



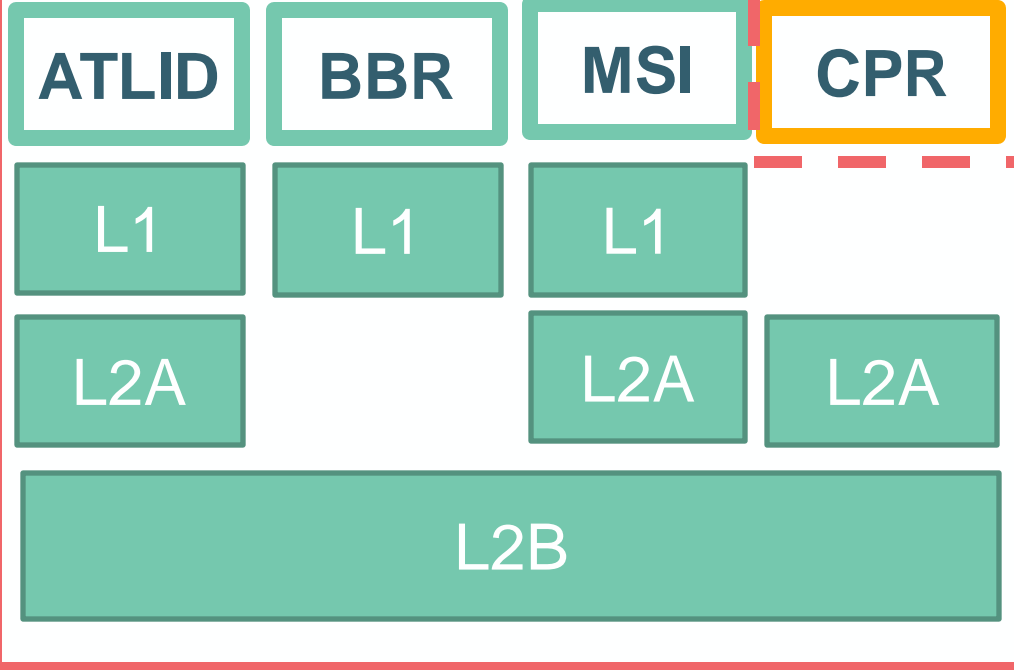
## ESA Product Overview

*J. v. Bismarck, M. Eisinger, F. Marnas, T. Hummel, T. Fehr, K. Wallace, R. Koopman, P. Deghaye and the ESA EarthCARE-Project, -PDGS and CARDINAL teams*

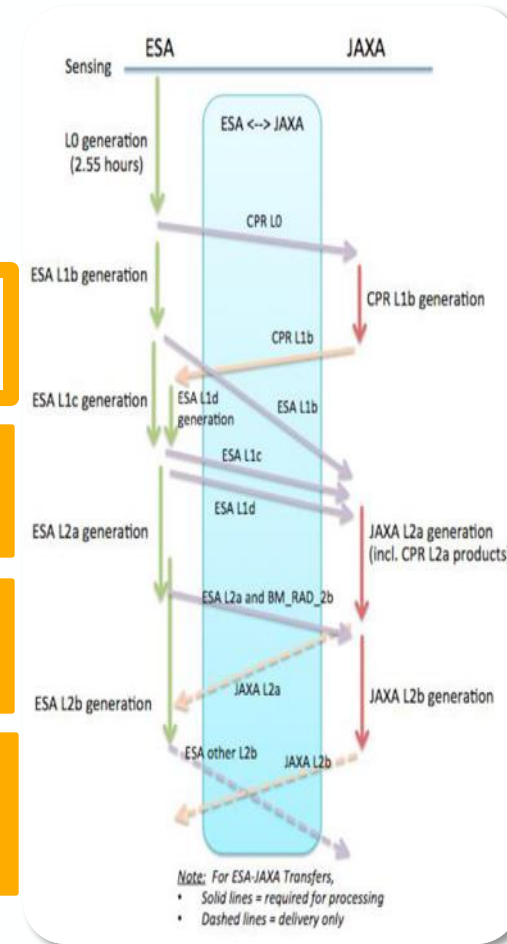
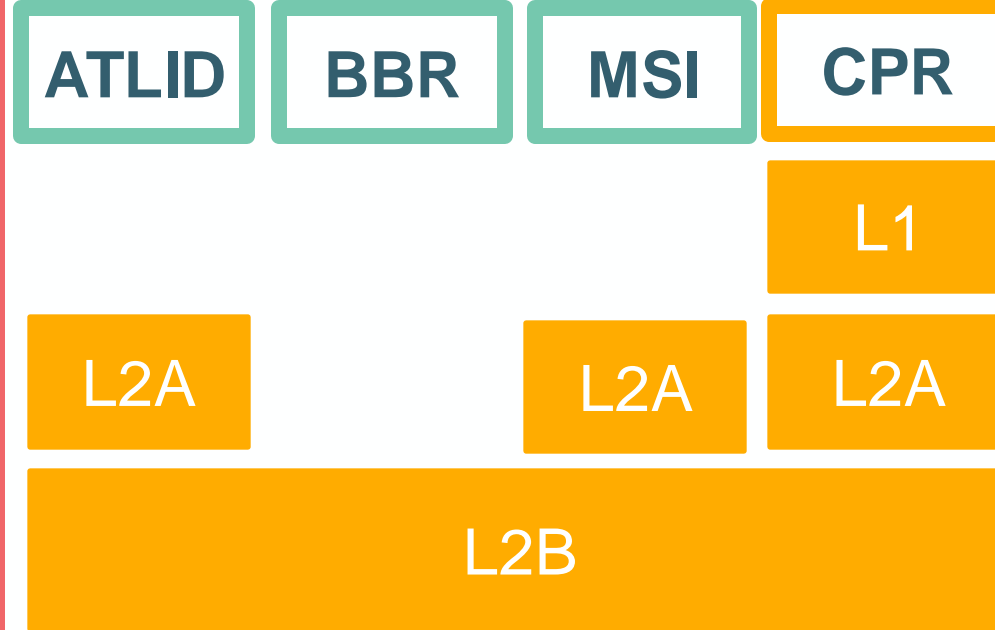
# EarthCARE data products are generated by ESA and JAXA



Covered in this Presentation



Next Presentation:



Aux Proc

X-JSG

X-MET

- Mutual dependency at Level 1 requiring for strong coordination between Agencies
- Separate Level 2 chains provide opportunity for collaboration and comparison
- Each agency coordinates the validation of its own products

