



PROGRAMME OF  
THE EUROPEAN UNION



IMPLEMENTED BY



#EUSpace

# Copernicus Atmosphere Monitoring Service (CAMS) (ECWWMF)

Melanie Ades, Enza Di Tomaso, Samuel Remy, Michael Kahnert, Jeronimo Escribano, Mark Parrington, Philipp Weiss, Peter Hill, Will McLean, Mark Fielding, Angela Benedetti, Antje Inness, Johannes Flemming, Richard Engelen



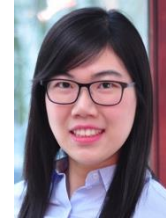
# Aerosols at ECWMF

The CAMS team works on the aerosol forecast production, but aerosols also form part of the research done by other scientists at ECMWF

## CAMS



**Johannes Flemming**  
Team Leader  
Reactive Gas & Aerosol Aspects



**Cathy Wing Yi Li**  
Evaluation



**Melanie Ades**  
Aerosol DA  
Background errors  
Dust assimilation



**Enza Di Tomaso**  
Aerosol DA  
AOD Obs updates  
GFAS fire assimilation



**Michael Kahnert**  
Lidar/ceilometer  
assimilation  
Dust inversion



**Philipp Weiss**  
Modelling with  
focus on Aerosols



**Jeronimo Escribano**  
Aerosol DA  
3MI assimilation



**Mark Parrington**  
Outreach/event  
monitoring  
Fire assimilation

Roberto Ribas, Chris Kelly, Emmanuele Russo and others

## CAMS2\_35



**Samuel Remy**  
Aerosol model  
developments  
CAMAERA lead



**Thierry Elias**  
Aerosol model  
developments



**Stelios Myriokefalitakis**  
Organic aerosol  
modelling



**Rose-Cloé Meyer**  
Aerosol model  
developments



**Maxime Farin**  
Aerosol model  
developments



**Swen Metzger**  
EQSAM4Clim

## NWP



**Angela Benedetti**  
Infrared Team Leader  
CAMEO WP lead for  
radiance assimilation



**Mark Fielding**  
EarthCARE cloud and  
aerosol assimilation lead



**Will McLean**  
EarthCare  
backscatter  
assimilation



**Samuel Quesada Ruiz**  
Aerosol radiance  
assimilation (CAMEO)

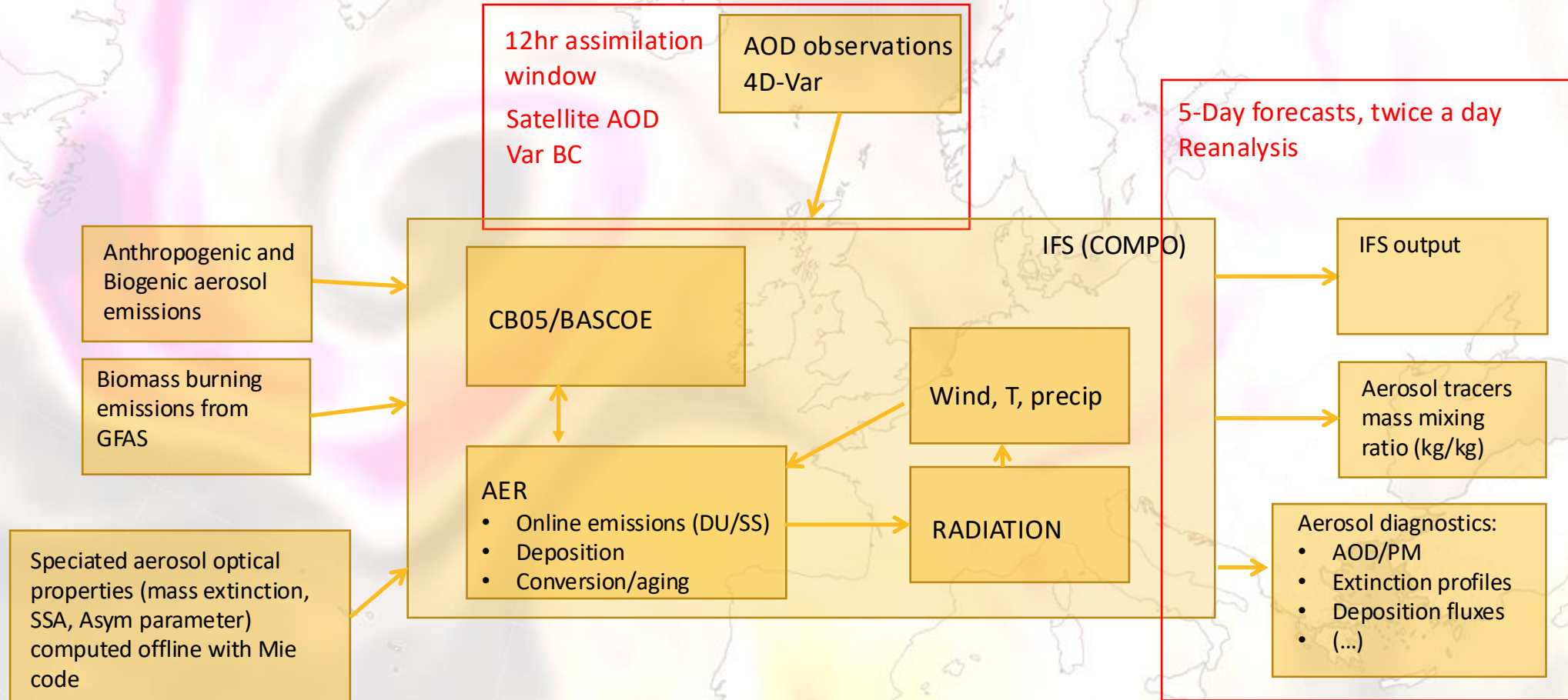


**Kirsti Salonen**  
Aeolus assimilation



**Peter Hill**  
Radiation

# IFS-COMPO Aerosol Forecasting and Assimilation



Aerosol Optical Depth Forecast  
Wed 11 Jun 2025 00:00 UTC

OrganicWalter



# IFS-COMPO Aerosol Model

- 8 species considered:
  - Desert dust (DD): 3 tracers
  - Sea-salt aerosol (SS): 3 tracers
  - Organic Matter (OM): 2 tracers
  - Black carbon (BC): 2 tracers
  - Sulfate (SO<sub>4</sub>) + precursor SO<sub>2</sub> when running uncoupled from chemistry
  - Nitrate: 2 tracers (from gas/particle partitioning, and from het. reactions)
  - Ammonium: 1 tracer
  - SOA: 2 tracers (biogenic and anthropogenic)
- Bulk/bin approach : bulk for OM/BC/SO<sub>4</sub>, 3 size bins for SS/DD
- For OM and BC, hydrophobic (fresh) and hydrophilic (aged) components are considered
- All species (apart from hydrophobic OM/BC) subject to hygroscopic growth/hydrophilic
- 16 tracers representing dry aerosol mass mixing ratio **except for sea-salt aerosol: mass mixing ratio at 80% RH**
- Assimilation minimises based on a **total aerosol variable** and AOD observations. The calculated increment is redistributed back into the 16 tracers based on their proportions in the first guess

# CY50R1 released 12<sup>th</sup> May 2026

Q2-2026

Q4-2026, tbc

CY49R1

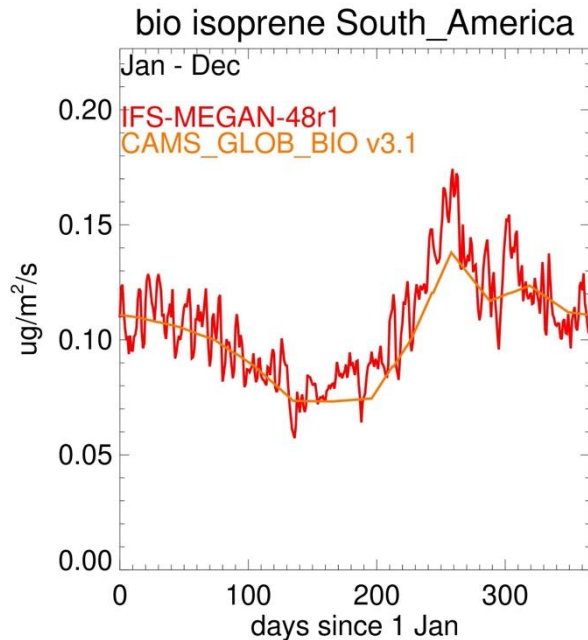
CY50R1

CY51R1

## CY50R1:

- New anthropogenic emissions (CAM5-GLOB-ANT M1) with regional inventories for North-America, Europe and China merged (Edgar 6.2 elsewhere)
- Online BVOC emissions
- Weekly cycle in anthropogenic emissions
- Update het. chem in troposphere
- Sedimentation velocity from Stokes formula
- Updated SOA/Am/Nitrate growth factors

# Online BVOC

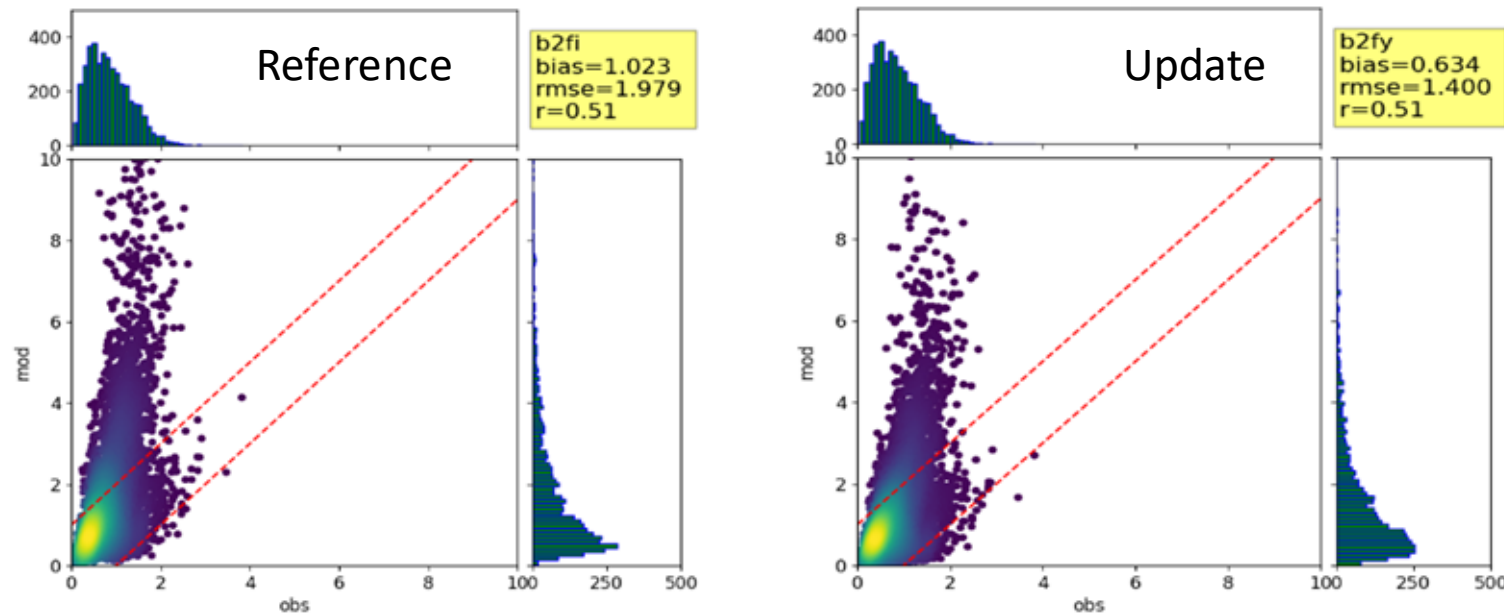


- CY50R1: activation of MEGAN v2.1, as implemented in ECLand, to replace BVOC emission climatology
- Allows simulation of variability in emissions due to meteorological and vegetation changes
- Impact on HCHO, Ozone, SOA, in particular its simulated variability



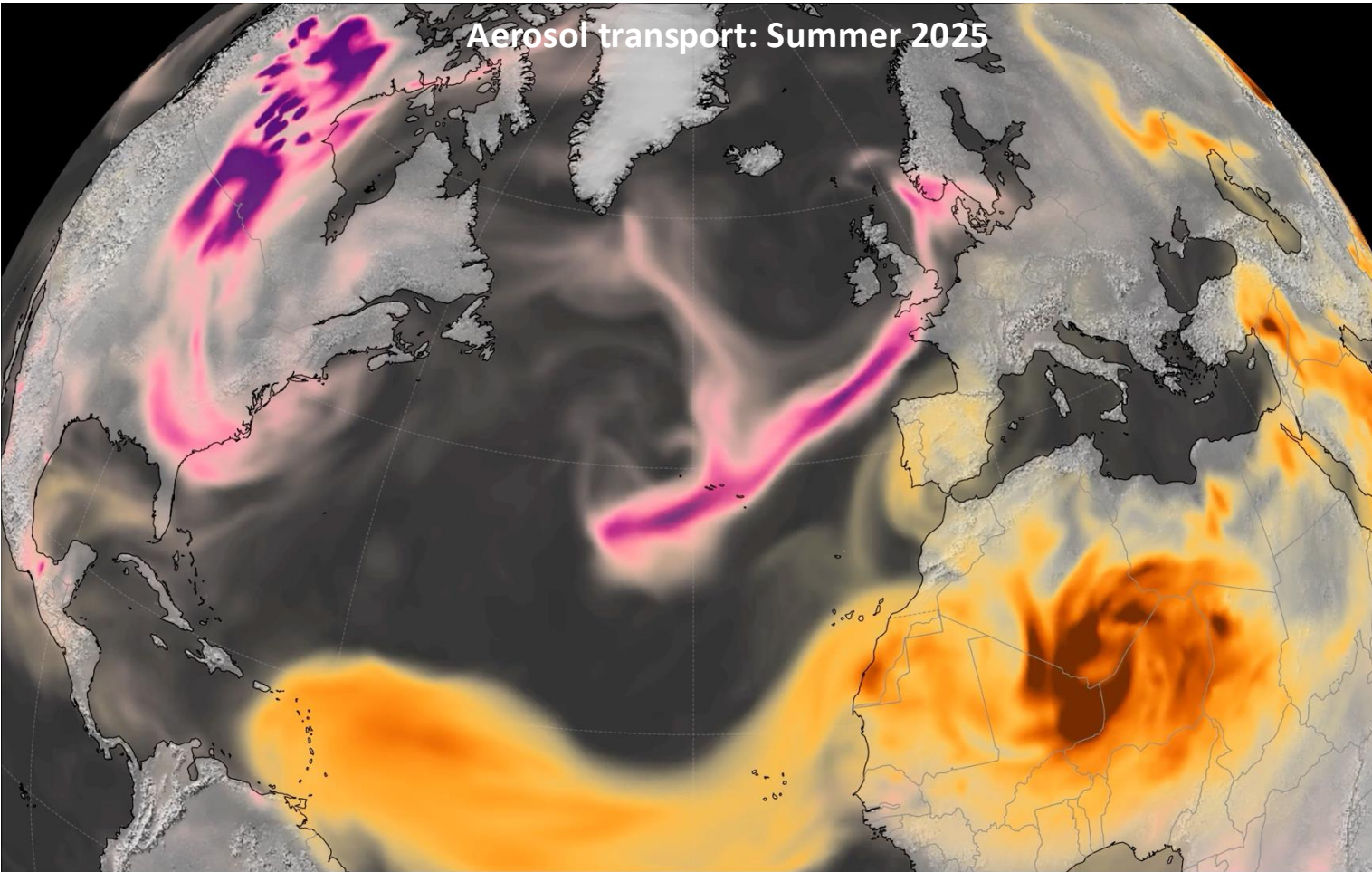
# Updates to heterogeneous reactions

- CY50R1: The modeling of heterogeneous reactions of trace gases on aerosol, cloud droplets and ice particles has been reviewed.
- This now includes reactions involving trace gases:
  - HO<sub>2</sub>, H<sub>2</sub>O<sub>2</sub>, N<sub>2</sub>O<sub>5</sub>, and HONO
- One of the net impacts is a reduction of H<sub>2</sub>O<sub>2</sub>, which reduces the sulfate formation in clouds. This leads to a **reduction** in sulphate during summertime, improving MB and RMSE when evaluated against CASTNET obs over the US:





# Current AOD satellite usage in IFS-COMPO



Total Aerosol Optical Depth  
01 Jun 2025 00:00 UTC



## Land & Ocean

EOS-Terra/MODIS

EOS-Aqua/MODIS

S-NPP/VIIRS

NOAA-20/VIIRS

## Ocean only

Metop-C/PMAp

Metop-B/PMAp

Sentinel-3A/SLSTR

Sentinel-3B/SLSTR



S3 AOD retrievals are assimilated (over ocean) in IFS-COMPO since CY50R1

- retrievals filtered for best quality (QI 2,3);
- product spatially aggregated to better match retrievals (9.5 km) & model (~40 km) resolution;
- assimilated obs bias corrected within a variational assimilation procedure (NOAA-20 VIIRS anchor).

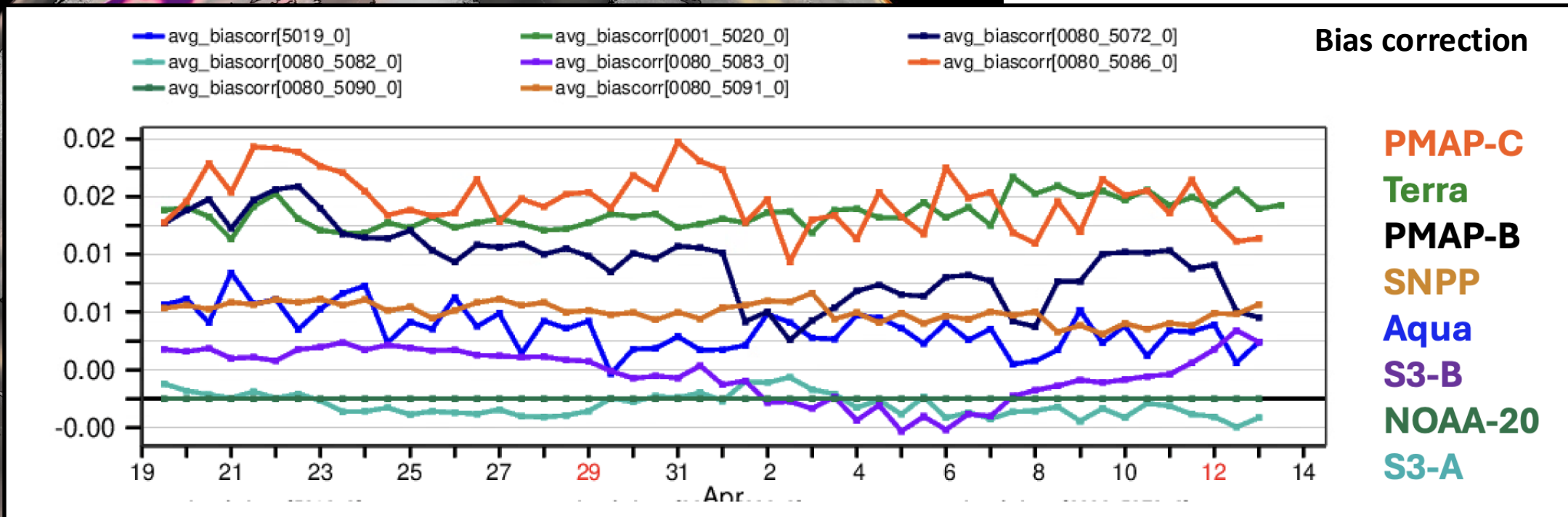
Thanks to Enza Di Tomaso

# Current AOD satellite usage in IFS-COMPO

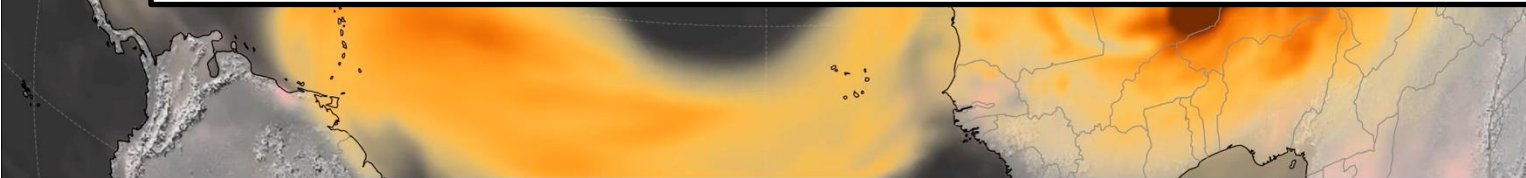
Aerosol transport: Summer 2025

Land & Ocean

Ocean only



- C/PMAP
- B/PMAP
- 3A/SLSTR
- 3B/SLSTR



55 AOD retrievals are assimilated (over ocean) in IFS-COMPO since CY50R1

- retrievals filtered for best quality (Q1 2,3);
- product spatially aggregated to better match retrievals (9.5 km) & model (~40 km) resolution;
- assimilated obs bias corrected within a variational assimilation procedure (NOAA-20 VIIRS anchor).

