



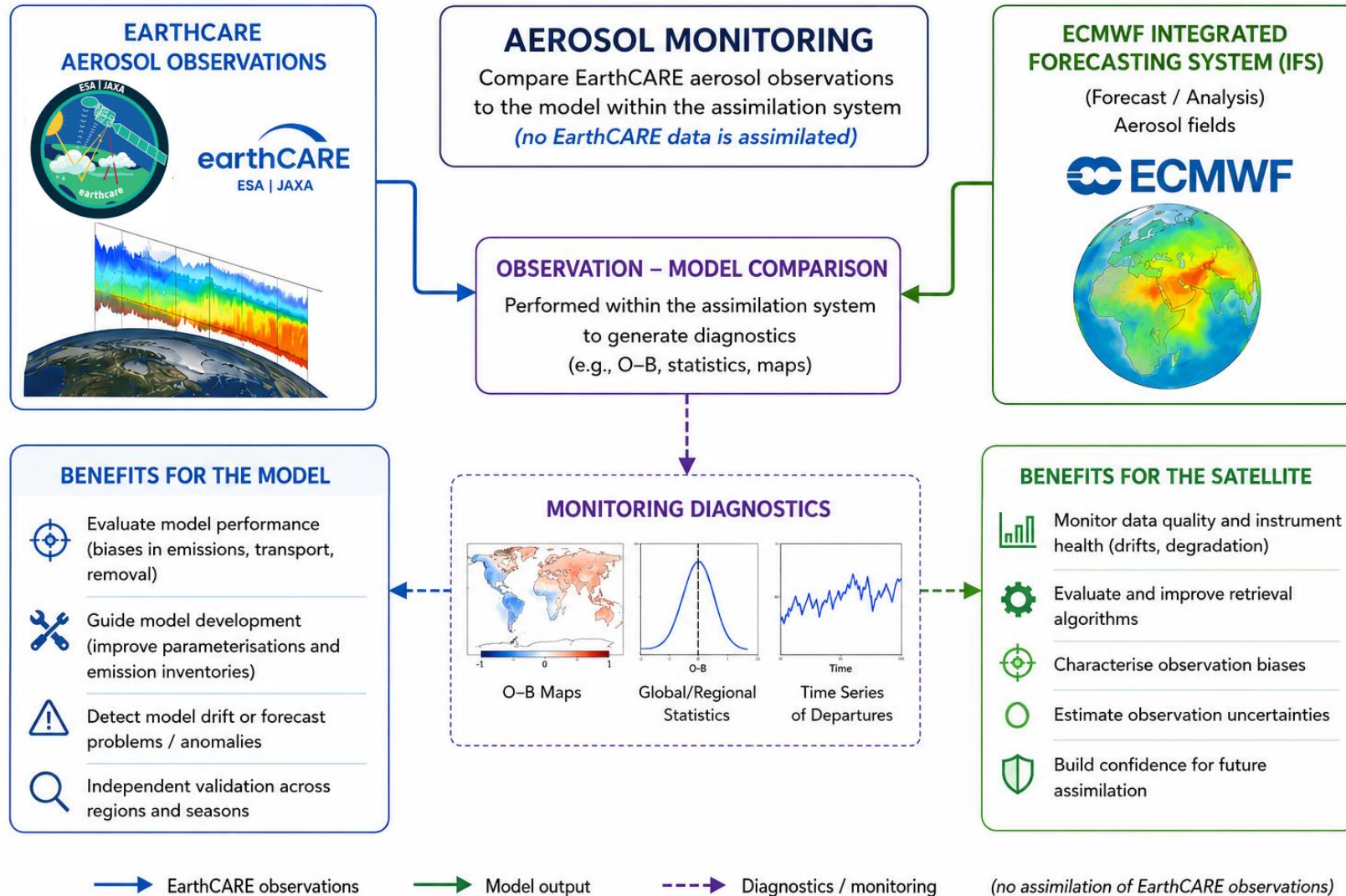
EarthCARE 2026 Science and Validation workshop

8–12 June 2026 | Rhodes House | Oxford, UK

Monitoring EarthCARE aerosol backscatter and evaluation of ECMWF atmospheric composition forecasts.

Peter Hill, Mark Fielding, Robin Hogan, William McLean, Michael Rennie, Kirsti Salonen (ECMWF)

Aerosol Monitoring Benefits



Focus on January - March 2026 period, monitoring from very short range **operational** atmospheric composition forecasts (CAMS IFS-COMPO).

Further details available in report. Available soon from:

