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Coordinated by HYGEOS

CAMAERA

WP1

TASK 1.1: OFFLINE DUST INVERSIONS

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Task 1.1: Dust emission inversions

CAMAERA

Rationale

- Spatial and temporal simulation of mineral dust in the model can be better estimated with the use of satellite aerosol optical depth observations
- Better the spatial and temporal estimates, better the assessment of the impact of the dust

Why in CAMAERA?

- Top-down emission inversions typically depends on the numerical modelling system: **target optimal dust emissions in IFS**
- Can be use as baseline for online dust inversions (WP2)
- Provides useful information for new dust scheme developments (WP5)

How?

- **Data assimilation** of satellite dust optical depth to estimate dust emissions
- Modified workflow of the **Local Ensemble Transform Kalman Filter** used at the Barcelona Supercomputing Center
- Scale factors for the prior **emissions** (3 days temporal resolution, gridpoint spatial resolution)

Expected outcomes from T1.1

Main outcomes:

- >1 yr of top-down emission estimates (factors over the emissions) with the current dust scheme (ongoing)

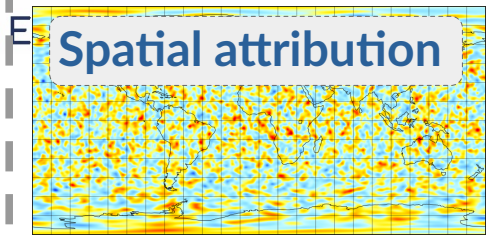
But also we are doing:

- Dust inversion for the new dust scheme developed in WP5 (ongoing)
- Verification of deterministic forecast with ground-based AOD observations (not started)
- New experimental ensemble perturbations (not started)

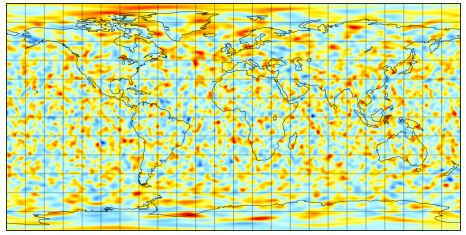
Method: modified ensemble and workflow of LETKF

