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Centro Nacional de Supercomputación

BSC Data Assimilation Updates

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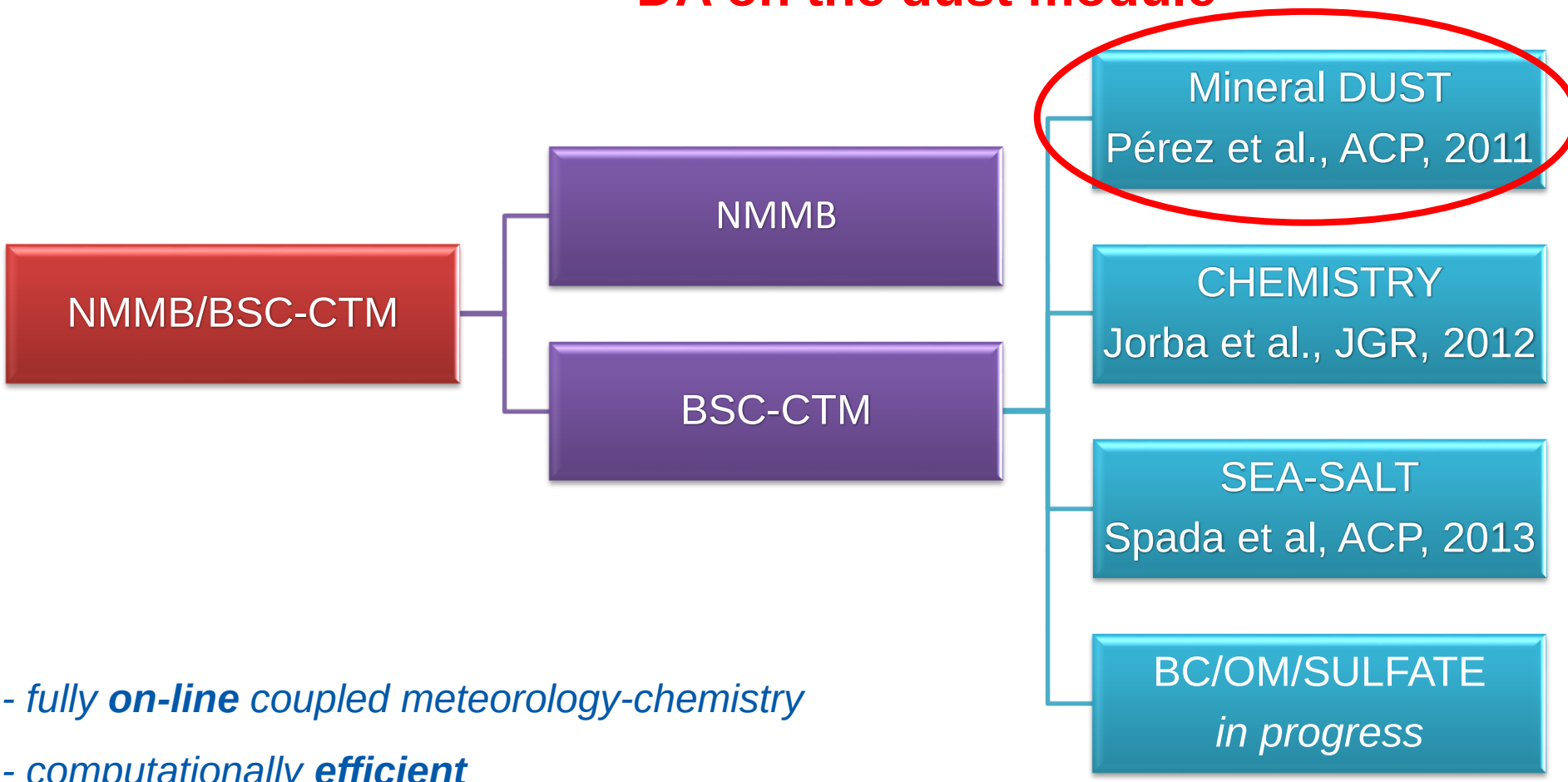
Special thanks to Francesco Benincasa @BSC

Barcelona, 18 June 2015

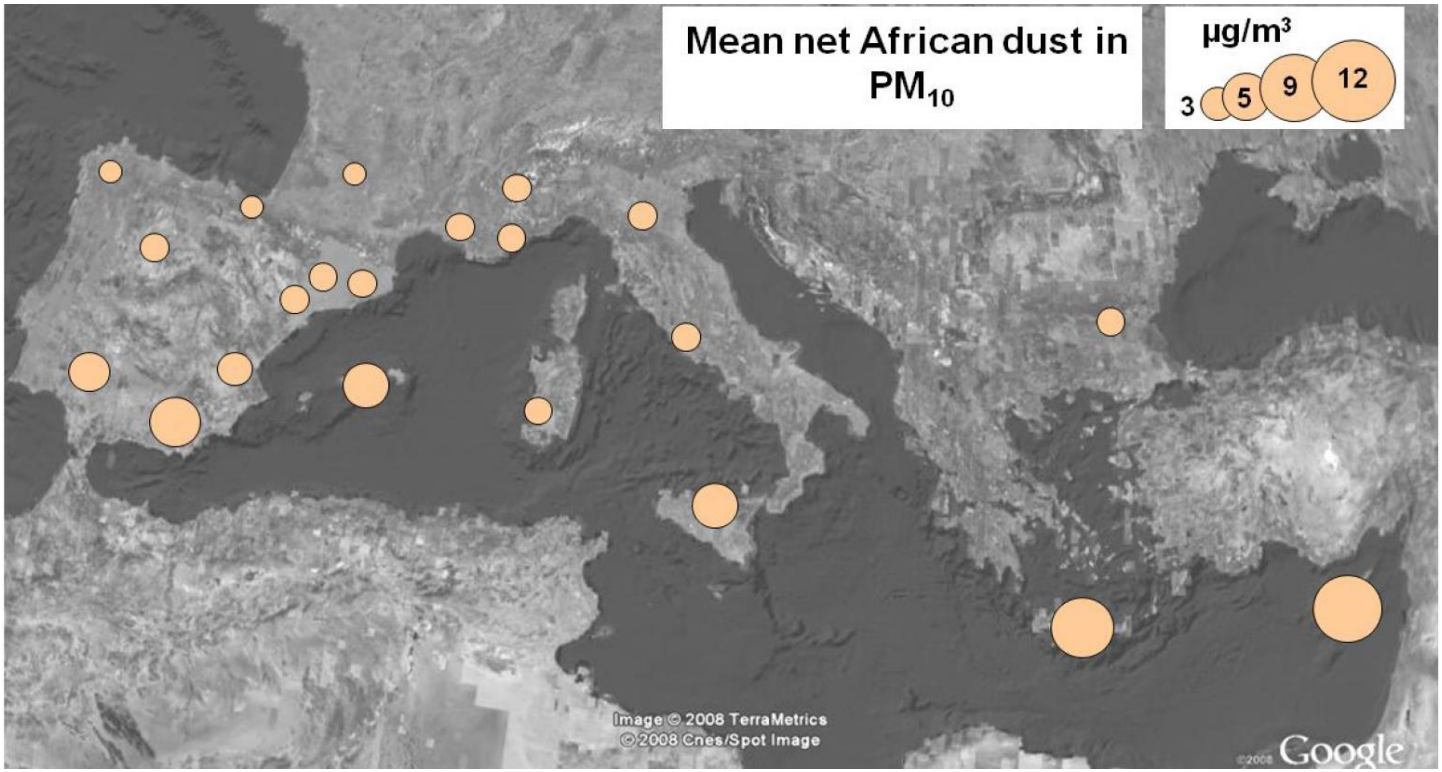
The “Barcelona Model” in ICAP

DA on the dust module



- *fully **on-line** coupled meteorology-chemistry*
- *computationally **efficient***
- ***multi-scale** thanks to its unified non-hydrostatic dynamical core*

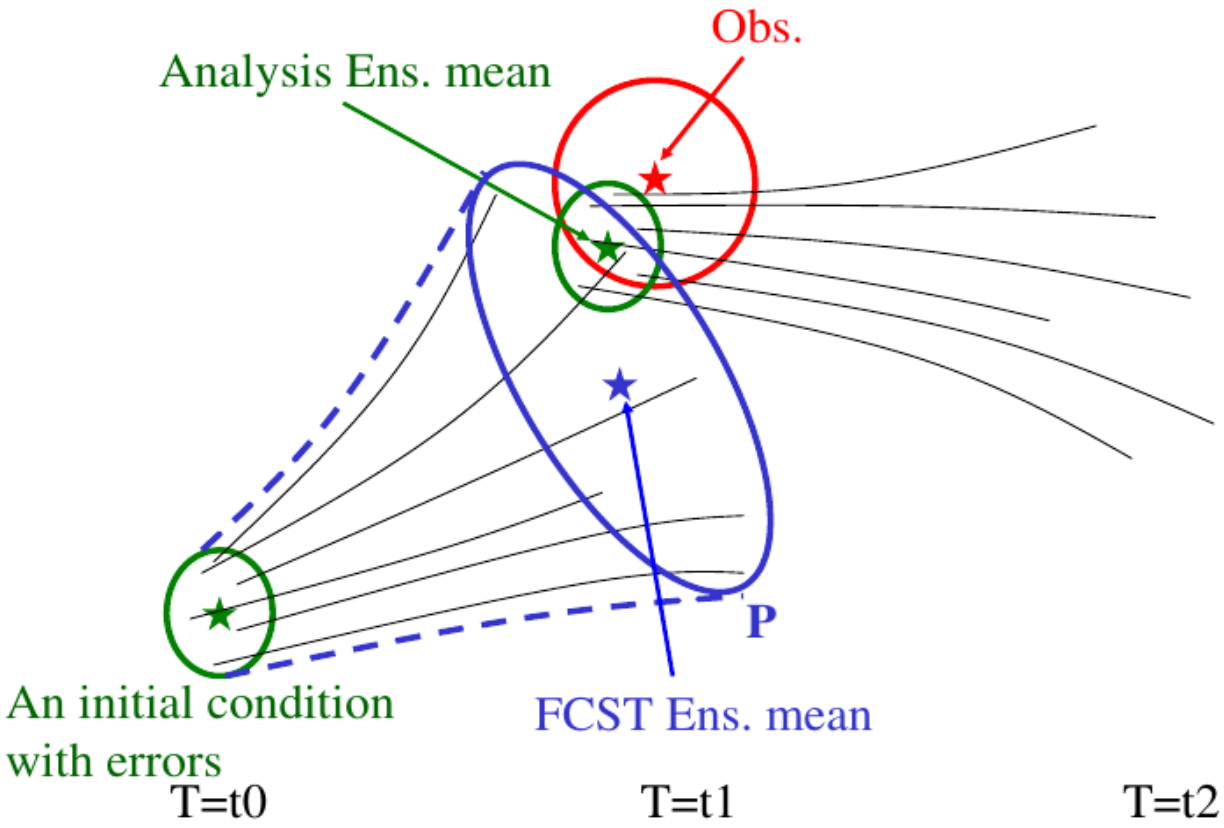
Motivations for caring about mineral dust even where ICAP meetings are held!



Querol et al., 2009

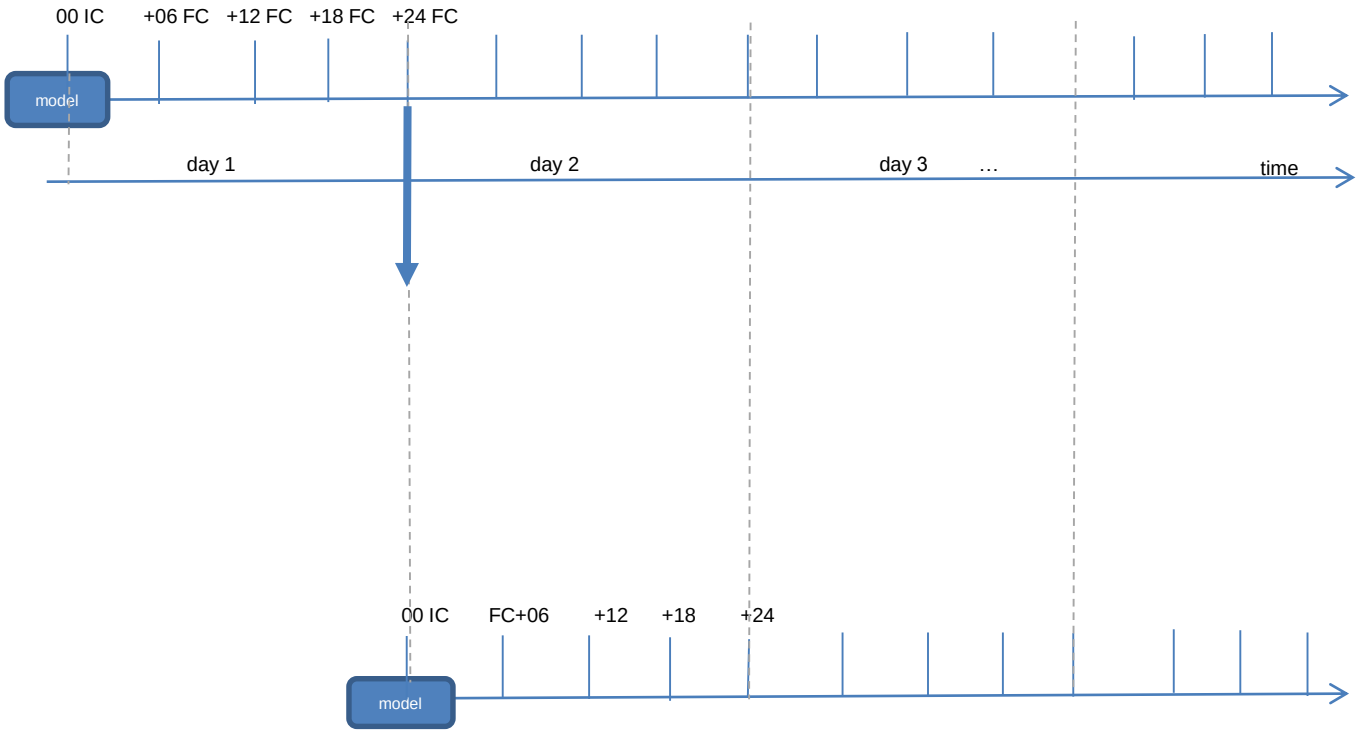
Studies performed with measurements taken in **Barcelona** show that Saharan dust outbreaks have **adverse health effects** (Perez et al. 2008, Pandolfi et al., 2014)

