CERTAINTY
CLOUD–AEROSOL INTERACTIONS
& THEIR IMPACTS IN THE EARTH SYSTEM

CERTAINTY:

Cloud-a**ER**osol in**T**eractions
& their imp**A**cts **IN T**he earth s**Y**stem

EarthCARE Science and Validation Workshop

This project has received funding from Horizon Europe programme
under Grant Agreement No 101137680

Funded by
the European Union

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EarthCare for aerosol-cloud science within CERTAINTY: Status and future directions

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Consortium

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18 partners from 10 countries

cnrs
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METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE
ECMWF
BSC Barcelona Supercomputing Center
Centro Nacional de Supercomputación
Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Infrastructuur en Waterstaat
Stockholm University
DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center
LUNDS UNIVERSITET
UNIVERSITY OF EASTERN FINLAND
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ΠΟΛΥΤΕΧΝΕΙΟ ΚΡΗΤΗΣ
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The University of Manchester

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Overarching objective

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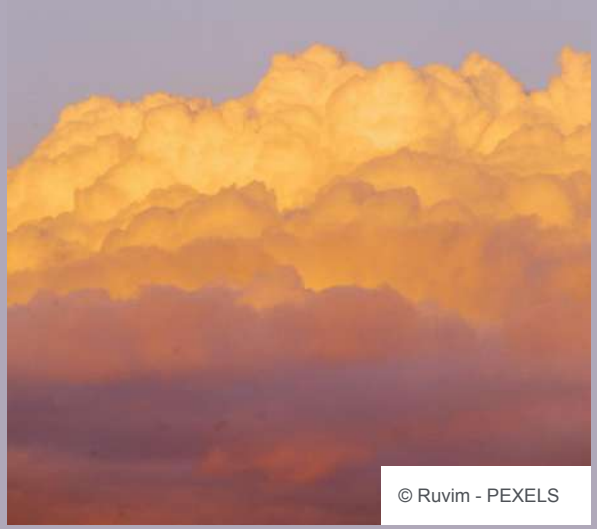
© Ruvim - PEXELS

The overarching objective of CERTAINTY is to

deliver the knowledge and models that provide improved confidence and representation of the role of cloud–aerosol-radiation interactions in climate and weather.

This translates to **better understanding and predictions of extreme events** and facilitates planning **climate mitigation/adaptation strategies** for the good of European citizens and global society.

Project duration: 1 January 2024 - 1 January 2028

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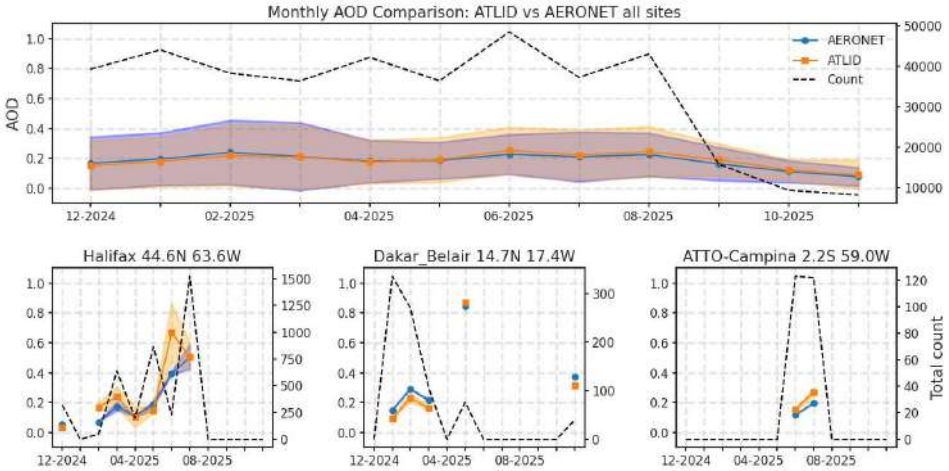
Validation of ATLID against AERONET

Xuemei Wang, David P. Donovan, Thanos Tsikerdekis, Ping Wang, and Gerd-Jan van Zadelhoff; KNMI, The Netherlands



Monthly mean AOD averaged over all sites (upper) and three selected AERONET sites (lower) over Dec 2024 – Nov 2025. Shades are standard deviations.