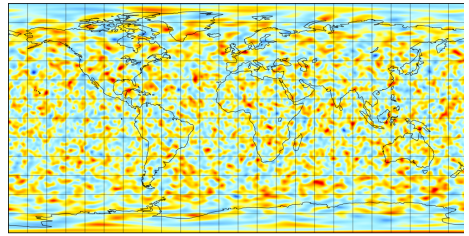
CAMAE

ENS



Spatial attribution



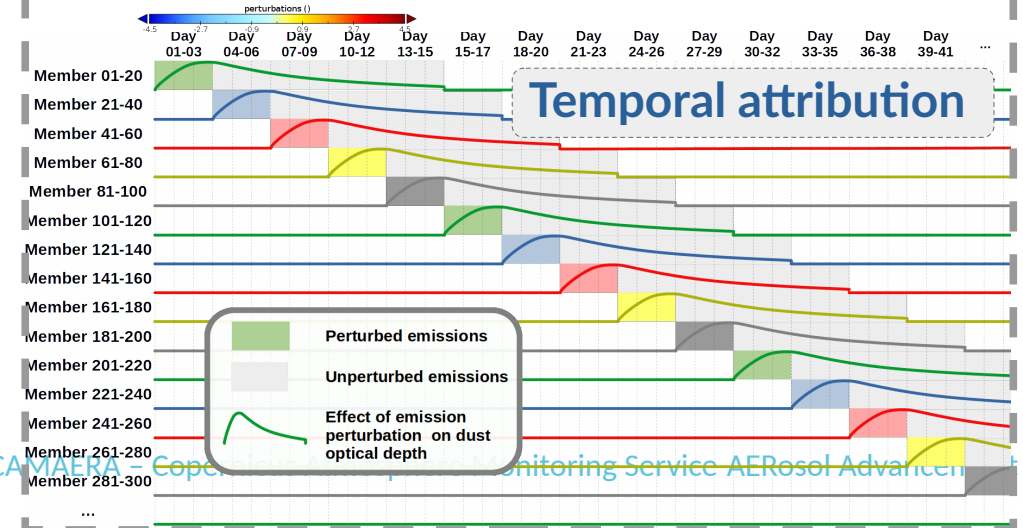


IFS
emission 1
dod 1

IFS
emission 2
dod 2

IFS
emission 3
dod 3

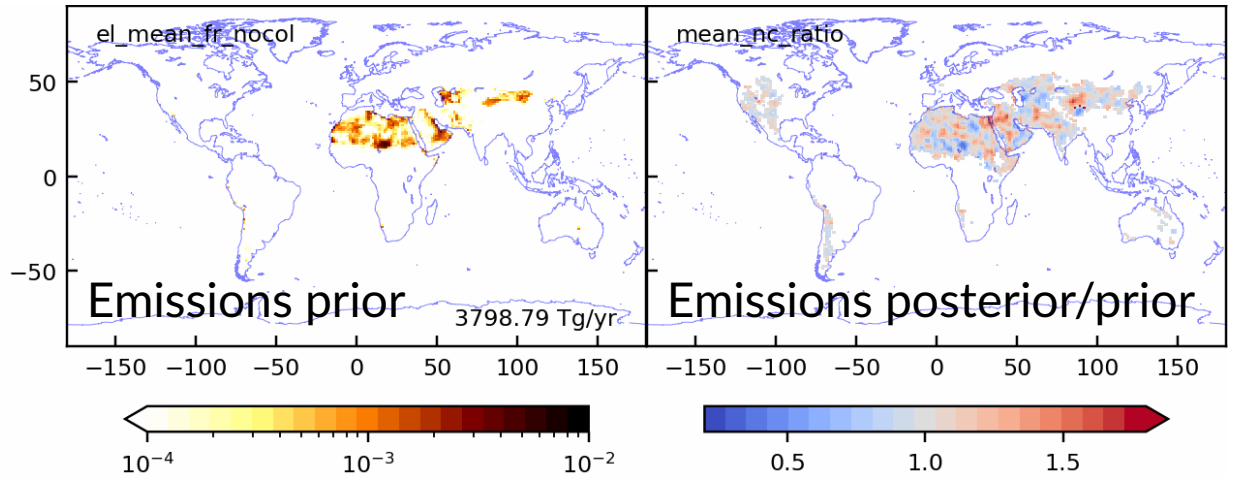
IFS
emission M
dod M

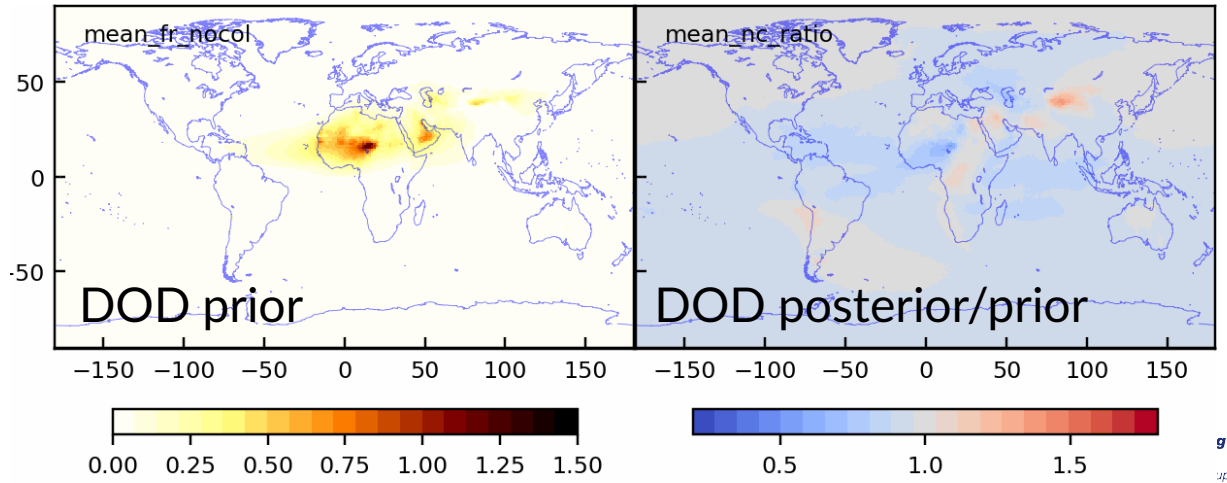


Temporal attribution

Assimilated DOD
