



EarthCARE 2026 Science and Validation workshop

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Validating EUMETSAT Cloud and Aerosol Products with EarthCARE: Insights from the Clouds and Aerosols analysis from its GEO+LEO satellites

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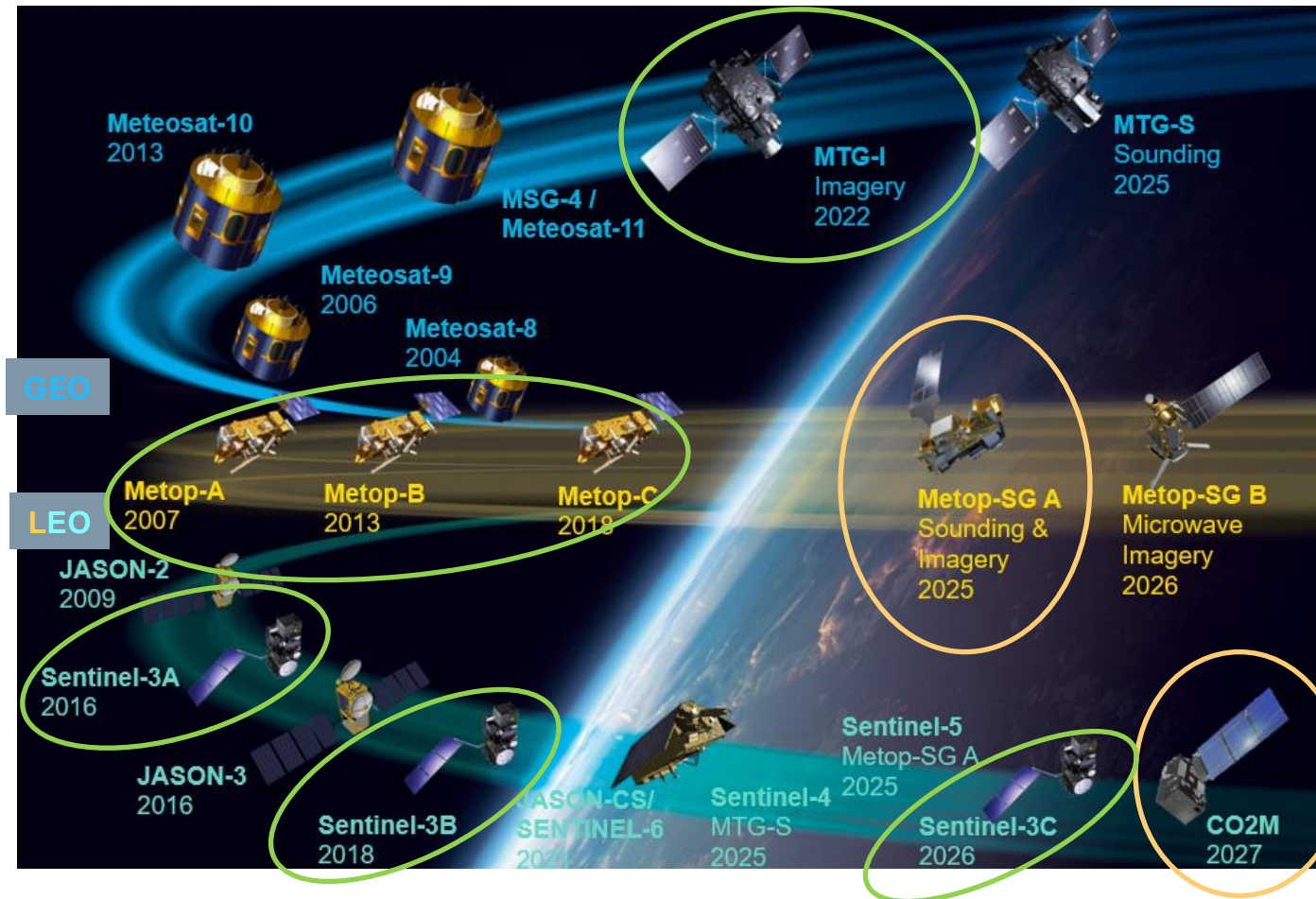


EUMETSAT – Cloud and Aerosols operational products

Current, under development phase and future



GEO and LEO missions



Operational products

Dissemination to operational users,
Near Real Time delivery (<3h from sensing time),
Robustness (availability),
Documented performance (validation report),
Stability of the performance,
Monitoring of the performance,
Continuous improvements,
Products tailored to user needs

Observation of Clouds

- MTG-I/FCI Cloud Mask, Type, CTTH, COT since 2025
- EPS-SG/VII CTT/CTP, COT, Top Phase, CER
- S3/SLSTR+OLCI NRT Cloud products
- ...

