Raindrop Size Distribution Measurements for GPM/DPR Algorithm Development

Katsuhiro NAKAGAWA[1], Hiroshi HANADO[2], Seiji KAWAMURA[2], Shigeo SUGITANI[2] , and Toshio IGUCHI[1]

[1]*Applied Electromagnetic Research Center,*
National Institute of Information and Communications Technology
Koganei, Tokyo 184-8795, Japan
[2]*Okinawa Subtropical Environment Remoto-Sensing Center,*
National Institute of Information and Communications Technology
Onna, Okinawa, 901-0411, Japan

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; Ku-band precipitation radar (KuPR) and Ka-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.

Intensive field observations for subtropical precipitation using a 400-MHz WPR (400-MHz WPR), a 2D-Video distrometer (2DVD), a Joss-type disdrometer, a Parsivel (Laser Optical) disdrometer, a Micro-rain radar (MRR), and COBRA (C-band polarimetric radar) were carried out during the month of June in 2007, 2008, and 2009 at Okinawa island, Japan. These instruments are part of the Okinawa Sub-tropical Environment Remote Sensing Center, operated by the National Institute of Information and Communication Technology (NICT). The 400-MHz WPR is able to observe simultaneously the atmospheric turbulence echo and the echo from precipitation. Therefore, by analyzing the echo power spectrum of the received signal, the raindrop size distribution can be estimated. Using these vertical and ground-based measurements of raindrop size distributions, the extinction cross-section and the back scattering cross section can be processed by the Mie scattering theory. Then, the specific attenuation (k)

and the radar reflectivity (Z) for Ka- and Ku-band are estimated. The vertical variations and characteristics (depending on rain type) of rain attenuation for Ka- and Ku-band can be analyzed. The GPM/DPR and TRMM/PR algorithm can be also evaluated using these results.

Keywords: GPM/DPR, raindrop size distribution, 400-MHz wind profiler