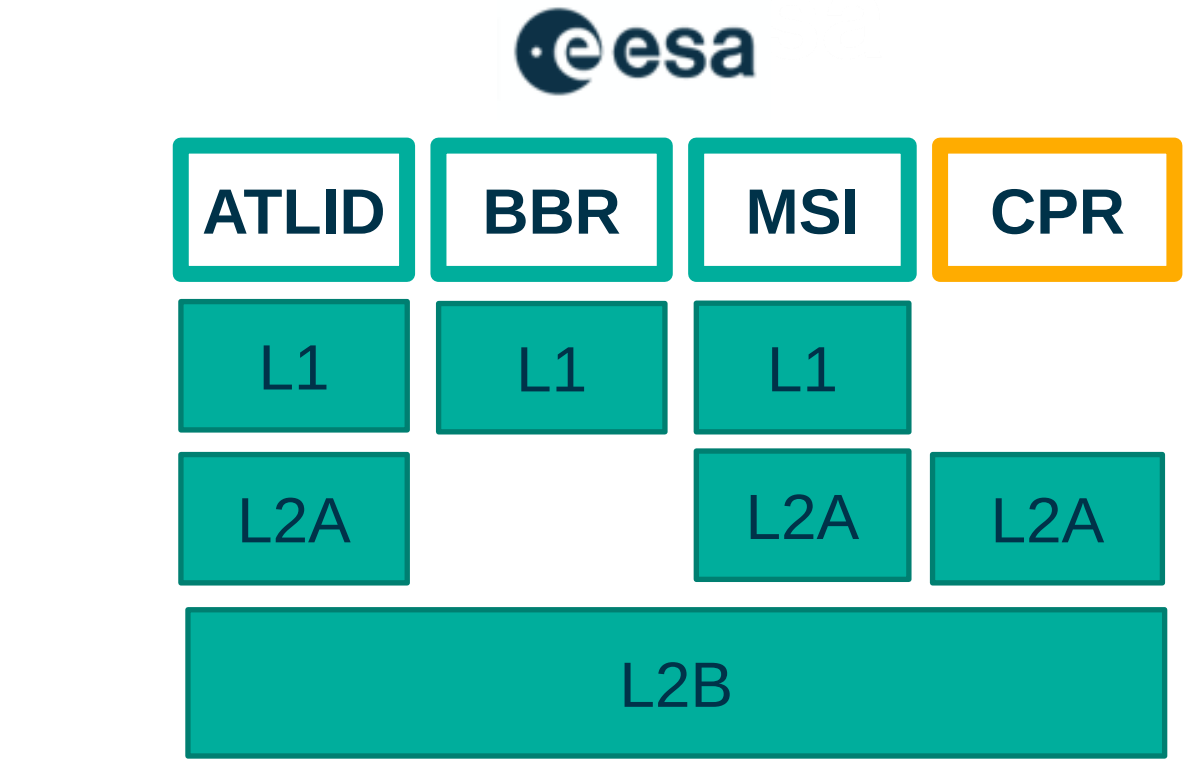
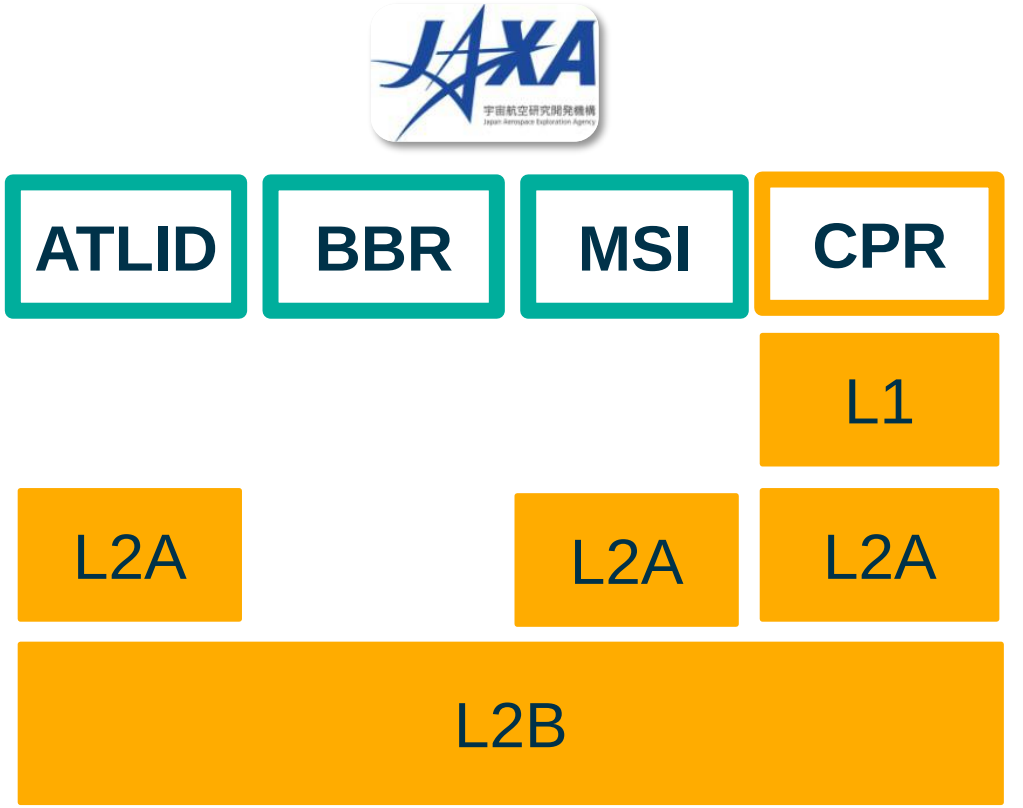
Latest Developments in EarthCARE's Processors and Products

