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Development of level 2 algorithms for EarthCARE CPR/ATLID.

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We develop algorithms that can be applied to EarthCARE Cloud Profiling Radar (CPR) and Atmospheric backscatter LIdar (ATLID), and Multi Spectral Imager (MSI) and discuss about the expected products. EarthCARE will carry CPR, ATLID and MSI and these combination corresponds to the CloudSat/CALIPSO and Aqua on MODIS for the A-train. Due to the similarities between the EarthCARE and the A-train, it will be possible to apply the similar types of algorithms that have been already developed and extensively used for the analyses of the A-train satellites and it is therefore expected to obtain the similar cloud products for the EarthCARE. On the other hand, there are some differences between the EarthCARE and A-train satellites, e.g., the EarthCRAE CPR has better sensitivity compared with the CloudSat. And Doppler capability of the EarthCARE-CPR is a new element and is expected to provide the better constraint for the retrievals of cloud/precipitation microphysics. And the vertical air motion and sedimentation velocity of cloud particles will be inferred.
We are planning to prepare level 2 algorithms for (1) CPR, (2) CPR and ATLID synergy and (3) CPR, ATLID and MSI, synergy. A distinguish feature of the CPR on EarthCARE is the Doppler capability. We first prepare the algorithms without Doppler velocity to produce clouds products and also prepare the algorithms with Doppler velocity. The cloud particle models and scattering properties are taken to be consistent through the CPR only to the CPR/ATLID/MSI synergy. And the discrete dipole approximation, geometrical optics with physical optics approach, hybrid of these are considered for the scattering properties of ice particles at CPR, ATLID and MSI wavelengths. The level 2 algorithms for CPR have a function to produce the following standard products; cloud mask, cloud particle types such as cloud phase and particle shapes and orientation, and cloud microphysics such as cloud water content, ice water content, water effective radius, ice effective radius, and optical thickness. And rain and snow amount as well as its rate, vertical air motion, sedimentation velocity of cloud particles are also produced as research products. For the level 2 algorithms for CPR and ATLID synergy, input parameters are radar reflectivity factor and Doppler velocity from CPR, backscattering coefficient, extinction coefficient and depolarization ratio at 355nm from ATLID. The algorithms have a function to produce the same list of cloud products for CPR-only case as standard products. As research products, mass mixing ratio of horizontally oriented particles, rain and snow amount/rate, vertical air motion and sedimentation velocity are produced. Level 2 algorithms for CPR/ATLID and MSI can produce similar products as CPR/ATLID synergy. Some of the algorithms have been developed and applied to the CloudSat and CALIPSO and global distribution of the cloud products have been obtained for more than six years. The information retrieved from the EarthCARE will provide a new insight for the cloud feedback processes and interaction between clouds and aerosols.