Thanks to Enza Di Tomaso



# Observation system experiments with Sentinel-3

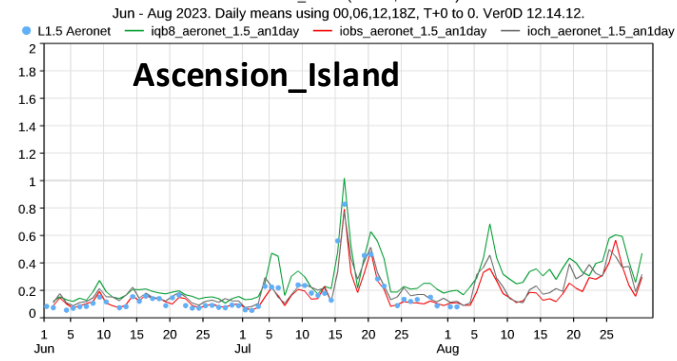
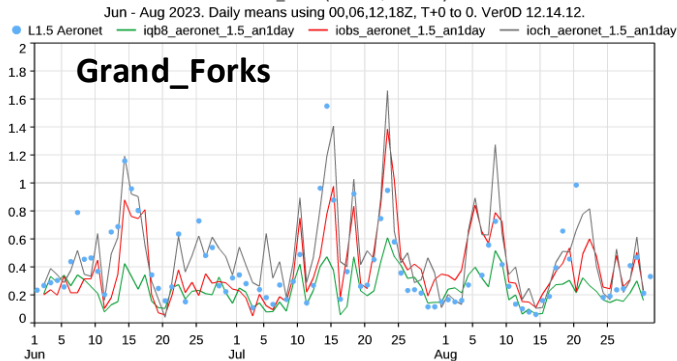
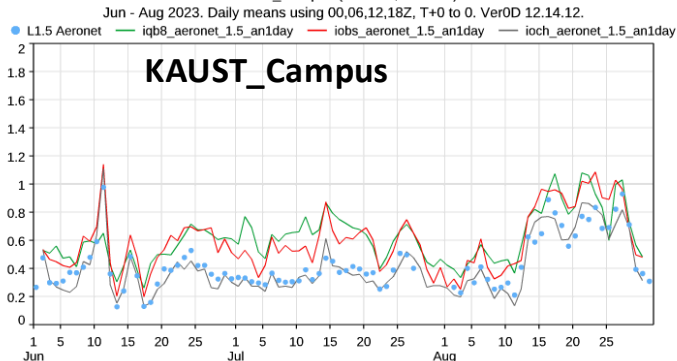
Denial experiment	S3+MetOp retrievals-only	Oper. configuration
No AOD assimilation	SLSTR S3-A/B <b>over land</b> and ocean PMAP Metop-B/C over ocean  Bias correction with no anchor	MODIS Terra and Aqua VIIRS SNPP and NOAA-20 SLSTR S3-A/B over ocean PMAP Metop-B/C over ocean  Bias correct with N20 anchor
Winter period: Dec 2022-Feb 2023		
Summer period: Jun-Aug 2023		



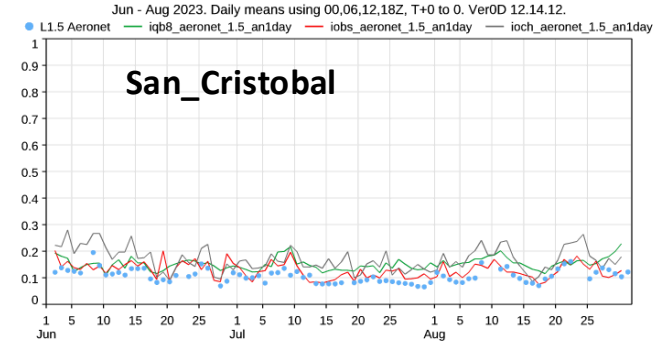
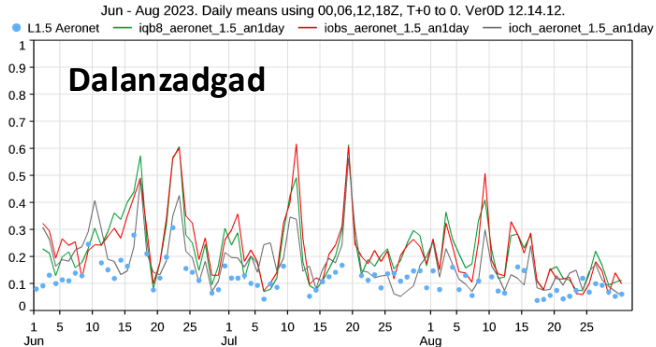
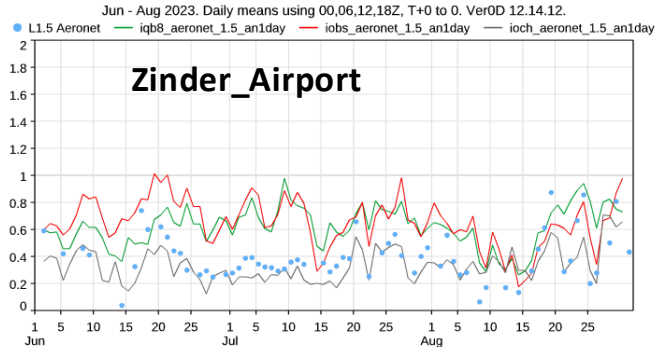
# Denial exp. vs S3+MetOp-only vs Oper. configuration

summer

Comparison of Aeronet AOT at 500nm for four stations: KAUST\_Campus, Grand\_Forks, Ascension\_Island, and Zinder\_Airport. Each plot shows daily means from June to August 2023, comparing four configurations: L1.5 Aeronet (blue dots), iqb8\_aeronet\_1.5\_an1day (green line), iobs\_aeronet\_1.5\_an1day (red line), and ioch\_aeronet\_1.5\_an1day (grey line). The y-axis represents AOT at 500nm, ranging from 0 to 2.0. The x-axis shows dates from June 1st to August 25th, 2023.



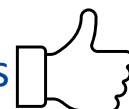
Comparison of Aeronet AOT at 500nm for three stations: Zinder\_Airport, Dalanzadgad, and San\_Cristobal\_USFQ. Each plot shows daily means from June to August 2023, comparing four configurations: L1.5 Aeronet (blue dots), iqb8\_aeronet\_1.5\_an1day (green line), iobs\_aeronet\_1.5\_an1day (red line), and ioch\_aeronet\_1.5\_an1day (grey line). The y-axis represents AOT at 500nm, ranging from 0 to 2.0. The x-axis shows dates from June 1st to August 25th, 2023.



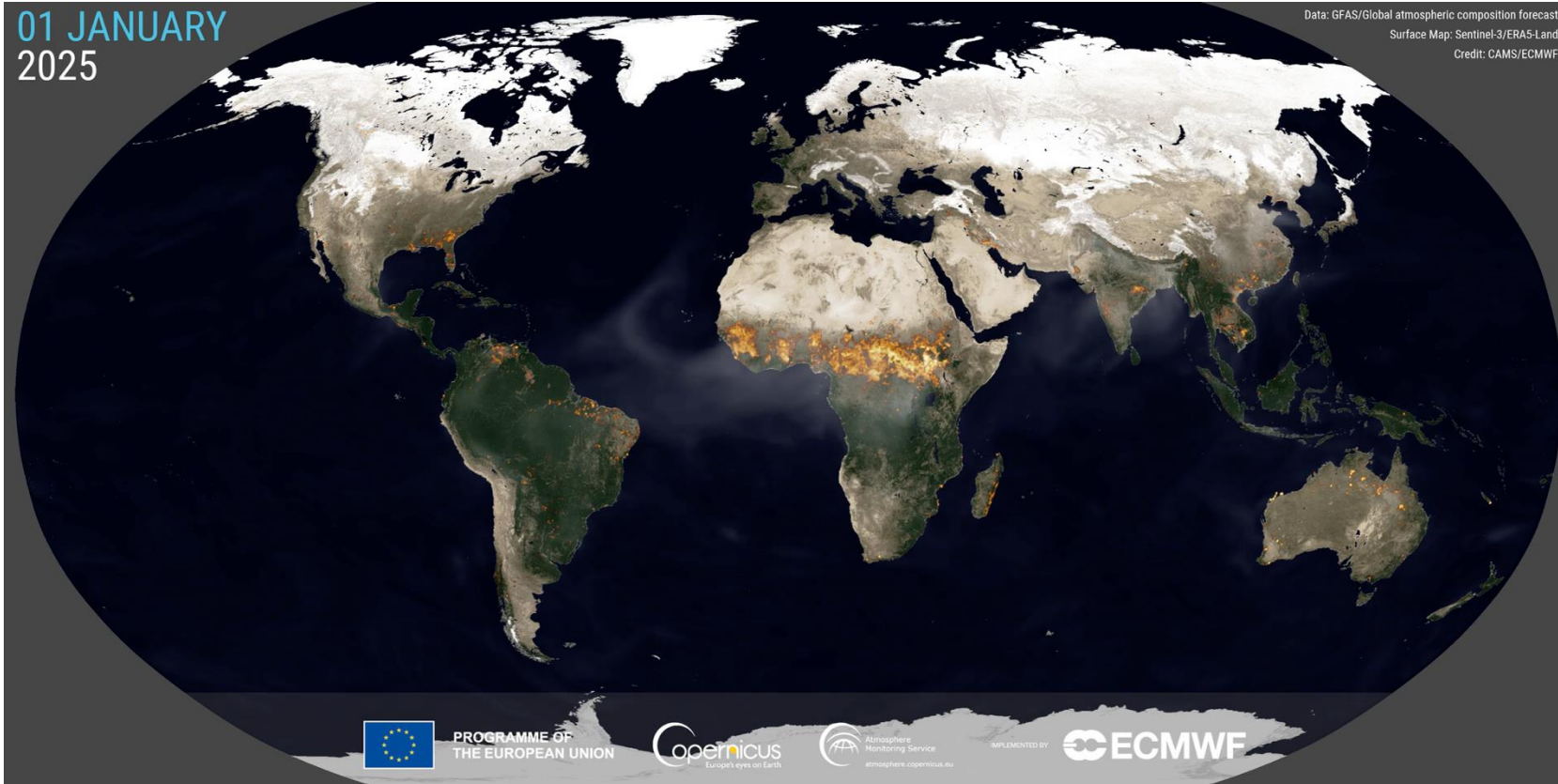
Dust-dominated stations



Coastal stations



# Fire emissions monitoring in CAMS: Global Fire Assimilation System (GFAS)



Operationally assimilated

Terra/MODIS

Aqua/MODIS

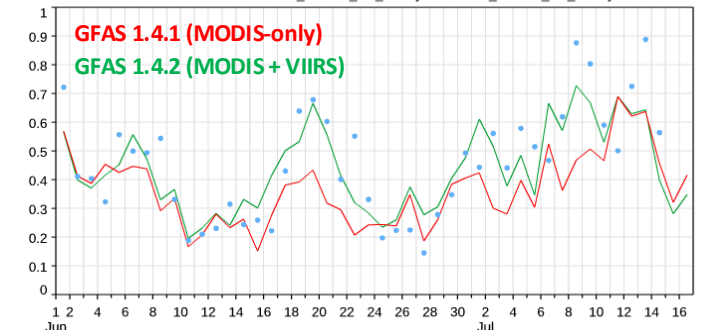
Active in GFAS 1.4.2 (used by cy50r1) and based on CAMS2\_64\_bis (NILU/KCL/IPMA) dev.:

S-NPP/VIIRS

+ together with new spurious signal mask

## IFS-COMPO forecast compared to AERONET retrievals

Comparison of iow1\_aeronet\_1.5\_fc1day & iovu\_aeronet\_1.5\_fc1day and L1.5 Aeronet AOT at 500nm over Sakeji\_School (11.23°S, 24.31°E).  
 1 Jun - 16 Jul 2024. Daily means using 00Z, T+3 to 24. Ver0D 12.14.5.  
 ● L1.5 Aeronet ● iow1\_aeronet\_1.5\_fc1day ● iovu\_aeronet\_1.5\_fc1day

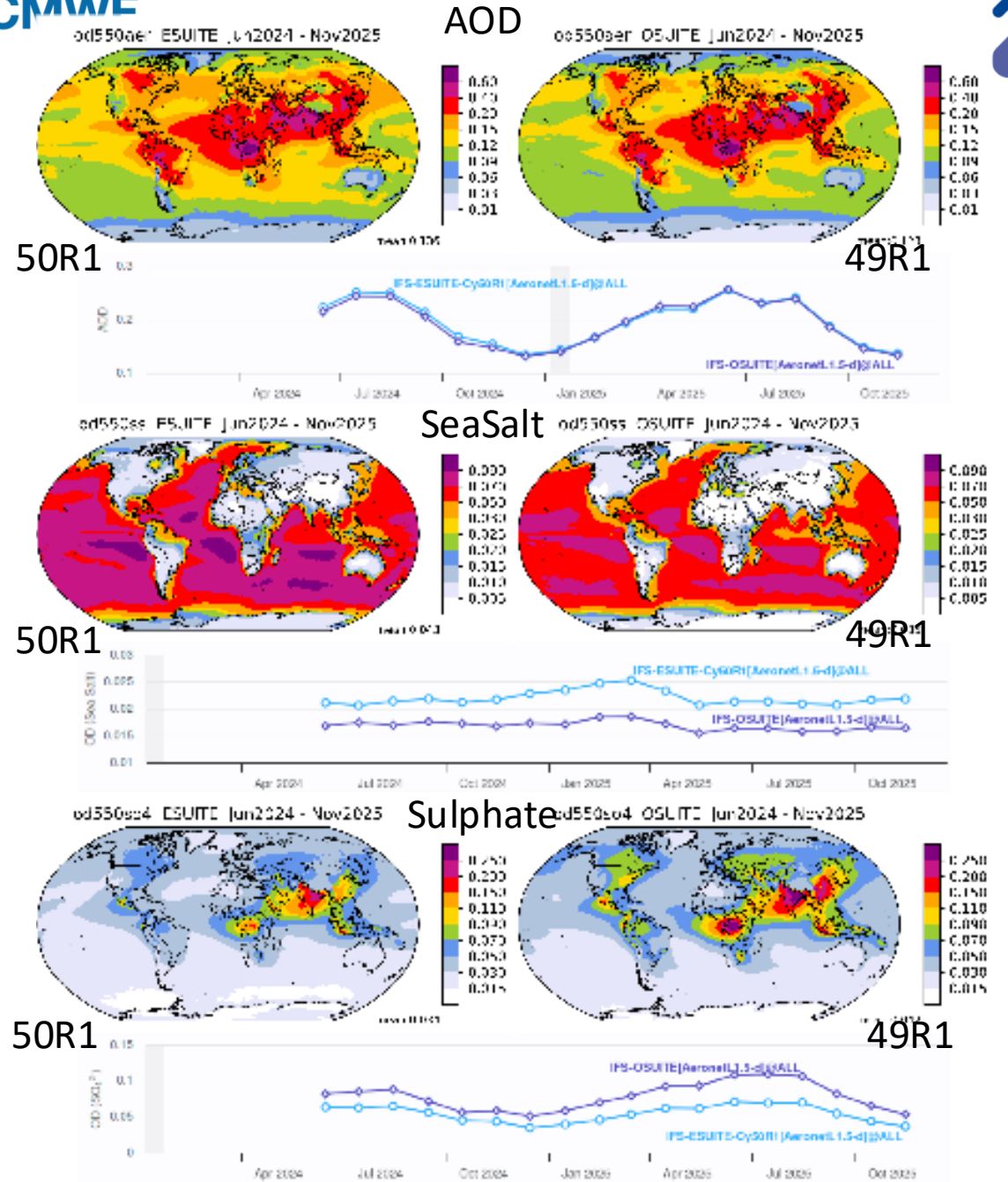


<https://atmosphere.copernicus.eu/2025-sees-intense-wildfire-year-northern-hemisphere>

Thanks to Enza Di Tomaso

# Validation report

- The aerosol composition in Cy50R1 has changed substantially compared to Cy49R1. **Increases** in optical depth are seen for sea salt, black carbon, while **decreases** are seen in sulphate, ammonium, organic matter. Nitrate is more scattered in 50R1 and less concentrated around pollution sources than in 49R1. Dust performs overall very similar.
- Despite these composition changes we find that changes in the scores for total AOD and the Angstrom Exponent are not very large, and both small improvements and degradations are observed.
- For surface PM, 50R1 underestimates PM10 more and overestimates PM2.5 less (globally). Scores have generally improved for PM, notably over Chile, which previously exhibited a strong underestimation.





PROGRAMME OF  
THE EUROPEAN UNION



IMPLEMENTED BY



# Current and future research



# Model updates for IFS-COMPO CY51R1

Q2-2027, tbc

2028

CY50R1

CY51R1

CY52R1

## CY51R1 Candidates

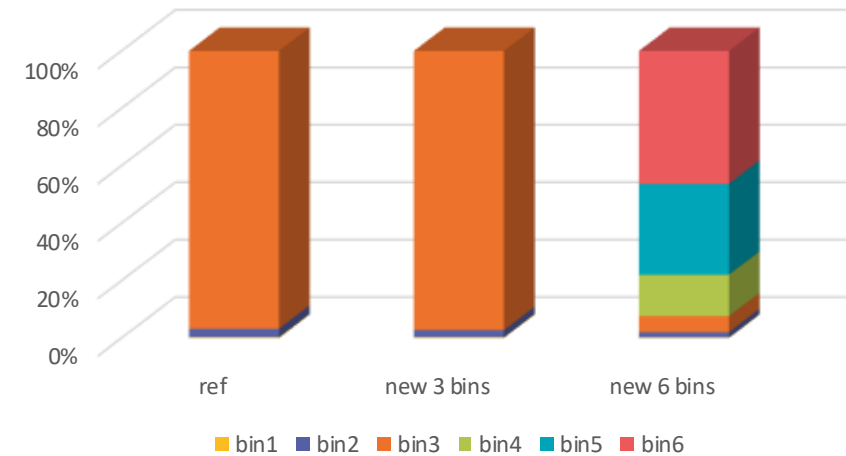
- Activation of inversion for NO<sub>x</sub> and CO
- HDD modulation of residential sector emissions
- **6 bin dust scheme**
- **New dust scheme from CAMAERA**
- **Updated aerosol dry deposition**
- **Updated aerosol optics (desert dust)**
- Updated VOC chemistry
- Update to E4C input
- Improved photolysis in stratosphere
- coupling of aerosol SAD in strato het. chem



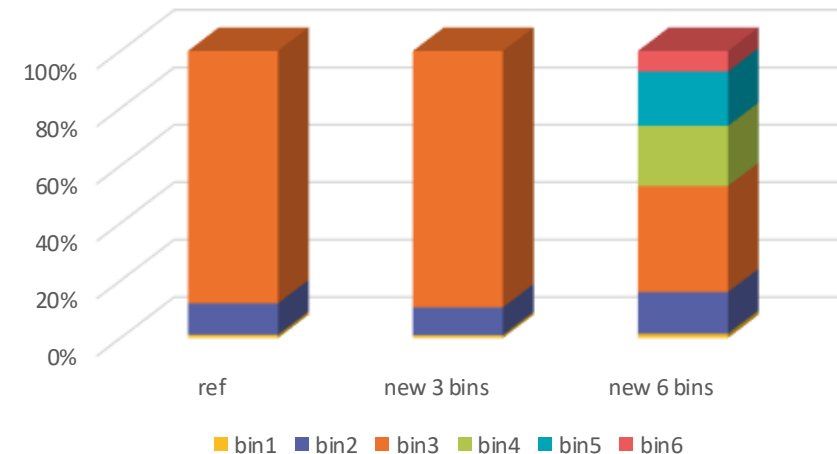
# “dust package” proposed for 51R1 – what is it?