Timon Hummel and the EarthCARE Team

EarthCARE processors



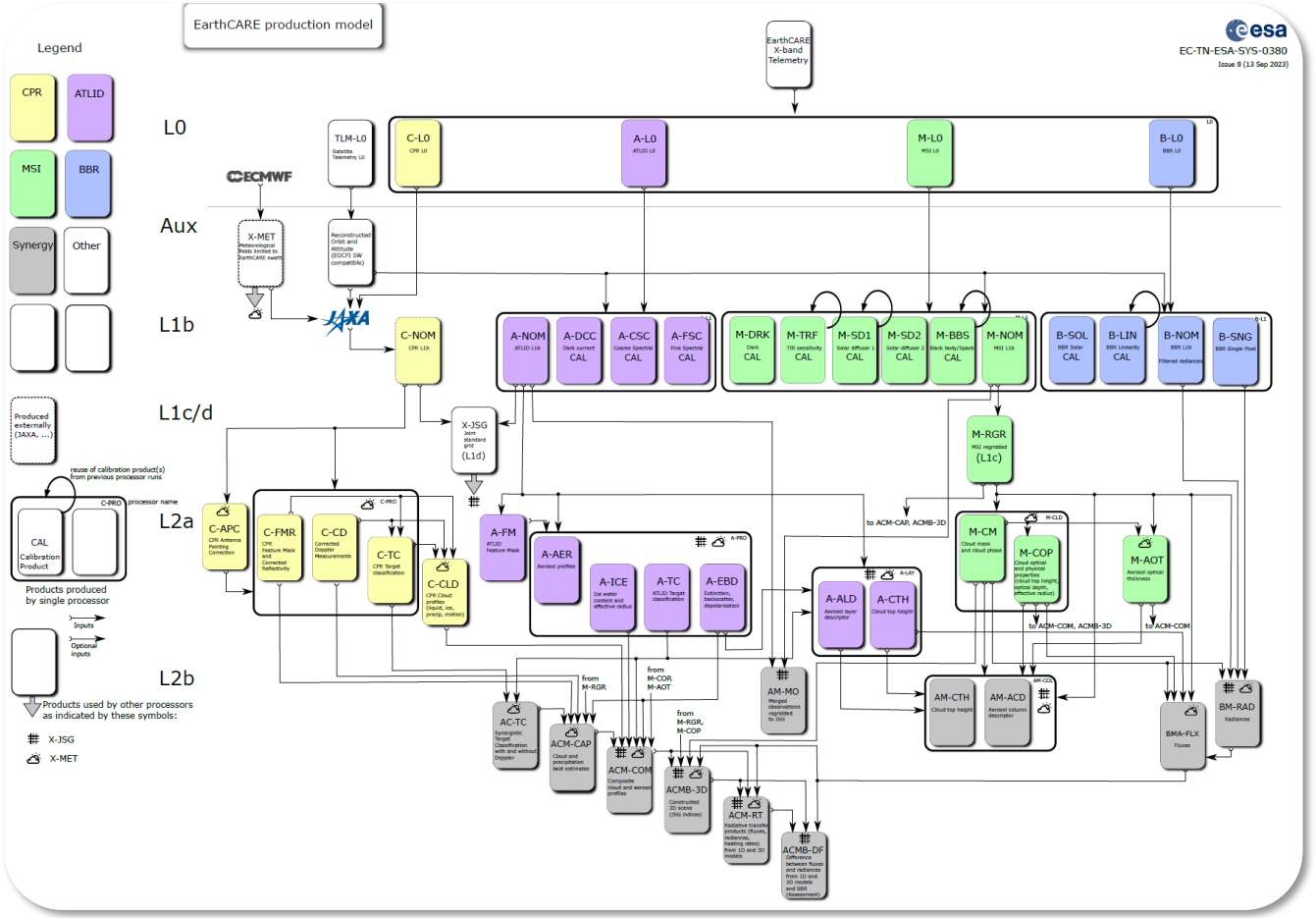


Aux Proc

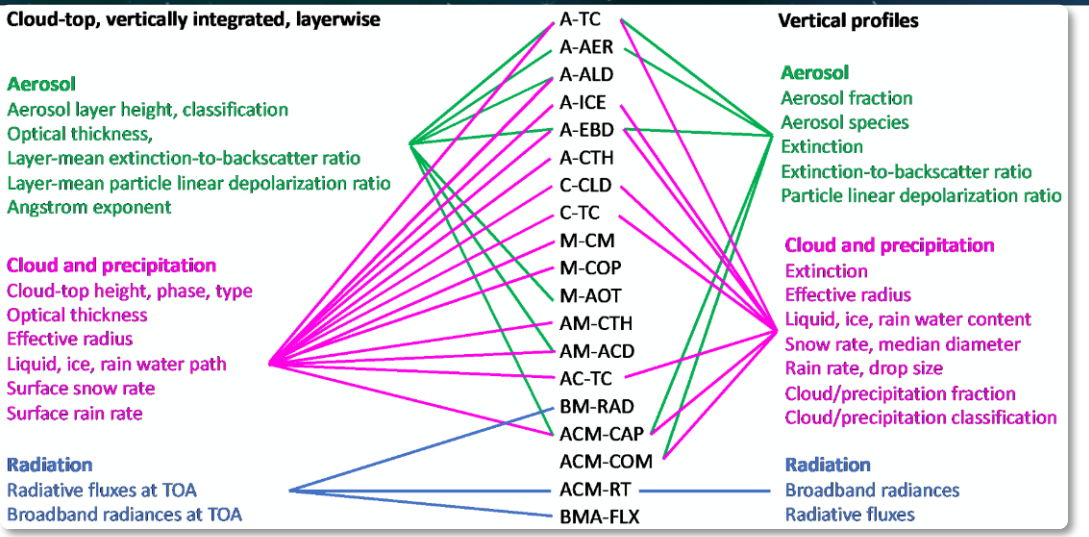
X-JSG | X-MET

Status: Processors suite fully installed at Ground-Segments.
First results from CPR and BBR Level-1.