Observation of Aerosols

- EPS/PMAp NRT AOD (synergy) since 2014
- S3/SLSTR NRT AOD since 2020
- S3/SLSTR+OLCI NRT AOD (synergy)
- S3/OLCI ALH
- EPS-SG/3MI NRT AOD + Aerosol characterization
- EPS-SG/MAP NRT Aerosols (synergy)
- CO2M/MAP NRT Aerosols
- MTG-I/FCI NRT Aerosols
- S3-NGO NRT Aerosols
- ...

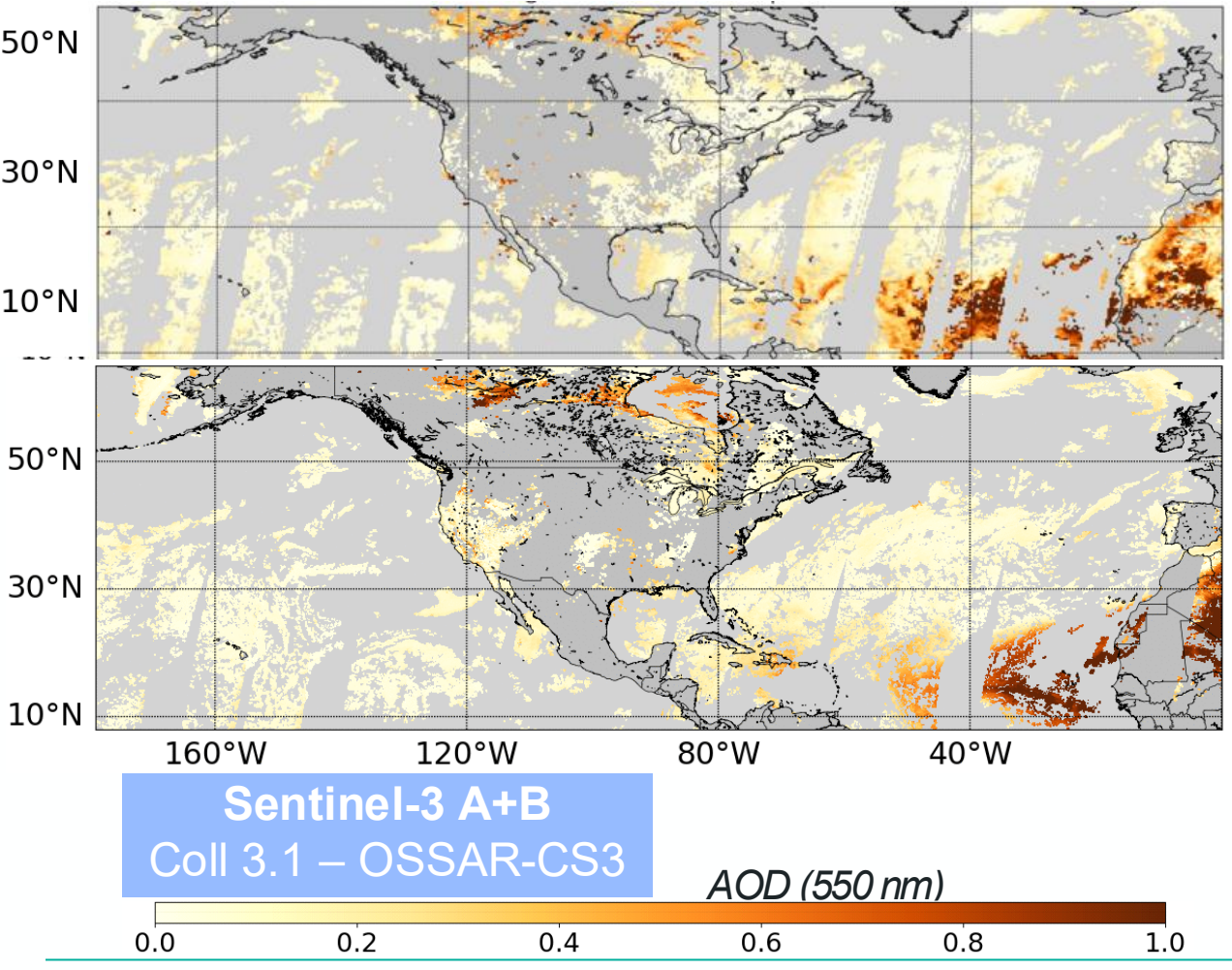
EUMETSAT – Aerosols and Cloud operational products

