Geophysical Research Abstracts
Vol. 15, EGU2013-9817, 2013
EGU General Assembly 2013

Current status of Dual Ka-band radar field campaign in Japan for GPM/DPR mission

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The Global Precipitation Measurement (GPM) mission is an expanded follow-on mission to TRMM (Tropical Rainfall Measuring Mission) and a GPM core satellite will carry dual frequency precipitation radar (DPR) and a GPM Microwave Imager on board. The DPR, which is being developed by National Institute of Information and Communications Technology (NICT) and Japan Aerospace Exploration Agency (JAXA), consists of two radars; K_u-band precipitation radar (KuPR) and K_a-band radar (KaPR). The DPR is expected to advance precipitation science by expanding the coverage of observations to higher latitudes than those of the TRMM/PR, measuring snow and light rain by the KaPR, and providing drop size distribution information based on the differential attenuation of echoes at two frequencies. In order to secure the quality of precipitation estimates, ground validation (GV) of satellite data and retrieval algorithms is essential. Since end-to-end comparisons between instantaneous precipitation data observed by satellite and ground-based instruments is not enough to improve the algorithms.

The error of various physical parameters in the precipitation retrieval algorithms (e.g. attenuation factor, drop size distribution, terminal velocity, density of the snow particles, etc.) will be estimated by the comparison with the ground-based observation data.

A dual K_a-band radar system is developed by the JAXA for the GPM/DPR algorithm development. The dual Ka-radar system which consists of two identical K_a-band radars can measure both the specific attenuation and the equivalent radar reflectivity at K_a-band. Those parameters are important particularly for snow measurement.

Using the dual Ka-radar system along with other instruments, such as a polarimetric precipitation radar, a wind-profiler radar, ground-based precipitation measurement systems, the uncertainties of the parameters in the DPR algorithm can be reduced. The verification of improvement of rain retrieval with the DPR algorithm is also included as an objective.

Observations using the dual Ka-radar system were performed in Okinawa Island, in Tsukuba, over the slope of Mt. Fuji, in Nagaoka, and in Sapporo, from 2011 to 2013. In Okinawa Island, the performance of the measurement has been confirmed by rain observation. In Tsukuba, one radar was directed in vertical and the other was in slant direction. By this configuration, total attenuation in the melting layer was estimated. The objective of the Mt. Fuji experiment was to observe the melting layer. The X-band polarimetric radar was simultaneously operated. Unfortunately, the melting layer did not come in between the two radars due to warm weather. In Nagaoka, much data on the wet snow was obtained. In Sapporo, dry snow has been observed by dual Ka-radar with meteorological instruments and other appliances.

Through those experiments the main results are the $k - Z_e$ relationships on various precipitation types. The feasibility of total attenuation in melting layer has been studied. Different $k - Z_e$ relationships have been obtained in snow observations. The vertical variations of rainfall are also analyzed for the DPR algorithm development.