Ensemble-Based DA Technique (LETKF)

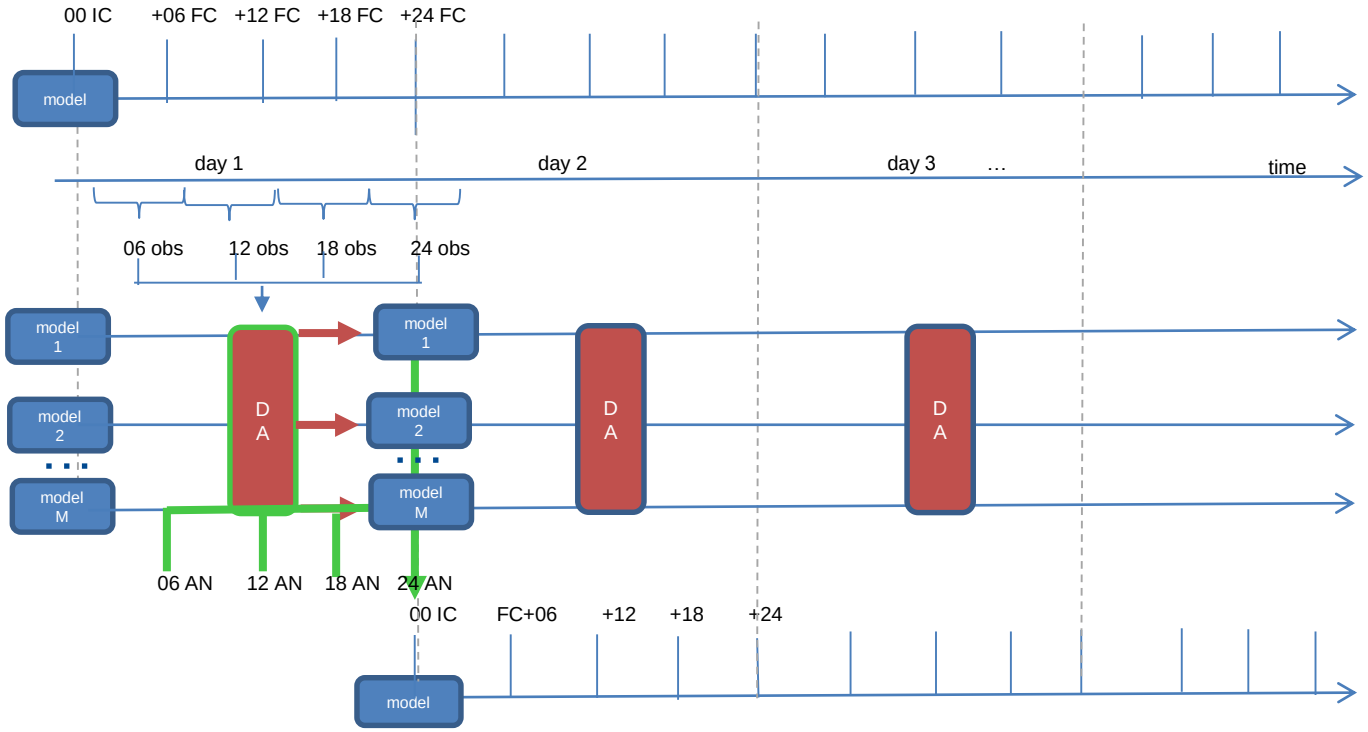


(courtesy of Takemasa Miyoshi)

Current Operational Flow

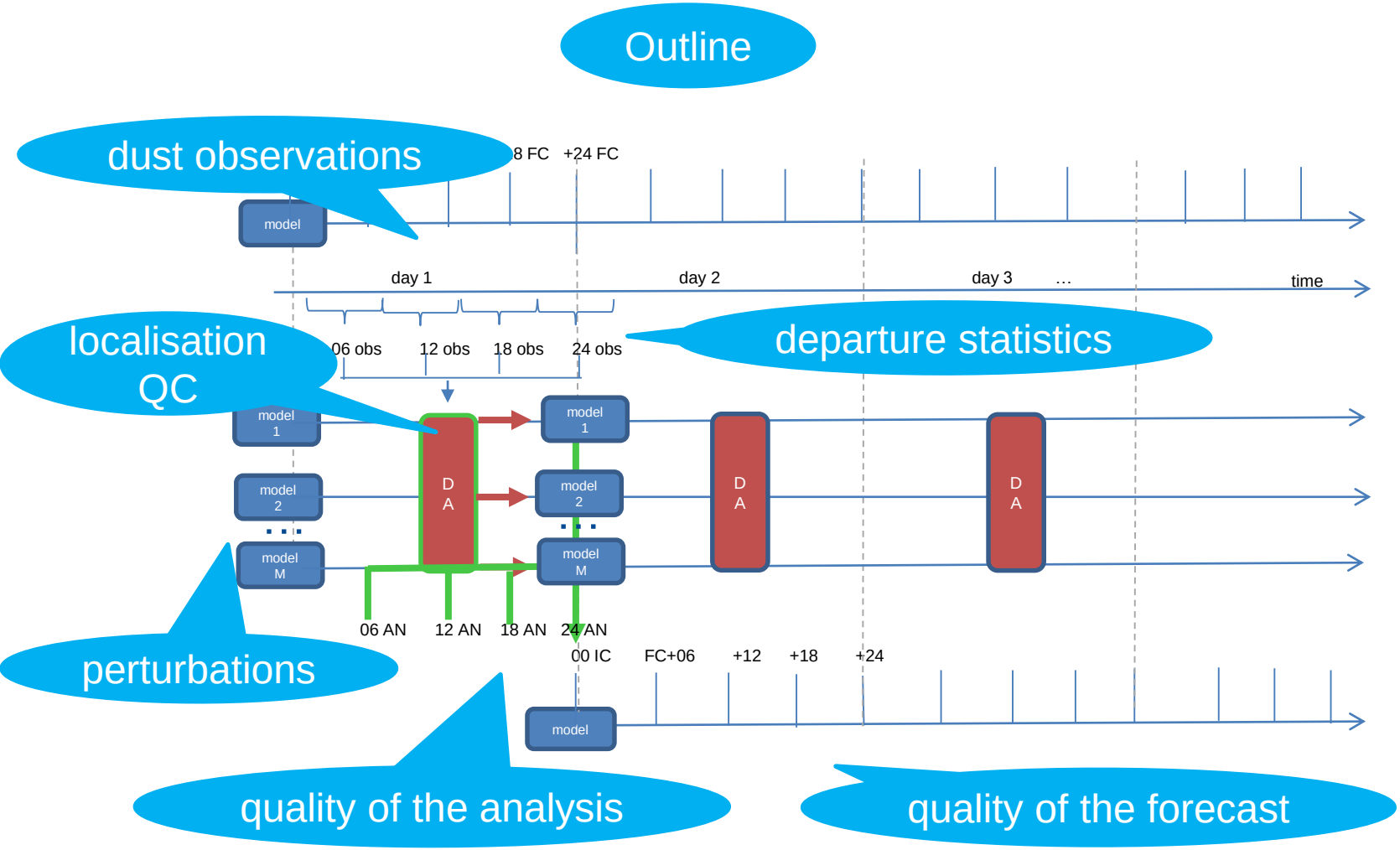


Data Assimilation Flow



- aerosol treatment by Nick Schutgens *(Schutgens et al. 2010)*
- core function by Takemasa Miyoshi *(Ott et al. 2004, Hunt et al. 2005)*

Data Assimilation Flow



- aerosol treatment by Nick Schutgens *(Schutgens et al. 2010)*
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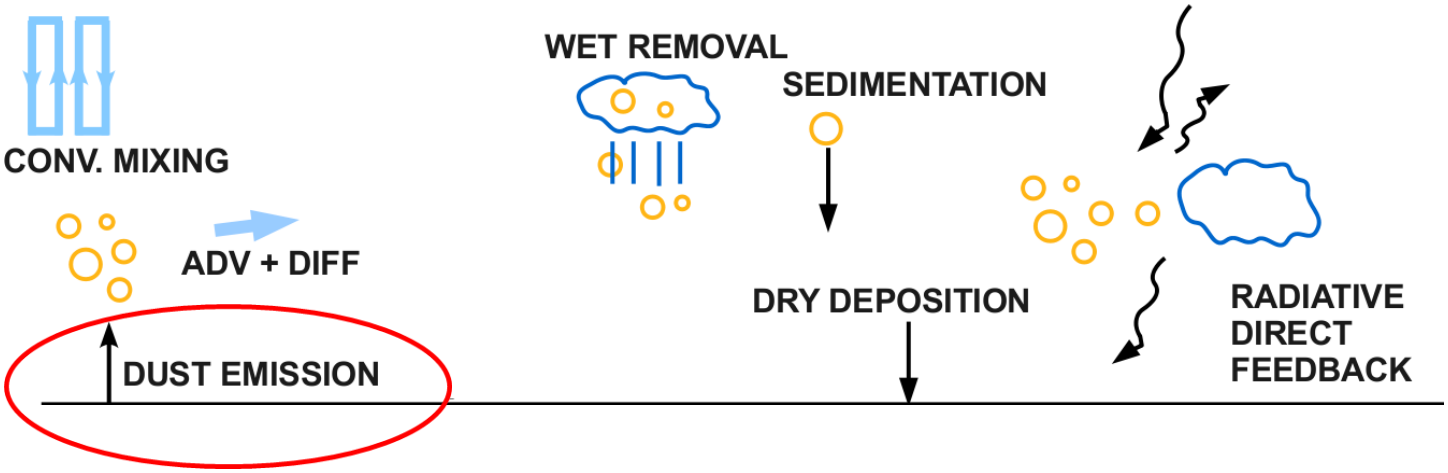
Creation of the Ensemble

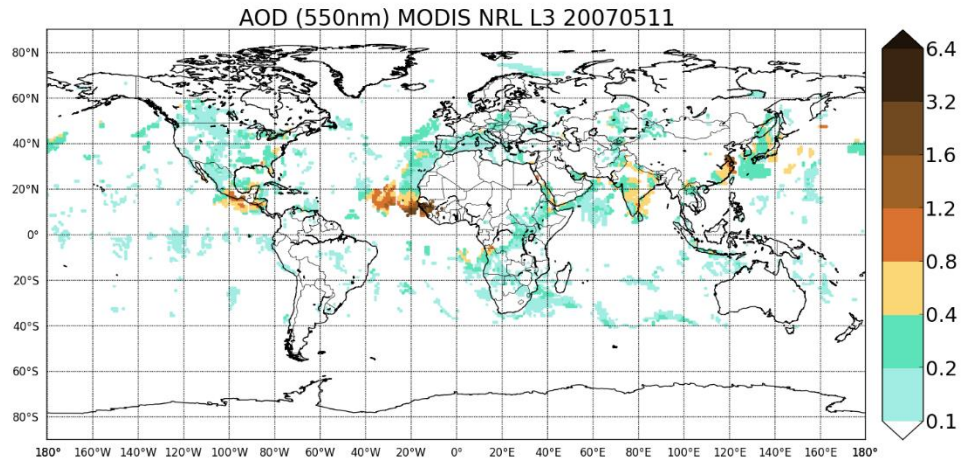


Vertical mass flux of dust into a transport bin *k*

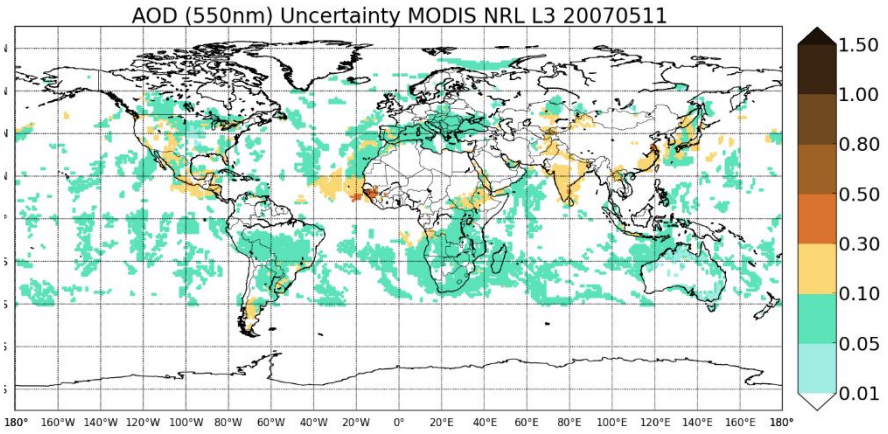
$$F_k = C\,S\,(1-V)\,\alpha\,H \sum_{i=0}^{3} m_i\,M_{i,k} \qquad k = 1, \cdots, 8$$

