Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

U02-03 会場:国際会議室 時間:5 月 26 日 09:55-10:20

熱帯降雨観測衛星と全球降水観測計画による新しい降水観測
New Precipitation Measurement Opened by TRMM and GPM

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Precipitation is one of the fundamental elements of the Earth climate system and also the major source of fresh water which is essential not only to human society but also to all ecosystems. The measurement of global precipitation is a challenge because of its high variability in space and time. The Tropical Rainfall Measuring Mission (TRMM) which is a venture between JAXA and NASA has proved the capability of precipitation measurement from space. The TRMM satellite was equipped with a radar (PR), a radiometer, etc. The combination of radar and microwave radiometer was found excellent, that is, the radar provides the structure of precipitation system, and the radiometer gives a wide coverage and frequent observations. The Global Precipitation Measurement (GPM), which consists of a core satellite with a dual-wavelength radar (DPR) and a microwave radiometer, and multiple low-orbit satellites with microwave radiometers, is an international project led by JAXA and NASA using fully the legacy of TRMM. The core satellite works to provide a reference standard for the microwave radiometers aboard other low-orbit satellites.

DPR is a child of TRMM PR. DPR consists of Ku and Ka-band radar. The Ku-band radar is based on the PR design, but the Ka-band radar is a newly designed one. After the launch of the GPM core satellite in February 2014, DPR performance is well examined by using ground-based calibrators, and comparisons with ground-based radars, rain gauges, etc. Statistical results on global precipitation were also evaluated with TRMM PR long-term statistics. Fortunately, TRMM PR was working even after the GPM core satellite launch, and DPR data have been compared with TRMM PR data for near simultaneous observations of precipitation systems. The Ku-band radar data showed excellent consistency with PR data. It has also been proved that the Ka-band radar performance meets the engineering specifications. Weak precipitation is detected with the Ka-band radar and its profiles show clear difference from the Ku-radar, but full utilization of the Ka-radar data is yet to be demonstrated.

One of the objectives of GPM is to expand the precipitation observation coverage into mid- and high-latitude regions where no TRMM data are available. The precipitation systems are associated with mid-latitude depressions, cold outbreaks over warm sea, etc., and are very different from those in tropical regions. The techniques developed and applied to rain in tropical regions using TRMM data may not work well for mid- and high-latitude regions. Water equivalent snow rate retrieval is a challenge for GPM. The advantage of DPR is expected to appear there. More precise rain rate retrieval for rain is another objective of DPR. Currently, DPR algorithm development is on-going, and soon new results could come out.

Combining the GPM core satellite data with other microwave radiometer satellites, global precipitation maps should have wider coverage and better accuracy. This could open new and wide applications for human societies. Also, the capability of DPR to penetrate precipitation system must contribute to better understanding of the structure of global precipitation systems and its climatology.

キーワード: 衛星, 降水, 地球観測, リモートセンシング, TRMM, GPM
Keywords: satellite, precipitation, Earth observation, remote sensing, TRMM, GPM