Current



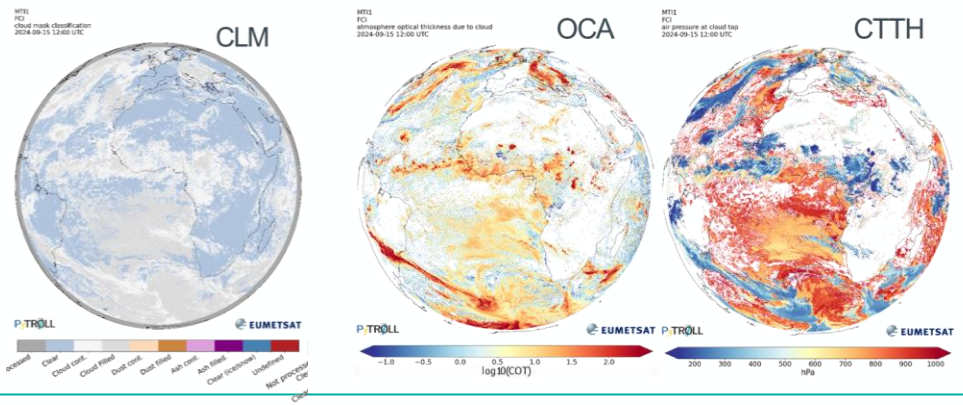
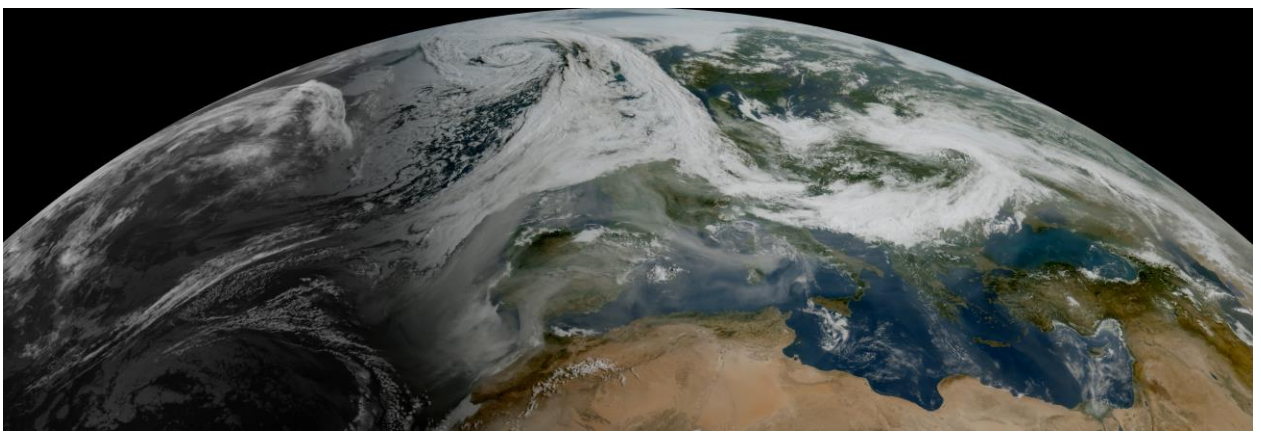
Metop B+C
PMAp V2.2.6