VIIRS SNPP Deep Blue

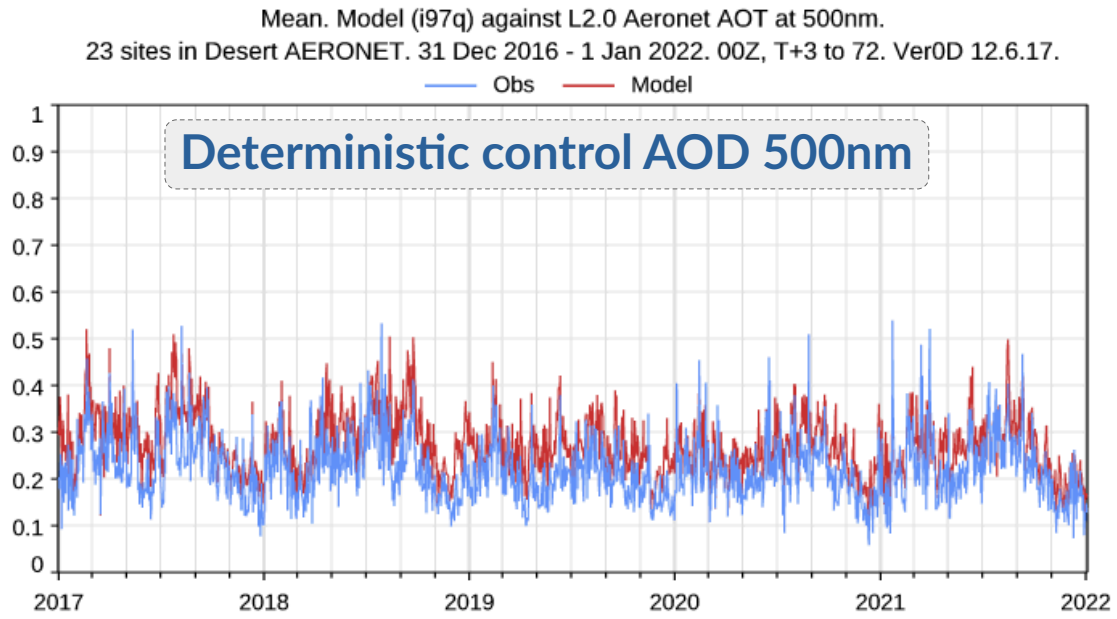
LETKF
x: emission factors

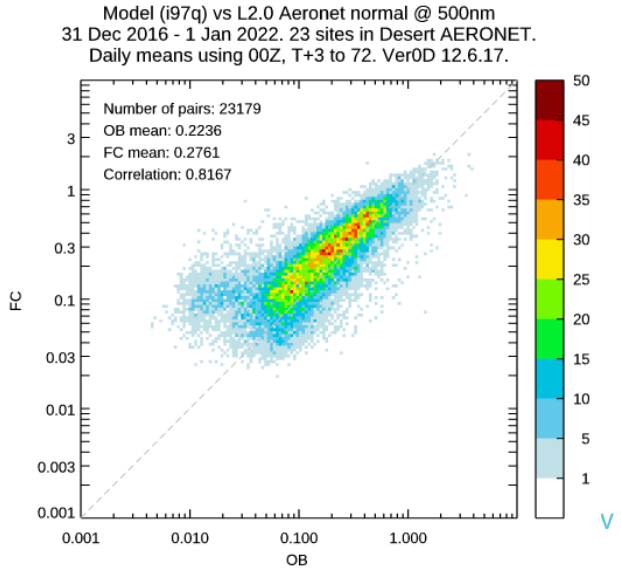


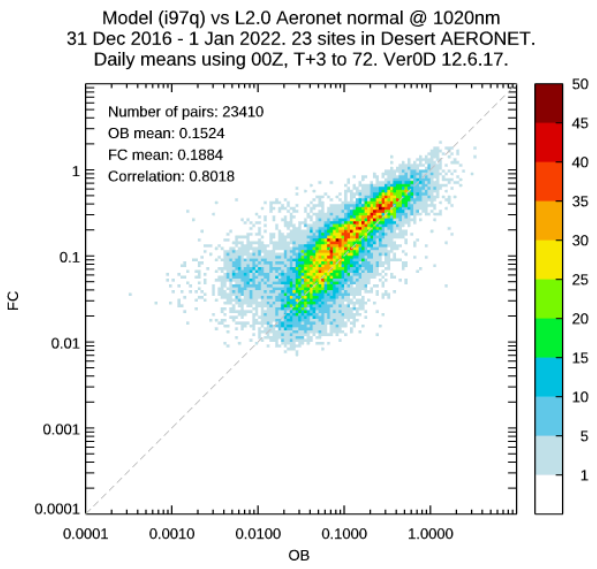


Example with MONARCH model

Current progress: Control run



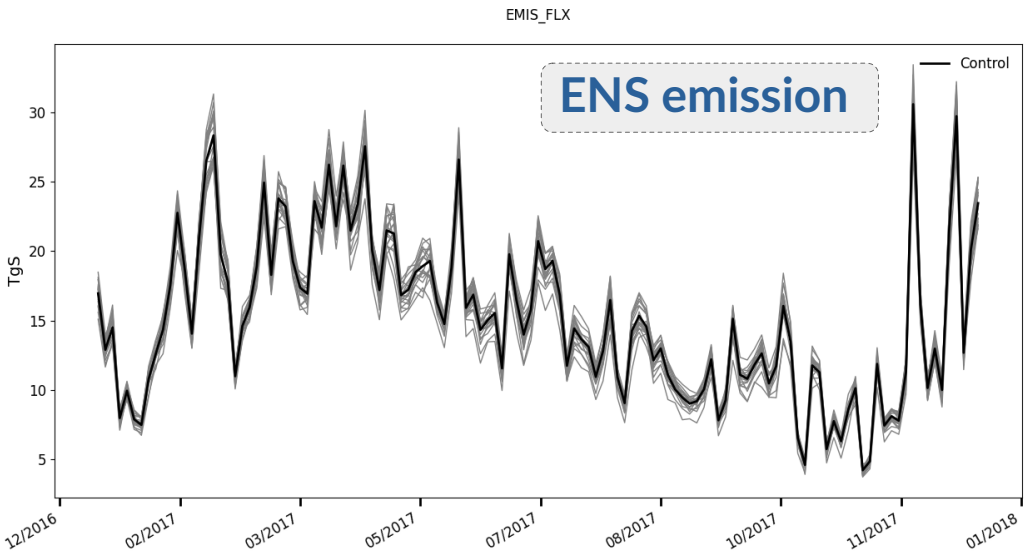




Correction factors with 3-day resolution

