JAXA TRMM Science Status

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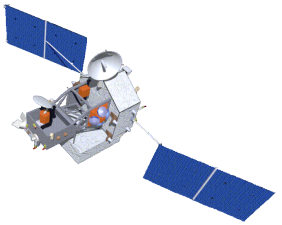
Thanks to: Robert Meneghini, John Kwiatokowski, Eric Stocker

PMM Science Team Meeting Nov.6, 2011

Progress from the last PMM

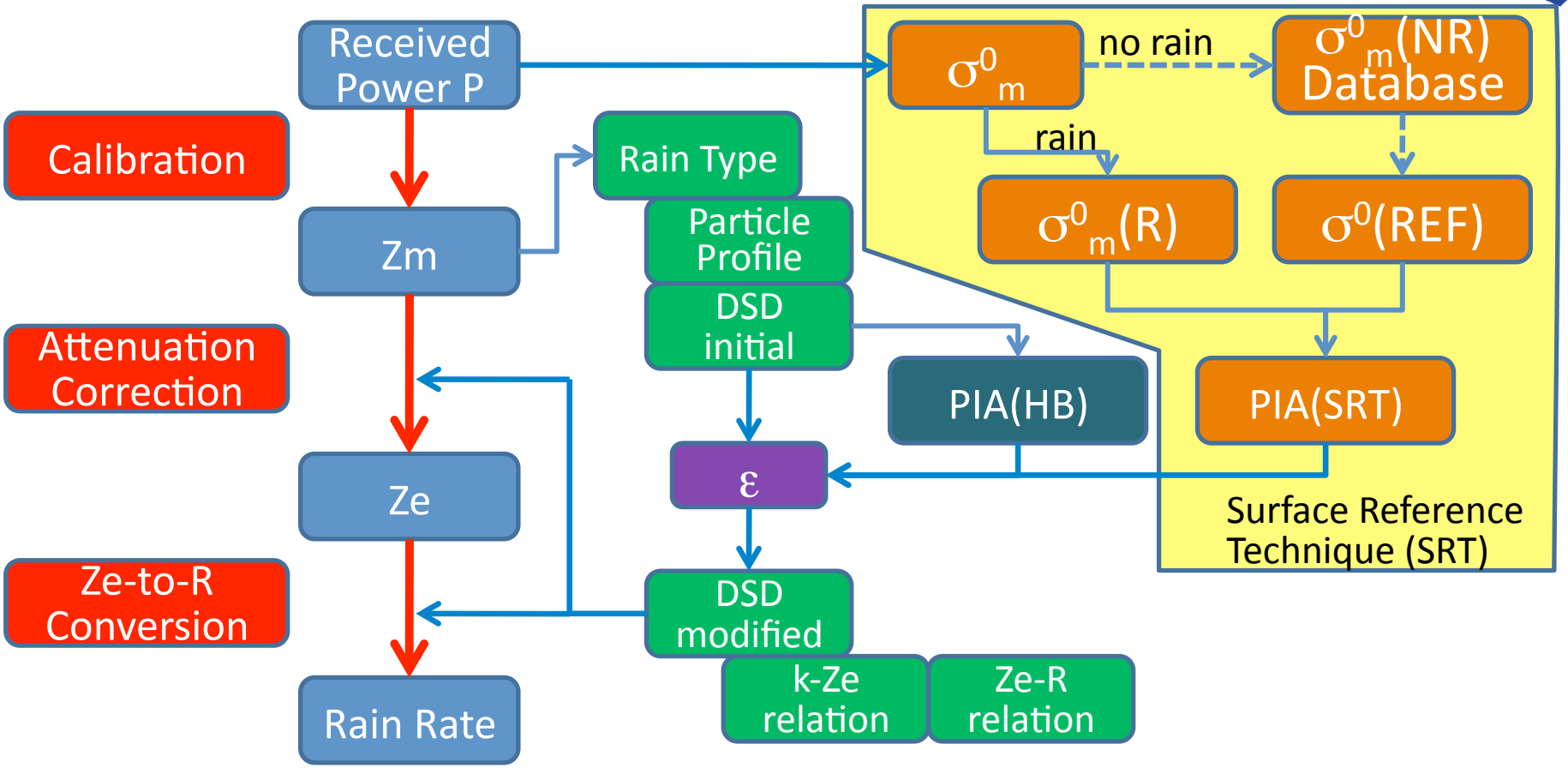


- TRMM PR version 7 algorithms completed
- PR V7 data evaluations
- Data continuities
  - Over satellite boost : Aug 2008
  - Over switching the electrics interface from A-side to B-side in June 2009
- TRMM Spectral Latent Heating (SLH) V7 development
- Analyses of accumulated data
- Progress in GSMaP

PR V7 ALGORITHM AND EVALUATIONS

*TODAY'S IGUCHI'S POSTER IS LOST AT SFO AND WILL BE POSTED TOMORROW

PR Algorithm Flow and adjustable parameters



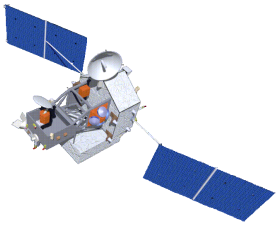
- Calibration
- Particle model
  - DSD parameters
  - particle profile
    - BB model
    - snow model

- Measurement errors
- PIA errors
- Rain profile in surface clutter
- Inhomogeneity

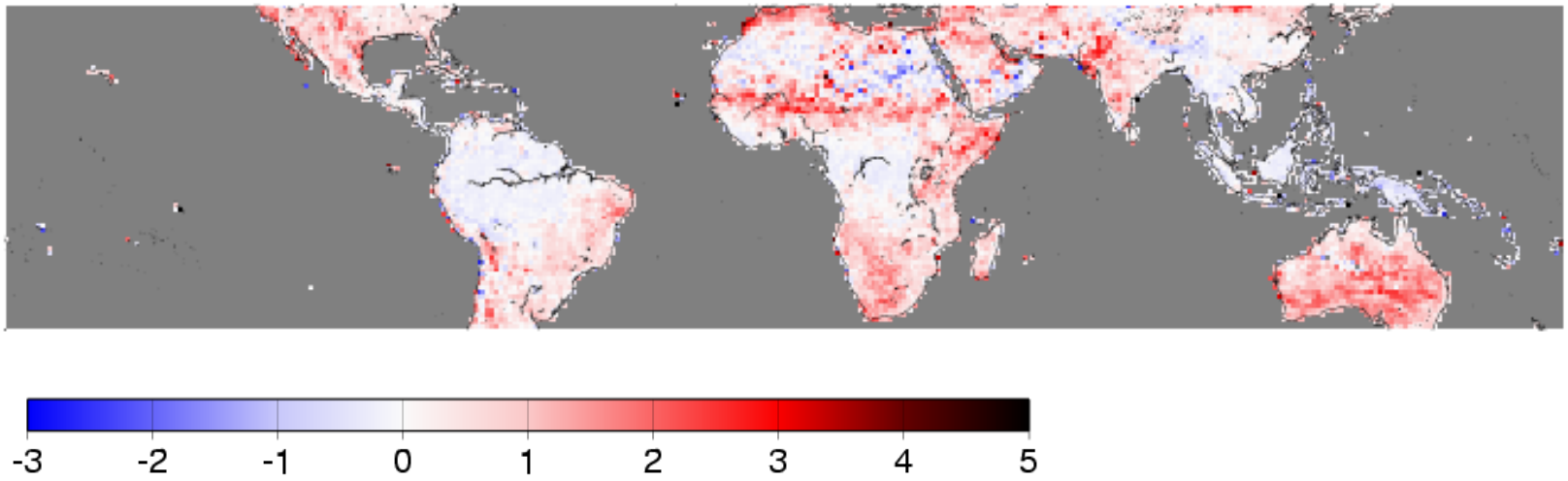
Major changes in V7 algorithm (PR team)

- Improved Path Integrated Attenuation (PIA) estimates by Surface Reference Technique (Backward reference, better hybrid reference, and new error evaluation)
- New classification of rain type with increased convective rain types
- Expected value to maximum likelihood value in estimating α
- Adding 0.5 dB to PIA estimates over land from 2A21 to compensate the wetting effect
- Changed the assumed vertical profiles of specific attenuation k (α in $k=\alpha Z_e^{\beta}$) (Changed the vertical profile of the mixing ratio of water to ice）
- Introduction of a new DSD model (Z-R relation)
- Changed the uncertainty of ζ (α and Z_m) in the Hitschfeld-Bordan attenuation correction method
- Introduction of NUBF correction
- Corrected the smearing of BB in off-nadir beams

