

EarthCARE-GPM Coincidence Dataset

Version 2

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1. Introduction.

Owing to the Tropical Rainfall Measuring Mission (TRMM) and the Global Precipitation Measurement (GPM) core satellite's unique asynchronous orbits, their orbital ground tracks intersect the orbital of many other sun-synchronous satellites. The CloudSat–GPM and CloudSat–TRMM coincidence dataset (CSATGPM and CSATTRMM; Turk et al. 2021) have provided “pseudo three-frequency” radar profiles (W-band from CPR, Ku/Ka-band from DPR), and the multi-channel passive microwave radiometer (13-channel (10–183 GHz) GMI and 9-channel (10–85 GHz) for TMI). These combined passive/active data are useful for many scientific purposes. Examples include algorithm evaluation and identification of deficiencies, snow and light rain sensitivity studies, radiative transfer simulations, training of machine learning techniques, and studying how land surface properties affect the radar, radiometer, and combined radar+radiometer precipitation retrieval algorithms (*Turk et al.*, 2021).

The Earth Clouds, Aerosols and Radiation Explorer (EarthCARE) satellite (Illingworth et al., 2015; Wehr et al., 2023), launched in May 2024, is equipped with four sensors that employ different observation methods. The Cloud-Profiling Radar (CPR; W-band), developed by the Japan Aerospace Exploration Agency (JAXA) and the National Institute of Information and Communications Technology (NICT), provides world's first measurement of Doppler velocity. The coincidence observation dataset from EarthCARE and GPM provides new information on vertical hydrometeor motion inside clouds, complementing previous studies based on CloudSat. In addition, this new dataset enables both daytime and nighttime analysis, whereas the CSATGPM was limited to daytime because CloudSat operated only under daylight conditions during the GPM mission period. It also includes observations from other EarthCARE instruments. The Atmospheric Lidar (ATLID) provides information on the vertical distribution of optically thin clouds and aerosols, and the Multi-Spectral Imager (MSI) provides information on their horizontal distribution, and the Broad-Band Radiometer (BBR) measures broadband radiances related to the Earth's radiation budget. The combined use of these observations enables a more comprehensive characterization of clouds and aerosols and contributes to a better understanding of their radiative effects.

This document summarizes Version 2 (V02) of EarthCARE–GPM coincidence dataset (Aoki et al. 2025). The coincidence identification algorithm is based on CSATGPM Version 5. The full contents of each EarthCARE and GPM data product are copied over with each variable in each group maintaining the same name, units, scale, offset and type as the native dataset that they were extracted from.

2. Data Processing.

The processing flow is driven by a pre-generated list of the ± 15 -minute time coincidences between the GPM-EarthCARE ground tracks. EarthCARE's tracks are obtained from orbital propagation using daily-updated two-line elements (TLE) provided by ESA, while GPM's tracks are obtained from GPS. For GPM, the current dataset spans the period starting from 1 August 2024. Table 1 shows the datasets used for each coincidence file.

Table 1. Individual datasets included in the EarthCARE-GPM coincidence datasets. For 2A.GPM.DPR, data from “HS” group is omitted. A product version more recent than that specified in the “Version” column is used.

Dataset Name	Source	Version	Description	*
1C-R.GPM.GMI	GMI	V08	GMI Level 1C brightness temperatures	✓
2A.GPM.GMI.GPROF	GMI	V08	GPROF precipitation algorithm for GMI	✓
2A.GPM.DPR	DPR	V08	DPR Ku-only and Ku/Ka-band radar reflectivity and precipitation profile	✓
2H.GPM.SLH	DPR	V08	Latent heating rate profile derived from 2A.GPM. DPR precipitation profile.	
1D.EC.AUX_JSG	EarthCARE	vCa	EarthCARE joint standard grid product (X-JSG).	✓
2A.EC.CPR_ECO	CPR	vCb	CPR one-sensor echo (radar reflectivity and Doppler velocity) product (JAXA L2).	✓
2A.EC.CPR_CLP	CPR	vCb	CPR one-sensor cloud (cloud mask, ice and liquid water content, terminal fall speed, and vertical air motion) product (JAXA L2).	✓
ECMWF.AUX-2D	ECMWF	vCa	Auxiliary ECMWF Meteorological analysis and forecast fields interpolated to X-JSG grid.	✓
2A.EC.ATL_CLA	ATLID	vCb	ATLID one-sensor cloud and aerosol product (JAXA L2).	
1C.EC.MSI_RGR	MSI	vCa	MSI radiance for visible (0.67um), near-infrared (0.865um), short wavelength infrared (1.65um, 2.21um), and thermal infrared (8.80um, 10.80um, 12.00um) band	
2A.EC.MSI_CLP	MSI	vCa	MSI one-sensor cloud product (JAXA L2).	
2B.EC.AC_CLP	CPR+ATLID	vCb	CPR+ATLID synergy cloud product (JAXA L2).	
2B.EC.ACM_CLP	CPR+ATLID+MSI	vBb	CPR+ATLID+MSI synergy cloud product (JAXA L2).	
2B.EC.ALL_RAD	CPR+ATLID+MSI+BBR	vBb	CPR+ATLID+MSI+BBR synergy radiation budget product (JAXA L2).	
2A.EC.CPR_CD	CPR	vBc	CPR one-sensor Doppler velocity product (ESA L2).	
2B.EC.ACM_CAP	CPR+ATLID+MSI	vBc	CPR+ATLID+MSI synergy cloud product (ESA L2).	
2B.EC.BMA_FLX	ATLID+MSI+BBR	vBc	ATLID+MSI+BBR radiative flux product (ESA L2).	

First, the EarthCARE AUX_JSG, and the GPM 1C-R.GPM.GMI and GPM 2A.GPM.DPR files are located that straddle the coincidence time (shaded rows in Table 1). Horizontal grid of the AUX_JSG is generated according to CPR footprint, and identical to horizontal grid of the EarthCARE products. In addition, its vertical coordinate aligned with ATLID. Owing to the orbitization of data from each spacecraft (GPM orbits begin at the southernmost latitude, and EarthCARE orbits are separated into 8 segments), these may cover more than one file. Since the AUX_JSG has finer along-track sampling (~ 1 -km) than the GPM radars (~ 5 -km), the GPM beam

locations are mapped to each EarthCARE profile location using a very simple nearest-neighbor approach to avoid any spatial or temporal resampling artifacts. For vertical bin matching, indices are provided to allow the user to map GPM radar levels to EarthCARE radar levels, or vice versa. In addition to the data from these files, other EarthCARE and GPM precipitation products (Table 1) are extracted for each EarthCARE position. These EarthCARE-mapped data are written into a single netCDF4 file, with data from each product contained in its own group (Section 5).

In Version 2 and later, EarthCARE-GPM coincidence dataset includes a number of products provided by the EarthCARE mission. To reduce the data volume for users interested only in CPR observations, two versions are provided: a **“light version” (V02)**, containing coincident curtains only for the products marked with a check mark (✓) in the (*) column of Table 1, and a **“full version” (F02)**, containing coincident curtains for all the products listed in the table.

2.1. Along-track segments.

The horizontal matching procedure is identical to CSATGPM product. In Figure 1, a short segment of overlapping GPM and EarthCARE data locations is depicted. For each EarthCARE X-JSG profile (latitude, longitude) location, the (along-track, across-track) coordinates of each 2A.GPM.DPR and 1C-R.GPM.GMI dataset sample are located, that are closest to this X-JSG location. As the EarthCARE track crosses over GPM, the GMI swath is intersected first (green locations), then the DPR swath (blue locations), then only the GMI swath again.