100 ensemble members (equivalent): emission of 20 members perturbed in d-0, 20 in d-3, 20 in d-6, 20 in d-9, 20 in d-12

2017 and 2018 produced



Current progress: First results on correction factors

Period 201704 → 201810

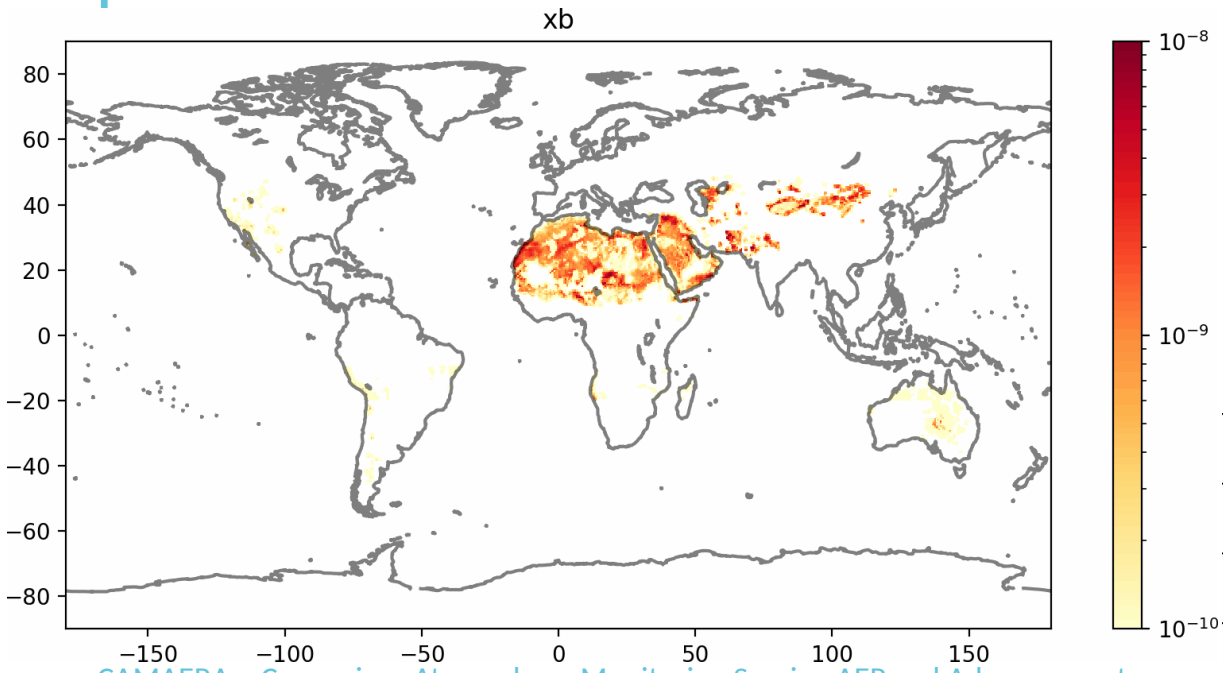
First ensemble created with dust emission perturbations (250km length scale)