- 6 bins for dust scheme : size bins defined as (in radius, micron) :
  - 0.03 – 0.5
  - 0.5 – 0.9
  - 0.9 – 2.5
  - 2.5 – 5
  - 5 – 10
  - 10 – 20
- New dust emission scheme from CAMAERA, adapted from SILAM dust emission scheme:
  - Threshold velocity for dust emissions from a fusion approach combining remote sensing (as in Pu et al 2020) and ground observations of present weather : Chong et al (2026, ESSD)
  - Use of a specific surface roughness input from remote sensing
  - Further tuned/optimized for high latitude dust
- Dry deposition (for all particles) from Pleim et al (2022)

Distribution of emissions into dust bins



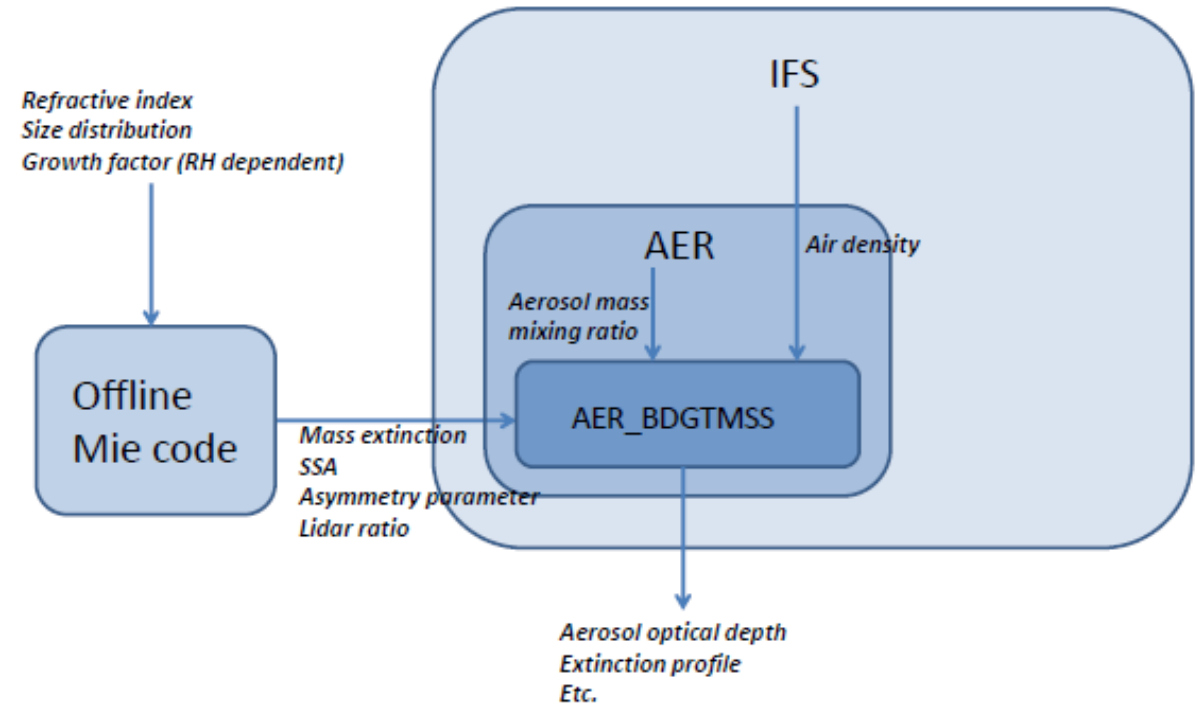
Distribution of mass into dust bins





# Aerosol optics in IFS-COMPO

- Mass extinction, SSA, Asymmetry parameter, lidar ratio at 338 wavelengths computed offline with Mie code as a function of :
  - Complex refractive index
  - Assumed size distribution
  - Hydrophilic growth
  - density
- For desert dust optics, asphericity scaling factors computed with MOP-SMAP





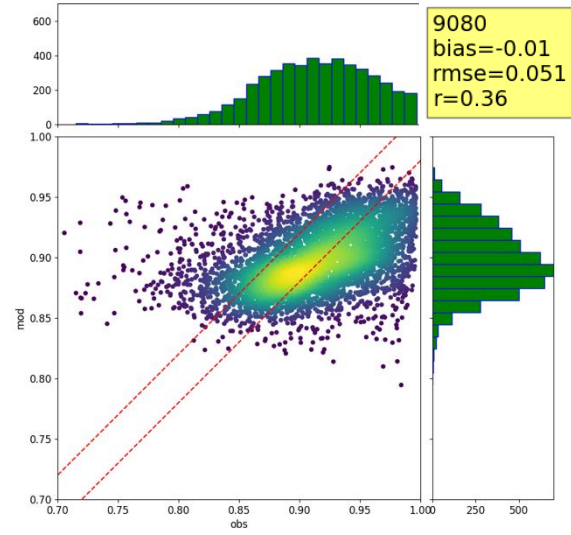
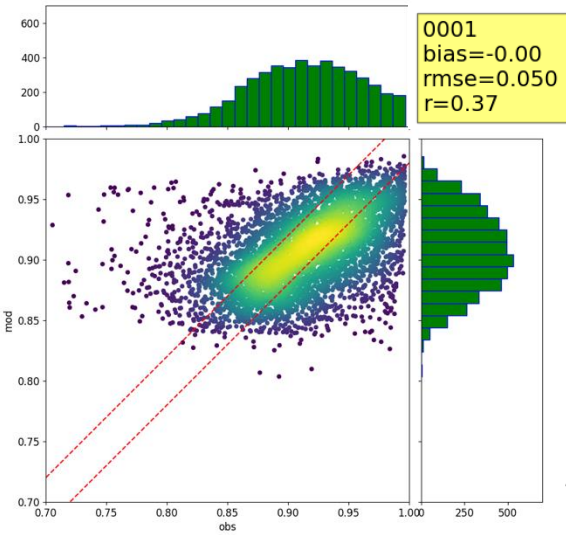
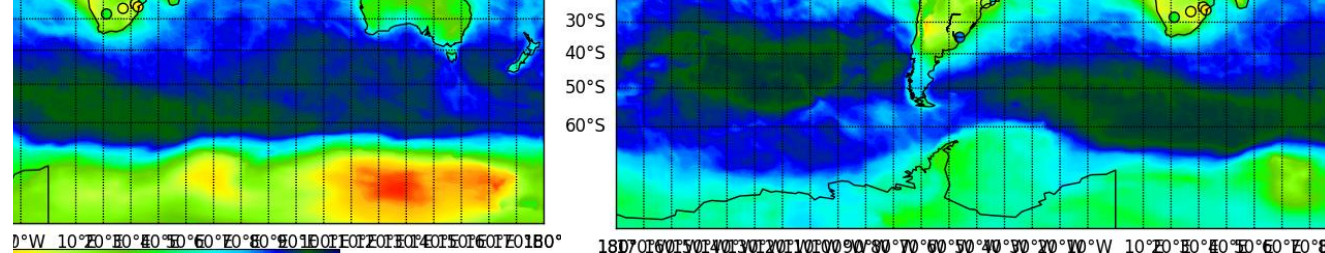
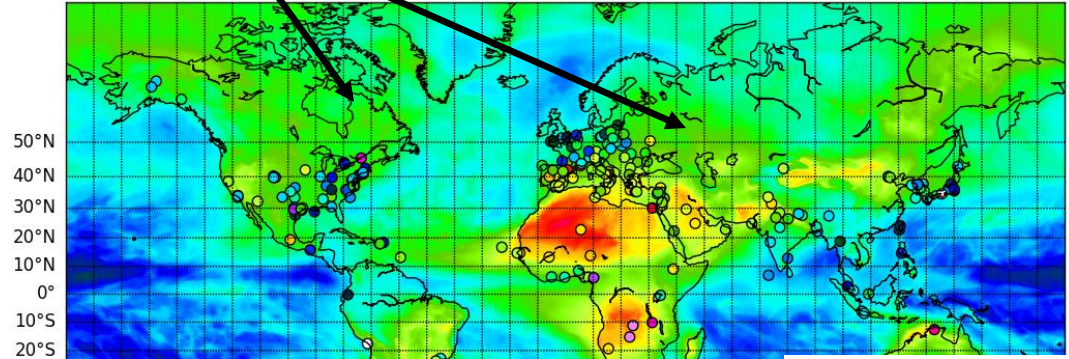
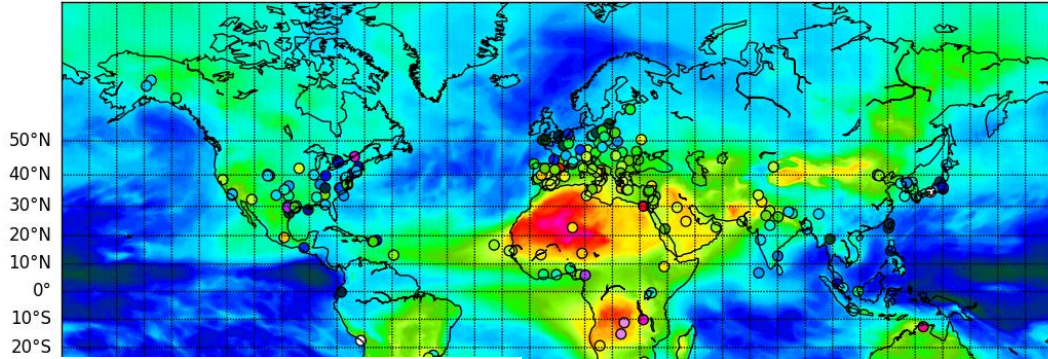
# Aerosol optics in IFS-COMPO

- Too low SSA at visible wavelengths over deserts
- Developing low bias in SSA over visible wavelengths

SSA at 440nm

0079 06\_2024\_lev1.5 ssa440

9080 06\_2024\_lev1.5 ssa440



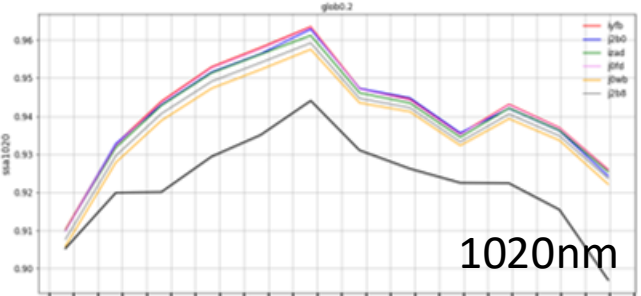
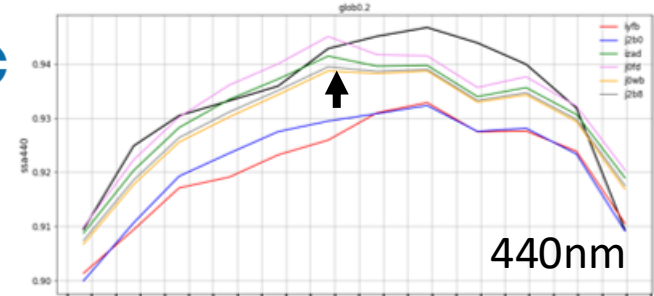
Thanks to Samuel Remy



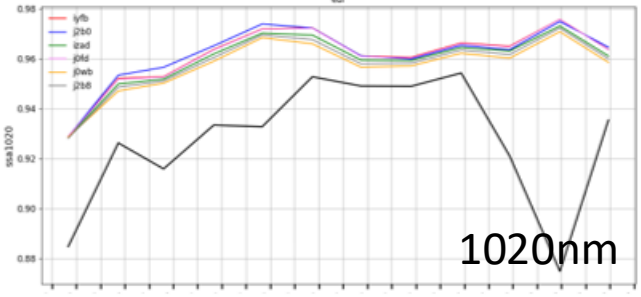
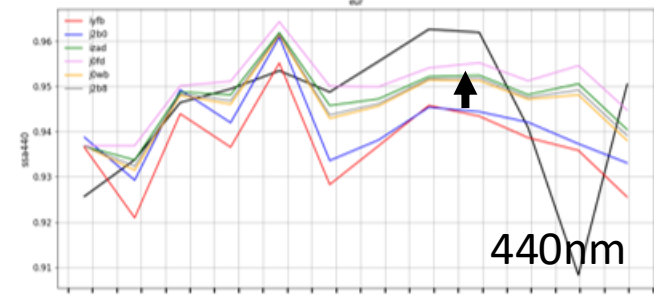
# Next steps

- Desert dust optics update proposed, improves nicely SSA/AAOD in visible
- Worked as well on BC/OM => not fully conclusive
- For the IR, there is still a large bias
- Coarse particles (including fungal spores) have more impact on IR SSA/AAOD
- Improving IR SSA/AAOD will be one objective of the future work on implementing coarse mode carbonaceous aerosols

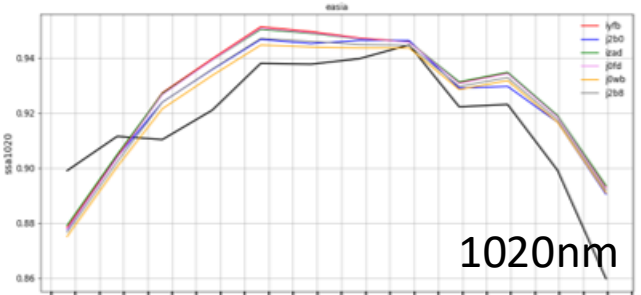
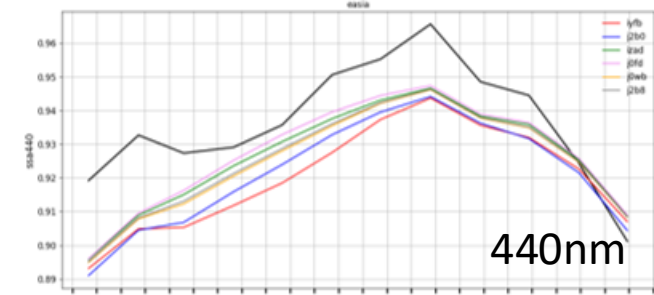
Globe



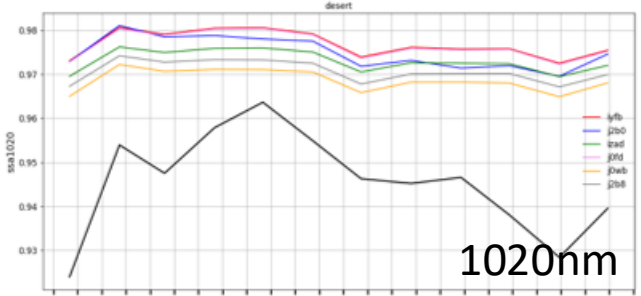
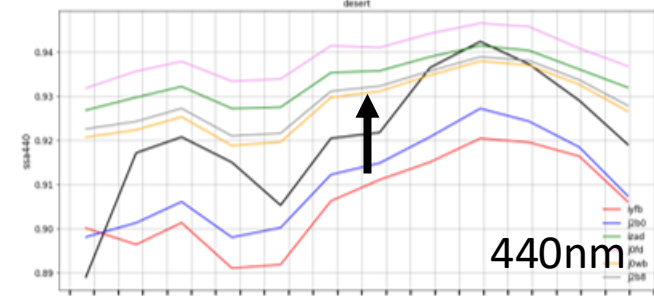
Europe



East Asia



Desert sites



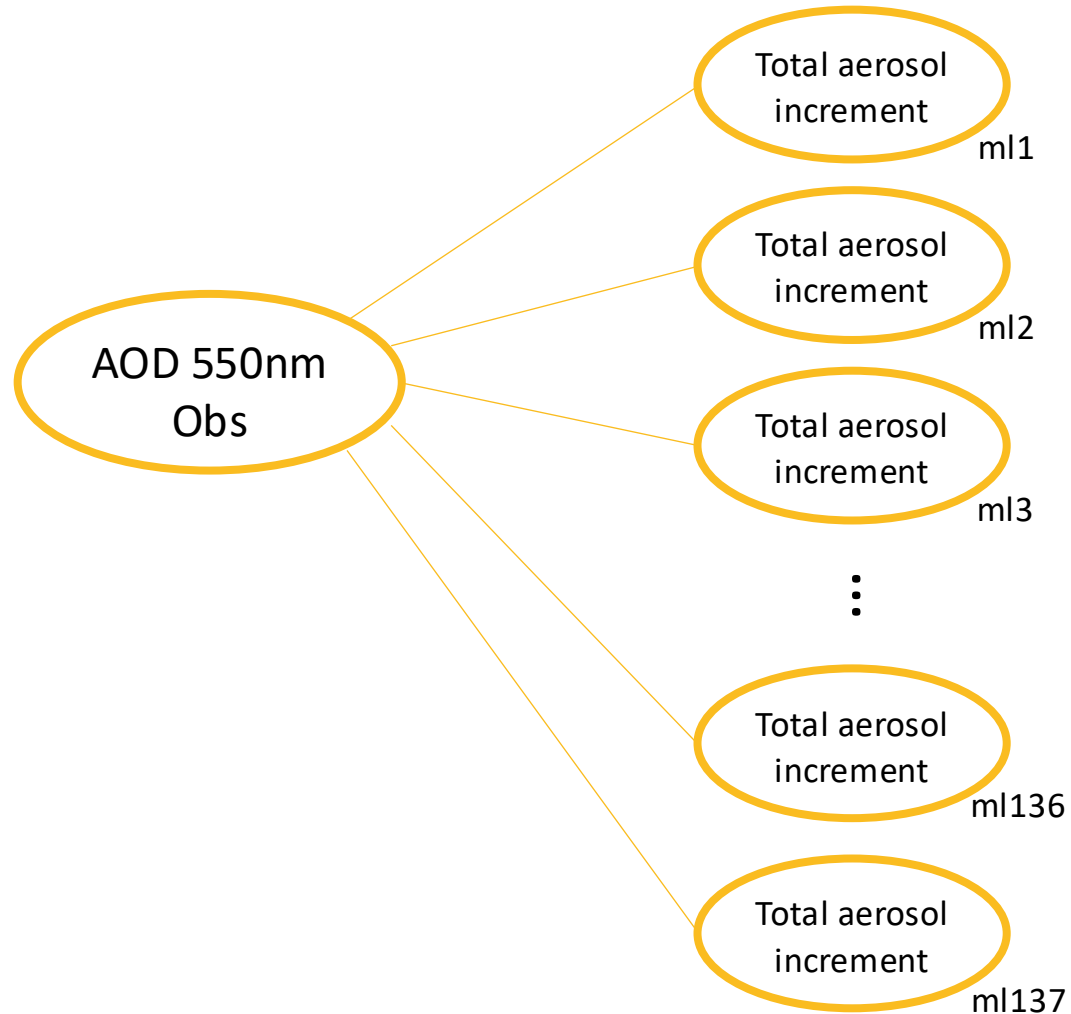
— ref Current optics  
— ref 6bins

— DUB02 Revised optics  
— DB17  
— DUB02\_R18  
— DUB02\_OPER

**Figure 10.** Monthly average of collocated simulated and retrieved SSA at 440nm (left) and 1020nm (right), averaged over the globe (top), Europe (middle top), East Asia (middle bottom) and a desert region spanning Sahara and Middle East (bottom). Ref (red), REF6BINS (blue), DUB02 (green), DB17 (pink), DUB02\_R18 (orange) and DUB02\_OPER (gray).

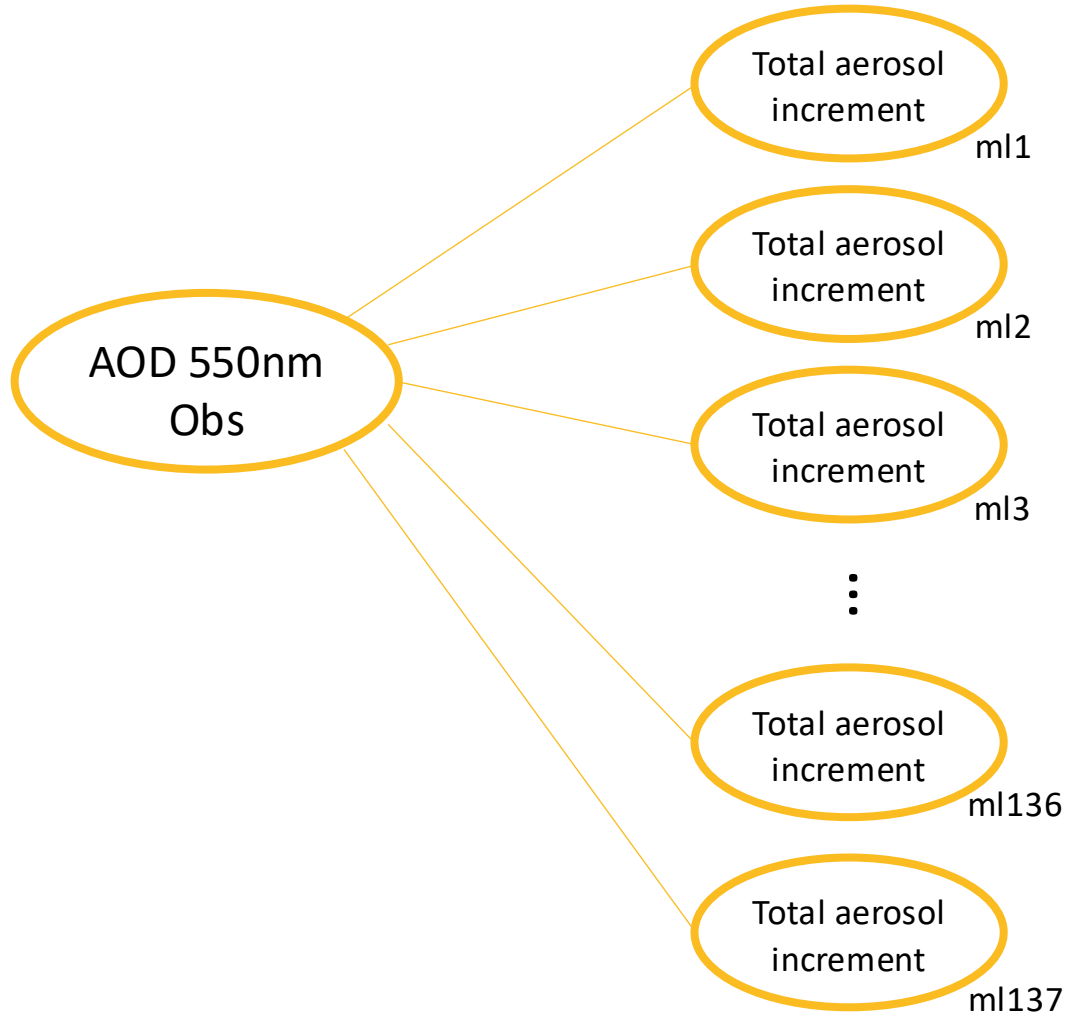


# Observation research



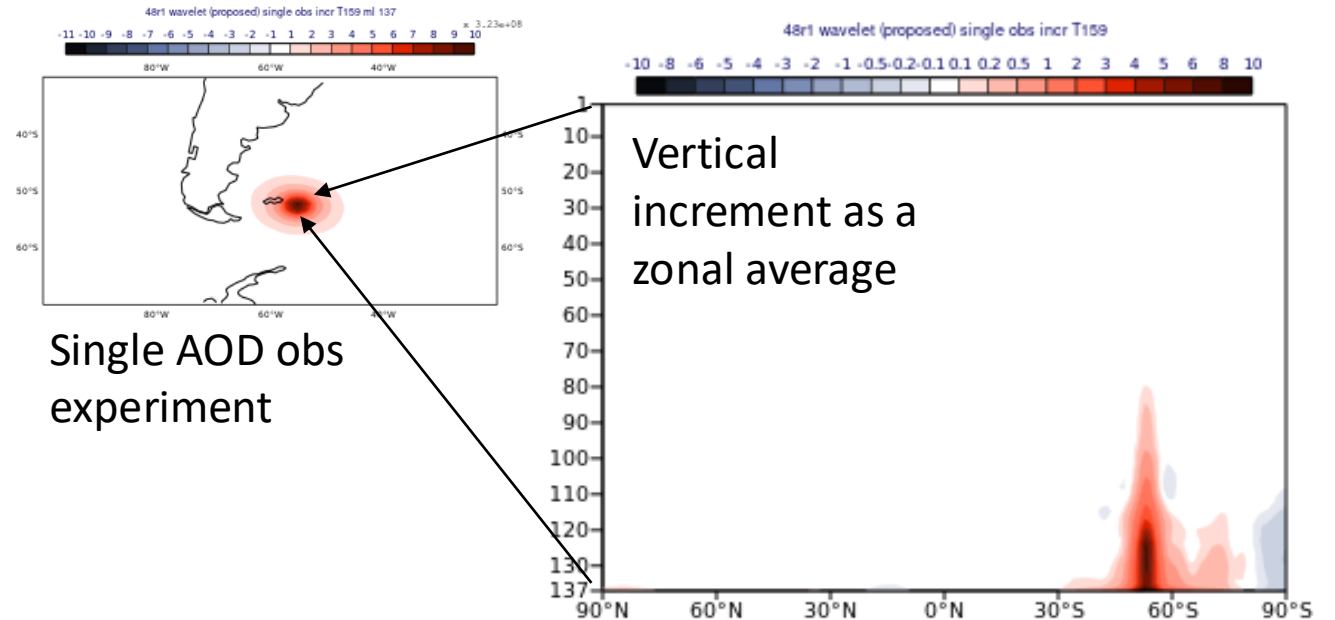
Currently, CAMS uses a 4DVar assimilation system to calculate an increment in total aerosol mass mixing ratio at each model level

