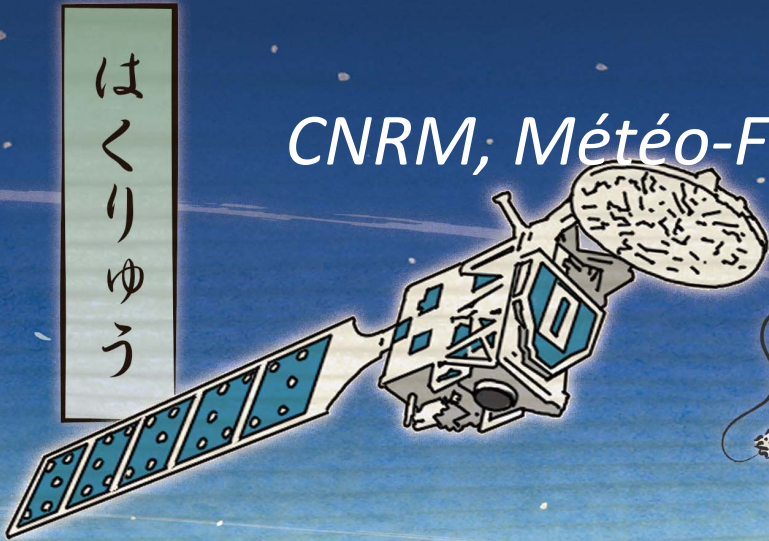


Added value of EarthCARE lidar observations for characterising aerosol species in a chemical transport model

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EarthCARE Science and Validation Workshop 2025

1-5 December 2025 | The University of Tokyo | Tokyo, Japan



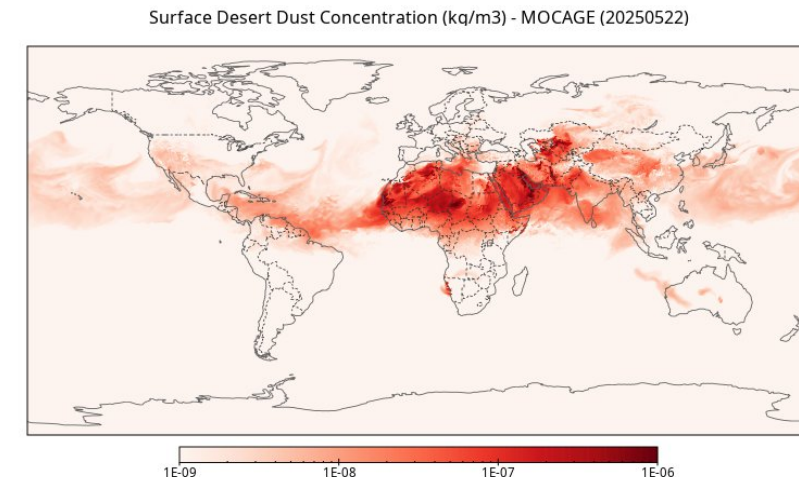


- **Motivations :**

- Assess the contribution of lidar measurements to better constrain the model outputs in a global assimilation system (vertical constraint).
- EarthCARE provides information on each type of aerosol ==>
 - the possibility of assimilating each type separately.
- Assess the impact on other parameters that are not directly observed: AOD, aerosol concentration, ...

- **Experiment :**

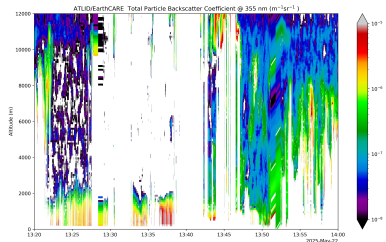
- Two month of assimilation: May - June 2025
- EarthCARE observations (Backscatter coefficient)
- Assimilation within MOCAGE model: 60 levels ; $0.5^\circ \times 0.5^\circ$ (lon, lat)
- This period coincides with a desert dust event



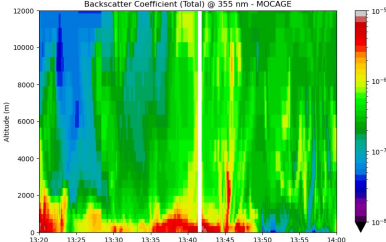
Model vs Assimilated EarthCARE (Backscatter coefficient @ 355 nm)