20x5 ens members

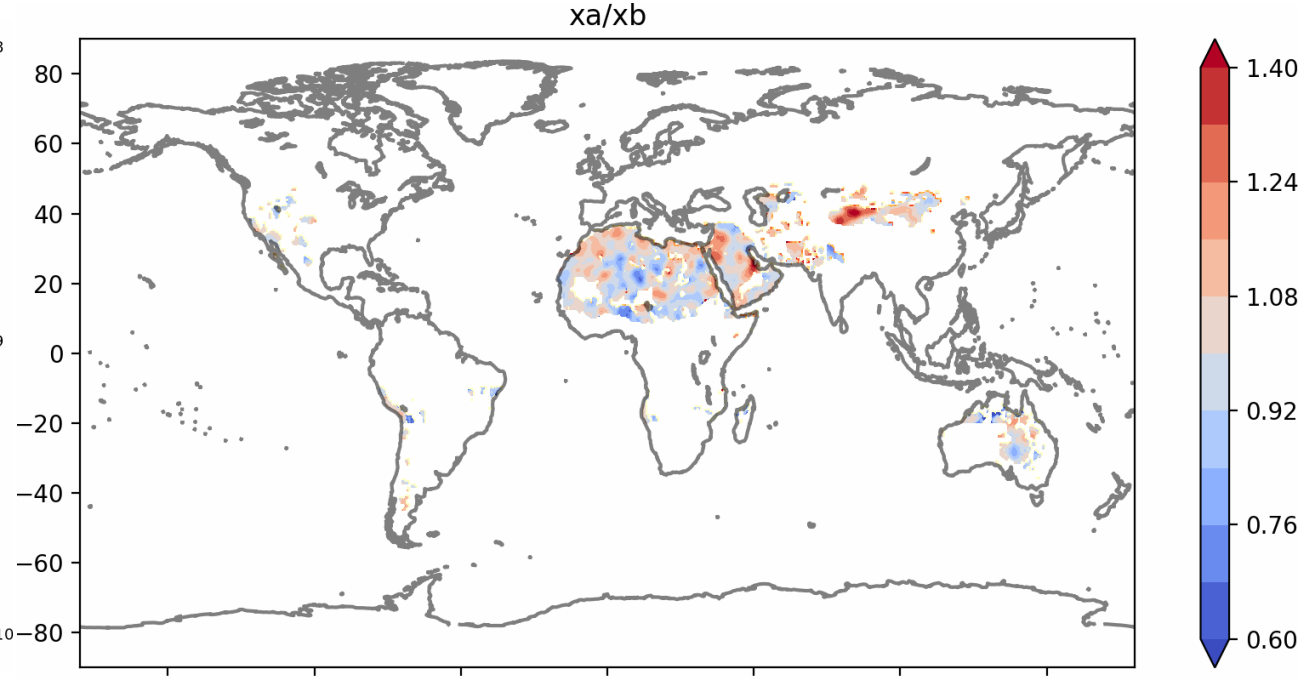
3 days temporal resolution, 0.5 deg spatial resolution

Assimilation of VIIRS AOD
[std of error = 0.2*AOD+0.05]

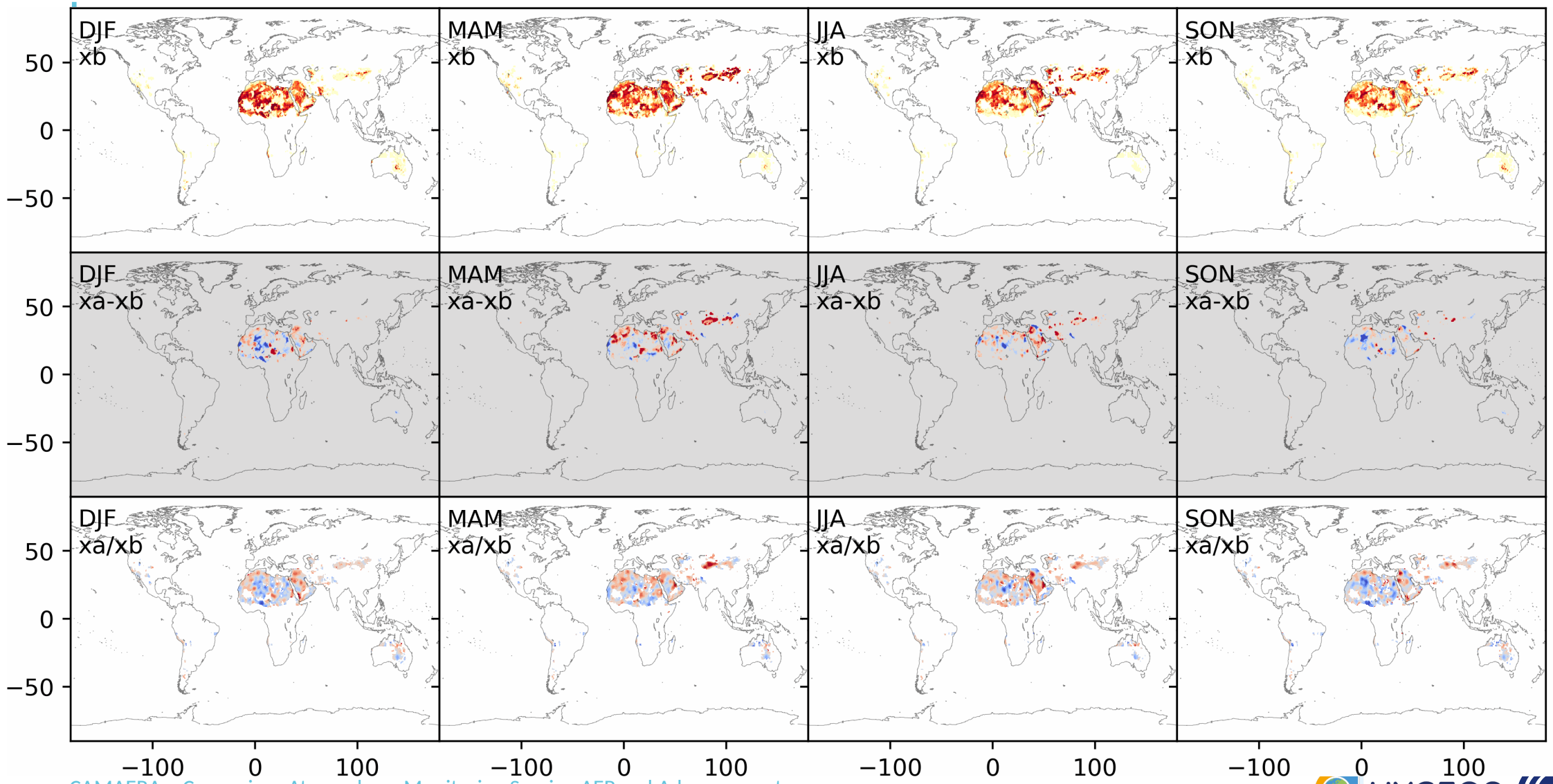
Prior emission (temporal average)