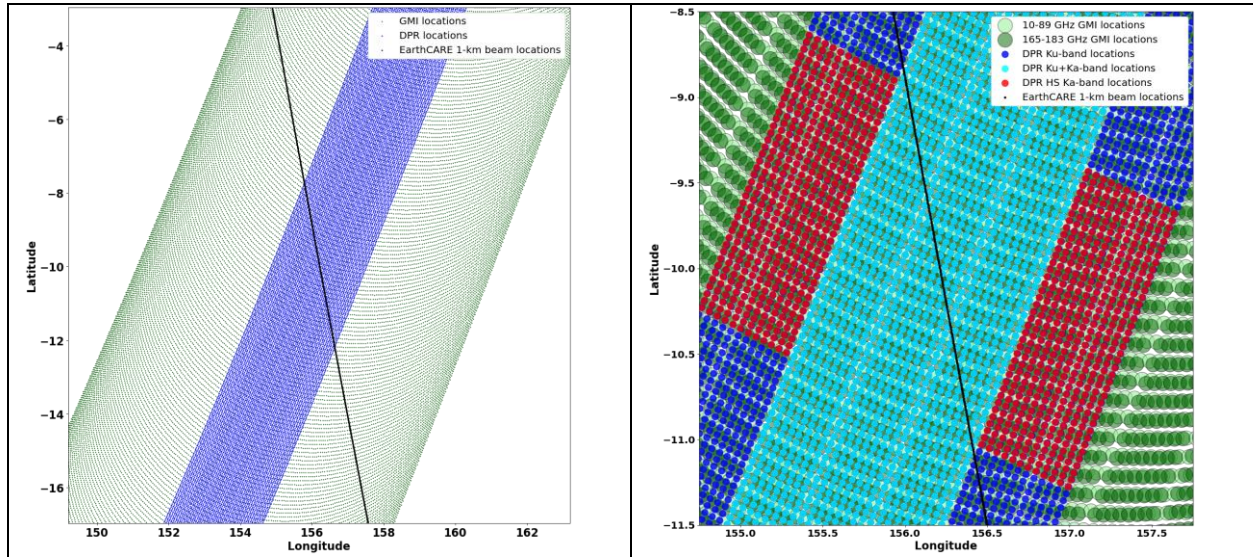


Figure 1. (Left) EarthCARE locations (black markers) overlaid on location of GMI (green) and DPR (blue). (Right) Enlarged view of the EarthCARE beam positions (black markers) overlaid on the GMI 10–89 GHz (light green), GMI 166–183 GHz (dark green), DPR Ku-only (dark blue), DPR Ku+Ka matched (light blue), and DPR high-sensitivity (HS) Ka-only (red) beam positions.

The GMI S2 (166-183 GHz) channels are gathered from feedhorns angled to provide a 49-degree Earth incidence angle. Therefore, the swath covered by these four channels is slightly narrower (and slightly offset) from the full S1 10-89 GHz channel locations (gathered from feedhorns that

provide a 53-degree incidence angle). The resampling of the S2 channels to their nearest S1 position is accommodated in the GMI 1C-R (resampled) dataset.

The DPR Ku-band radar samples at 49 locations across a normal scan (NS) 245-km swath. The DPR Ka-band also gathers 49 locations, but these are divided into two scan types. In the first type of scan (Ka-band matched scan, or MS), the beams are matched to the central 25 beams of the DPR Ku-band radar. This arrangement provided a DPR Ka-band swath coverage (125-km) covering approximately one-half of the Ku-band coverage (245-km). The 24 DPR Ka-band high sensitivity (HS) beam locations covered the outer portions of the swath not covered by the matched-scan Ka-band beams, thereby providing Ka-band coverage across the full 245-km swath. As seen from Figure 1, the HS beam positions are slightly offset, relative to the associated Ku-band location. In Version 7 and later DPR products, these three groups (NS, MS and HS) were renamed and made into two groups, full swath (FS) and HS.

The vertical coordinates provided by the individual products differ among satellites and products (Figure 2). For 2A.GPM.DPR, the vertical bins have a spacing of 125 m and cover altitudes from 0 to 22 km. For 2H.GPM.SLH, the vertical grid spacing is 250 m. For the EarthCARE products, the X-JSG vertical grid has a spacing of approximately 100 m from about -0.5 to 20 km altitude and a spacing of approximately 500 m between 20 and 40 km, with ~242 vertical bins in total. This grid is based on the ATLID vertical grid, and products such as 2A.EC.ATL_CLA and 2B.EC.ACM_CAP use the same vertical coordinate. In contrast, 2A.EC.CPR_ECO and 2A.EC.CPR_CD_ use the native CPR observation grid, with a vertical spacing of 100 m. The 2A.EC.CPR_CLP, 2A.EC.AC_CLP, and 2A.EC.ACM_CLP products use a different 100-m vertical grid extending from approximately -0.5 to 20 km, while 2B.EC.ALL_RAD uses a vertical grid with a spacing of 500 m.

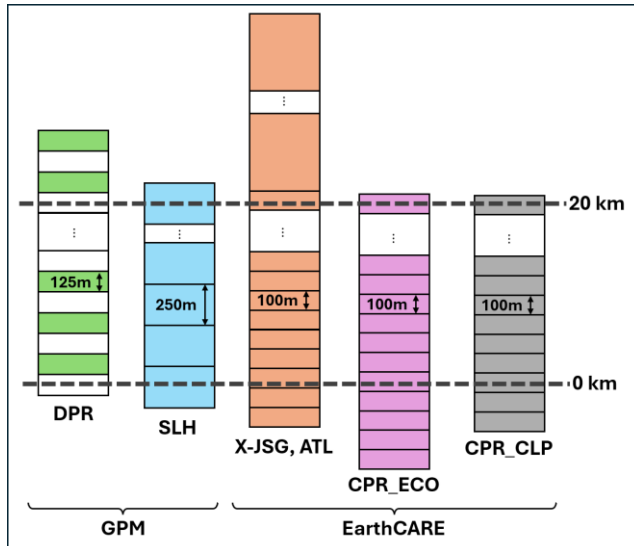


Figure 2. Depiction of nearest-neighbor bin matching. EarthCARE products are generally reported at a vertical bin spacing of approximately 100 m, whereas DPR observation are reported at a spacing of 125 m; however, the vertical grid spacing varies among products. The original vertical coordinates are retained without rebinning or interpolation, and bin-index variables are provided to identify mutually corresponding bins between the vertical grids using a nearest-neighbor approach.

In the ECAREGPM product, the curtain data are stored on the original vertical coordinates of the respective source products; no vertical rebinning or interpolation is applied. Instead, indices of corresponding vertical bins are stored as variables so that data on different vertical grids can be matched (*bin_dpr2ec* and *bin_ec2dpr*, stored in 2A.GPM.DPR group). The vertical matching is performed in two ways, depending on whether the user wishes to map the DPR bins onto the

EarthCARE vertical grid or the EarthCARE bins onto the DPR vertical grid. The matching is based on the height information provided in each source product. For DPR, the height variable in the FS/PRE group of 2A.GPM.DPR is used as the reference, whereas for EarthCARE, the height variable in X-JSG is used as the reference. The vertical axes of the individual products are then mapped onto the respective reference vertical coordinates using a nearest-neighbor approach, without modifying or averaging any values in the native dataset. In addition, each product group contains bin-index variables that relate its native vertical grid to the DPR and X-JSG reference grids. For example, CPR_ECO provides *bin_eco2ec* and *bin_eco2dpr*, which identify the corresponding bins in the X-JSG and DPR vertical coordinates, respectively.

2.2. Swath segments.

To provide the user some flexibility in mapping or depicting the precipitation in the region of the coincidence, a “swath” segment of selected variable from GMI, GPROF, DPR, SLH and MSI, are added to the end of each product group, along with the associated geolocation variables (discussed in Section 5). This swath segment covers the area encompassed by the EarthCARE coincidence curtain. With these swath data segments, users are able to display maps of TB imagery, or plot vertical radar cross sections away from the coincidence curtain.

3. File Format and Naming Details.

The output files are written in netCDF4 format. The file size averages approximately 150 MB for the full version and 50 MB for the light version, but varies with latitude. At the highest GPM latitudes, the GPM radar scans more in a N-S direction, so the coincidence distance segment is shorter than it is near the equator. For EarthCARE, which does not scan, the along-track dimension is referred to as a *beam*. For DPR, the along-track and across-track dimensions are referred to as a *scan* and *ray*, respectively. For GMI, the along-track and across-track dimensions are referred to as a *scan* and *pixel*, respectively, and each radiometer frequency is referred to as a *channel*. This maintains common dimension names. The file names are chosen to be consistent with existing PPS standards. An example name for light version is:

2B.ECAREGPM.COIN.COIN2026.20250205-S153627-E154051.062114.V02.nc4

The fifth field carries the start and end times of the GPM data that encompass the coincidence segment (**20250205-S153627-E154051**), the sixth field is the starting GPM orbit revolution number (**062114**), and the fourth field provides the name of the coincidence algorithm (**COIN2026**). Data from each GPM and EarthCARE data product (Table 1) are contained in its own group in the coincidence file. Details on the contents of each of these groups are provided in Section 5.

4. Associated Quick-Look Imagery.

For each output datafile, an associated image is created, showing depictions of the radar vertical profiles and the GMI TB. These have the same name as the datafiles, but with a “**prof.png**” in

place of “nc4”, respectively. These images are intended for quick visual inspection of the precipitation conditions during the coincidence time. They depict the GMI TB segment, the EarthCARE reflectivity vertical segment, and the DPR-Ku and DPR-Ka reflectivity vertical segments. The EarthCARE ground track is shown overlaid on top of two GMI channels, mapped onto a polarstereo grid centered at the coincidence location.