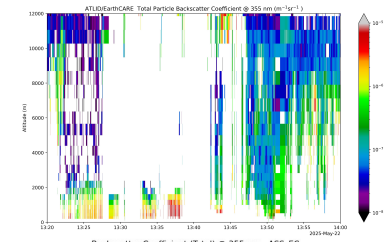
Obs



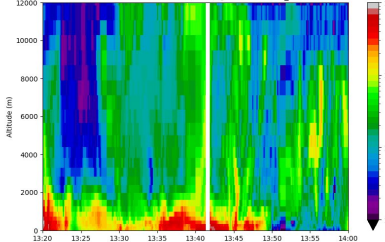
Model



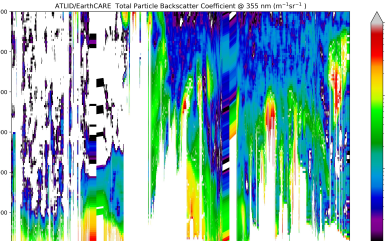
Obs
(Model grid)



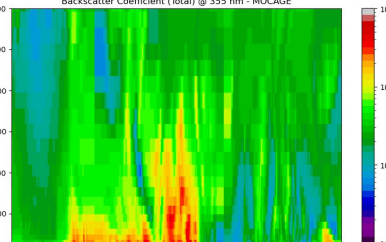
Assim.



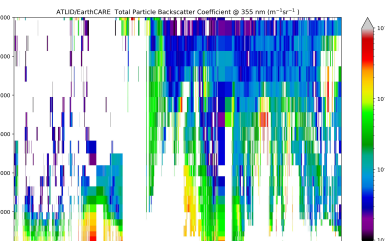
Obs



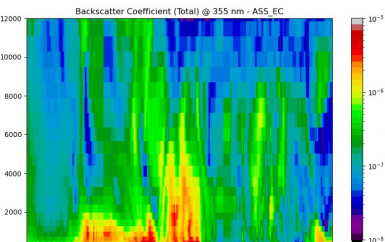
Model



Obs
(Model grid)



Assim.



Impact of assimilation on other parameters

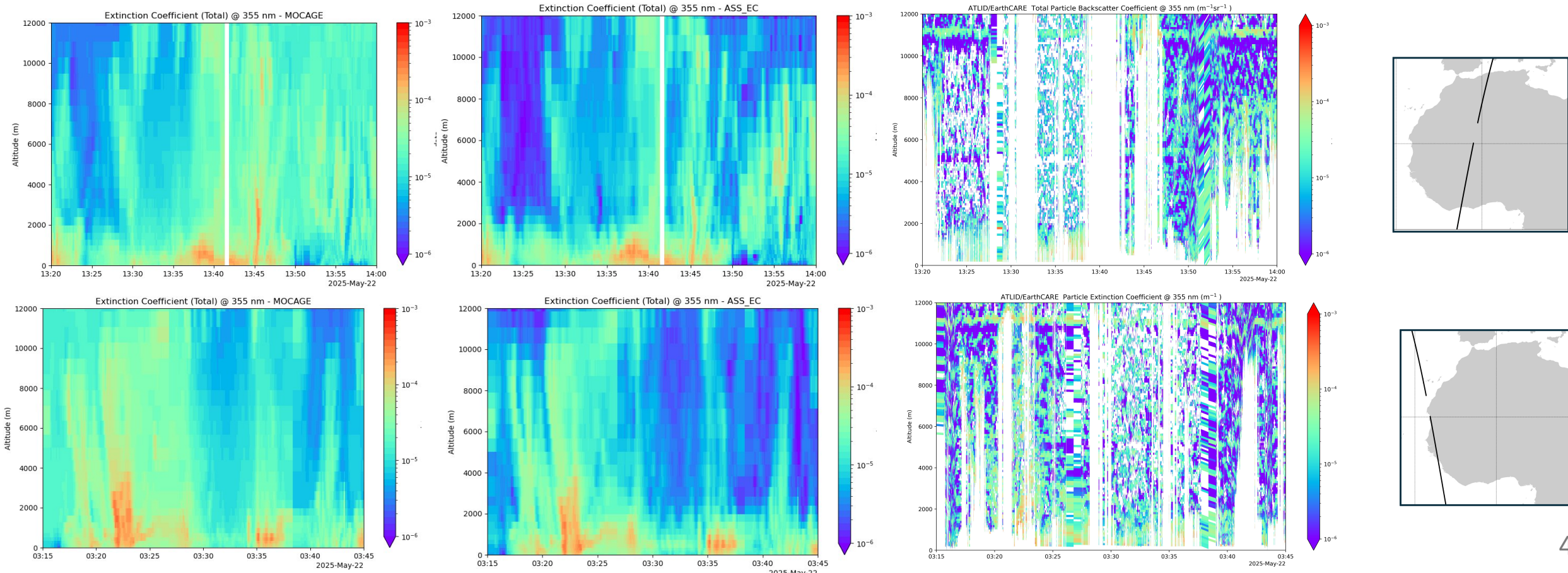


- Impact on the extinction coefficient @ 355 nm
 - > The extinction coefficient from EarthCARE is used as a validation product