Distribution of $\Delta\sigma^0_m$(R) for $\zeta < 0.1$



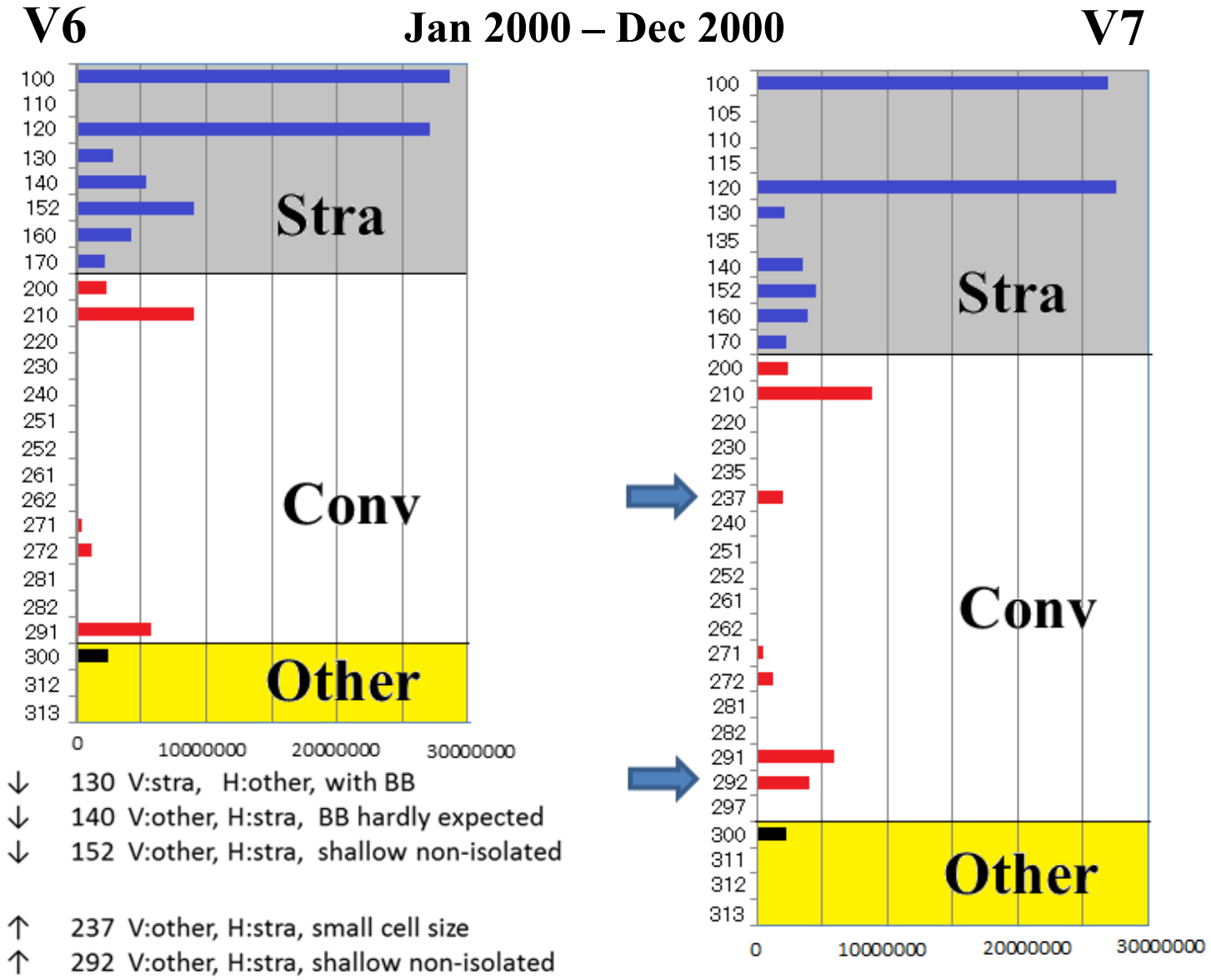
(a) land at θ = 0 - 18 deg. V6



This panel shows the differences of the radar scattering cross sections between very weak rain cases and no-rain cases. There are found fake negative values. In V7, we added +0.5 to PIA over land in order to amend this bias.

by Sinta Seto

New rain-type classification



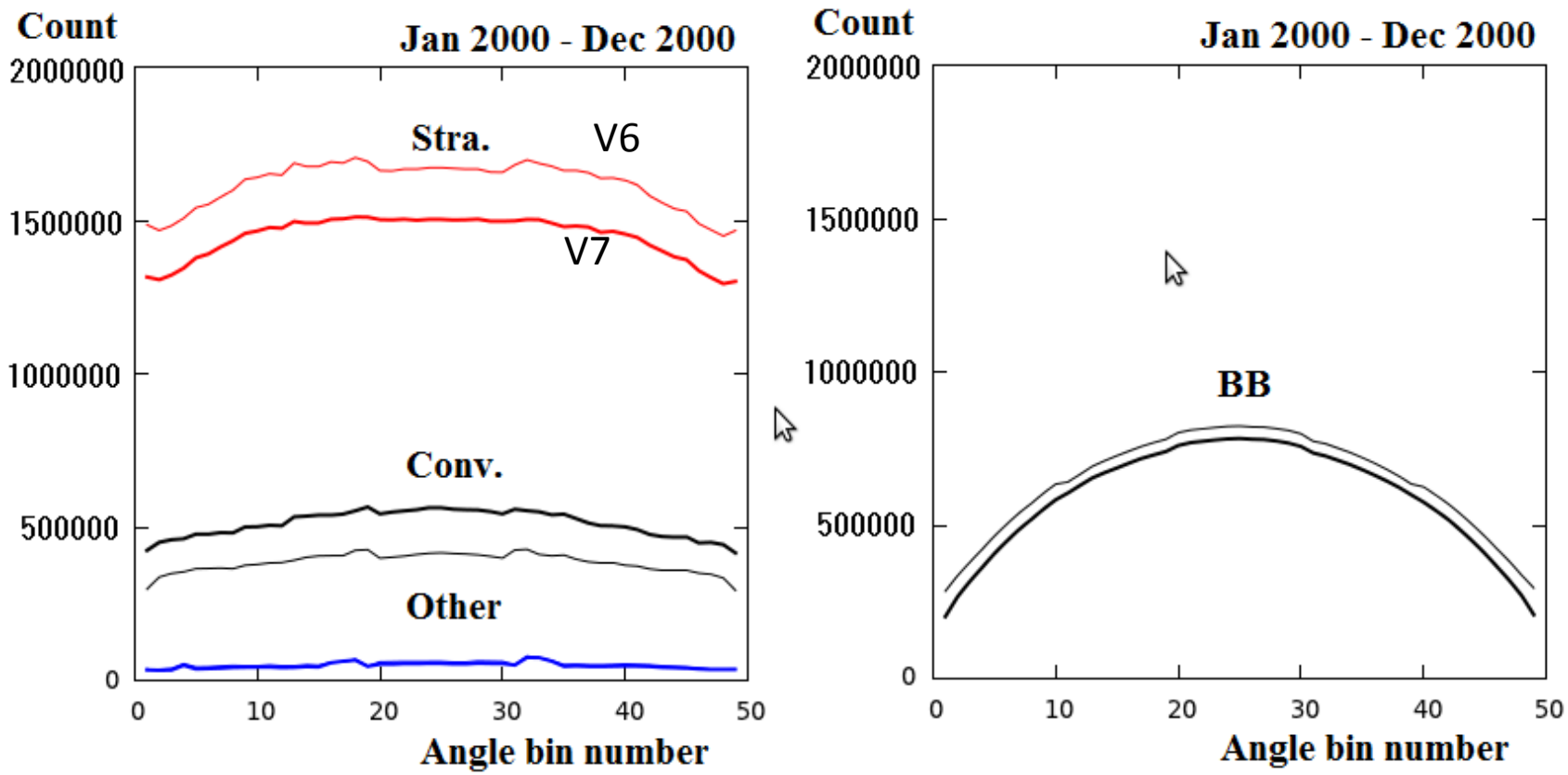
↓ 130 V:stra, H:other, with BB
↓ 140 V:other, H:stra, BB hardly expected
↓ 152 V:other, H:stra, shallow non-isolated

↑ 237 V:other, H:stra, small cell size
↑ 292 V:other, H:stra, shallow non-isolated

Many of shallow non-isolated rain cases moved to convective in V7.

J. Awaka

Angle bin dependence in rain types and BB counts

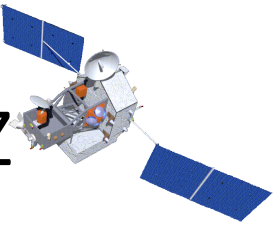


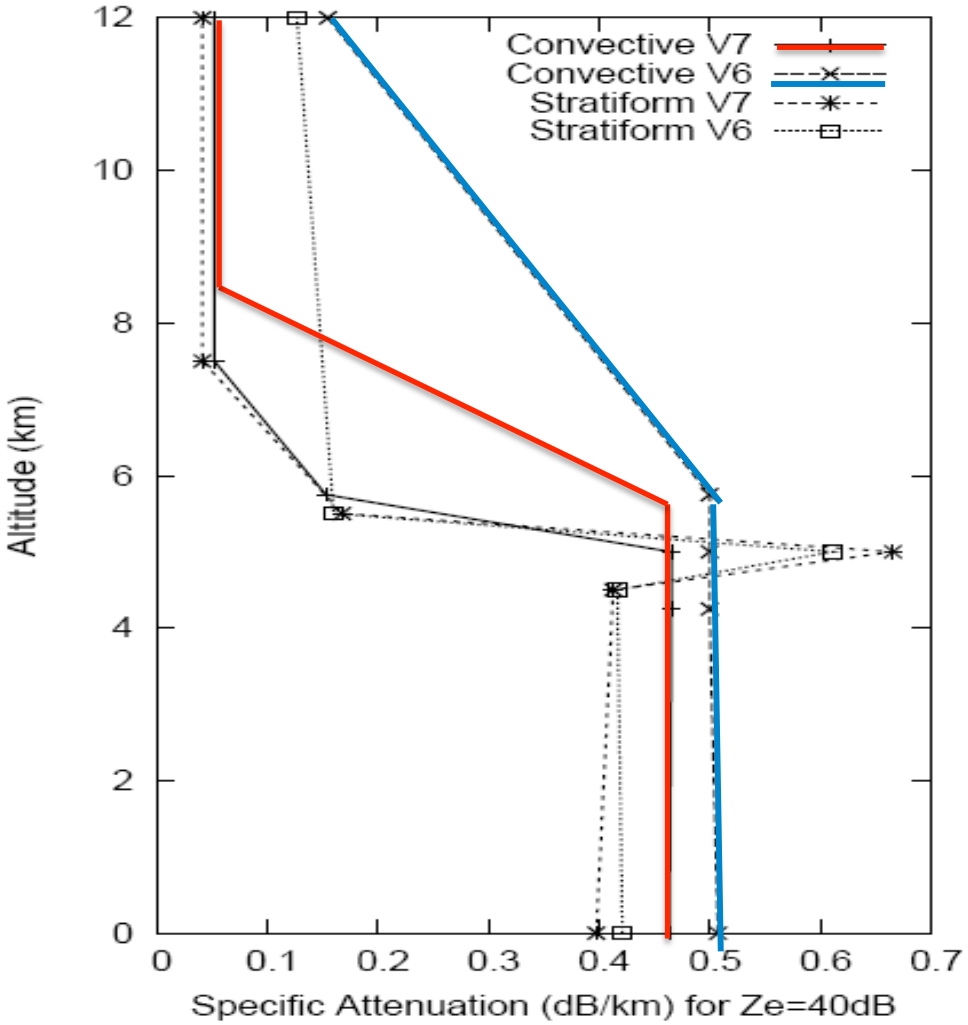
Thin: V6, Thick: V7 OAT

Angle bin dependences of each rain-type counts are reduced

Plot by J. Awaka

Specific attenuation *k* profiles for Z_e=40 dBZ





0 degree C height is assumed at 5 km
The lapse rate is assumed to be
-6 degrees/km.