Methods:

- 1-year aerosol optical depth (AOD): ATLID Level 2 EBD and TC vs AERONET Level 2 products.

Messages:

- The global monthly mean AOD from ATLID is inline with AERONET. Mean bias is 0.007 (13.3% of AERONET).
- Individual sites exhibit larger biases than global mean and they are due to:
  - Collocation distance (50 km)
  - Cloud contamination

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Using ATLID to evaluate CAMS

Xuemei Wang, David P. Donovan, Thanos Tsikerdekis, Ping Wang, and Gerd-Jan van Zadelhoff; KNMI, The Netherlands

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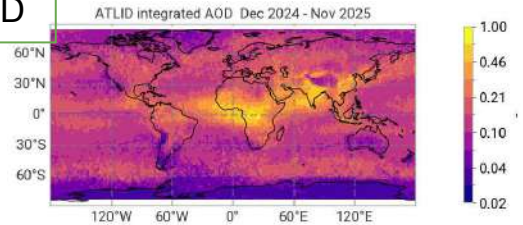
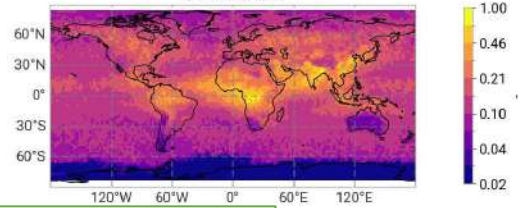
Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Infrastructuur en Waterstaat

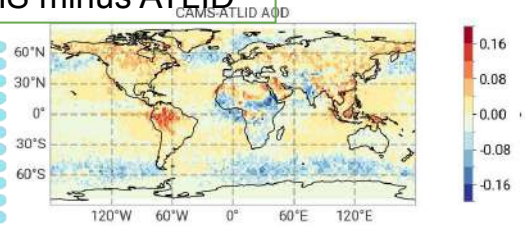
ATLID



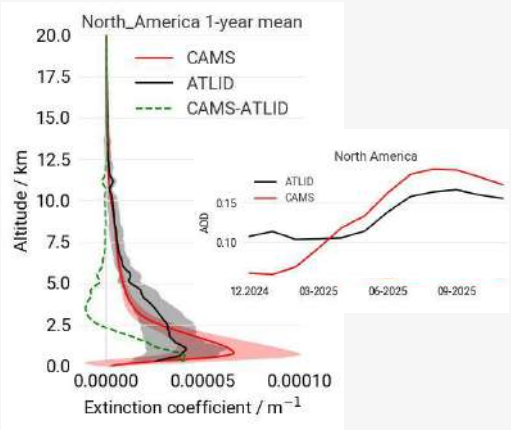
CAMS composition forecasts



CAMS minus ATLID



Global maps of AOD at 2° over Dec 2024 – Nov 2025.



1-year mean aerosol extinction coefficient profiles and monthly mean AOD in North America.

Methods:

- Collocate and grid 1-year AOD to 2°. Then, grid median AOD is derived.

Messages:

- ATLID and CAMS can reproduce global AOD spatial distributions.
- CAMS underestimates global AOD by 0.0052 (4.3% of ATLID).
- North America (an example region):
  - The profiles suggest issues with vertical mixing or transport in CAMS.
  - AOD time series exhibit significant changes during the fire season.