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

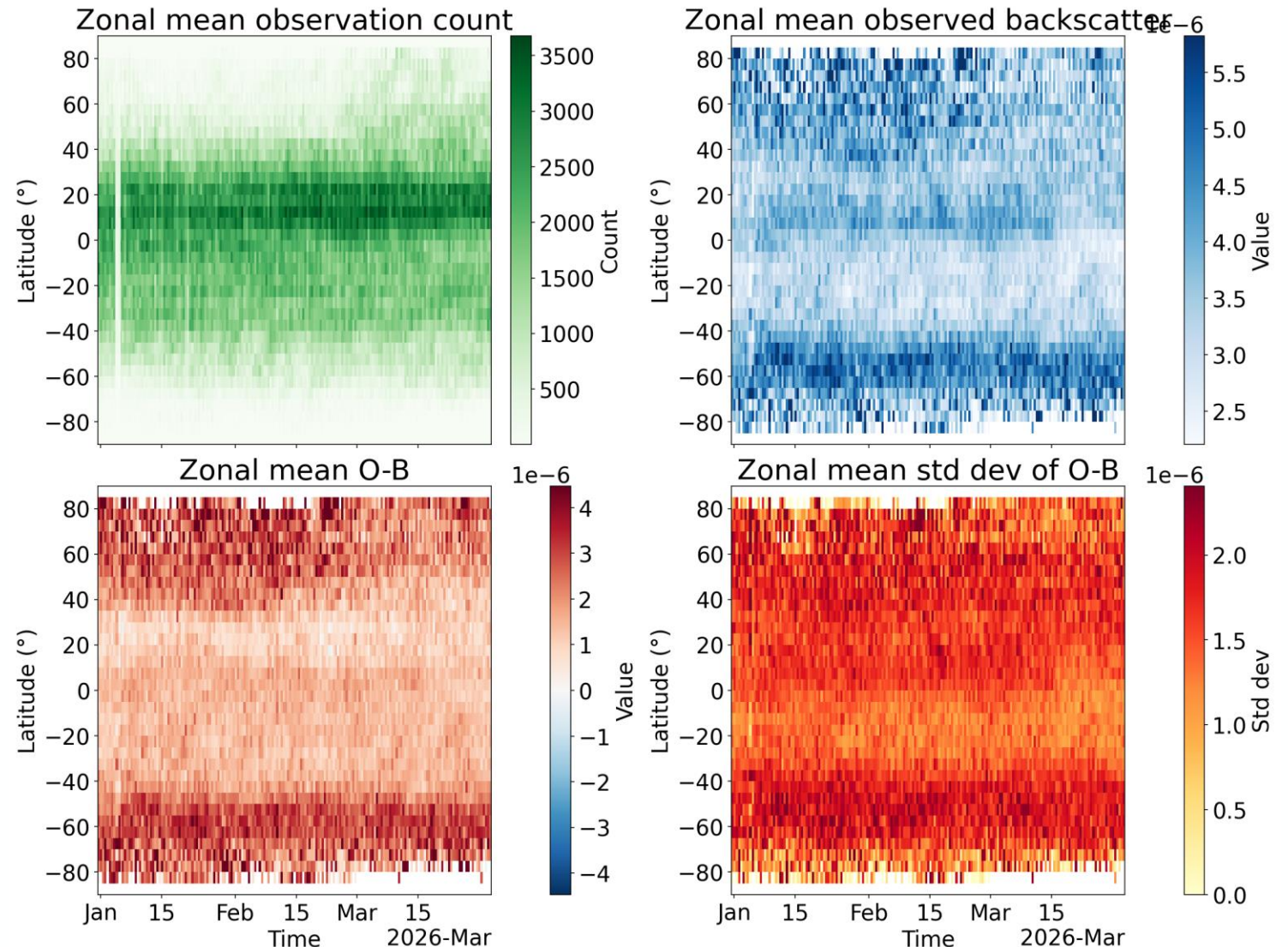
Aerosol monitoring Jan-Mar 2026



ATLID L2 aerosol particulate backscatter is stable across the period.

Temporary decrease in observations on 5 January due to delay in availability of EarthCARE product.

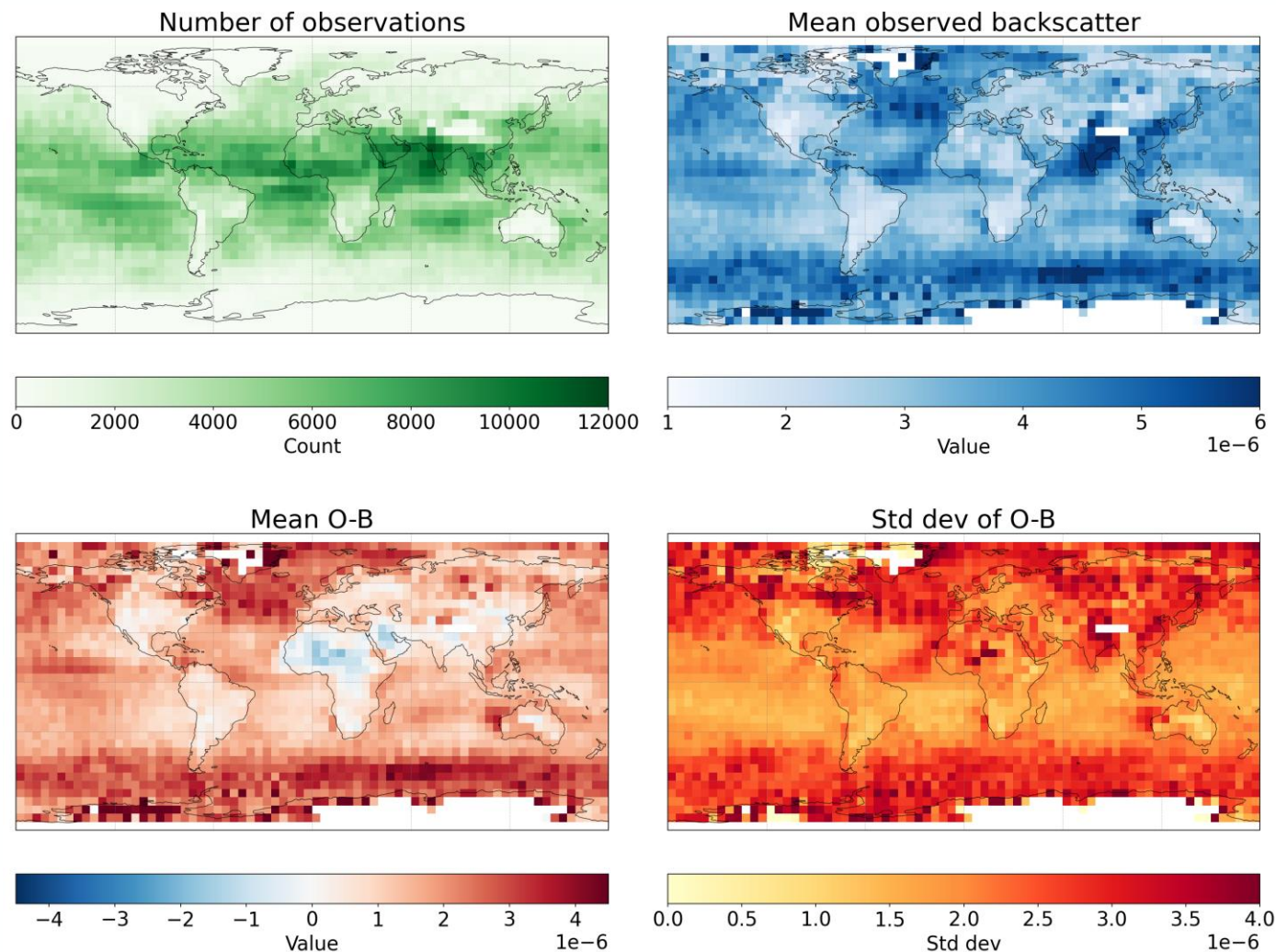
Large O-B (observation – background) i.e. EarthCARE aerosol backscatter is much larger than the model prediction.