NRL MODIS L3 Product

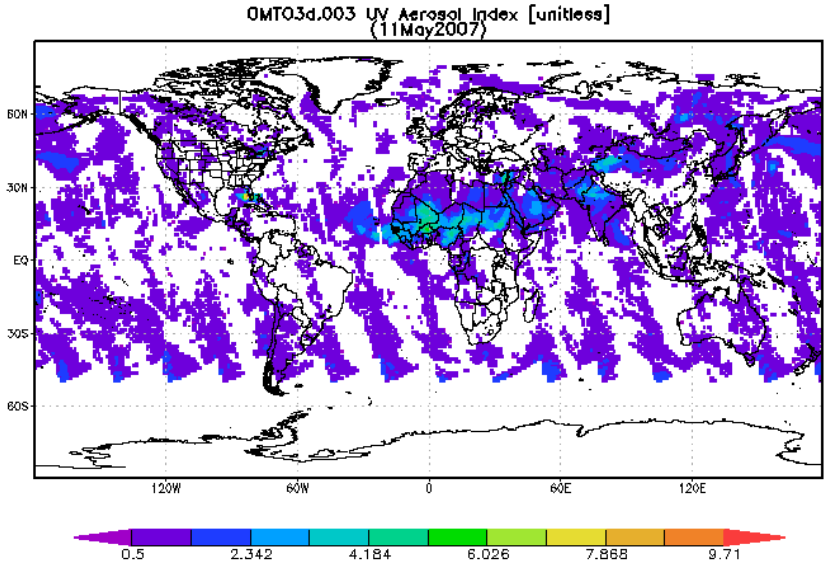
Aerosol Optical Depth



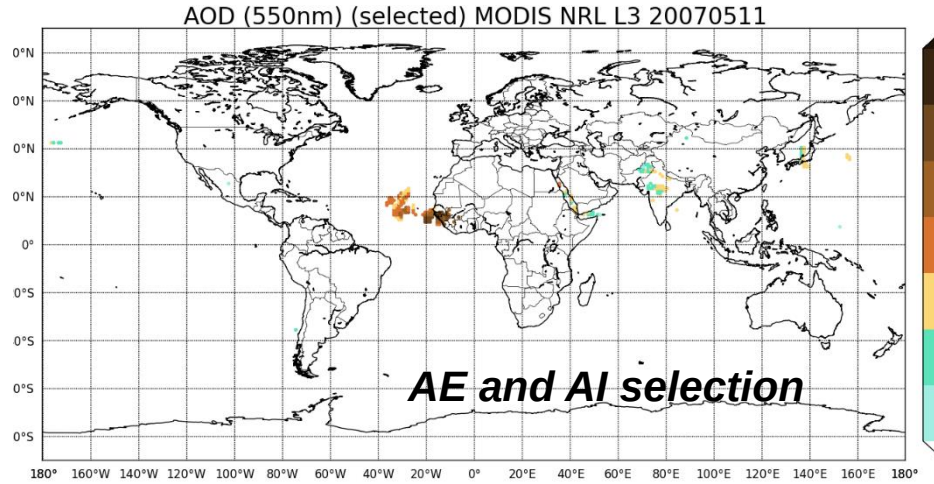
Uncertainty



OMI Aerosol Index

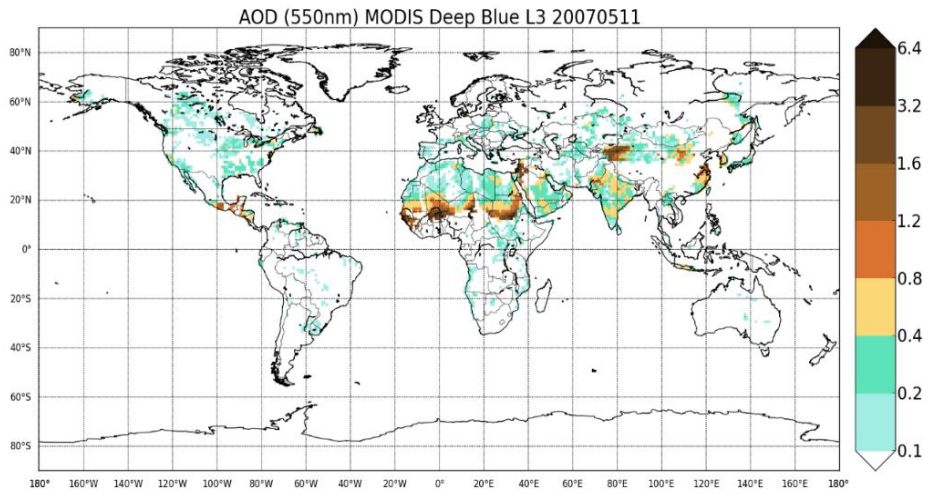


Selected Aerosol Optical Depth

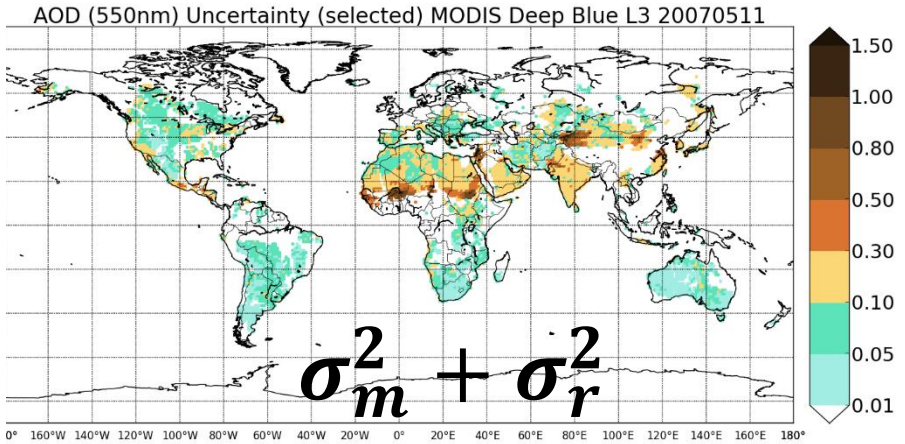


MODIS Deep Blue L3 Product, Coll 6

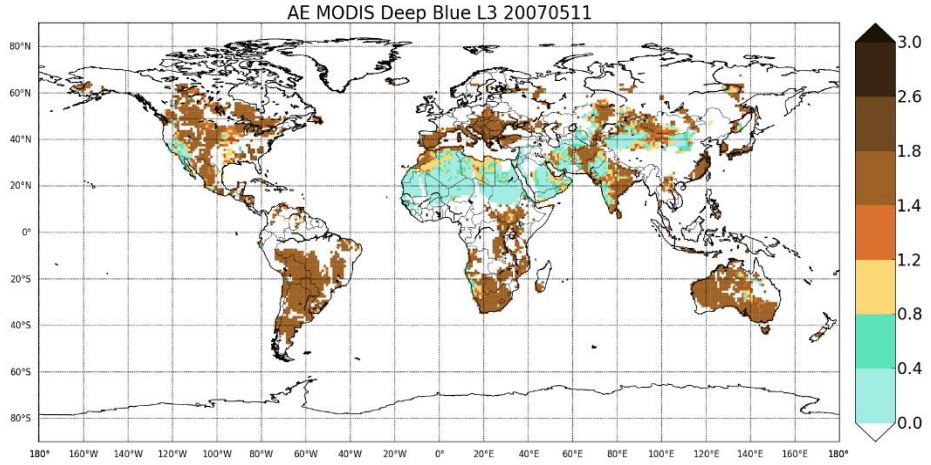
Aerosol Optical Depth



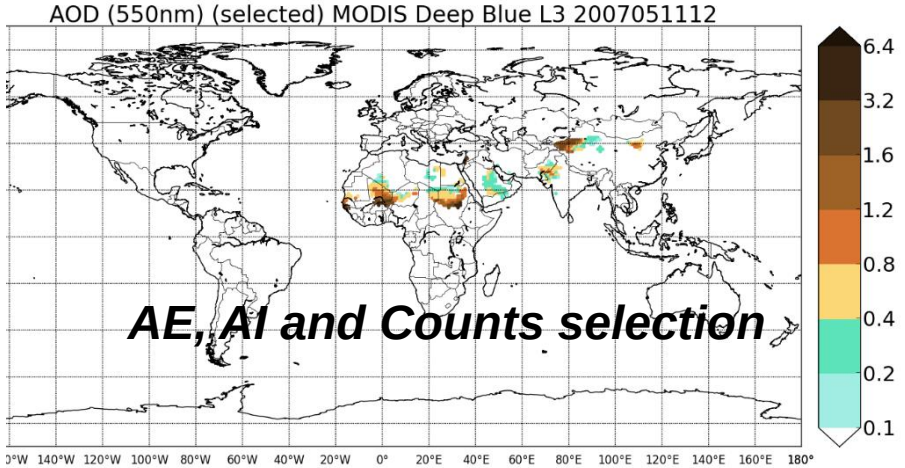
Uncertainty



Ångström Exponent

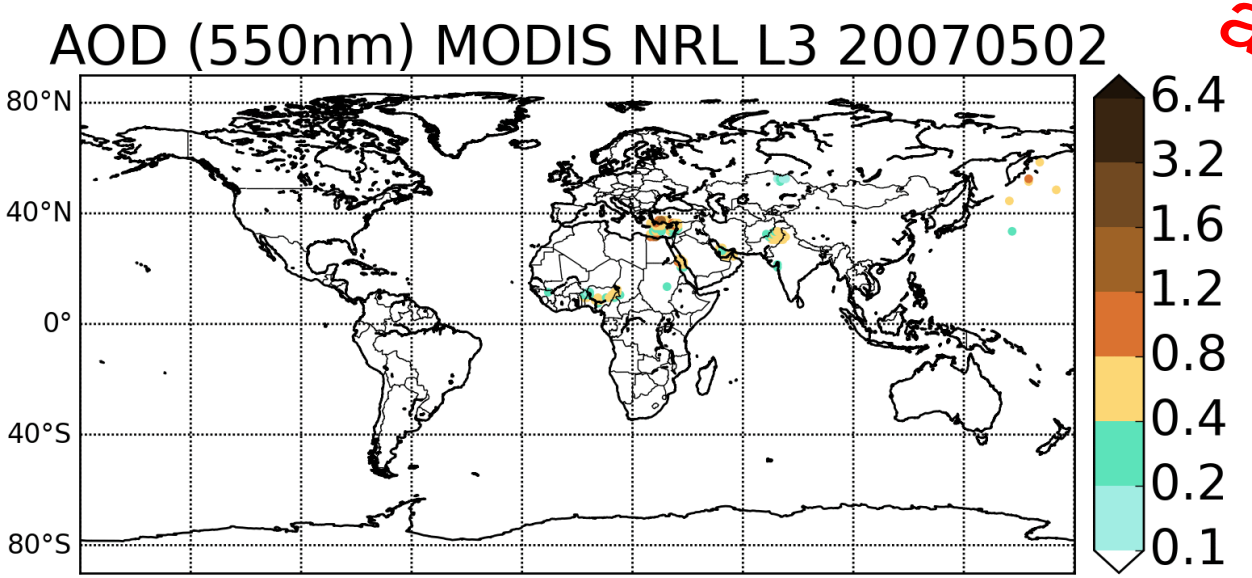


Selected Aerosol Optical Depth



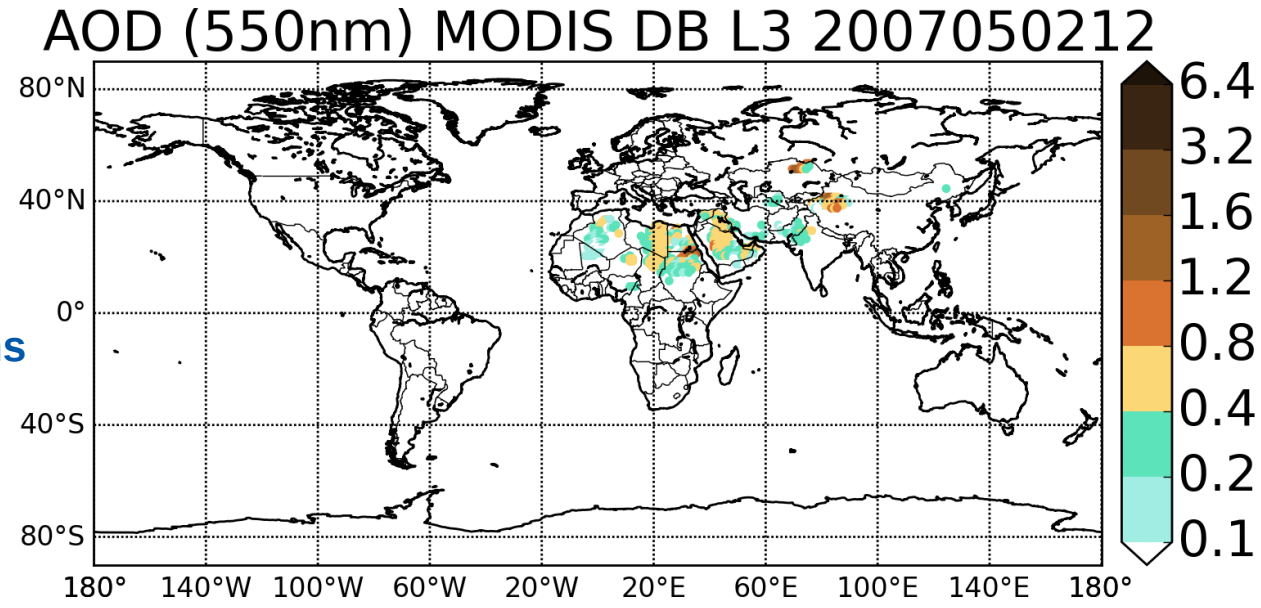