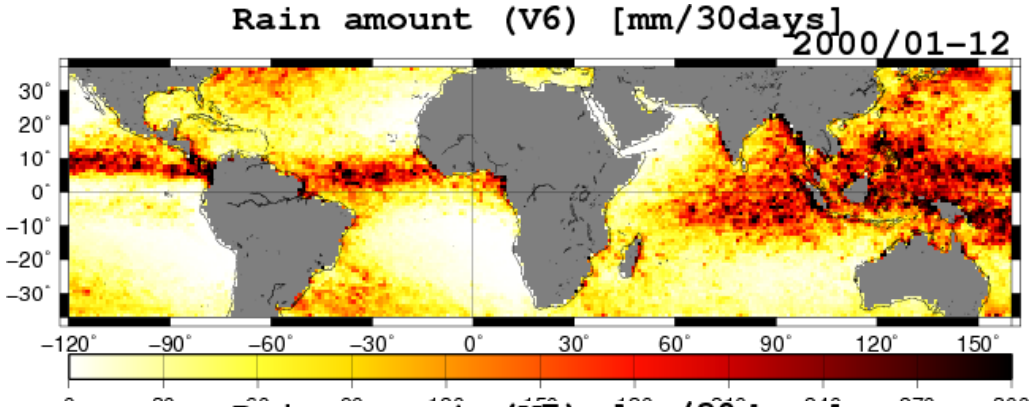
For convective rain,
the assumed profile has been
changed to the red line in V7 (ITE232).
(100% ice above the -20 degree level.)
It was the blue line before the change
(mixed phase over 12km)

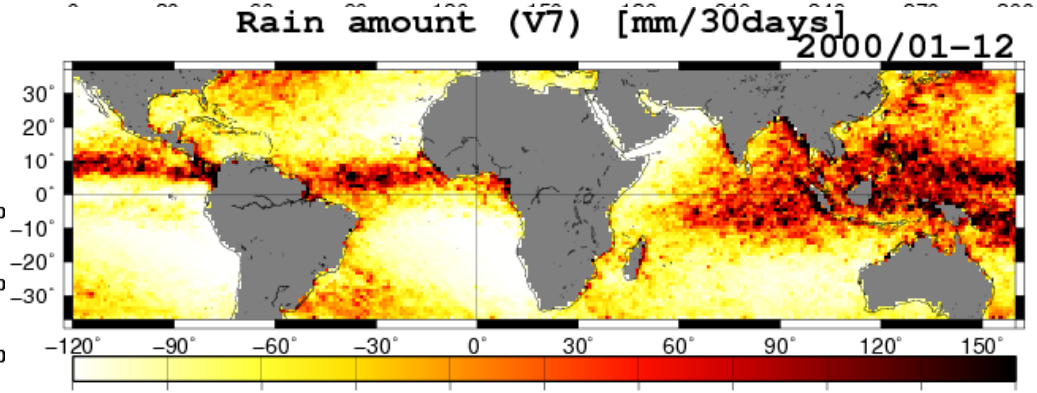
For stratiform rain,
V6 (solid) was
100% ice above the -15 degree level.
V7 (dashed) introduced some mixed
phase

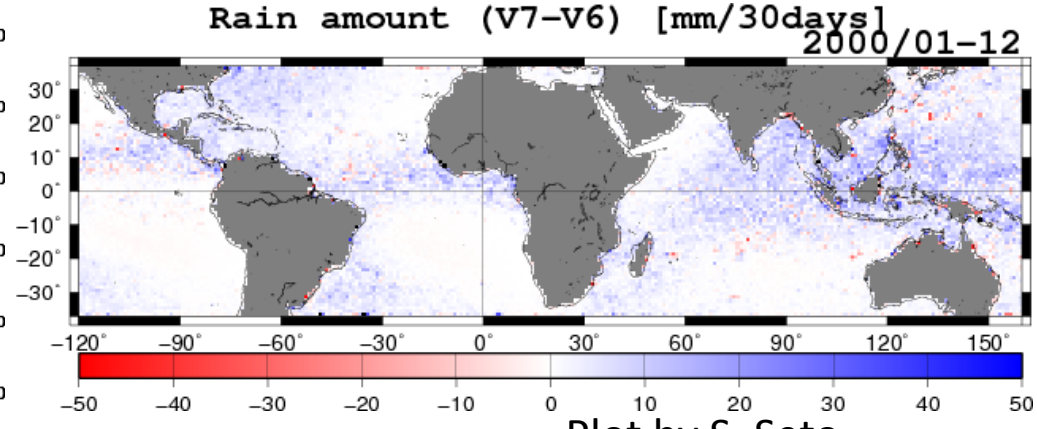
Plot by T. Iguchi

Rain rate (Over ocean)

Rain amount over ocean is larger in V7 than in V6, particularly in Tropics. Not only heavy but weak rain increases

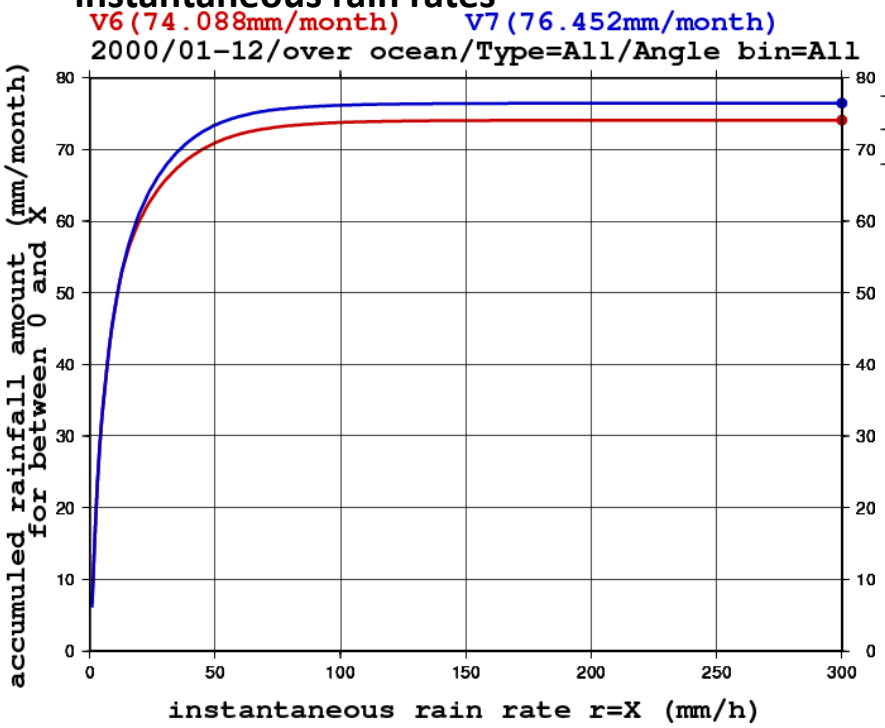






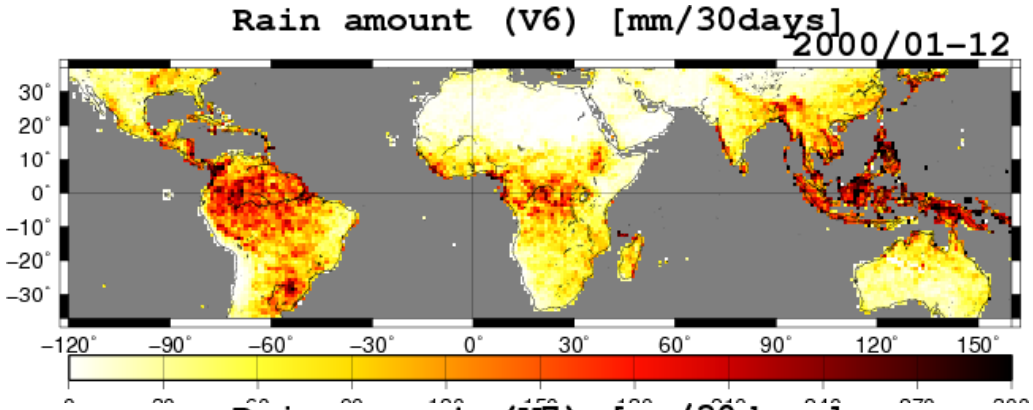
Plot by S. Seto

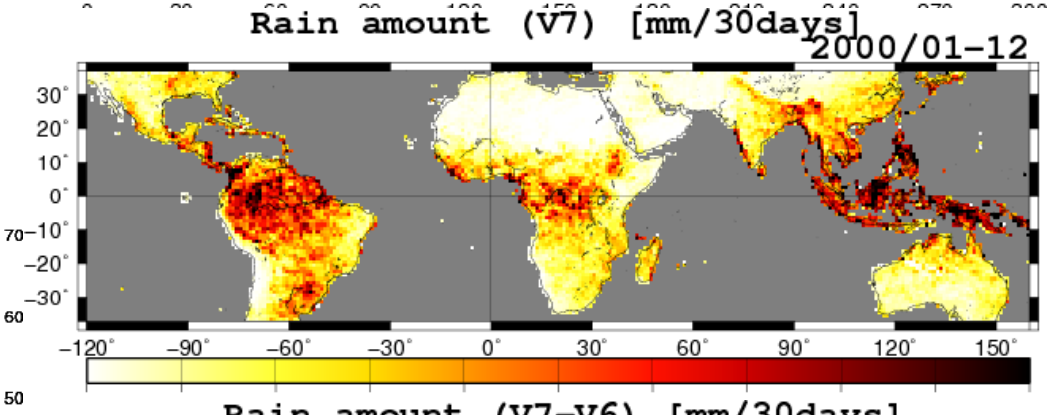
Cumulative distribution function of instantaneous rain rates

