

## NEW GSMAP MICROWAVE IMAGER OVER-LAND PRECIPITATION RETRIEVAL ALGORITHM

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### 1. Introduction

We have been developing precipitation retrieval algorithms for Microwave Imagers (MWI) under the Global Satellite Mapping of Precipitation (GSMaP) project to monitor global precipitation distribution. These algorithms have been adopted as Japan Aerospace Exploration Agency (JAXA) near-realtime precipitation retrieval system (<http://sharaku.eorc.jaxa.jp/GSMaP/index.htm>).

The basic idea of the MWI precipitation retrieval algorithm is to find surface precipitation rate that gives forward-calculated brightness temperatures (TBs) best-fit with the observed TBs. The conventional over-land precipitation retrieval algorithm (Aonashi et al. 2009) generally tends to underestimate Precipitation Radar (PR) surface rain (Rainsurf).

The objective of the present study is to develop new MWI over-land precipitation algorithm that alleviates the above retrieval bias. For this purpose, we derived the indices from MWI TBs that affected the relation between MWI TBs and the surface precipitation, using TRMM MWI (TMI) and PR data sets. Then, we corrected the forward calculation part of the algorithm with these indices.

We validated the performance of the new algorithm using TRMM data sets for 2004.

### 2. The conventional over-land algorithm

The conventional over-land algorithm for TMI consists of the forward calculation part and the retrieval part. In the forward calculation part, we derive look-up tables (LUTs) between high-frequency (37 and 85 GHz) polarization-corrected brightness temperature (PCT) depressions and the surface precipitation using the radiative transfer model (RTM) (Liu, 1998). The retrieval part finds surface precipitation rates that give forward-calculated PCT at 37 GHz (PCT37) and 85 GHz (PCT85) best fit with the TMI TBs.

### 3. The new over-land algorithm

We derived the indices from MWI TBs that affected the relation between MWI TBs and the surface precipitation. Then, we corrected the forward calculation part of the algorithm with these indices.

For this purpose, first, we performed forward calculation experiments to examine the dependency of PCT depressions to the variations in the precipitation-related variables. The results showed that PCT37 depression was sensitive to freezing level height (FLH) and depth of frozen precipitation (DFP) while it had little sensitivity against other frozen precipitation properties. It was also found that PCT85 was much sensitive to the DFP and other frozen precipitation properties than PCT37.

As the MWI index for DFP, we introduced the ratio of PCT85 depressions to PCT37 depressions (R8537) as the index of the frozen precipitation depth. We expressed R8537 in terms of ratio of precipitation retrieved from PCT85 depression (rain85) to those from PCT37 (rain37) using the conventional over-land algorithm. We also employed PCT37 in no rain areas (PCT37nr) for the indirect index of FLH, since PCT37nr can be regarded as a function of surface temperature.

Then, we checked the PCT depressions to the above MWI indices by comparing TMI retrievals and PR Rainsurf for 1998, for various R8537 and PCT37nr classes. The results show:

1) Relationship between Rain85 and Rainsurf is very sensitive to R8537.

2) Relationship between Rain37 and Rainsurf mainly depends on PCT37nr. Rain37 underestimates Rainsurf for low PCT37nr cases

Then, we derived linear fitting coefficients between Rain37, Rain85 and Rainsurf for each R8537 and PCT37nr class for 1998. The new algorithm used these fitting coefficients for the statistical correction of the LUTs.

### 4. Validation results

We validated the performance of the new algorithm using TRMM TMI and PR data sets over land for 2004. The results indicate that the new algorithm with statistical LUT correction using R8537 and PCT37nr alleviated negative bias of the TMI precipitation retrievals compared to the conventional algorithm. The new algorithm also reduced the zonal mean retrieval differences between the over-land TMI retrievals and PR Rainsurf.

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