JAXA EarthCARE Product Overview

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on behalf of the joint JAXA-ESA EarthCARE Team

Japan Aerospace Exploration Agency (JAXA)

EarthCARE Science and Validation Workshop 2025
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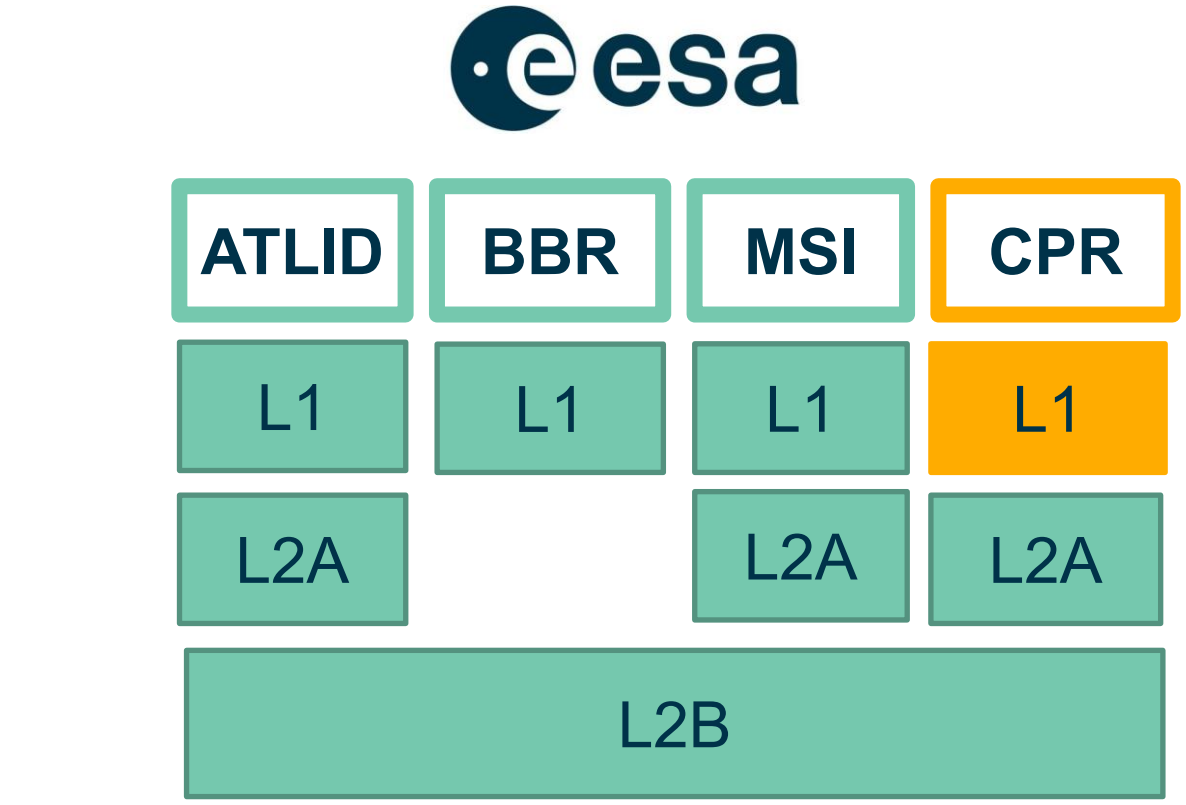
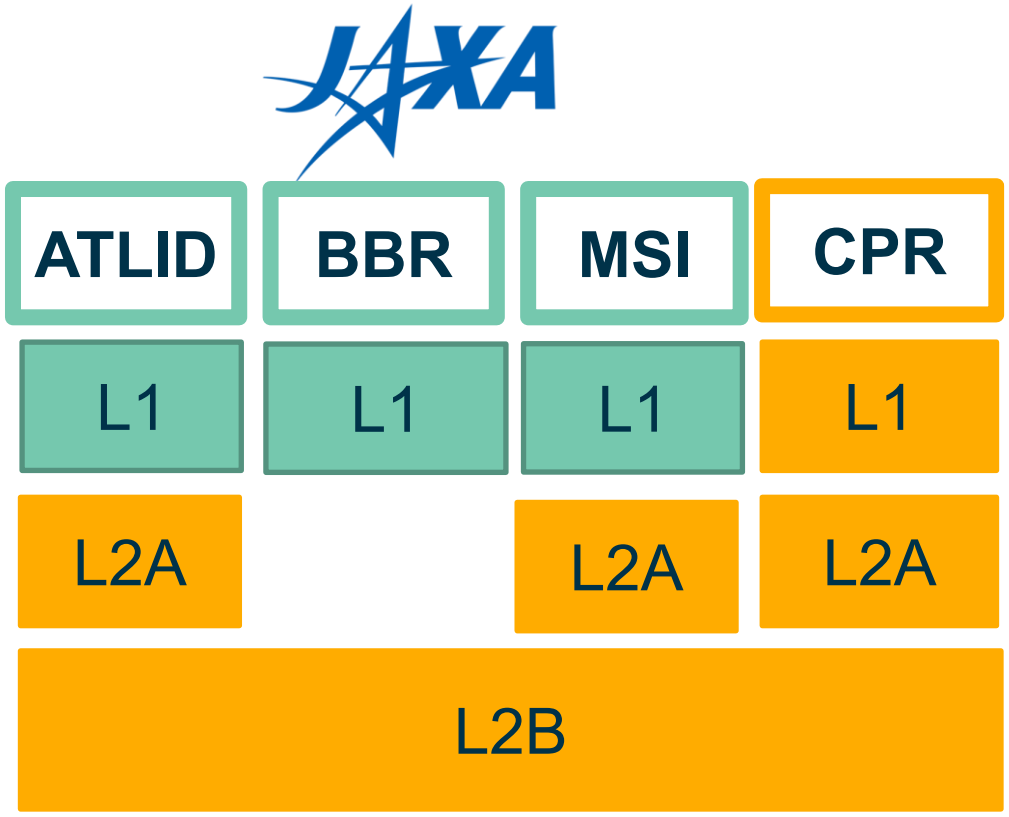
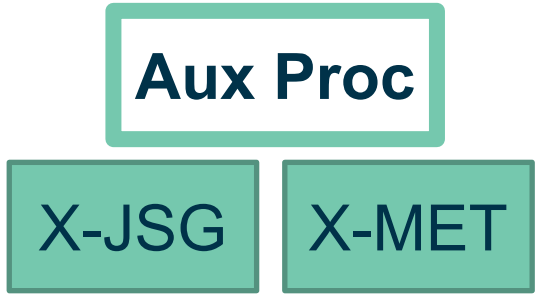
EarthCARE data products