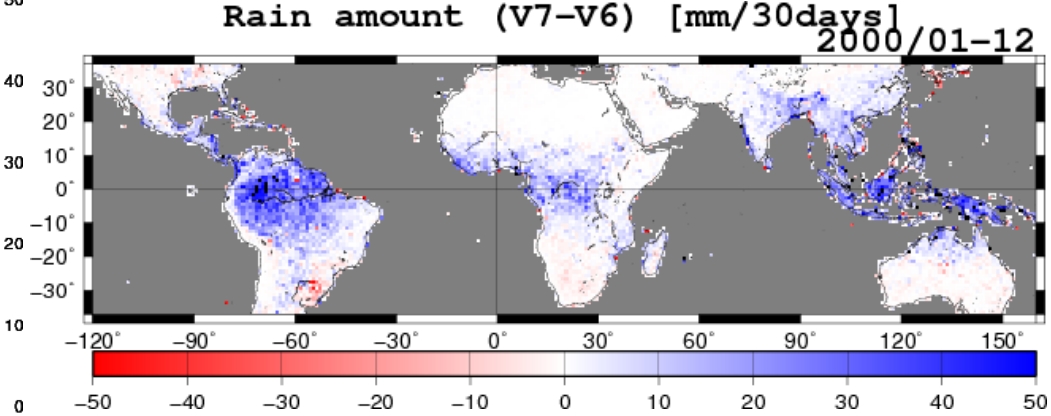


Rain rate (Over land)

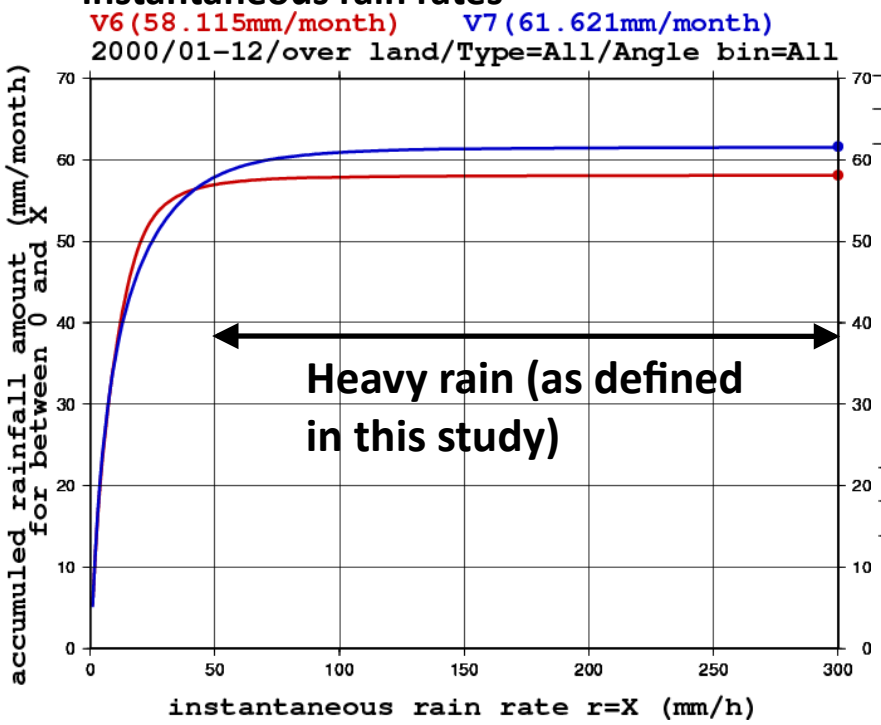
Rain amount over land is larger in V7 than in V6, particularly in Tropics. Contribution of heavy rain (> 50mm/h) increases in V7





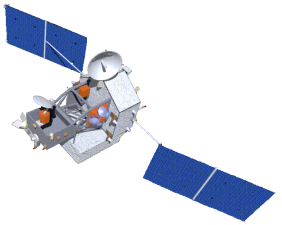


Cumulative distribution function of instantaneous rain rates



Plot by S. Seto

Summary of changes in V7 and their effects



(Only those that affect the rainfall estimates)

- New PIA by SRT increase reliability and remove some angle-bin dependence.
- Addition of 0.5 dB to PIA: increase in heavy rain over land
- 100% solid ice above -20 degree C: increase for high profile rain, but decrease in light rain
- Use of GANAL for 0 deg. C and change in the vertical model: (effect not clear)
- Introduction of non-spherical rain drop model: decrease
- New Ze-R relation for stratiform rain: increase
- Increase of convective rain cells: increase
- Introduction of NUBF correction: increase in heavy rain
- Change from expected value to ML estimate: increase in heavy rain

Note: Increase or decrease of the estimates depends on the structure of rain and other parameters, and cannot be judged in all cases.