Model

issued from BSC assim

Ext. Coef. (Obs)

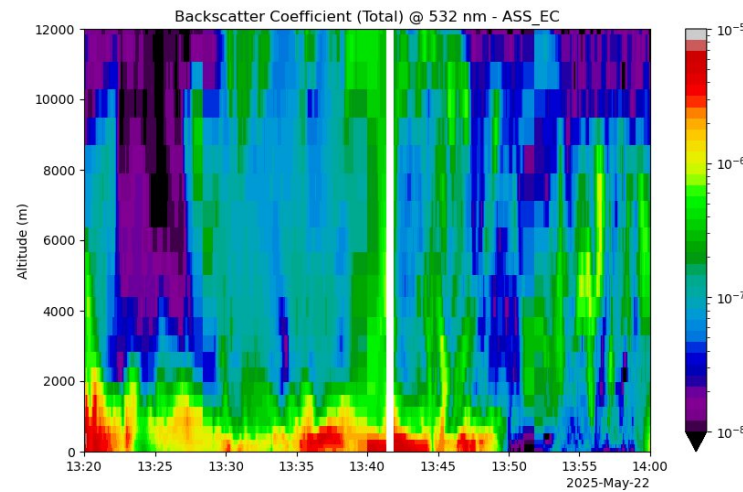
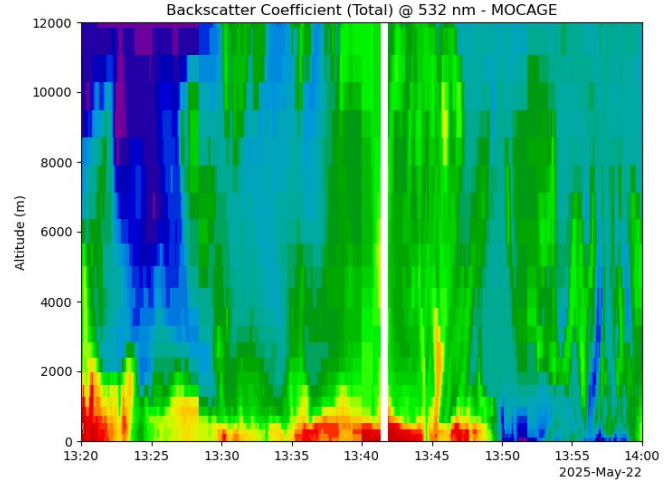


Impact of assimilation on other parameters



- Impact on the backscatter coefficient @ 532 nm

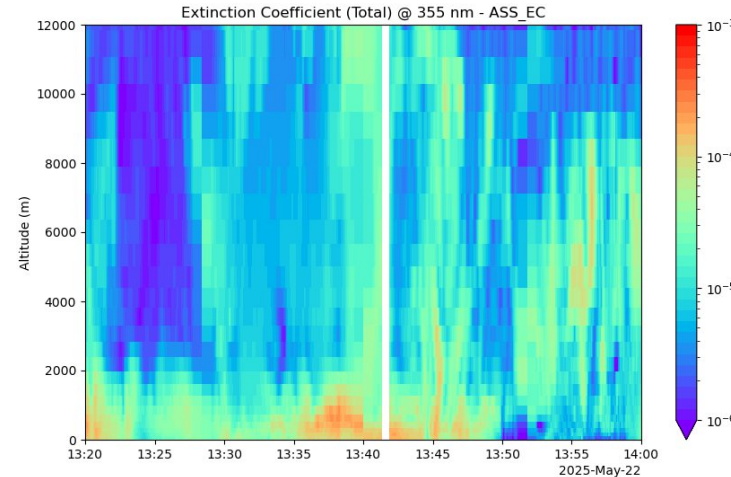
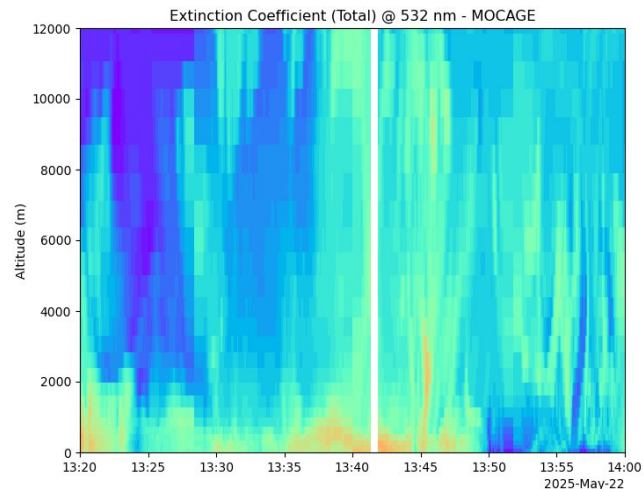
Model