Ratio of posterior to prior emissions



Example results (2017 04 -> 2018 10)



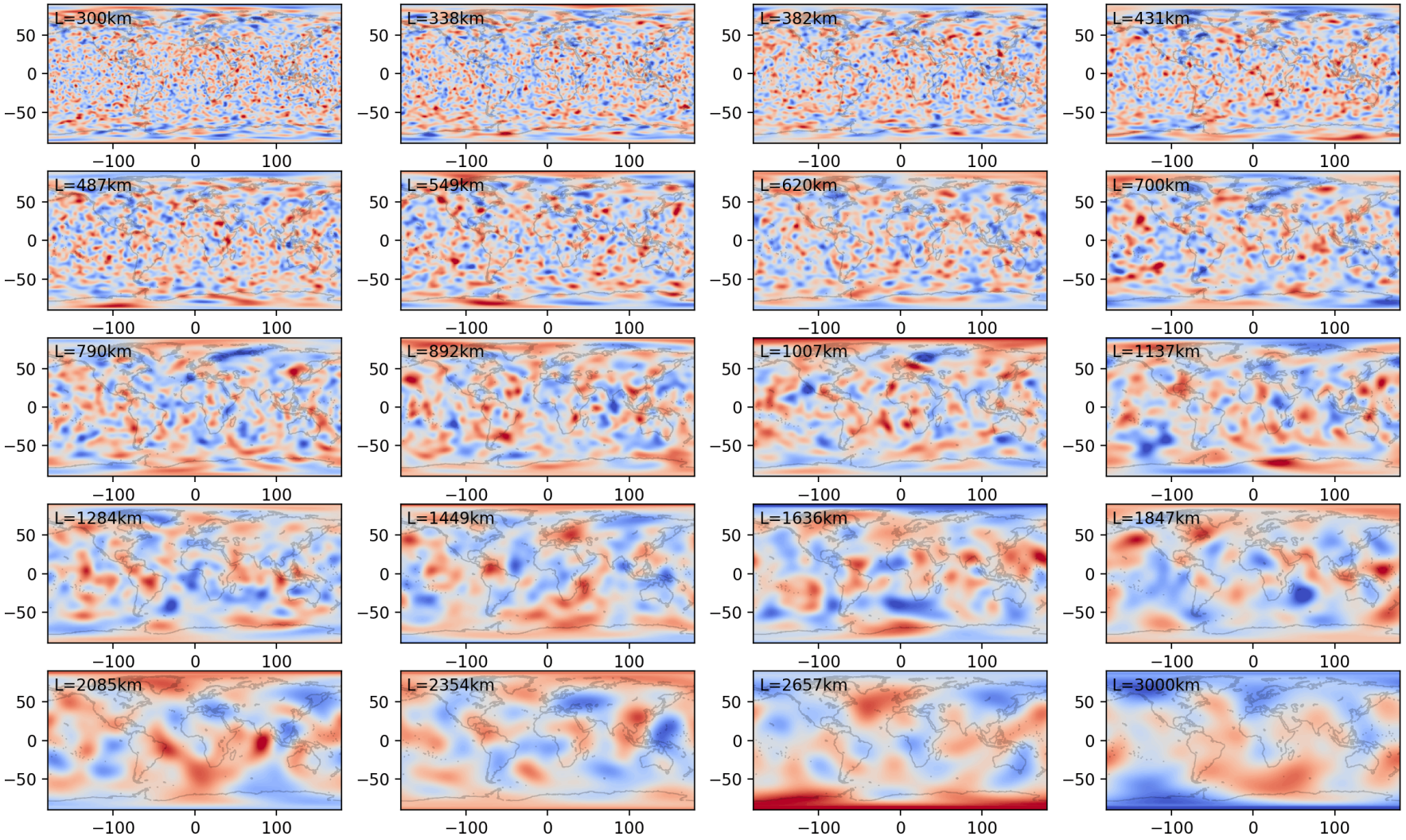
Ongoing work

1- Testing in BSC's MONARCH model a new set of perturbations with varying length scale

