

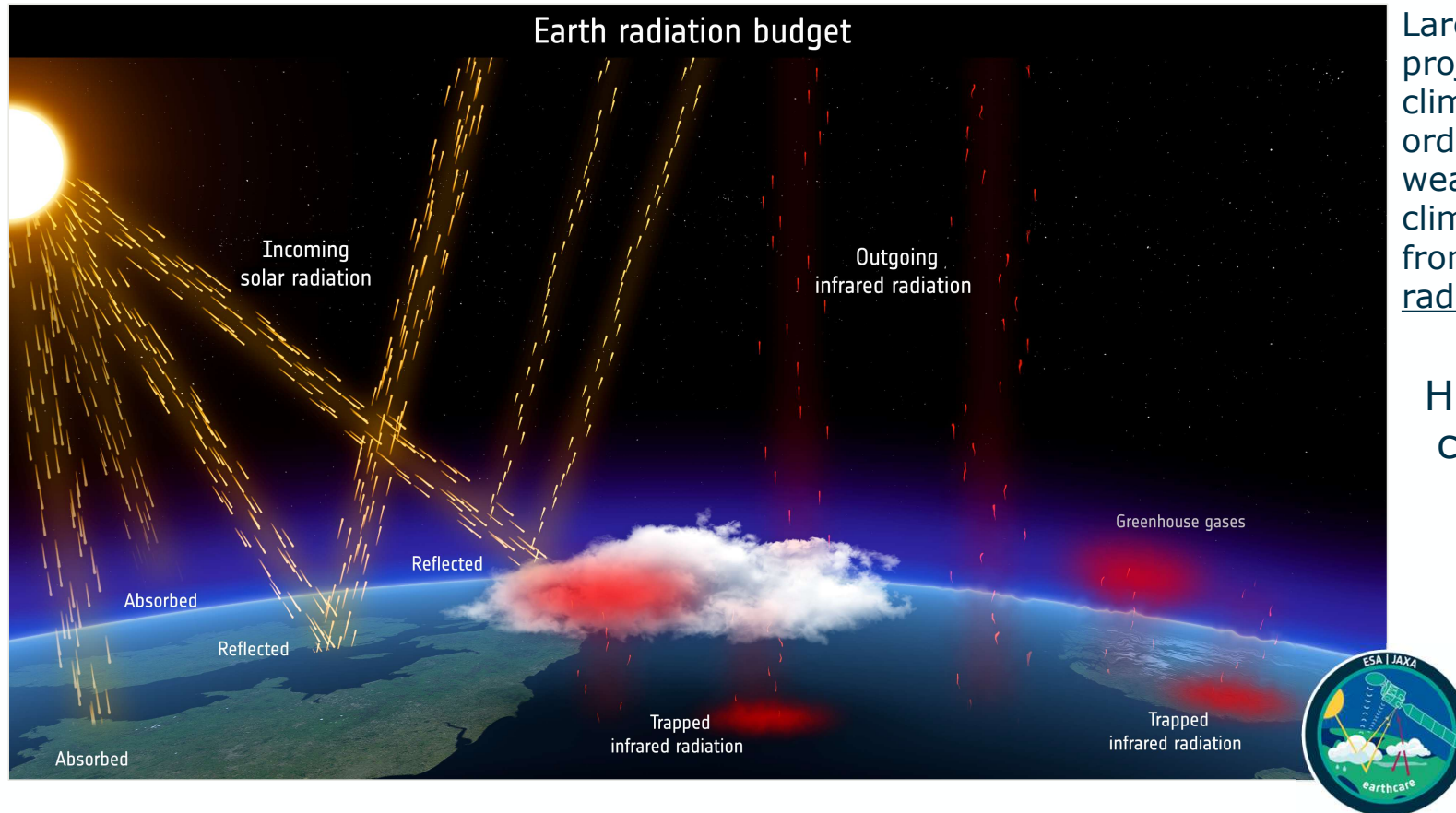
EarthCARE Cal/Val activities

Paolo Castracane (Starion for ESA) on behalf of
Timon Hummel (ESA)

