Next precipitation measuring mission after GPM/DPR

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1. TRMM/PR and GPM/DPR

The precipitation radar (PR) onboard the Tropical Rainfall Measuring Mission (TRMM) satellite is the first spaceborne precipitation radar in the world. The aim of the mission is to reveal the role of the tropical precipitation on the global circulation and therefore the requiring the accurate precipitation estimation as well as the three-dimensional structure of the precipitation systems. TRMM/PR has been contributed to improve the precipitation estimation from passive microwave radiometer and to characterize the tropical precipitation systems such as diurnal cycles of precipitation and extreme precipitation based on the long-term precipitation data. Improvements of the passive microwave radiometer estimation and the real time availability of multiple satellite data, hourly global precipitation map such GSMaP (Global Satellite Map of Precipitation) was established. The multiple satellite concept became the basis of the Global Precipitation Measurement (GPM) mission. The Dual-frequency Precipitation Radar (DPR) was developed for the GPM/core satellite. The radar concept of the DPR is similar to the TRMM/PR except for the adding the new channel (Ka-band) in order to realize more accurate precipitation estimation and to observe solid precipitation (snow, graupel, hail etc.) by dual-frequency radar and the observation area expanded up to the 65 degrees in latitude. The GPM/DPR has been producing the estimates of the solid precipitation as well as cloud physical parameters of the precipitation (rain and snow). During the GPM era, the hourly global precipitation map (GSMaP) has been improved and utilizing for the practical applications such as flood prediction indicating that the GSMaP product became indispensable precipitation product. And DPR data has been utilizing for numerical weather prediction in the Japan Meteorological Agency.

2. Direction of future precipitation measuring mission

Regarding precipitation research, a comprehensive understanding of aerosols, clouds and rainfall related to the formation of clouds and precipitation, such as radiation budget related to global warming and assessment of impact of climate change on precipitation systems, is required. Therefore, dynamic observation such as Doppler velocity observation is required in addition to the combined use of sensors (multi-wavelength radar and lidar) is required. It should be noted that the accurate long-term precipitation record is also essential for the climate researches. In this context, continuous precipitation observation by radar is also important.

The GSMaP is still required for further improvement of its accuracy and data latency, especially for the practical use, future precipitation measuring mission is required to contribute the better GSMaP precipitation estimation such as improvement of the precipitation estimation by passive microwave radiometer and/or direct utilization of radar data (but it requires better coverage of data in time and space).

3. Next precipitation measuring mission

In the next precipitation observation mission, it is necessary to consider the technological feasibility that satisfies the scientific requirements relating to the global warming and the improvements for GSMaP. The

first approach is to upgrade GPM/DPR. Even with existing technology, it is possible to expand the swath width by about 2 times than GPM/DPR and gain the sensitivity. On the Doppler velocity measurement, it is difficult to realize with the existing antenna size, so the deployable antenna must be considered.

NASA has started “Aerosol –Cloud, convection and precipitation (A-CCP)” mission study, JAXA is cooperating with NASA by proposing DPR follow-on radar to the A-CCP mission.

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