LEO observations of AOD



GEO observations of Cloud product

MTG-I/FCI
RGB composite map

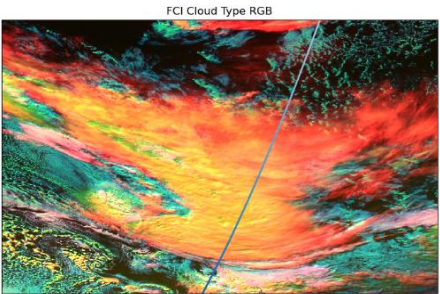


Cloud mask,
cloud top
height, cloud
microphysics

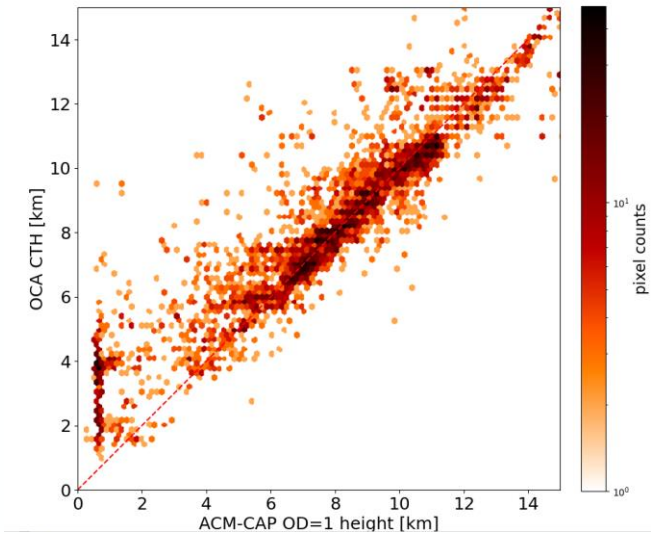
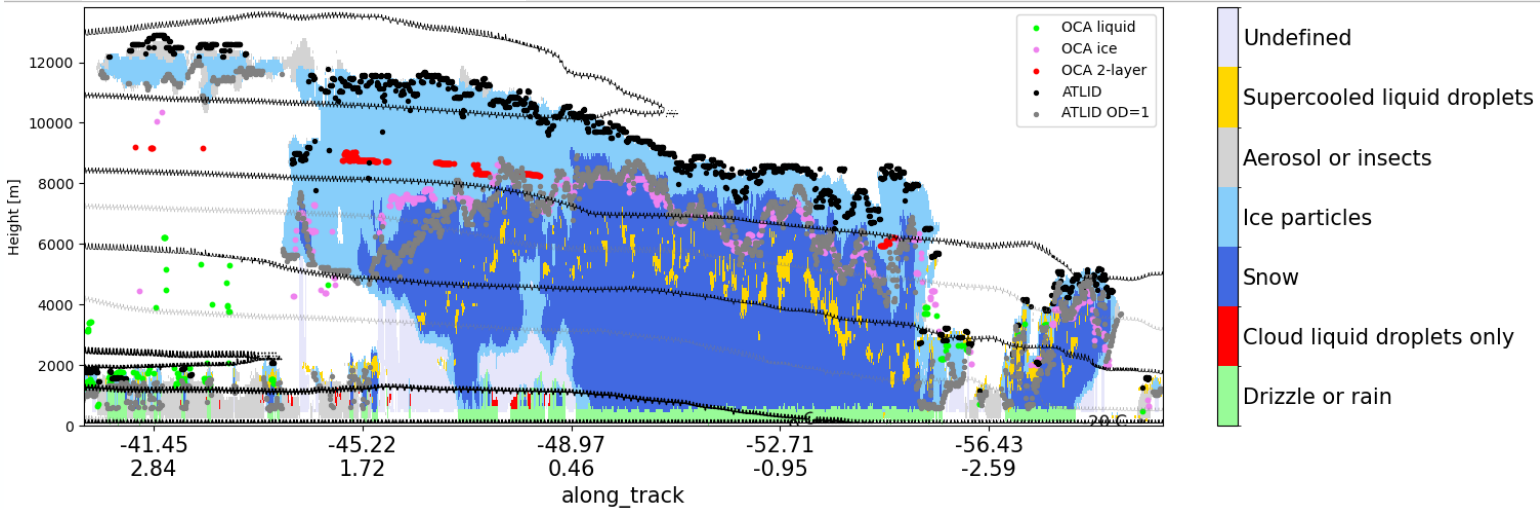
Cloud products with MTG-I/FCI

Working on constant monitoring of GEO cloud products

- Cloud top height assessment
- Cloud microphysics and optical thickness
- Defining reference for multi-layer clouds retrievals

