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Precipitation Observation from Space -Tropical Rainfall Measuring Mission and Global Precipitation Measurement Mission-

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Satellite observation is a unique and effective tool to cover a large area homogeneously in a short time. Its advantage is obvious when it observes geophysical parameters varying both in temporally and horizontally, like precipitation. The Tropical Rainfall Measuring Mission (TRMM) satellite is the first satellite mission focused on ”rainfall” observation. TRMM is a joint mission between Japan and the U.S. and was launched in November 1997. The major objective of the TRMM satellite is to determine accurate rainfall amount associated with tropical convective activities, which is a drive source of global atmospheric circulation. To this purpose, the TRMM carries the world’s first satellite-borne Precipitation Radar (PR) developed by Japan, in addition to conventional instruments, such as an infrared imager and microwave imager (TRMM Microwave Imager; TMI). The combined use of PR and the TMI has greatly improved the estimation of rainfall amount. It has also revealed the three-dimensional structure of tropical cyclones over the ocean, which was rarely observed before the TRMM satellite. The success of TRMM shows the potential of satellite remote sensing contributions for understanding the water cycle on Earth and improving weather forecasts. More than 12 years after the satellite’s launch, it continues to perform excellent observations and provide valuable meteorological and climatological data relating to precipitation.

We have operated ”JAXA/EORC Tropical Cyclone Database” (http://sharaku.eorc.jaxa.jp/TYP_DB/index_e.shtml) using the TRMM datasets and the passive microwave imager datasets of the AMSR and the AMSR-E. We have picked up the data and images of the typhoons and the hurricanes, and constructed the database by them.

We have also provided ”Latent Heat Research Product” (http://www.eorc.jaxa.jp/TRMM/lh/index.html) since May 2008. The latent heat research product is based on the Spectral Latent Heating (SLH) algorithm (Shige, Takayabu et al., 2004, 2007) from the TRMM PR information. Heating profile lookup tables were derived from numerical simulations of tropical clouds utilizing a cloud-resolving model.

Currently, the Global Precipitation Measurement (GPM) mission, led by Japan and the U.S., is scheduled under international collaboration to fulfill various user requirements that cannot be achieved by the single TRMM satellite. One major characteristic of the GPM mission as follow-on and expansion of the TRMM satellite is operation of the GPM core satellite, which will carry a dual-frequency precipitation radar (DPR) and a passive microwave radiometer, with a non-sun-synchronous orbit as a ”calibrator” to other satellites. The other is its collaboration with a constellation of several other satellites developed by each international partner (space agency), each of which will carry passive microwave radiometers and/or microwave sounders, to increase observation frequency. Although the TRMM satellite focused on observation of the tropics, the GPM mission covers broader areas including high latitudes. Generation of global rainfall map product is one of major target of the GPM mission.

Global Rainfall Map with high frequency and accuracy will contribute to various applications such as weather, flood forecast, agriculture, and more. JAXA has developed and operates global rainfall map production system, a prototype for GPM era, in near-real-time since October 2008, and hourly and 0.1-degree resolution binary data and images available via internet (http://sharaku.eorc.jaxa.jp/GSMaP/). The algorithms are based on outcomes from the Global Satellite Mapping for Precipitation (GSMaP) project (Okamoto et al., 2005; Aonashi et al., 2009; Ushio et al., 2009). Near-real-time data is utilized in various areas, such as science researches, weather forecast/service, flood warning and rain analysis over river basin, oceanographic condition forecast, agriculture, and teaching.

Keywords: satellite, precipitation, TRMM, GPM, radar, microwave radiometer