More profiles and Lunar AOD on poster P087

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Validation of ATLID layer products to study aerosol impact on clouds

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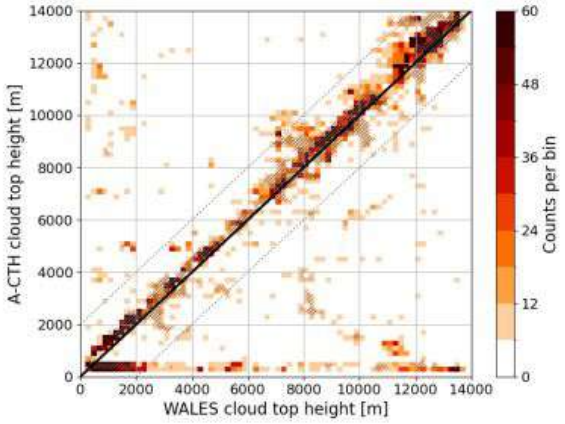
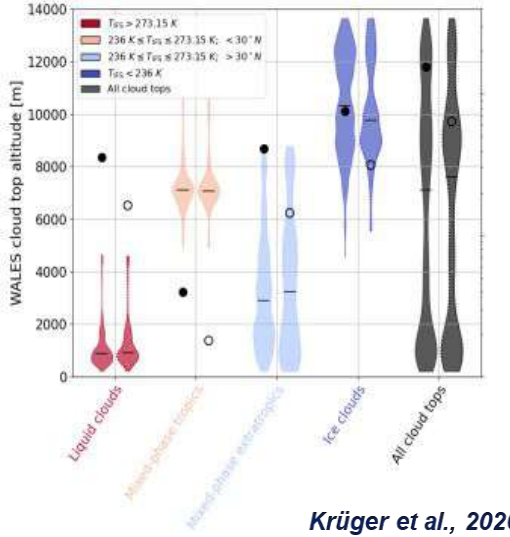
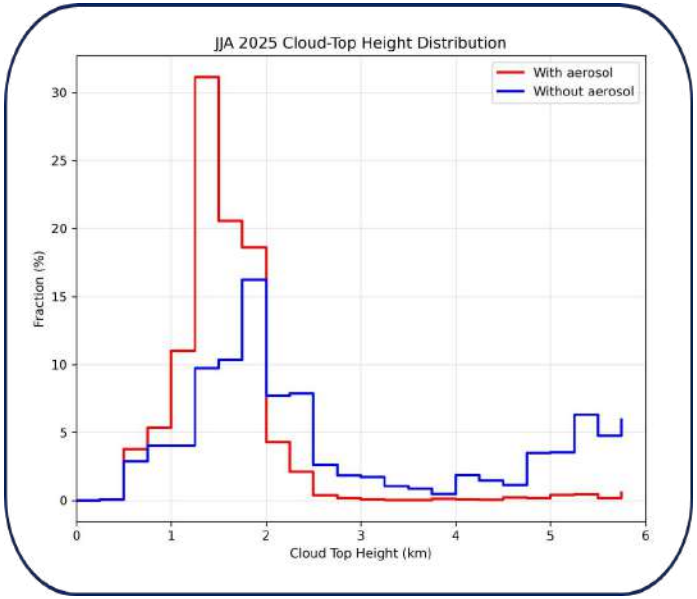
K. Krüger, K. Corko, M. Wirth, S. Groß; DLR, Germany







Krüger et al., 2026

- Validation of A-FM/TC/CTH using airborne lidar measurements
- Investigate vertical distribution of aerosol and clouds → aerosol impact on clouds

→ Poster and talk by K. Krüger (Tuesday) on validation

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Long-term study to investigate aerosol effect on cirrus clouds