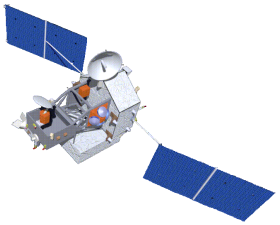
DATA CONTINUITY IN V7

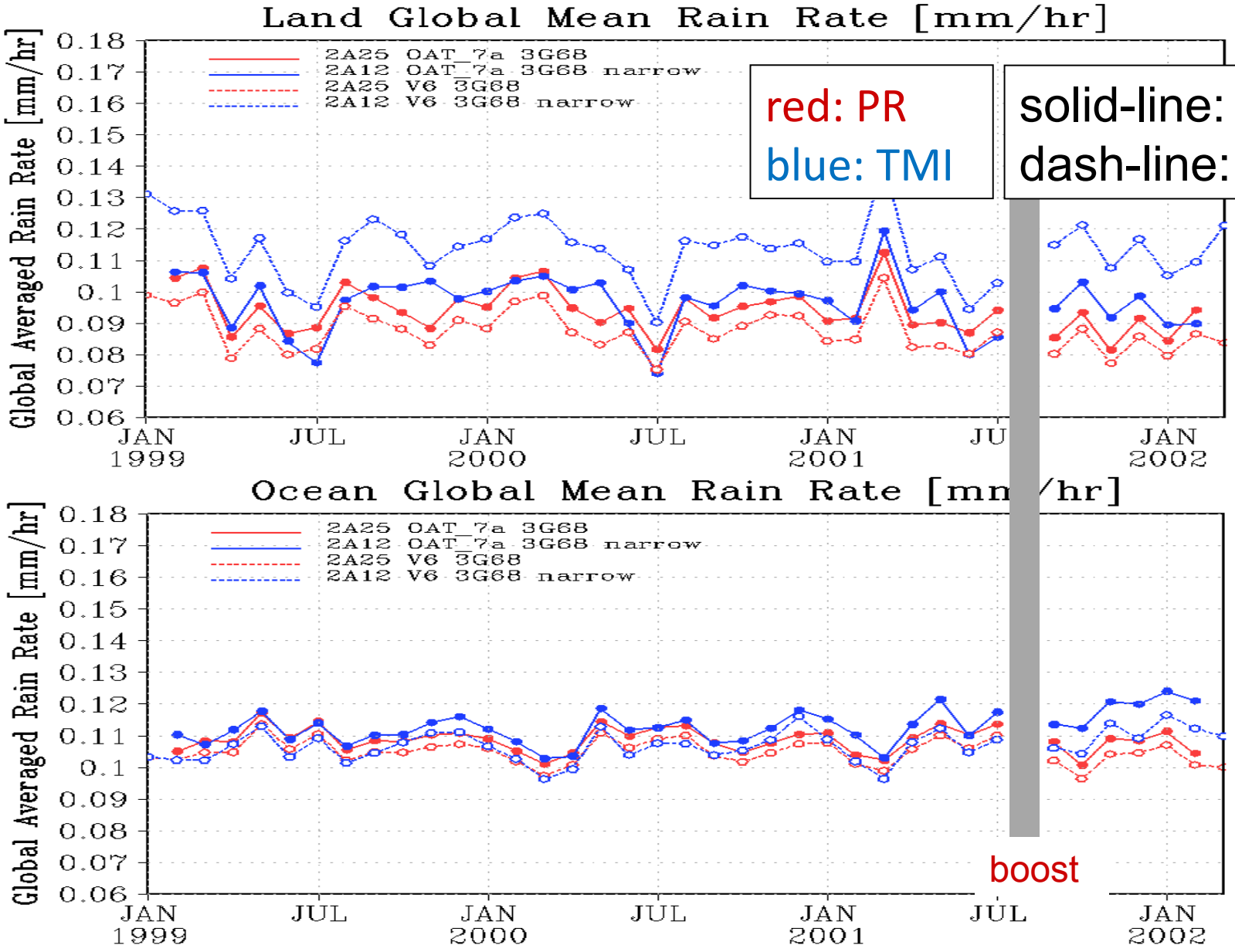
OVER SATELLITE REBOOST : AUG 2008

OVER SWITCHING THE ELECTRICS INTERFACE FROM A-SIDE TO B-SIDE: JUNE 2009

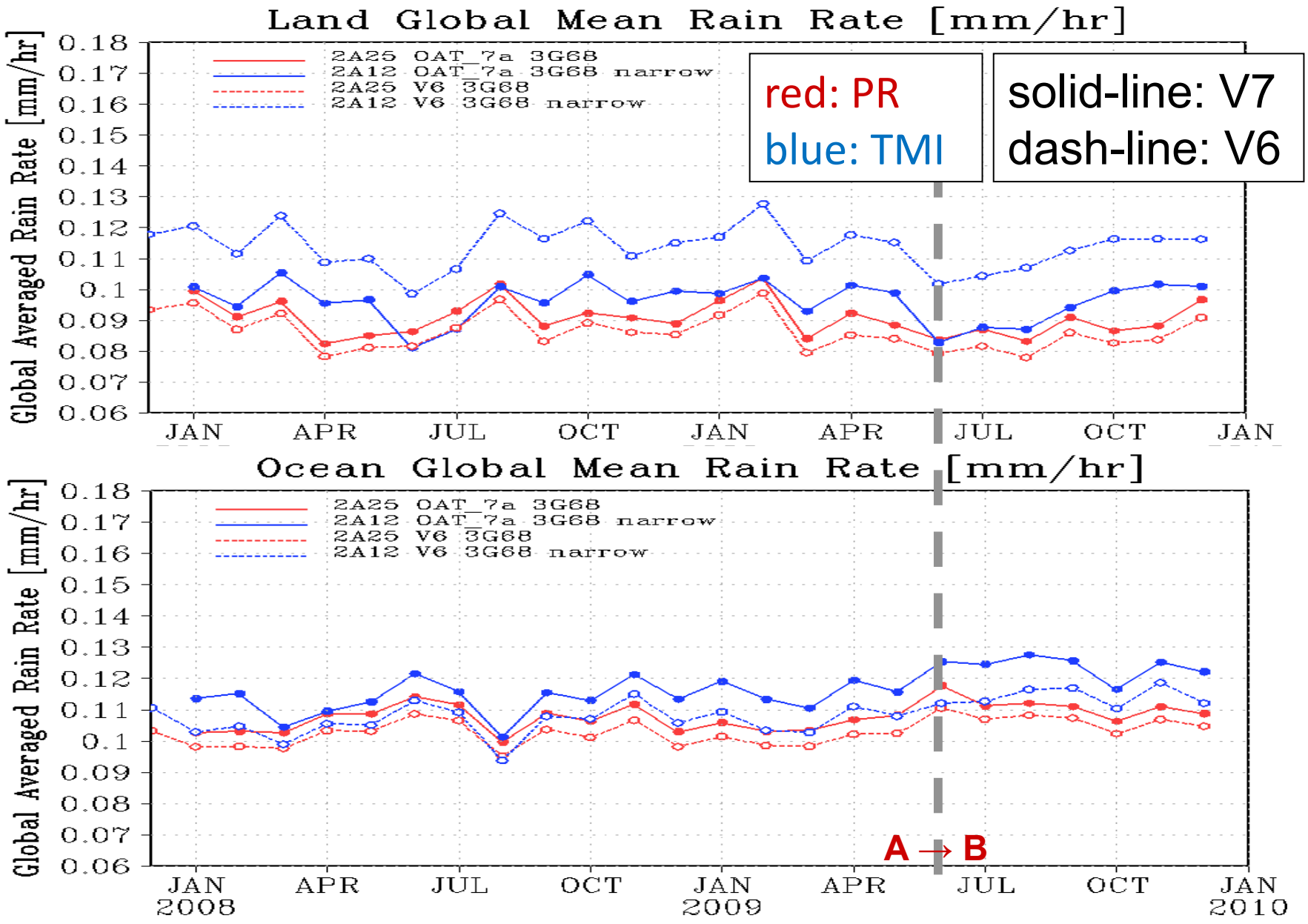
* TRMM Precipitation Radar (PR) suffered a loss of its original (A-side) electronics interface, and switched to its redundancy (B-side) electronics in June 2009. After re-calibration of B-side, PR B-side data was released ensuring continuity with A-side driven measurements

Time series: over Boost (by EORC)



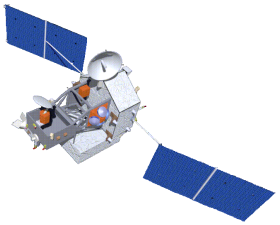


Time series: over switching A→B (by EORC)



SLH V7 CURRENT STATUS

Change in Input Data



	SLH beta (old)	SLH standard (new)
Precipitation Profiles	PR2A25 V6	PR2A25 V7
0 ^{o}C level	PR3A25 BB height	GANAL (same as PR2A23 and PR2A25 V7)

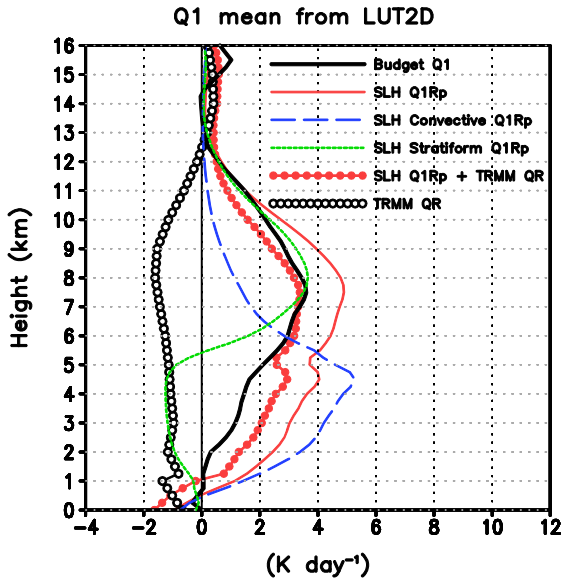
Change in SLH algorithm

	SLH beta (old)	SLH standard (new)
Precipitation in Look Up Table	= rain + graupel + snow	= rain + graupel
Pmelt ≤ Psfc for Anvil	no cooling below ML	cooling
Topography & low 0 ^{o}C level	Not considered	considered

SCSMEX Q1R (New Data)

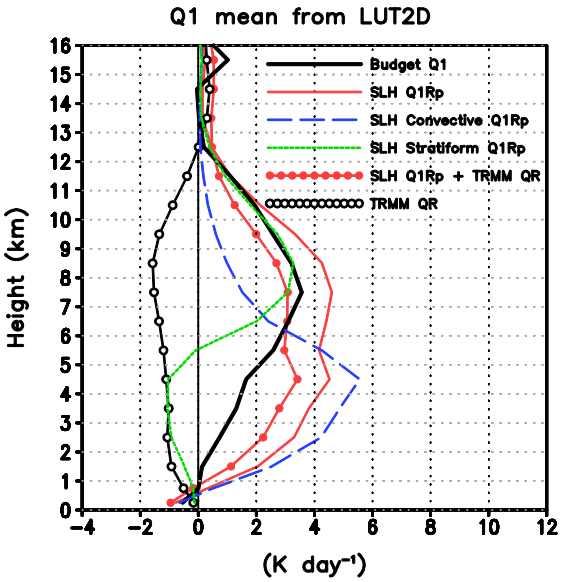
Input: 2A25 V6 + GANAL

EORC test v30a4 (31 Aug 2010)



Input: 2A25 V7 + GANAL

V3.22 (1 Aug 2011)

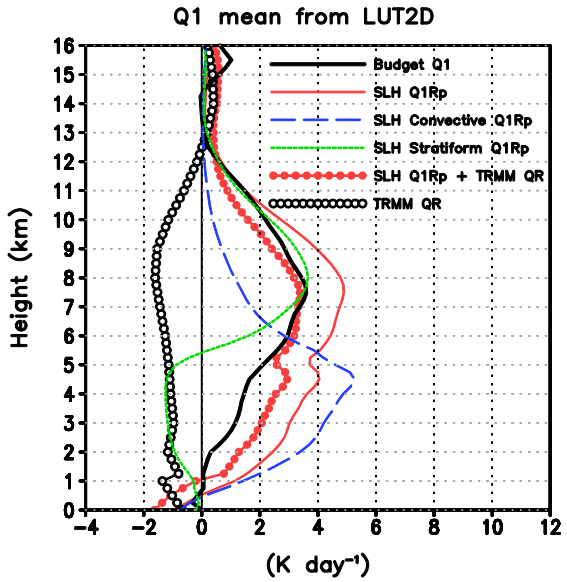


Plot by S. Shige

SCSMEX Q1R (+algorithm adjusted)