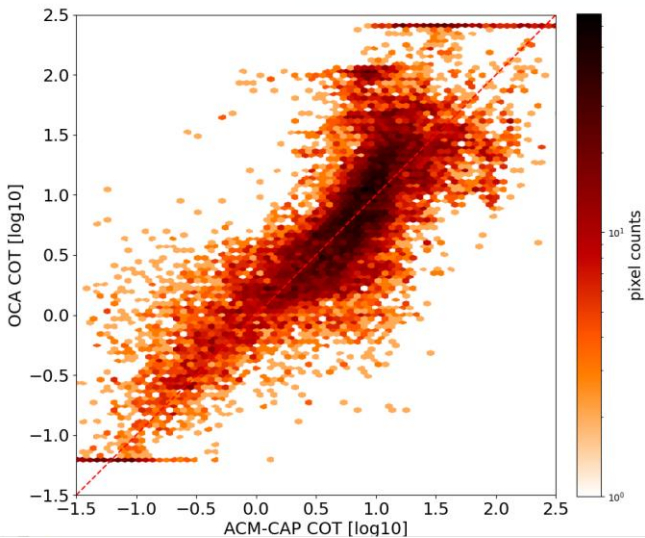


AC-TC (BC version)



Example of FCI-OCA ice clouds top height assessed at particular optical depth from the ATLID CTH

FCI-OCA cloud optical thickness against ACM-CAP



Future NRT Cloud portfolio for Copernicus Sentinel-3

EUMETSAT is now entrusted by Copernicus and Member States to build the **Sentinel-3 NRT Cloud portfolio** dedicated to Cloud expert users, NWP and Meteo services, as much as possible **relying on Sentinel-3 multi-spectral synergy**.

Phase I - first prototypes available internally at EUMETSAT:

<https://www.eumetsat.int/S3-synergy-cloud-mask> , <https://www.eumetsat.int/S3-OLCI-CTP>

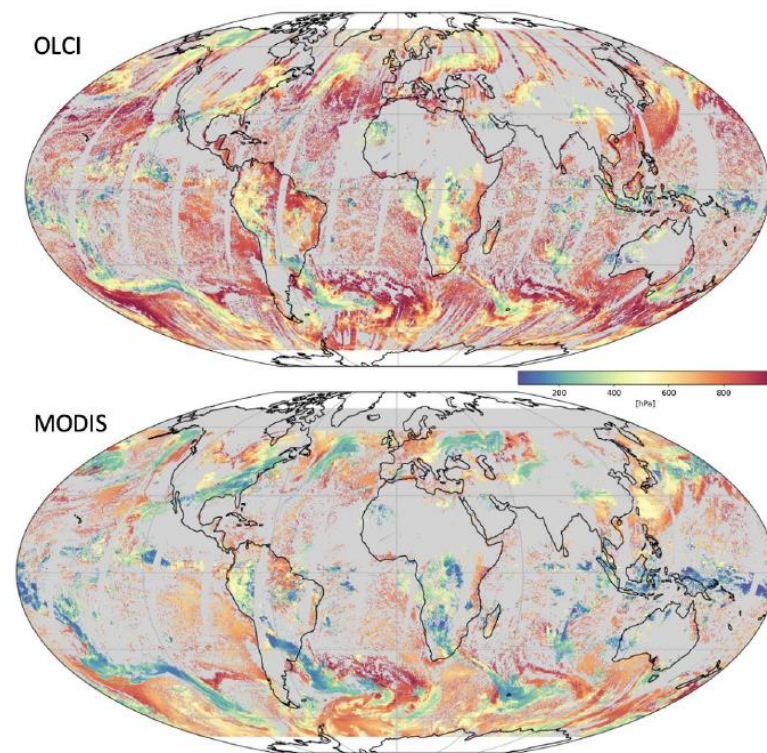
- Retrievals of COD, CTP, optical properties (e.g. CER), and spectral obstruction.