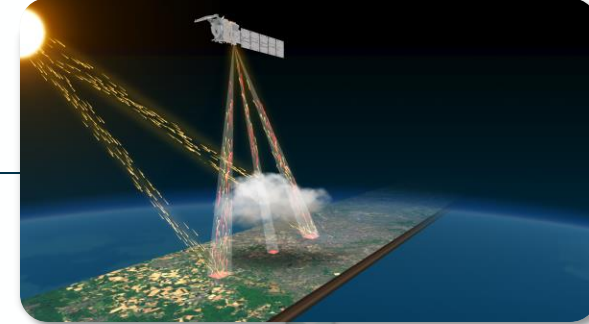
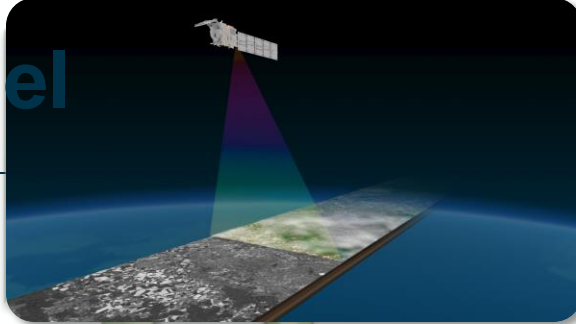
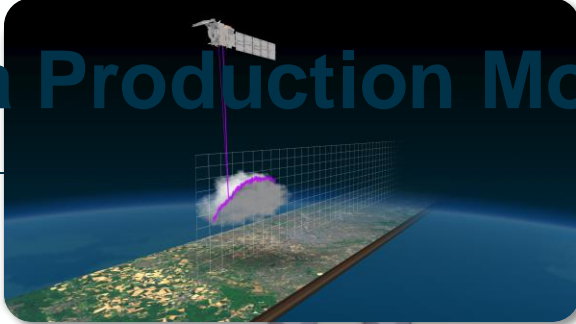




# Data Production Model

## CPR Level 1b (JAXA)

- Radar reflectivity
- Doppler velocity profiles



## CPR Level 2a

Radar echo product, feature mask, cloud type, liquid and ice cloud properties, vertical motion, rain and snow estimates, ...

## ATLID Level 2a

Feature mask and target classification, extinction, backscatter & depol. profiles, aerosol properties, ice cloud properties, ...

## MSI Level 2a

Cloud mask, cloud micro-physical parameters, cloud top height, aerosol parameters, ...

## BBR Level 2a

Unfiltered top-of-atmosphere radiances, short-wave and long-wave fluxes  
**BBR Level 2b:** enhanced products using MSI

## Synergistic Level 2b

1. Target classification
2. Cloud & aer. prof. at x-sec

## 3D Scenes Construction

Expand syn. retrievals across-track using MSI;  $\approx 40\text{km}$  wide

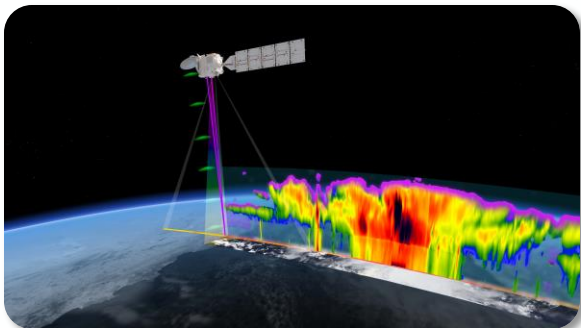
## Radiative Transfer Products

calculated radiances, fluxes, heating rate profiles

EarthCARE  
Data Production  
Model

## Assessment

Comparison of calculated fluxes and radiances to BBR observations



# EarthCARE product levels



**Level 0** instrument science packets with annotation headers (unprocessed data), time-ordered, duplicate packets removed

**Level 1b** instrument measurements in physical units, annotated with geolocation, error quantification and quality flags, on instrument spatial grid

**Level 1c** same as level 1b, but spatially interpolated to reference band (MSI M-RGR only)

**Level 1d** auxiliary data products, not containing instrument measurements: meteorological fields (X-MET) and spatial grid for synergy processing (X-JSG)

**Level 2a** geophysical parameters, single instrument, on instrument spatial grid

**Level 2b** geophysical parameters, two or more instruments (synergy), on instrument or joint spatial grid

# EarthCARE Production Model (ESA)



## EarthCARE Retrievals:

Aerosol & Cloud profiles (ice, liquid, mixed, precipitation)

Horizontal distribution of cloud and aerosol fields  
 → Retrieve the 3D atmospheric state

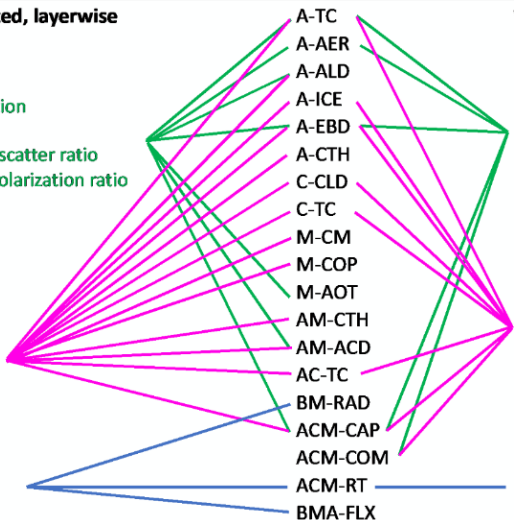
Broad-band Solar & Thermal Radiation  
 → Validate 3D atmosphere RT calc. with BBR

### Cloud-top, vertically integrated, layerwise

**Aerosol**  
 Aerosol layer height, classification  
 Optical thickness,  
 Layer-mean extinction-to-backscatter ratio  
 Layer-mean particle linear depolarization ratio  
 Angstrom exponent

**Cloud and precipitation**  
 Cloud-top height, phase, type  
 Optical thickness  
 Effective radius  
 Liquid, ice, rain water path  
 Surface snow rate  
 Surface rain rate