EarthCARE production model (ESA)



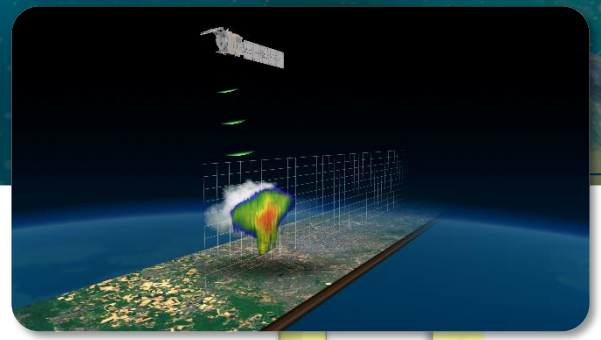
AMT special issue
https://amt.copernicus.org/articles/special_issue1156.html

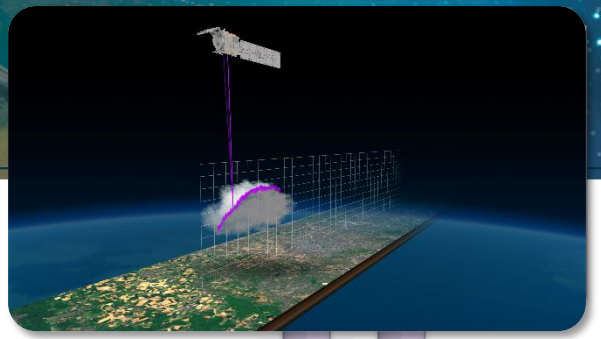


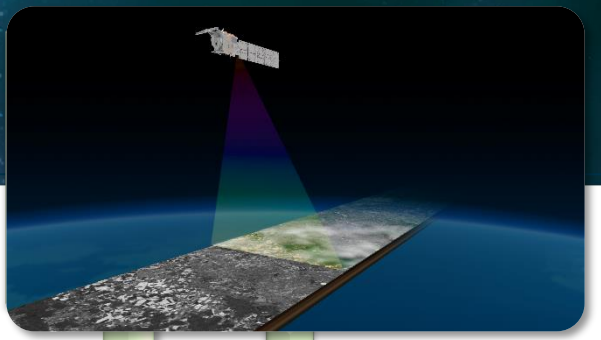
- 2 Level-2 chains at ESA and JAXA
- 24 Data Processors (ESA chain) developed by Scientific Team (CARDINAL – P.I. : KNMI)
- Target data release dates after launch (L):

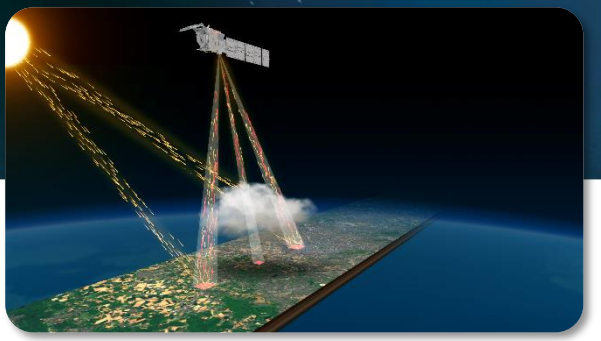
Level 1	Level 2a	Level 2b
L + 6 months	L + 9 months	L + 18 months
~Dec. 2024	~March 2025	~Dec. 2025

- EarthCARE Cal/Val and Science Workshops coordinated along with the data release









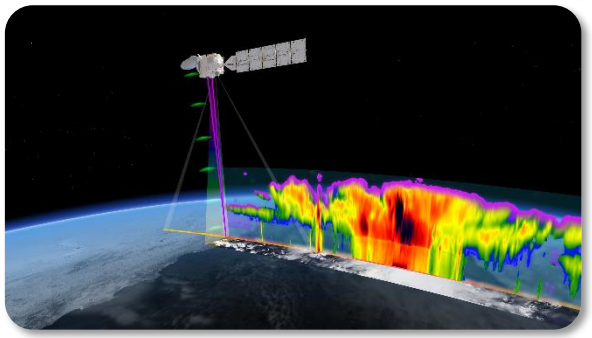
CPR Level 2a
Radar echo product, feature mask, cloud type, liquid and ice cloud properties, vertical motion, rain and snow estimates, ...