Preparation of Phase II developments:

- Adaptation to the new Sentinel-3 NRT **L1C synergy product (OLCI + SLSTR)**

Enhancing the validation framework:

- GEO-LEO match up in partnership with LOA (S2CLOP ongoing study)
- Injecting EarthCARE for Sentinel-3 CTP validation
- Same benefits as for MTG and EPS-SG
- Needs will apply regarding the asset of EarthCARE for Sentinel-3 CTP validation



Inter-comparison OLCI (5 O₂-A bands) vs. MODIS (TIR)
CTP – 18.02.2020

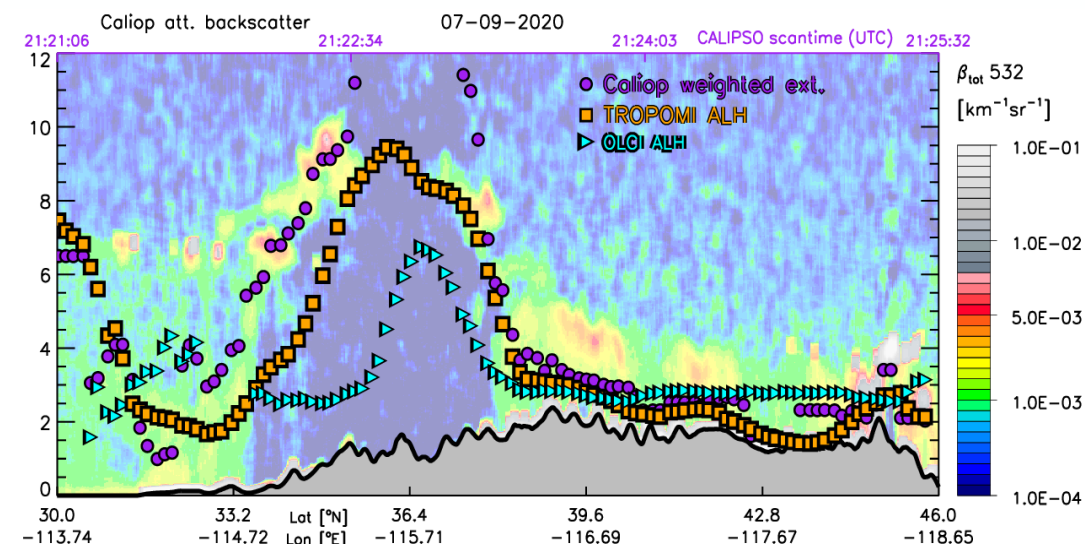
EarthCARE to support the aerosol product development & validation led by EUMETSAT



Support the development of aerosol products:

- Vertical distribution assumption in the aerosol retrieval:
 - Consolidating definition and in-depth interpretation of complex cases (e.g. multi-layers)
- Qualitative and quantitative validation of ALH or Aerosol Profile products
- Additional diagnosis in case of different sources of measurements sensitive to aerosol height and profiling:
 - UV (MTG-S/S4, EPS-SG/S5),
 - O₂ absorption (S3/OLCI, EPS-SG/3MI),
 - polarisation (EPS-SG/3MI),
 - TIR profiling (EPS-SG/IASI-NG, MTG-S/IRS)...
 - Especially, in the context of synergy: S3-SYN, EPS-SG/MAP
- Additionally:
 - EarthCARE aerosol modelling expertise can support ongoing EUMETSAT Aerosol component specification for all its missions:
 - for example: S3 Day2/Day3 Aerosol component revision

California wildfires, 7 Sept 2020



Sentinel-3 OLCI ALH prototype (credits KNMI)
quicklook CALIOP Att.Backscatter - S5P/TROPOMI - S3/OLCI ALH

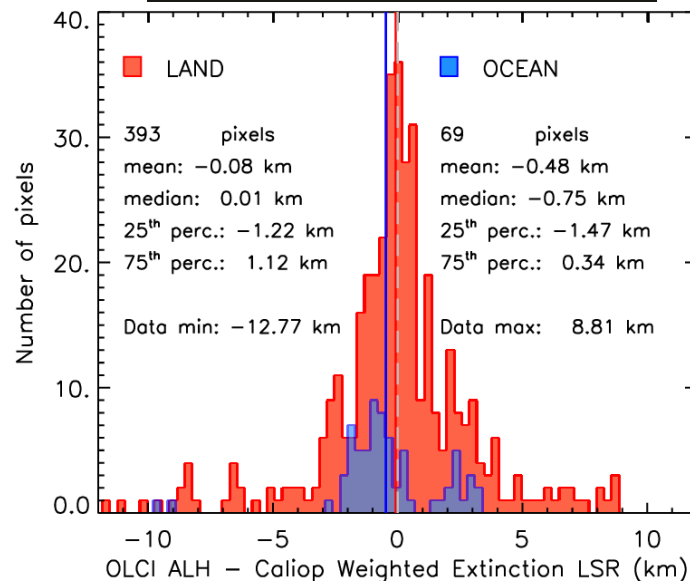
Aerosol Layer Height (ALH) prototyping – From five O₂-A medium spectral bands (OLCI)