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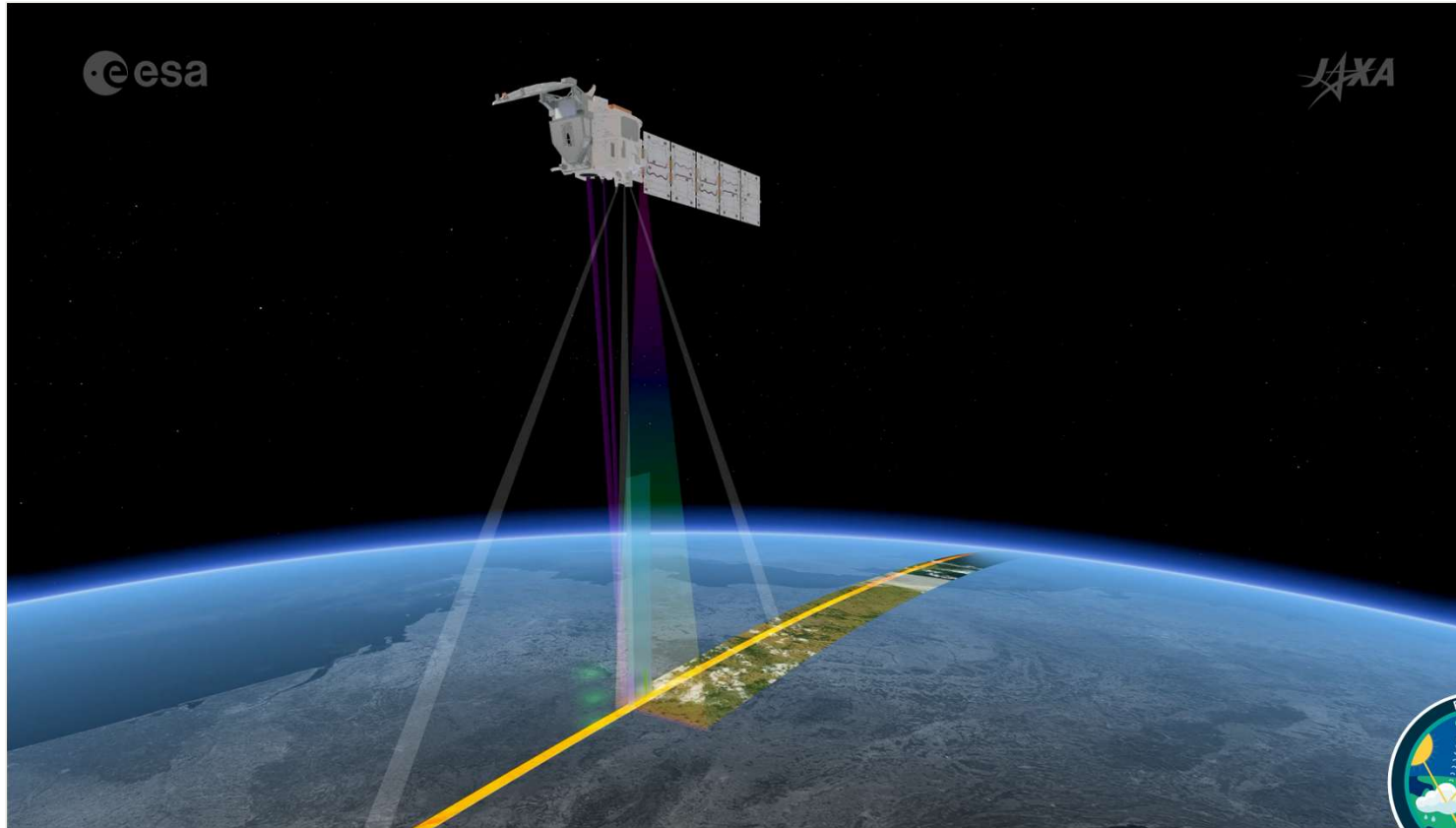
EarthCARE - Mission



Largest uncertainty in projections of the future climate, to be addressed in order to improve numerical weather prediction and climate modelling, comes from cloud, aerosol and radiation interactions.

How do aerosols and clouds, heat or cool the Earth?