An example is provided in Figure 3. In this example, the EarthCARE-GMI coincidence occurs with a 60 second time offset (i.e., the start of the GPM data occurred 60 seconds after the start of the EarthCARE data). EarthCARE data occur between 153627-154051 UTC on 5 February 2025, covering tropical organized convective cloud system in western Pacific. The EarthCARE-GMI intersection curtain is of length 1846; that is extends across 1846 EarthCARE profiles ($nbeam=1846$).

Using the GMI data contained in the swath segment (Section 2.2), the left side of the image displays the GMI 18.7H and 166H GHz channels for the GMI swath segment that covers the extent of this EarthCARE track intersection, mapped onto a polarstereo grid centered at the orbit intersection location ($center_lat, center_lon$) (Section 5). The EarthCARE track is drawn with 10 ~equally spaced markers along the track (0, 180, 360, 540,...1620), so that the vertical structure can be identified from the EarthCARE and DPR profiles on the right side. The two solid lines show the (more limited) segment covered by the DPR Ku-band swath during this coincidence.

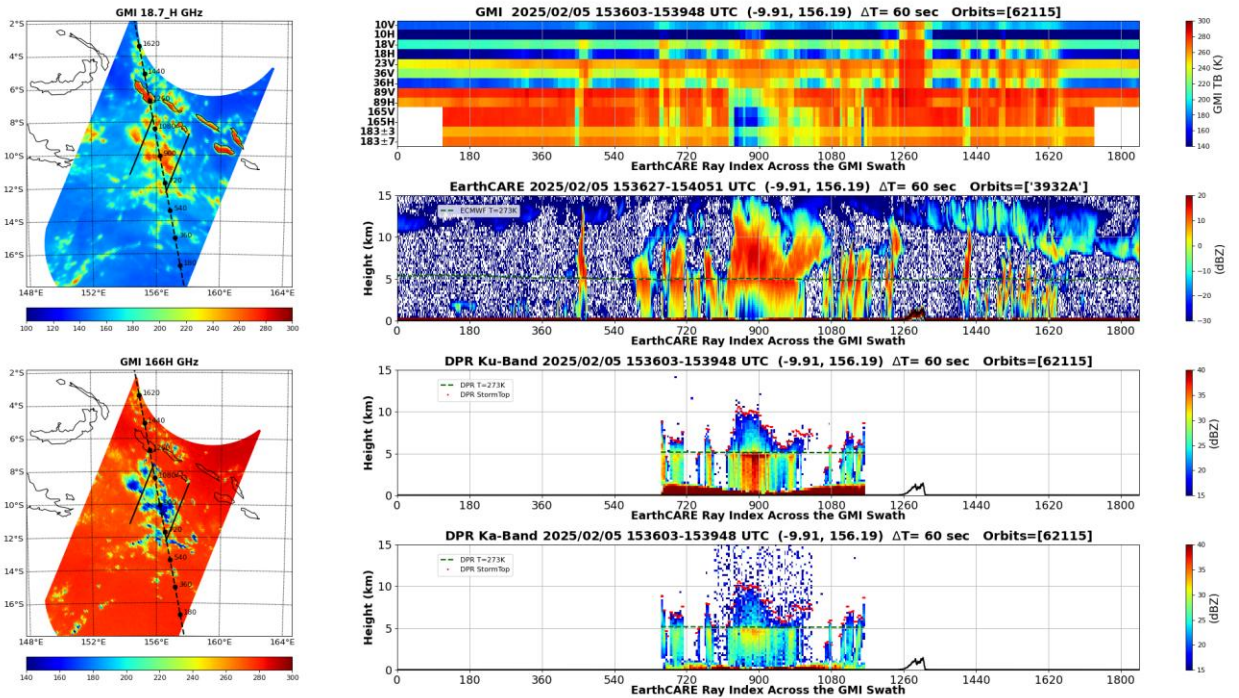


Figure 3. Example quick-look GMI TB, and EarthCARE and DPR profile imagery, for the EarthCARE and GPM coincidence that occurred for EarthCARE between 153627-154051 UTC on 5 February 2025. Each EarthCARE beam is about 1-km apart (x-axis of profiles). The digital elevation map (DEM) used by the EarthCARE and GPM data are shown as a heavy black line near the surface (more evident for the over-land cases that are over terrain). The zero-degree isotherm line is shown as a green dashed line (labeled “T=273K”). The color scale on the right indicates TB Kelvin units (blue=cold, red=warm), and equivalent radar reflectivity factor (dB) for the four radar profiles.

The right side of the image has four rows. The top row displays the trace of the GMI TB along this same coincidence curtain (i.e., at the same 1846 locations, first row) is shown above EarthCARE, for the 13 GMI channels (Table 2).

Below this, is the EarthCARE 94 GHz reflectivity profile (the *integrated radar reflectivity_1km* variable in the 2A.EC.CPR_ECO group) profile (second row) between 153627-154051 UTC on 5 February 2025, occurring along the southernmost tip of South America. The dashed green line indicates the height of the freezing level (~ 5 -km) from the associated ECMWF.AUX-2D product.

The third and fourth rows show the associated DPR Ku- and Ka-band radar reflectivity profiles from the *zFactorMeasured* variable in the 2A.GPM.DPR group (Section 5). The dashed green line indicates the height of the freezing level from the 2A.GPM.DPR variable *FS/VER/heightZeroDeg*. These DPR data occur between 193327-193913 UTC. As a consequence of the more limited DPR swath relative to GMI, the DPR profiles extend across a shorter distance in the middle of the coincidence segment. As has been shown previously, the DPR captures a more limited depiction of the rain structure.

The EarthCARE CPR is the world's first spaceborne Doppler radar and provides vertical Doppler velocity measurements. The measured Doppler velocity represents the sum of the cloud-particle terminal fall velocity and the vertical air motion. Figures 4 and 5 show examples of EarthCARE–GPM coincidence events for rainfall and snowfall cases, respectively.

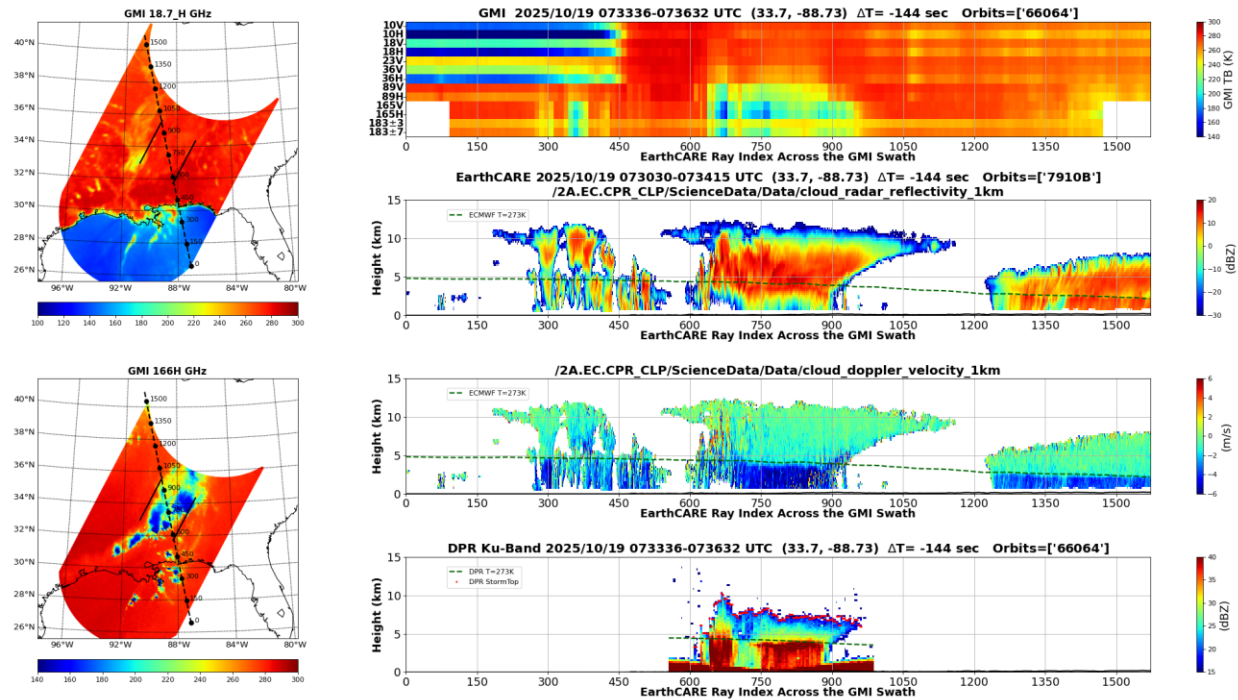


Figure 4. Example of an EarthCARE–GPM coincidence during a rainfall event observed by EarthCARE from 07:30:30 to 07:34:15 UTC on 19 October 2025. EarthCARE CPR Doppler velocity profiles (downward negative) are shown together with the corresponding radar reflectivity profiles and GMI Tb.