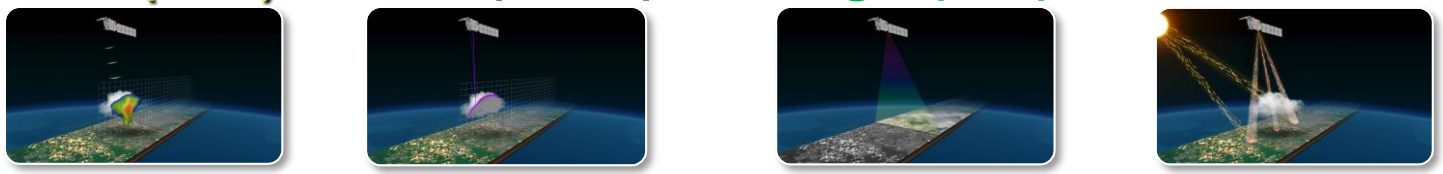


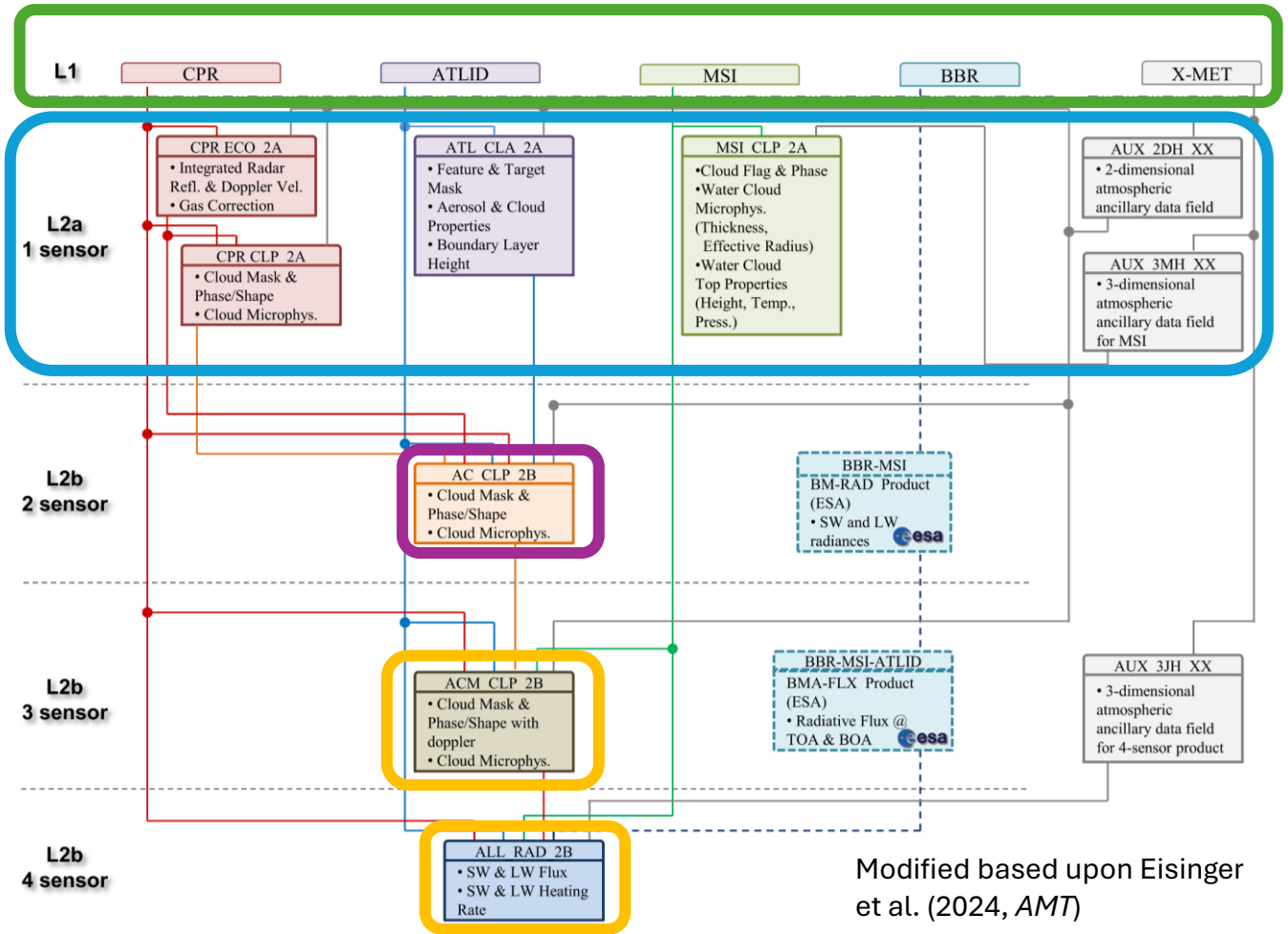


- L1 products have been developed by the agency responsible for the instrument.
- As for L2 products, both agencies develop algorithms independently, for collaboration and comparison.
- Each agency coordinates the validation of its own products.

EarthCARE Production Model (JAXA)

Radar (CPR) **Lidar (ATLID)** **Imager (MSI)** **Broadband radiometer (BBR)**





Modified based upon Eisinger et al. (2024, *AMT*)

Level 1: Calibrated Instrument Data (Published 14/01/2025)

Level 2a: Single sensor Products (Published 17/03/2025)