EarthCARE – Mission Objective



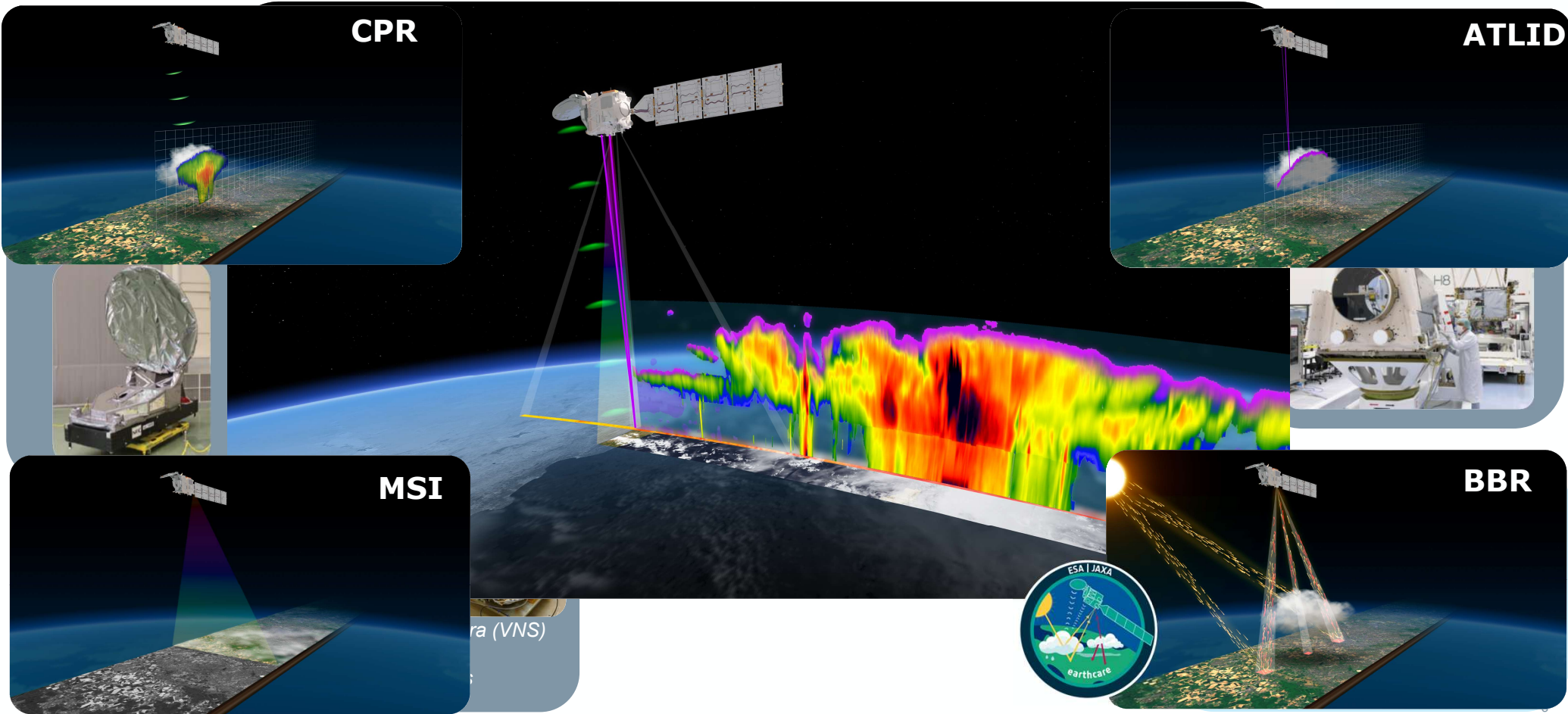
Systematic provision of vertical profiles of clouds and aerosols, with measurements of solar and emitted thermal radiation

How do aerosols and clouds, heat or cool the Earth?

Direct verification of impact of clouds and aerosols on atmospheric heating rates and radiative fluxes.