# Observation research

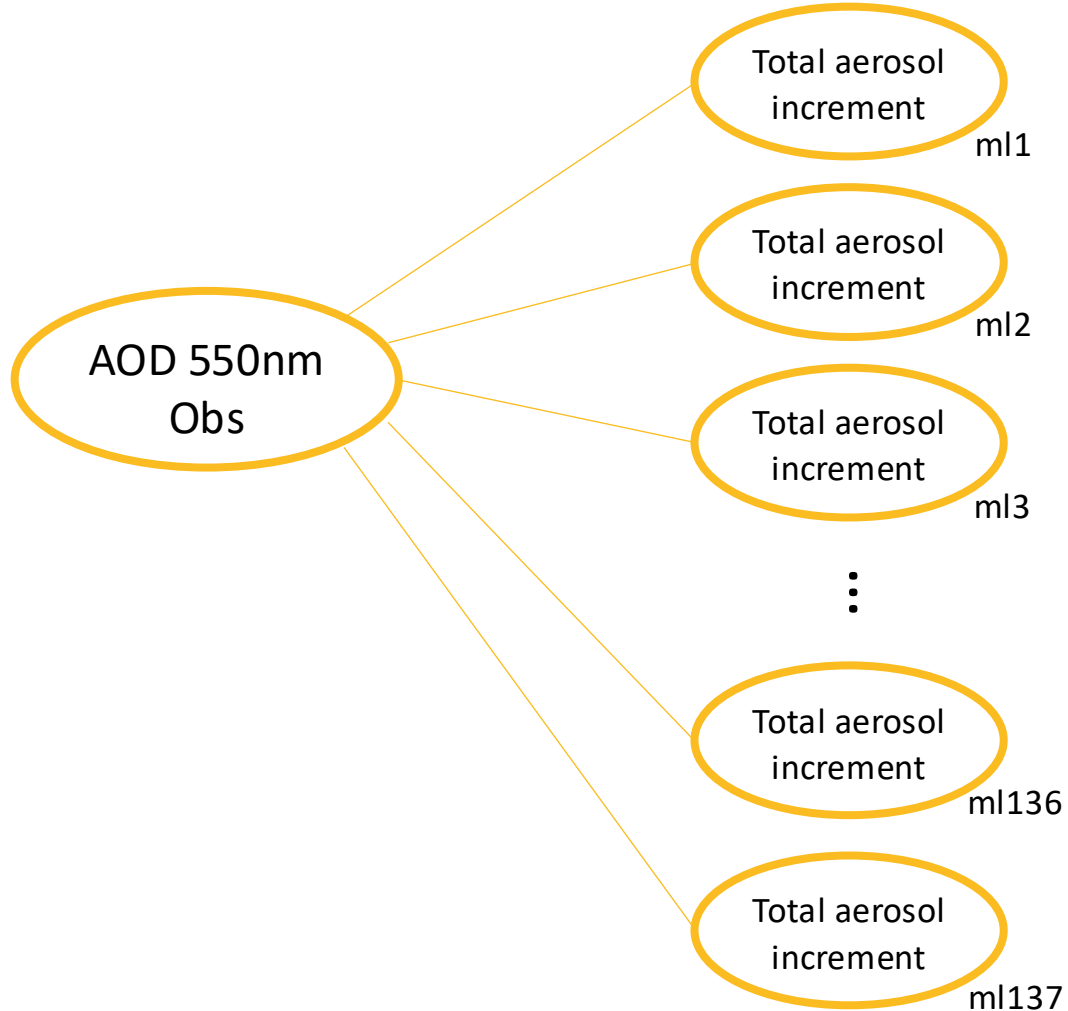


Currently, CAMS uses a 4DVar assimilation system to calculate an increment in total aerosol mass mixing ratio at each model level

- Since we don't currently assimilate profile observations, vertical distribution of the analysis increment is partly controlled by the background errors

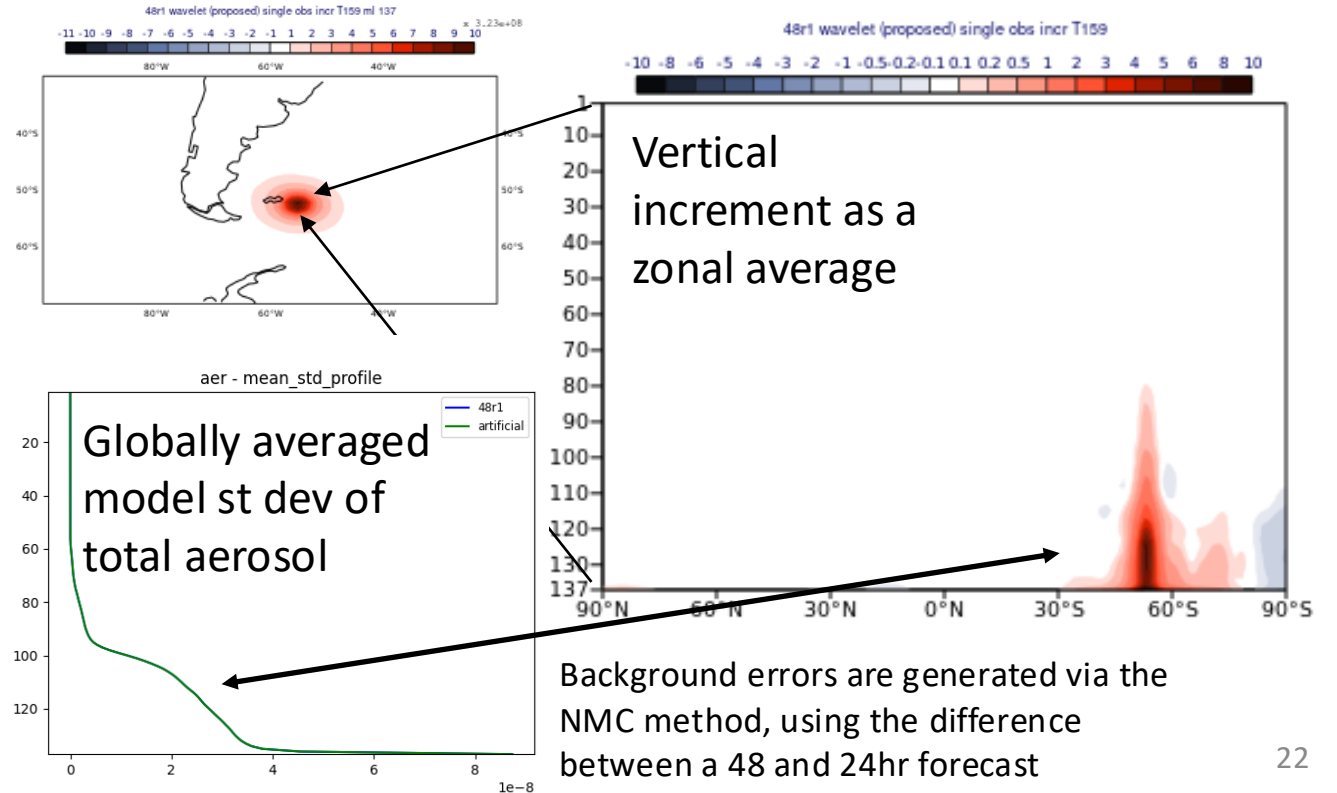


# Observation research

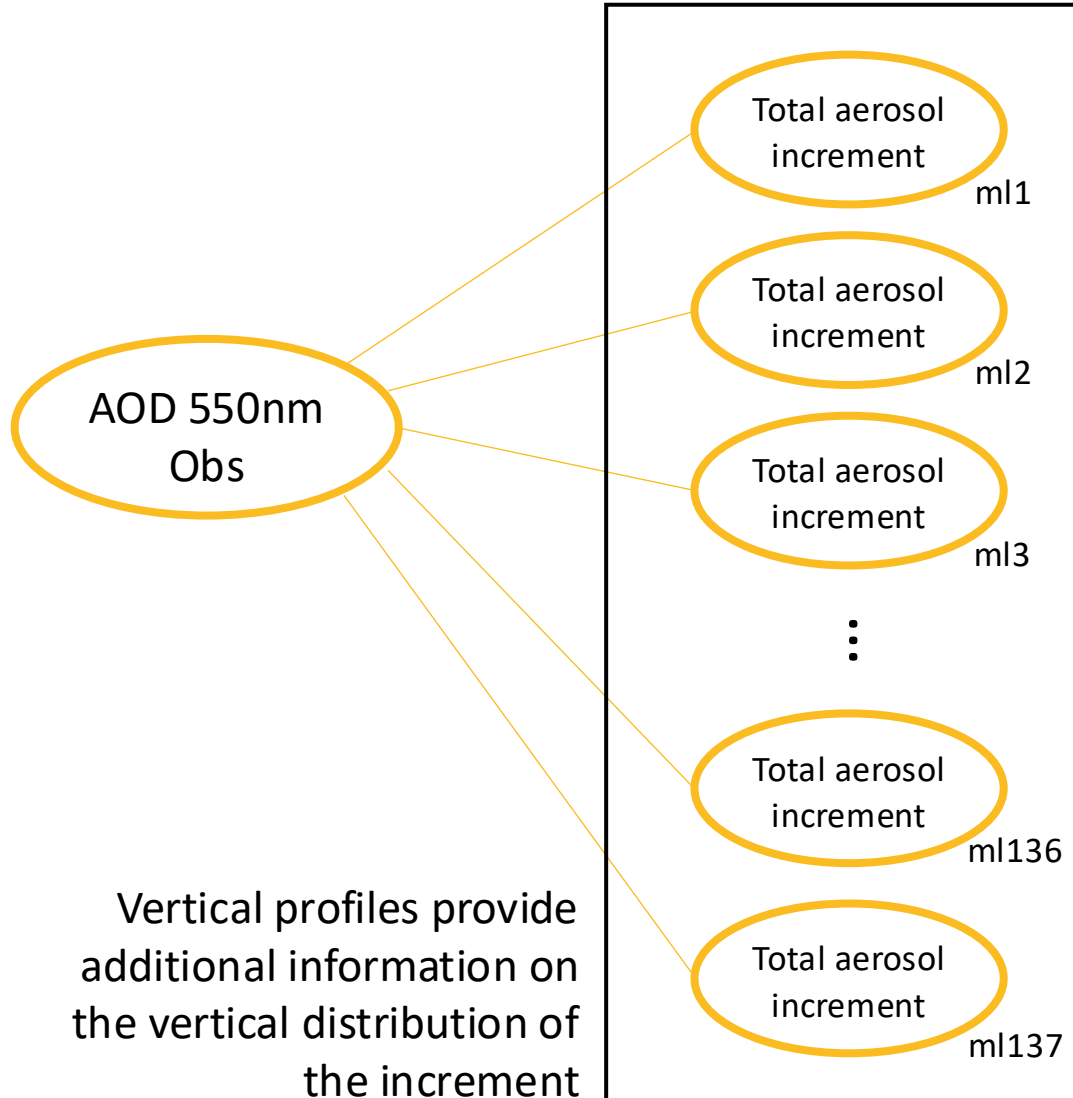


Currently, CAMS uses a 4DVar assimilation system to calculate an increment in total aerosol mass mixing ratio at each model level

- Since we don't currently assimilate profile observations, vertical distribution of the analysis increment is partly controlled by the background errors



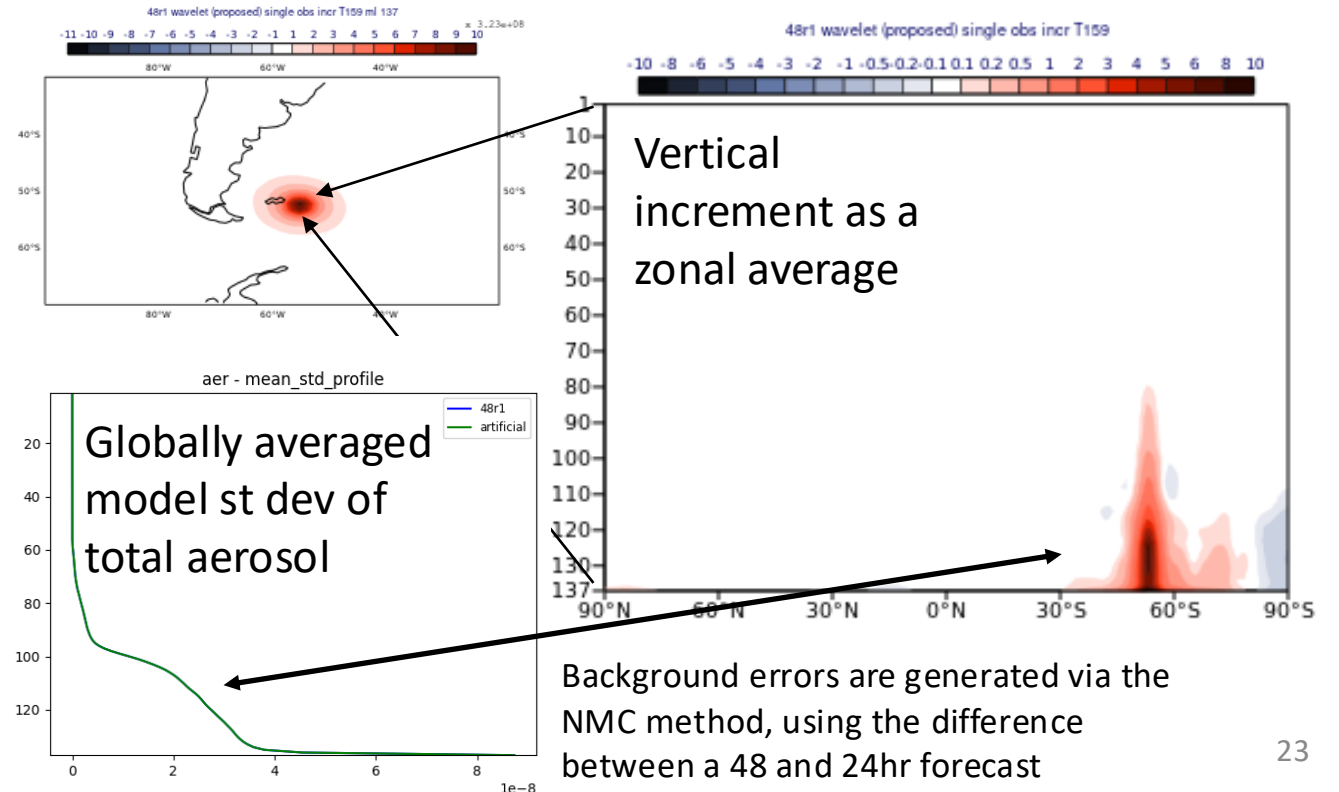
# Observation research



Vertical profiles provide additional information on the vertical distribution of the increment

Currently, CAMS uses a 4DVar assimilation system to calculate an increment in total aerosol mass mixing ratio at each model level

- Since we don't currently assimilate profile observations, vertical distribution of the analysis increment is partly controlled by the background errors



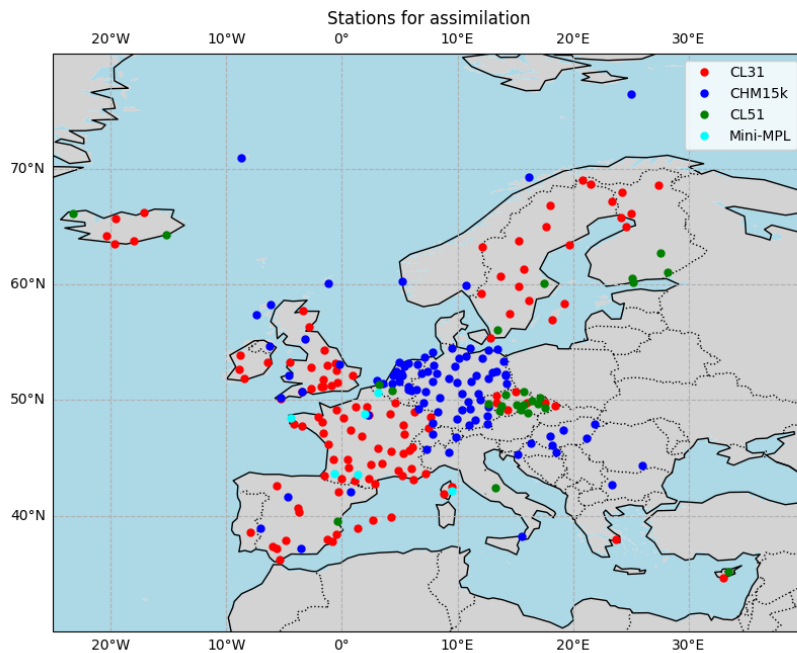
Background errors are generated via the NMC method, using the difference between a 48 and 24hr forecast



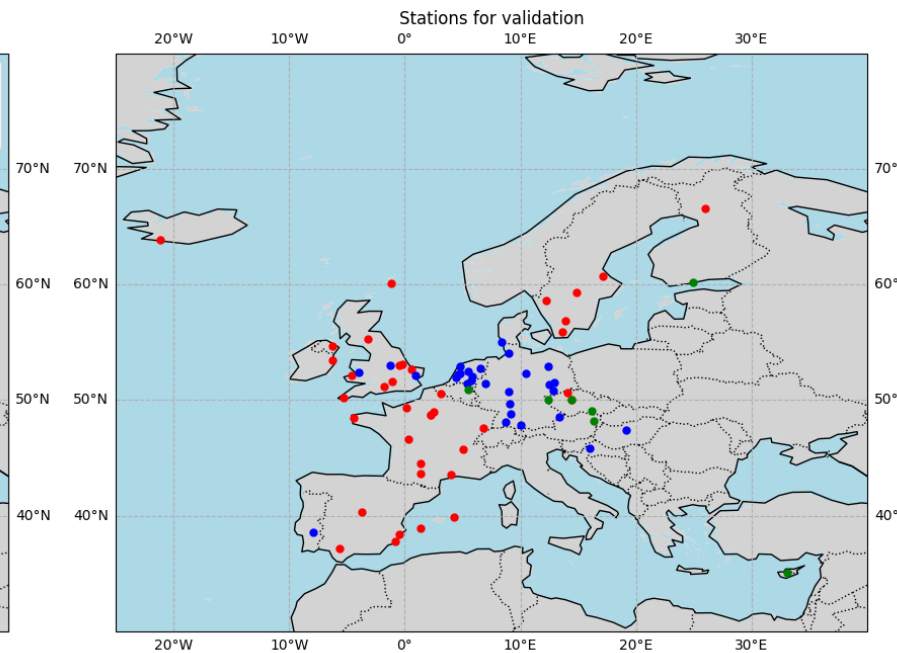
# E-PROFILE (CAMAERA HE)

- Pre-processing of raw E-PROFILE ceilometer/lidar data to remove clouds, fog, precipitation and noise
- New observation operator at 910nm introduced including water vapour effects
- Effect of asphericity for dust
- Background and observation errors

**CAMAERA** is a Horizon Europe CAMS advancement project which aims to **enhance the quality of the aerosol products** delivered by CAMS through improvements of the modelling capabilities and data assimilation aspects of the CAMS regional and global systems.