Dust Selected Observations

Selected NRL MODIS observations

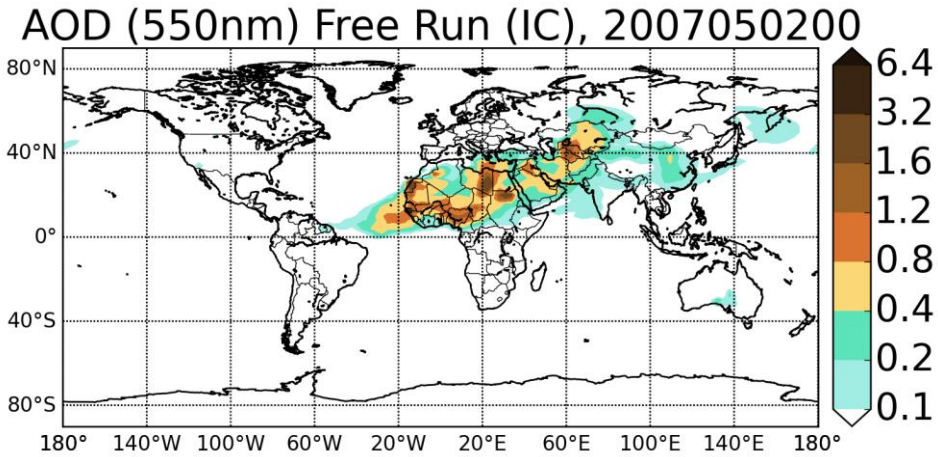


animation

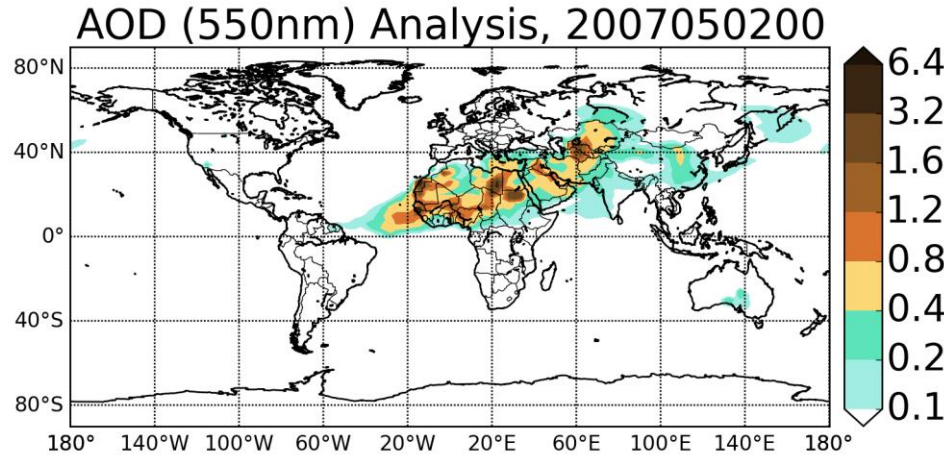
Selected MODIS DB observations

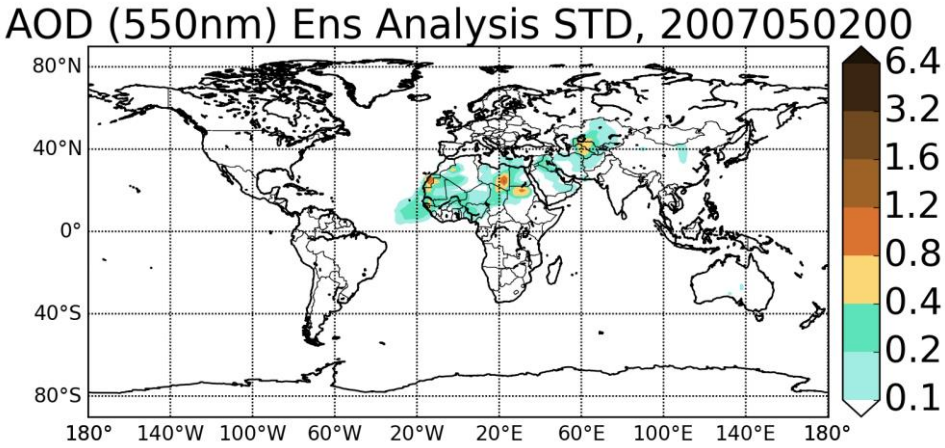


Dust Analysis (NRL MODIS)

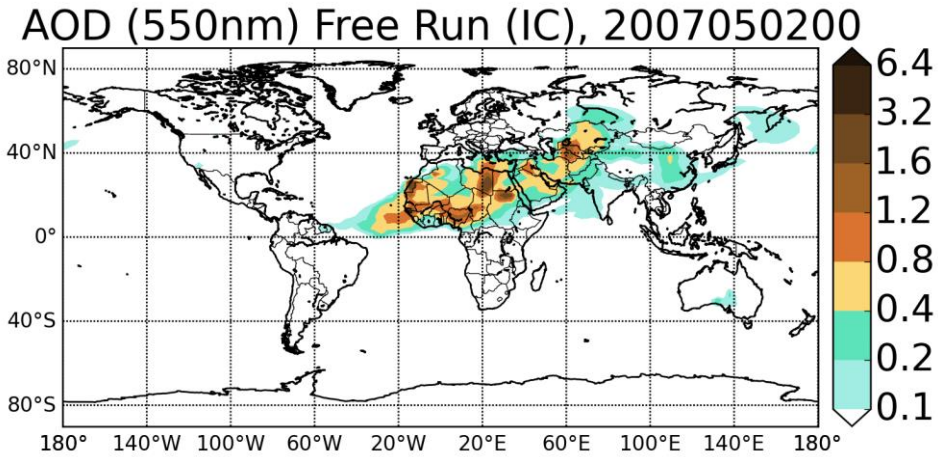


animation

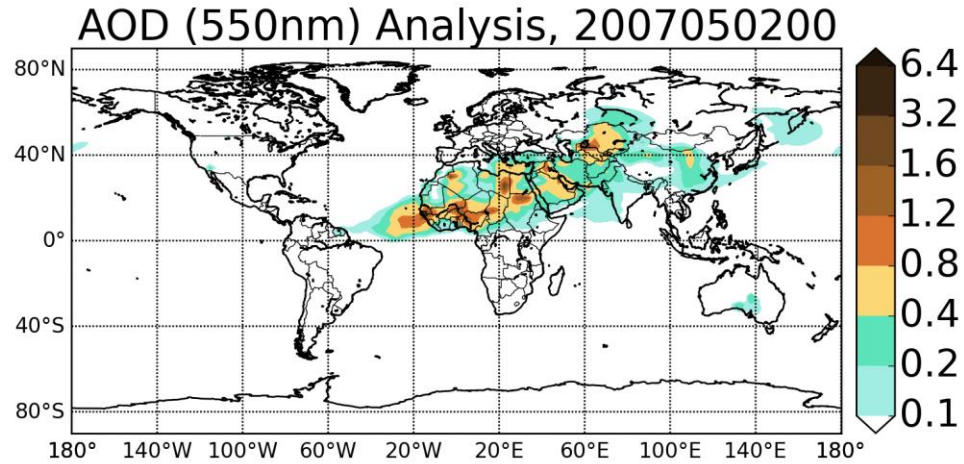


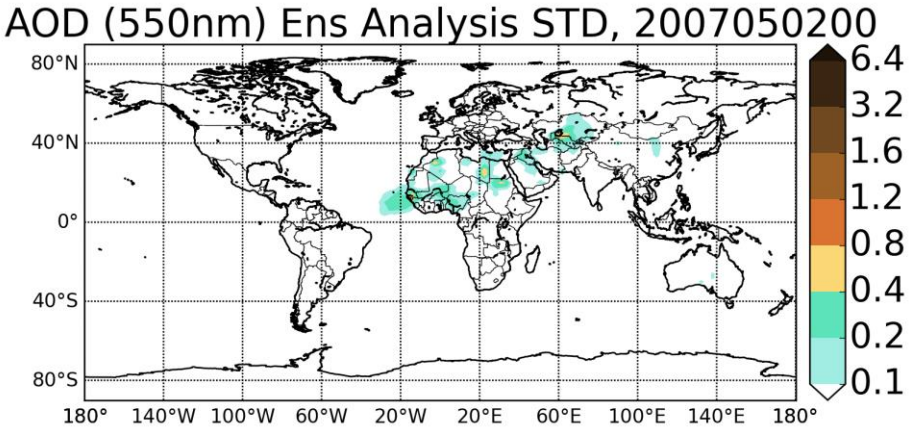


Dust Analysis (NRL MODIS + DB)

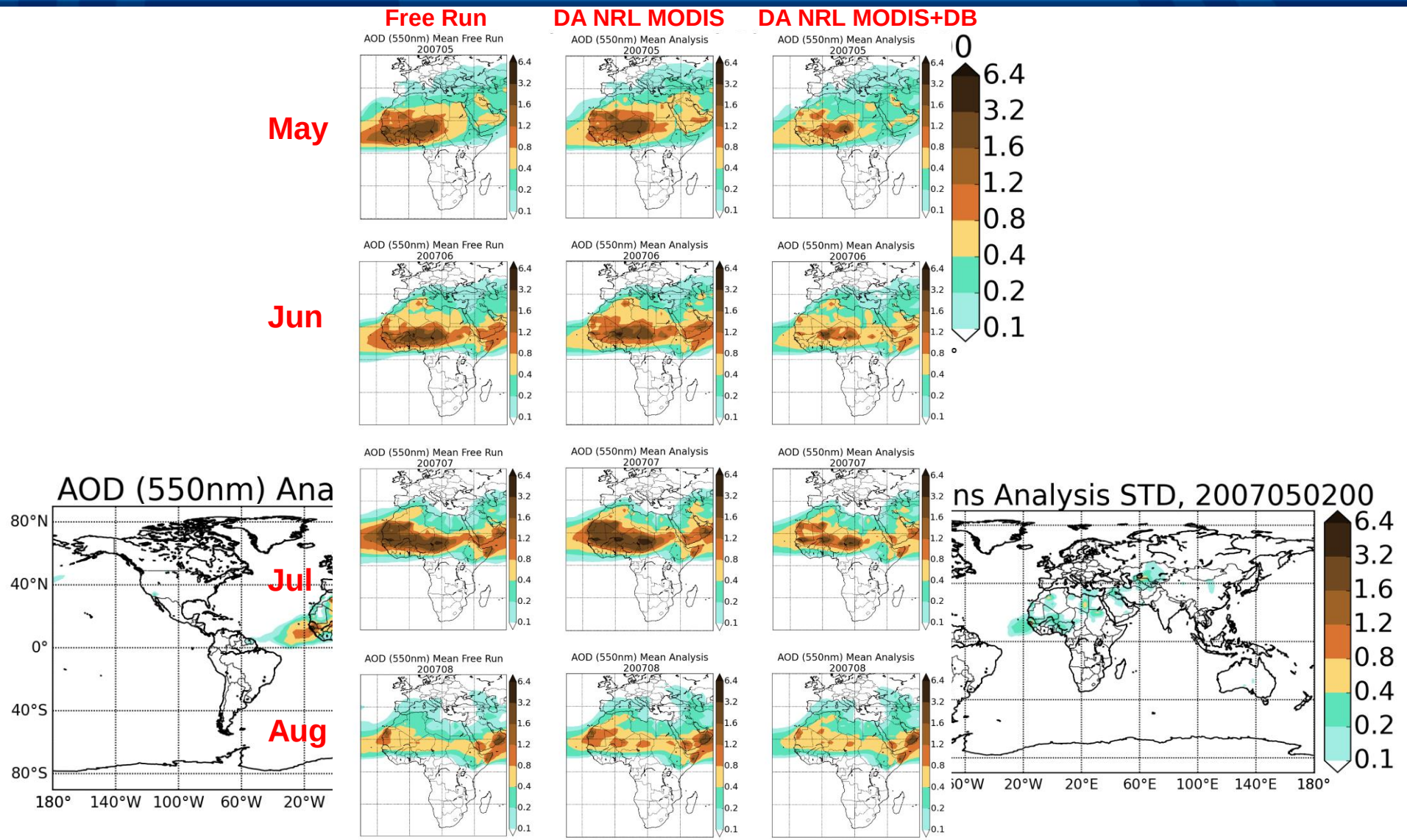


animation



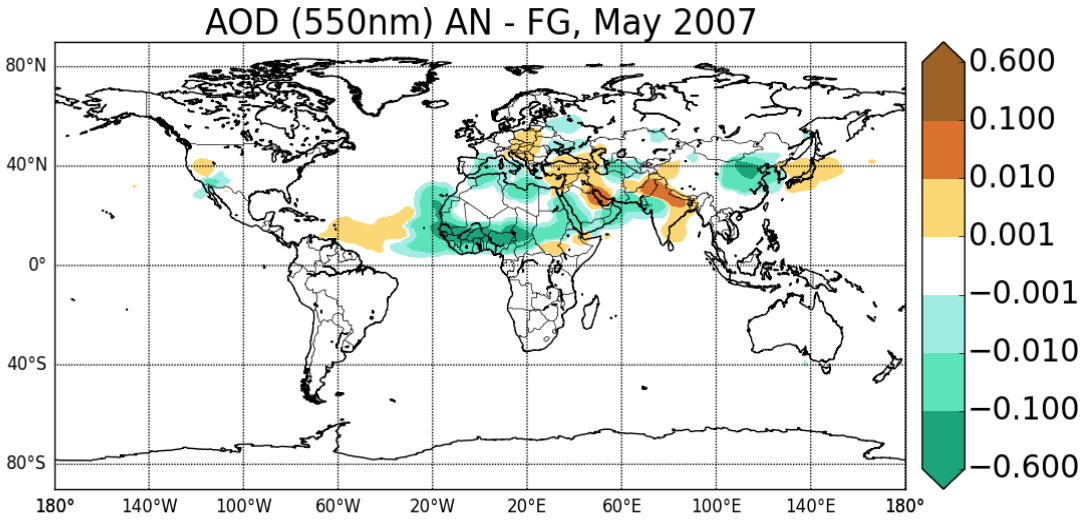


Dust Analysis (NRL MODIS + DB)