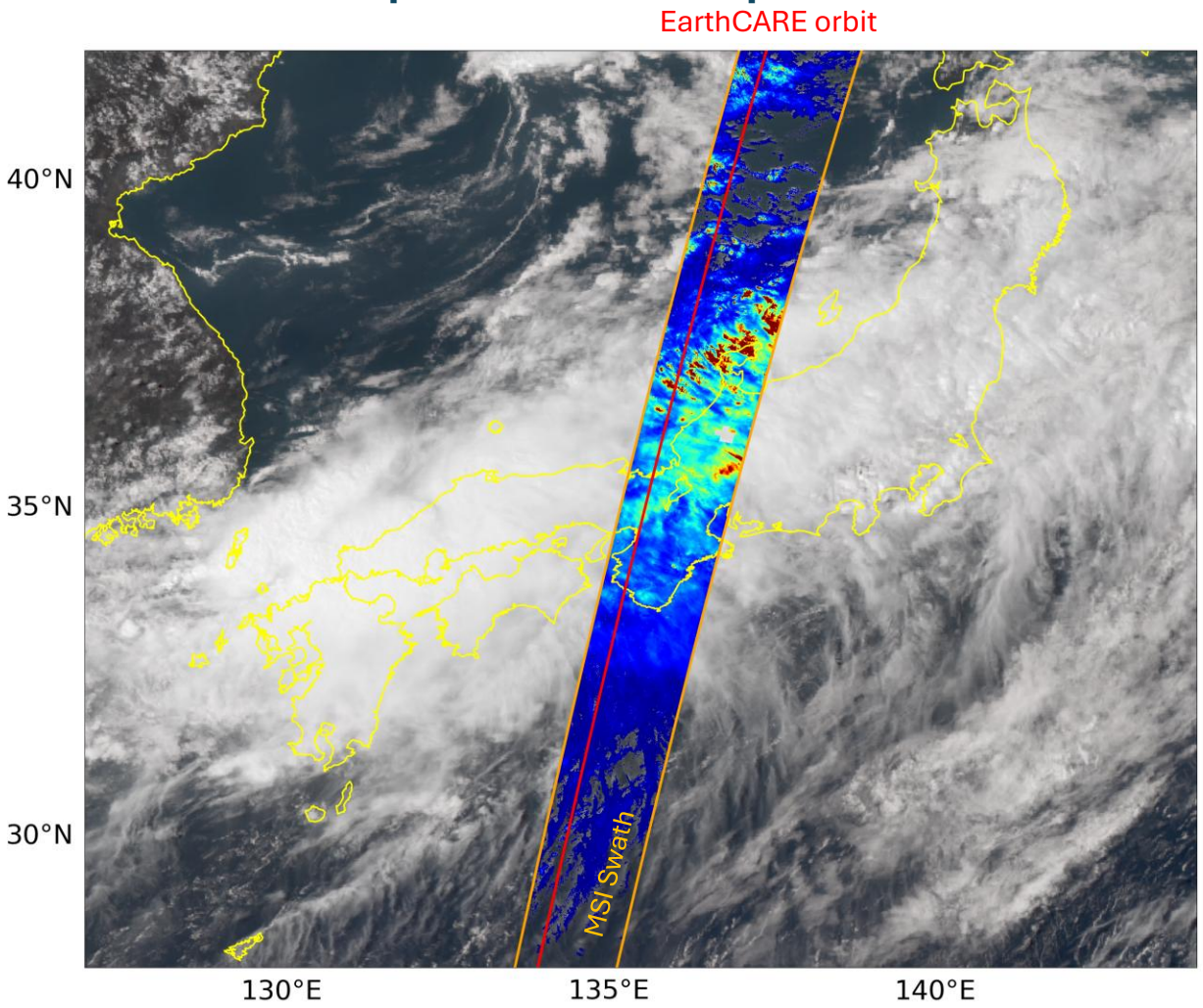
Level 2b: two-sensor synergy Products (Published 17/03/2025)

Level 2b: three- and four-sensor synergy Products Published Today

All Observation Data Now Publicly Available!

JAXA's 3-sensor synergy product (ACM_CLP) and 4-sensor synergy product (ALL_RAD)

Rain cloud widespread over the Japan Island



- On **August 10, 2025, at 5UTC**, the EarthCARE satellite passed near Osaka-city in Japan and observed **rain clouds extending from western to eastern Japan**.
- At this time, **localized heavy rainfall systems also formed over northern Kyushu**.
- Here, I introduce **JAXA's 3-sensor synergy product (ACM_CLP)** and **4-sensor synergy product (ALL_RAD)** with this case.

Cloud distribution around the Japan Islands (5UTC, Aug. 10th, 2025)

- The colormap represents **Cloud Optical Thickness (COT) from L2a MSI_CLP**.
- The background is an RGB composite image from the Himawari-9 meteorological satellite.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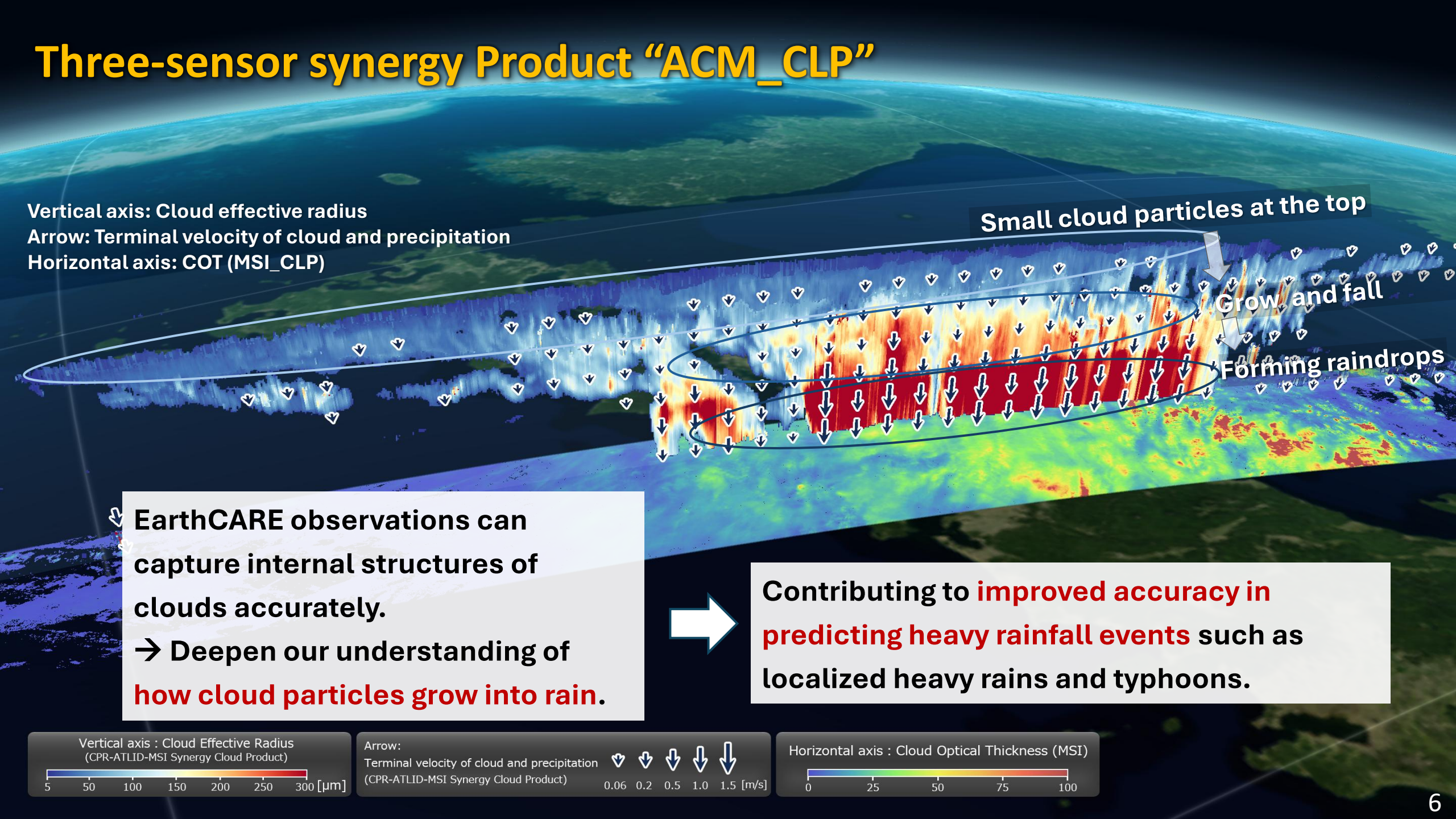
earthcare