In the rainfall case shown in Figure 4, a clear difference in Doppler velocity is observed across the 0°C level. Above this level, relatively slow fall velocities of approximately 0–1 m s⁻¹ are associated with snow and ice particles, whereas below it, faster fall velocities of approximately 5 m s⁻¹ are associated with rain. Near the convective core at a ray index of approximately 600, the Doppler velocity exhibits an overturning pattern, with both upward and downward velocities. This pattern may indicate intense updrafts and downdrafts, turbulence, and a mixture of densely distributed particles spanning a wide range of sizes.

In contrast, the snowfall case shown in Figure 5 exhibits Doppler velocities corresponding to the slow fall speeds of snow and ice particles, approximately 0–1 m s⁻¹. A closer examination reveals small-scale variations between upward and downward velocities. These variations may be related to updrafts and downdrafts within individual cloud cells, as well as to differences in the growth stage of the snow particles.

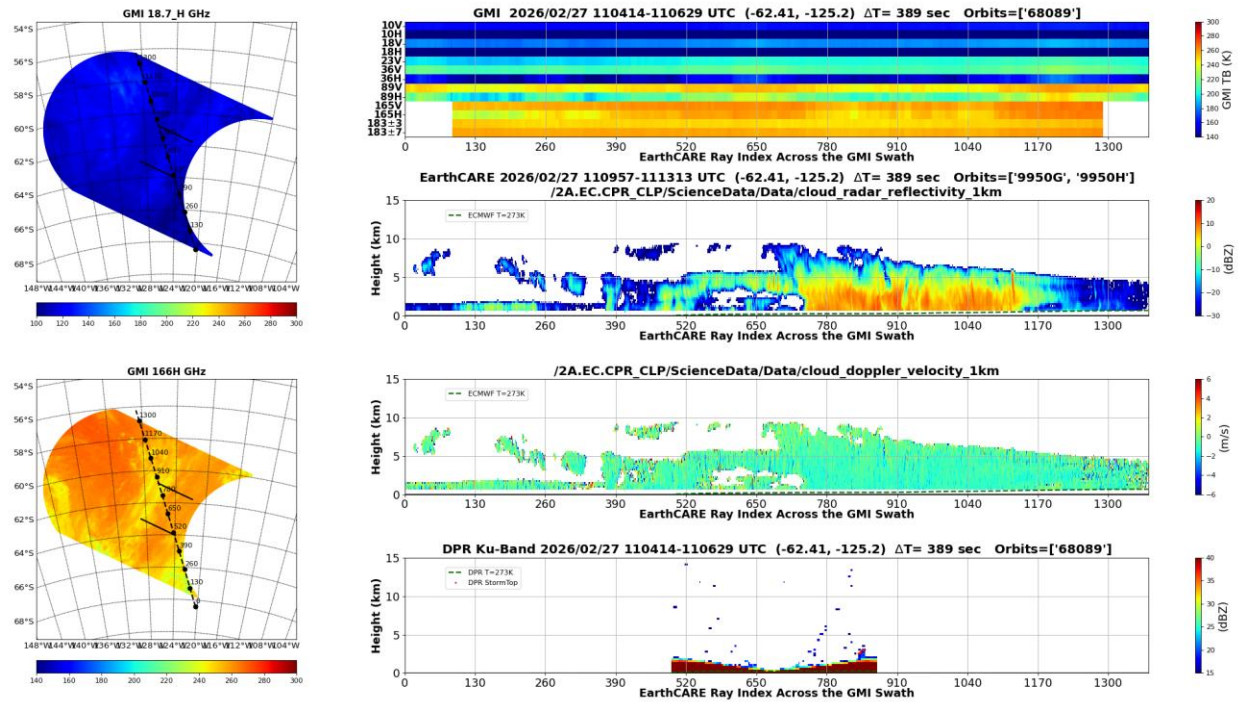


Figure 5. Example of an EarthCARE–GPM coincidence during a snowfall event observed by EarthCARE from 11:09:57 to 11:13:13 UTC on 27 February 2026. EarthCARE CPR Doppler velocity profiles (downward negative) are shown together with the corresponding radar reflectivity profiles and GMI Tb.

5. Description of File Contents.

The variables in each group maintain the same name, units, scale, offset and type as the native dataset that they were extracted from. Therefore, for further description the user can refer to the original algorithm product description documents or algorithm theoretical basis documents (ATBD):

Description of EarthCARE-related data products released by JAXA:
https://www.eorc.jaxa.jp/EARTHCARE/data/L2prd_list_std_e.html

Description of EarthCARE-related data products released by ESA:
<https://earthcarehandbook.earth.esa.int/>

Description of GPM-related data products:
<https://gpm.nasa.gov/science/precipitation-algorithms>

The output files are written in netCDF4 format. Depending upon the distance of the coincidence segment, the files range in size between 30-100 MB for light version (V02) and between 100-400 MB for full version (F02). For EarthCARE, which does not scan, the along-track dimension is referred to as a *beam*. For DPR, the along-track and across-track dimensions are referred to as a *scan* and *ray*, respectively. For GMI, the along-track and across-track dimensions are referred to as a *scan* and *pixel*, respectively, and each radiometer frequency is referred to as a *channel*. This maintains common dimension names.

Each file has a set of global attributes and a collection of groups, where the name of each group corresponds to the Dataset name in Table 1. Running a “ncdump -h” command on a file will list all groups, and every variable contained in the group.

5.1. Global attributes

Each netCDF4 file contains several global attributes, providing the *center_date*, *center_lat*, *center_lon* and *EC_minus_GPM_timediff* (seconds) at the coincidence cross-over point, determined from the actual data. For reference, the predicted latitudes, longitudes and dates from each of GPM and EarthCARE are also provided, that were determined by the orbital tracking (Section 2). For example:

```
// global attributes:
:center_date_GPM = "2025/02/05 15:37:37" ;
:center_lat = -9.90814315863554 ;
:center_lon = 156.194205199316 ;
:center_date_ECARE = "2025/02/05 15:38:38" ;
:EC_minus_GPM_timediff = 60LL ;
:predicted_lat_GPM = -9.962 ;
:predicted_lon_GPM = 156.195 ;
:predicted_date_GPM = "2025/02/05 15:37:37" ;
:predicted_lat_ECARE = -9.936 ;
:predicted_lon_ECARE = 156.199 ;
:predicted_date_ECARE = "2025/02/05 15:38:33" ;
:predicted_EC_minus_GPM_timediff = 56LL ;
:start_date = "2025/02/05 15:36:27" ;
:end_date = "2025/02/05 15:40:51" ;
:description = "EarthCARE+GPM coincidence dataset" ;
:algorithm_name = "COIN2026" ;
:version = "2.0" ;
:production_date = "2026/10/06 07:39:06" ;
:production_source = "Shunsuke Aoki, JAXA/EORC" ;
```

5.2. EarthCARE-related groups

The V02 dataset includes AUX_JSG, CPR_ECO, CPR_CLP, and AUX-2D products.

- 1D.AUX_JSG (X-JSG) provides the Joint Standard Grid (JSG), a common grid for integrating observations from multiple EarthCARE sensors. It contains coordinate information such as latitude, longitude, altitude, and time.
- 2A.CPR_ECO is a product that applies corrections to radar reflectivity and Doppler velocity and includes quality controlling. It contains raw, uncorrected values and provides precise observation altitudes within 100 m, making it useful when such detailed information is needed.
- 2A.CPR_CLP is a one-sensor cloud product from CPR, offering cloud mask, radar reflectivity, and Doppler velocity, as well as additional variables such as ice and liquid water content, terminal fall speed, and vertical air motion. For analysis purposes, CPR_CLP is recommended as a first choice, since it incorporates the corrections made in CPR_ECO and is therefore easier to handle.
- ECMWF.AUX-2D provides auxiliary data such as temperature, pressure, and specific humidity from ECMWF forecasts.

In addition, full version of the dataset (F02) includes additional EarthCARE products.