**Radiation**  
 Radiative fluxes at TOA  
 Broadband radiances at TOA

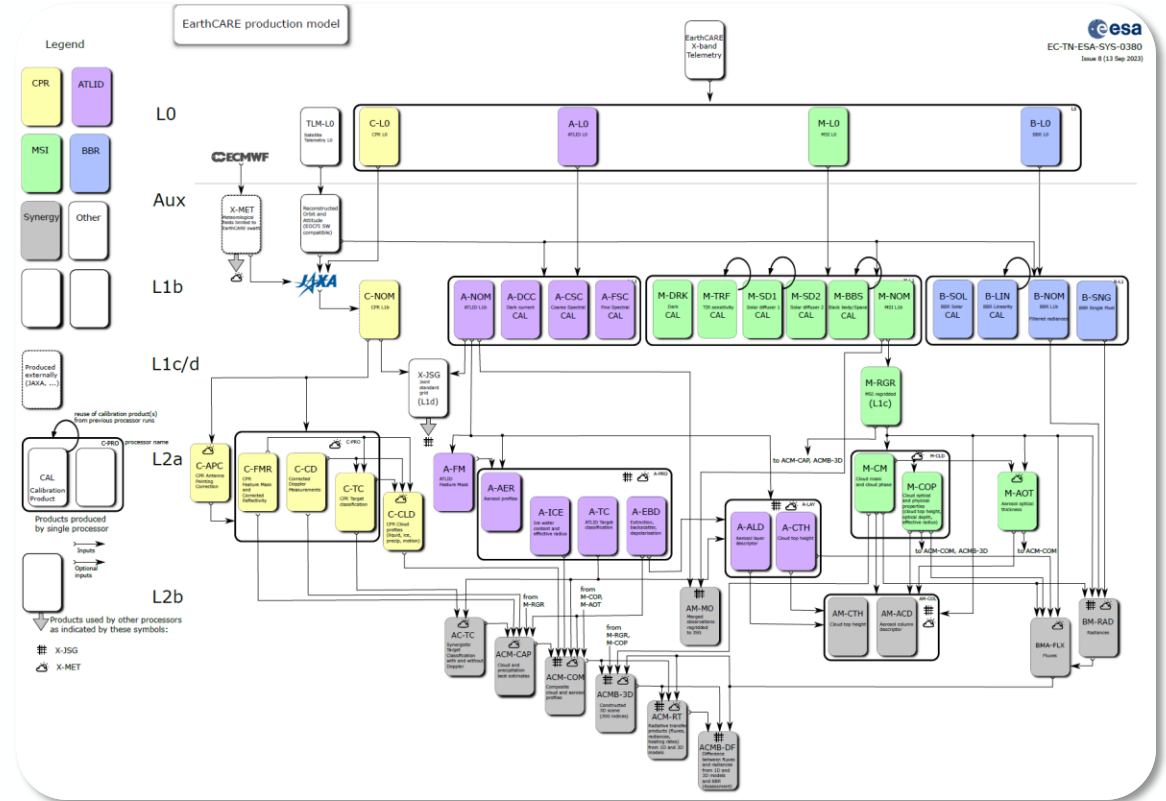


**Vertical profiles**

**Aerosol**  
 Aerosol fraction  
 Aerosol species  
 Extinction  
 Extinction-to-backscatter ratio  
 Particle linear depolarization ratio

**Cloud and precipitation**  
 Extinction  
 Effective radius  
 Liquid, ice, rain water content  
 Snow rate, median diameter  
 Rain rate, drop size  
 Cloud/precipitation fraction  
 Cloud/precipitation classification

**Radiation**  
 Broadband radiances  
 Radiative fluxes

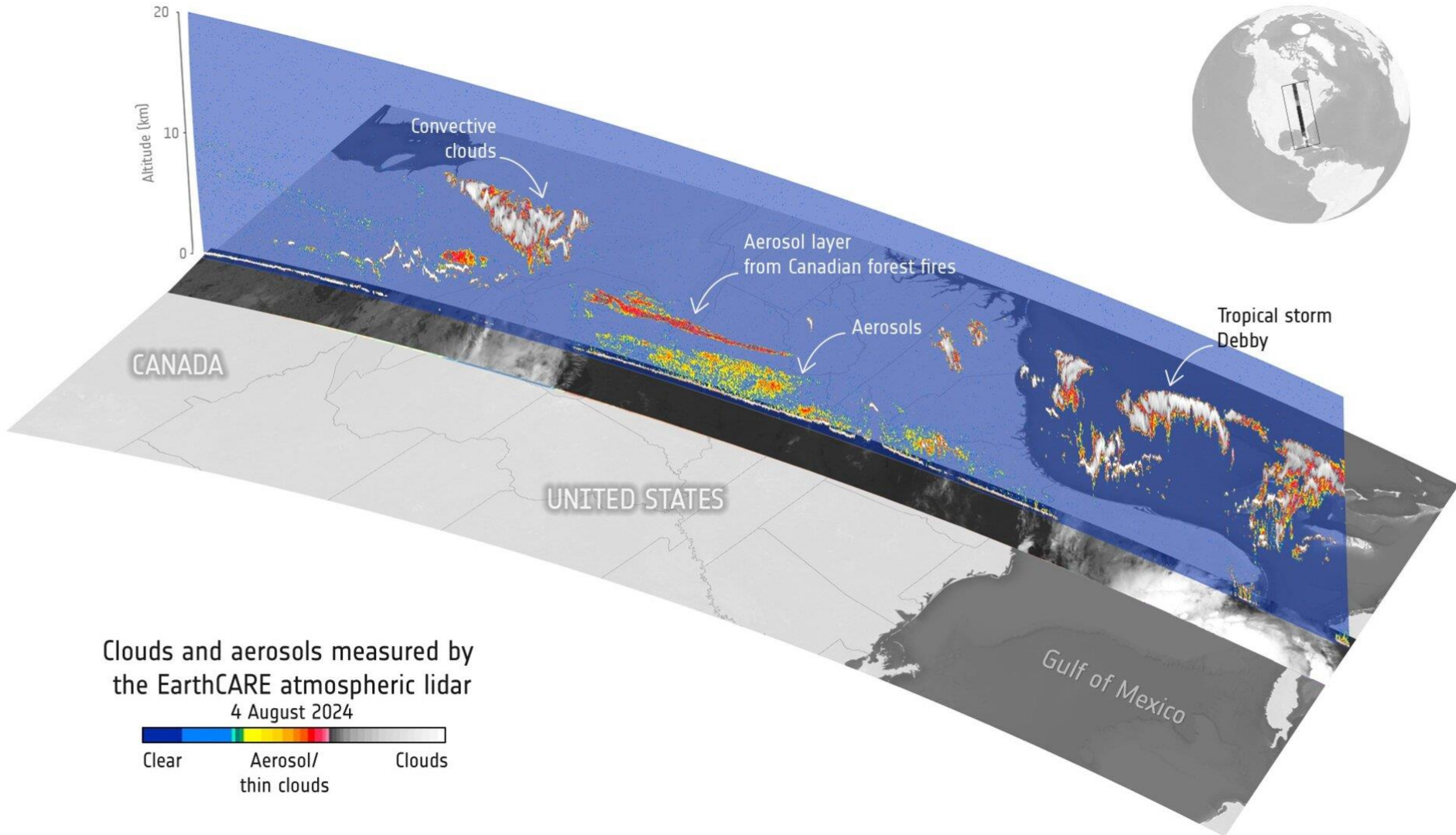
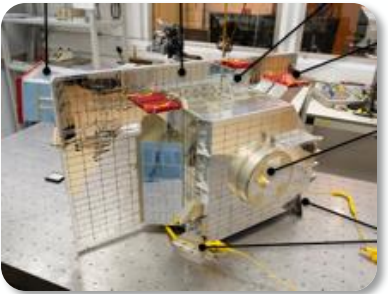
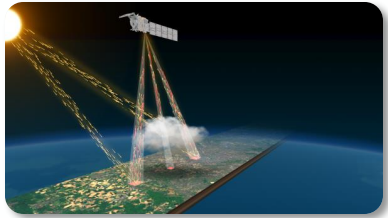