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, ...

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

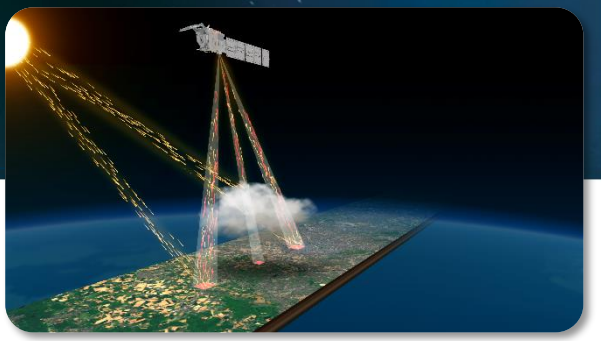
EarthCARE
Data Production
Model



CPR Level 1b (JAXA)
Radar reflectivity and Doppler velocity profiles

ATLID Level 1b (ESA)
Attenuated backscatter in
- Rayleigh channel
- Co-polar Mie channel
- Cross-polar Mie channel

MSI Level 1b/c (ESA)
TOA radiances for four solar channels, TOA brightness temperatures for three thermal channels



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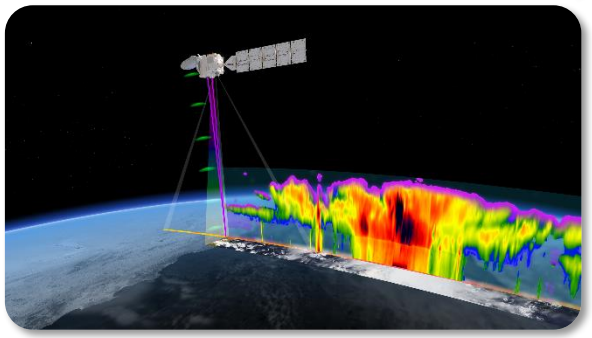
EarthCARE Data Production Model



3D Scenes Construction
Expand syn. retrievals across-track using MSI; ≈40km wide

Radiative Transfer Products
calculated radiances, fluxes, heating rate profiles

CPR Level 1b (JAXA)
Radar reflectivity and Doppler velocity profiles

ATLID Level 1b (ESA)
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- Rayleigh channel
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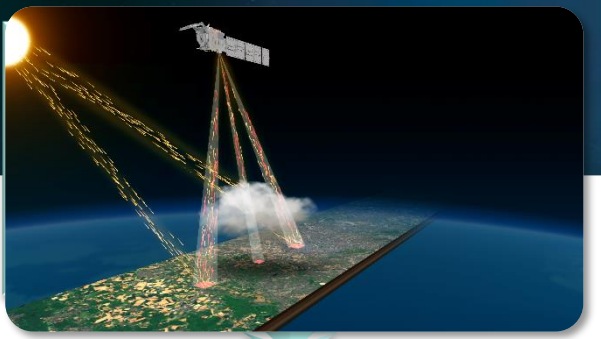


CPR Level 2a
Radar echo product, feature mask, cloud type, liquid and ice cloud properties, vertical motion, rain and snow estimates, ...

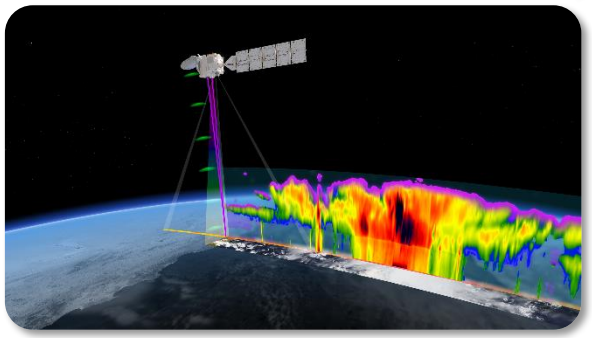
ATLID Level 2a
Feature mask and target classification, extinction, backscatter & depol. profiles, aerosol properties, ice cloud properties, ...

