The Global Satellite Mapping of Precipitation (GSMaP) Project
- Integration of microwave and infrared radiometers for global precipitation map -

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Microwave radiometer, Global precipitation, Infrared radiometer, GPM, TRMM

1 Introduction
Precipitation is a key meteorological parameter in the global and energy cycle. The High resolution global precipitation map has been required for many scientific and operational applications, and one of the major goals in scientific community. Toward this end, many researchers have created the global precipitation map using microwave radiometers which has been proved to the best sensor to estimate precipitation with the necessary accuracy and detail from low earth orbit.

At present, several satellites carrying microwave radiometers such as TRMM, Aqua, DMSP-F13, 14, 15 are in operation. With these currently available radiometers, global precipitation distribution on a daily basis can be estimated very accurately. However, these sensors are in low earth orbit, and the high resolution global precipitation map using the microwave radiometers has a drawback of sampling error if we need a hourly scale map. In this case, we need to combine the infrared data from geostationary satellites which does not have any sampling problem.

The research project, “The Global Satellite Mapping of Precipitation (GSMaP)” started in 2002, which is sponsored by Japan Science and Technology Agency (JST). The aim of the project is to develop rainfall rate retrieval algorithms based on the reliable physical models of precipitation and producing high precision and resolution global precipitation maps from the satellite data in order to obtain the basic information for the research of global precipitation variation and for the long term water resource management. In this presentation, we are going to introduce the GSMaP project and to deal with an integration method for combining the data from some microwave and infrared radiometers.

2 Global precipitation map from microwave radiometers
Currently, the data from six different satellites loading microwave radiometers have been available since 2003. Before 2003, TRMM/TMI and DSMP satellites data are available for mapping the precipitation on a global scale. Table 1 lists the microwave radiometer data sets which have been processed by the GSMaP project so far. The algorithm we are using is the improved version of the Aonashi et al. [1996], and is still tried to be modified using the TRMM/PR data. The SSM/I data are under the initial evaluation and not yet back to 1980’s. One of the data processed in the GSMaP is shown in figure 1. This is one example of the 7 years climatology data for the TRMM/TMI. The distribution of the precipitation in this figure has been evaluated from the data of TRMM/PR and TMI-GPROF algorithm and shown that the three data sets are in excellent agreement in terms of zonal mean, histogram and so on, indicating that the improved algorithm is working well.

3 Utilization of infrared data for high resolution map
Because the microwave radiometers are all in a LEO, the sampling problem is inherent for mapping the global precipitation in fine temporal scale even with the multiple satellites. In order to overcome the problem, we are going to use the infrared radiometer data on a geo-stationary orbit which don’t have any sampling problem. However, the Geo-IR data only
gives information on cloud top layers which is not sensitive to precipitation below the cloud. Therefore, we mainly use the microwave radiometer retrieved precipitation rates, and then the precipitation distribution is propagated along with the moving vector derived from the IR images at present and 1 hour before to fill the gaps between the radiometer overpasses, which is similar to Joyce et al. [2004]. Figure 2 shows the block diagram of the infrared-microwave radiometer combined algorithm, and Figure 3 shows one example of the global precipitation map using both microwave and infrared radiometer data with the resolution of 0.1 degree/1 hour. The TRMM/TMI and Aqua/AMSR-E data are used for the microwave radiometer data and the NCEP/CPC 4km Global (60N - 60S) IR Dataset supplied from GSFC/DAAC are used for the IR data. Kalman filtering is also going to be introduced in the near future. The initial evaluation with the radar-rain gauge network shows above the 0.5 correlation coefficient 3 hours later from the most recent microwave radiometer overpasses, indicating the effectiveness of this approach.

Table 1. Data of the microwave radiometer processed in this project.

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<tr>
<th>Satellite (Sensor)</th>
<th>Processed</th>
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<td>DMSP(SSMI:F13, F14, F15)</td>
<td>Sep. 2003</td>
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References


Joyce, R., J. Janowiak, P. Arkin, and P. Xie, CMORPH: A method that produces global precipitation estimates from passive microwave and infrared data at high spatial and temporal resolution, J. Hydrometeorology, 5, 487-503, 2004