- 24 Data Processors (ESA chain) developed by Scientific Team (CARDINAL – P.I. : KNMI)
- EarthCARE Cal/Val and Science Workshops coordinated along with the data releases
- Two Level 2 chains at ESA and JAXA

AMT special issue: EarthCARE Level 2 algorithms and data products

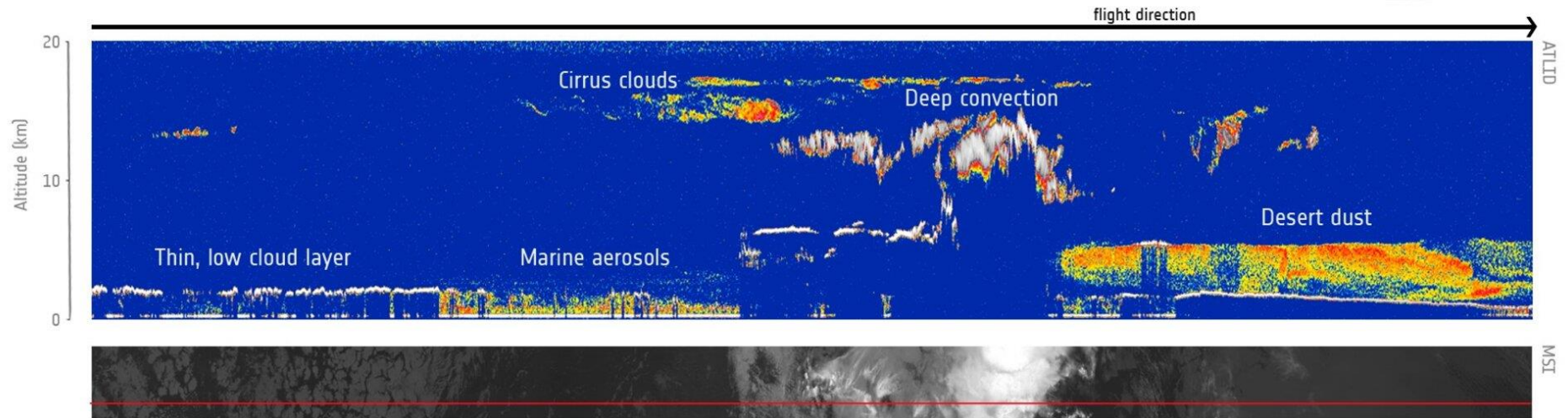
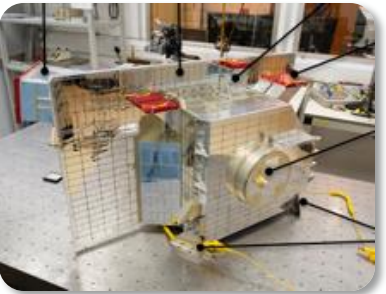
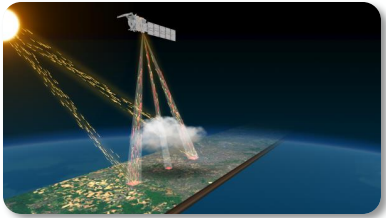


# EarthCARE ATLID *First Images: Debby, Forest Fires*

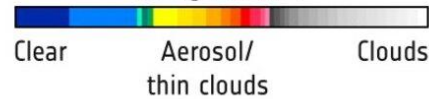




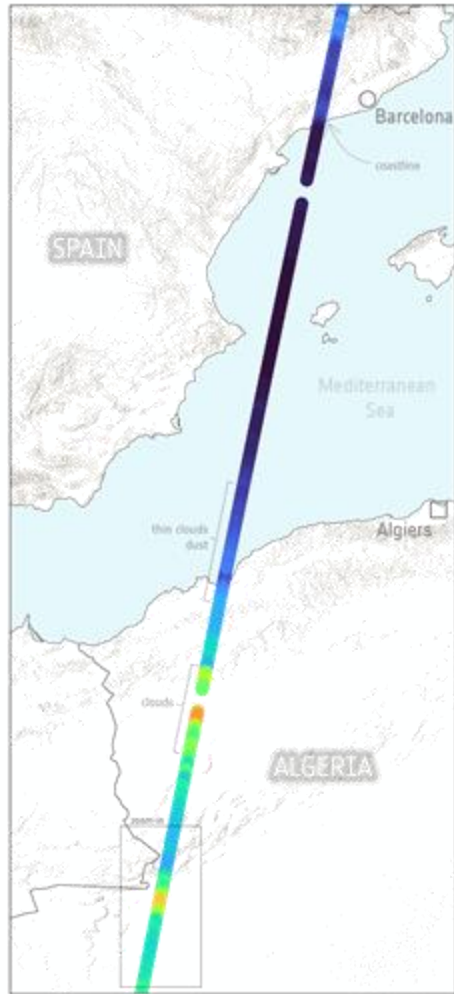
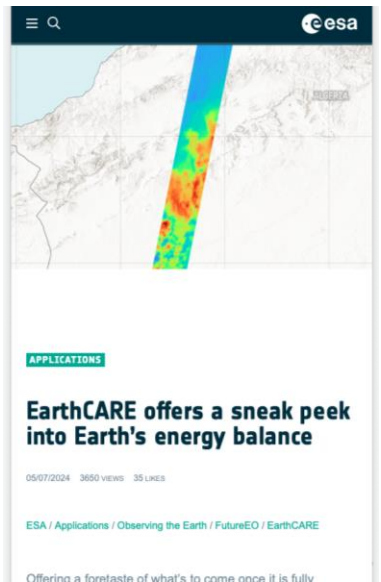
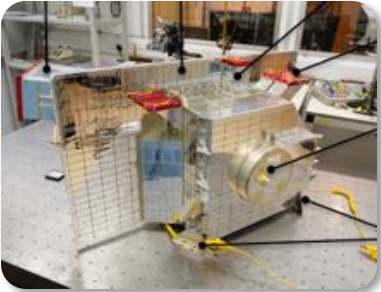
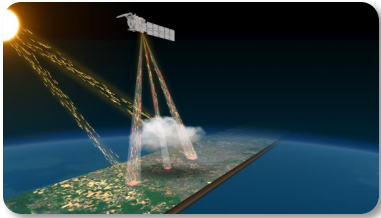
# EarthCARE ATLID *First Images*: Tropical Atlantic



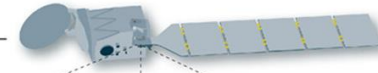
Clouds and aerosols measured by the EarthCARE atmospheric lidar  
3 August 2024



