Precipitation Measuring Mission by Active Sensors

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We propose precipitation observation mission with DPR2, which is greatly improved performance of the dual-frequency precipitation radar (DPR) onboard the core satellite of Global Precipitation Measurement (GPM) mission in order to improve the understanding of cloud-precipitation mechanism and to monitor global precipitation. Based on the global precipitation observation heritages of more than 20 years by the precipitation radar (PR) onboard the tropical rainfall measuring mission (TRMM) satellite and GPM/DPR and new mission concept has been discussed by considering the current scientific issues regarding precipitation.

One of the urgent issues is the climate change (the global warming) issue. It is necessary to grasp phenomena of various scales to solve this issue, because it is necessary to evaluate not only the global climate (temperature) change but also the impact on the precipitation systems by global warming and it turns out the necessity of the accurate understanding of the earth's water circulation covering from the microphysical processes, cloud scale phenomena to the global scale precipitation and interactions among them. Considering the precipitation observation, we need better understanding of the cloud-precipitation processes, the global distribution of solid and liquid precipitation and the intense precipitation that affects the soil recharge and flooding. To implement these scientific purposes, observation (system) including cloud observation as well as observation specialized in precipitation in TRMM and GPM is necessary. Furthermore, in order to accurately grasp the precipitation formation mechanism from clouds, it is necessary to acquire dynamic information in the cloud. On the other hand, acquiring climatological information of global precipitation continued from TRMM and GPM is important as the long term record of precipitation. The improvement of the global precipitation map such as GSMaP are also necessary for practical use of precipitation information.

We need to consider the international cooperation such as the framework of TRMM and GPM that is Japan-US cooperative mission. In the United States, Cloud, Convection and Precipitation (CCP) and Aerosol (A) observations are listed as high priority observation in Decadal Survey report. The mission architecture study has been started focusing on aerosol, cloud and precipitation observation. The observation method exemplified in Decadal Survey is high sensitivity observation of cloud by scanning W-band cloud radar and Ka-band radar and Doppler velocity measurement with these radars. This observation concept is complementary to DPR2 concept.

DPR2 plans to improve the sensitivity from 10 times to 100 times (10 to 20 dB) of DPR by using advanced semiconductor devices such as GaN and introducing pulse compression technology, and also plans to introduce Doppler velocity measurement. Improvement in sensitivity is necessary to resolve that DPR has insufficient sensitivity to weak snowfall, as well as to sufficiently overlap the sensitivity range of cloud radar. Resources for improving the sensitivity can be utilized to the expansion of the scan width (but the sensitivity gets worse accordingly), for example, the data of the DPR2 observation can be directly input to the GSMaP to improve the accuracy. Regarding the utilization of this sensitivity resource as maximum, it is also consider the flexible radar operation. Theoretically, it is necessary to maintain correlation between

radar pulses for Doppler velocity measurement. Because of the very fast movement of satellite, sufficient correlation cannot be obtained with the antenna size of DPR, and at least double sized antenna is necessary. Technically, a deployable antenna should be introduced to realize the large antenna and it is a large development item for DPR2, the heritages from EarthCARE can be used for radar control and signal processing system on the Doppler velocity measurement.

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