Three-sensor synergy Product “ACM_CLP”



EarthCARE observations can capture internal structures of clouds accurately.
→ Deepen our understanding of how cloud particles grow into rain.

Contributing to improved accuracy in predicting heavy rainfall events such as localized heavy rains and typhoons.

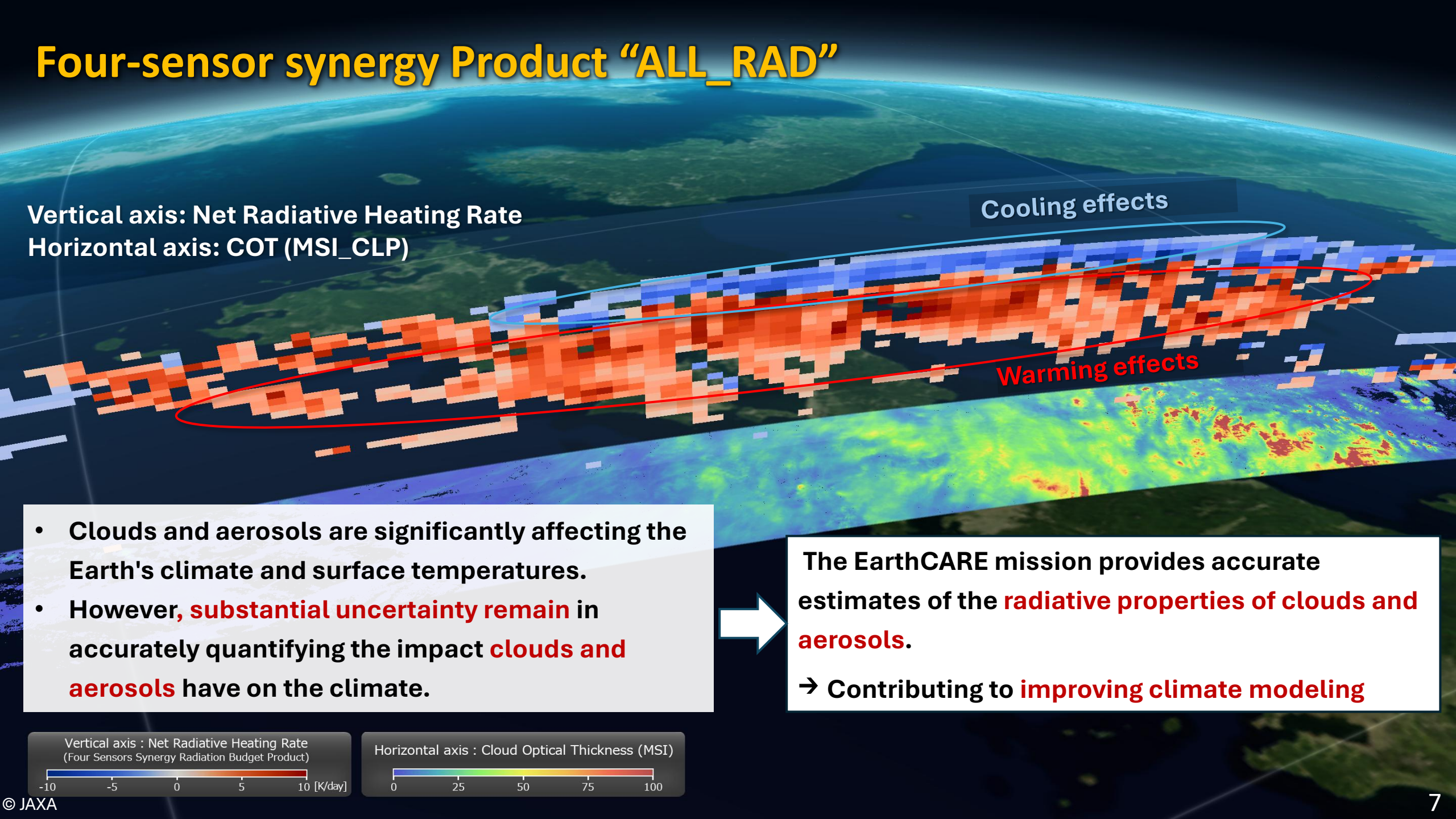
Vertical axis : Cloud Effective Radius
(CPR-ATLID-MSI Synergy Cloud Product)
5 50 100 150 200 250 300 [μm]

Arrow:
Terminal velocity of cloud and precipitation
(CPR-ATLID-MSI Synergy Cloud Product)
0.06 0.2 0.5 1.0 1.5 [m/s]

Horizontal axis : Cloud Optical Thickness (MSI)
0 25 50 75 100

Four-sensor synergy Product “ALL_RAD”

Vertical axis: Net Radiative Heating Rate
Horizontal axis: COT (MSI_CLP)



- Clouds and aerosols are significantly affecting the Earth's climate and surface temperatures.
- However, substantial uncertainty remain in accurately quantifying the impact clouds and aerosols have on the climate.

The EarthCARE mission provides accurate estimates of the radiative properties of clouds and aerosols.

→ Contributing to improving climate modeling

Data Quality Updates News

- **JAXA's All Level 2a: Single sensor Products and Level 2b: two-sensor synergy Products were updated on 27th November 2025.**
- Please see JAXA/EORC homepage (https://www.eorc.jaxa.jp/EARTHCARE/index.html) for details.