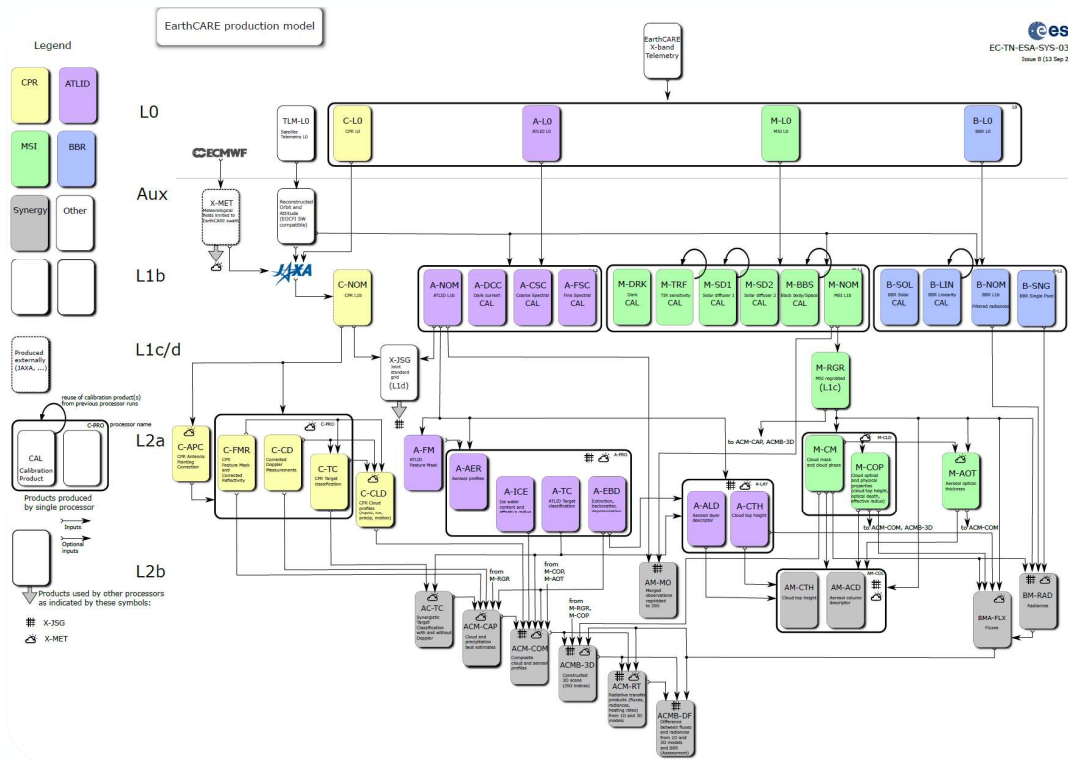


EarthCARE – Space Segment



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EarthCARE ESA Production Model



- 24 Data Processors
- 47 Data Products
- 25 Level 2 Science Products
- Level 2 product chains at ESA and JAXA

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

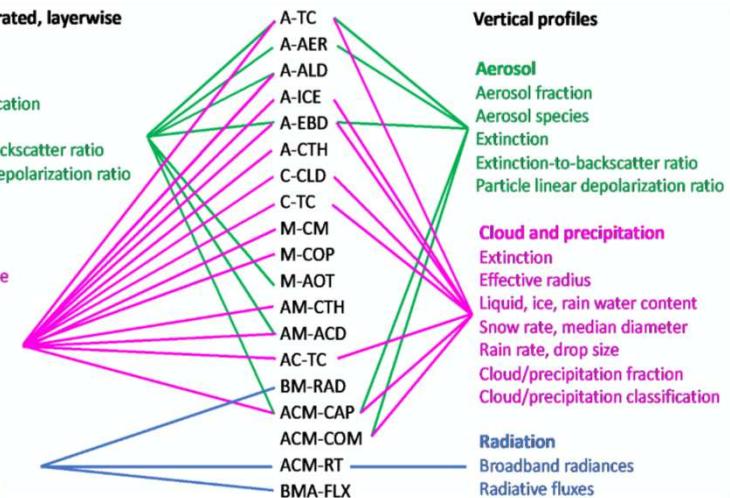
Radiation
Radiative fluxes at TOA
Broadband radiances at TOA