Aerosol monitoring Jan-Mar 2026



Cloud Contaminated



Improved screening using superob cloud and aerosol fractions reduces cloud contamination and brings observations closer to the model.

But lose a lot of potentially useful information (large decrease in observation count) and O-B still positive.

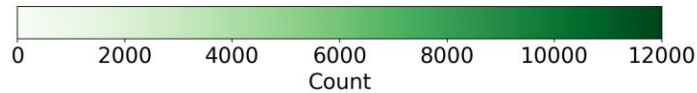
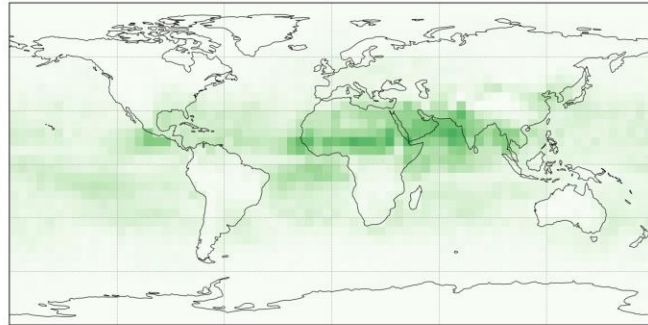
Working towards improved screening (e.g. using model variables).

Aerosol monitoring Jan-Mar 2026

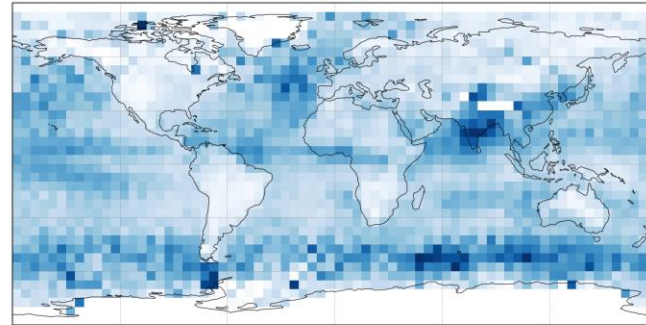


Excluding cloud fraction > 0 and aerosol fraction < 0.9

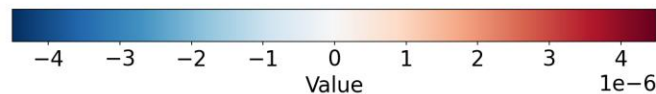
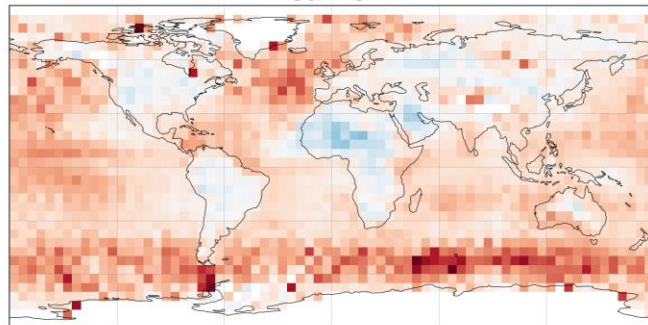
Number of observations



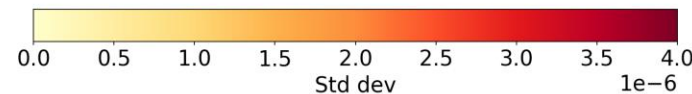
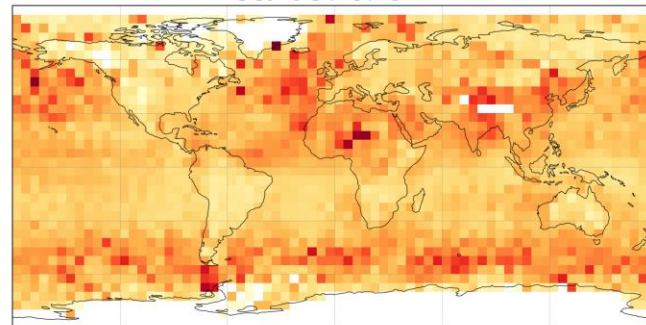
Mean observed backscatter



Mean O-B



Std dev of O-B



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But lose a lot of potentially useful information (large decrease in observation count) and O-B still positive.

Working towards improved screening (e.g. using model variables).