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

EarthCARE Data Production Model



3D Scenes Construction
Expand syn. retrievals across-track using MSI; ≈40km wide

Assessment

Radiative
calculated
heating rate profiles

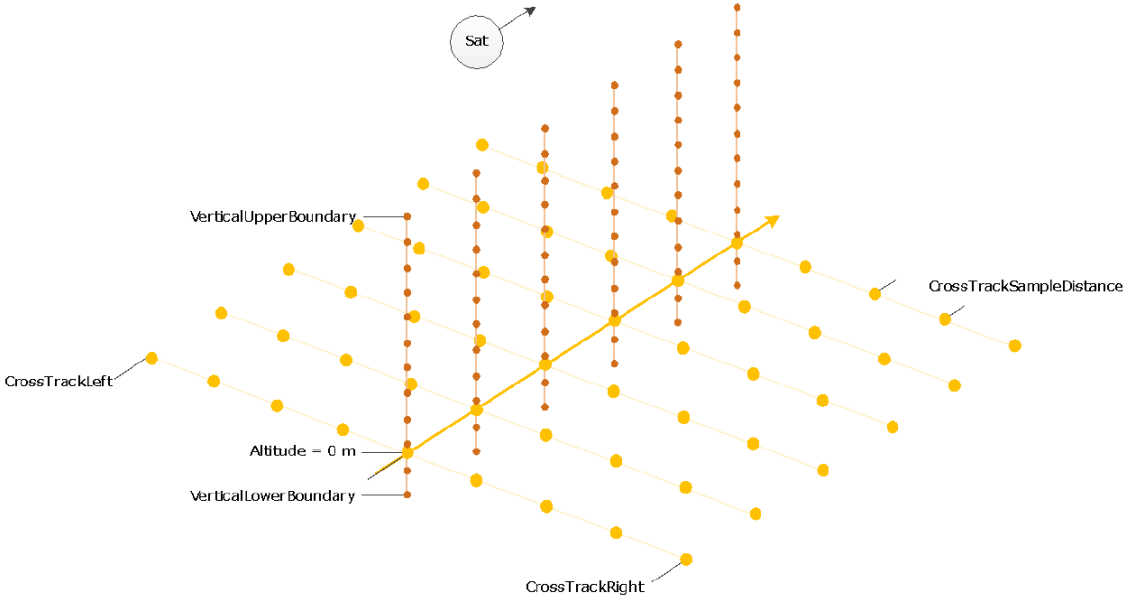
P6.10	Overview of the EarthCARE Cloud, Aerosol and Radiation science products.	Gerd-jan Van Zadelhoff KNMI

X-JSG: The Joint Standard Grid

- Spatial grid for use in EarthCARE synergy (L2b) processors and products
- Combination of two 2D grids (“inverted T”) to define a 3D grid:
- Horizontal (along track, across track) and Vertical (along track, height)
- Grid is continuous (no gaps)

