

Simulation of EarthCARE Doppler Velocity Measurements with NICAM: Effects of Doppler Broadening and Folding

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The Earth Clouds, Aerosol and Radiation Explorer (EarthCARE) is a joint satellite mission between Japanese Aerospace Exploration Agency (JAXA) and European Space Agency (ESA) and its satellite is planning to launch in 2021. Cloud Profiling Radar (CPR) that has Doppler measurement capability is installed in this satellite.

Doppler velocity measurement from space suffered from several errors and was studied in several papers. In this study, we focused Doppler broadening error due to the finite beam-width and velocity folding error due to the PRF limitation. The radar reflectivity factor and Doppler velocity field simulated by the NICAM (global cloud-resolving model) output are used for this study. The pulse-pair covariance measured by the CPR is calculated from those data. Then, we investigated the Doppler broadening error reduction with horizontal integration and the folding error reduction with unfolding method used in ground processing algorithms.

We selected two scenes (cirrus cloud and precipitation) for this study. In the cirrus cloud case, the standard deviations of the broadening errors decrease when the integration length becomes large. They are 2.0 (500 m integration), 1.78 (1 km integration), and 0.48 m/s (10 km integration) for -10 dBZe cloud echo, respectively. In the precipitation case, large falling speeds of rain cause Doppler folding error. The unfolding method is thus needed in addition to the horizontal integration. The standard deviation of the errors for 0 dBZe echo are reduced from 2.8 to 1.7 m/s for 1 km integration and from 1.4 to 0.9 m/s for 10 km integration with use of unfolding method.

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