Development of the next-generation GSMaP over-land algorithm: Comparison between GMI retrieval bias and KuPR precipitation characteristics

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1. Introduction:

The objective of the present study is to develop a new scattering-based precipitation retrieval algorithm (scattering algorithm) for GMI over land and coastal areas by improving the conventional GSMaP scattering algorithm which used fixed precipitation profiles for a given precipitation class.

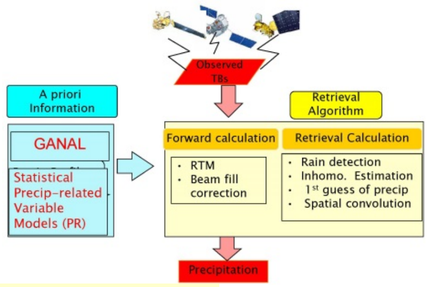


Fig 1. Basic Idea of the Current Retrieval Algorithm

2. Data used in the present study

We made 6-hourly match-up data of the following data:

1) GPM V05A
2) the conventional GSMaP scattering algorithm (V6.1.20180403) retrievals.

Note: This algorithm switched off the statistical correction for each surface temperature class which is adopted by the current operational GSMaP scattering algorithm.

3) JRA55 global analysis during June 2014 – May 2015.

3. Comparing GMI scattering bias with KuPR precipitation characteristics

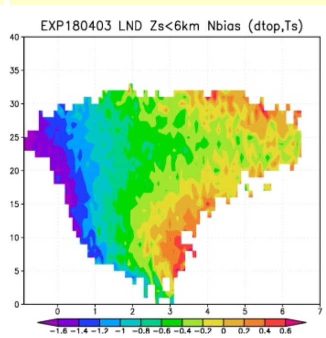
We examined relation among the depression of GMI high-frequency (36 and 89 GHz) TBs in precipitation regions (TB depression), the bias of the conventional GSMaP scattering algorithm (scattering bias), and KuPR precipitation characteristics.

Both the TB depressions and the scattering bias had high correlation with a frozen precipitation depth (FPD) which was expressed as KuPR precipitation top level minus JRA55 freezing level height (Table 1). Magnitude of the scattering bias for a given FPD, however, changed largely in terms of surface conditions (Land/Coast, surface temperature, height), reflecting variations of precipitation profiles (Fig.2).

Table1: Correlation between Scattering Bias and KuPR precipitation features for Jun. '14- May '15.

Features	Land	Coast
surf. Rain	-0.03381	0.017938
FPD	0.54994	0.572301
Strat Rain Ratio	-0.001	0.342114
Precip Coverage	0.20543	0.437991
STD of ln(Pr)	-0.13003	-0.40636
Surf. Temp	0.12127	-0.12396
Surf. Height	0.00219	-0.02942

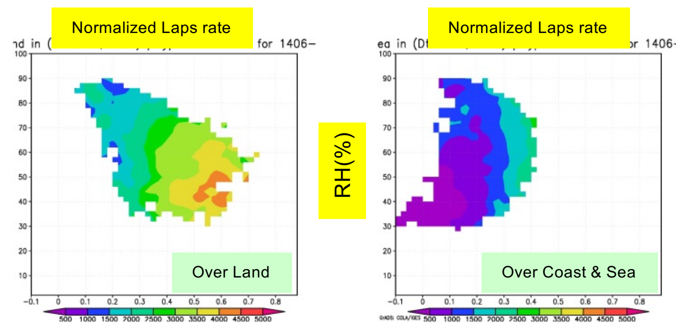
Fig.2: Scattering bias in (FPD,Ts) over Land for Jun. '14- May '15.



4. Development of a new scattering algorithm

We developed a new scattering algorithm which considered the FPD variation in its forward calculation part. For this purpose, first, we compared JRA55 analysis and the FPD to find physical variables with relatively high correlation with the FPD, lapse rates and relative humidity at low-middle levels (see Fig. 3).

Fig.3: FPD averaged for (Normalized lapse rate,RH) for lower troposphere (height :1.5-4.5 km) for Jun. '14- May '15. (Ts > 20 C)



Then, we fitted the FPD using these variables by the SVD method (FPD_ENV). As Fig. 4 shows, correlation between FPD and FPD_ENV was around 0.38 over land for Ts > 20C.

We also examined the applicability of FPD_ENV by checking GMI scattering retrieval-KuPR surface rain relations classified with FPD_ENV. The results looked encouraging (see Fig.5).

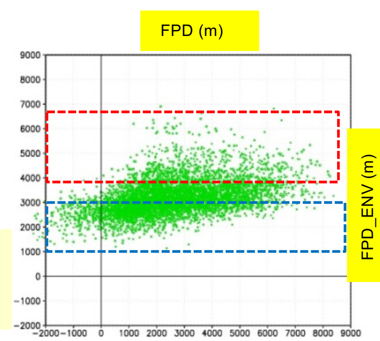
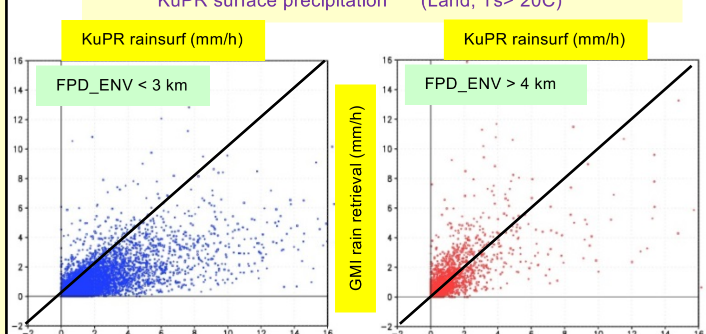


Fig.4: Scatter diagram between FPD and FPD_ENV (Land, Ts> 20C)

Fig.5: Scatter diagrams between GMI scattering retrieval and KuPR surface precipitation (Land, Ts> 20C)



In the future, we will statistically derive precipitation profiles as the function of FPD_ENV for various surface conditions, and employ the precipitation profiles in the forward calculation of the algorithm.

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