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



Data Release Schedule



17 March
2025

14 Jan 2025 Level 1b Single Sensor Products

Level 2a Single Sensor Products
Level 2b Two Sensor Products

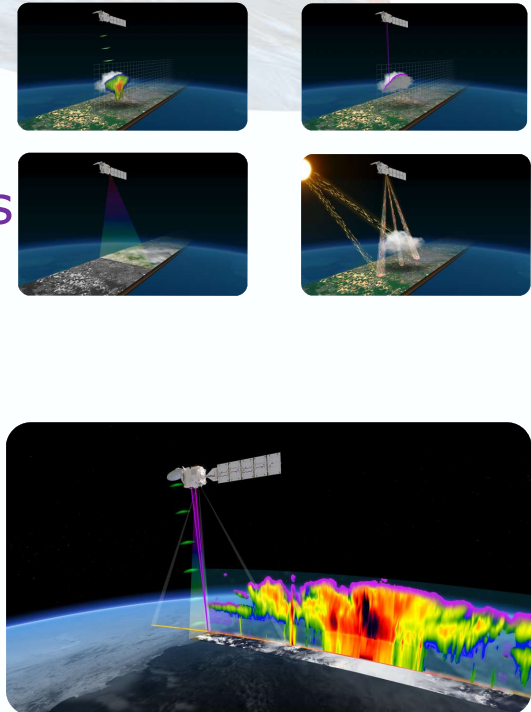
Dec 2025

Level 2b Synergistic Products*

* Earlier release possible if of sufficient quality

Free and Open Data Policy

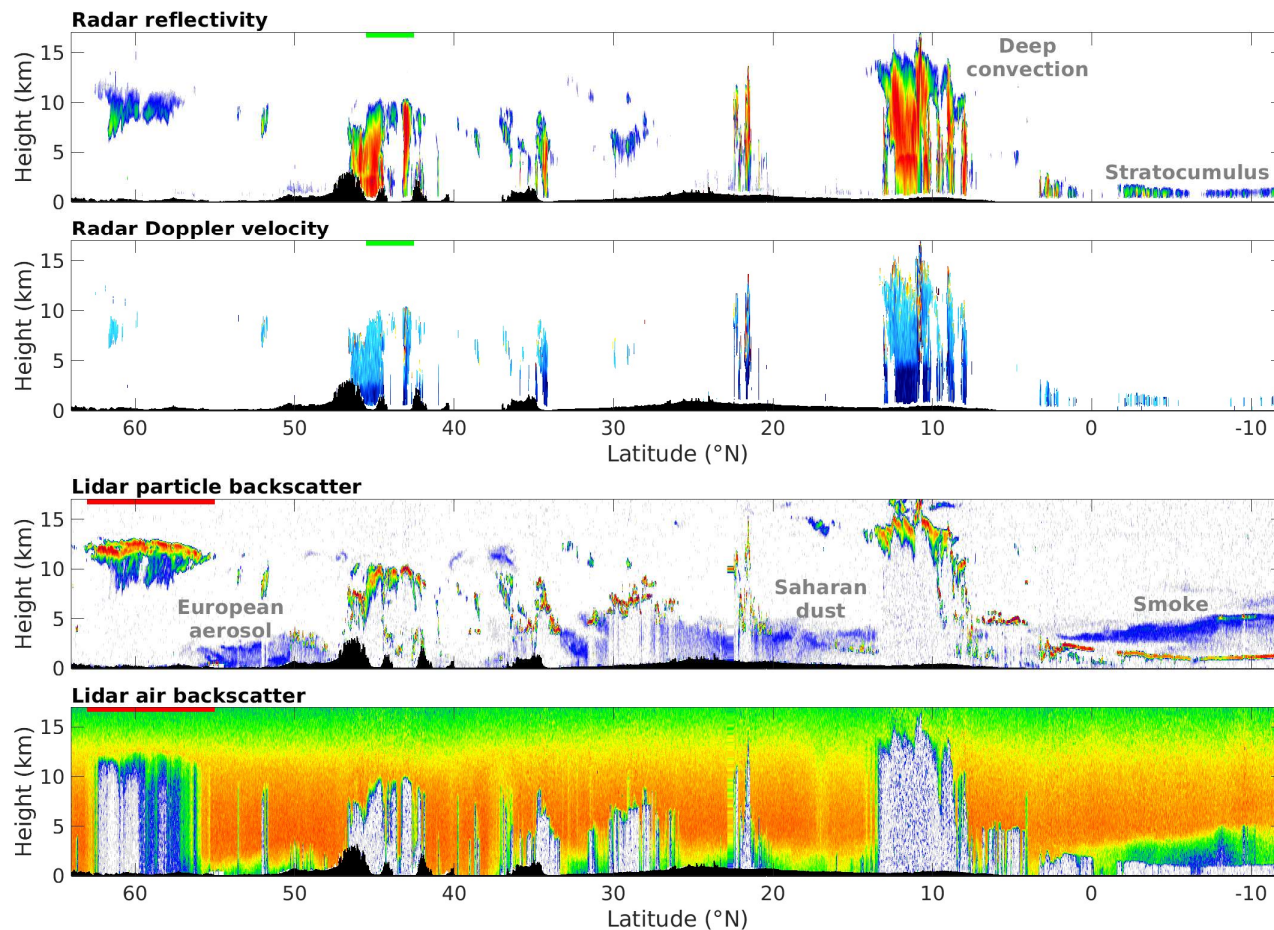
<https://earth.esa.int/eogateway/missions/earthcare/data>