derived from the assim
of EarthCARE BSC @ 355 nm

- Impact on the extinction coefficient @ 532 nm

Model



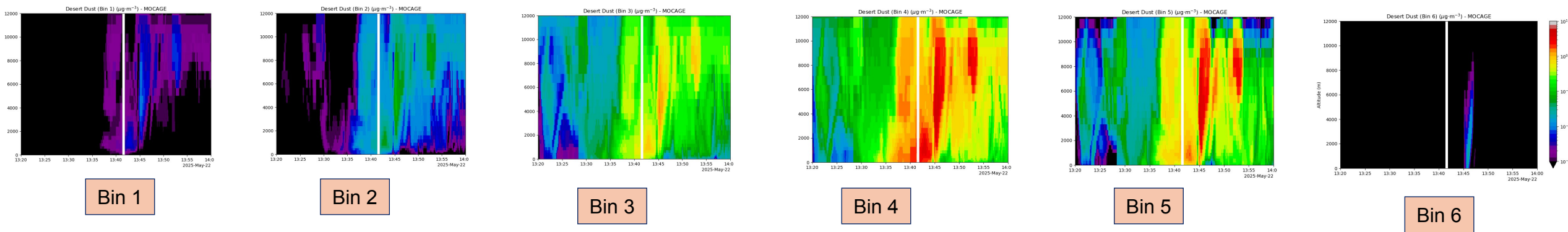
derived from the assim
of EarthCARE BSC @ 355 nm

Impact of assimilation on other parameters

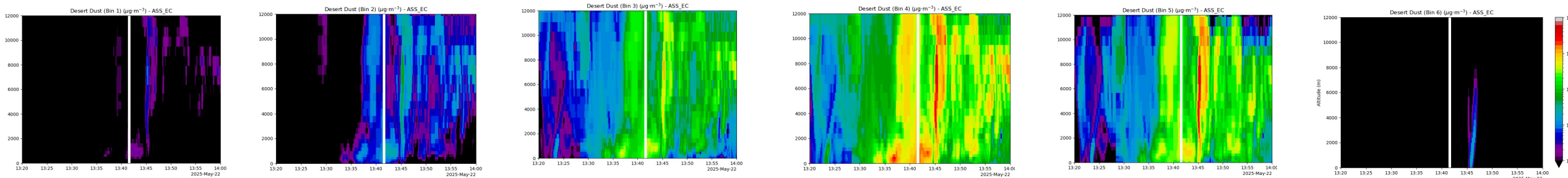


- Desert dust concentration by bins

Model



Assimilation



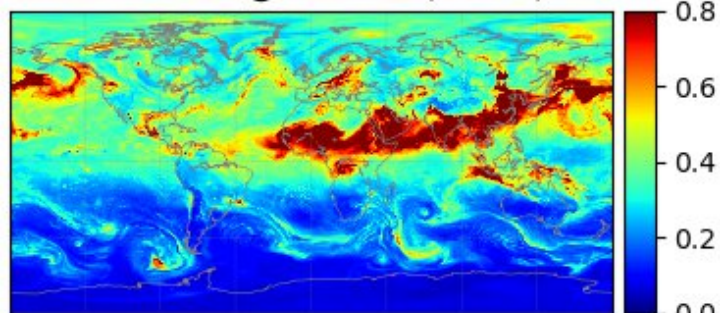
Bins	Bin 1	Bin 2	Bin 3	Bin 4	Bin 5	Bin 6
Bounds (μm)	0.002 → 0.01	0.01 → 0.1	0.1 → 1	1 → 2.5	2.5 → 10	10 → 50