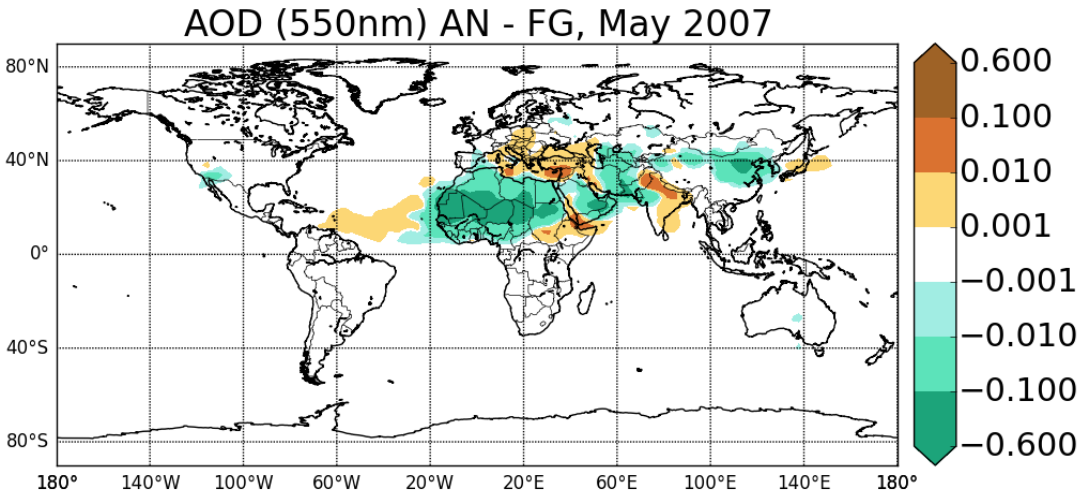


Mean Increments

MODIS NRL

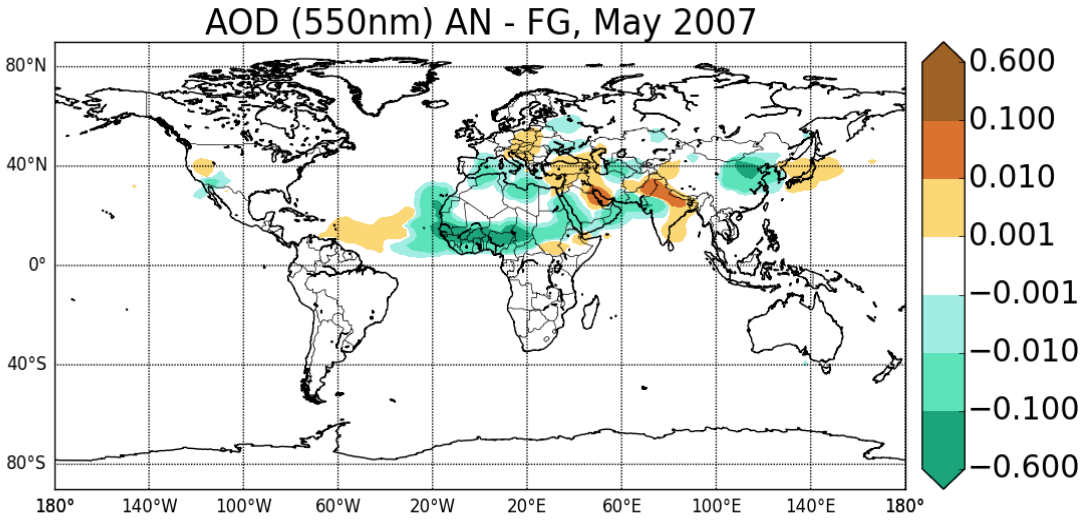


MODIS NRL +DB

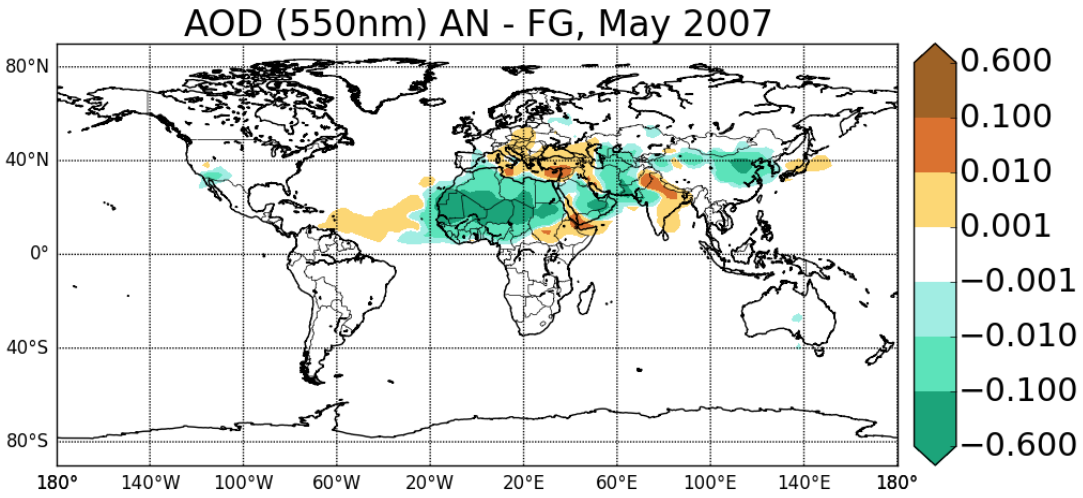


Mean Increments

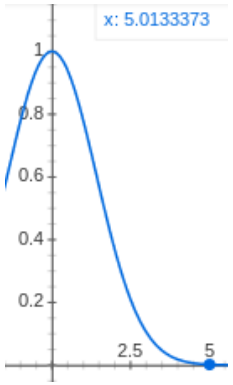
MODIS NRL

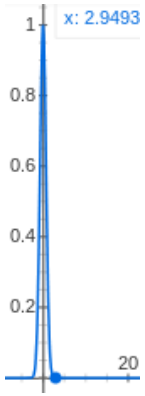


MODIS NRL +DB

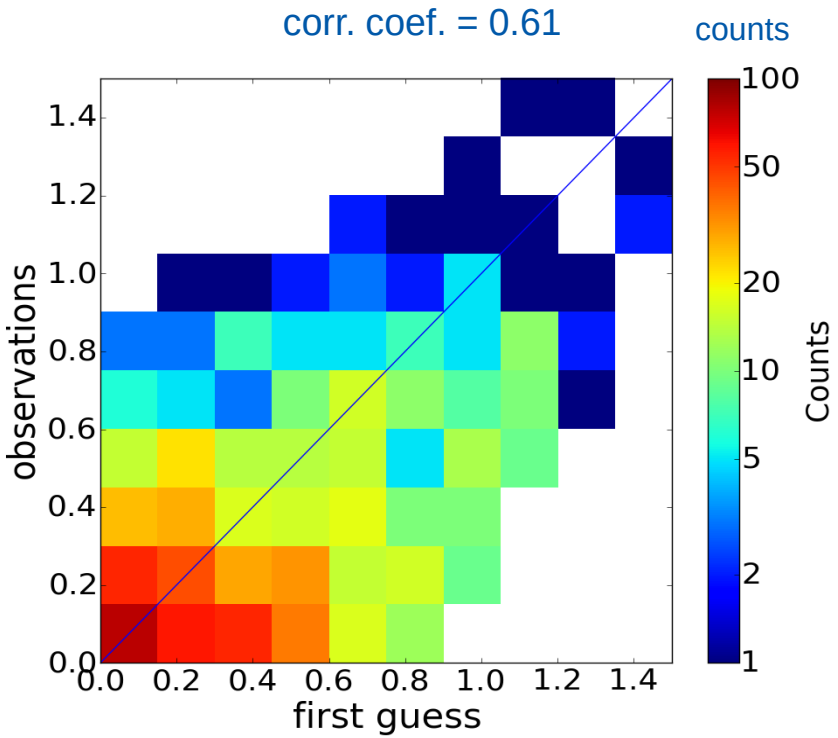


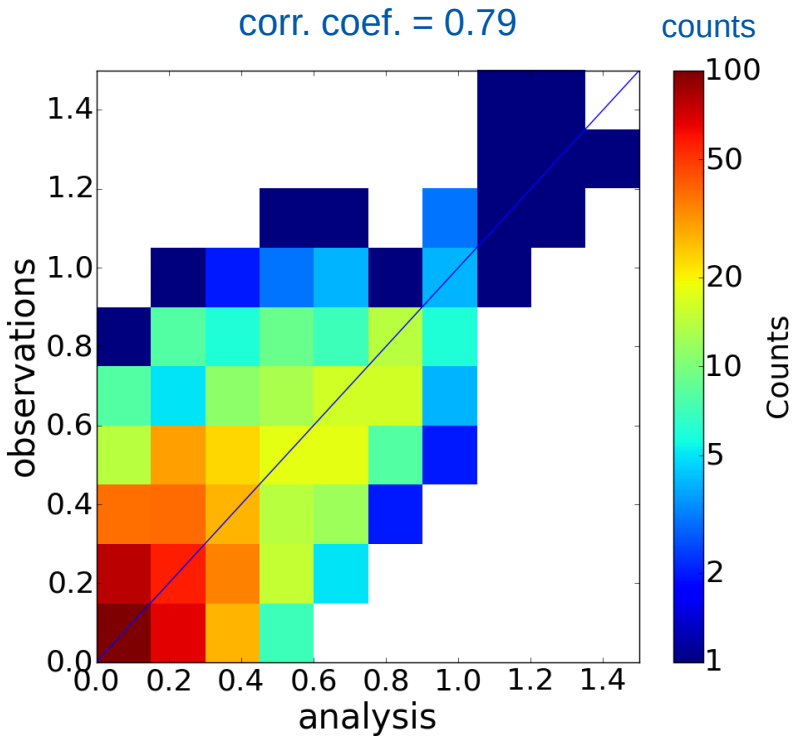
Localisation function





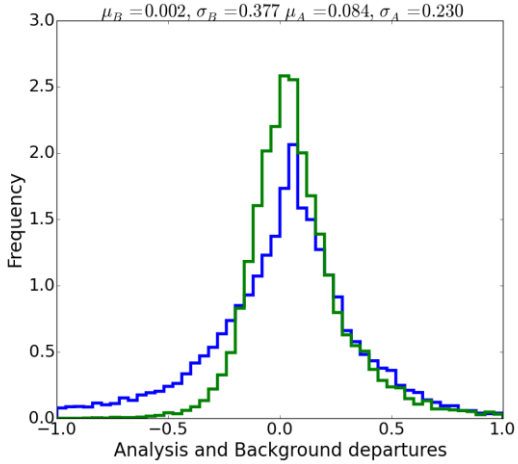
Departure Statistics (assimilating NRL MODIS)



