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# Orbital Operations Status of the GPM/DPR and the next Precipitation Measurement Mission

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The Dual-frequency Precipitation Radar (DPR) on the Global Precipitation Measurement (GPM) core satellite was developed by Japan Aerospace Exploration Agency (JAXA) and National Institute of Information and Communications Technology (NICT). The GPM is a follow-on mission of the Tropical Rainfall Measuring Mission (TRMM). The objectives of the GPM mission are to observe global precipitation more frequently and accurately than TRMM. The frequent precipitation measurement about every three hours will be achieved by some constellation satellites with microwave radiometers (MWRs) or microwave sounders (MWSs), which will be developed by various countries. The accurate measurement of precipitation in mid-high latitudes will be achieved by the DPR. The GPM core satellite is a joint product of National Aeronautics and Space Administration (NASA), JAXA and NICT. NASA developed the satellite bus and the GPM microwave radiometer (GMI), and JAXA and NICT developed the DPR.

The configuration of precipitation measurement using an active radar and a passive radiometer is similar to TRMM. The major difference is that DPR is used in GPM instead of the precipitation radar (PR) in TRMM. The inclination of the core satellite is 65 degrees, and the flight altitude is about 407 km. The non-sun-synchronous circular orbit is necessary for measuring the diurnal change of rainfall similarly to TRMM. The DPR consists of two radars, which are Ku-band (13.6 GHz) precipitation radar (KuPR) and Ka-band (35.5 GHz) precipitation radar (KaPR). The objectives of the DPR are

(1) to provide three-dimensional precipitation structure including snowfall over both ocean and land,

(2) to improve the sensitivity and accuracy of precipitation measurement,

(3) to calibrate the estimated precipitation amount by MWRs and MWSs on the constellation satellites.

Both KuPR and KaPR have almost the same design as TRMM PR. The DPR system design and performance were verified through ground tests. The results of these tests show DPR meets its specification.

GPM core observatory was successfully launched by H2A launch vehicle at 3:37 (UT), Feb. 28, 2014. DPR function and performance verification was conducted at NASA GSFC. DPR function verifications show that DPR functions are normal. Calibration data has been collected in internal calibration mode and external calibration mode using active radar calibrator (ARC). Internal calibration results were almost the same characteristic as S/C I&T test results. Results of antenna pattern measurement show there is no significant change from final test results. DPR performances are almost same as the results taken on the ground. The results of orbital checkout show that DPR meets its specification on orbit.

After completion of initial checkout, DPR entered Normal Operations and Initial Calibration and Validation period was started. JAXA conducted internal calibrations, external calibrations and phase code changes to mitigate KuPR sidelobe clutter effect. JAXA evaluated these operations results and concluded that DPR data could go public. DPR products released to the public on Sep. 2, 2014 and Normal Observation Operation period was started. JAXA is continuing DPR trend monitoring, calibration and validation operations to confirm that DPR keeps its function and performance on orbit.

The GPM Core Observatory was sized for a 3-year operational mission after 60-day on-orbit checkout period, with consumables sized to reach 5-years. JAXA, NICT and GPM users are studying future precipitation measurement mission which carries the upgraded DPR. The preliminary concept study of the upgraded DPR will be reported.

Keywords: GPM, DPR, Precipitation