# EarthCARE BBR *First Images*: Med./North Africa



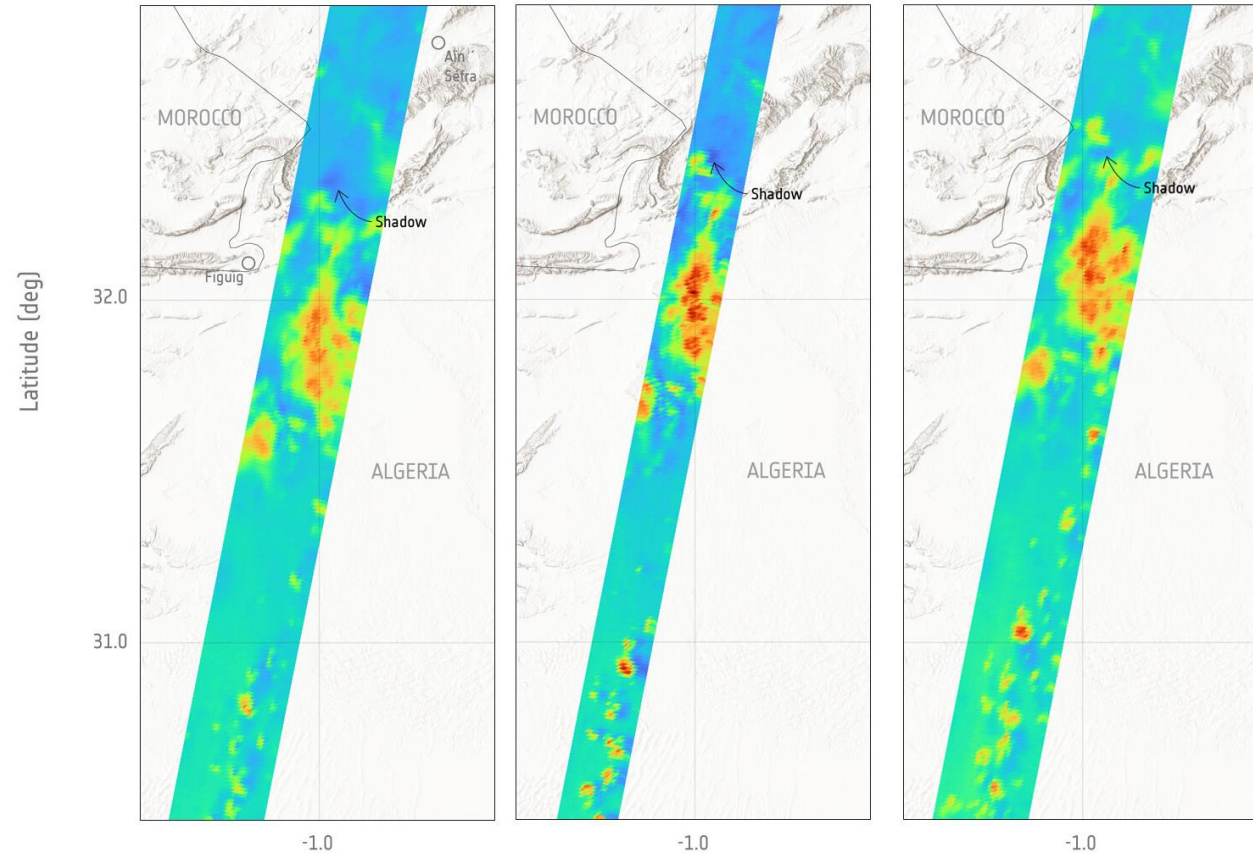
flight direction ←



forward

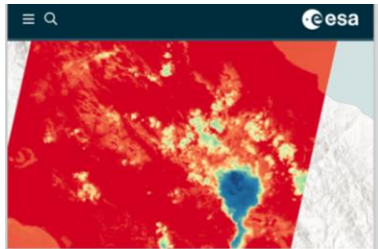
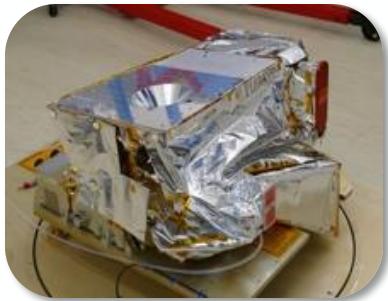
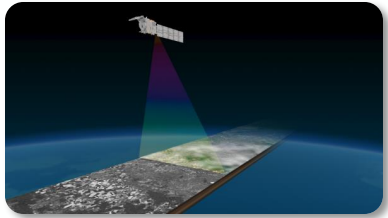
down