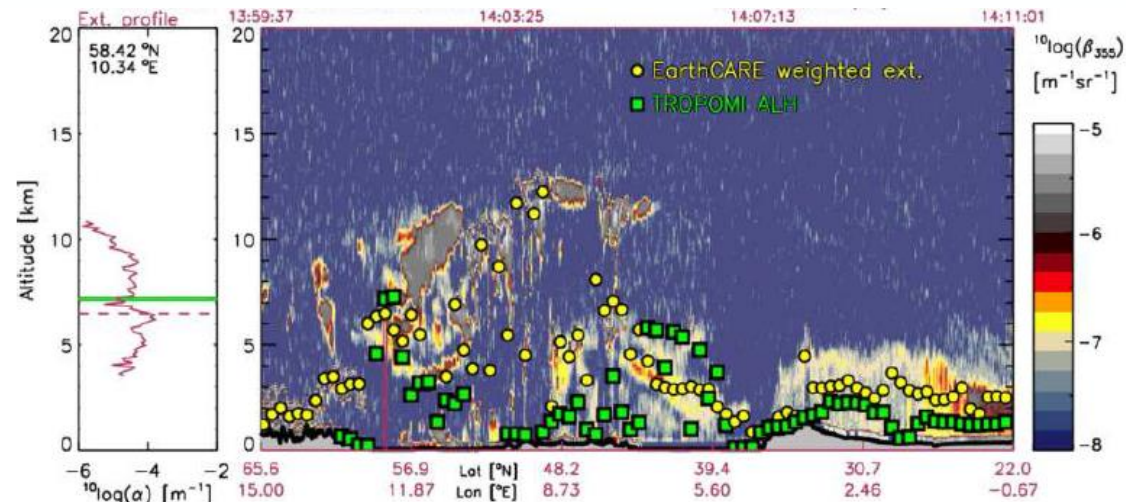
Sentinel-3 OLCI Aerosol Layer Height Prototype OLCOAH Algorithm Technical Baseline Document

Sentinel-3 OLCI ALH ATBD
(KNMI, EUMETSAT)

Histogram
Sentinel-3 OLCI ALH vs CALIOP



First latitude cross-section S5P/TROPOMI
EarthCARE/ATLID (S3/ALH being added very soon)



The Sentinel-3 OLCI ALH (fine imagery) prototype demonstrates the feasibility to retrieve global ALH from Sentinel-3 optical measurements.

- Evaluation primarily based on satellite inter-comparison with S-5P/TROPOMI ALH and CALIOP.
- Since CALIOP decommissioning, preparing the switch towards EarthCARE thanks to works by KNMI:
→ 1st tests with S5P ALH vs. EarthCARE/ATLID.

Conclusion



EarthCARE L2A/B products very helpful and precious in the next 10+ years to come for the community

→ increasing need of exploiting EarthCARE products for validation purposes of the products from current/upcoming EUMETSAT imagery missions (MTG-I, EPS-SG, S3, CO2M, etc.)

EUMETSAT operational NRT Clouds+Aerosols products

→ constant evolutive improvement in order to ensure product quality and anticipate/fulfil user needs

→ important need to monitor, inter-compare and validate the products → **Benefiting from EarthCARE cloud and aerosol products**

Clouds & Aerosols:

- On going intercomparison of cloud parameters from GEO MTG-I/FCI (CTH, COT) for Day-2 development and improvements of operational products
- Work in progress for current prototype S3/ALH (to become an operational product in upcoming years)
- **Plans to use EarthCARE products for validating other upcoming operational products (EPS-SG/VII&3MI, S3/SLSTR-OLCI...)**

Limitations to be taken into account: geometry, spatial/temporal resolution, time observation, parallax, multi-layer, etc.

Welcoming EarthCARE experts to fruitful discussions/recommendations for current/future NRT Cloud/Aerosol products in the next years

→ Focus on: Scattering height (CTP, ALH),
Optical properties (COT, AOT),
Microphysical properties of clouds and aerosols,
Multi-layer cases...