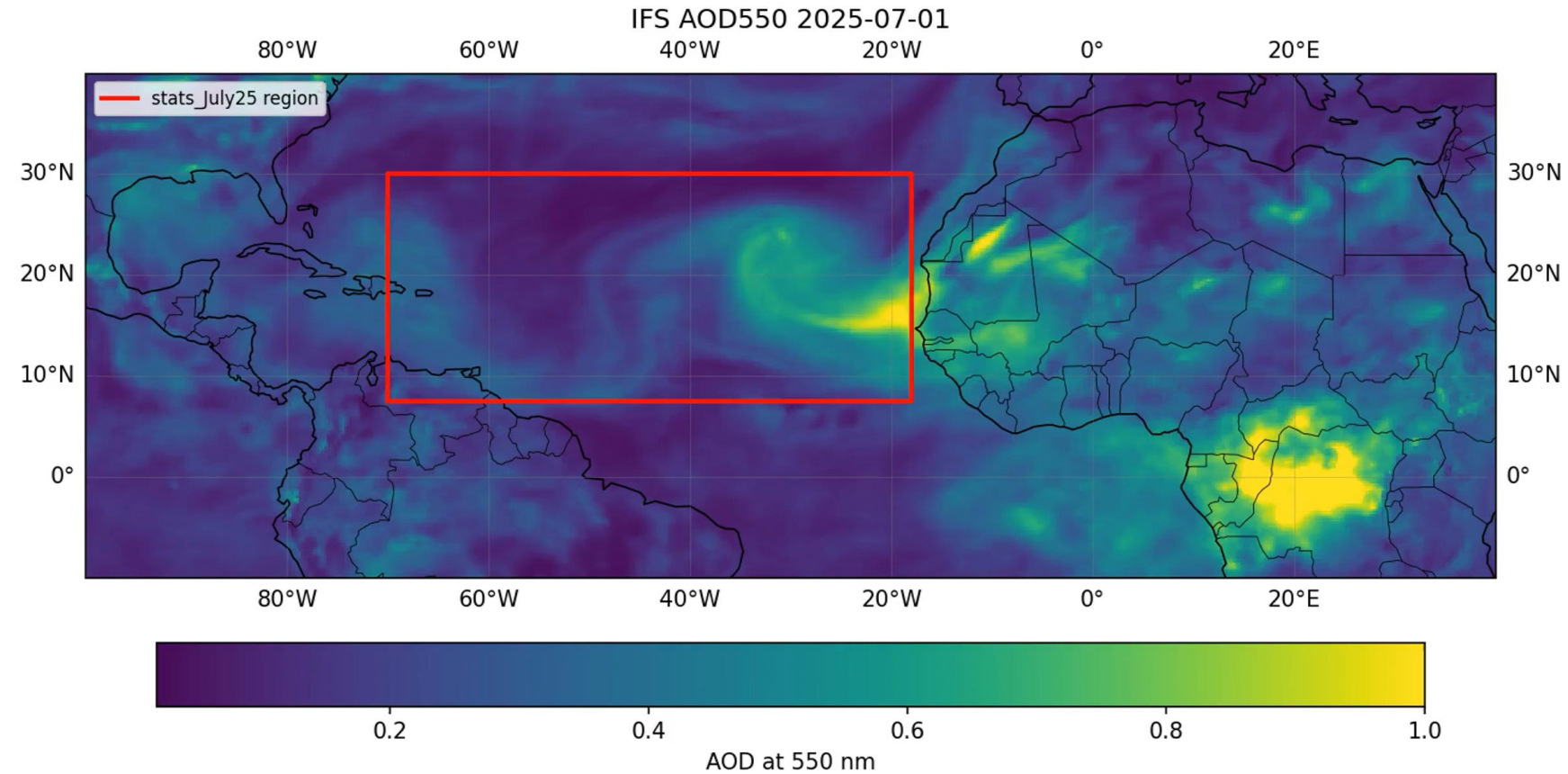
Evaluating model dust over the Atlantic



Study aerosol properties over the northern tropical Atlantic ocean:

- Relatively simple region. Free-tropospheric AOD in this region mainly due to transport from Sahara
- Longitude is a reasonable proxy for distance travelled
- Relatively large radiative impact (dark surface)

Focus on July 2025 (lots of dust transport) and region defined by red box.



Extract model data along EarthCARE track

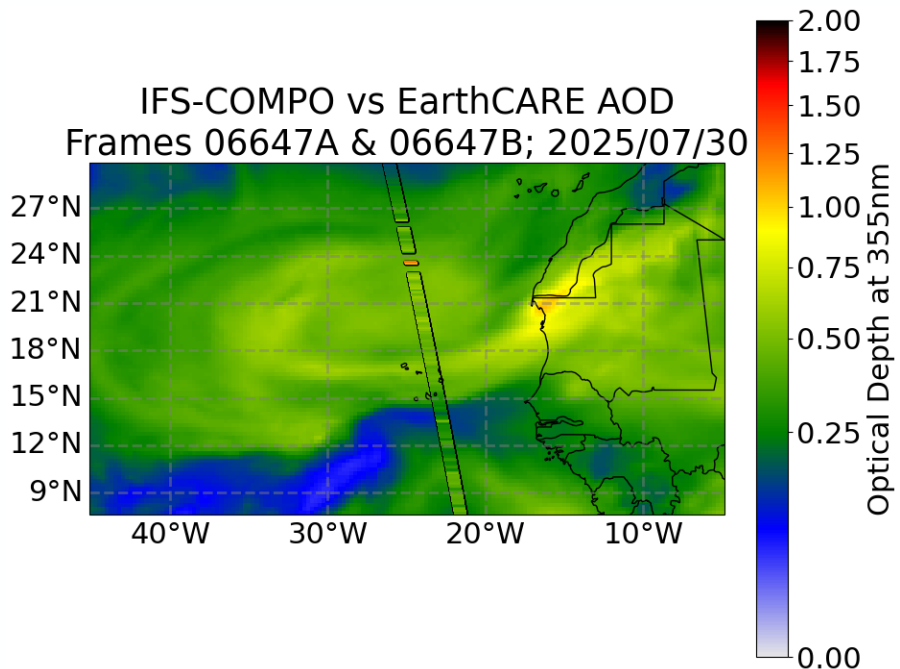


Identify all frames within region of interest and extract model data along EarthCARE track. Mask out model data where EarthCARE does not provide aerosol extinction.

