

# EarthCARE products and challenges for climate change studies

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Clouds and precipitation, convective motions and cloud-aerosol interactions are key components to control climate systems. Though recent progresses improved estimation of vertical distribution of clouds and radiation budgets, there are large differences among global cloud products. In addition, inconsistencies exist in representation of cloud- and precipitation-microphysics and radiation in climate models. We need better Earth observing systems that can provide aerosols-, cloud- and precipitation-microphysics, their radiation properties and in-cloud air motions to reduce uncertainties in climate change predictions.

The Earth Clouds Aerosol and Radiation Explorer (EarthCARE) is a joint mission by Japan Aerospace Exploration and the European Space Agencies. Launch schedule is in 2021. It will carry cloud profiling radar with Doppler function (CPR), atmospheric high spectral resolution lidar (ATLID), multi-spectral imager (MSI) and broad band radiometer (BBR). JAXA EarthCARE science team have developed algorithms for JAXA EarthCARE products. Since EarthCARE mission corresponds to an advanced version of CloudSat, CALIPSO, MODIS and CERES, algorithms for A-train satellites are extended for EarthCARE. The algorithms for CloudSat and CALIPSO have been used to produce KU-products, which are distributed to evaluate and improve climate and numerical weather forecast models. Doppler capability of CPR and high spectral resolution function of ATLID are expected to provide vertical air motion and terminal velocity of clouds, leading to improve the situation.

We develop synergetic ground-based observation systems to evaluate algorithms for space-borne active sensors. The system includes cloud radar, multiple-field-of-view multiple scattering polarization lidar, multiple high spectral resolution lidar and Doppler lidar. The system can capture the characteristics of CloudSat and CALIPSO, Aeolus and EarthCARE so that the system is also expected to help to construct continuous and homogeneous data sets among these satellites.

Keywords: EarthCARE, cloud radar, A-train, clouds, precipitation