- 2A.ATL_CLA is a one-sensor cloud and aerosol product from ATLID. It provides feature and target masks, as well as vertical profiles of extinction coefficient, backscatter coefficient, depolarization ratio, and lidar ratio for clouds and aerosols.
- 1C.MSI_RGR provides MSI observations regridded to a common spatial grid so that all seven channels are aligned. It contains radiances in the solar channels and brightness temperatures in the thermal infrared channels, making it useful for multispectral analysis and cloud and aerosol retrievals.
- 2A.MSI_CLP is a one-sensor cloud product from MSI, providing cloud detection and cloud properties across the MSI swath. It includes cloud optical thickness, effective particle radius, and cloud-top temperature, pressure, and height, making it useful for examining the horizontal distribution of clouds.
- 2B.AC_CLP is a synergistic cloud product combining CPR and ATLID observations. It provides cloud masks, cloud particle types, liquid and ice water content, effective particle radius, and cloud optical thickness. It also includes terminal fall speed and vertical air motion, allowing cloud microphysical properties and motion to be examined together.
- 2B.ACM_CLP is a synergistic cloud product combining CPR, ATLID, and MSI observations. It provides similar variables retrieved in AC_CLP. The inclusion of MSI observations provides additional constraints on cloud properties retrieved from radar and lidar measurements.
- 2B.ALL_RAD is a radiation budget product that uses retrieved cloud and aerosol properties to calculate shortwave and longwave radiative fluxes and vertical profiles of radiative heating

rates. These calculations are based on one-dimensional radiative transfer simulations, making the product useful for examining the radiative effects of clouds and aerosols.

- 2A.CPR_CD_ is an ESA Doppler velocity product from CPR. It provides quality-controlled Doppler velocities through processing that addresses effects such as antenna mispointing, non-uniform beam filling, and velocity folding. Its JAXA counterpart is CPR_ECO.
- 2B.ACM_CAP is an ESA synergistic cloud, aerosol, and precipitation product combining CPR, ATLID, and MSI observations. It uses a unified variational retrieval to estimate their physical properties and associated uncertainties, allowing clouds, aerosols, and precipitation to be examined within a consistent retrieval framework. The corresponding JAXA cloud product is ACM_CLP.
- 2B.BMA_FLX is an ESA product providing top-of-atmosphere shortwave and longwave radiative fluxes derived from BBR radiance measurements, with additional information from MSI and ATLID. It converts directional radiances into radiative fluxes and combines estimates from the three BBR viewing directions, making it useful for evaluating Earth's radiation budget and comparing observation-based flux estimates with radiative transfer calculations.

The first data group reported contains all variables from EarthCARE AUX_JSG. The dimension **nbeam** provides the number of EarthCARE beams that are contained in this coincidence curtain, and **nbin_ec** provides the number of EarthCARE bins ($nbin_ec \sim 242$). For reference, the added variables *beam_index*, *beam_orbit*, and *beam_frame* provides the beam index number from the original AUX_JSG dataset, and the EarthCARE orbit revolution number and frame number associated with each of these beams.

```
group: \1D.EC.AUX_JSG {
  dimensions:
    nbeam = 1846 ;
    nbin_ec = 242 ;
    across_track = 207 ;
    num_lidar_profile_time = 5 ;
    num_radar_profile_time = 2 ;
    nbin_dpr = 176 ;
  variables:
    int Beam_index(nbeam) ;
      Beam_index:FillValue = -2147483647 ;
      Beam_index:longname = "EarthCARE AUX_JSG Beam index" ;
    int Beam_orbit(nbeam) ;
      Beam_orbit:FillValue = -2147483647 ;
      Beam_orbit:longname = "EarthCARE orbit revolution number that corresponds to the
EarthCARE AUX_JSG Beam index" ;
    int Beam_frame(nbeam) ;
      Beam_frame:FillValue = -2147483647 ;
      Beam_frame:longname = "EarthCARE frame revolution number (A-H)-->(0-7)" ;
    int64 bin_ec2dpr(nbeam, nbin_dpr) ;
      bin_ec2dpr:FillValue = -9999LL ;
      bin_ec2dpr:valid_min = 0LL ;
      bin_ec2dpr:valid_max = 241LL ;
      bin_ec2dpr:longname = "bin number from the 1D.EC.AUX_JSG profile that matched with
the 2A.GPM.DPR bin height" ;
    float bin_height_ec2dpr(nbeam, nbin_dpr) ;
      bin_height_ec2dpr:FillValue = -9999.f ;
      bin_height_ec2dpr:units = "m" ;
      bin_height_ec2dpr:longname = "1D.EC.AUX_JSG bin height matched with the 2A.GPM.DPR
bin height" ;
```

```
// group attributes:
      :satname = "EarthCARE" ;
      :sensor = "AUX" ;
      :files_used = "ECA_E_AUX_JSG_1DS_20250205T1535_20250205T1546_03932A_vBa.h5" ;
      :description = "Variables from 1D.EC.AUX_JSG, subsetted along the coincidence
curtain" ;
```

The 2A.EC.CPR_ECO group contains all variables from the original CPR_ECO. AUX_JSG group, the dimension **nbeam** provides the number of EarthCARE beams that are contained in this coincidence curtain. The additional variables *beam_index*, *beam_orbit*, and *beam_frame* provide, respectively, the beam index number from the original CPR_ECO dataset, and the EarthCARE orbit revolution number and frame number associated with each beam. For the vertical dimension, **nbin_CPR_ECO** specifies the number of bins on the native CPR_ECO vertical grid ($nbin_CPR_ECO = 218$). Mapping indices are provided, allowing users to map the CPR_ECO vertical bins onto the EarthCARE X-JSG bins or the DPR bins. The variable *bin_eco2ec* provides the CPR_ECO bin index corresponding to each X-JSG bin, while *bin_height_eco2ec* provides the associated height of the CPR_ECO bin. On the other hand, *bin_eco2dpr* provides the CPR_ECO bin index corresponding to each DPR bin, while *bin_height_eco2dpr* provides the associated height of the CPR_ECO bin.

```
group: \2A.EC.CPR_ECO {
  dimensions:
    nbeam = 1846 ;
    nbin_CPR_ECO = 218 ;
    num_surface_elevation_10km = 3 ;
    nbin_dpr = 176 ;
    nbin_ec = 242 ;
  variables:
    int Beam_index(nbeam) ;
      Beam_index: FillValue = -2147483647 ;
      Beam_index: longname = "EarthCARE CPR_ECO Beam index" ;
    int Beam_orbit(nbeam) ;
      Beam_orbit: FillValue = -2147483647 ;
      Beam_orbit: longname = "EarthCARE orbit revolution number that corresponds to the
EarthCARE CPR_ECO Beam index" ;
    int Beam_frame(nbeam) ;
      Beam_frame: FillValue = -2147483647 ;
      Beam_frame: longname = "EarthCARE frame revolution number (A-H)-->(0-7)" ;
    int64 bin_eco2dpr(nbeam, nbin_dpr) ;
      bin_eco2dpr: FillValue = -9999LL ;
      bin_eco2dpr: valid_min = 0LL ;
      bin_eco2dpr: valid_max = 217LL ;
      bin_eco2dpr: longname = "bin number from the 2A.EC.CPR_ECO profile that matched with
the 2A.GPM.DPR bin height" ;
    float bin_height_eco2dpr(nbeam, nbin_dpr) ;
      bin_height_eco2dpr: units = "m" ;
      bin_height_eco2dpr: FillValue = -9999.f ;
      bin_height_eco2dpr: longname = "2A.EC.CPR_ECO bin height matched with the 2A.GPM.DPR
bin height" ;
    int64 bin_eco2ec(nbeam, nbin_ec) ;
      bin_eco2ec: FillValue = -9999LL ;
      bin_eco2ec: valid_min = 0LL ;
      bin_eco2ec: valid_max = 217LL ;
      bin_eco2ec: longname = "bin number from the 2A.EC.CPR_ECO profile that matched with
the EarthCARE bin height" ;
    float bin_height_eco2ec(nbeam, nbin_ec) ;
      bin_height_eco2ec: FillValue = -9999.f ;
      bin_height_eco2ec: units = "m" ;
      bin_height_eco2ec: longname = "2A.EC.CPR_ECO bin height matched with the EarthCARE
bin height" ;
```

```
// group attributes:
: satname = "EarthCARE" ;
: sensor = "CPR" ;
: files_used = "ECA_J_CPR_ECO_2AS_20250205T1535_20250205T1546_03932A_vCc.h5" ;
: description = "Variables from EarthCARE CPR_ECO, subsetting along the coincidence
curtain" ;
```

All variables from CPR_ECO are then provided for each of these **nbeam** locations. Variables of interest are *integrated_radar_reflectivity_1/10km*, *unfolded_doppler_velocity_1/10km_bias_corr*, and *bin_height*.