backward





# EarthCARE MSI *First Images*: Central Italy

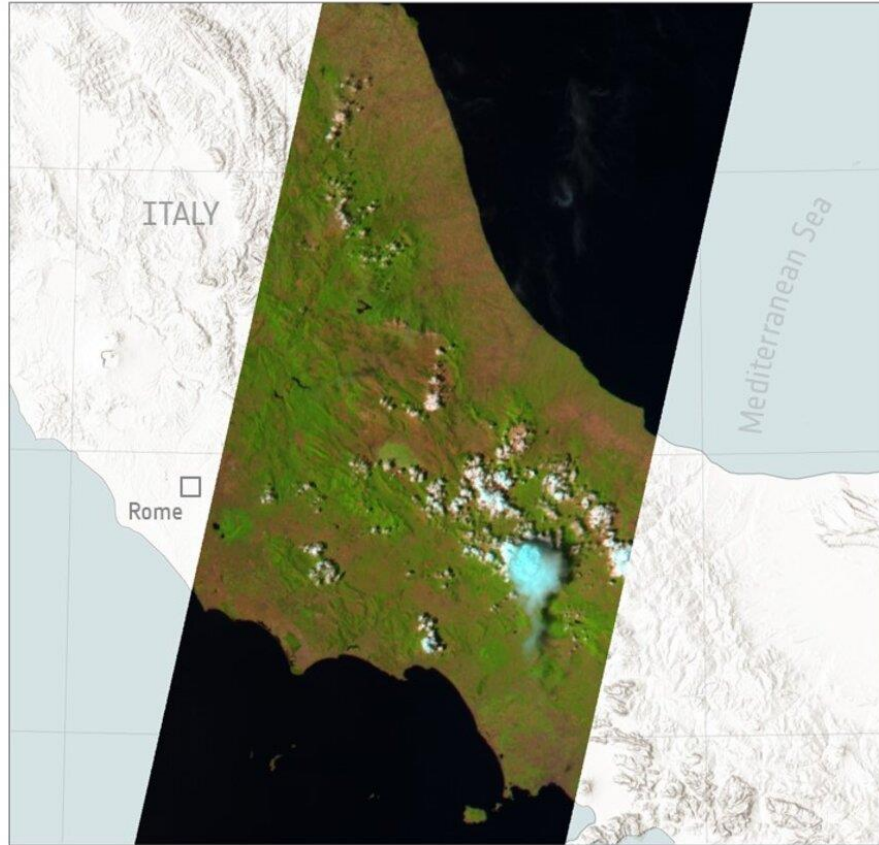


**APPLICATIONS**  
EarthCARE's multispectral imager puts clouds into context

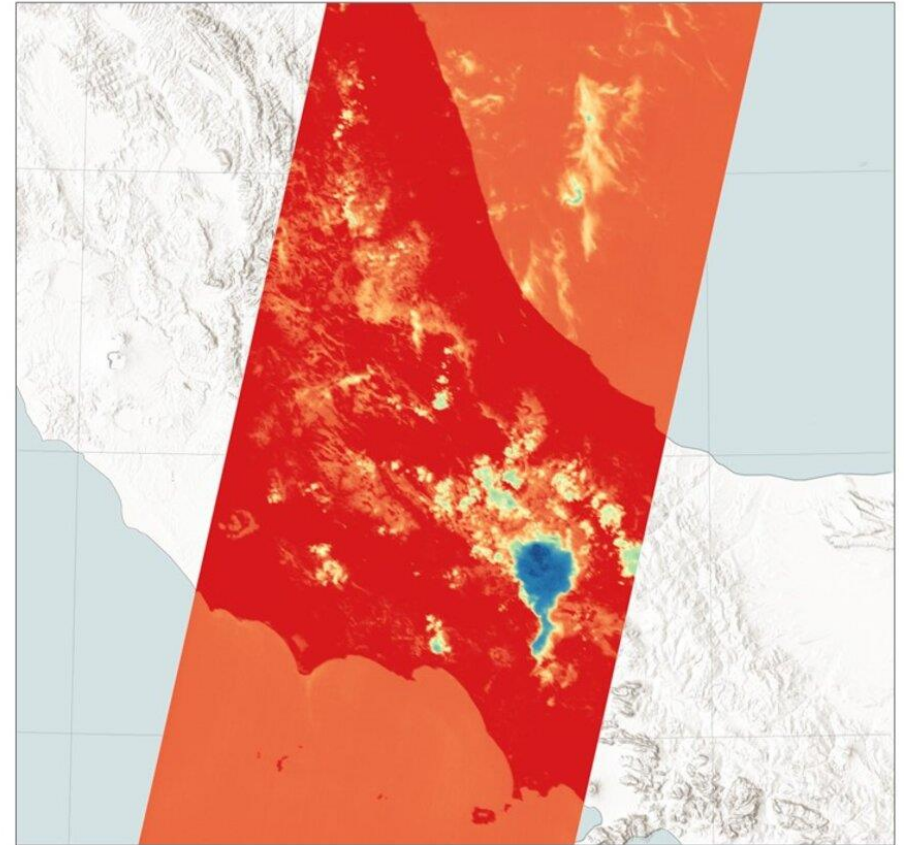
24/07/2024 4171 views 62 Likes

ESA / Applications / Observing the Earth / FutureEO / EarthCARE

VIS-NIR-SWIR1



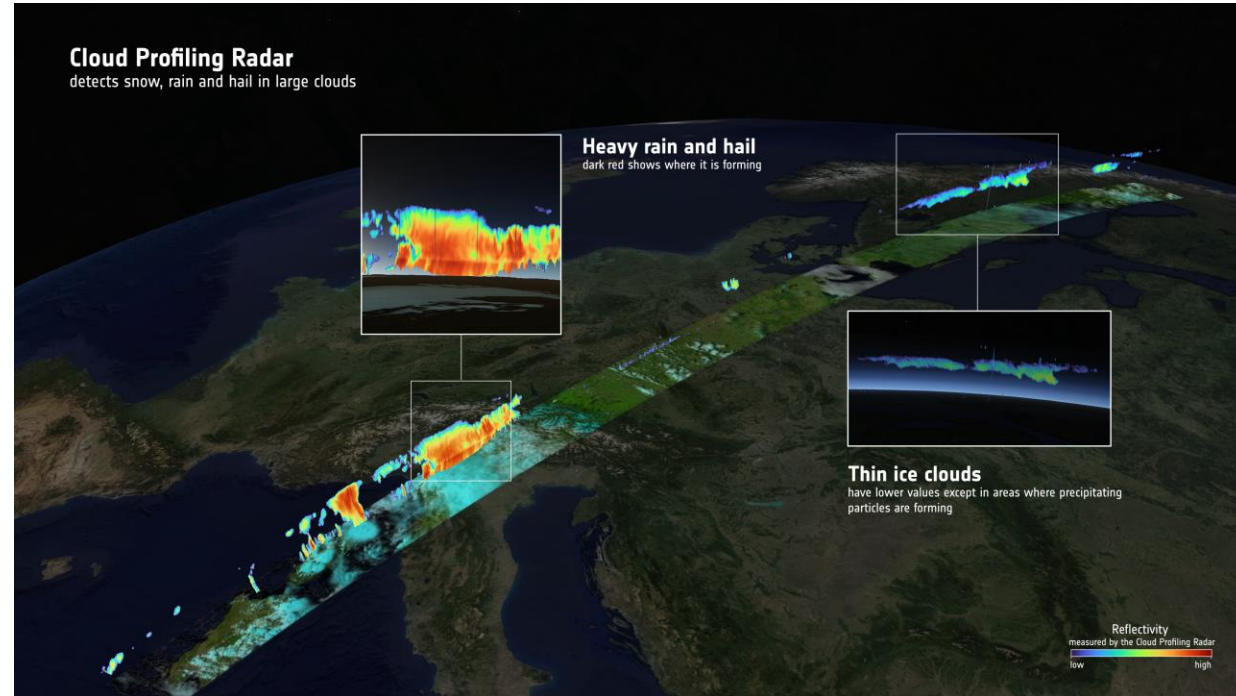
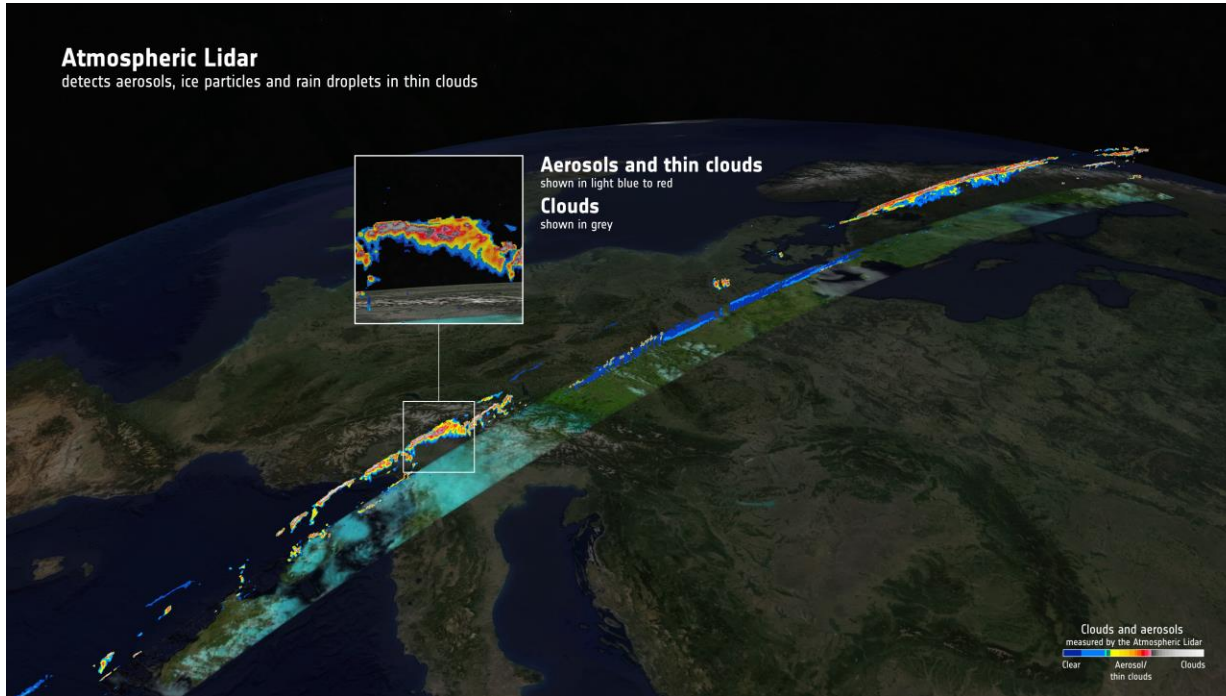
TIR1



