The next generation GSMaP MWI precipitation algorithm: Improvement of the first guess of physical variables based on MWI TB statistical error analysis

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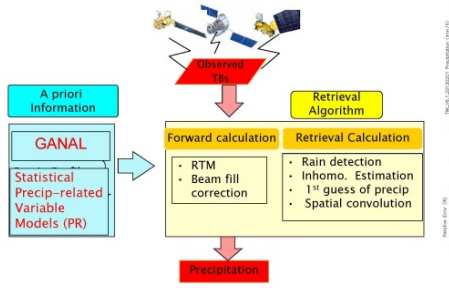
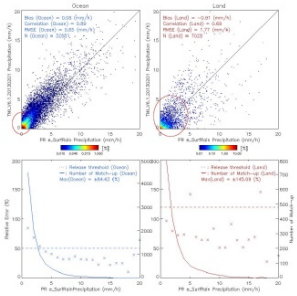
1. Introduction:

The current GSMaP Microwave Imager (MWI) precipitation retrieval algorithm uses a priori information as "the truth". We have been developing a next generation algorithm that assumes a priori information as the first guess and retrieves the physical variables including precipitation and precipitation types etc. from MWI TBs. The basic idea of this algorithm is to derive the statistically optimal values of the physical variables, based on Bayes' theorem. We assume multi-regime PDFs for precipitation profile and surface emissivity.

Basic Idea of the Current Retrieval Algorithm

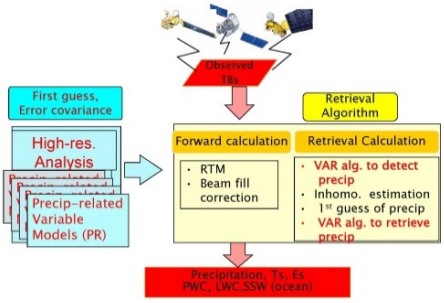




TMI Retrieval V6.1.20130201 vs. PR Estimated Surface Rain

Ave. over TMI 10GHzFOV

Basic Idea of the NEW Retrieval Algorithm



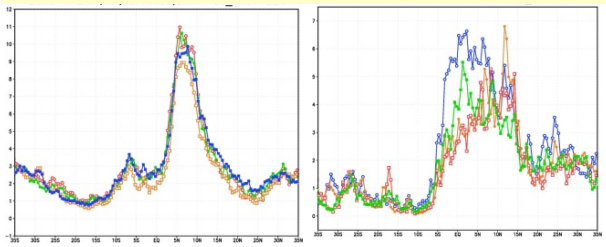
2. Data used for Statistical analyses of MWI TB 1st guess

We performed statistical error analyses of the forward-calculated MWI TBs of the conventional GSMaP algorithm (v6.1.20161129) using the TRMM.V7 (Apr.2013-Jul. 2014) & GPM.V05A (Jun.2014-Dec 2015) data.

Zonal mean Precip. (mm/dy) over Sea (left) & Land (right)

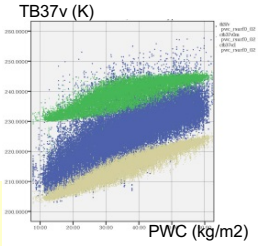
Jun.-Jul.'14

PR, TMI, KuPR, GMI



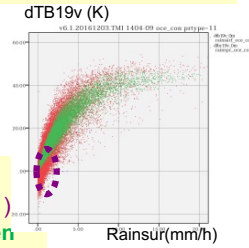
3. Over-Sea Statistical Analysis

The forward calculation using the conventional first guess of CLWC overestimated TBs for most points with very weak precipitation.



GMI TB37v for Pr (0-0.2 mm/h) vs. PWC over Sea (prtype=8)
TBo: Blue, TBc (0.5 kg/m2) : Green, TBc (CLWC=0) : brown

The forward calculation from the PR surface precipitation tended to overestimate tropical TBs for weak precipitation.



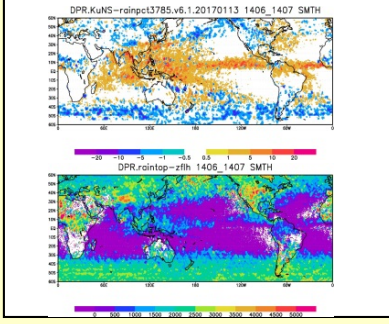
PR Rainsurf vs. TMI (TB19v-TBc0mm) over Sea (10S-10N, 0E-170W; prtype=11)
TBo: Red, TBc (CLWC=0.5 kg.m2):Green

4. Statistical Analysis of Scattering Signals

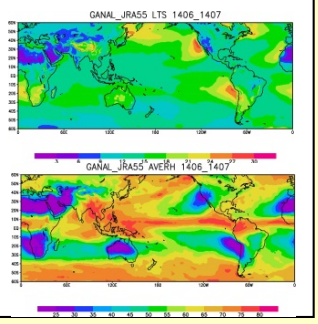
The GMI scattering algorithm overestimated (underestimated) KuPR precip. over areas with deep (shallow) frozen precip layers.

We compared these variables with environmental parameters derived from JRA55 global analysis. Over land, the algorithm biases and the frozen precip depth seems to decrease with the lower tropospheric stabilty (LTS) and Column-averaged relative humidity. Over sea, no significant correlations were found.

Mean difference for Jun.-Jul. '14
(up) KuPR GMI scatter rain (mm/dy)
(dwn) KuPR raintop – FLH (m)



JRA55 mean for Jun.-Jul. '14
(up) Lower Tropos. Stability (dK)
(dwn) Column-averaged RH (%)

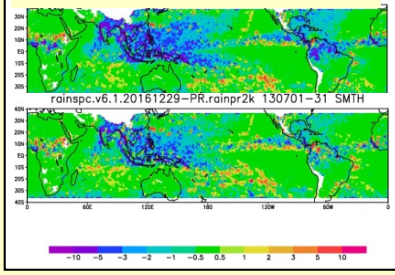


5. Improvement of the over-sea precipitation retrieval

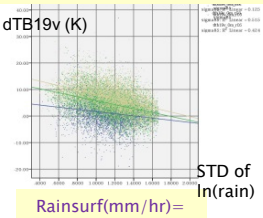
We set the CLWC first guess as a function of PWC and SST. Besides, we corrected TB19v based on the above results. These improved the precipitation retrieval by reducing negative biases for tropical precipitation.

However, there still exists negative biases for weak precipitation with high inhomogeneity.

Mean precip. differences (mm/dy)
TMI retrievals minus PR for Jul. 13
(up) Conventional (dwn) Improved



TMI(TB19v-TBc0m) vs. STD. of ln(PR rain) over sea for Apr.'13- Jan. '14



Rainsurf(mm/hr)=
0.1-0.2 (Blue),
0.2-0.4(Green),
0.4-0.6 (Brown)

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