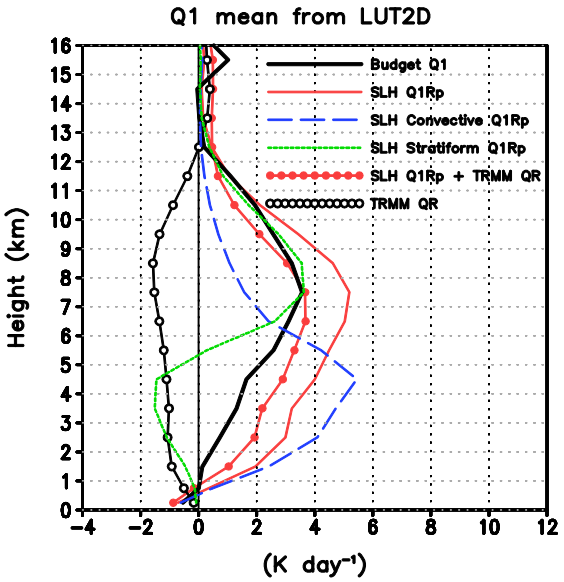
Input: 2A25 V6 + GANAL

EORC test v30a4 (31 Aug 2010)



Input: 2A25 V7 + GANAL

V3.40 (7 Oct 2011)

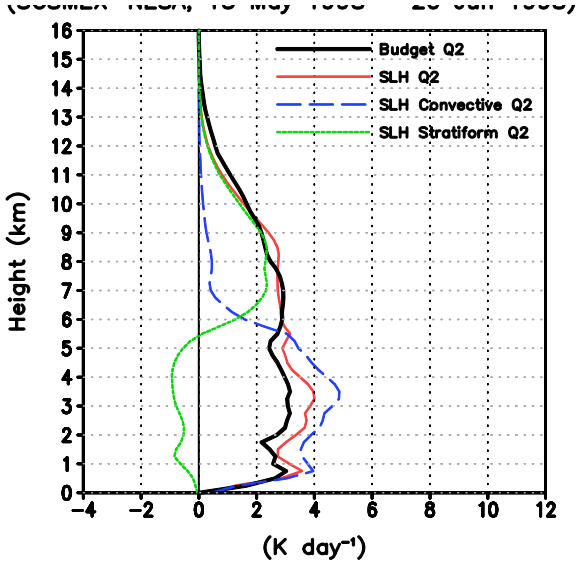


Plot by S. Shige

SCSMEX Q2

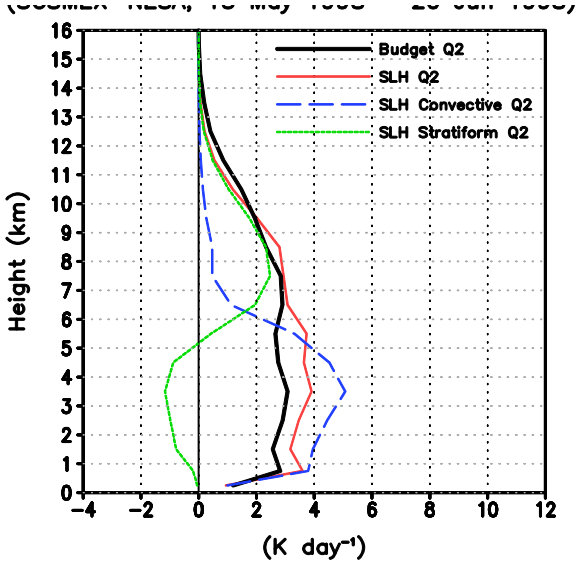
Input: 2A25 V6 + GANAL

EORC test v30a4 (31 Aug 2010)



Input: 2A25 V7 + GANAL

V3.40 (7 Oct 2011)



Plot by S. Shige

SLH Products and current status

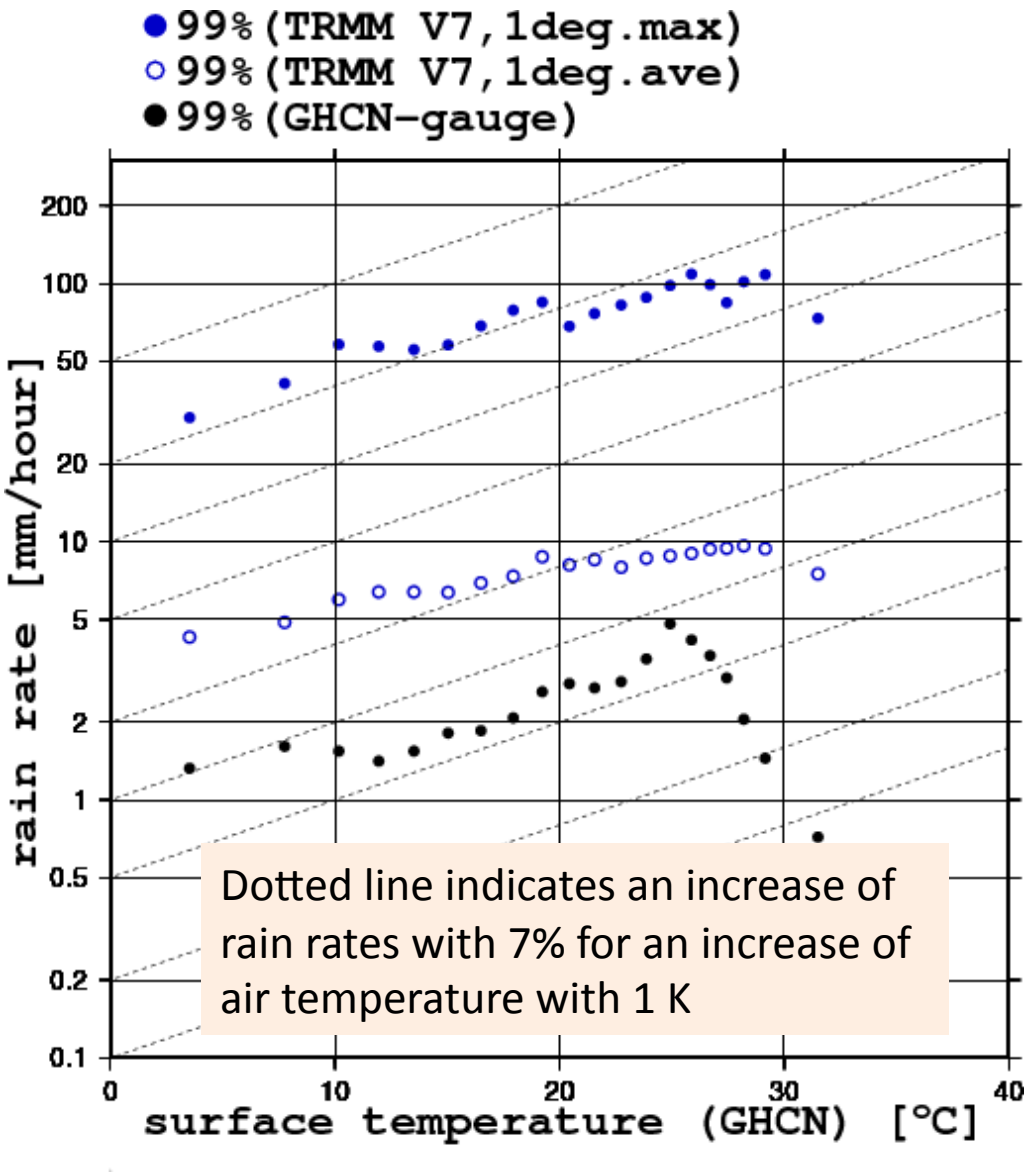
Product	Temporal	Horizontal	Vertical
3G25	Orbit	0.5 deg res.	19
3H25	Month	0.5 deg res.	19
2H25	Orbit	5 km res.	19

We are now at the final bug fixing stage and will submit the algorithm very soon.

ANALYSES WITH ACCUMULATED TRMM DATA AND GSMAP PROGRESS

Relation between surface air temperature and extreme rain rates - An analysis with TRMM/PR V7

All TRMM data in the year of 2000 are used where GHCN is available.



Surface air temperature
GHCN (ground measurement)

↕ Data matchup
1 x 1 lat./lon box
Daily

Rain rate
GHCN (gauge)
TRMM PR V7 (max at 1 deg.)
TRMM PR V7 (ave. of 1 deg.)

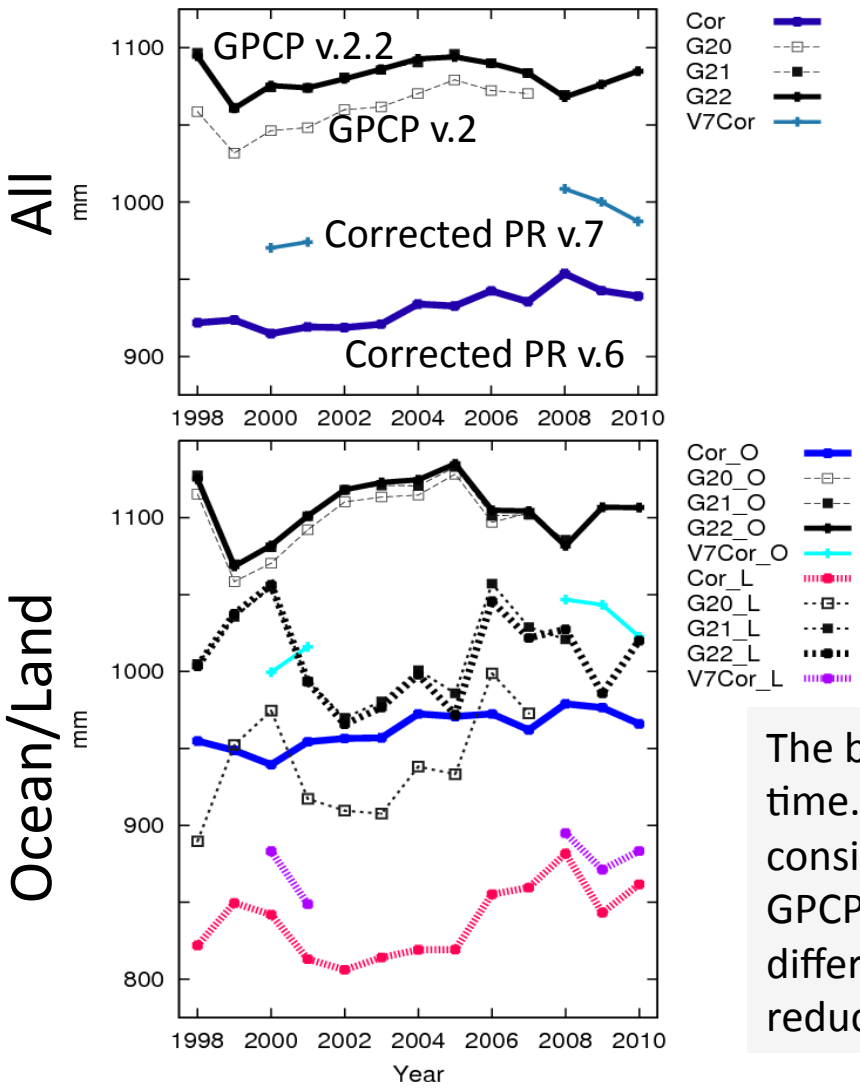
For each surface air temperature range bin (bin width is about 2K), 99 percentile rain rates (as extreme rain rates) are derived.