Qualitatively model does well (e.g. example frame shown).

Cloud contamination is an issue.

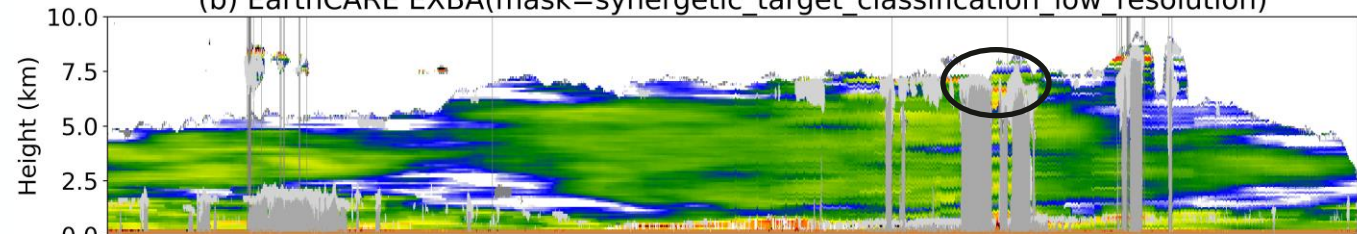
Frames 06647A & 06647B; 30-07-2025; 03:20 - 03:26



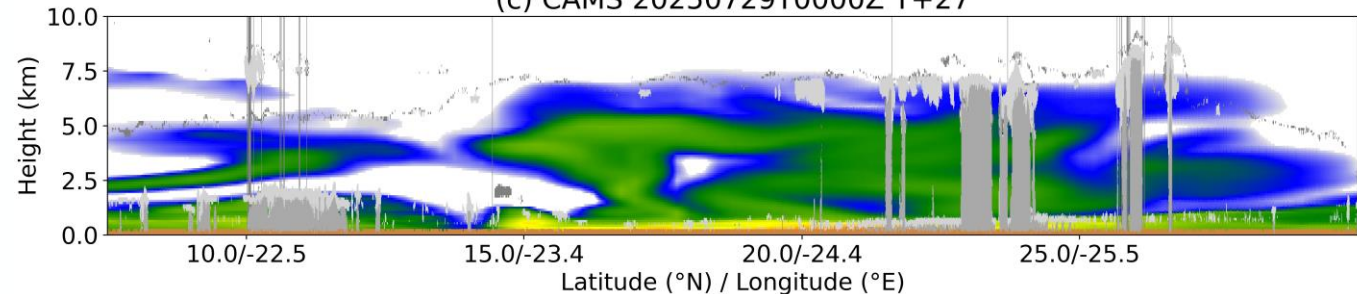
(a) Multispectral Imager Brightness temperature



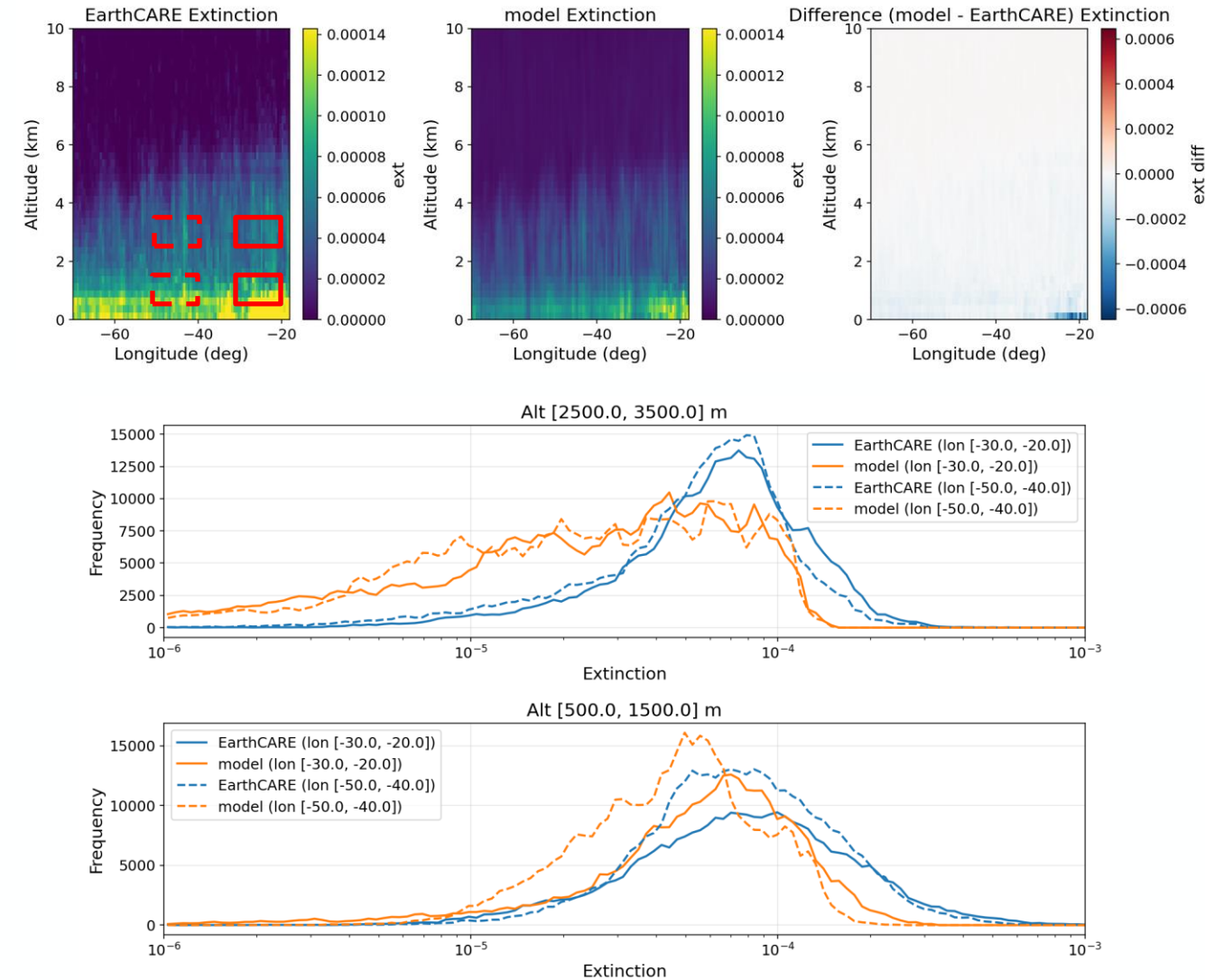
(b) EarthCARE EXBA(mask=synergetic_target_classification_low_resolution)



