular)
  - consistently reprocessed data records
  - single source of gauge analysis
  - publication of additional intermediate data fields
- RT
  - retrospective processing back to March 2000 (limited by IR dataset)
    - only done with input data sets that would have been used by RT for that time (i.e., not gauge)
    - done with input data on production machine – a superset of the data available in real time
  - updated algorithms (GPROF, in particular)
  - consistently reprocessed data records
  - calibration to the V7 production data

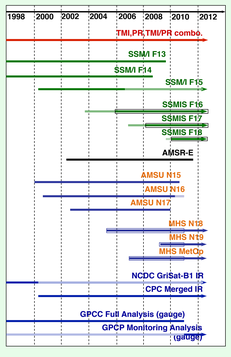
Due to a processing error, the AMSU-B precipitation estimates, spanning 2000 – 2010, were not included in either product
- Both products have since been reprocessed to include AMSU-B estimates
- This affected version numbering:
  - TMPA RT – '7', and '7R2' for AMSU era
  - TMPA Production – '7', and '7A' for AMSU era

QUICK COMPARISON OF TMPA ALGORITHMS AND INPUTS

The general TMPA approach is:
- All microwave products calibrated to a standard and merged
  - TRMM Combined Instrument (TCI; 2B31) for Production
  - climatological TMI (2A12) for RT
- Geo-IR Tb calibrated by the merged microwave to produce merged geo-IR precipitation estimates
- microwave and IR estimates merged

The final steps for Production are
- Monthly merged satellite and GPCC gauge analysis combined to Satellite-Gauge (SG) product with weighting by estimated inverse error variance
- Scaling the 3-hourlies to sum to the monthly SG

The final steps for RT are
- Calibration to *monthly climatological* TCI over ocean and land
- Calibration to TMPA Production monthly estimates (3B43) over land



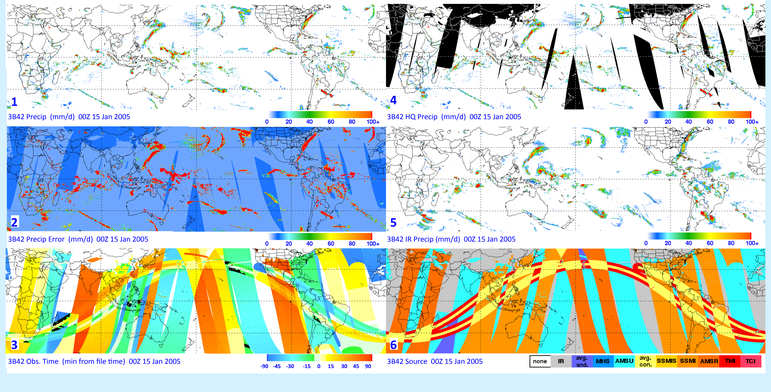
Graph shows data records used in Production TMPA

Periods of record not used in the datasets are shown in lighter color

Additional data records used in TMPA V.7, but not V.6, are boxed

TMPA V.7 PRODUCTION 3-HOURLY OUTPUT FIELDS

1 Precipitation
2 Precipitation Error
3 Satellite Observation Time
4 HQ Precipitation
5 IR Precipitation
6 Sat Precipitation Source



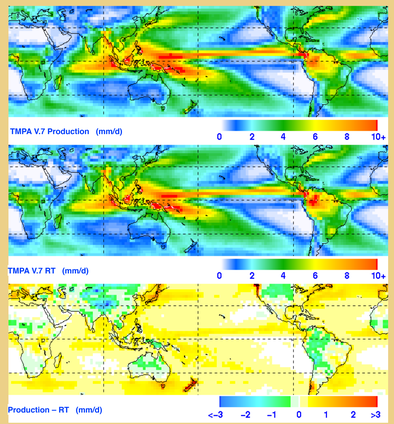
COMPARISONS OF CLIMATOLOGIES

TMPA V.7 Production – RT (March 2000-December 2011)

Ideally, calibrations should make the RT climatology roughly equivalent to Production's

Production higher over ocean
- Difference locally scales with precipitation amount
- Differences relatively larger at higher latitudes

RT higher over many land areas
- Largest in interior of Asia
- But lower in coastal areas at higher latitudes



TMPA V.7 Production – GPCP V2.2 (1998-2010)

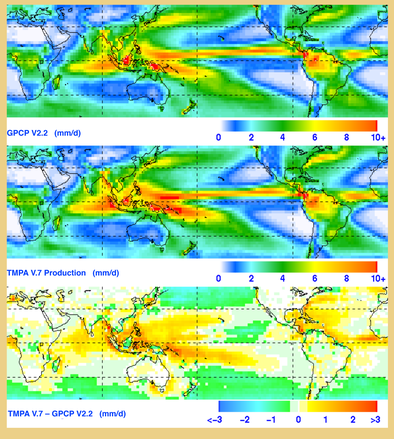
TMPA averaged to GPCP's 2.5° grid

Monthly (and long-term) difference governed by:
- Land: precipitation gauge analysis
  - both use the latest GPCC analysis
  - results very similar
  - some differences due to interpolating gauge analysis to TMPA scale and to satellite differences in gauge-sparse regions
- Ocean: calibrating satellite estimator
  - GPCP uses
    - Microwave Emission Brightness Temperature Histogram (METH) log-normal fitted histogram approach
    - TOVS/AIRS cloud volume proxy at higher latitudes
  - TMPA uses
    - TCI calibration, extended past orbital band (35°N-S)