Impact of assimilation on other parameters

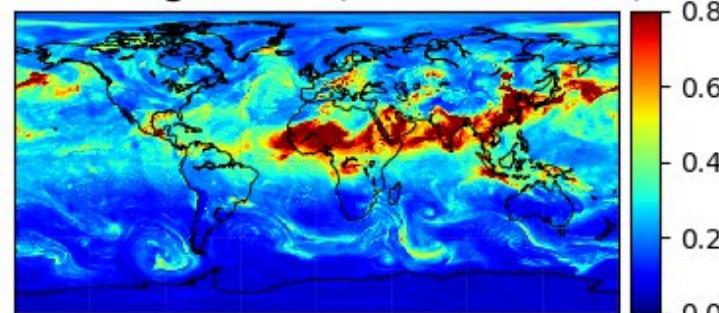
- Impact on AOD @ 355 nm

Total AOD

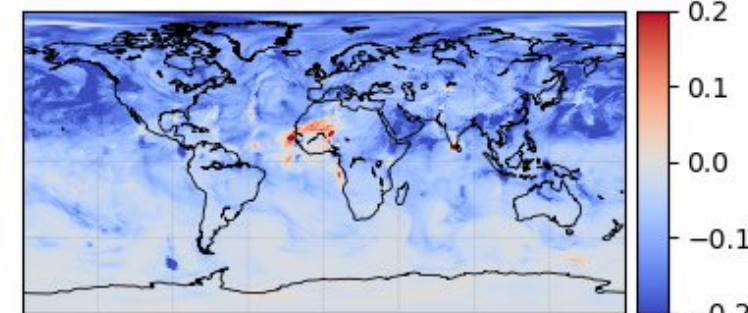
Total AOD @ 355 nm (Model)



Total AOD @ 355 nm (Assim EarthCARE)

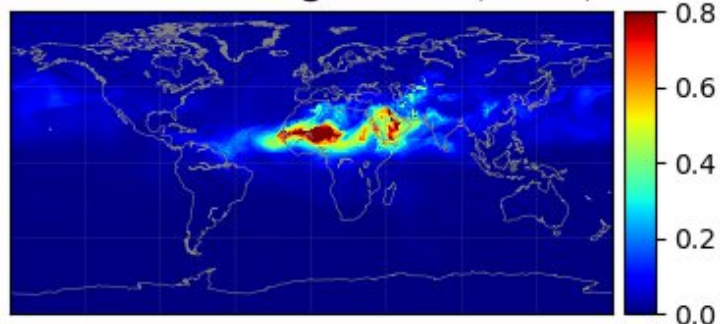


Assim - Model

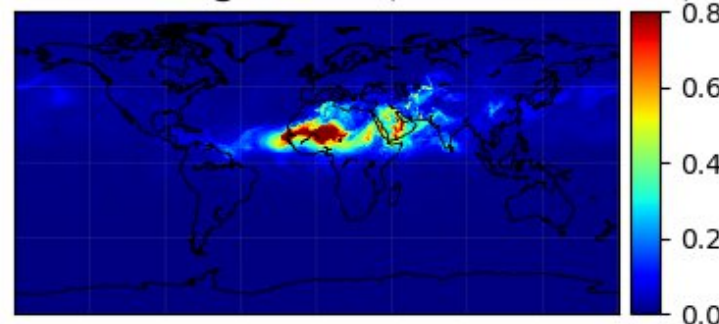


Desert Dust AOD

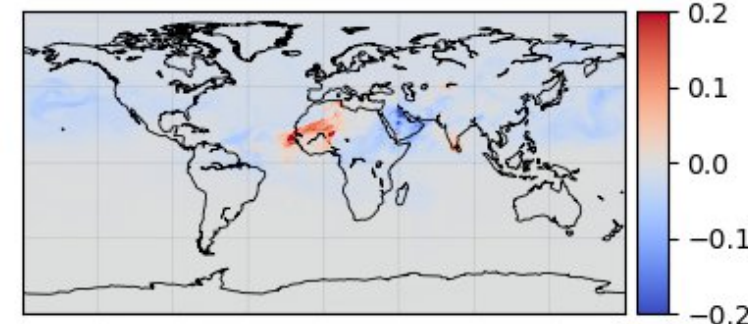
Desert Dust AOD @ 355 nm (Model)



Desert Dust AOD @ 355 nm (Assim EarthCARE)