Product name	Product ID	Changes
L2a CPR One-sensor Echo Product	CPR_ECO	• Implementation of AW3D DEM, instead of ACE2
		• Improvements of Mirro Echo Flag（2nd Trip Echo, Multiple Scattering, 2.4km Artifact)
		• Improved atmospheric gaseous attenuation calculations
L2a CPR One-sensor Cloud Product	CPR_CLP	• Improved to match MSI optical thickness following vicarious calibration of MSI L1
L2b CPR-ATLID Synergy Cloud Product	AC__CLP	
L2a ATLID One-sensor Cloud and Aerosol Product	ATL_CLA	• Improved lidar detection of the ground surface reduces misidentification of the ground surface as clouds or aerosols
		• Reduced variability in depolarization and lidar ratio
L2a MSI One-sensor Cloud Product	MSI_CLP	• Extending cloud microphysics estimates to solar zenith angles of 70 to 80 degrees
		• Incorporating vicarious calibration results using Himawari-9 observations
ECMWF-AUX-2D Product	AUX__2D	• Changed DEM of AUX2D from ACE2 to AW3D
		• Added output variables
		• Fixed bugs (minor)
ECMWF-AUX-3D Product	AUX__3D	• Fixed bugs (minor)

Re-processing Campaign status

- JAXA's re-processing campaign of past data is beginning on **JAXA Supercomputer System (JSS).**
- Reprocessing of the past 18-month data is expected to be completed in **five months (around late April 2026).**
- Re-processed product will be **released once each reprocessing is complete**.

Level	Product ID	Version	Expected date of re-processing completion
L1b	CPR_NOM	vDa	**Completed**
L2a	CPR_ECO	vCb	Late Jan. 2026
	CPR_CLP	vCa	Mid Feb. 2026
	ATL_CLA	vCb	Late Feb. 2026
	MSI_CLP	vCa	Late Mar. 2026
L2b	AC__CLP	vCa	Mid Mar.2026
	ACM_CLP	vBa	Early Apr. 2026
	ALL_RAD	vBa	**Late Apr. 2026**
AUX	AUX_2DH	vCa	Early December 2025
	AUX_3JH	vCa	Mid Dec. 2025
	AUX_3MH	vCa	Mid Jan. 2026

JAXA EarthCARE Science Team & EORC
for L2 algorithm developments, validations, applications

JAXA EarthCARE Science Team
(lead: Prof. Hajime Okamoto, Kyusyu Univ.)

PIs/CIs by Research Announcement on the Earth Observations (EO-RA)

4th EO-RA (EO-RA4): JFY2025-2027
- 24 PIs
  - ✓ Algorithm Development : 6
  - ✓ Validation : 4
  - ✓ Application Research : 9
  - ✓ Related Research: 5

NICT

MoU

Earth Observation Research Center (EORC)

Report

Advise

JAXA EarthCARE Science Advisory committee (lead: Prof. Masaki Satoh, Univ. Tokyo)

DLR

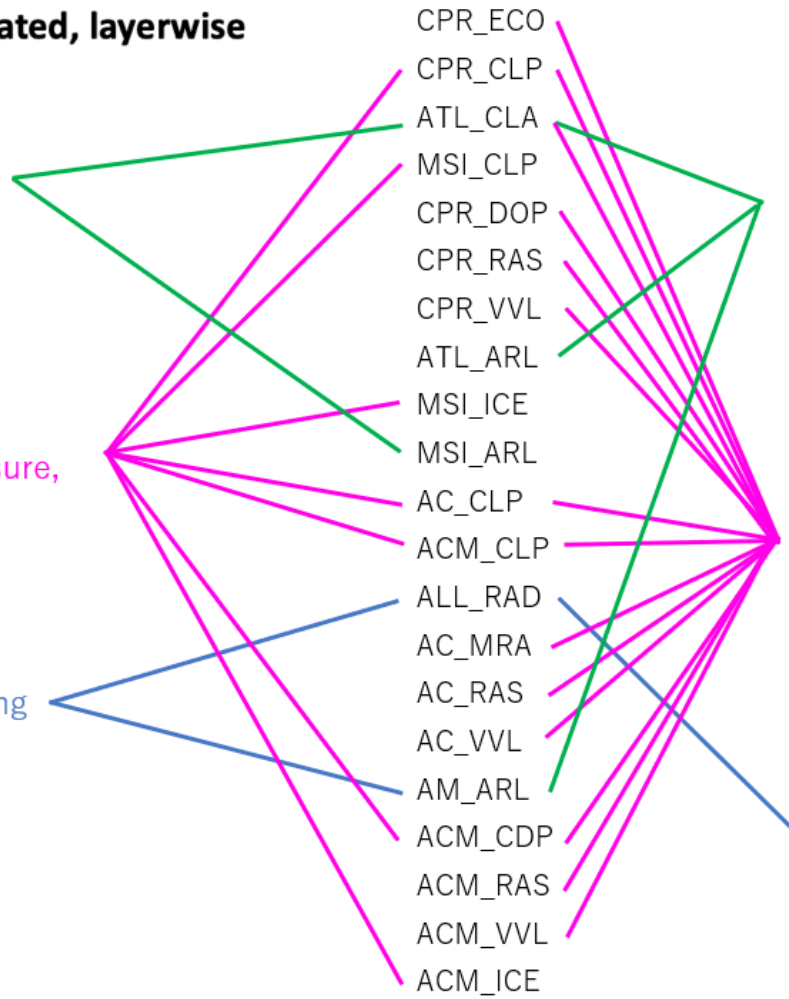
IA for EarthCARE between JAXA and DLR was signed in July 2024.

https://www.satnavi.jaxa.jp/en/news/2024/08/02/9628/index.html

MoU for EarthCARE between JAXA and NOAA was signed in Sep. 2024.

JAXA L2 products & algorithm developments

Overview of JAXA L2 products



PI for MSI_CLP
Prof. T. Y. Nakajima (Tokai Univ.)

PI for CPR_CLP, AC_CLP, ACM_CLP
Prof. H. Okamoto (Kyushu Univ.)

PI for ALL_RAD:
Prof. K. Suzuki (Univ. Tokyo)

PI for ATL_CLA
T. Nishizawa (NIES)

PI for CPR_ECO
H. Horie (NICT)

PI for CPR_CLP, AC_CLP, ACM_CLP
Prof. H. Okamoto (Kyushu Univ.)