2- Computing a second ensemble with new dust scheme

3- Explore possible inflation for the ensemble spread

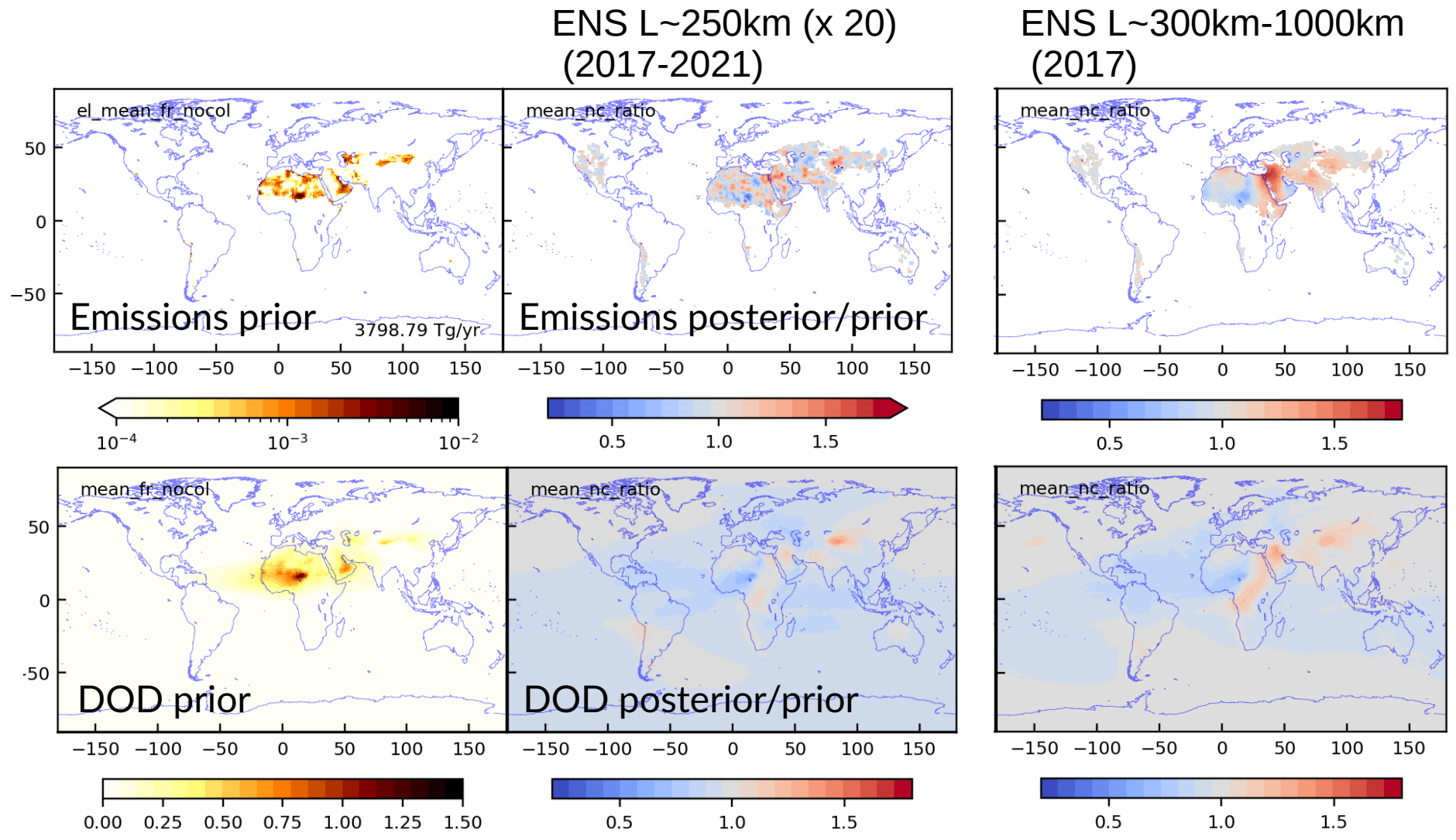
4- Preparations for deterministic analysis run



Ongoing work: Ensemble generation with varying length scale (MONARCH)