TRMM PR V7 extreme rain estimates shows a Clausius-Clapeyron-like relation with surface air temperature.

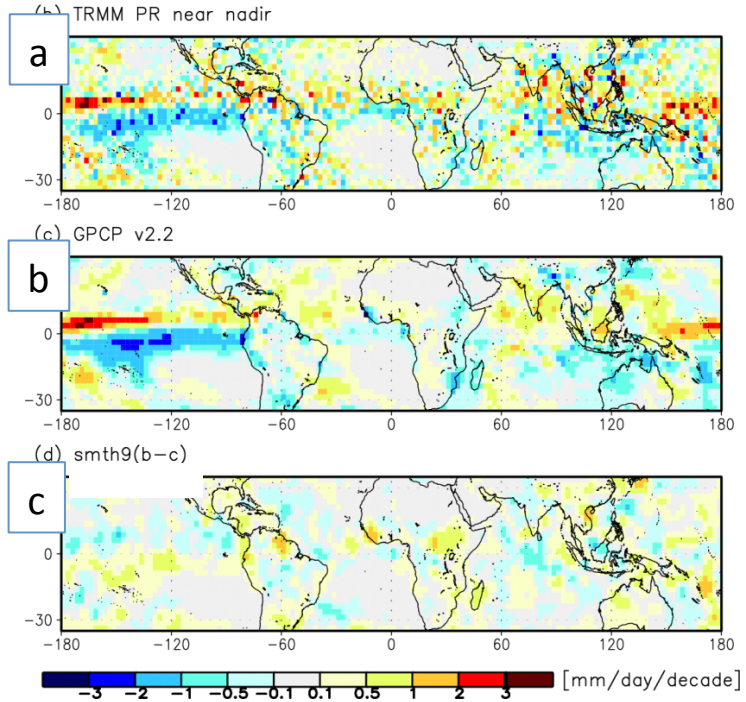
S. Seto

Interannual variation of rainfall from 13 years of the TRMM PR data

Interannual variation of R over 35˚N-S. The yearly data was averaged on the basis of monthly data for the bias-corrected (Cor) data and GPCP data.



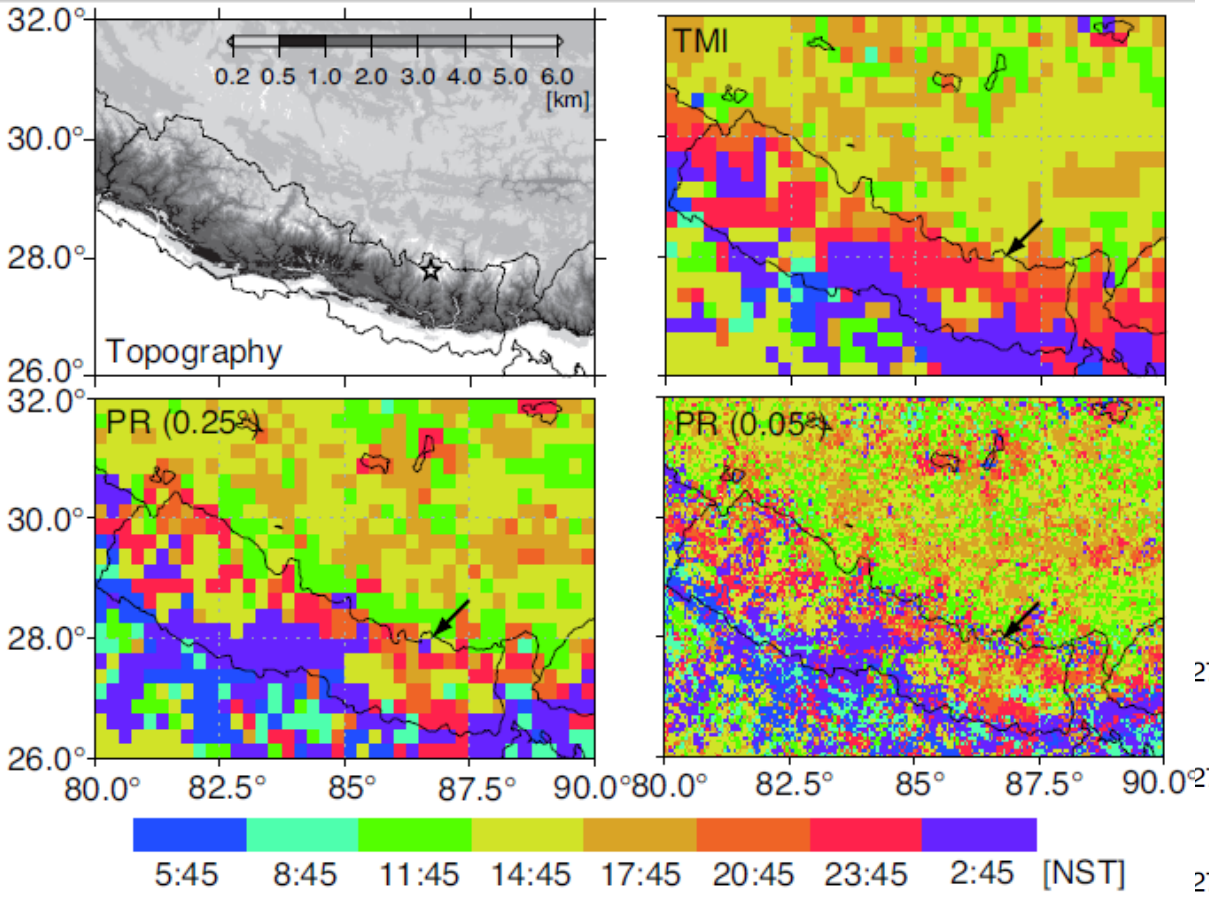
Maps of the changing ratio (trend) of R for (a) the near-nadir R, (b) GPCP v2.2, and (c) the difference; a-b



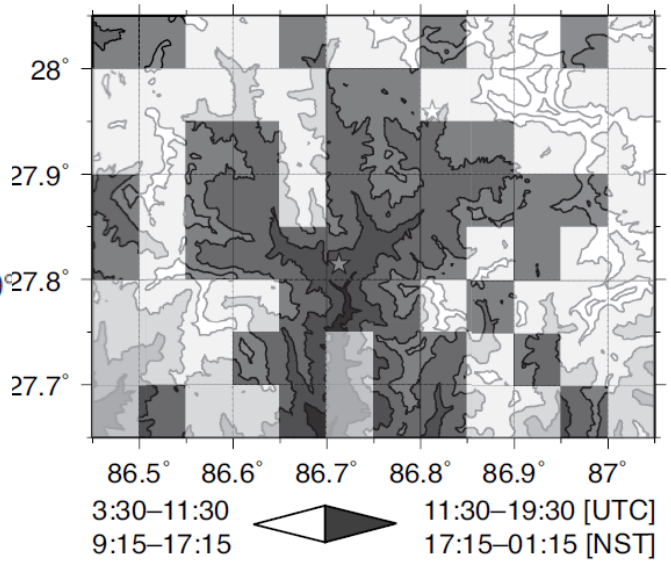
The bias-corrected R shows a quasilinear change in time. Results are not substantially altered when considering the year-to-year variation based on the GPCP v.2 data. However, the highest record was different among datasets and using latest GPCP v2.2 reduces the magnitudes of trends (nearly zero).