PI for ALL_RAD:
Prof. K. Suzuki (Univ. Tokyo)

Based upon Wehr et al. (2023, *AMT*)

Satellite simulator developments and contributions to improvements of climate models

EarthCARE
2024-

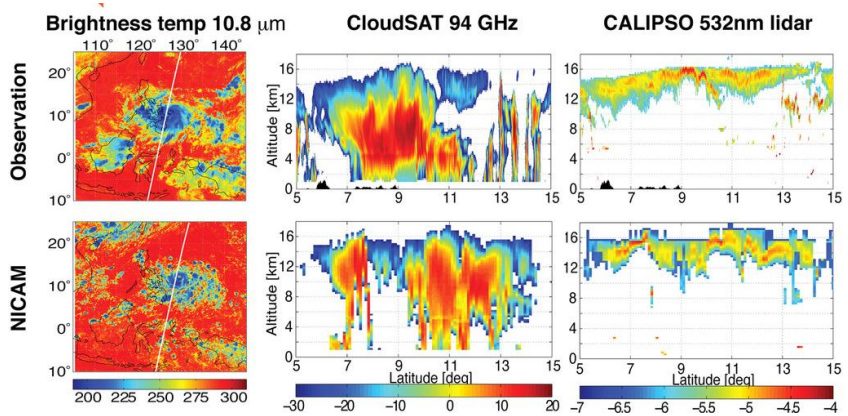
The CFMIP Observation Simulator Package (COSP) for **EarthCARE/CPR** has been developed in Prof. Suzuki (Univ. Tokyo)'s group and used to develop an evaluation method for **IPCC climate models**.

EarthCARE-ORCESTRA Model Intercomparison (ECOMIP) for weather and climate modellers to compare to each other and to EarthCARE data, centred on the ORCESTRA campaign.

Joint-Simulator (Joint Simulator for Satellite Sensors)

PI. Prof. M. Satoh (Univ. Tokyo)

Joint-Simulator *(Hashino et al. 2013, Roh et al. 2023) can* ***simulate EarthCARE observations from numerical weather/climate model*** *outputs, developed by the JAXA EarthCARE mission.*



Improvements of climate models which lead to better climate projections

JAXA EarthCARE Validation Activity

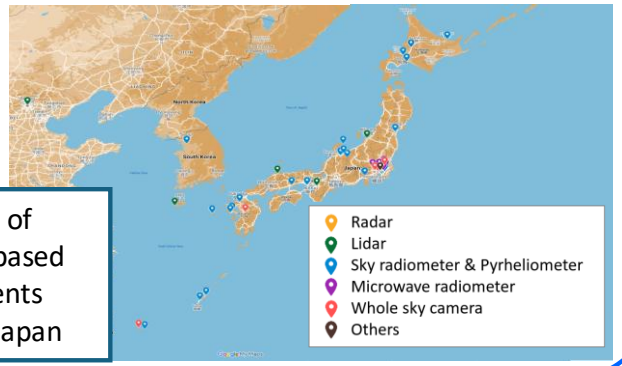
- ## JAXA's Validation Approach summary

Long-term observation network

- Lidar network (AD-Net) by NIES
- SKYNET observation stations
- Wind Profilers (WINDAS) by JMA

etc.

→provide detailed validations of the JAXA EarthCARE products



Location of ground-based instruments around Japan

Campaign observation

- NICT Koganei validation super site
  - Ground-based doppler CPR developed by NICT, Multiple-field-of-view multiple-scattering polarization lidar (MFMSPL), High spectral resolution lidar (HSRL), Direct Detection Doppler lidar (355nm) by Prof. Okamoto's kakenhi funding.

→provide multi-sensor-combined and detailed evaluations

- Airborne campaign
  - Mainly by collaboration with DLR

→provide abundant number of matchup data which is important especially in the early phase