Assimilated lidar/ceilometer stations



Withheld ceilometer stations



Thanks to Michael Kahnert



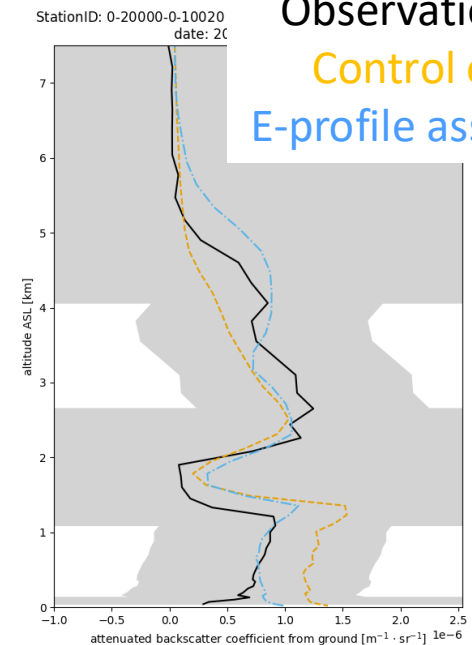
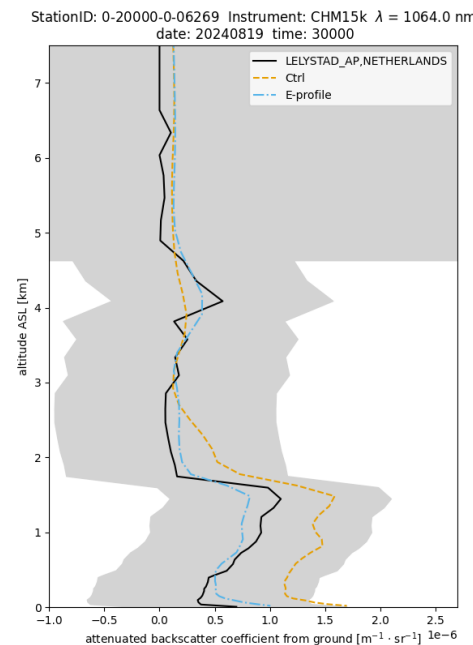
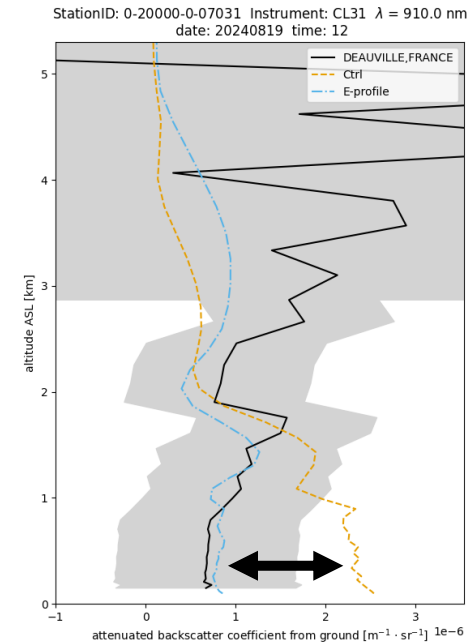
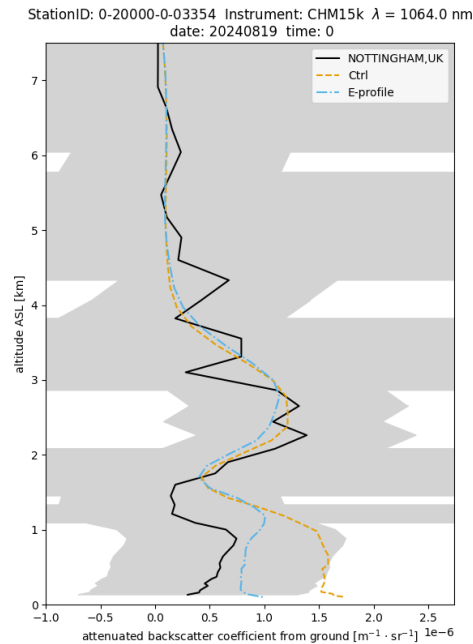
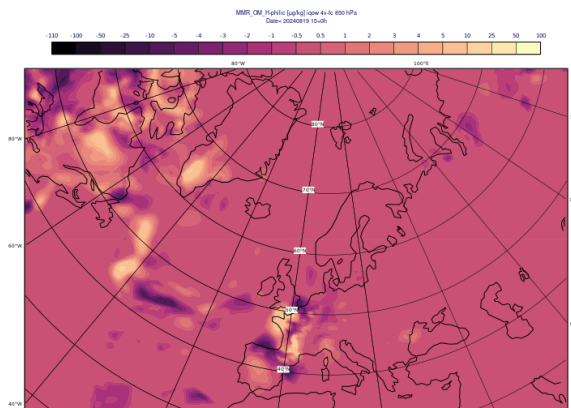
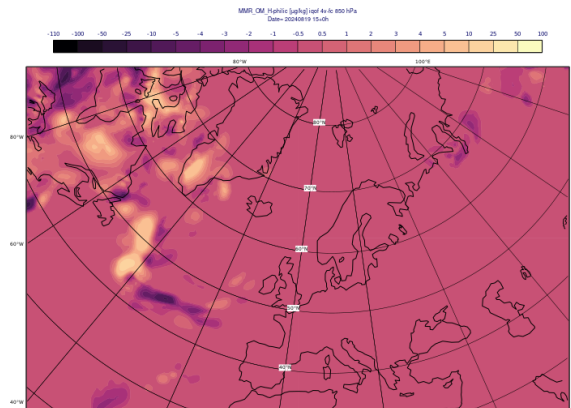
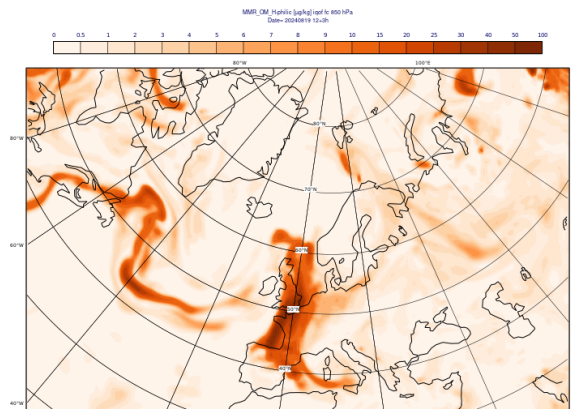
# E-PROFILE obs

Hydrophilic OM mixing ratio  
850 hPa

Canadian Wildfire,  
August 2024

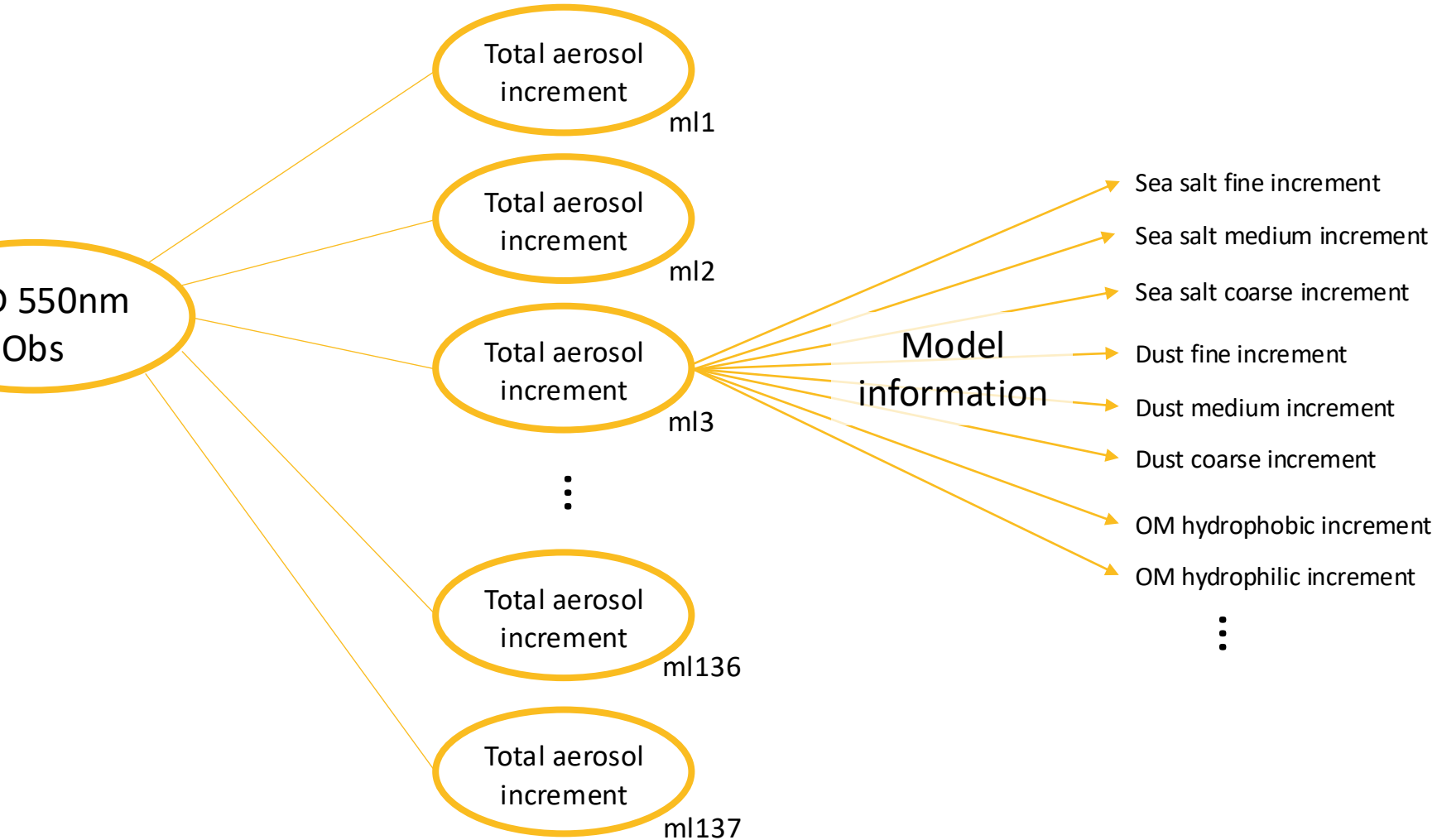
Analysis increment  
Control experiment  
AOD assimilation

Analysis increment  
E-profile assimilation  
AOD assimilation



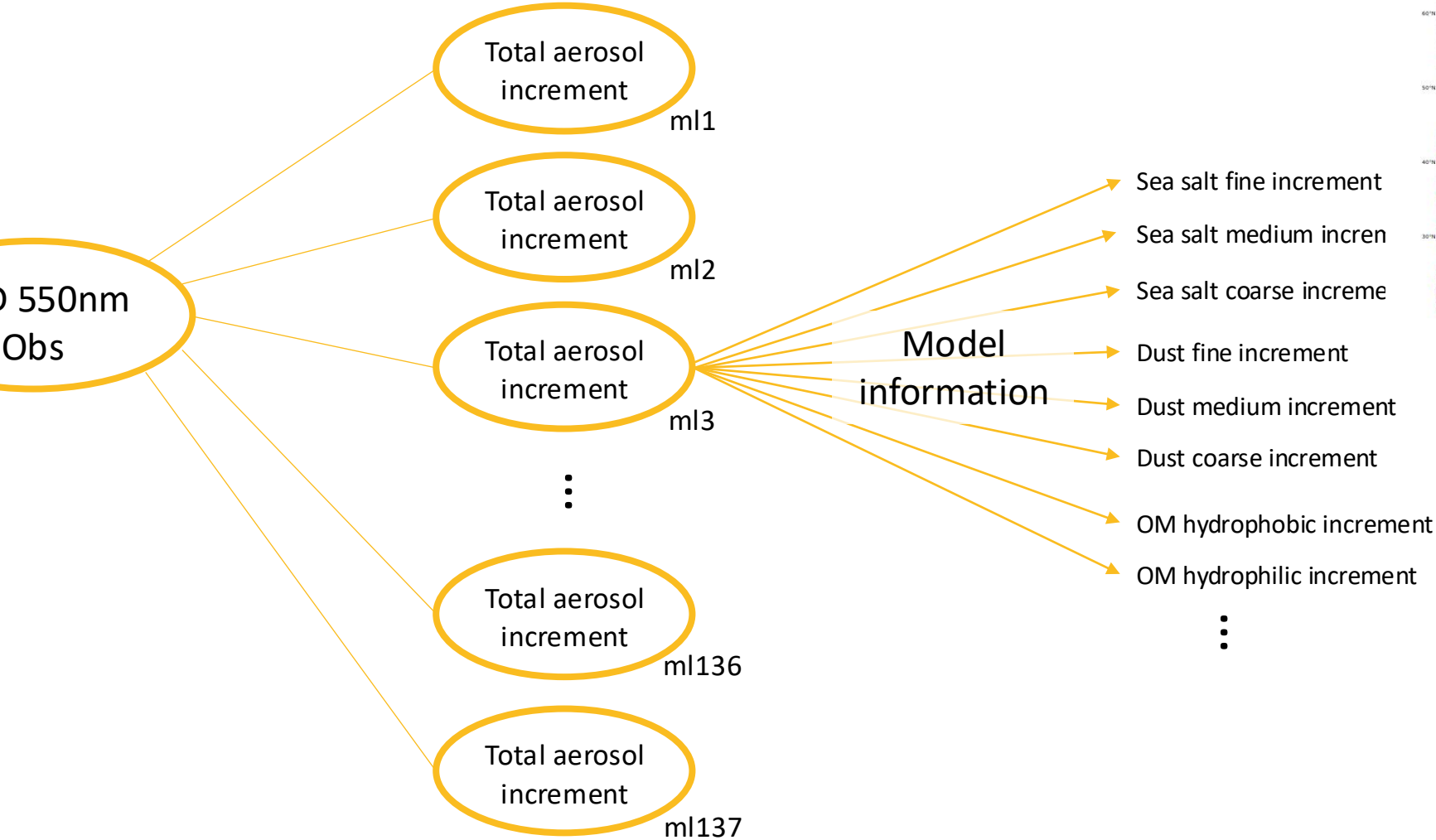
Observations  
Control exp  
E-profile assim

# Observation research



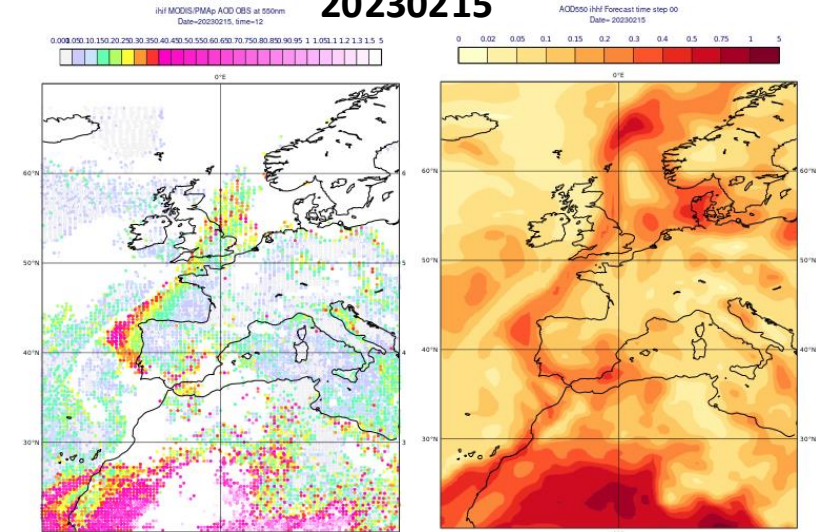


# Observation research



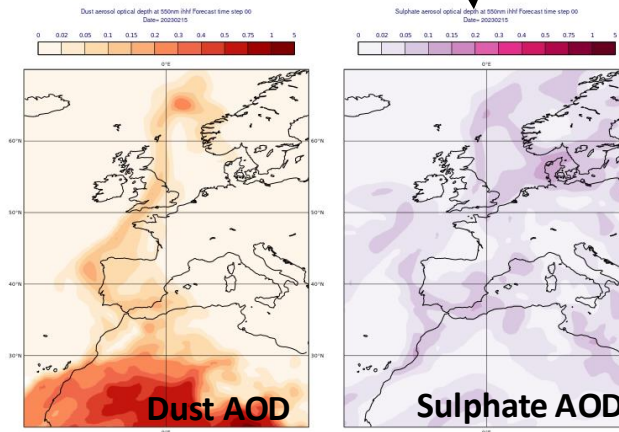
Dust plume across Europe Feb 2023

20230215



MODIS/PMAp AOD 550

CAMS AOD 550



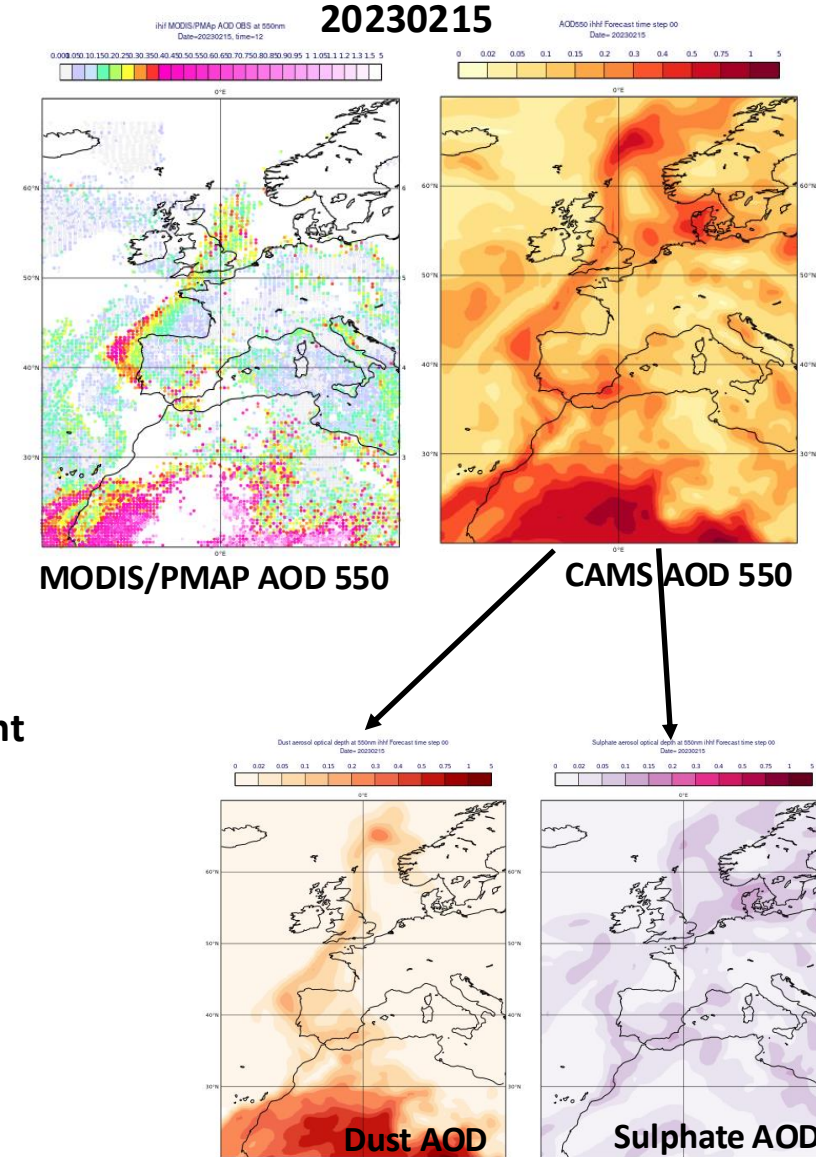
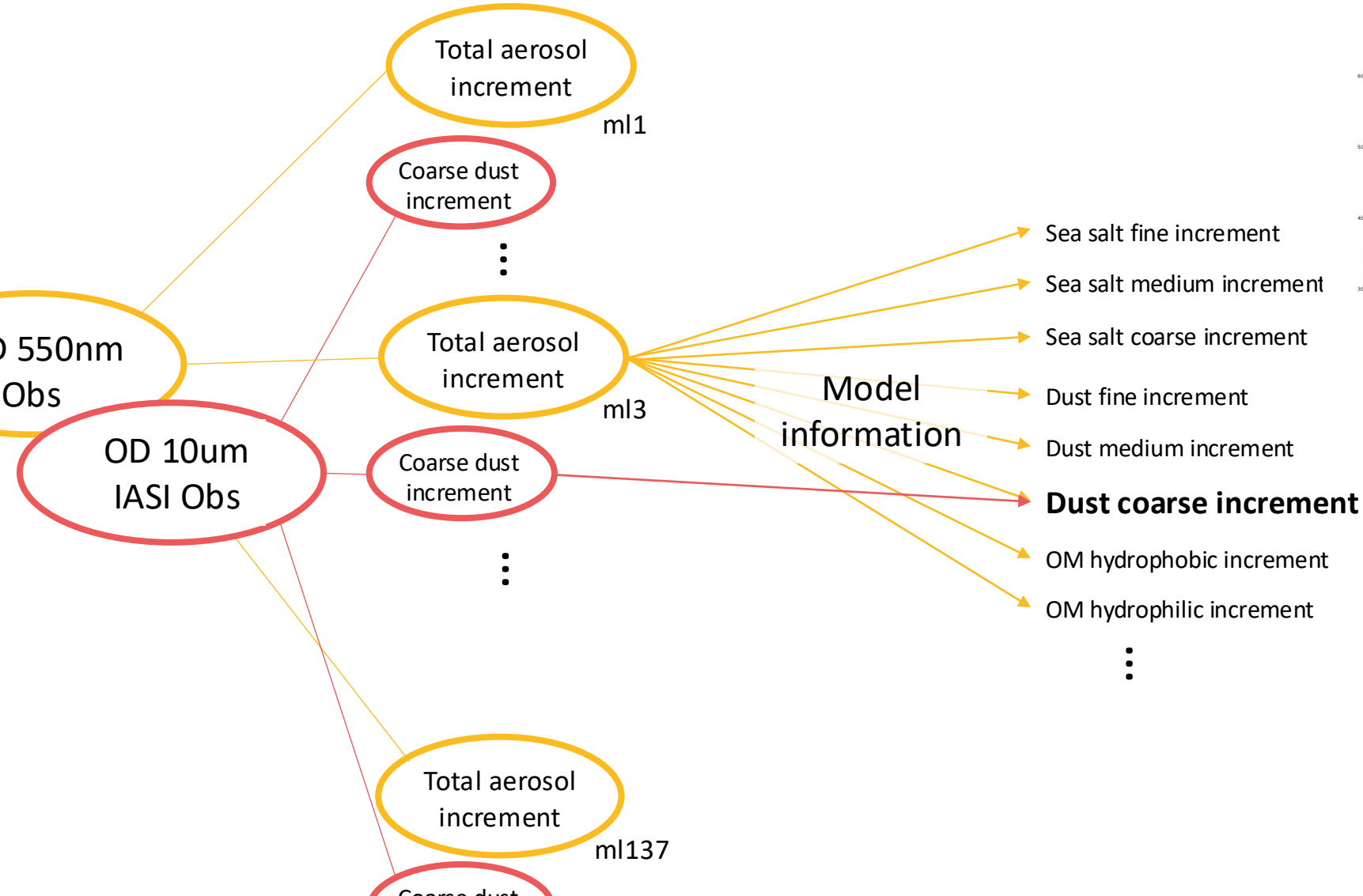
Dust AOD

Sulphate AOD



# Dust plume across Europe Feb 2023

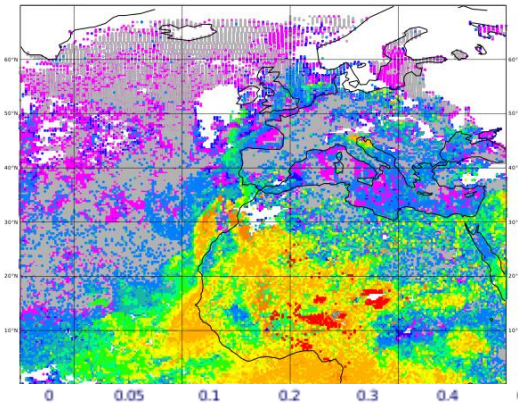
## Observation research



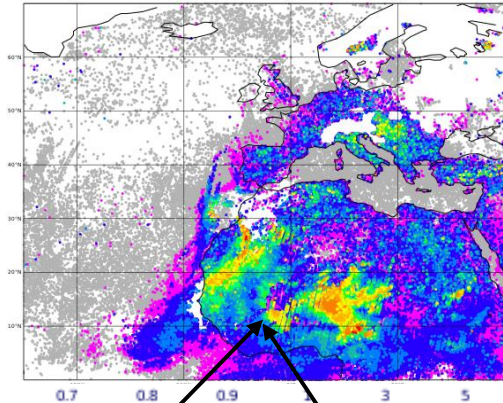


# IASI ULB Dust observations

VIIRS – all obs, 14-17<sup>th</sup> Feb



IASI 10um – all obs, 14-17<sup>th</sup> Feb



Comparison of model (ihf) and L1.5 Aeronet AOT at 500nm over IER\_Cinzana (13.28°N, 5.93°W).