This CPR_ECO group is then followed by additional EarthCARE groups each containing all variables from the EarthCARE data products provided in Table 1. All of these data products are mapped to the same EarthCARE locations (i.e., have the same **nbeam** value).

Note that not all data products are always available, and as a consequence many files will have missing groups for missing data products. This can be accommodated by first checking if the desired group exists.

5.3. GPM-related groups

The last four groups contain the matched variables from 1C-R.GPM.GMI, 2A.GPM.GPROF, 2A.GPM.DPR and 2B.GPM.DPRGMI. The data from these GPM products are also mapped to the same EarthCARE locations (i.e., have the same **nbeam** value).

5.3.1. 1C-R.GPM.GMI group

This group contains the GMI intercalibrated TB product variables associated with the 1C-R.GPM.GMI files used, which is explained in the official [ATBD](#) for this data product.

For 1C-R.GPM.GMI, the variable *scan_indices* points to the GMI scan line and pixel locations from the 1C-R.GPM.GMI file listed in the group attributes. The *time_diff* and *distance_diff* provide the time separation and spatial offset between the EarthCARE beam location and the GMI coordinates, respectively. While this dataset processing is driven by maximum ± 15 -minute time coincidences between the GPM- EarthCARE ground tracks, the pixel-to-pixel time separation *time_diff* can sometimes be several minutes larger than this, depending upon the orbital direction of each satellite. As shown in Figure 1, *distance_diff* will oscillate between ~ 0.5 -5 km as the EarthCARE locations move across the GMI scanning pattern. Owing to the coarser GMI sampling spacing, the same GMI pixel is repeated ~ 5 times.

```
group: \1C-R.GPM.GMI {
  dimensions:
    nbeam = 1846 ;
    nchannel = 13 ;
    scan_pixel = 2 ;
  variables:
    int scan_indices(nbeam, scan_pixel) ;
    scan_indices:_FillValue = -9999 ;
```

```

        scan_indices:longname = "GMI scan line and pixel indices that corresponds to the
EarthCARE beam index" ;
        int scan_orbit(nbeam) ;
        scan_orbit:_FillValue = -9999 ;
        scan_orbit:longname = "GPM orbit revolution that corresponds to the EarthCARE beam
index" ;
        int time_diff(nbeam) ;
        time_diff:_FillValue = -9999 ;
        time_diff:units = "seconds" ;
        time_diff:longname = "GMI-minus-EarthCARE time difference" ;
        float distance_diff(nbeam) ;
        distance_diff:_FillValue = -9999.f ;
        distance_diff:units = "km" ;
        distance_diff:longname = "GMI-EarthCARE distance difference" ;
        double scan_time(nbeam) ;
        scan_time:_FillValue = -9999. ;
        scan_time:units = "seconds" ;
        scan_time:longname = "seconds since 1 Jan 1970" ;

// group attributes:
:satname = "GPM" ;
:sensor = "GMI" ;
:files_used = "1C-R.GPM.GMI.XCAL2016-C.20250205-S151707-E165022.062115.V08A.nc" ;
:orbits_used = 62115 ;
:description = "variables from the 1C-R.GPM.GMI dataset, along the coincidence
curtain" ;

```

This is followed by the **S1** group which contains all variables for the GPM 1C-R files listed in the group attributes above. In most cases there is only one 1C-R file needed, but depending upon the southernmost latitudes of GPM, two files may be concatenated to accommodate the coincidence segment. For most users, the variables of interest are *Quality*, *incidenceAngle* and *Tc*.

The 1C-R.GPM.GMI group closes with an additional group called **SWATH**. This provides a small subset of the *Tc* swath encompassing the area of the coincidence curtain. In this group, three variables are provided, namely *Latitude*, *Longitude* and *Tc*.

```

group: SWATH {
  dimensions:
    nscan = 125 ;
    npixel = 221 ;
    nchannel = 13 ;
  variables:
    float Latitude(nscan, npixel) ;
    Latitude:_FillValue = -9999.9f ;
    Latitude:longname = "latitude of S1 channels" ;
    Latitude:units = "degrees" ;
    float Longitude(nscan, npixel) ;
    Longitude:_FillValue = -9999.9f ;
    Longitude:longname = "longitude of S1 channels" ;
    Longitude:units = "degrees" ;
    float Tc(nscan, npixel, nchannel) ;
    Tc:_FillValue = -9999.9f ;
    Tc:longname = "brightness temperature channels (10-89 GHz) from the 1C-R S1 group,
channels (166 and 183 GHz) from the 1C-R S2 group" ;
    string Tc:channel_order = "10.65_V", "10.65_H", "18.7_V", "18.7_H", "23.8_V",
"36.5_V", "36.5_H", "89.0_V", "89.0_H", "166V", "166H", "183.31+/-3", "183.31+/-7" ;
    Tc:units = "K" ;

    // group attributes:
    :description = "selected full-swath variables from S1 groups, that encompass the
coincidence curtain. S2 variables are merged into the S1 swath." ;
  } // group SWATH
} // group S1
} // group \1C-R.GPM.GMI

```

5.3.2. 2A.GPM.GMI.GPROF

This group contains the GPROF precipitation product variables that were derived from the 1C-R.GPM.GMI files used, and which is explained in the official [ATBD](#) for this data product. The layout of the main group is similar to the content in the 1C-R.GPM.GMI main group:

```
group: \2A.GPM.GMI.GPROF {
  dimensions:
    nbeam = 1846 ;
    scan_pixel = 2 ;
    nscan = 125 ;
    npixel = 221 ;
    nlyrs = 28 ;
  variables:
    int scan_indices(nbeam, scan_pixel) ;
        scan_indices:longname = "GMI scan line and sample indices" ;
        scan_indices:_FillValue = -9999 ;
    int scan_orbit(nbeam) ;
        scan_orbit:_FillValue = -9999 ;
        scan_orbit:longname = "GPM orbit revolution number that corresponds to the EarthCARE
beam index" ;
    int time_diff(nbeam) ;
        time_diff:_FillValue = -9999 ;
        time_diff:units = "seconds" ;
        time_diff:longname = "GMI-minus-EarthCARE time difference" ;
    float distance_diff(nbeam) ;
        distance_diff:_FillValue = -9999.f ;
        distance_diff:units = "km" ;
        distance_diff:longname = "GMI-EarthCARE distance difference" ;
    double scan_time(nbeam) ;
        scan_time:_FillValue = -9999. ;
        scan_time:units = "seconds" ;
        scan_time:longname = "seconds since 1 Jan 1970" ;

    // group attributes:
        :satname = "GPM" ;
        :sensor = "GMI" ;
        :files_used = "2A.GPM.GMI.GPROFNv1.20250205-S151707-E165022.062115.V08A.nc" ;
        :description = "variables from the 2A.GPM.GMI.GPROF dataset, along the coincidence
curtain" ;
```

Variables of interest are *qualityFlag*, *pixelStatus*, *surfaceTypeIndex* and *surfacePrecipitation*. The 2A.GPM.GMI.GPROF group closes out with a “SWATH” group containing *Latitude*, *Longitude* and *surfacePrecipitation* that encompasses the coincidence curtain, allowing users to plot or analyze the precipitation horizontal pattern.

```
group: SWATH {
  dimensions:
    nscan = 125 ;
    npixel = 221 ;
  variables:
    float Latitude(nscan, npixel) ;
        Latitude:_FillValue = -9999.9f ;
        Latitude:units = "degrees" ;
    float Longitude(nscan, npixel) ;
        Longitude:_FillValue = -9999.9f ;
        Longitude:units = "degrees" ;
    float surfacePrecipitation(nscan, npixel) ;
        surfacePrecipitation:_FillValue = -9999.9f ;
        surfacePrecipitation:units = "mm/hr" ;
```

```

// group attributes:
      :description = "selected full-swath variables from S1 groups, that encompass the
coincidence curtain" ;
    } // group SWATH
  } // group S1
} // group \2A.GPM.GMI.GPROF

```

5.3.3. 2A.GPM.DPR

This group contains the DPR precipitation product variables associated with the 2A.GPM.DPR files used, which is explained in the official [ATBD](#) for this data product.