(c) CAMS 20250729T0000Z T+27



Cloud contamination in EarthCARE?



Use synergetic target classification to identify aerosol extinction in EarthCARE.

EarthCARE mean extinction is much larger than model, particularly to the east of the domain (where cloud is more frequent)

This bias arises from larger aerosol extinction values in EarthCARE.

Comparison is further complicated by modelled extinction values smaller than EarthCARE sensitivity.

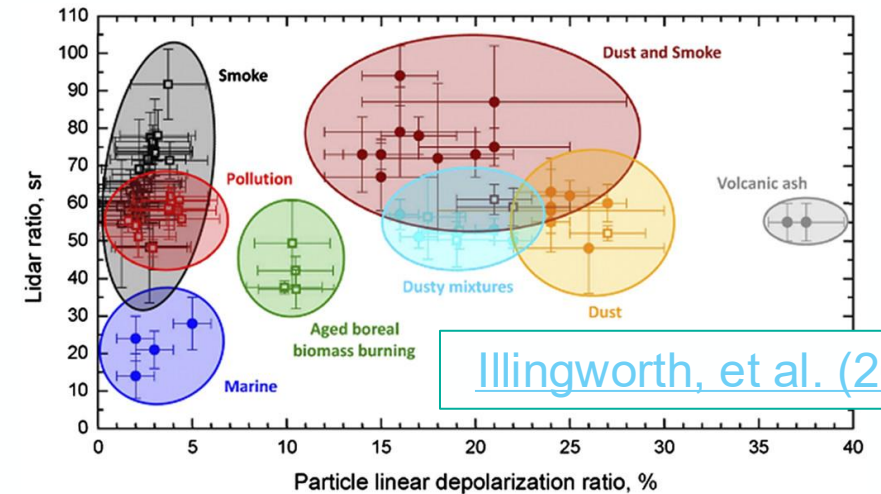
Model lidar ratio errors



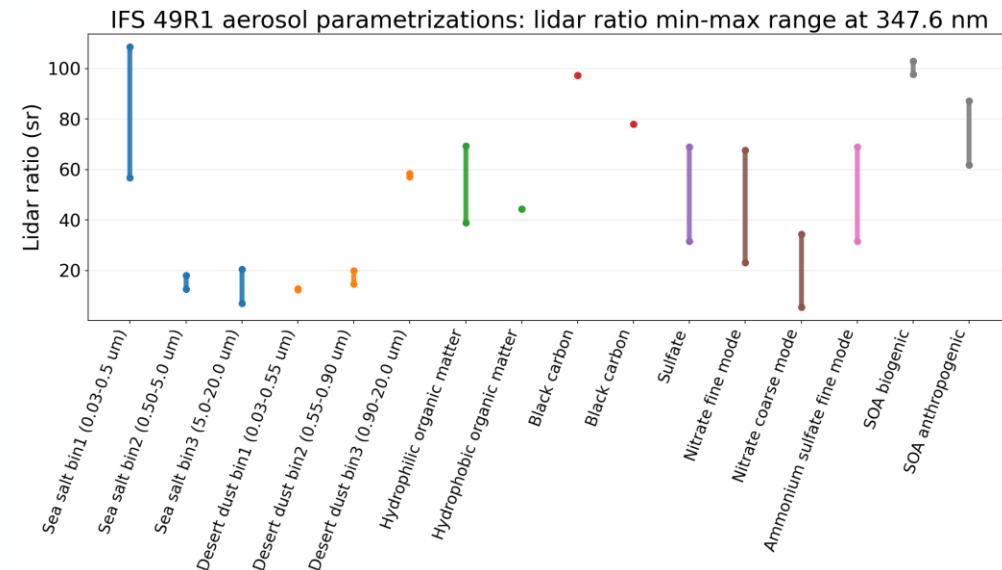
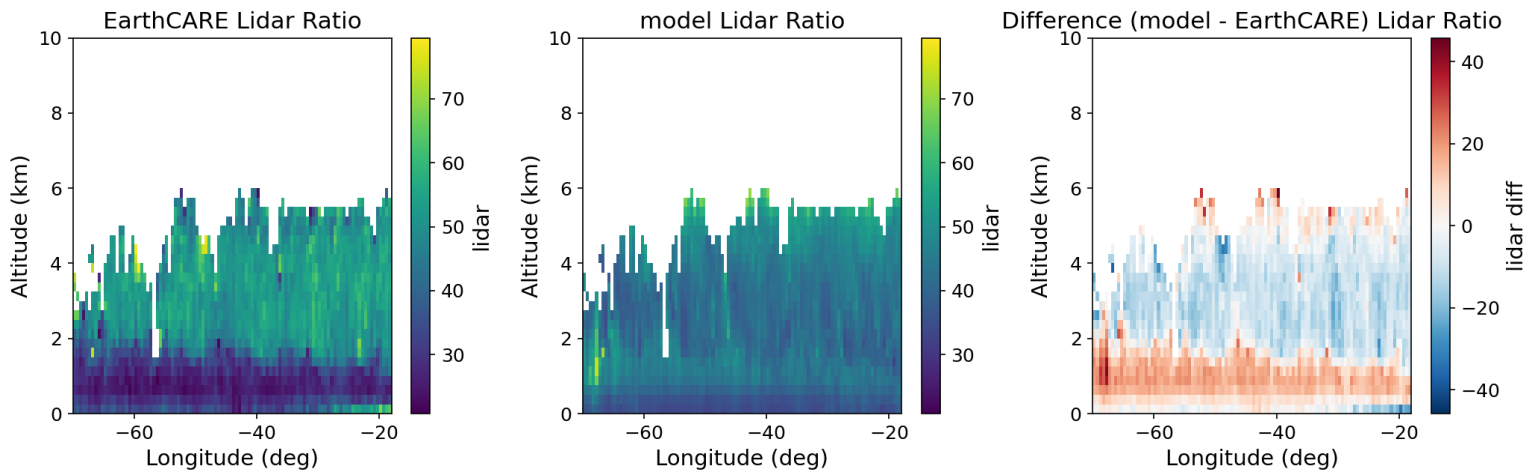
Only consider points where model extinction is within 20% of observed value (but results not sensitive to this)