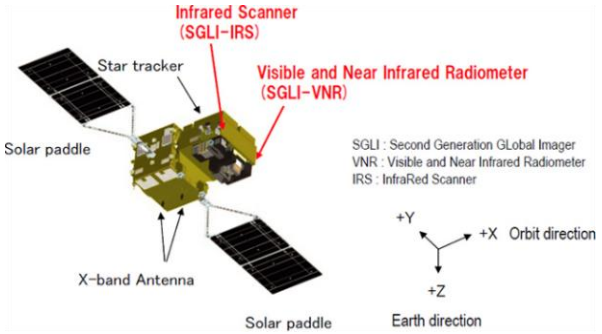
Comparison with other satellite data

- CloudSat, CALIPSO, GCOM-C/SGLI, MODIS, VIIRS, CERES, etc. Himawari/AHI

→provide global evaluations of the JAXA EarthCARE products

JAXA's GCOM-C satellite

carrying a visible-infrared imager, SGLI 250m resolution



*GCOM-C: Global Change Observation Mission-Climate

Collaboration with ESA

- ✓ ESA-JAXA Validation Implementation Plan
- ✓ Validation workshops

Collaboration with DLR

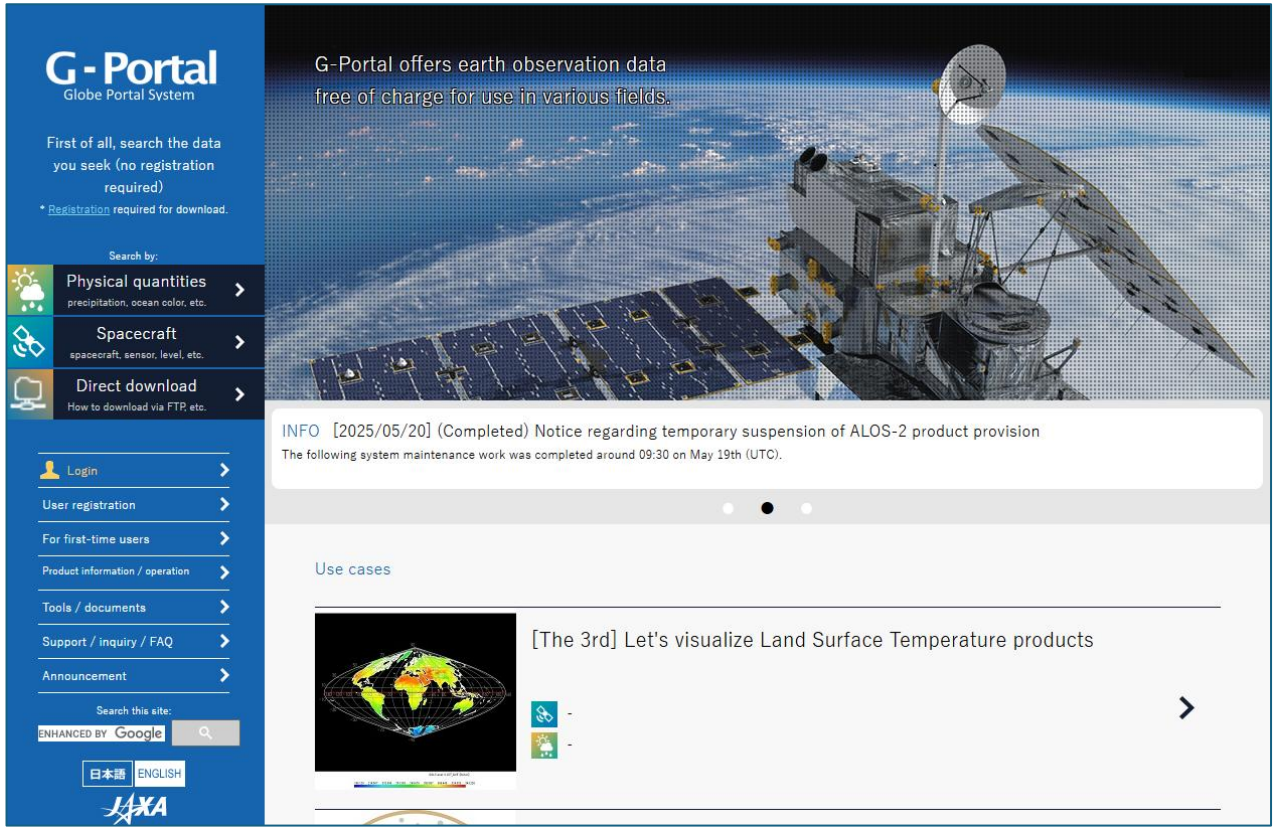
- ✓ DLR research aircraft HALO (High Altitude and Long Range Aircraft)
- ✓ https://www.satnavi.jaxa.jp/en/news/2024/08/02/96928/index.html

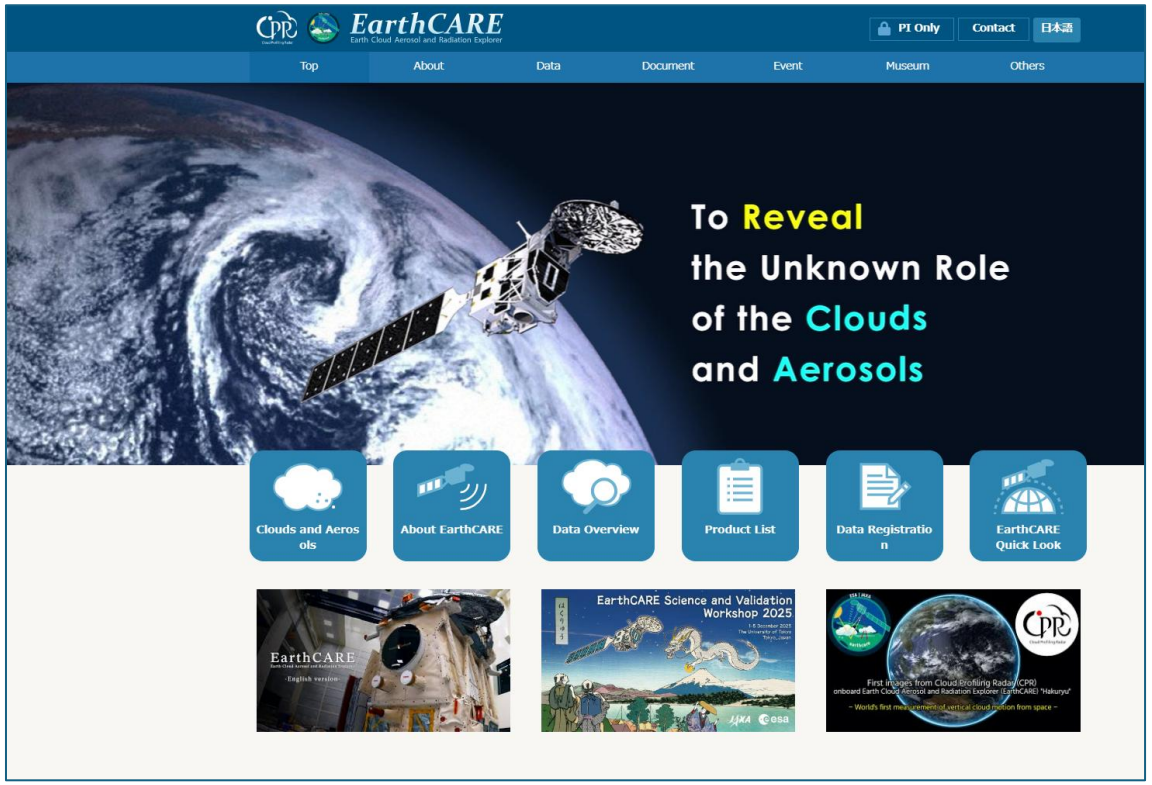
Collaboration with NOAA

Websites to obtain EarthCARE data and provide references

EarthCARE data can be downloaded from JAXA's Earth observation satellite data provision system G-Portal (https://gportal.jaxa.jp/gpr/) and the ESA homepage (https://earth.esa.int/eogateway/missions/earthcare).

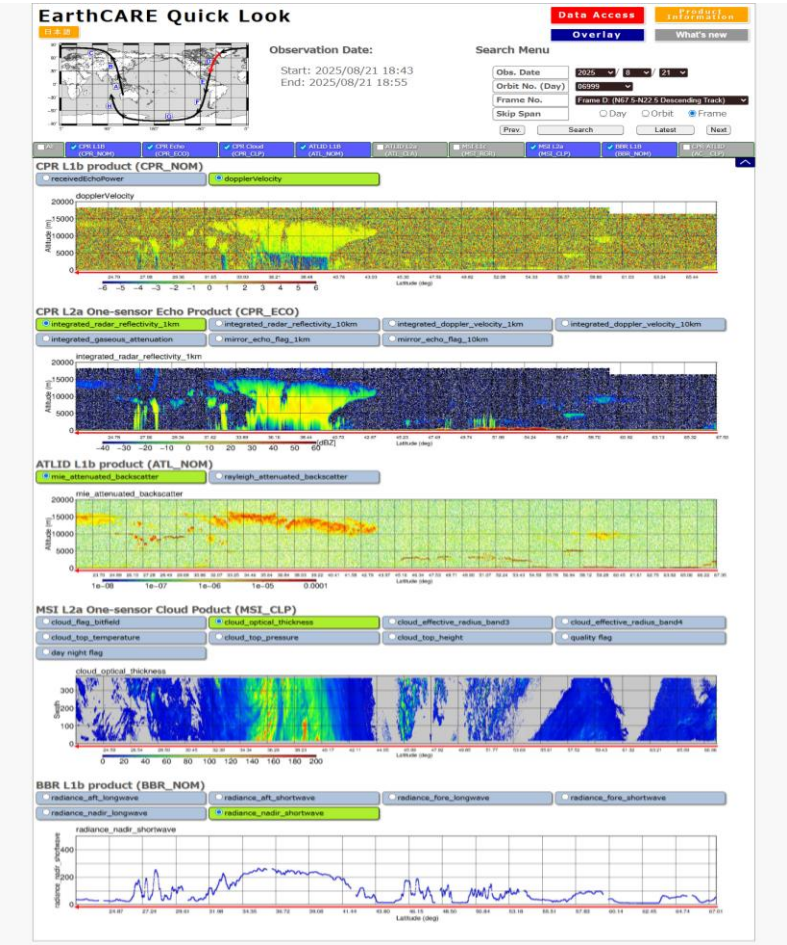
Information such as Products Definitions Documents (PDD) and Algorithm Description Documents (ATBD) can be viewed on the JAXA/EORC EarthCARE homepage. https://www.eorc.jaxa.jp/EARTHCARE/index.html