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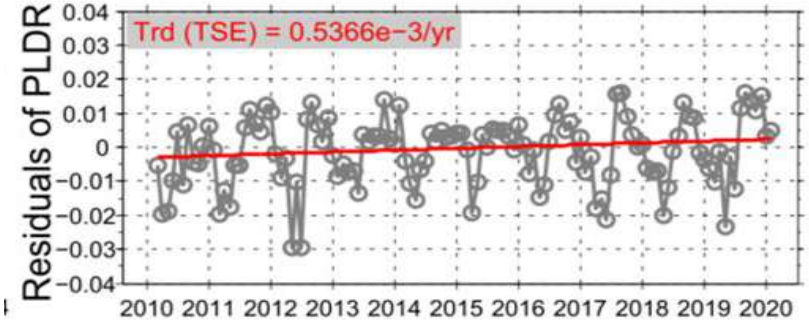
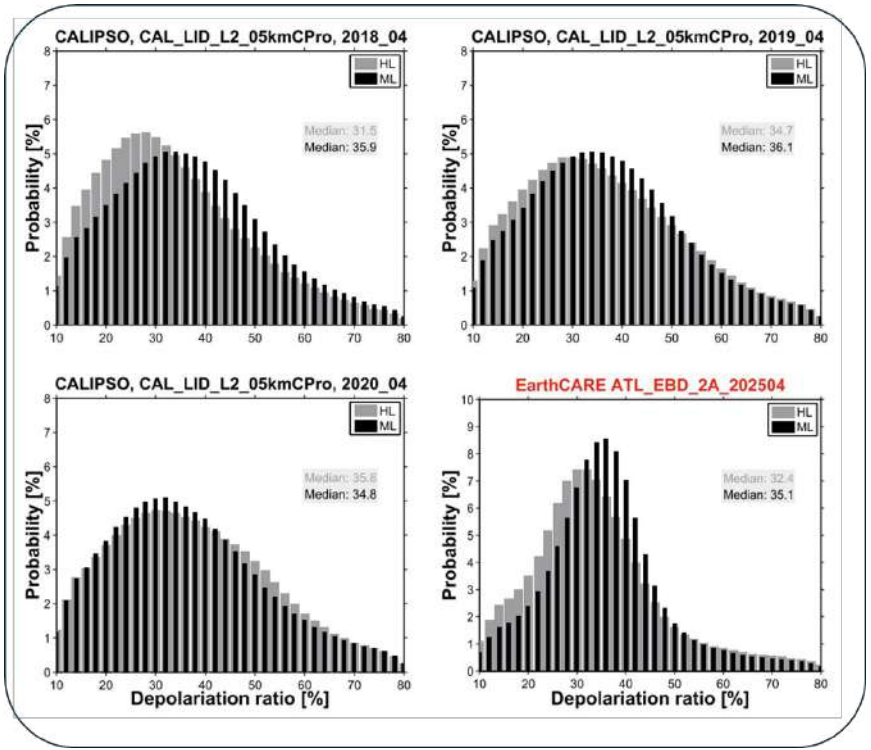
Q. Li, S. Groß; DLR, Germany



Li and Groß, 2022



- Change in cirrus depolarization in European midlatitude correlated with aviation
- Transition from CALIPSO/Cloudsat to EarthCARE

→ Talk by S. Groß (Friday)

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EarthCARE Radiative Closures at TOA with CERTAINTY dust optical properties for ARI studies

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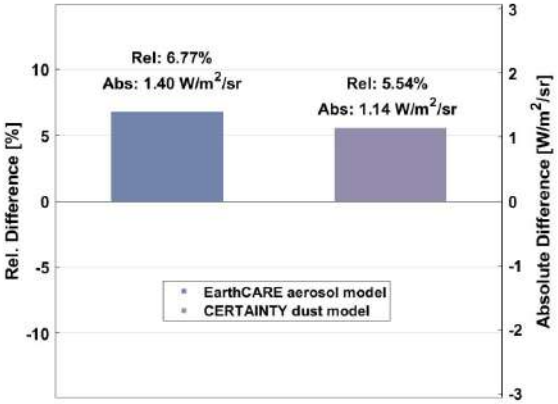
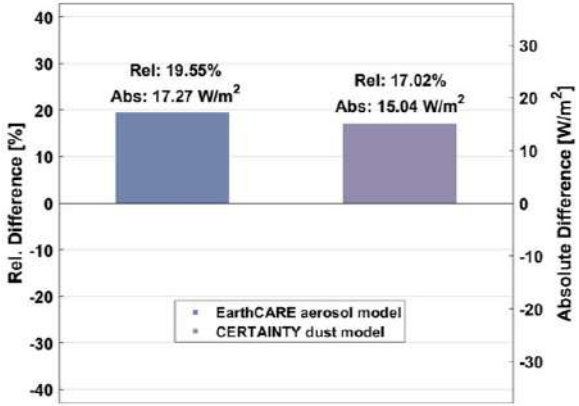
Closure at TOA with Unfiltered Radiances



Closure at TOA with Effective Fluxes



Comparison between:
- EarthCARE aerosol model
- CERTAINTY dust model

In preparation, Kouklaki et al.

