Passive Microwave Precipitation Retrieval Algorithm for AMSR2 Using JMA Reanalysis Data

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Variations in precipitation have huge impact on human society in many respects, such as water resources, disaster prevention, etc. In order to understand world-wide precipitation variations due to the climate change, it is essential to monitor global precipitation distribution for a long period. Satellite passive microwave imagers (MWIs) recently have become the principal sensors for global precipitation retrievals since their brightness temperatures (TBs) give information on emission from raindrops and scattering by frozen particles, and these emission and scattering signals (lower frequency TB increases and higher frequency TB depressions from precipitation free atmosphere) have more direct relationship with precipitation rates than infrared radiometer (IR) cloud top TBs.

Japan Aerospace Exploration Agency (JAXA) has started the Global Climate Observation Mission-Water (GCOM-W) project that is going to launch a series of earth observation satellites with sophisticated MWIs. The first GCOM-W satellite (GCOM-W1) is equipped with the Advanced Microwave Scanning Radiometer 2 (AMSR2), the six-frequency (7, 10, 18, 23, 36, and 89 GHz) dual polarization (vertical and horizontal) conical scanning MWI.

The goal of the present study is to develop the precipitation retrieval algorithm for AMSR2 that provides precipitation data with same quality over a long period. For this purpose, we made use of the outputs from Japan Meteorological Agency (JMA) reanalysis (JRA25 and JCDAS) that executed six hourly forecast analysis cycles since 1979, using the JMA global forecast model with horizontal resolution of about 120 km (T106L40) and the three dimensional variational data assimilation scheme. This is because these reanalysis data are expected to have much less chronological quality differences than the operational global analysis data.

The basic idea of the precipitation retrieval algorithm is to find precipitation rates that give Radiative Transfer Model (RTM)-calculated TBs that best fit with AMSR2 TBs. This algorithm employs Polarization Corrected Temperatures (PCT) at 36 and 89 GHz (PCT36, PCT89) over land and coast, TBs with vertical polarization at 10, 18, and 36 GHz (TB10v, TB18v, and TB36v) in addition to PCT36 and PCT89 over ocean. The precipitation retrieval algorithm consists of the forward calculation part to calculate the Look-Up Tables (LUTs), and the retrieval part to estimate precipitation rates from the observed TBs using the LUTs.

In the forward calculation part, we adopted atmospheric temperature, Freezing Level Height (FLH), and surface temperature over land and coast from JRA25 and JCDAS data. We also employed precipitation profiles and rain drop size distribution models based on the TRMM observation studies. We calculated LUTs by incorporating the above atmospheric and precipitation variables into RTM.

In the retrieval part, first, we detected precipitation areas and estimated precipitation inhomogeneity based on the TRMM observation studies. Then, we retrieved precipitation using the scattering signals. As the scattering signals, we choose PCT36 in addition to PCT89, in spite of coarser resolution and smaller signals of PCT36. This is based on the statistical comparison between the TRMM Microwave Imager (TMI) scattering signals and TRMM Precipitation Radar (PR) precipitation. For the retrieval over ocean, emission signals at lower frequencies were

available, in addition to the scattering signals. The retrieval algorithm found the optimal precipitation over ocean by minimizing a cost function that was a weighted sum of squares of differences between the observation and the forward calculation for TB10v and TB18v.

In order to validate the retrieval algorithm, we are going to apply this algorithm to the Advanced Microwave Scanning Radiometer on EOS (AMSRE) aboard NASA Aqua satellite, and compare the resultant precipitation retrieval with coincident PR observations.

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