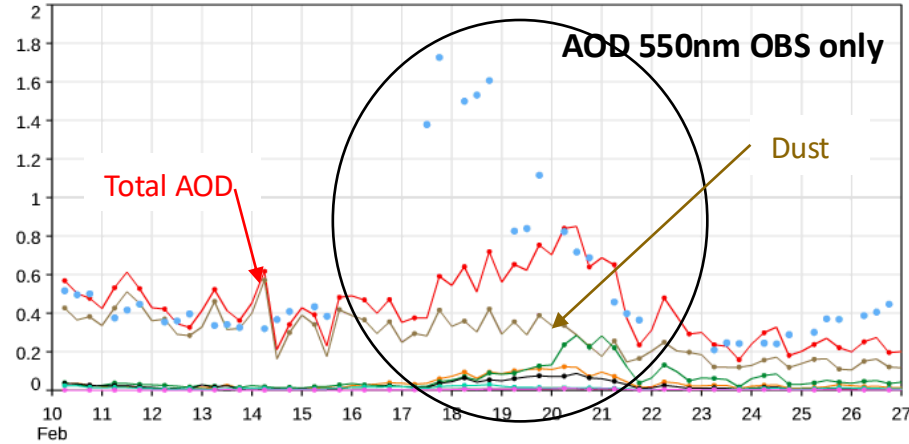
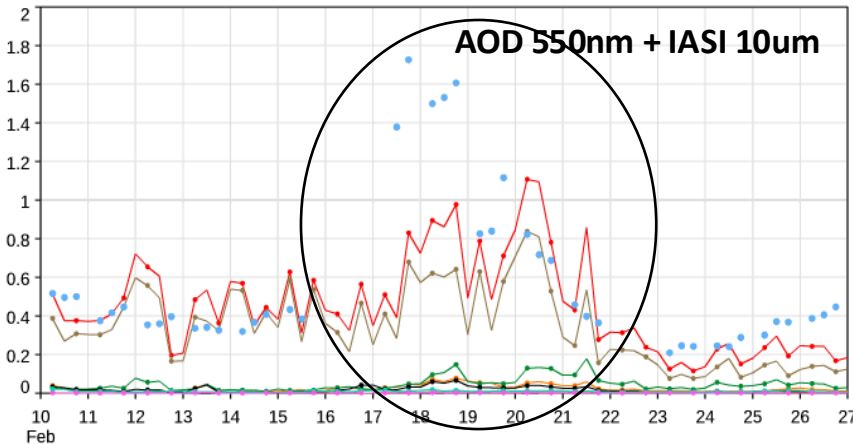
10-26 Feb 2023. 00,12Z, T+6 to 12. Ver0D 12.17.5.

● L1.5 Aeronet ● Total ● SO4 ● SS ● DU ● OM ● BC ● NO3 ● NH4

Comparison of model (ihf) and L1.5 Aeronet AOT at 500nm over IER\_Cinzana (13.28°N, 5.93°W).

10-26 Feb 2023. 00,12Z, T+6 to 12. Ver0D 12.17.5.

● L1.5 Aeronet ● Total ● SO4 ● SS ● DU ● OM ● BC ● NO3 ● NH4

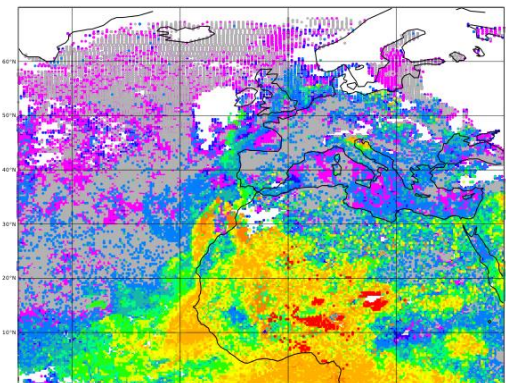




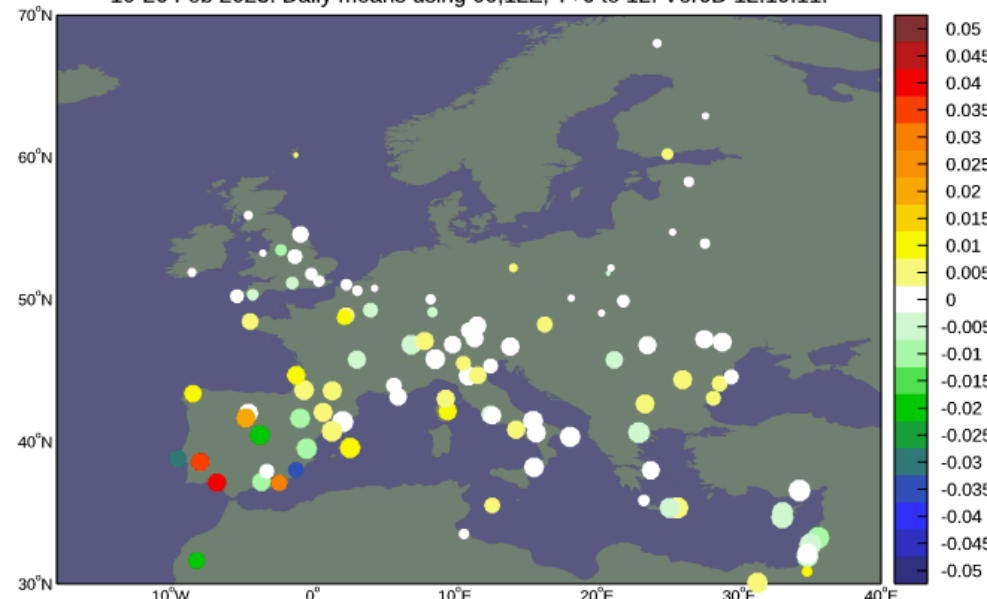
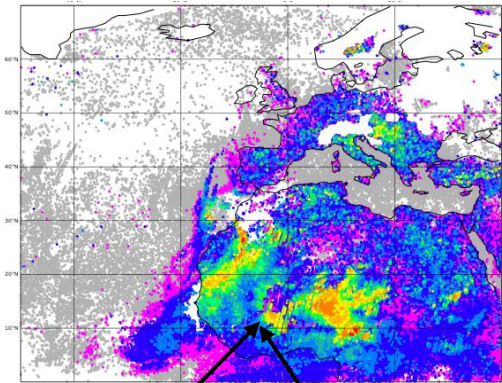
# IASI ULB Dust observations

FC-OBS Bias Abs Diff (IASI-OPER). Model vs L2.0 Aeronet Any AE AOT @ 1020nm. 10-26 Feb 2023. Daily means using 00,12Z, T+6 to 12. Ver0D 12.19.11.

VIIRS – all obs, 14-17<sup>th</sup> Feb

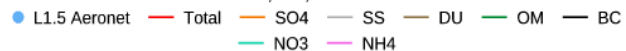


IASI 10um – all obs, 14-17<sup>th</sup> Feb

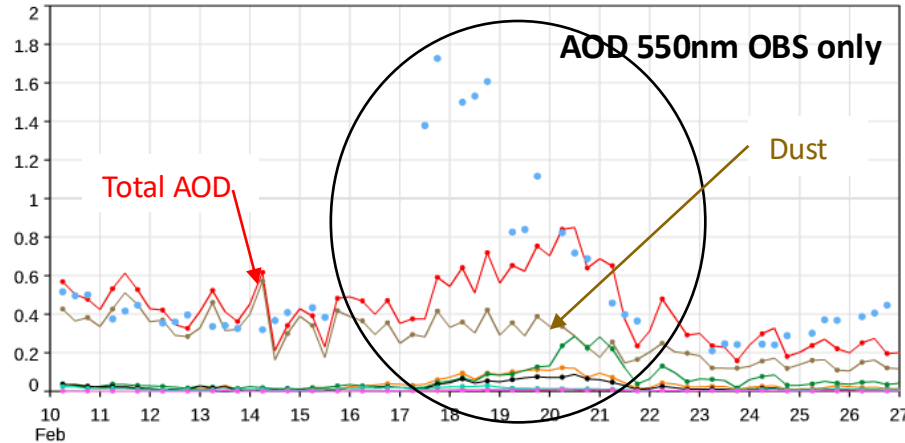
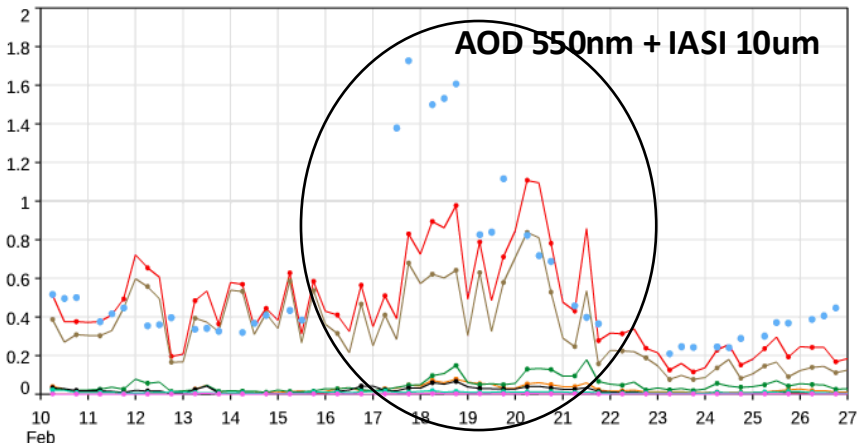
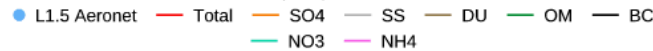


Difference in bias: Aeronet AOT@1020nm (IASI + AOD versus AOD only) 10-26th Feb

Comparison of model (ihf) and L1.5 Aeronet AOT at 500nm over IER\_Cinzana (13.28°N, 5.93°W). 10-26 Feb 2023. 00,12Z, T+6 to 12. Ver0D 12.17.5.



Comparison of model (ihf) and L1.5 Aeronet AOT at 500nm over IER\_Cinzana (13.28°N, 5.93°W). 10-26 Feb 2023. 00,12Z, T+6 to 12. Ver0D 12.17.5.





PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth



IMPLEMENTED BY



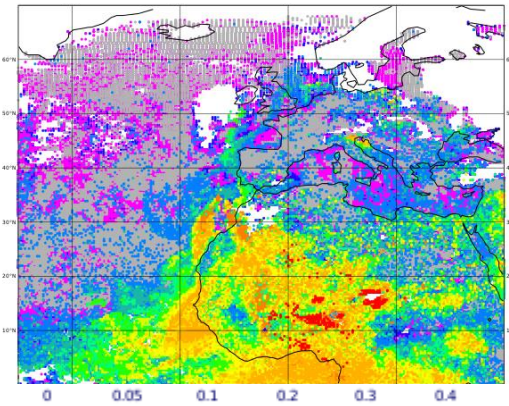
Total AOD

Dust AOD

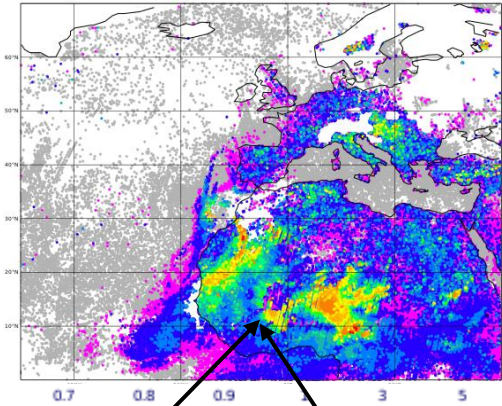
OM AOD

# IASI ULB Dust observations

VIIRS – all obs, 14-17<sup>th</sup> Feb



IASI 10um – all obs, 14-17<sup>th</sup> Feb



Comparison of model (ihif) and L1.5 Aeronet AOT at 500nm over IER\_Cinzana (13.28°N, 5.93°W).

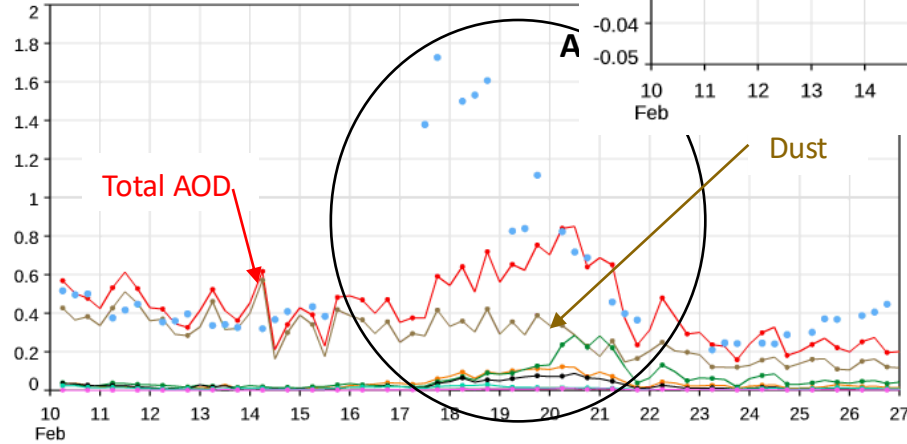
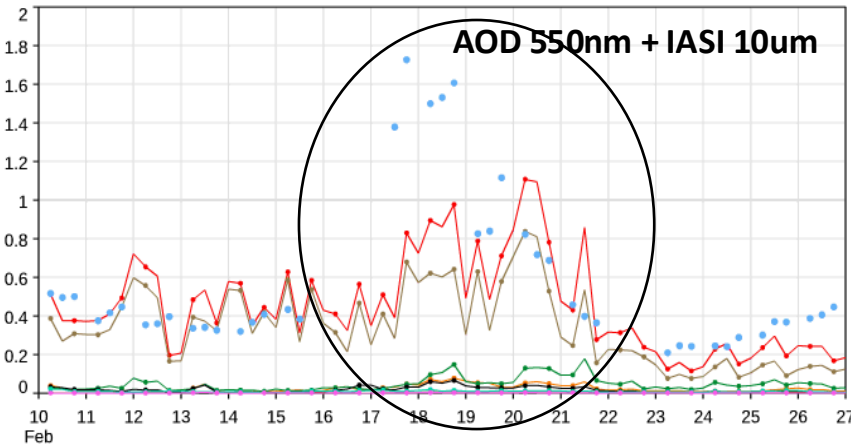
10-26 Feb 2023. 00,12Z, T+6 to 12. Ver0D 12.17.5.

● L1.5 Aeronet ● Total ● SO4 ● SS ● DU ● OM ● BC ● NO3 ● NH4

Comparison of model (ihhf) and L1.5 Aeronet IER\_Cinzana (13.28°N, 5.93°W).

10-26 Feb 2023. 00,12Z, T+6 to 12. V

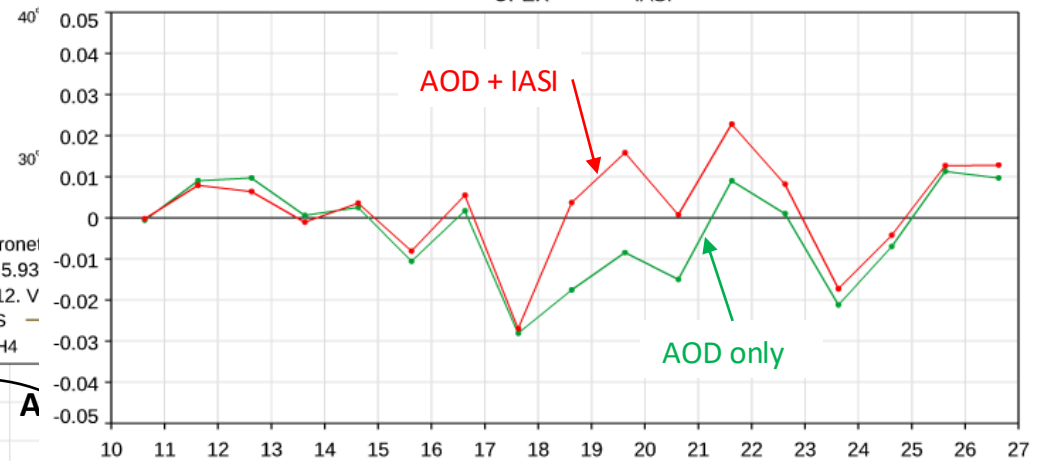
● L1.5 Aeronet ● Total ● SO4 ● SS ● NO3 ● NH4



FC-OBS Bias Abs Diff (IASI-OPER). Model vs L2.0 Aeronet Any AE AOT @ 1020nm. 10-26 Feb 2023. Daily means using 00,12Z, T+6 to 12. Ver0D 12.19.11.



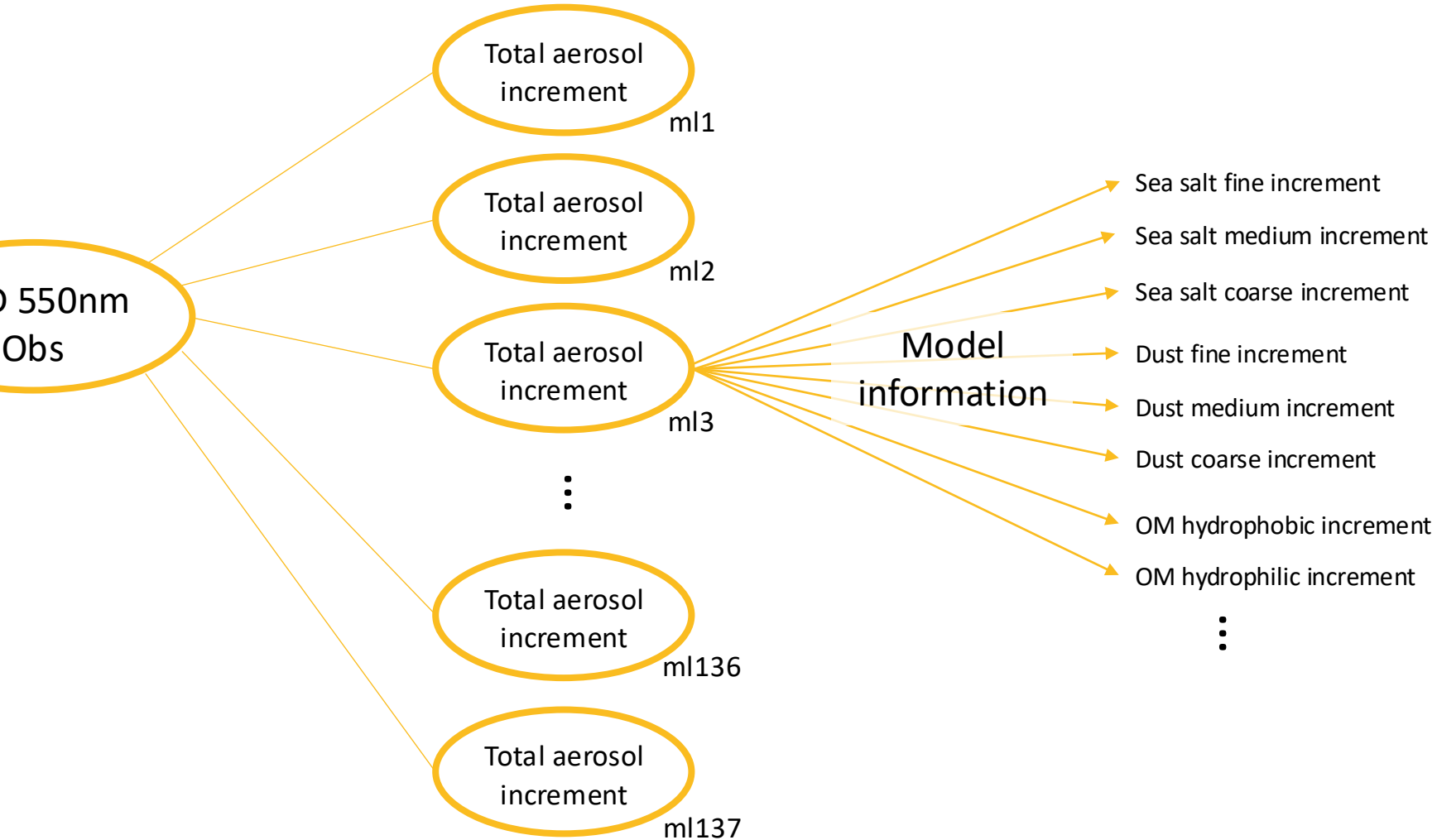
FC-OBS bias. Model against L2.0 Aeronet AOT at 1020nm. 108 sites in Europe. 10-26 Feb 2023. 00,12Z, T+6 to 12. Ver0D 12.19.11.