The variable *scan_indices* points to the DPR scan and ray locations from the 2A.GPM.DPR file listed in the group attributes. The variable *scan_indices* points to the DPR scan and ray locations from the 2A.GPM.DPR file listed in the group attributes. The *time_diff* and *distance_diff* provide the time separation and spatial offset between the EarthCARE beam location and the DPR coordinates, respectively. While this dataset processing is driven by maximum ± 15 -minute time coincidences between the GPM-EarthCARE ground tracks, the pixel-to-pixel time separation *time_diff* can sometimes be several minutes larger than this, depending upon the orbital direction of each satellite. As shown in Figure 1, *distance_diff* will oscillate between ~ 0.5 -5 km as the EarthCARE locations move across the DPR scanning pattern. Owing to the coarser DPR sampling spacing, the same DPR pixel is repeated ~ 5 times.

```

group: \2A.GPM.DPR {
  dimensions:
    nbeam = 1846 ;
    nbin_ec = 242 ;
    scan_ray = 2 ;
    nbin = 176 ;
    nscan = 87 ;
    nray = 49 ;
    nfreqHI = 3 ;
    nNode = 5 ;
    nbinSZP = 7 ;
    nfreq = 2 ;
    nDSD = 2 ;
    nNUBF = 3 ;
    LS = 2 ;
    method = 6 ;
    three = 3 ;
    foreBack = 2 ;
    nearFar = 2 ;
    nsdew = 3 ;
    four = 4 ;
    nNP = 4 ;
    XYZ = 3 ;
  variables:
    int scan_indices(nbeam, scan_ray) ;
      scan_indices:_FillValue = -9999 ;
      scan_indices:longname = "scan and ray indices" ;
    int scan_orbit(nbeam) ;
      scan_orbit:_FillValue = -9999 ;
      scan_orbit:longname = "GPM orbit revolution number that corresponds to the EarthCARE
beam index" ;
    int time_diff(nbeam) ;
      time_diff:_FillValue = -9999 ;
      time_diff:units = "seconds" ;
      time_diff:longname = "DPR-minus-EarthCARE time difference" ;

```

```

float distance_diff(nbeam) ;
    distance_diff:FillValue = -9999.f ;
    distance_diff:units = "km" ;
    distance_diff:longname = "DPR-EarthCARE distance difference" ;
double scan_time(nbeam) ;
    scan_time:FillValue = -9999. ;
    scan_time:longname = "number of seconds since 1 Jan 1970" ;
    scan_time:units = "seconds" ;
float bin_height_dpr2ec(nbeam, nbin_ec) ;
    bin_height_dpr2ec:FillValue = -9999.f ;
    bin_height_dpr2ec:units = "m" ;
    bin_height_dpr2ec:longname = "DPR bin height above the reference surface matched
with the EarthCARE bin height" ;
short bin_dpr2ec(nbeam, nbin_ec) ;
    bin_dpr2ec:FillValue = -9999s ;
    bin_dpr2ec:longname = "bin number from the DPR profile that matched with the
EarthCARE bin height" ;
    bin_dpr2ec:valid_min = 0s ;
    bin_dpr2ec:valid_max = 175s ;
float bin_height_ec2dpr(nbeam, nbin) ;
    bin_height_ec2dpr:FillValue = -9999.f ;
    bin_height_ec2dpr:units = "m" ;
    bin_height_ec2dpr:longname = "EarthCARE bin height above the reference surface
matched with the DPR bin height" ;
short bin_ec2dpr(nbeam, nbin) ;
    bin_ec2dpr:FillValue = -9999s ;
    bin_ec2dpr:longname = "bin number from the EarthCARE profile that matched with the
DPR bin height" ;
    bin_ec2dpr:valid_min = 0s ;
    bin_ec2dpr:valid_max = 241s ;

// group attributes:
:files_used = "2A.GPM.DPR.V10-20260310.20250205-S151707-E165022.062115.V08A.nc" ;
:description = "variables from the 2A.GPM.DPR dataset" ;
:satname = "GPM" ;
:sensor = "DPR" ;

```

In this coincidence dataset, all EarthCARE and DPR profiles are each provided at their full vertical levels (*nbin*= 176 for DPR, *nbin_ec*= 242 for EarthCARE). Mapping indices are provided for users who prefer to map DPR to EarthCARE, and vice versa. The variable *bin_dpr* provide the DPR bin indices to map DPR to the 242 bins of the EarthCARE profile. *bin_height_dpr* provides the associated height of the DPR bin. Conversely, the variable *bin_ec* provide EarthCARE bin indices to map EarthCARE to the 176 bins of the DPR profile. *bin_height_ec* provides the associated height of the EarthCARE bin.

The variables in this group are written in the same sub-group hierarchy (FS main group, followed by various sub-groups) as the 2A.GPM.DPR files used (see the [ATBD](#) for this product for the group structure). Variables of interest are the Ku- and Ka-band reflectivity factors contained in the preprocessing module FS/PRE/*zFactorMeasured*, and the near-surface precipitation rate in the solver module FS/SLV/*precipRate*.

The 2A.GPM.DPR FS group closes out with a “**SWATH**” group containing *Latitude*, *Longitude*, *height*, *zFactorMeasured*, *typePrecip*, *precipitationRateESurface*, and *precipitationRate* that encompasses the coincidence curtain. From this, the reflectivity and precipitation rate profiles can be depicted in the region surrounding the coincidence curtain.

```

group: SWATH {
    dimensions:
        nscan = 87 ;

```

```

nray = 49 ;
nbin = 176 ;
nfreq = 2 ;
variables:
  float Latitude(nscan, nray) ;
    Latitude:_FillValue = -9999.9f ;
    Latitude:units = "degrees" ;
  float Longitude(nscan, nray) ;
    Longitude:_FillValue = -9999.9f ;
    Longitude:units = "degrees" ;
  short height(nscan, nray, nbin) ;
    height:_FillValue = -9999s ;
    height:units = "m" ;
  float zFactorMeasured(nscan, nray, nbin, nfreq) ;
    zFactorMeasured:units = "dBZ" ;
    zFactorMeasured:_FillValue = -9999.9f ;
  int typePrecip(nscan, nray) ;
    typePrecip:_FillValue = -9999 ;
  float precipRateESurface(nscan, nray) ;
    precipRateESurface:_FillValue = -9999.9f ;
    precipRateESurface:units = "mm/hr" ;
  float precipRate(nscan, nray, nbin) ;
    precipRate:_FillValue = -9999.9f ;
    precipRate:units = "mm/hr" ;

  // group attributes:
  :description = "selected full-swath variables from FS groups, that encompass the
coincidence curtain" ;
} // group SWATH
} // group FS
} // group \2A.GPM.DPR

```

5.3.4. 2H.GPM.SLH

This group contains the GPM Spectral Latent Heating (SLH) product variables associated with the 2A.GPM.DPR files used, which is explained in the official [ATBD](#) for this data product.

The variable *scan_indices* points to the DPR scan and ray locations from the 2A.GPM.DPR file listed in the group attributes. The *time_diff* and *distance_diff* provide the time separation and spatial offset between the EarthCARE beam location and the DPR coordinates, respectively. While this dataset processing is driven by maximum ± 15 -minute time coincidences between the GPM-EarthCARE ground tracks, the pixel-to-pixel time separation *time_diff* can sometimes be several minutes larger than this, depending upon the orbital direction of each satellite. As shown in Figure 1, *distance_diff* will oscillate between ~ 0.5 -5 km as the EarthCARE locations move across the DPR scanning pattern. Owing to the coarser DPR sampling spacing, the same DPR pixel is repeated ~ 5 times.

```

group: \2H.GPM.SLH {
  dimensions:
    nbeam = 1846 ;
    scan_ray = 2 ;
    nbin_ec = 242 ;
    nscan = 87 ;
    nray = 49 ;
    nlayer = 80 ;
    nbin_dpr = 176 ;
  variables:
    int scan_indices(nbeam, scan_ray) ;
      scan_indices:_FillValue = -9999 ;
      scan_indices:longname = "scan and ray indices" ;
    int scan_orbit(nbeam) ;