Closure during PERCUSION with BBR observations at TOA under clear-sky conditions.

- Good agreement in both cases, improved closures with the CERTAINTY model
- Difference with BBR effective fluxes ~15W/m^2 (EC target: 10W/m^2)
- Aerosol Radiative Effect = ~33W/m^2

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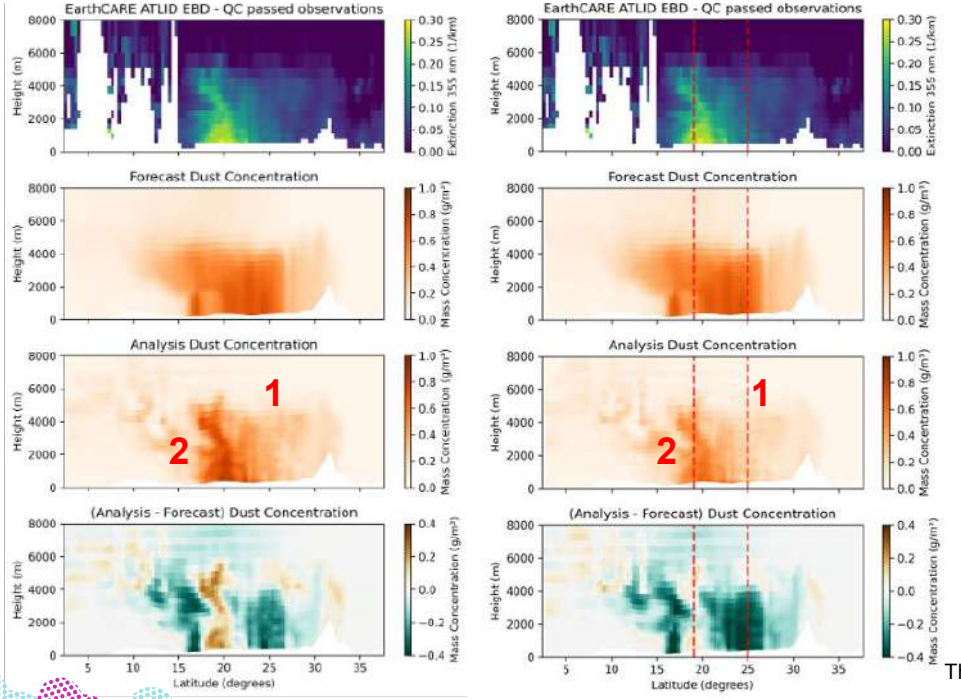
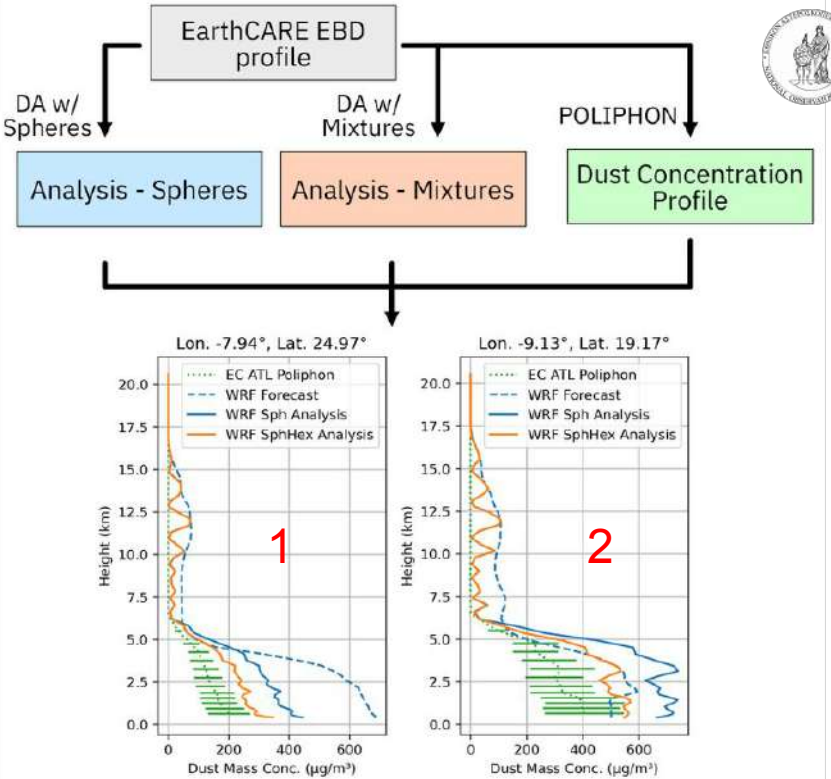
Assimilate EarthCARE ATLID extinction coefficient and study the impact on model dust concentrations