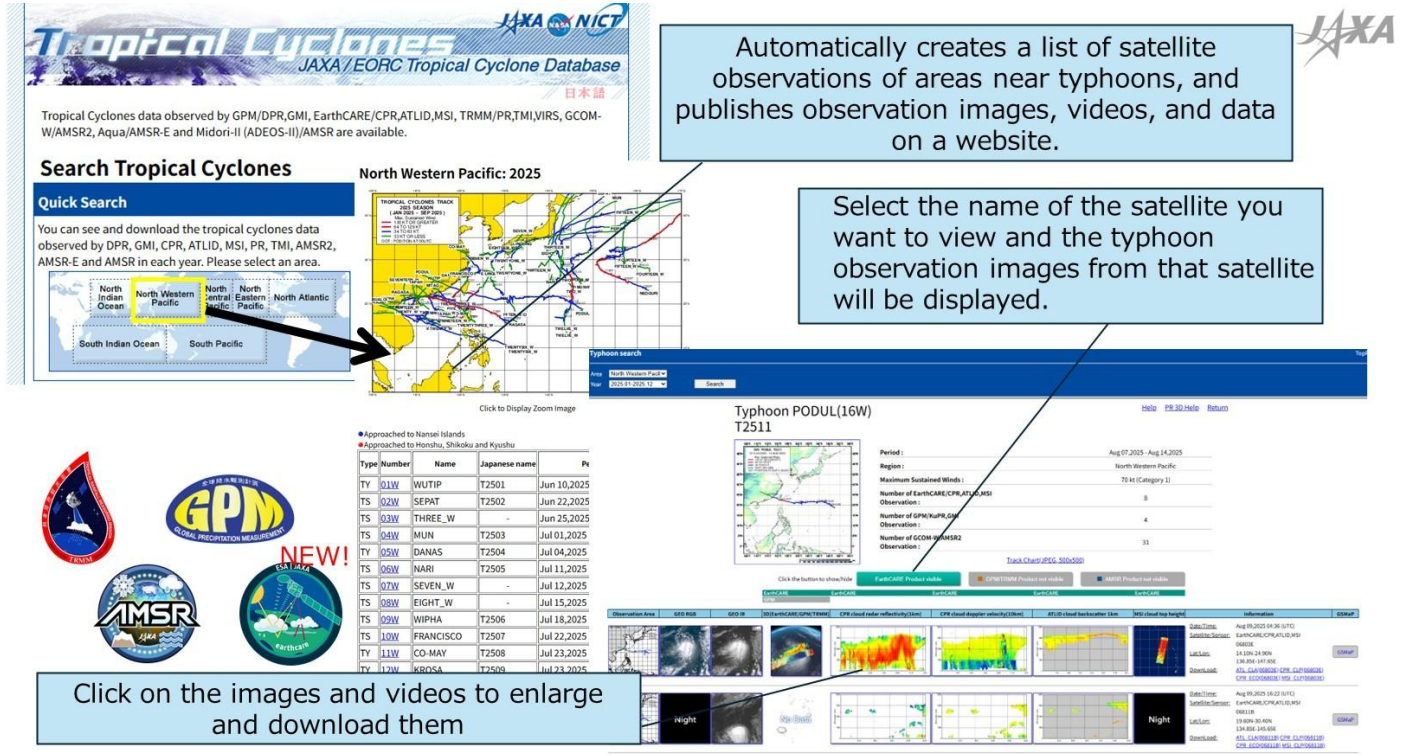


Useful JAXA's websites (Quicklook & Tropical Cyclone DB)

JAXA EarthCARE Quicklook
https://www.eorc.jaxa.jp/EARTHCARE/Quicklook/index.html



EarthCARE satellite observation data has been added to the "**JAXA/EORC Tropical Cyclone Database**" to promote the use of such data in typhoon research.
https://sharaku.eorc.jaxa.jp/TYP_DB/index.html



https://www.satnavi.jaxa.jp/en/news/2025/10/01/11416/index.html

The EarthCARE satellite has captured the **"eye" of Hurricane Humberto**, and the JAXA published a quick report (https://earth.jaxa.jp/en/earthview/2025/10/01/9051/index.html).

Summary

- **All of the JAXA standard products have been released to the users**:
  - CPR Level-1: 14/03/2025
  - Level-2a + two-sensor Level-2b synergy: 17/03/2925
  - Three- and four-sensor L2b synergy procuts planned for: **Today!**

- **Very promising early product quality and offering significant scientific opportunities.**

- **EarthCARE data can be downloaded from JAXA's Earth observation satellite data provision system G-Portal (https://gportal.jaxa.jp/gpr/) and the ESA homepage (https://earth.esa.int/eogateway/missions/earthcare).**
  - JAXA EarthCARE Quicklook (https://www.eorc.jaxa.jp/EARTHCARE/Quicklook/index.html)
  - JAXA/EORC Tropical Cyclone Database (https://sharaku.eorc.jaxa.jp/TYP_DB/index.html)

- **JAXA/EORC and JAXA EarthCARE Science Team** continues to ..
  - Monitor the product quality and provide regular reports to users
  - Continuously enhance the quality of existing processors and products, building on the valuable findings and recommendations of the Validation Teams.
  - Provide User support