TMPA has less land-sea contrast in Maritime Continent, Southeast Asia
- Coastal zones have the biggest difference, but it's not just the problematic "coast" area

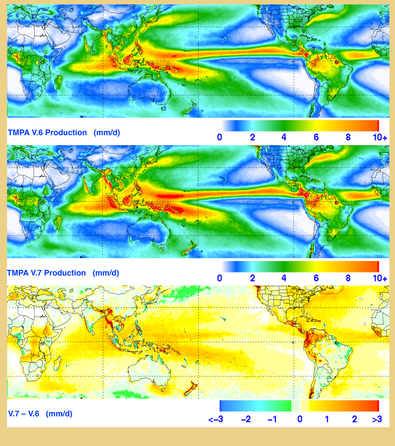
TMPA (both V.6 and V.7) has secondary maximum running from Hawaii to the Philippines

GPCP is higher at higher latitudes because
- METH tends to be higher than TCI and GPROF-based esimates
- The TOVS/AIRS estimates tend to be higher and kick in at latitude 45°-55°, depending on season



TMPA Production V.7 – V.6 (1998-2010)

Monthly (and long-term) difference governed by:
- Land: precipitation gauge analysis
  - significant upgrades in the GPCC version used
  - changes mostly positive
  - mostly in complex terrain
- Ocean: calibrating satellite estimator
  - modest upgrades in TCI
  - V.6 had low bias over much of this period due to AMSU algorithm issues
    - early AMSU precipitation data sets in 2000-2007 had deficient rainfall occurrence
    - V.7 uses a consistently processed AMSU (and MHS) algorithm throughout
  - V.7 has ~7% positive offset from (new, higher) TCI

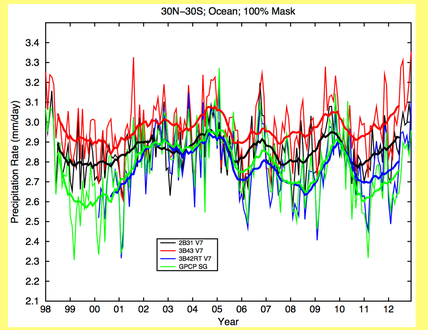


TIME SERIES COMPARISON FOR TROPICAL OCEAN

TMPA V.7 Production (red) follows calibrator (TRMM Combined Instrument, TCI; black)
- ~7% offset results from unresolved issues with the calibration scheme

TMPA V.7 RT (blue) also consistent with TCI
- Mean somewhat lower
- RT interannual cycle has higher amplitude than TCI
- RT interannual cycle lags the TCI
- TCI calibration is (monthly) climatological, so the behavior follows the passive MW precipitation

GPCP V2.2 SG (green) is generally consistent with TMPA V.7
- Overall average is close to RT
- Relatively strong correlation in month-to-month variation (thin lines)
- Interannual variation
  - also well-correlated
  - GPCP matches RT behavior more closely
  - both GPCP and RT behavior depends on microwave estimates
    - but respective microwave algorithms are very different



COMPARISON TO MONTHLY ATOLL GAUGES

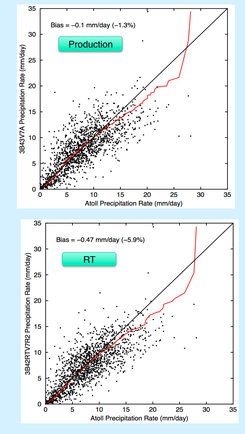
PACRAIN atoll gauges March 2003 – December 2011

Data issues:
- Atolls specifically selected for lack of orography
  - presumably representative of "open ocean"
- Atolls are not included in the GPCC gauge analysis
  - therefore, these are independent data for both plots

All these are single gauges
- there is an issue comparing point gauge measurements to satellite grid box estimates

TMPA Production nearly unbiased
- But Production is high by about 7%

TMPA RT low by about 6%
- Consistent with the Production bias



FINAL REMARKS

The (quasi-)global time series and patterns of precipitation agree rather well among GPCP TMPA V.7 Production and RT, and GPCP V.2.2

Large-scale quantitative differences tend to stem from the calibrators – a "trusted" satellite over ocean, gauge over land
- This puts a lot of focus on the calibrators
- Modelers see these differences as a huge issue

Questions or to get on the notification e-mail list: george.j.huffman@nasa.gov

Web pages: http://precip.gsfc.nasa.gov
http://trmm.gsfc.nasa.gov

3B42/43 document: ftp://meso.gsfc.nasa.gov/pub/trmmdocs/3B42_3B43_doc.pdf
3B4xRT documents: ftp://meso.gsfc.nasa.gov/pub/trmmdocs/rt/