Studies on future spaceborne precipitation measuring mission

*Nobuhiro Takahashi[1], Kinji Furukawa[2], Yusuke Muraki[2], Daisuke Joudoi[2], Riko Oki[2]

1. Institute for Space-Earth Environmental Research, Nagoya University, 2. Japan Aerospace Exploration Agency

Dual frequency precipitation radar (DPR) onboard the core satellite of the Global Precipitation Measurement (GPM) has been demonstrated its feasibilities for three years. In the scientific viewpoint, GPM/DPR is contributing to provide precipitation structures globally including snowfall over 90 % of global coverage, almost 20 years of accumulation of accurate global rainfall (mainly tropics to sub-tropics) since the observation by the precipitation radar (PR) onboard the Tropical Rainfall Measuring Mission (TRMM) satellite, and hourly global precipitation map (such as GSMaP) by combining not only the sensors onboard the GPM/core satellite but also the satellites that equip microwave radiometer. The societal importance of the space based precipitation observation has changed since the launch of the TRMM. The TRMM mission is rather a process-study mission to reveal the three dimensional heating profiles of the precipitation systems especially for the tropical rainfall systems. Success of the TRMM in terms of the accurate precipitation measurement and long-term observation period, provision of the accurate precipitation map was added for the TRMM’ s roll. Global precipitation maps such as GSMaP which is one of major purposes of GPM provide hourly 0.1 degree in latitude/longitude data and utilized for the flood forecasting/warning system, agricultural applications and so on. On the technological aspect, the success of the GPM/DPR has shown maturities of its technology such active phased array system using slotted waveguide antenna, solid state power amplifier and so on. In addition, recent studies on the pulse compression technology and the TRMM end of mission experiment (Takahashi et al., 2016) indicate the further advances of the spaceborne precipitation radar are possible with current technology.
Based on achievements of TRMM and GPM, science targets of the future precipitation mission have been discussed among the GPM science community.
One of the science targets is cloud-precipitation processes. Since the cloud and precipitation interaction is important process of the precipitation formation. Both the cloud and precipitation observation is also very helpful to evaluate the cloud physical processes of the numerical climate models. The societal contribution target will be to improve GSMaP both on the accuracy and data latency.
For these purposes, three types of missions are considered: 1)small radar constellation satellites to upgrade the GSMaP product by replace the passive microwave estimation by radar estimation (radar constellation), 2) development of the DPR type radar with better sensitivity and the wider swath observation based on the advances on the solid state power amplifier and the wide swath operation of the TRMM EOM experiment (DPR2), and 3) radar observation of precipitation from geostationary satellite (GPR).
Feasibility studies for these missions have started on the key elements such as precipitation estimation accuracy for radar constellation satellite, feasibility study on the pulse compression technology for wide swath operation of DPR2, and feasibility of the large antenna design and the clutter mitigation for GPR. Time scale of these missions are different; DPR2 is almost ready to move the development phase, the development of small radar for the radar constellation needs the feasibility of small antenna system through bread board model (BBM) development, and several fundamental technologies such as deployable large size antenna are needed to demonstrate in orbit for GPR.

Keywords: precipitation observation mission, radar