Results using spherical shape model for dust *(WRF default)*

Results using CERTAINTY dust model





T421 Georgiou et al., Session: Modelling - Data Assimilation (Thursday)

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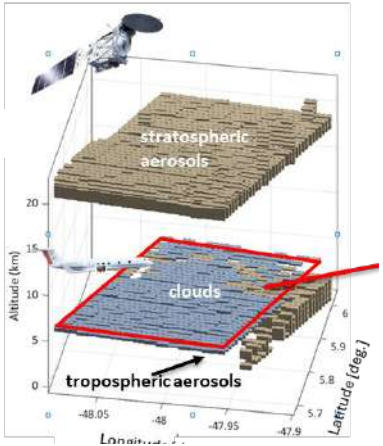
New products from EarthCARE and synergies

New EarthCARE 3D reconstructed scenes using machine learning



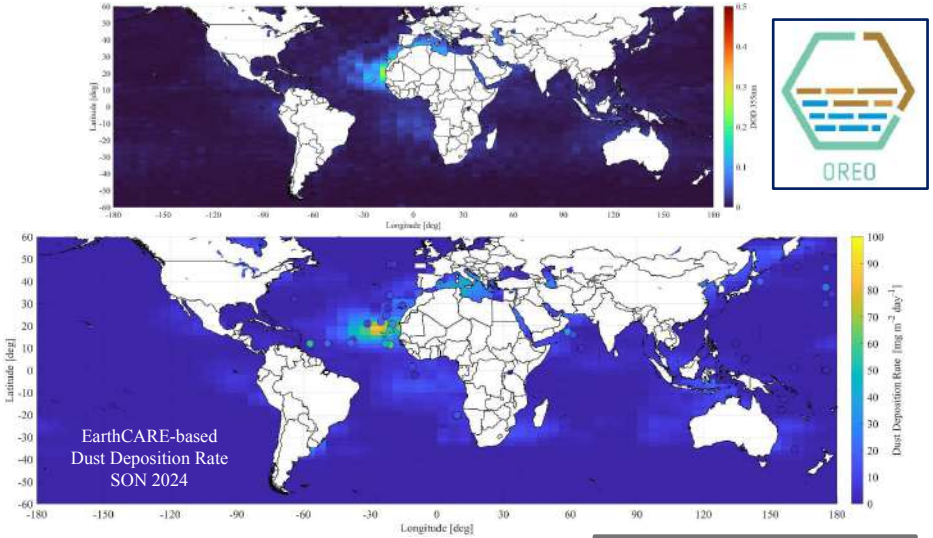
Original EarthCARE 3D reconstruction

Kouklaki et al., Session: Aerosol-Cloud-Radiation Coupling and Radiative Closure - Part 1

Obs3RvE

Girtsou et al., Session: Novel Developments - Clouds and Convection

EarthCARE Dust Deposition



OREO

Rizos et al., Session: Aerosol and Lidar Observations

Bridging CERTAINTY with EarthCARE+ and EarthCARE DISC

*New **3D cloud types, microphysical properties, and cloud radiative effect*** using ML techniques applied within the **Obs3RvE** ESA project (EC synergy with MTG)

From:
EarthCARE-based Atmospheric Dust

To:
EarthCARE-based **Dust Deposition** across the Ocean developed in **OREO** ESA project

Thanks and questions

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