M. Hirose

Topographic Effects in diurnal variations

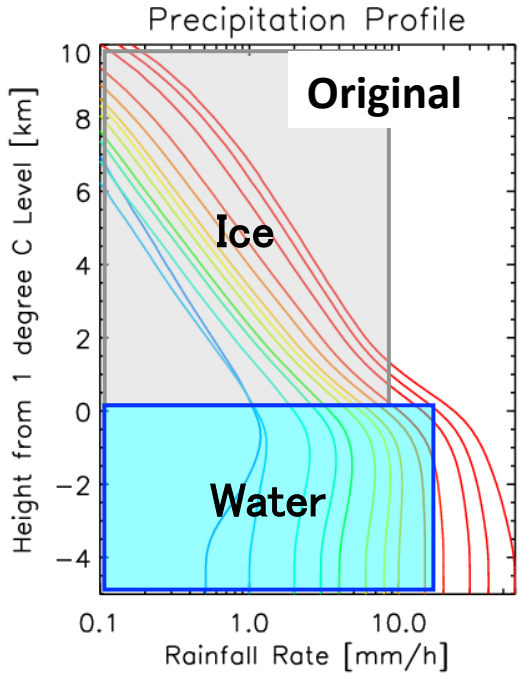


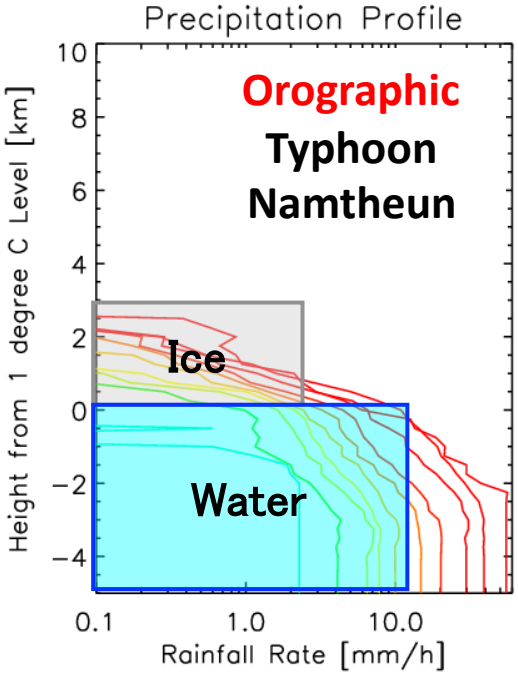
0.05 degree resolution accumulated data show good correspondence with the topography



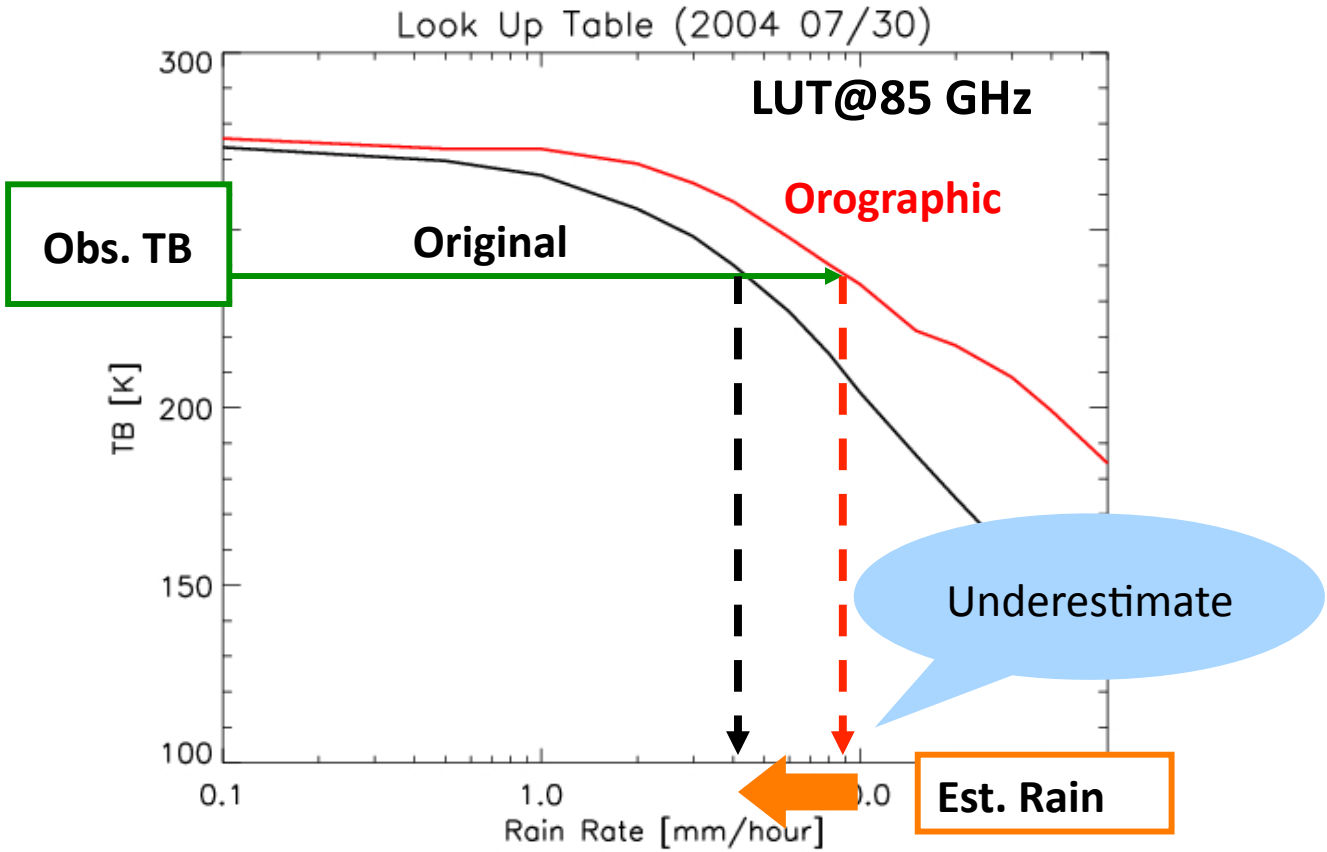
Yamamoto et al. 2011, JMSJ

Improvement in orographic rain estimate with TMI for GSMaP



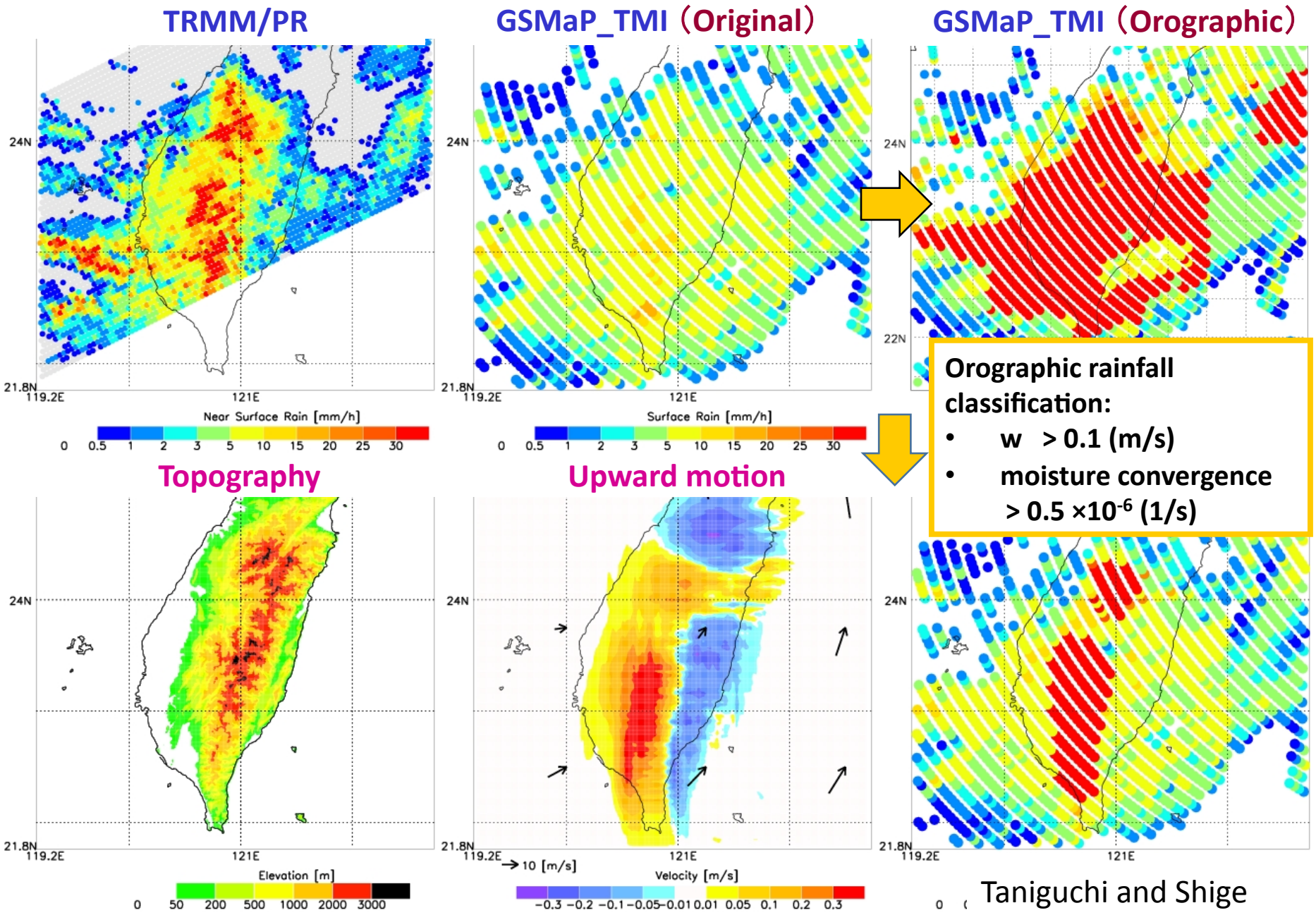


Look-up table:
Relationship between *Tb*s and rain rates



Taniguchi and Shige

Orographic Heavy Rainfall in Taiwan associated with Morakot (8/8/2009)



Taniguchi and Shige

Progress from the last PMM

- TRMM PR version 7 algorithms fixed: more physics
- Evaluations showed improvements in PR V7
- No problem with Data continuities
  - Over satellite reboost : Aug 2008
  - Over switching the electrics interface from a-side to B-side in June 2009
- TRMM SLH version 7 development: almost fixed
- Analyses of accumulated data
  - extreme rain against temperature
  - Interannual variation of rainfall
  - 0.5 deg PR diurnal variation matches topography
  - Improved estimates of orographic rain with TMI for GSMaP
  - Extreme rainfall statistics become available
- Progress in GSMaP → Visit K. Aonashi for details (poster)