Now as a European average over time



# Observation research – 3MI & PACE



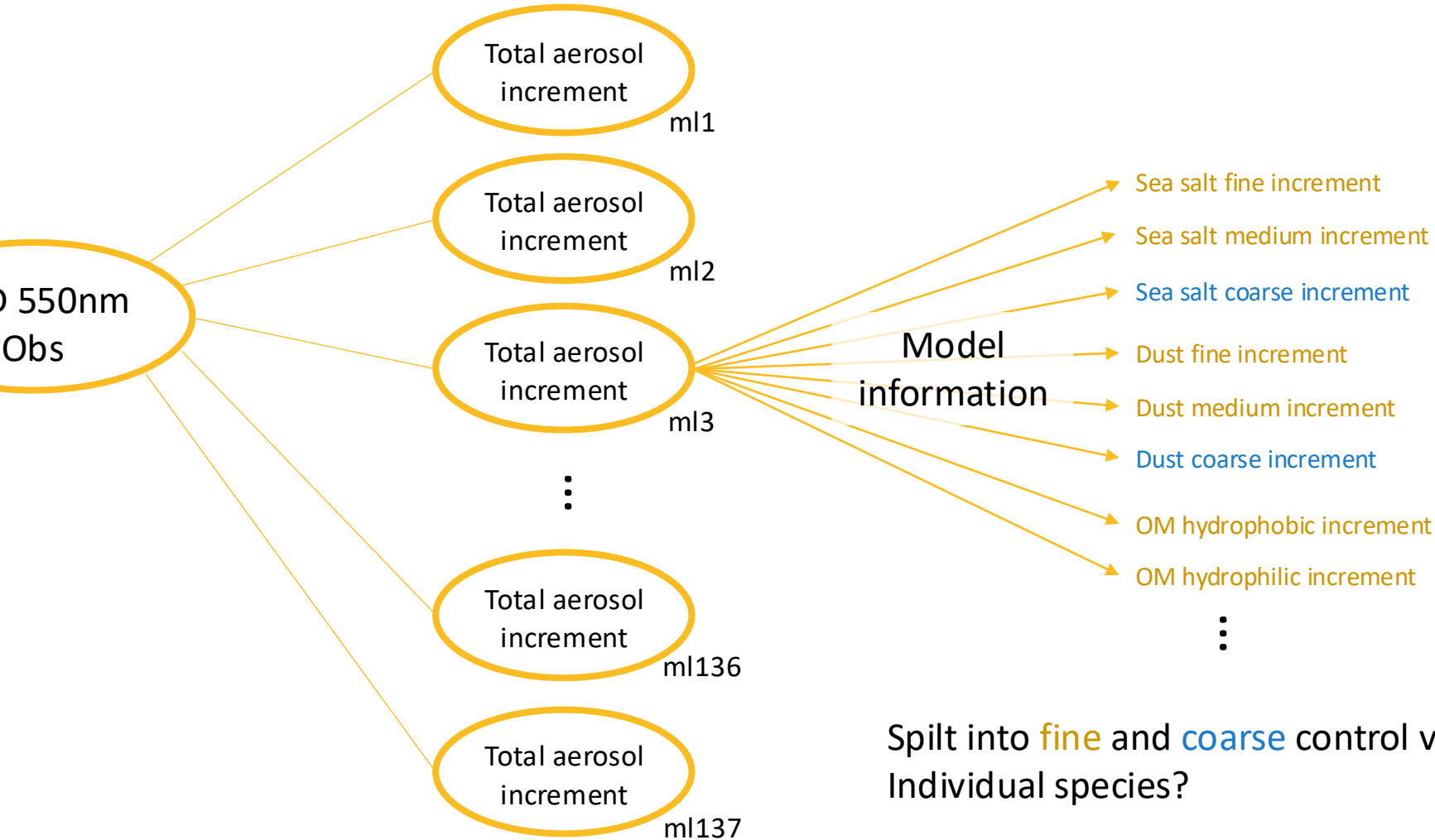
3MI observations will provide:

- AOD total, fine & coarse (8 wavelengths)
- AAOD total, fine & coarse (8 wavelengths)
- SSA total, fine & coarse (8 wavelengths)
- A variety of other observations

How do we match these observations to the specific tracers in the model?



# Observation research – 3MI & PACE



3MI observations will provide:

- AOD total, fine & coarse (8 wavelengths)
- AAOD total, fine & coarse (8 wavelengths)
- SSA total, fine & coarse (8 wavelengths)
- A variety of other observations

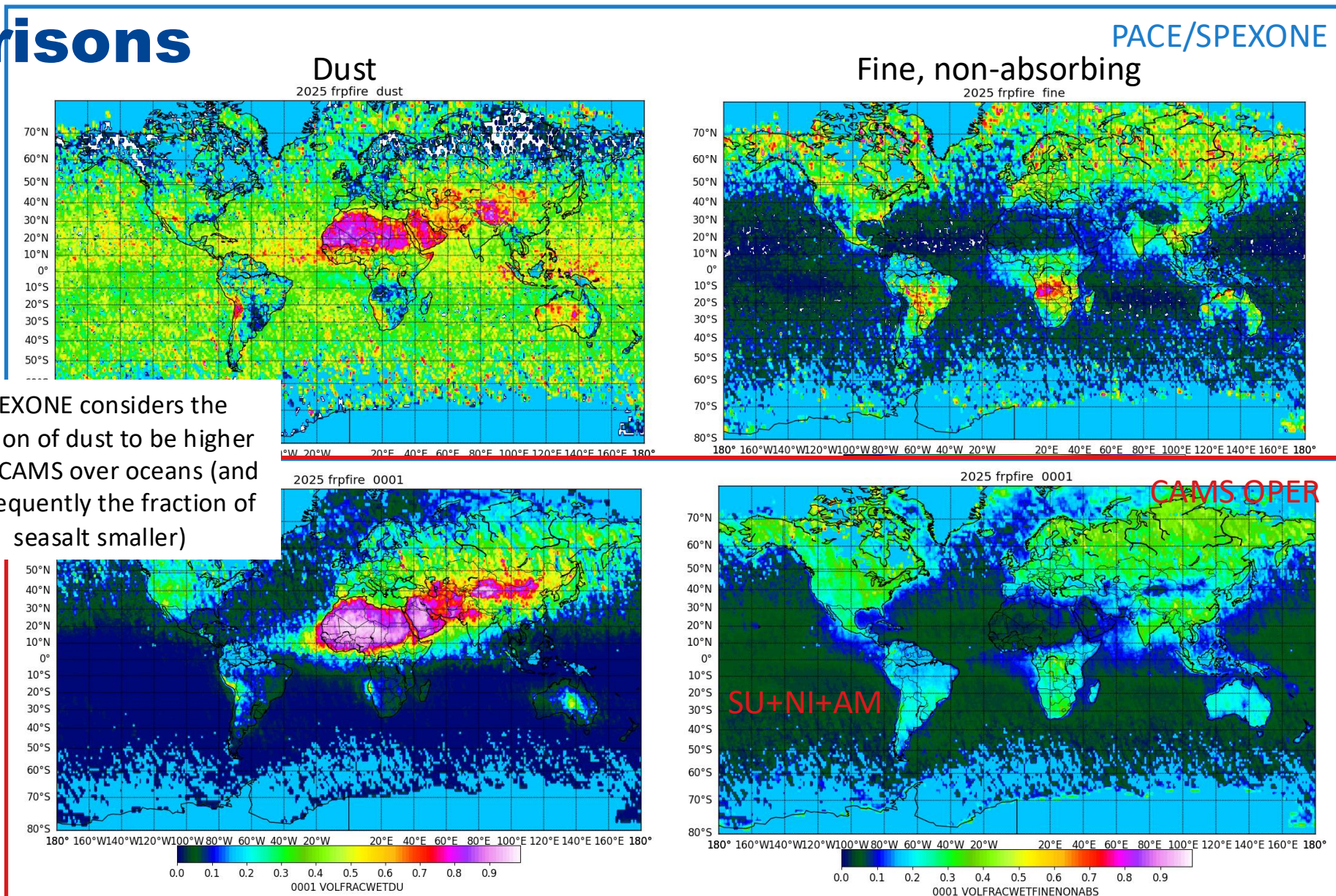
How do we match these observations to the specific tracers in the model?

Spilt into **fine** and **coarse** control variables?  
Individual species?



# PACE comparisons

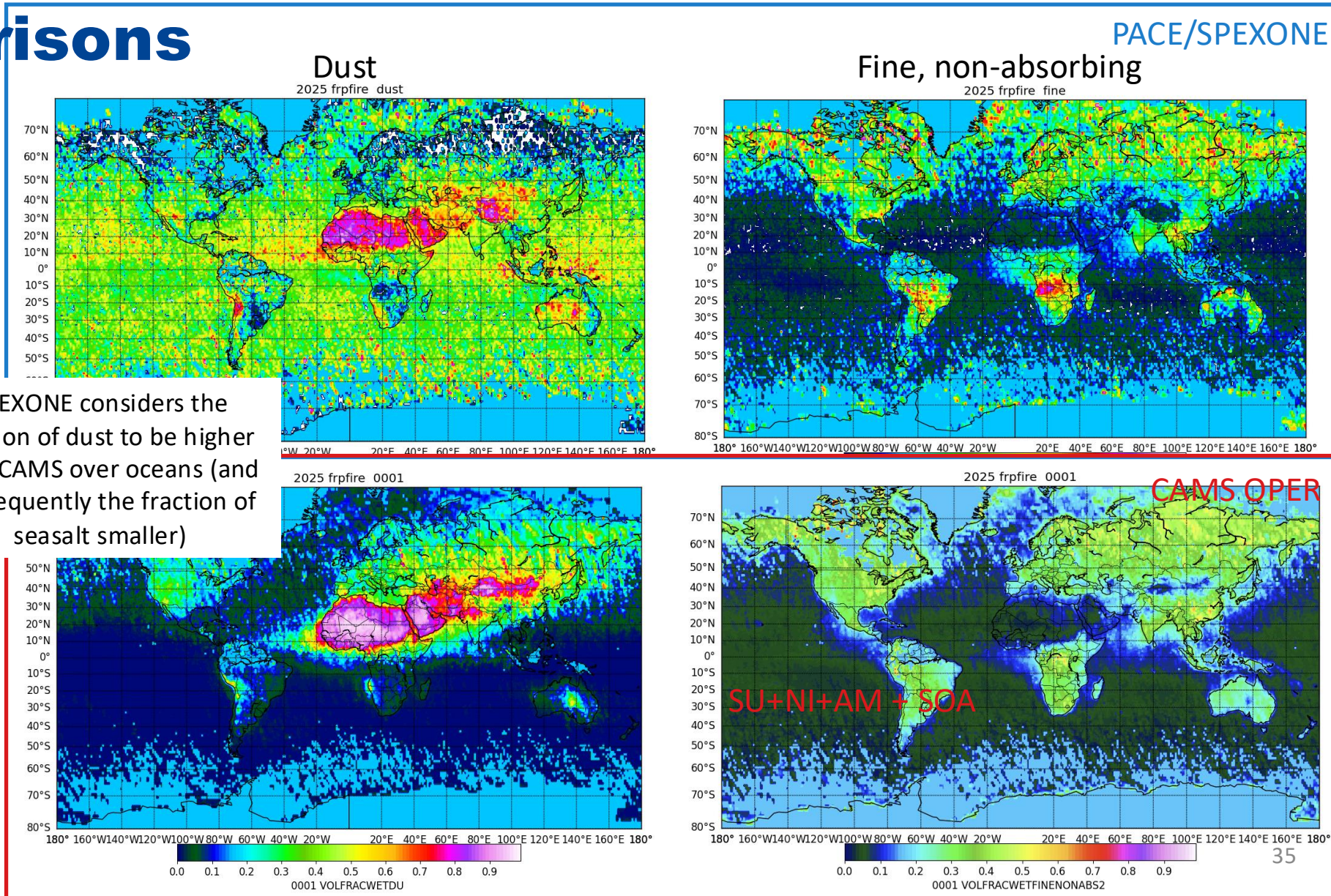
- Volume fraction of 'dust' and 'fine, non-absorbing' aerosols, accumulated and averaged between Jan – Oct 2025
- Simulated from CAMS operational system  
fine, non absorbing = SU+NI+AM(+SOA?)
- Observations retrieved by PACE/SPEXONE





# PACE comparisons

- Volume fraction of 'dust' and 'fine, non-absorbing' aerosols, accumulated and averaged between Jan – Oct 2025
- Simulated from CAMS operational system  
fine, non absorbing = SU+NI+AM(+SOA?)
- Observations retrieved by PACE/SPEXONE



Thanks to Samuel Remy

# Aerosols for NWP

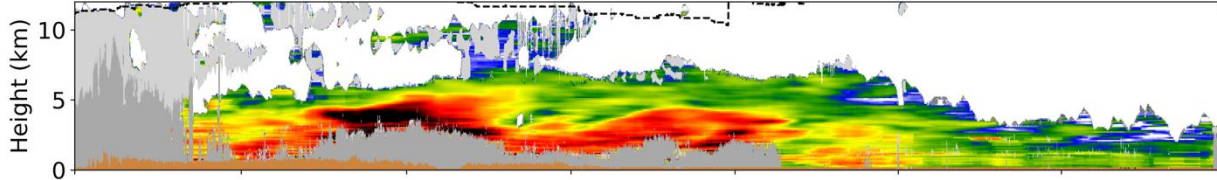
Canadian wildfire case  
16 August 2024

IFS-COMPO vs EarthCARE AOD  
Frame 01242D; 16/8/2024

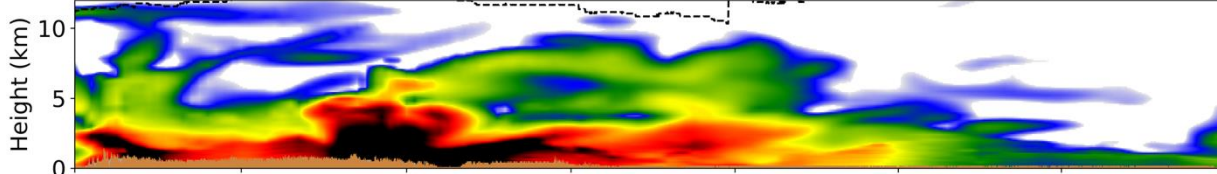
(a) Multispectral Imager channels 1-3 RGB



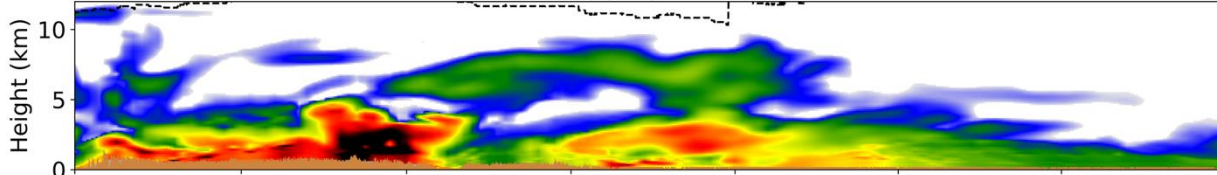
(b) EarthCARE



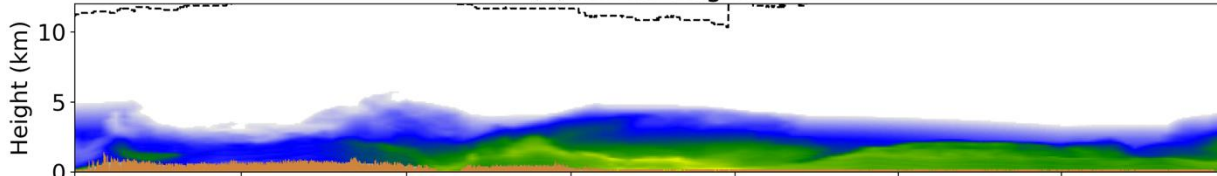
(c) IFS-COMPO



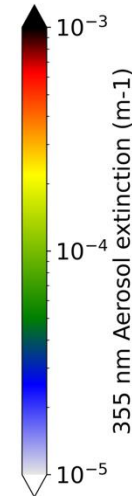
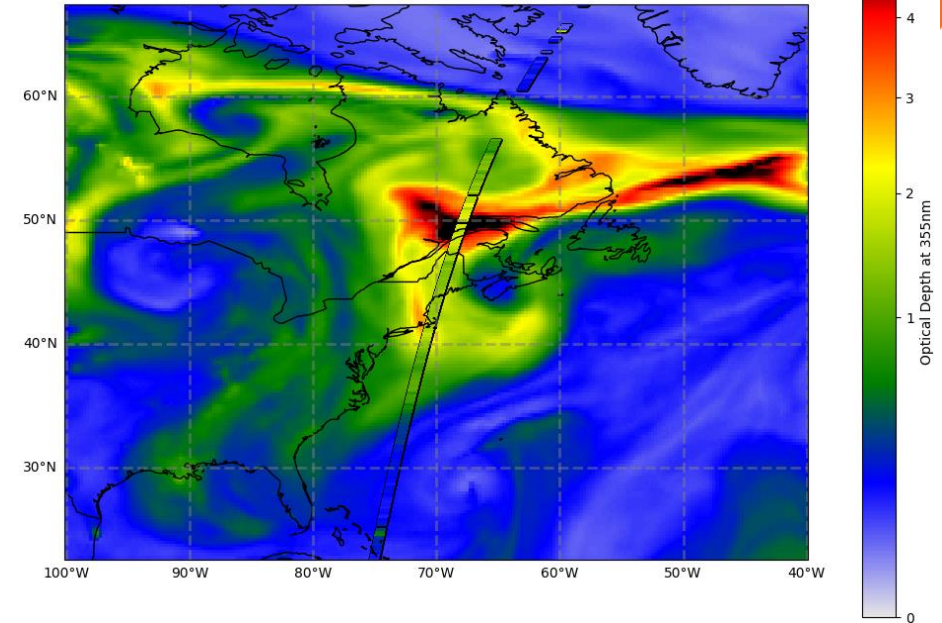
(d) Hybrid



(e) Climatological



Latitude (°N) / Longitude (°E)



NWP currently use an aerosol climatology

## NWP Hybrid Aerosol Scheme:

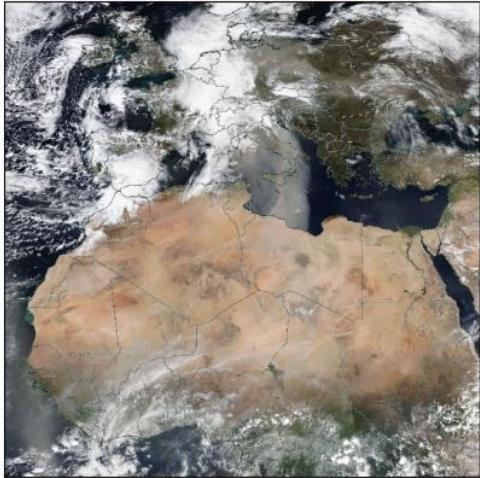
- Black Carbon, dust, and organic matter are prognostic. (7 bins total)
- Sea salt and sulphate (+Ammonia, Nitrate and SOA from 49R2) use existing climatologies.
- Choice of prognostic/climatological based on
  - capturing main impacts
  - Aerosol can be run independently of expensive chemistry.