<u>Processor input:</u>

- Horizontal grid from CPR
- Vertical grid from ATLID



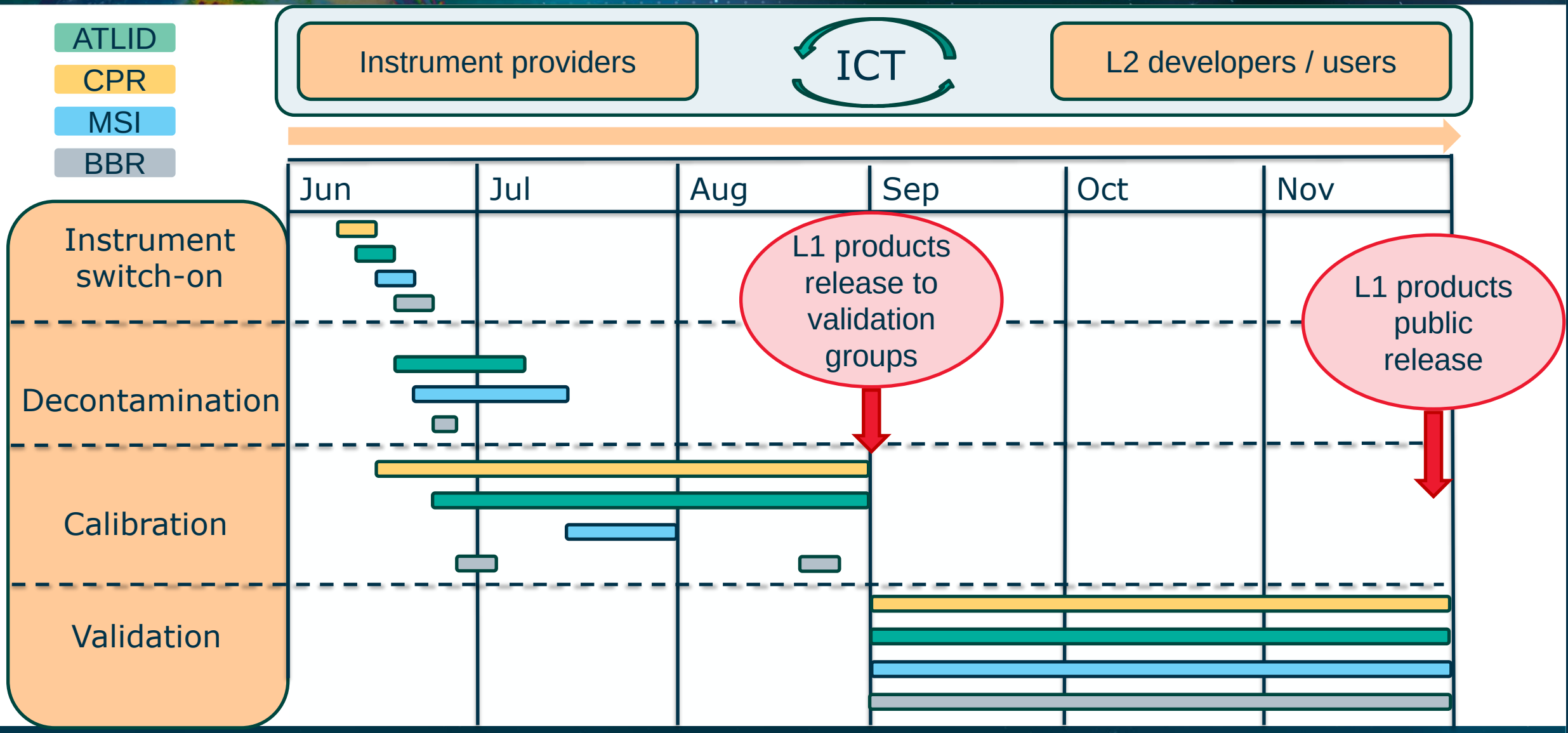
<u>Status</u>: Operational and continuously disseminated to the processing chain

X-MET: Meteorological fields for EarthCARE swath

- Meteorological parameters from ECMWF deterministic forecast runs for the EarthCARE swath and overpass time on the original model spatial grid.
- This allows a reduction of the data volume by a factor of about 15 compared to global fields (from 750 GB/day to 54 GB/day).
- Model parameters to be extracted to X-MET have been selected based on the needs of EarthCARE level 1 and level 2 processors. The list of model parameters is configurable.
- Some parameters in X-MET are derived from a combination of model parameters.
- Used in most EarthCARE data processors