Assim - Model



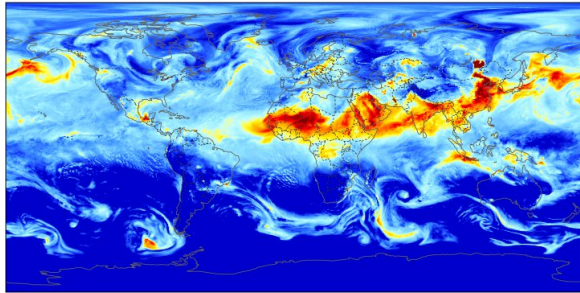
Impact of assimilation on other parameters



- Comparison to CAMS AOD @ 550 nm

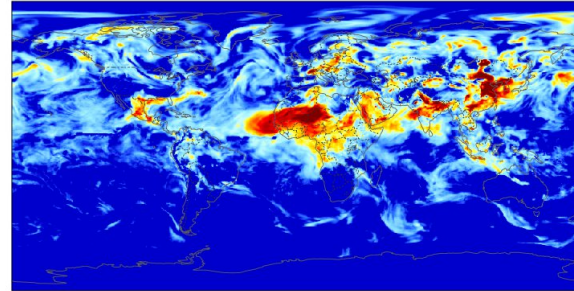
Model

Total AOD @ 550 nm (Model)



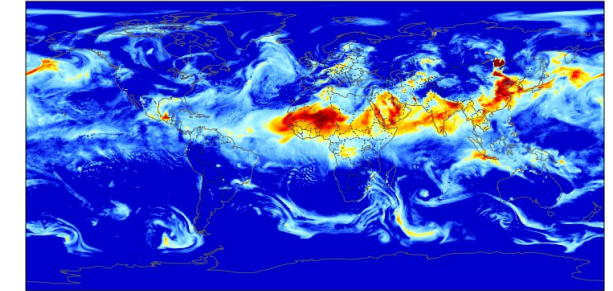
CAMS

Total AOD @ 550 nm (CAMS)



Assim. field

Total AOD @ 550 nm (Assim BSC EarthCARE)

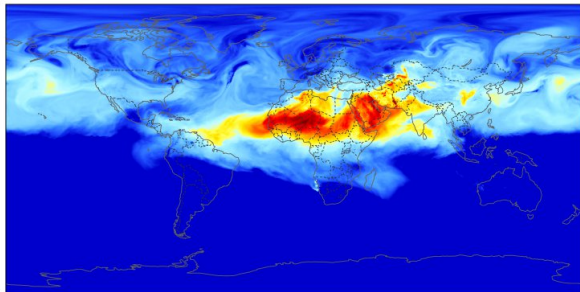


Total AOD

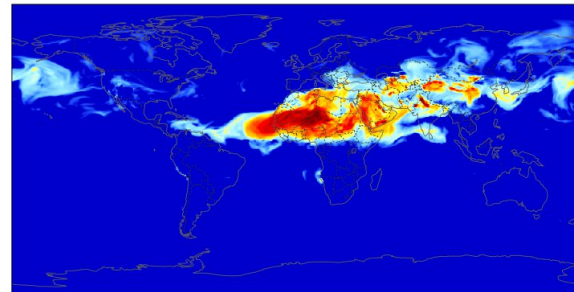


Desert Dust AOD

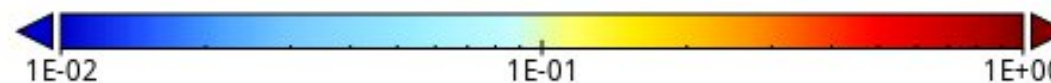
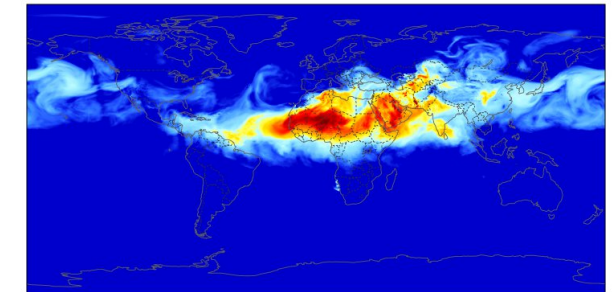
Desrt Dust AOD @ 550 nm (Model)



Desrt Dust AOD @ 550 nm (CAMS)



Desrt Dust AOD @ 550 nm (EarthCARE Assim)





- **Summary :**

- Importance of EarthCARE measurements for constraining the model via data assimilation
- Improvements have been observed even for unobservable variables
- Work in progress on species assimilation

- **Outlooks :**

- Aerosol Online assimilation (within NWP model)
 - Cloud-aerosol interactions
 - Impact on meteorological parameters