EarthCARE shows clear change in lidar ratio between boundary layer (sea-salt) and free troposphere (dust). Indicates where to focus for studying dust transport.

Little change in lidar ratio with altitude in the model – problems with speciation or with assumed lidar ratios?



[Illingworth, et al. \(2015\)](#)



Modelled AOD gradient is reasonable

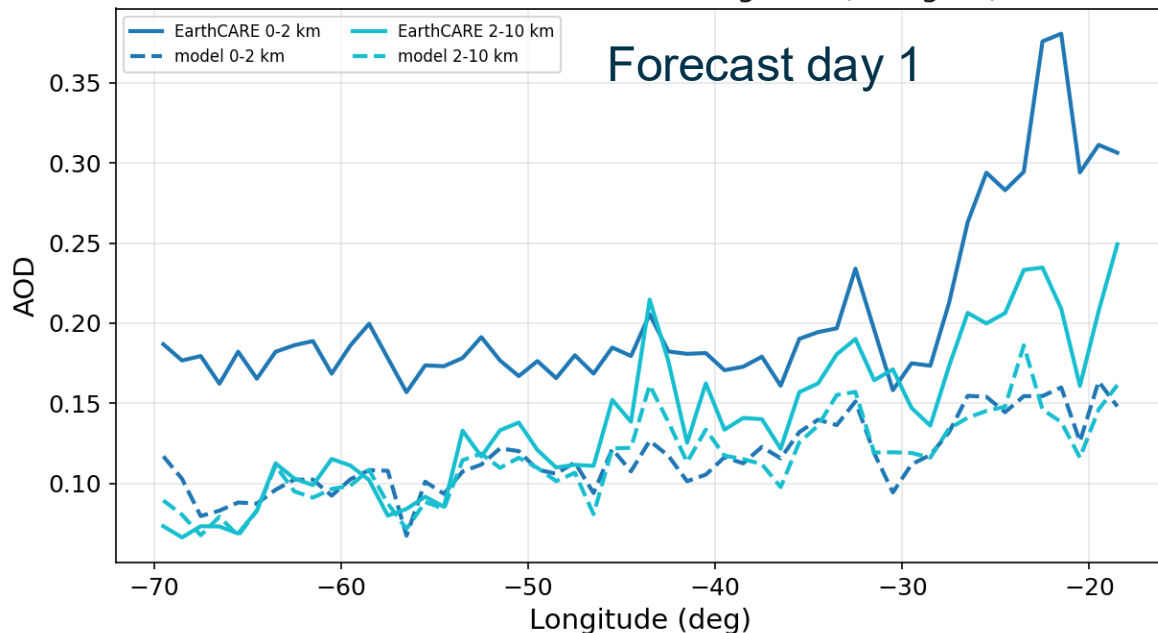


Both observations and model show decrease in AOD at all altitudes with increasing distance West.

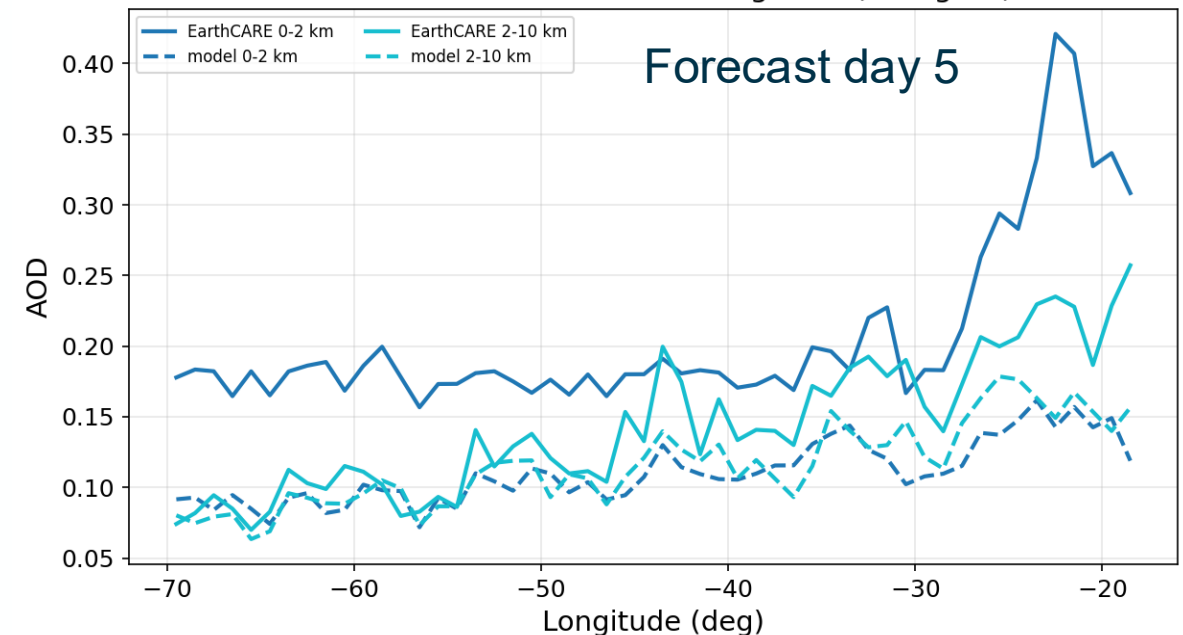
Gradient is larger for EarthCARE, possibly a result of increased cloud contamination to the East.