Status: Operational and continuously disseminated to the processing chain

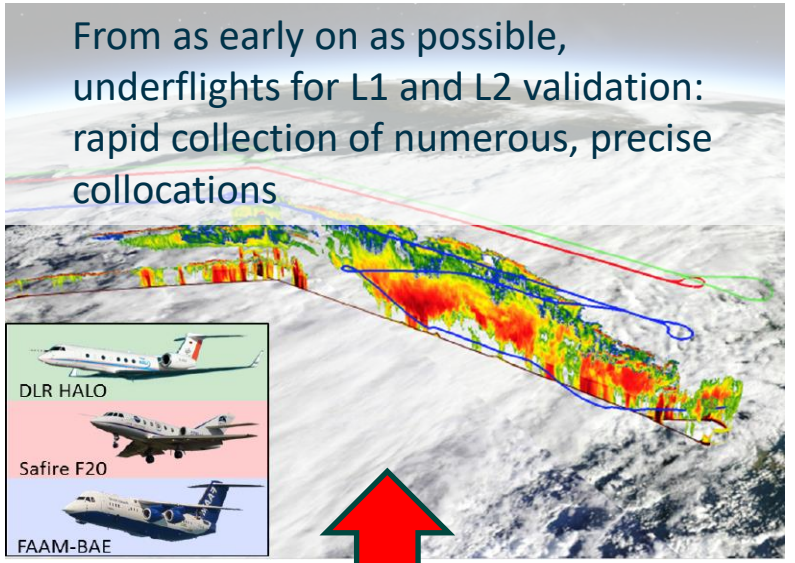
Status and Commissioning Timeline



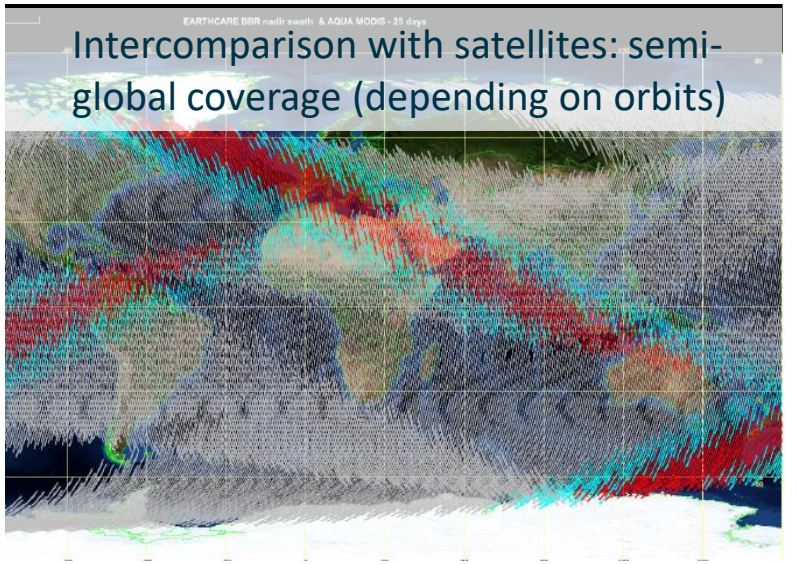
ESA Validation Approaches

Parallel surface-based/network data acquisition, continuously, over the mission lifetime: slower collection of collocations but broader coverage of geophysical and meteorological conditions

From as early on as possible, underflights for L1 and L2 validation: rapid collection of numerous, precise collocations



Intercomparison with satellites: semi-global coverage (depending on orbits)

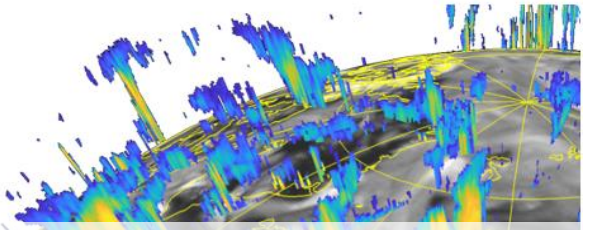


Airborne Campaigns

Satellite-Satellite

Networks

Assimilation



Systematic monitoring (including calibration drift detection) of radar and lidar data with NWP model, starting from launch

Conclusion

- Cloud, aerosol and radiation interaction are currently still one of the largest source of uncertainty in projections of the future climate.
- Synergy between L2 processors and L1 data streams will enable direct verification of the impact of clouds & aerosols on atmospheric heating rates and radiative fluxes.
- An extensive suite of Level-1 and Level-2 processors has been installed in ESA's ground segment, with currently ongoing commissioning activities for the instruments and processors.
- Level-1 data release is planned for December 2024, followed by Level-2a and two-sensor Level-2b products in March 2025, and three/four-sensor Level-2b products in December 2025.
- Continuous product validation approaches are being performed during and beyond the commissioning phase.