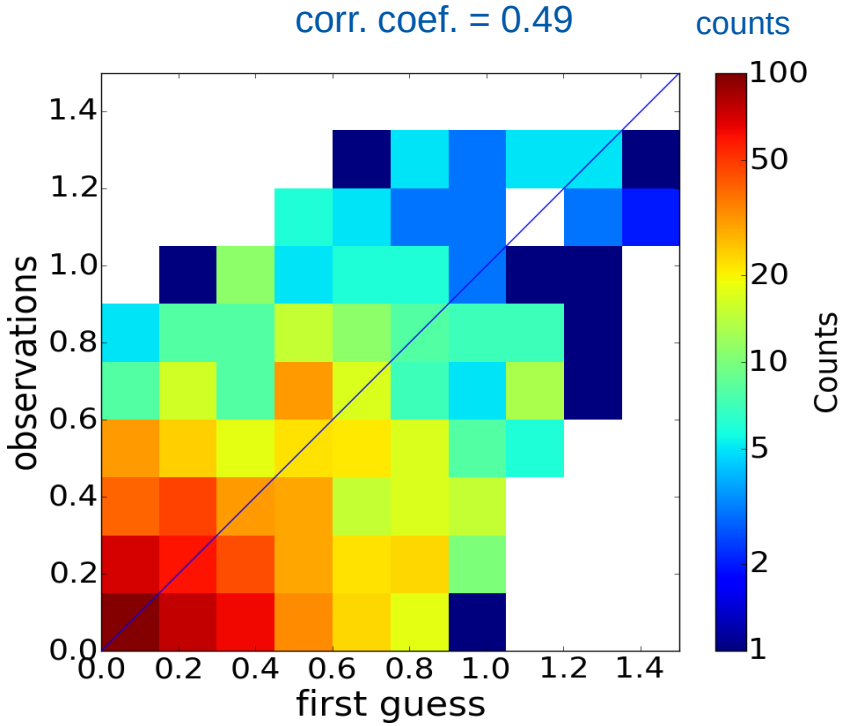


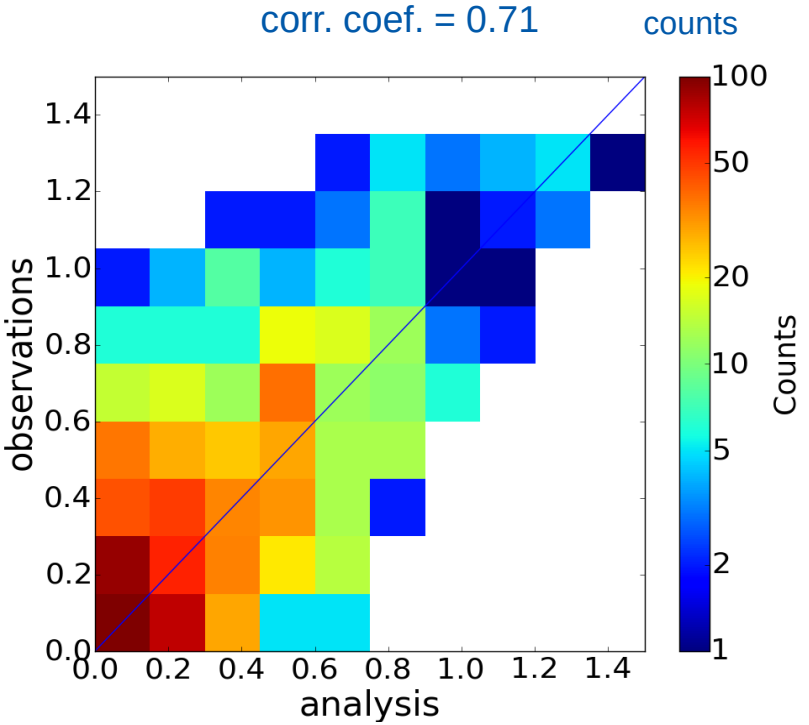
Scatter in the analysis is smaller than for the first guess;

Analysis performs better in reducing too high value than increasing too low values

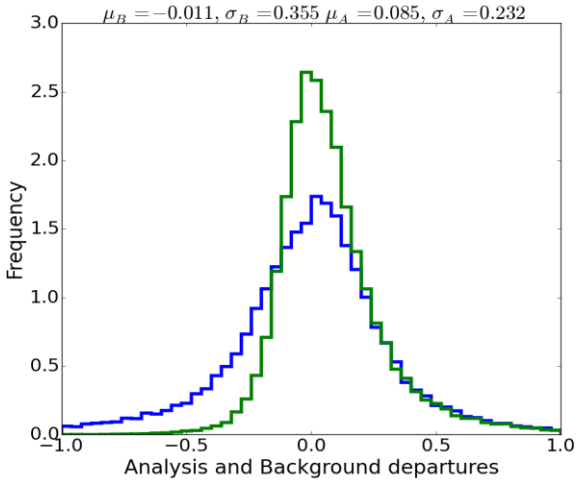


Departure Statistics (assimilating NRL MODIS + DB)





Departure statistics are improved after QC



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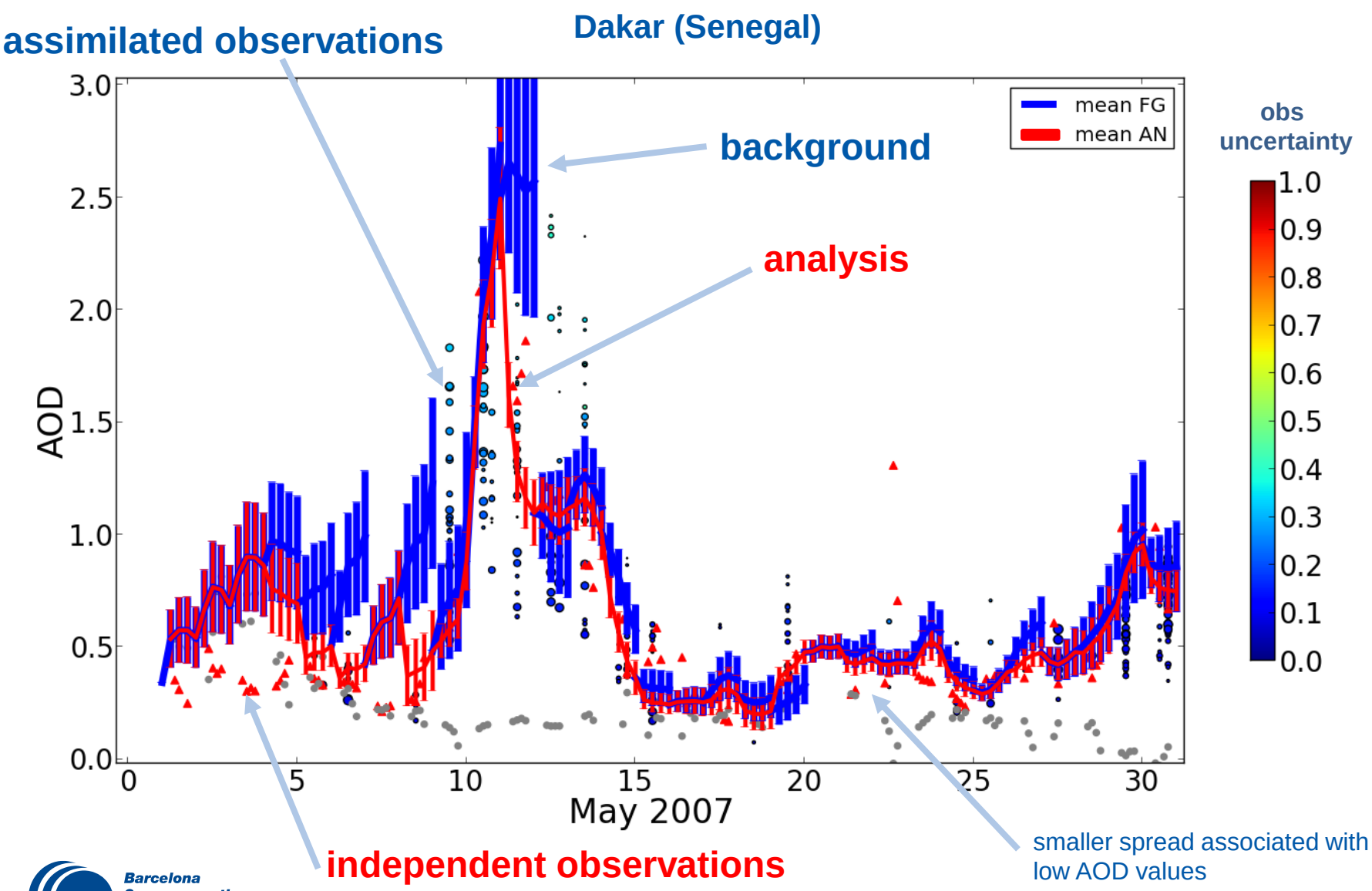
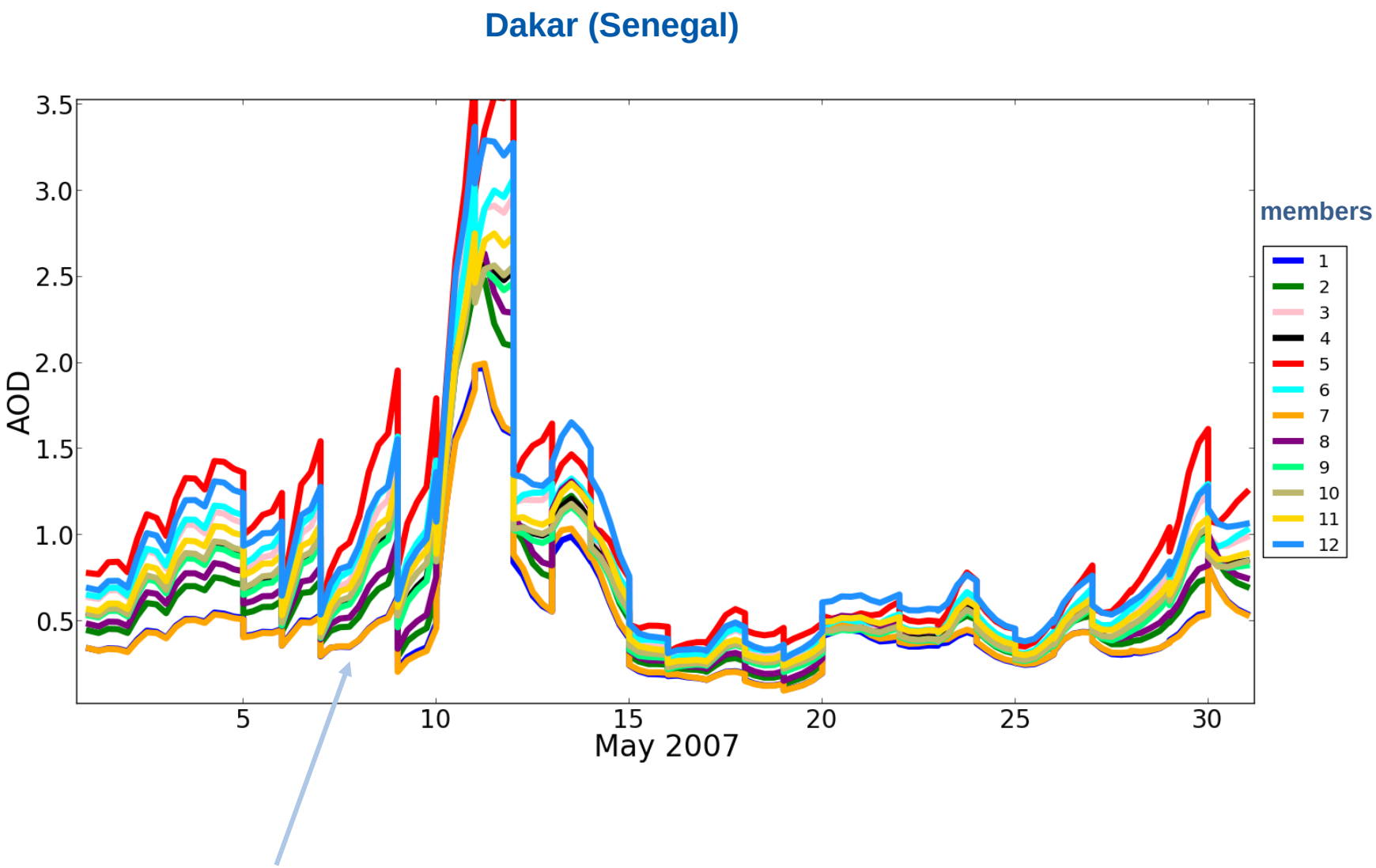
Inside the box

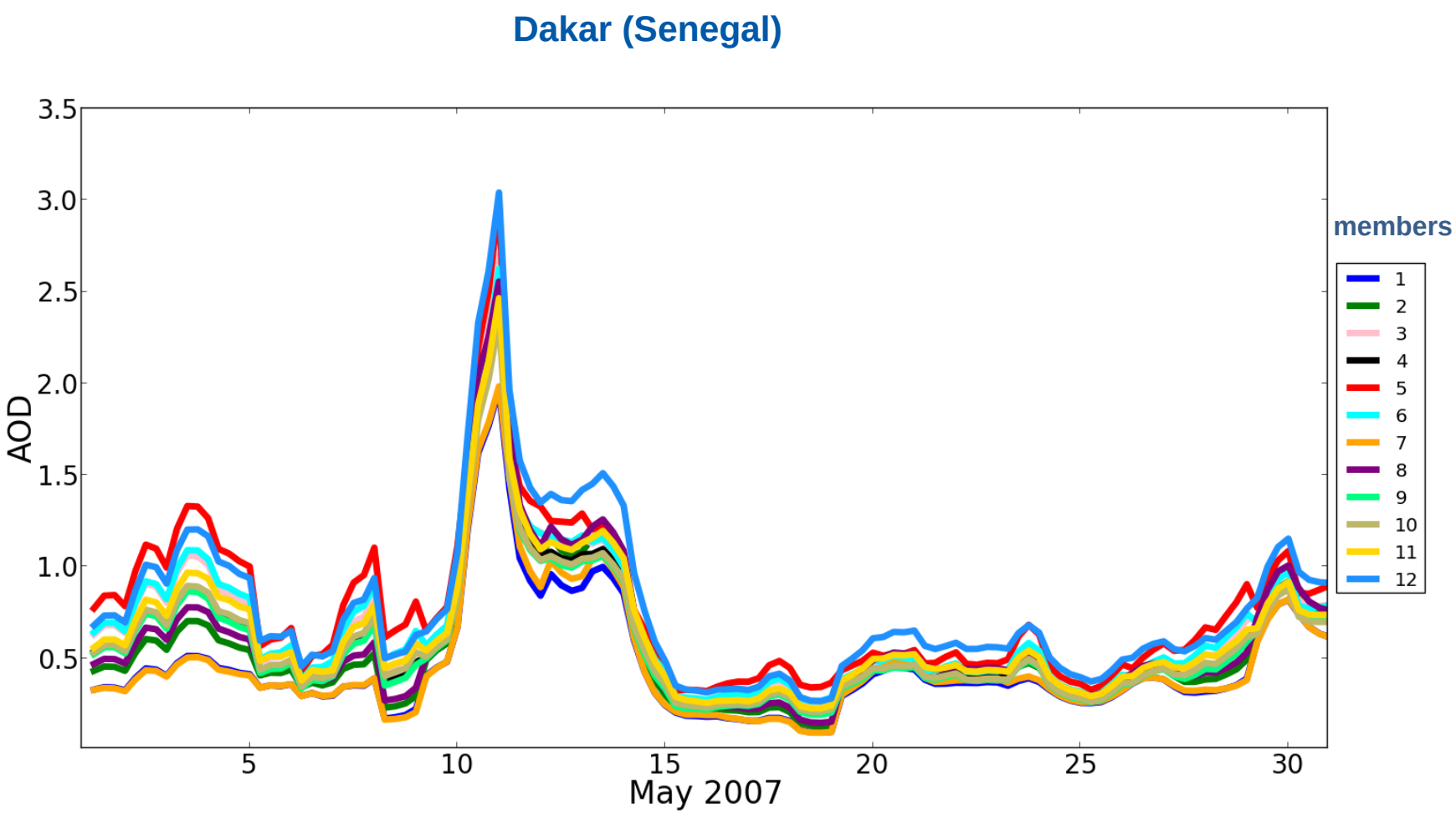


Background Ensemble (assimilating NRL MODIS)