No apparent dependence on forecast lead time? What about free-running forecasts?

Extinction-derived AOD vs Longitude (1-degree)



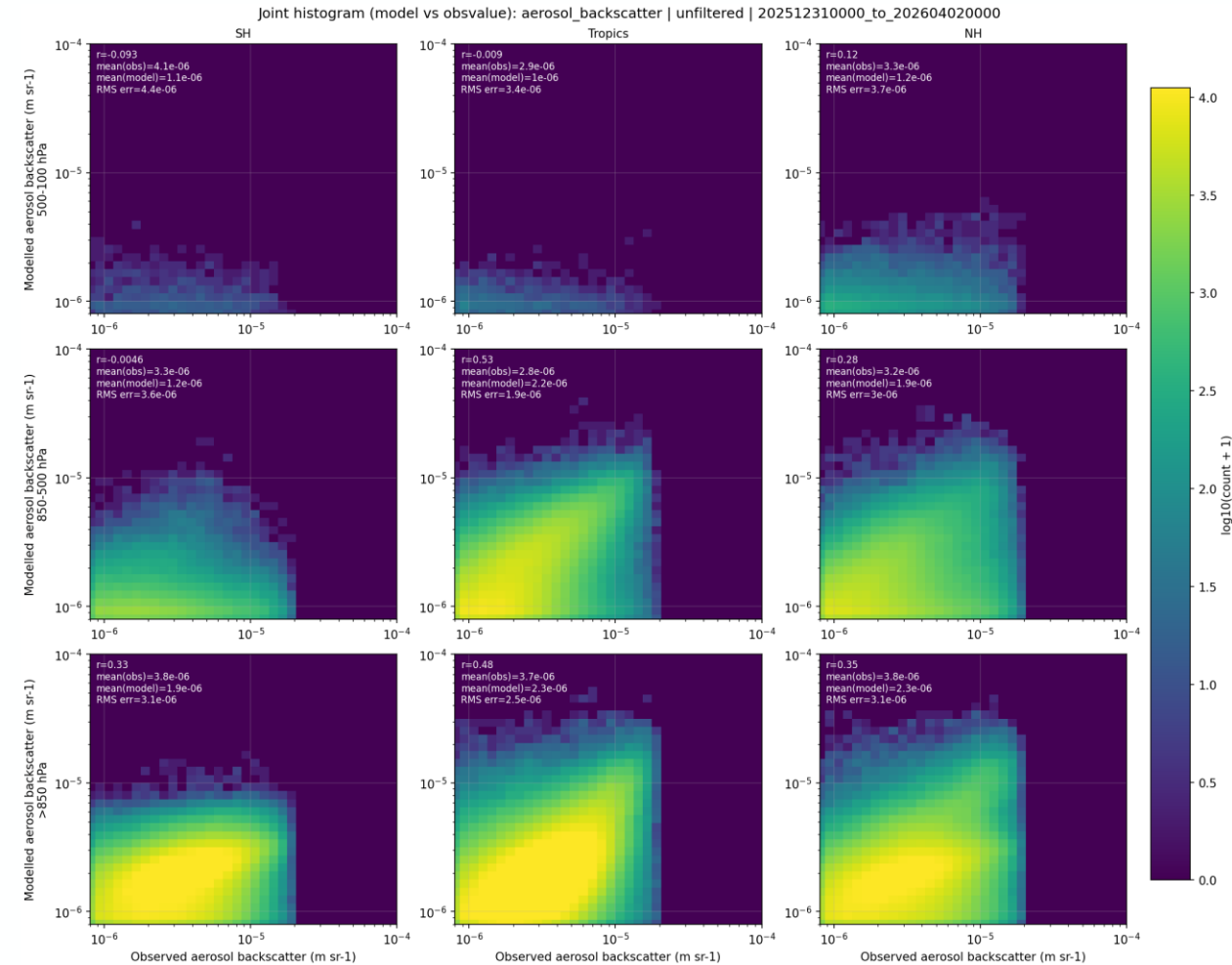
Extinction-derived AOD vs Longitude (1-degree)



- ECMWF is monitoring aerosol backscatter from EarthCARE in the operational atmospheric composition model to provide cross-validation of model and observed aerosol backscatter and confirm suitability for future assimilation.
- Cloud contamination of the aerosol products is an issue for both monitoring and model evaluation.
- Comparison of aerosol over the tropical north Atlantic reveals uncertainty around the model lidar ratio.
- Short-range forecasts do a reasonable job of capturing the decrease in AOD with longitude across the Atlantic.
- Future work will look at free-running forecasts and a longer time-period.

Additional Slides

Cloud Contaminated



Excluding cloud fraction > 0 and aerosol fraction < 0.9