Thanks to Peter Hill

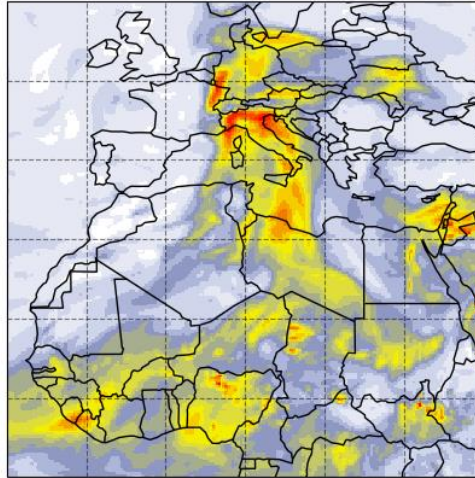


# Aerosols for NWP

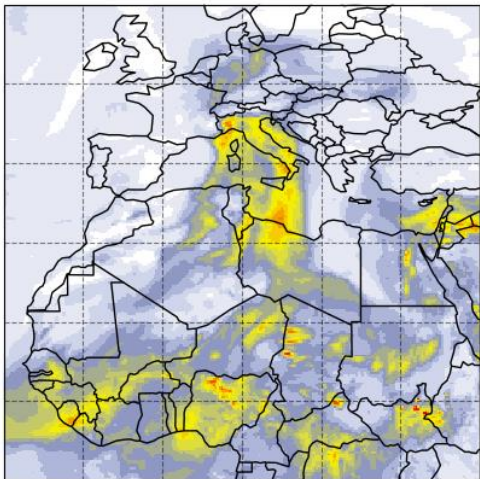
(a) NPP-SUOMI true-colour reflectance



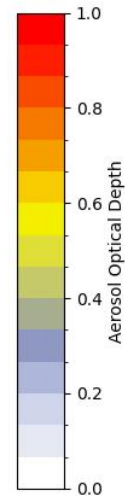
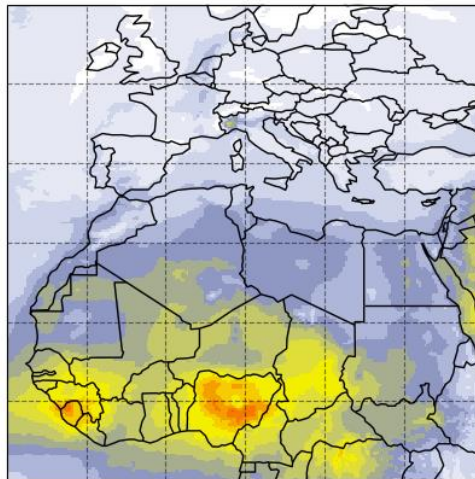
(b) IFS-COMPO



(c) Hybrid aerosol



(d) Climatological aerosol

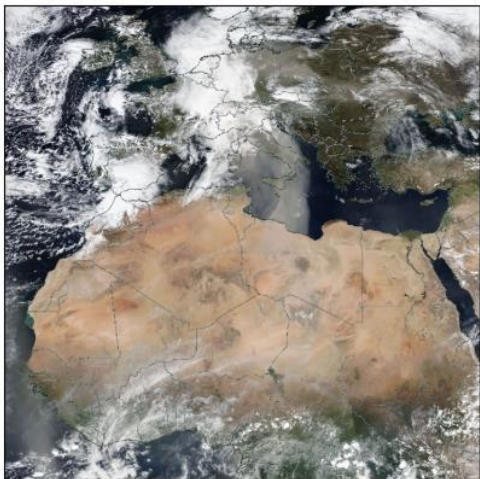


- Satellite composite of images between 11.00 and 13.00.
- Dust transport north over Italy into Germany driven by deep low pressure system off west coast of Ireland.
- Big impact on German energy network due to unexpectedly low solar generation
- Model simulations at 12Z on 30 March initiated at 00Z on 30 March

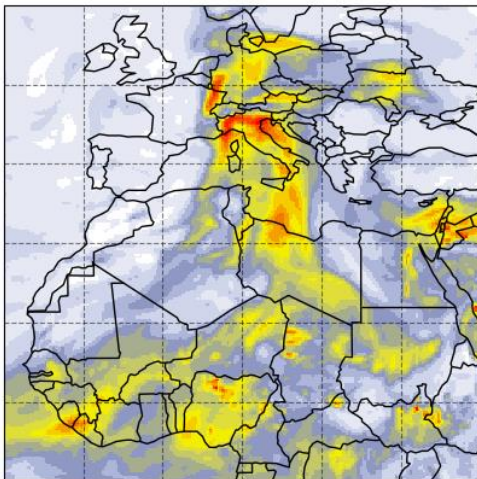


# Aerosols for NWP

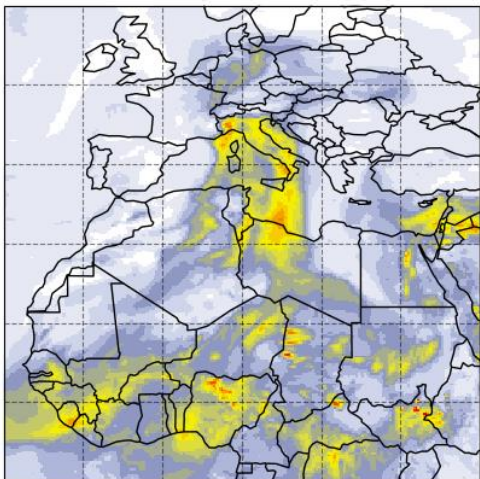
(a) NPP-SUOMI true-colour reflectance



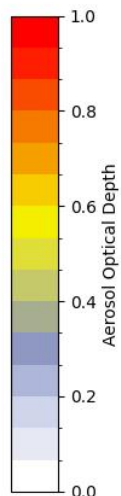
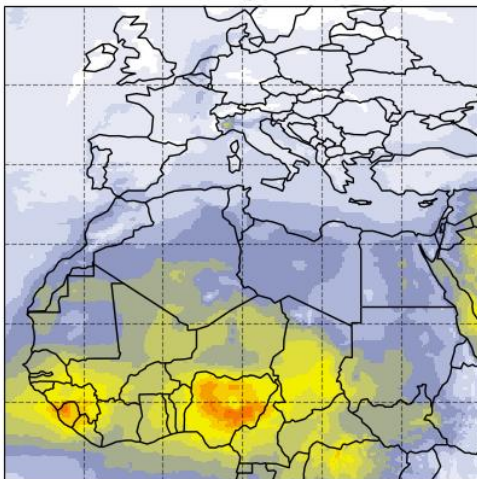
(b) IFS-COMPO



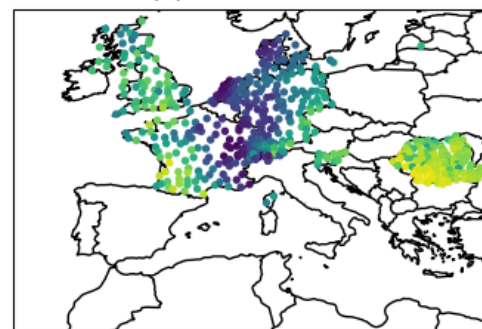
(c) Hybrid aerosol



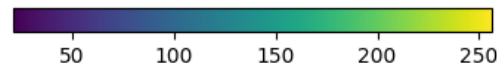
(d) Climatological aerosol



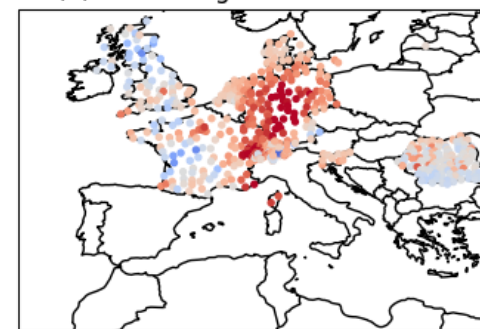
(a) Observations



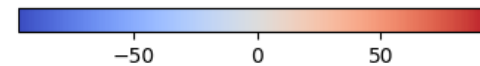
Surf solar SW rad (W m-2)



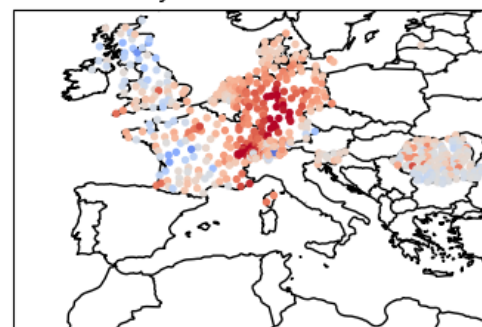
(b) Climatological - Observations



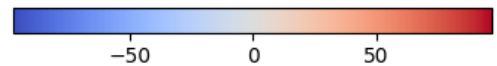
Surf solar SW rad (W m-2)



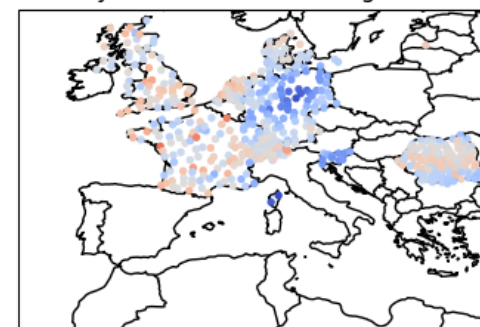
(c) Hybrid - Observations



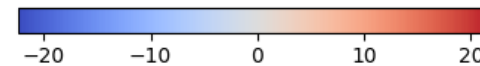
Surf solar SW rad (W m-2)



(d) Hybrid MAE - Climatological MAE



Surf solar SW rad (W m-2)



Thanks to Peter Hill



PROGRAMME OF  
THE EUROPEAN UNION



IMPLEMENTED BY



#EUSpace

# Thank you



© European Union 2023

Unless otherwise noted the reuse of this presentation is authorised under the [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/) license. For any use or reproduction of elements that are not owned by the EU, permission may need to be sought directly from the respective right holders.

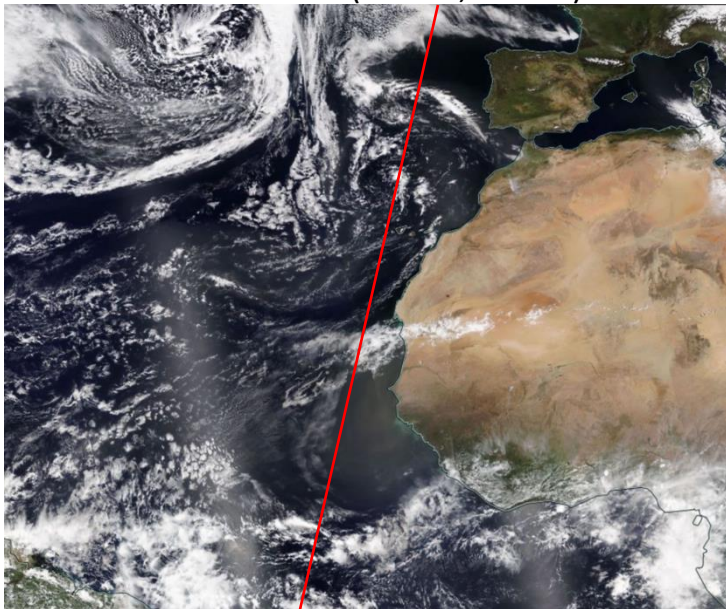
Slide xx: [element concerned](#), source: [e.g. Fotolia.com](#); Slide xx: [element concerned](#), source: [e.g. iStock.com](#)



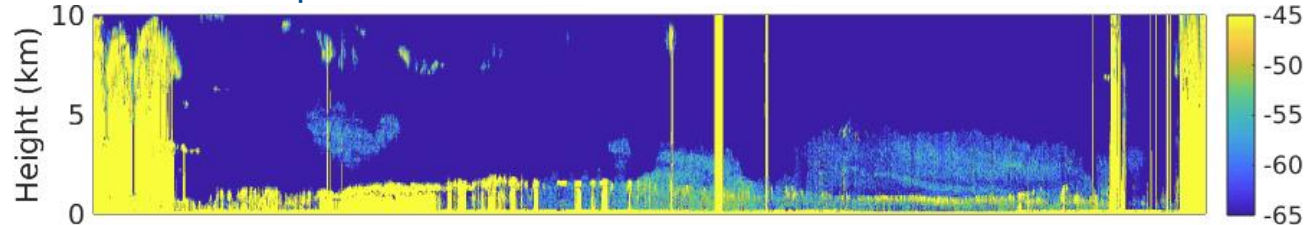
# EarthCARE

- ATLID **aerosol backscatter** provides a new vertical constraint on aerosol profiles for atmospheric composition models in both day and night.
- As part of EarthCARE DISC, feasibility studies are being performed for monitoring and assimilation of L2 aerosol products.

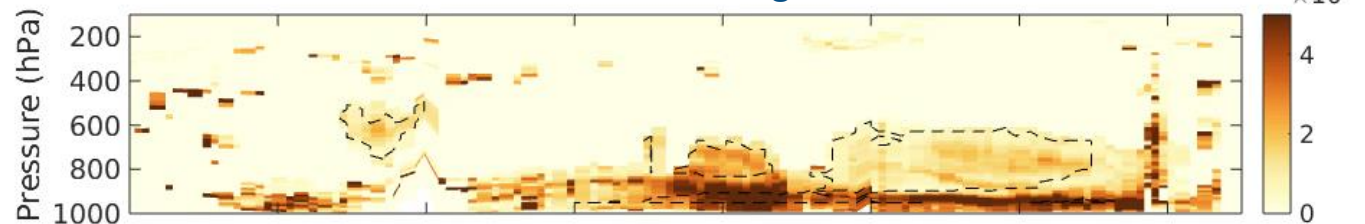
2025-03-31 1600 UTC (4772D, 4772E)



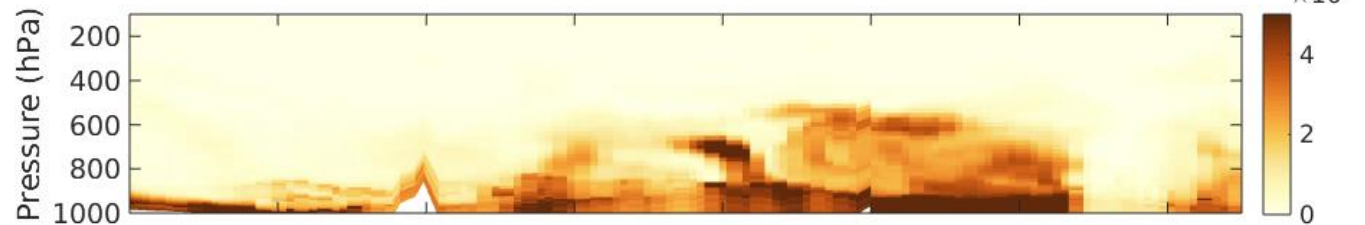
### EarthCARE particulate backscatter observations



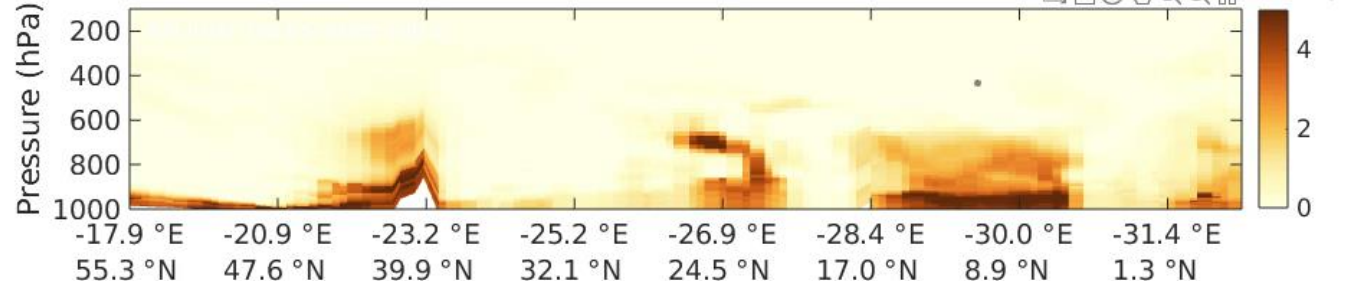
### EarthCARE aerosol backscatter averaged to model scale



### Model aerosol backscatter before assimilation



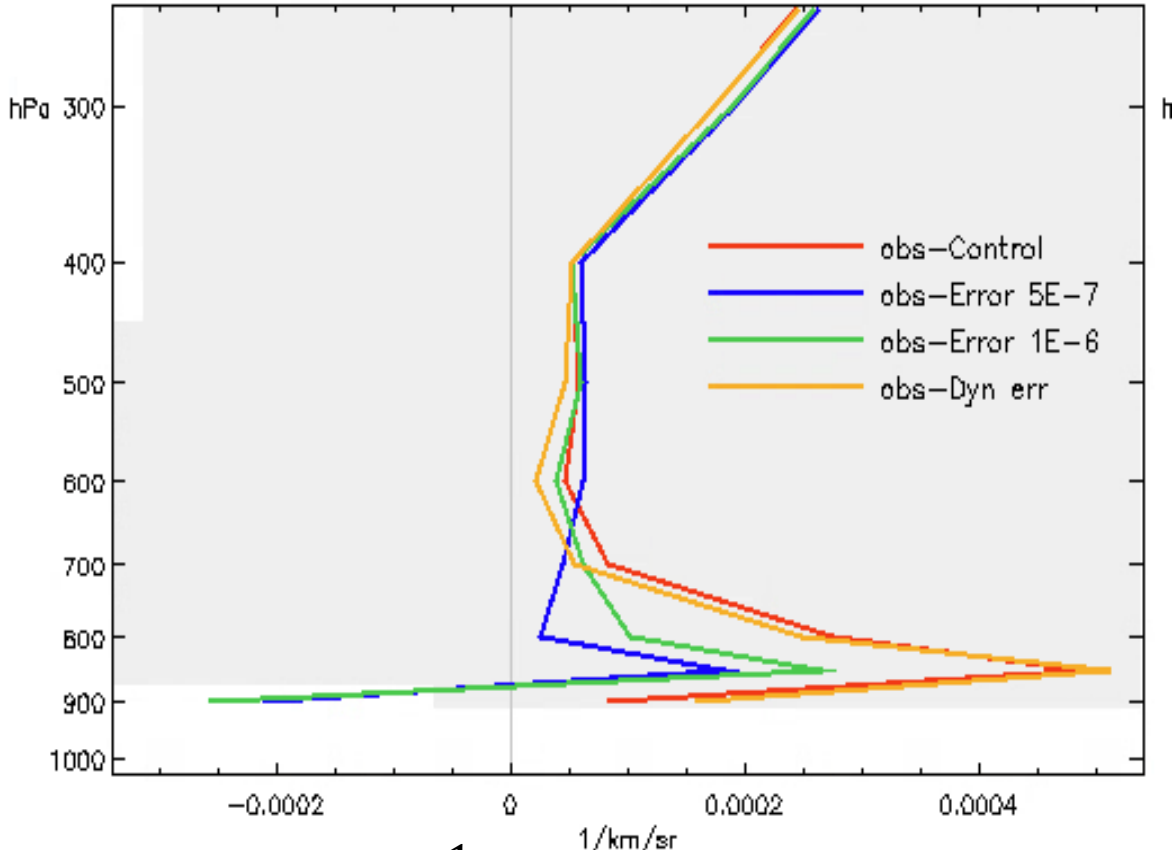
### Model aerosol backscatter after assimilation



Thanks to Will McLean

# EarthCARE

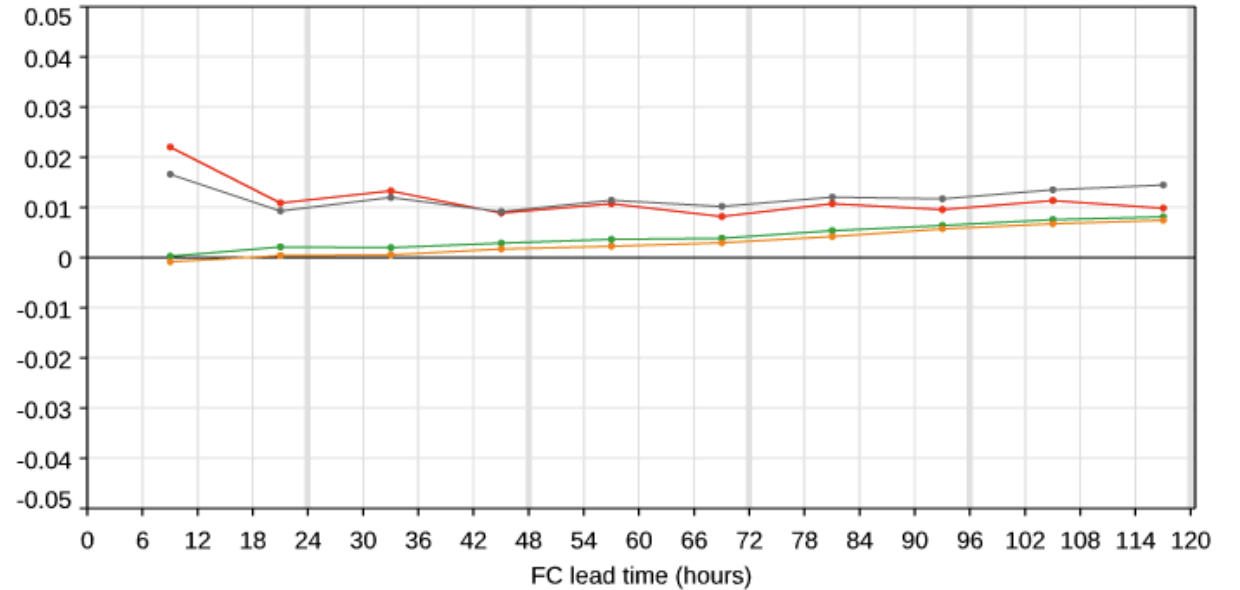
Average of 32 OB-FC profiles of Unatten. Backscatter @355nm ( $\text{km}^{-1}\text{sr}^{-1}$ ) over Leipzig in Oct 2025. T+6 to 30.



$$\text{'Dynamic error'} = \frac{1}{4}\beta + 5 \times 10^{-7} (\text{m sr})^{-1}$$

FC-OBS bias. Model against L1.5 Aeronet AOT at 500nm. 123 sites in Europe. Oct - Dec 2025. 00,12Z. Ver0D 12.19.11.

Control    ATLID EBD with 5E-7 error used    ATLID EBD with 1E-6 error used  
ATLID EBD with a dynamic error



Assimilating ATLID with **fixed obs error** + AOD leads to an improvement in the match to an independent lidar profile over Leipzig

Assimilating ATLID with a **dynamic obs error** + AOD over Europe leads to a slight improvement on the operational system

Angela Benedetti's talk on Friday