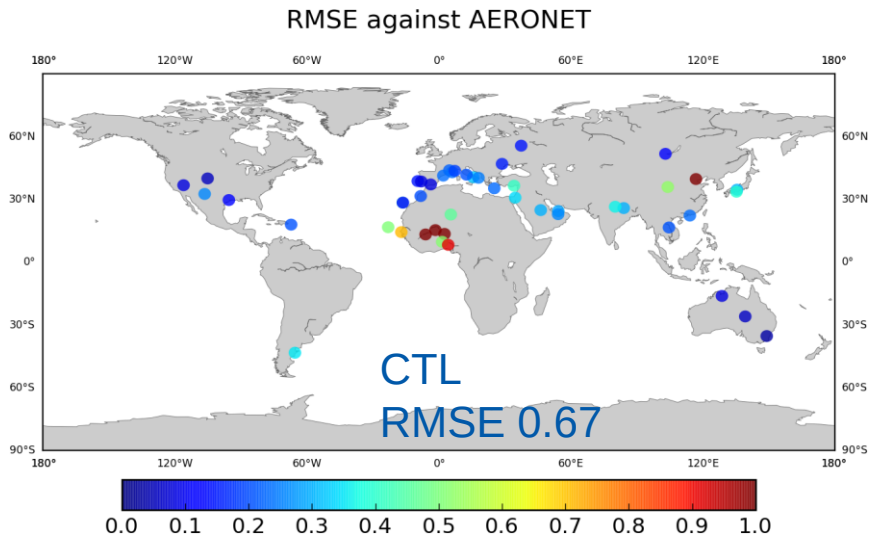
FG spread increases towards the end of the window

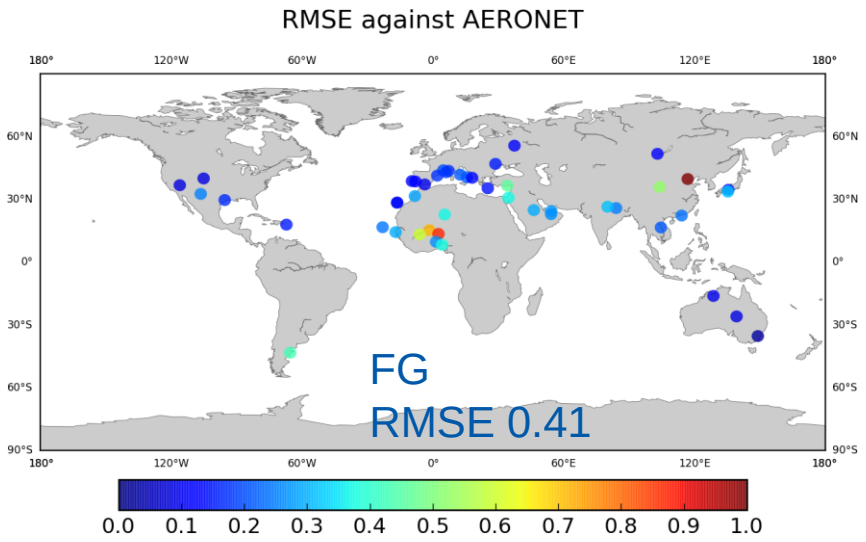
Analysis Ensemble (assimilating NRL MODIS)

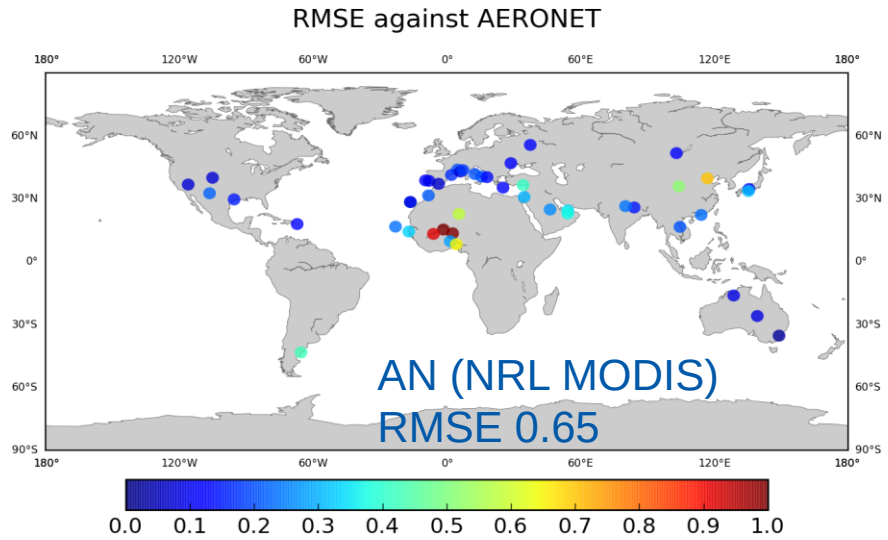


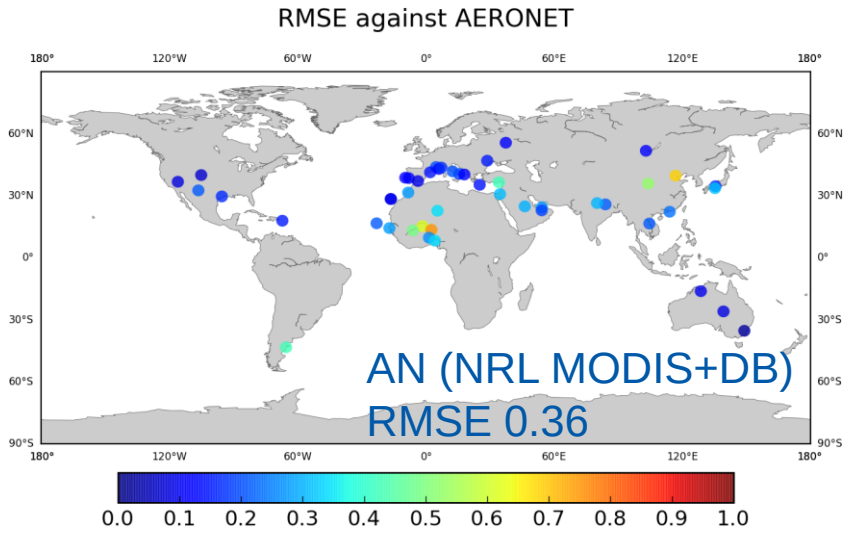
AN spread generally smaller than FG spread

Validation against Level 2 AERONET



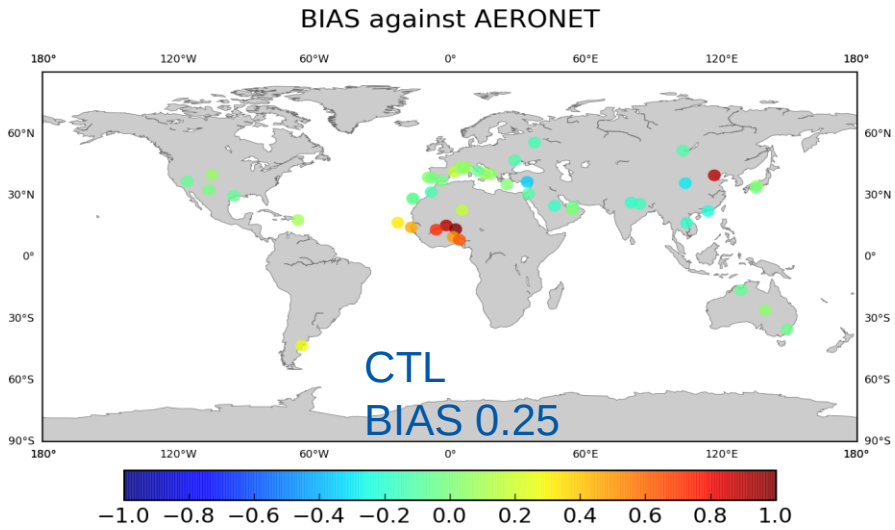


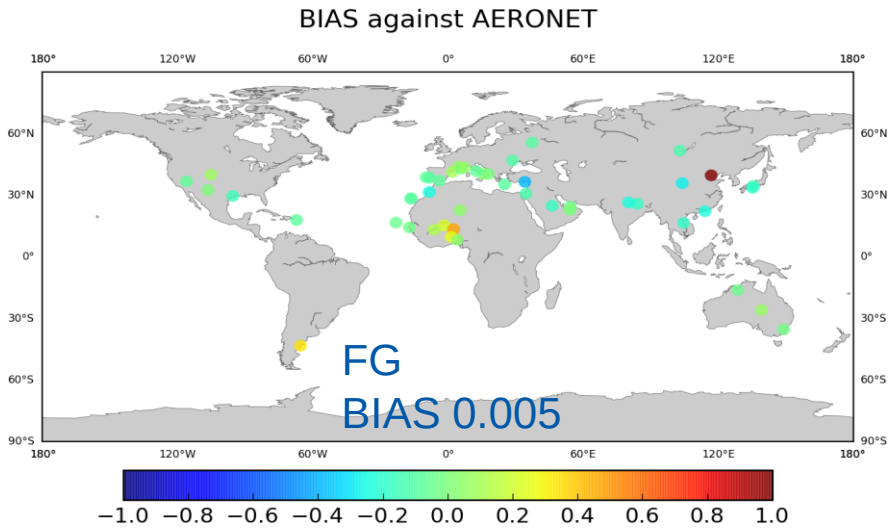


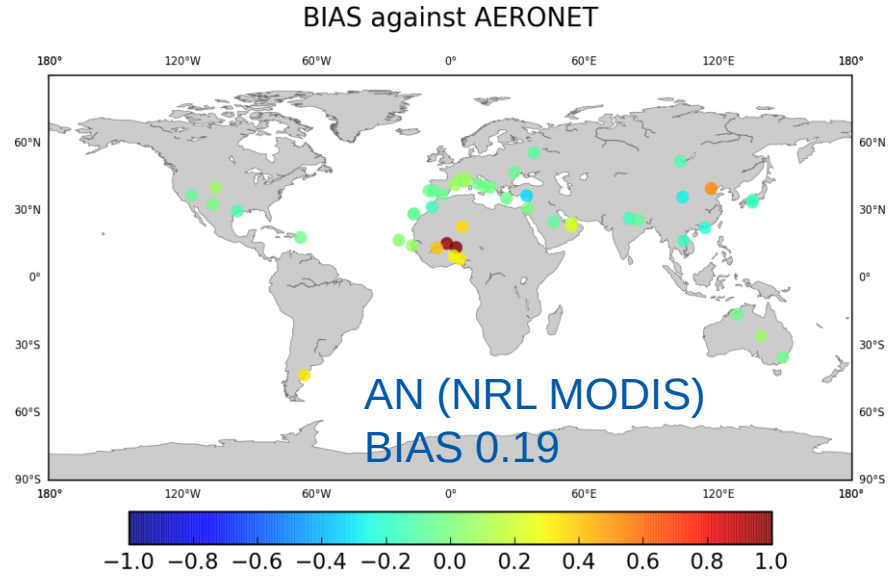


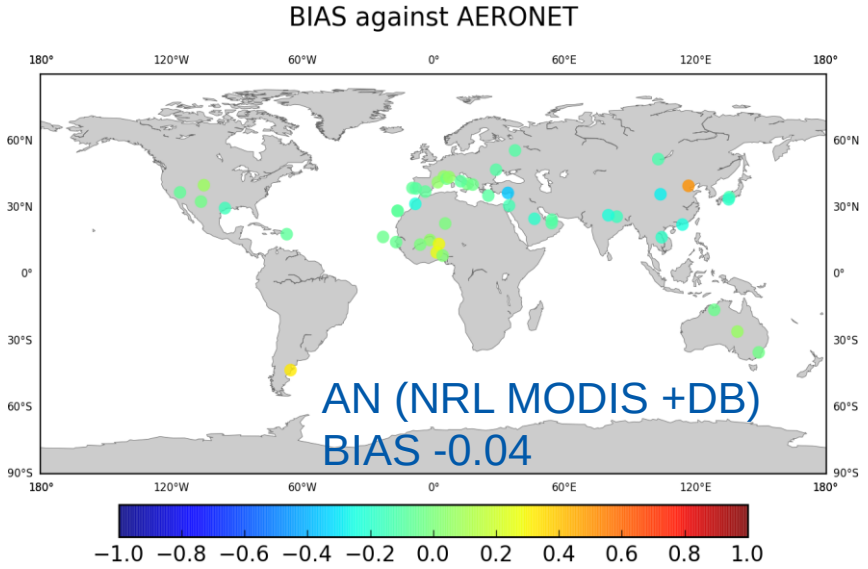
(4 months data)