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First Results: Level-1

Credits: Robin Hogan (ECMWF)



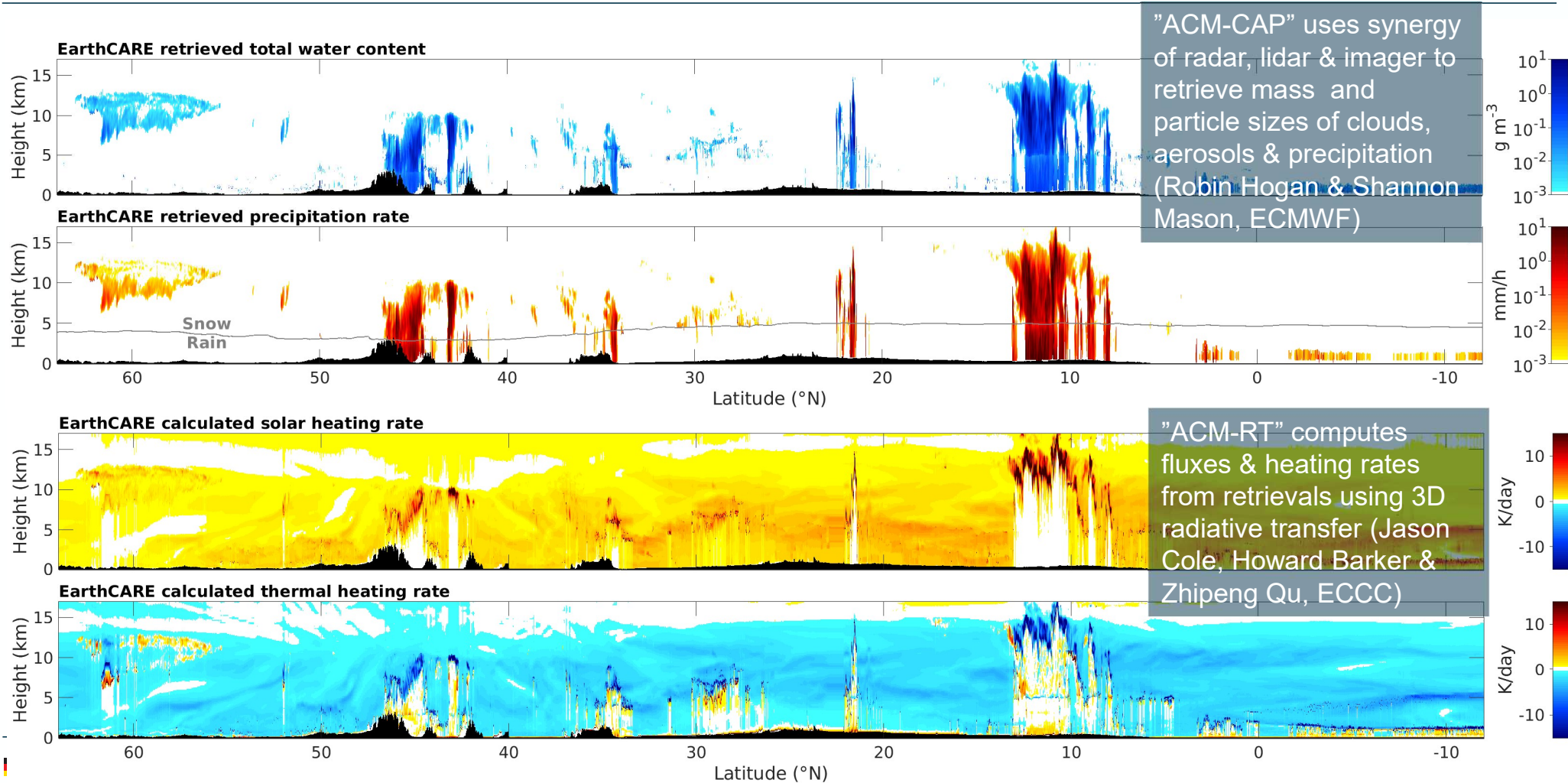
CPR:

- In stratiform clouds we measure rain and snow fall speeds
- Infer raindrop mean diameter and snow rimed fraction, as well as rain/snow rates
- Strength and width of modest updrafts can be characterized (folding velocity 5-6 m/s)

ATLID:

- HSRL separates backscatter due to particles ("Mie") and air ("Rayleigh")
- Attenuation of air gives unambiguous estimate of profile of particle extinction coefficient, most important radiative property of clouds or aerosols

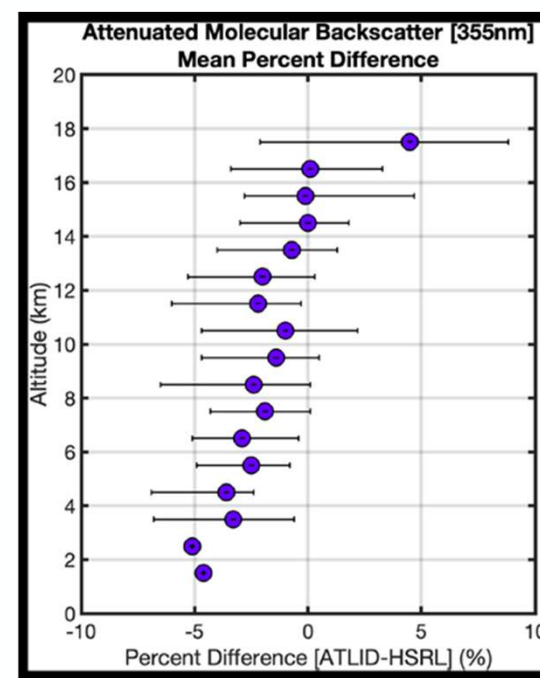
First Results: Level-2





- 10

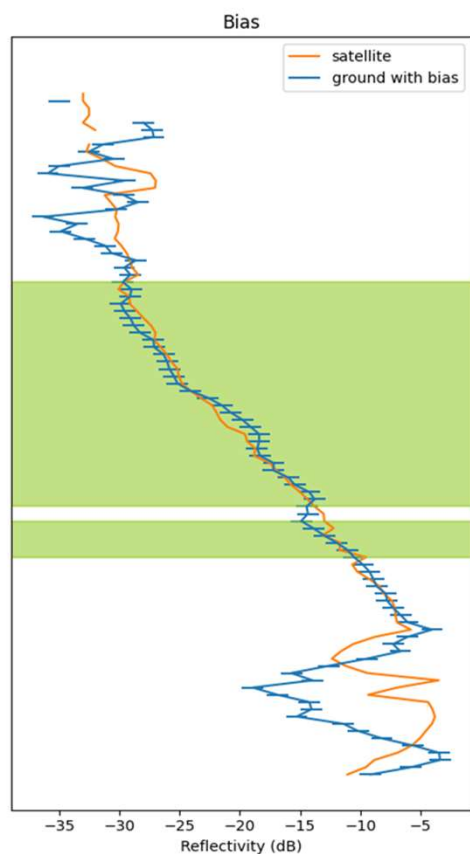
Excellent intercomparison results for ATLID L1 data from airborne HSRL data, but also some biases identified.



