Technology demonstration mission for next generation precipitation observation radars

*Tomoo Ushio[1], Toshio Iguchi[2], Kenji Nakamura[4], Kinji Furukawa[3], Riko Oki[3], Daisuke Jodoi[3]

1. Tokyo Metropolitan University, 2. NICT, 3. JAXA, 4. Dokkyo University

We have studied doppler velocity measurement for precipitation particles using a precipitation observation radar in a low Earth orbit as a post-mission of Dual-frequency Precipitation Radar (DPR) on the Global Precipitation Measurement (GPM) core satellite. Also, we have studied Geostationary Precipitation Radar (GPR) which can observe precipitation continuously and flexibly from a geostationary orbit as a future mission. In this study, we have studied the method which can separate precipitation echoes from ground/sea clutters by the doppler velocities in order to observe high latitude areas. Therefore, we need to verify the feasibility of the doppler velocity measurement for precipitation particles. Additionally, we need to improve antenna performance drastically in order to observe precipitation from a geostationary orbit which is far away from a low Earth orbit. Therefore, we need to verify the feasibility of upsizing an antenna for the GPR.

Based on the above background, the purpose of the proposed mission is to demonstrate that it is possible to measure the doppler velocity of precipitation particles from an orbit by a pulse compression radar using a planar antenna and to operate antenna deployment and connection mechanisms normally in an orbit. Also, we aim to get data regarding antenna deployment behavior and structural characteristics.

We consider the value of the proposed mission as follows. Firstly, the value of the doppler velocity measurement demonstration is as follows.
This demonstration contributes to realize post-GPM/DPR mission. If the doppler velocity measurement becomes possible in the mission, it is expected to understand the mechanical structure of a precipitation system globally and to improve the accuracy of weather and flood forecasts. This demonstration contributes to realize the GPR mission. If the GPR becomes possible, it is expected to identify the forming process of a typhoon and to improve the accuracy of weather and flood forecasts.
Next, the value of the antenna deployment and connection demonstration is as follows.
This demonstration contributes to improve the performance of satellite antennas for earth observation, communication, radio astronomy, disaster monitoring, national security, etc. because the deployment and connection mechanisms make it possible to enlarge planar antennas. This demonstration contributes to realize innovative missions like the GPR because the deployment and connection mechanisms make it possible to construct a 30-m-class large planar antenna. The deployment and connection mechanisms have the potential to construct super large space structures like Space Solar Power Systems (SSPS).
We consider the feasibility of the proposed mission as follows. When we assume that the size of a demonstration system is 1.2m x 2.2m x 0.7m in storage state and 1.2m x 2.2m x 4.4m in deployment state, we expect that the system meets the installation condition for HTV-X which has been developed as a post-KOUNOTORI (HTV) by JAXA. Also, as a result of thermal analysis for the system, we expect that the system meets the thermal condition for HTV-X. Furthermore, we demonstrated that it is possible to operate the half size deployment and connection mechanisms of the system normally by a ground experiment in FY2017.
As future works, we will study the feasibility of the doppler velocity measurement from the aspect of HTV-X attitude control performance. Also, we will improve the function and performance of the deployment and connection mechanisms.

Keywords: Precipitation Radar, Technology Demonstration, Doppler Velocity, Deployable Antenna, GPM/DPR Follow on