Validation against Level 2 AERONET



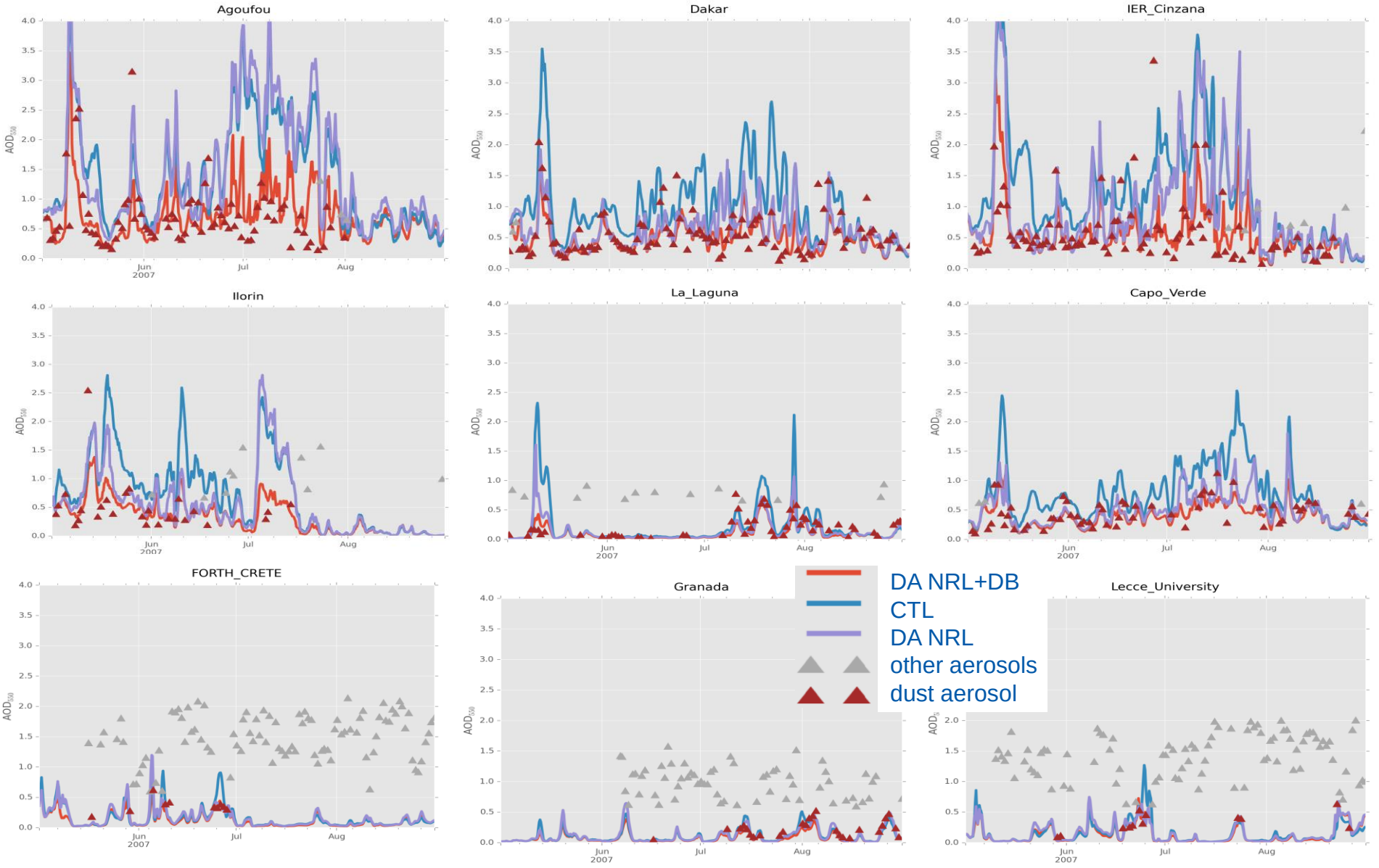






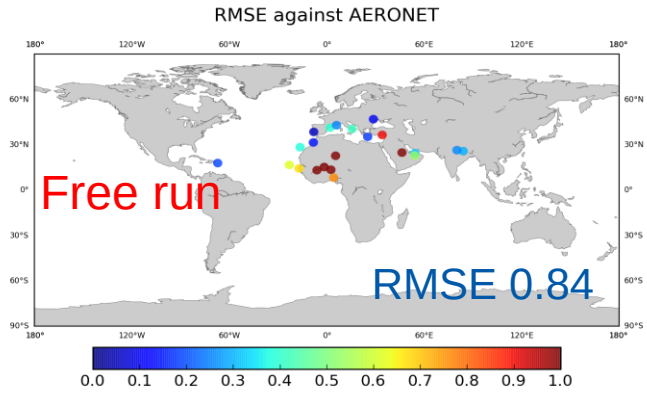
(4 months data)

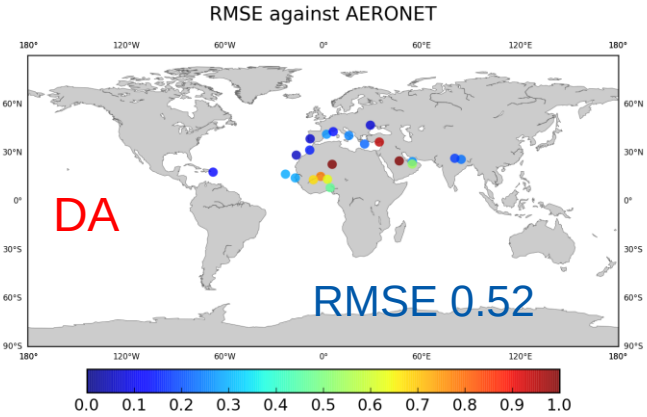
Analysis versus AERONET

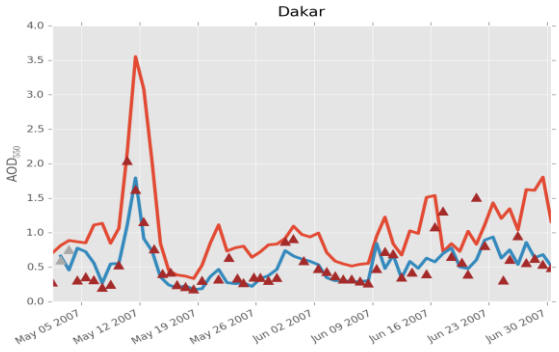


Forecast versus AERONET

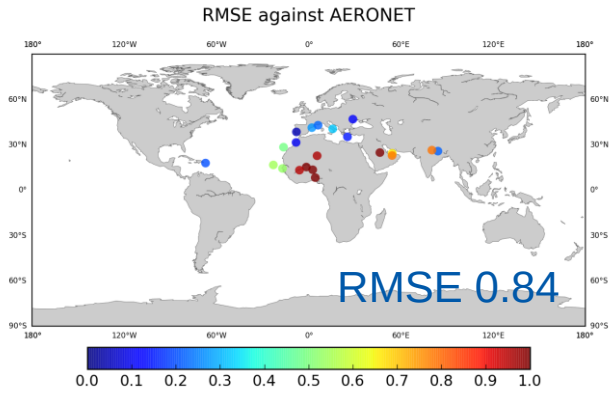
FC+12

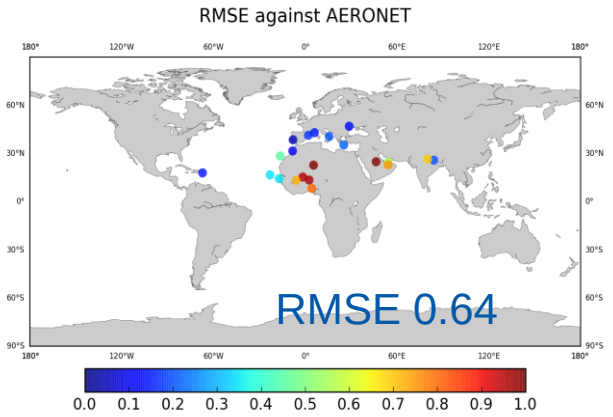


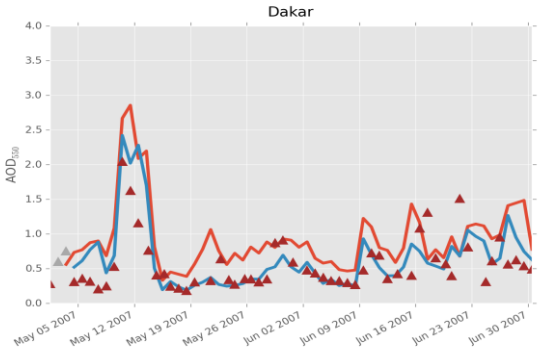




FC+60







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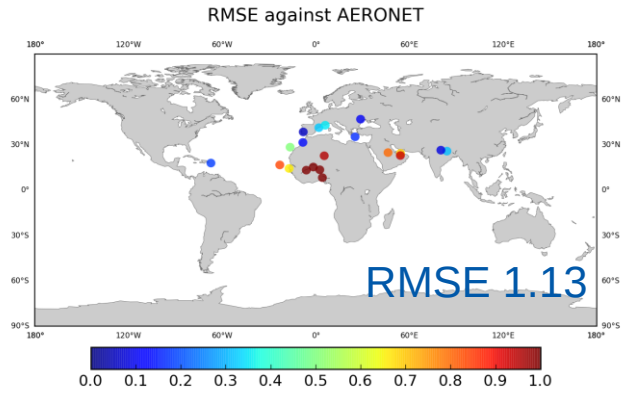
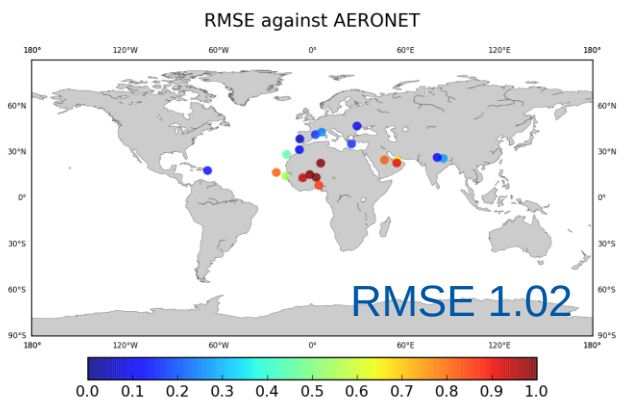
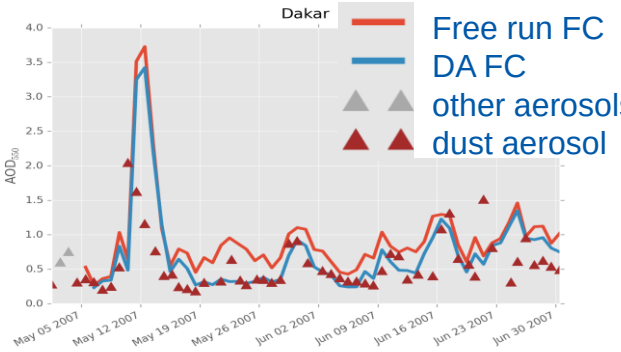


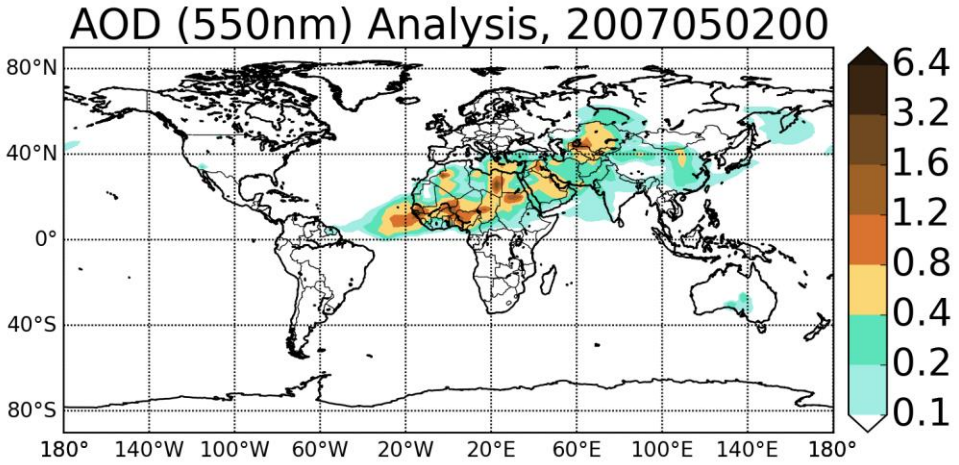




Conclusions

First foundations have been built for a DA capability for the “Barcelona model” participating in ICAP;

Not yet there to perform an operational forecast but more than ready to produce dust reanalysis.



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Thank you!

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