```

```

        scan_orbit:_FillValue = -9999 ;
        scan_orbit:longname = "GPM orbit revolution number that corresponds to the EarthCARE
beam index" ;
        int time_diff(nbeam) ;
            time_diff:_FillValue = -9999 ;
            time_diff:units = "seconds" ;
            time_diff:longname = "DPR-minus-EarthCARE time difference" ;
        float distance_diff(nbeam) ;
            distance_diff:_FillValue = -9999.f ;
            distance_diff:units = "km" ;
            distance_diff:longname = "DPR-EarthCARE distance difference" ;
        double scan_time(nbeam) ;
            scan_time:_FillValue = -9999. ;
            scan_time:longname = "number of seconds since 1 Jan 1970" ;
            scan_time:units = "seconds" ;
        short bin_height_slh2ec(nbeam, nbin_ec) ;
            bin_height_slh2ec:_FillValue = -9999s ;
            bin_height_slh2ec:units = "m" ;
            bin_height_slh2ec:longname = "2H.GPM.SLH bin height above the reference surface that
matched with the EarthCARE bin height" ;
        short bin_slh2ec(nbeam, nbin_ec) ;
            bin_slh2ec:_FillValue = -9999s ;
            bin_slh2ec:longname = "bin number from the 2H.GPM.SLH profile that matched with the
EarthCARE bin height" ;
            bin_slh2ec:valid_max = 79s ;
            bin_slh2ec:valid_min = 0s ;
        short bin_height_ec2slh(nbeam, nlayer) ;
            bin_height_ec2slh:_FillValue = -9999s ;
            bin_height_ec2slh:units = "m" ;
            bin_height_ec2slh:longname = "EarthCARE bin height above the reference surface that
matched with the 2H.GPM.SLH bin height" ;
        short bin_ec2slh(nbeam, nlayer) ;
            bin_ec2slh:_FillValue = -9999s ;
            bin_ec2slh:valid_min = 0s ;
            bin_ec2slh:longname = "bin number from the EarthCARE profile that matched with the
2H.GPM.SLH bin height" ;
            bin_ec2slh:valid_max = 241s ;
        int64 bin_slh2dpr(nbeam, nbin_dpr) ;
            bin_slh2dpr:_FillValue = -9999LL ;
            bin_slh2dpr:valid_min = 0LL ;
            bin_slh2dpr:valid_max = 79LL ;
            bin_slh2dpr:longname = "bin number from the 2H.GPM.SLH profile that matched with
the 2A.GPM.DPR bin height" ;
        float bin_height_slh2dpr(nbeam, nbin_dpr) ;
            bin_height_slh2dpr:_FillValue = -9999.f ;
            bin_height_slh2dpr:units = "m" ;
            bin_height_slh2dpr:longname = "2H.GPM.SLH bin height matched with the 2A.GPM.DPR
bin height" ;

        // group attributes:
        :files_used = "2A.GPM.DPR.GPM-SLH.20250205-S151707-E165022.062115.V08A.nc" ;
        :description = "variables from the 2H.GPM.SLH SLH dataset" ;
        :satname = "GPM" ;
        :sensor = "DPR" ;

```

The SLH product is provided at 80 levels (*nlayer*= 80), with a vertical interval of 500 m from 0 to 20 km altitude. Mapping indices are provided for users who prefer to map SLH to EarthCARE, and vice versa. The variable *bin_slh2ec* provide the SLH bin indices to map SLH to the EarthCARE bins. *bin_height_slh2ec* provides the associated height of the SLH bin. Conversely, the variable *bin_ec2slh* provide EarthCARE bin indices to map EarthCARE to the 80 bins of the SLH profile. *bin_height_ec2slh* provides the associated height of the EarthCARE bin.

The variables in this group are written in the same sub-group hierarchy (Swath group) as the 2H.GPM.SLH files used (see the [ATBD](#) for this product for the group structure). For most users, the variables of interest are the latent heating profiles contained in Swath/*latentHeating*, the

apparent heat source ($Q1$) minus radiative heating rate (Qr) contained in *Swath/Q1minusQr*, and the apparent moisture sink ($Q2$) contained in *Swath/Q2*.

The 2H.GPM.SLH Swath group close out with a “**SWATH**” group containing *Latitude*, *Longitude*, *rainTypeSLH* and *latentHeating* that encompasses the coincidence curtain.

```
group: SWATH {
  dimensions:
    nscan = 87 ;
    nray = 49 ;
    nlayer = 80 ;
  variables:
    float Latitude(nscan, nray) ;
      Latitude:_FillValue = -9999.9f ;
      Latitude:units = "degrees" ;
    float Longitude(nscan, nray) ;
      Longitude:_FillValue = -9999.9f ;
      Longitude:units = "degrees" ;
    short height(nscan, nray, nlayer) ;
      height:_FillValue = -9999s ;
      height:units = "m" ;
    short rainTypeSLH(nscan, nray) ;
      rainTypeSLH:_FillValue = -9999s ;
    float latentHeating(nscan, nray, nlayer) ;
      latentHeating:_FillValue = -9999.9f ;
      latentHeating:units = "K/hr" ;

  // group attributes:
    :description = "selected full-swath variables from SLH groups, that encompass the
coincidence curtain" ;
```

5.3.5. 2B.GPM.DPRGMI

The 2B.GPM.DPRGM V08 product is temporarily not included in the ECAREGPM V02 output because it has not yet been produced. To use 2B.GPM.DPRGMI V07 for coincidence cases, refer to ECAREGPM V01.

6. References

Further information on the EarthCARE data products is available from JAXA G-Portal and ESA Earth Online. Further information on the GPM data products is available from the JAXA G-Portal, and the NASA Precipitation Measurement Missions (PMM) and the Precipitation Processing System (PPS).

Aoki, S., Kubota, T., and Turk, F. J.: Exploring vertical motions in convective and stratiform precipitation using spaceborne radar observations: insights from EarthCARE and GPM coincidence dataset, *Atmos. Meas. Tech.*, 19, 79–100, <https://doi.org/10.5194/amt-19-79-2026>, 2026.

JAXA G-Portal:

<https://gportal.jaxa.jp/gpr/?lang=en>

JAXA/EORC EarthCARE web site - Data Sources of EarthCARE
https://www.eorc.jaxa.jp/EARTHCARE/data/product_operation_info_e.html

ESA Earth Online
<https://earth.esa.int/eogateway/missions/earthcare>

ESA EarthCARE Product Data Handbook Catalogue
<https://earthcarehandbook.earth.esa.int/>

NASA Precipitation Measurement Mission online documentation:
<https://gpm.nasa.gov/resources/documents>

NASA Precipitation Processing System Science Team Online Request Module (STORM):
<https://storm.pps.eosdis.nasa.gov/storm/>

Turk, F. Joseph, Sarah E. Ringerud, Andrea Camplani, Daniele Casella, Randy J. Chase, Ardeshtir Ebtehaj, Jie Gong, et al. “Applications of a CloudSat-TRMM and CloudSat-GPM Satellite Coincidence Dataset.” *Remote Sensing* 13, no. 12 (January 2021): 2264.
<https://doi.org/10.3390/rs13122264>.

7. Change Log

August 2025: Version 1 (V01)

Version 1 was developed based on CSATGPM Version 5.

October 2026: Version 2 (V02)

All GPM datasets have been updated to Version 8 (V08), and all EarthCARE datasets have been updated to their latest major versions. Corresponding changes to product formats have been incorporated.

Additional EarthCARE products using ATLID, MSI, and BBR observations have been included. The dataset is now available in two versions, Light (V02) and Full (F02), containing the following products.

- **Light (V02):**

1C-R.GPM.GMI, 2A.GPM.GMI.GPROF, 2A.GPM.DPR, 1D.EC.AUX_JSG,
2A.EC.CPR_ECO, 2A.EC.CPR_CLP, and ECMWF.AUX-2D.

- **Full (F02):**

All products included in Light (V02),
2H.GPM.SLH, 2A.EC.ATL_CLA, 1C.EC.MSI_RGR, 2A.EC.MSI_CLP,
2B.EC.AC_CLP, 2B.EC.ACM_CLP, 2B.EC.ALL_RAD, 2A.EC.CPR_CD_,
2B.EC.ACM_CAP, and 2B.EC.BMA_FLX.

The vertical reference variables in the DPR group have been renamed to bin_dpr2ec, bin_height_dpr2ec, bin_ec2dpr, and bin_height_ec2dpr.

Data availability

Data can be downloaded from the JAXA/EORC ftp server.

Location: /2B.ECAREGPM.COIN/Version/YYYY/MM/DD

The predicted orbit intersection points of EarthCARE and GPM are reported below:

/2B.ECAREGPM.COIN/Version/daily_coincidence/GPM_EARTHCARE

The columns are

2, 3: YYYYMMDD and HHMMSS of GPM

4: epoch seconds of GPM

5,6: latitude, longitude of GPM

7,8: YYYYMMDD and HHMMSS of EarthCARE

9: epoch seconds of EarthCARE

10,11: latitude,longitude of EarthCARE

12: GPM–EARTHCARE time offset in seconds

13: spatial offset in km (always 3-4 km or less, since the positions are calculated every second)

The versions of the source products used in each coincidence dataset file are listed in monthly files stored at the following location:

/2B.ECAREGPM.COIN/Version/source_product_versions

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