

The EarthCARE Satellite Mission

The Earth Cloud Aerosol Radiation Explorer (EarthCARE) mission is a joint mission between ESA and JAXA. It is the next evolution in multi-sensor space-borne observations of Earth's atmosphere. With the first space-borne Doppler radar, a high spectral resolution lidar, a multispectral imager and broadband radiometer, EarthCARE will observe the interactions among clouds, aerosols, precipitation and radiant energy transfer, so as to better understand the controls on Earth's energy budget. These interactions are still poorly represented in climate models, but EarthCARE will deliver unprecedented information for improving parameterizations and eventually climate prediction.



Scientific Objectives

Overall objective: *Closure of the Earth's radiation budget at the top of the atmosphere*

- ▶ The observation of the vertical profiles of natural and anthropogenic aerosols on a global scale, their radiative properties and interaction with clouds
- ▶ The observation of the vertical distributions of atmospheric liquid water and ice on a global scale, their transport by clouds and the radiative impact.
- ▶ The observation of cloud distribution, cloud-precipitation interactions and the characteristics of vertical motions within clouds
- ▶ The retrieval of profiles of atmospheric radiative heating and cooling through the combination of the retrieved aerosol and cloud properties

Mission Details

- ▶ Launch: mid-2022
- ▶ Duration: 3 years, including a 6-month commissioning phase

What are the main advantages of EarthCARE?

- ▶ **Doppler Capability**
 - First characterization from space of large-scale (10 km) vertical velocity in clouds
 - Improved phase determination and microphysical cloud property retrievals
- ▶ **Coincident measurements**
 - Improved data product retrievals through instrument synergy
 - Radiation budget closure studies comparing observation-based radiative transfer calculations to TOA broadband measurements
- ▶ **High spectral resolution lidar technique**
 - Measured lidar ratio and therefore more accurate cloud and aerosol property retrievals
- ▶ **Improved radar sensitivity and more aggressive oversampling**
 - Better sampling of thin, ice clouds and low, shallow clouds, which are critical to understanding climate change

Satellite Details

- ▶ Orbit: Sun-synchronous, 14:00 local equatorial crossing (descending node), 25 day repeat cycle (389 orbits)
- ▶ Altitude: approx. 393 km
- ▶ Payload:
 - **Cloud Profiling Radar (CPR):** 94 GHz cloud radar with Doppler capability; 100 m oversampling; minimum sensitivity: -35 dBZ
 - **Atmospheric Lidar (ATLID):** high spectral resolution; 355 nm linearly polarized laser; depolarization detector
 - **Multispectral Imager (MSI):** pushbroom-style imager; cross-track observations (150 km swath); 7 spectral channels between 0.6 μm - 12.0 μm
 - **Broadband Radiometer (BBR):** three, fixed single-mirror telescopes (forward, nadir, backward); SW radiance (0.25 - 4.0 μm) and TW (0.25 - 50 μm)

Data Products

- ▶ Level 1b (single-instrument), level 2a (single-instrument + external), and level 2b (synergistic)

The German EarthCARE Project Office

The main goal of the project office is to build an EarthCARE science community in Germany. As a central point of contact and coordination, we aim to facilitate communication and collaboration within the community and with other potential EarthCARE users. Ultimately, our efforts will aid in the development of mechanisms to advance and support the anticipated research activities (calibration, validation and scientific) associated with EarthCARE and the next generation of Earth observing satellites.

For more information, please visit our website:

<https://www.mpimet.mpg.de/en/science/the-atmosphere-in-the-earth-system/earthcare/>