Temperature  
17 July 2024



# Data Synergy



\* [https://www.esa.int/Applications/Observing\\_the\\_Earth/FutureEO/EarthCARE/EarthCARE\\_synergy\\_reveals\\_power\\_of\\_clouds\\_and\\_aerosols](https://www.esa.int/Applications/Observing_the_Earth/FutureEO/EarthCARE/EarthCARE_synergy_reveals_power_of_clouds_and_aerosols)

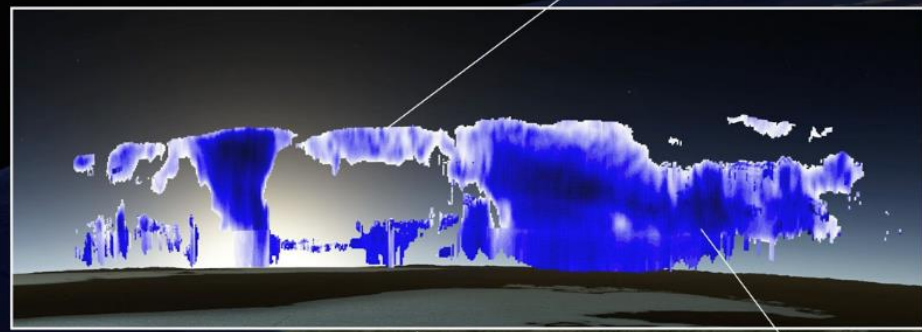




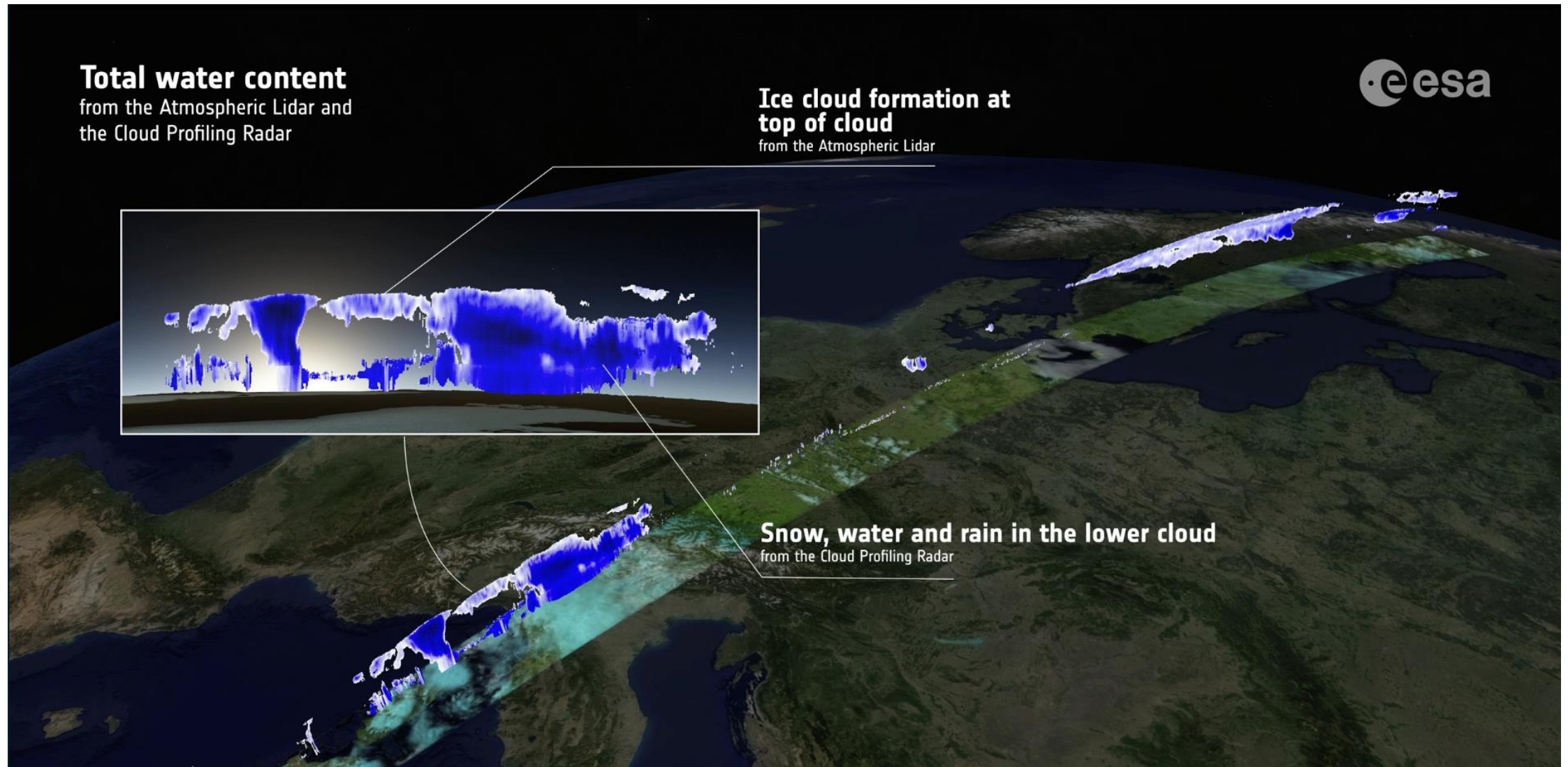


**Total water content**  
from the Atmospheric Lidar and  
the Cloud Profiling Radar

**Ice cloud formation at  
top of cloud**  
from the Atmospheric Lidar

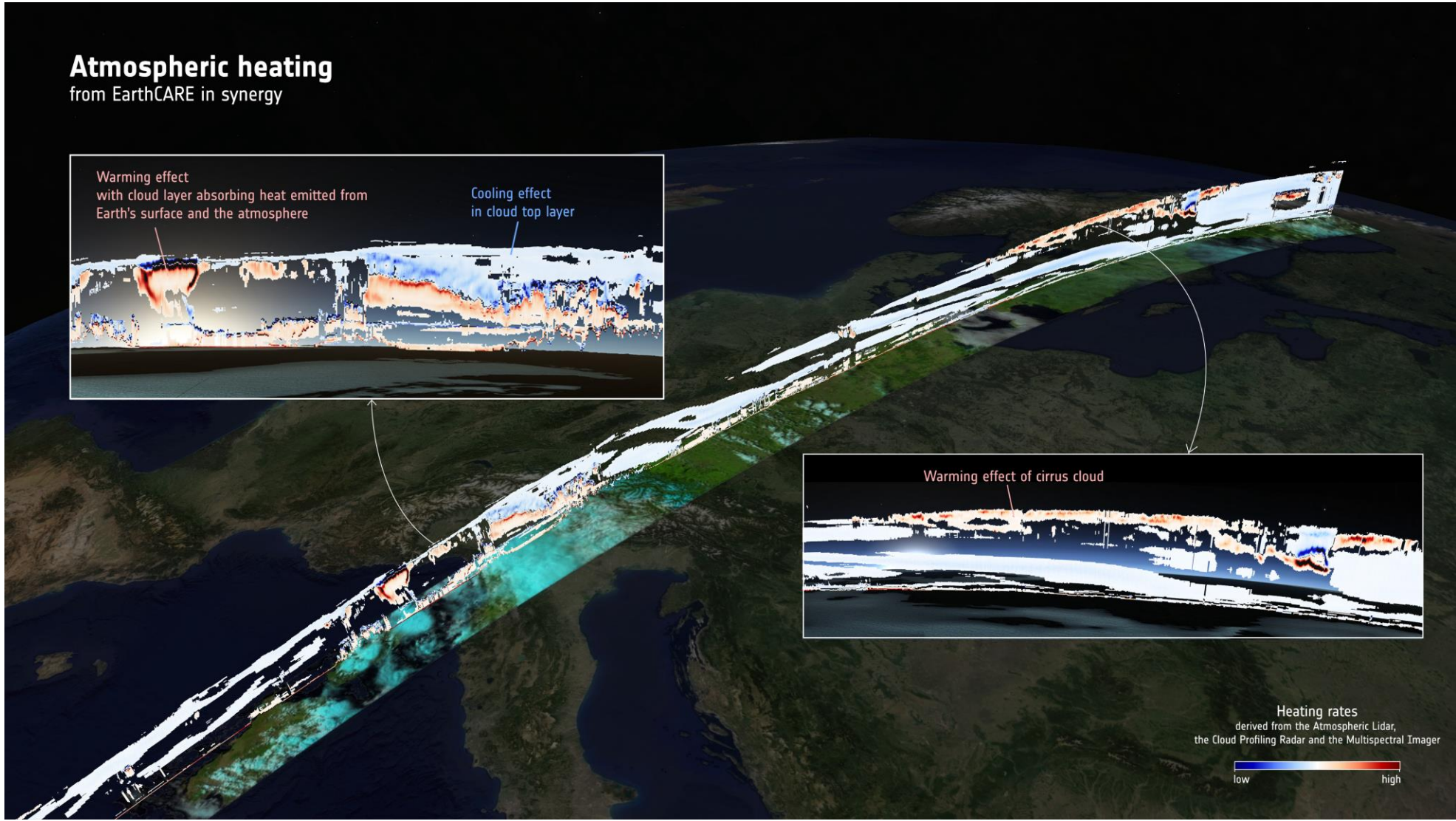
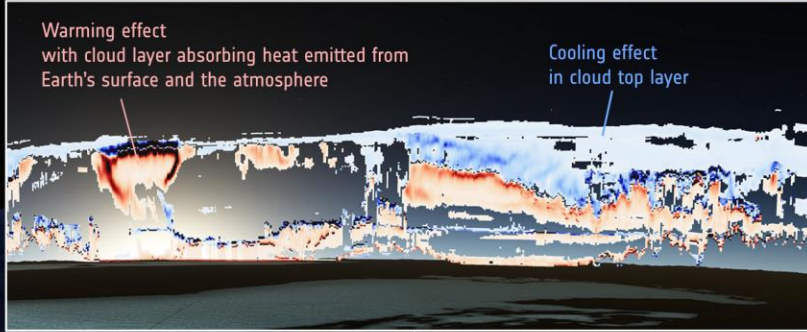


**Snow, water and rain in the lower cloud**  
from the Cloud Profiling Radar





# Atmospheric heating from EarthCARE in synergy





# ESA L1/L2 Status Overview



- L1 product available to ECVT since Q3 2024, release to public underway
- L2a and L2b 2-sensor ESA product rollout to ECVT underway since November 2024, ongoing

## Preliminary Data Release Schedule to Public



→ THE EUROPEAN SPACE AGENCY

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EarthCARE | Mission ▾ Instruments ▾ Data ▾ Events ↗ News ▾

EarthCARE / Data / EarthCARE Data

## EarthCARE Data

### DATA COLLECTIONS

The following EarthCARE collections are available:

- EarthCARE L0 and L1 Products for the Commissioning Team
- EarthCARE ESA L2 Products for the Commissioning Team
- EarthCARE JAXA L2 Products for the Commissioning Team
- EarthCARE L1 Products for Cal/Val Users
- EarthCARE ESA L2 Products for Cal/Val Users
- EarthCARE JAXA L2 Products for Cal/Val Users
- EarthCARE Auxiliary Data for Cal/Val Users
- EarthCARE L1 Products
- EarthCARE ESA L2 Products
- EarthCARE JAXA L2 Products
- EarthCARE Orbit Data

- More information in the dedicated Instrument sessions in the coming days, and :
  - <https://earth.esa.int/eogateway/missions/earthcare/data>
  - <https://ecvt.csde.esa.int/confluence/display/ECAOPI/EarthCARE+Data+Products>