New GSMaP over-land precipitation retrieval algorithm for AMSR2

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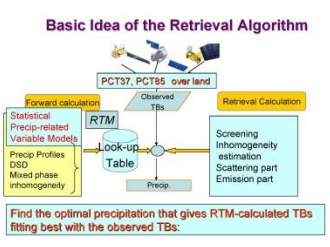
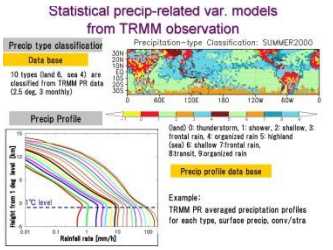
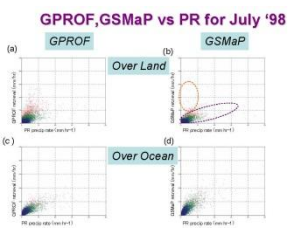
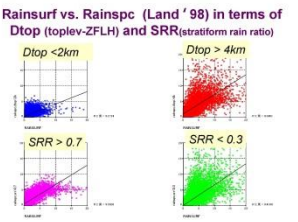
1. Introduction:

The conventional GSMaP over-land algorithm finds surface precipitation rates that give forward-calculated brightness temperature (TB) depressions in higher frequencies best fit with the Microwave Imager (MWI) observation. This algorithm uses TBs around 37 GHz (TB37) (at 37.0 GHz for the TRMM Microwave Imager (TMI), and at 36.5 GHz for the Advanced Microwave Scanning Radiometer2 (AMSR2)) and TBs around 85 GHz (TB85) (at 85.5 GHz for TMI and at 89.0 GHz for AMSR2).This algorithm underestimates PR Rainsurf particularly for shallow precipitation events. This algorithm also showed differences in retrieval biases between stratiform and convective precipitation.









2. Methodology:

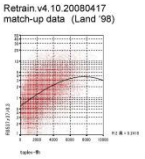
The present study developed the new over-land algorithm for the Global Change Observation Mission-Water satellite (GCOM-W1) AMSR2 that estimated the indices of the frozen precipitation depth and stratiform rain ratio from MWI TBs, and statistically calibrated the conventional forward calculation using the indices.

As the index of the frozen precipitation depth, we introduced the ratio of TB85 depressions to TB 37 depressions (R8537). This is based on the TRMM observation and simulation experiment results that TB85 was much sensitive to the frozen precipitation than TB37, and that the TB85 depression became larger than the TB37 depression for deeper frozen precipitation.

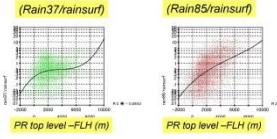
As the index of stratiform rain ratio, we introduced the horizontal precipitation inhomogeneity derived from Rain85 (Sigma85).

Index of Dtop, R8537

- Index of Dtop: the ratio of TB85 depressions to TB 37 depressions (R8537).
- R8537 in terms of ratio of precipitation retrieved from TB85 to TB37 using the conventional GSMaP algorithm.

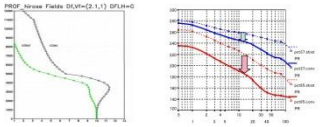


Ratio of TMI scattering signals to PR in terms of precip top level (July, 1998)



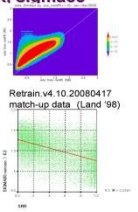
Experimental Simulation with different Dtoplev

TB85 depression became larger than the TB37 depr. for precipitation with higher top levels.



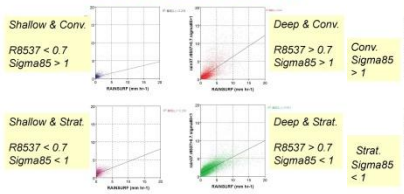
Index of SRR, sigma85

- First guess of Sigma85 from Rain85 within the TB10v FOVs.
- Adjustment using the statistical relationship between Sigma85 and PR (Kubota et al. 2009).

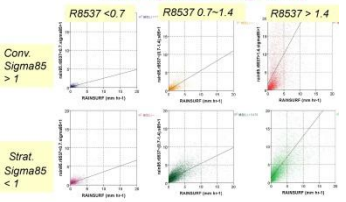


In order to calibrate the conventional forward calculation, first, we classified the conventional TRMM retrievals with R8537 and Sigma85 for 1998. Then we compared them with Rainsurf. Then, we derived linear fitting coefficients between Rain37, Rain85 and Rainsurf for each R8537 and Sigma85 class and precipitation type for 1998. The new over-land algorithm used these fitting coefficients for the calibration of the forward calculation.

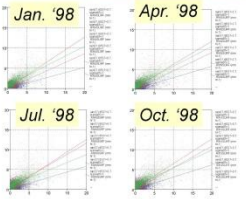
Rainsurf vs. rain37 Land '98 Class by (r8537, sigma85)



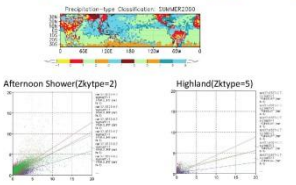
Rainsurf vs. rain85 Land '98 class by (r8537, sigma85)



Rainsurf vs. rain37 Land '98 class (r8537,sigma85): Seasonal change



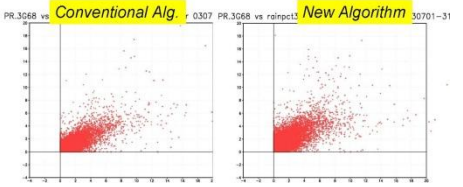
Rainsurf vs. rain37 Land '98 class (r8537,sigma85): Precip type change



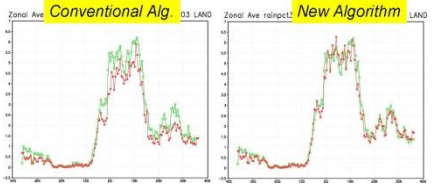
3. Results:

We validated the performance of the new over-land algorithm using TRMM data sets for 2003. The results show that the calibration using R8537 and Sigma85 alleviated negative bias of the precipitation retrievals compared to Rainsurf, in particular, for Himalaya and South America.

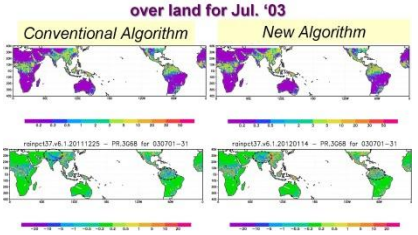
Comparison of over-land retrievals Rainsurf vs.TMI retrieval: Scatter Diagram over Land for Jul. '03



Comparison of over-land retrievals Rainsurf vs. TMI retrieval: Zonal Mean over Land for Jul. '03



Daily precip (mm/day) of TMI retrieval and their difference from PR rainsurf: over land for Jul. '03



4. Future directions:

(1) Improvement of the forward calculation by introducing microwave properties of non-spherical frozen particles into the RTM code used in the algorithm.
(2) Introduction of a priori information from NWP model etc. , in particular, for classification of orographic shallow precipitation.