Corrected emissions for 2017 with new ensemble in MONARCH as test case

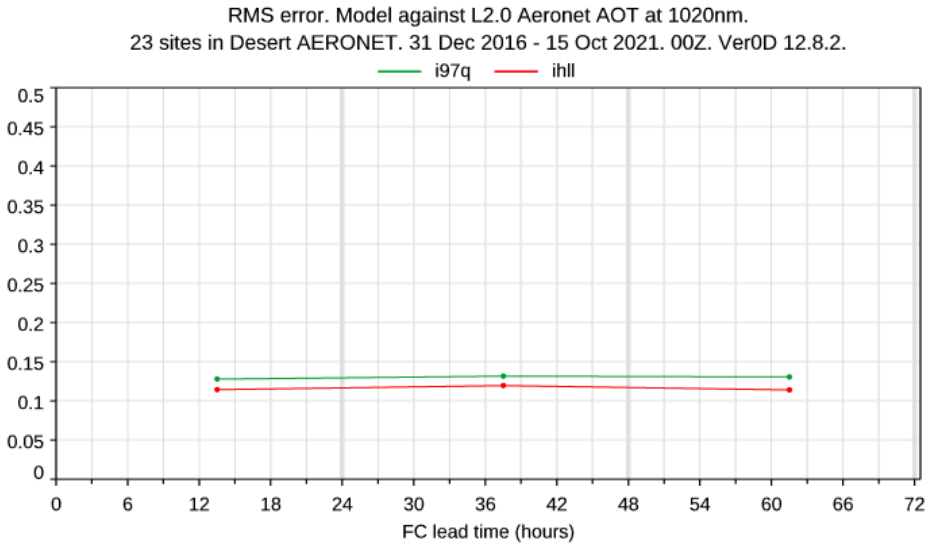
- New corrections seem smoother in space
- Impact on DOD is in the same direction
- Skill scores against AERONET are similar (not show)

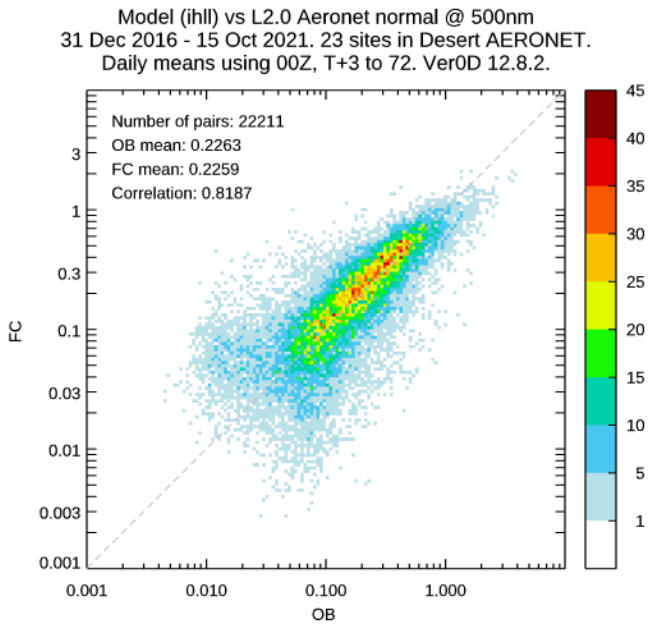


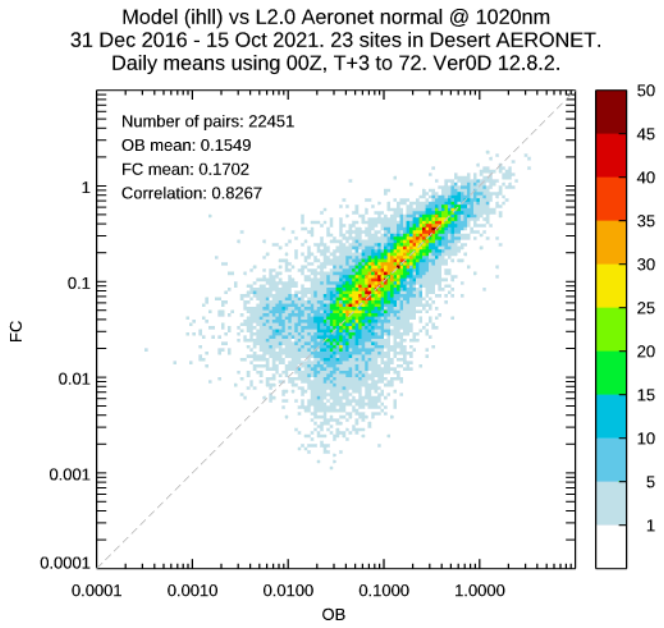
Ongoing work: Second ensemble with new dust scheme

A second ensemble is being run with the new SILAM-based dust emission scheme from WP5.

Evaluation of the control run is encouraging.







Green=first control run (operational dust emission scheme)
Red = second control run (new dust emission scheme)

Summary

Current status:

- IFS ensemble for about 2 years produced
- Inversion tested for ~ 1yr, correction factors computed
- Computation of ensemble with SILAM-WP5 dust emission scheme in progress
- New set of perturbations tested with MONARCH

Next:

- Estimate inflation for the ensemble spread using simple diagnostics in obs. space
- Extend analyses to all the simulated period
- Deterministic forecast with correction factors applied
- Emission factors for the new IFS dust scheme

Thanks!