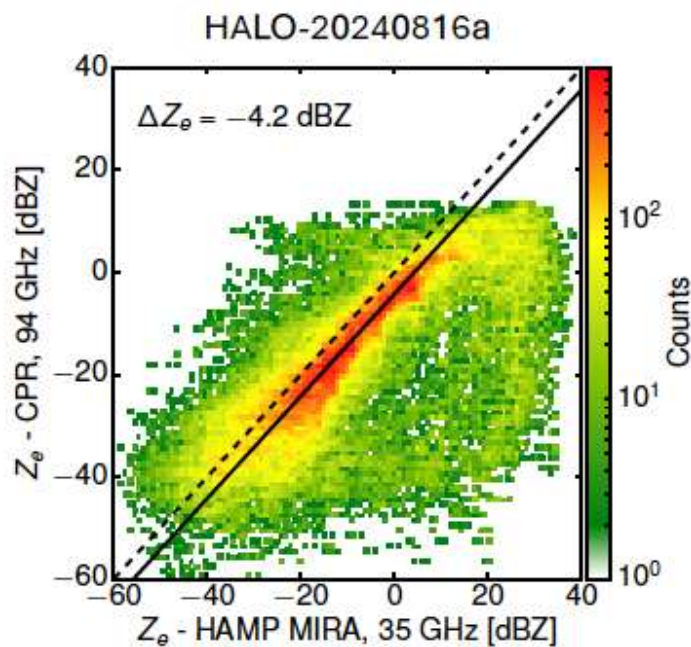
CPR Validation Level-1

Comparison with ground-based/airborne observation shows about -4 dB bias (w/o external cal. result)

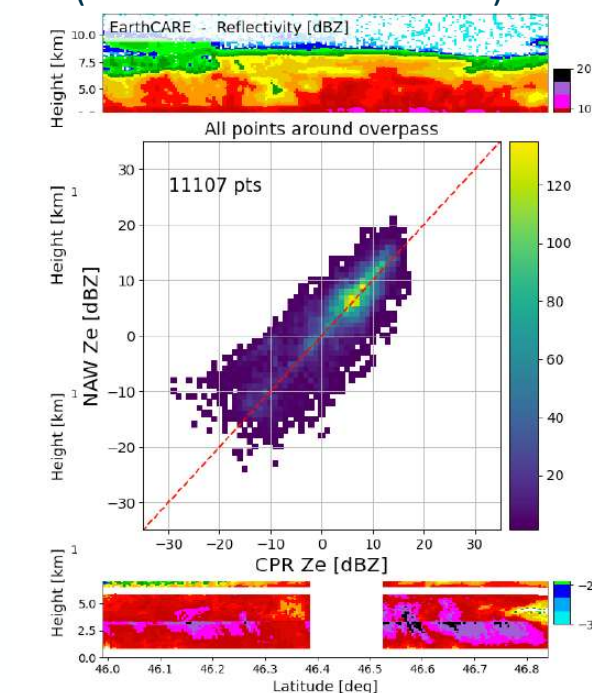
ACTRIS' ground-based radar network



Comparison with MIRA onboard HALO



Comparison with NAW
(after +5 dB offset for CPR)



EarthCARE Work in progress



- Commissioning activity finalized with industry and **L1 and L2a + two-sensor L2b data public**
- **Validation activities** show very promising results and good performance.
- Data delivery performance is being optimised with **data latency** target at Level 2 being 60% of data within 5.5 hours
- **Cal/Val Workshops:**
 - Level 1b in 14-17 January 2025 (online)
 - Level 2a + 2b two-sensor synergy 17-20 March 2025 (ESA-ESRIN, IT)
- **Science Workshop:**
01-05 December 2025, Tokyo, Japan
- **EarthCARE Science Meeting** in the frame of ESA's Living Planet Symposium (LPS25) in June 2025 (Vienna, AT)

