

# Assimilation of VIIRS AOD and dust and smoke products for regional forecasting of aerosols

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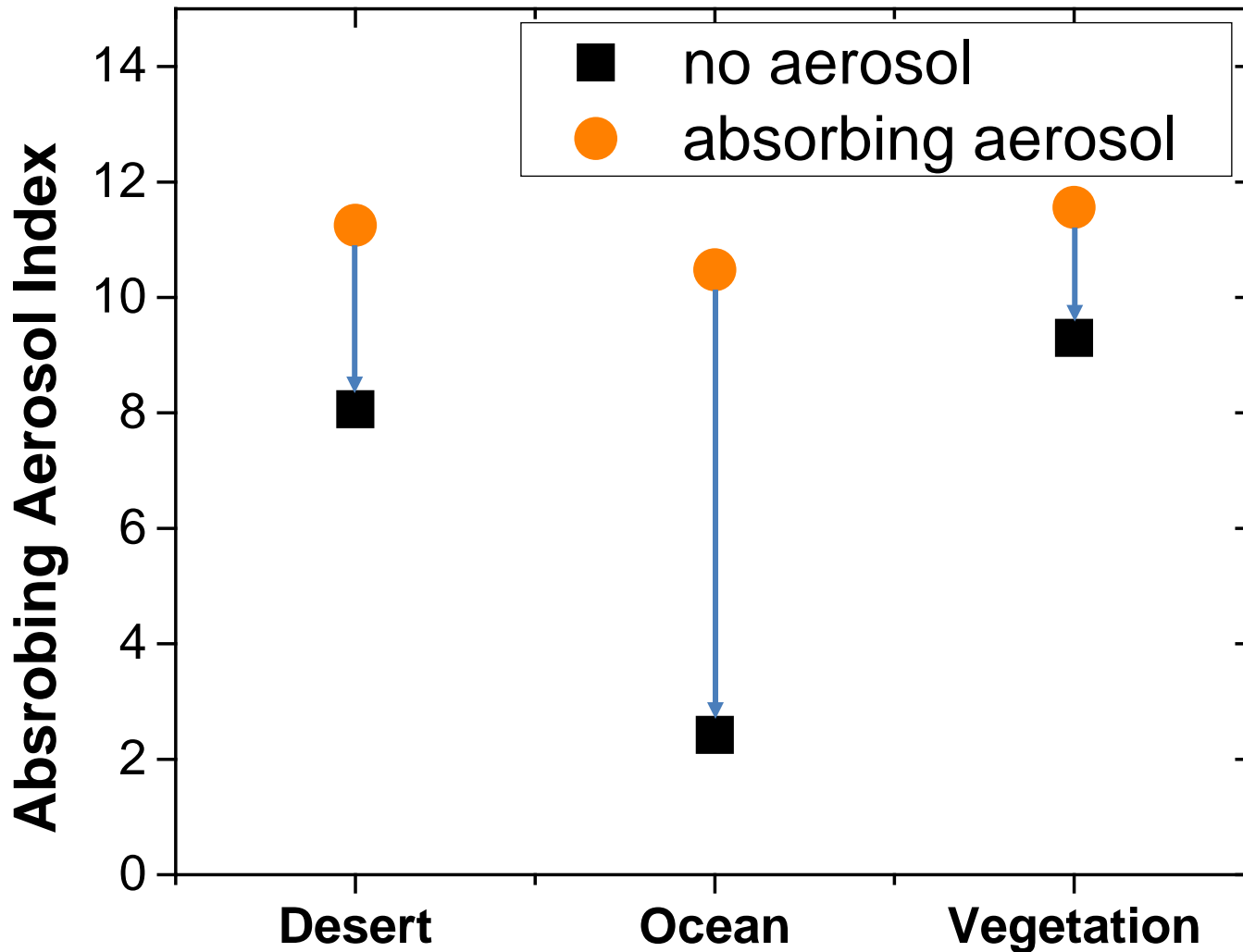
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# Outline

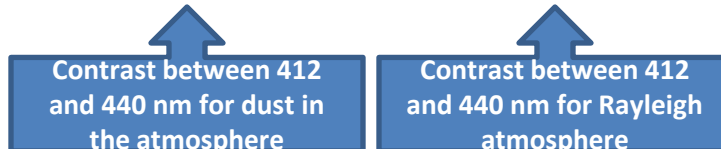
- Simulations with regional model WRF-Chem of smoke fires over CONUS in July 2016 and a dust storm over Northern Africa/Europe in March 2014 .
- Assimilation of VIIRS Aerosol Optical Depth at 550 nm using 3D-Var algorithm in the Gridpoint Statistical Interpolation (GSI) (assimilation of VIIRS AOD at 550 nm has been implemented in the GSI and submitted for review to be include in the trunk for public distribution)
- In parallel to the above assimilation of VIIRS AOD 550nm combined with smoke and dust masks. VIIRS AOD and masks are obtained daily from NESDIS ftp with minimal delay and are being tested for application for assimilation into RAP-Chem and HRRR-Smoke forecasts.



VIIRS dust detection algorithm takes advantage of changes to spectral contrast with and without dust in the atmosphere - *Spectral contrast change provides absorbing aerosol index (AAI).*

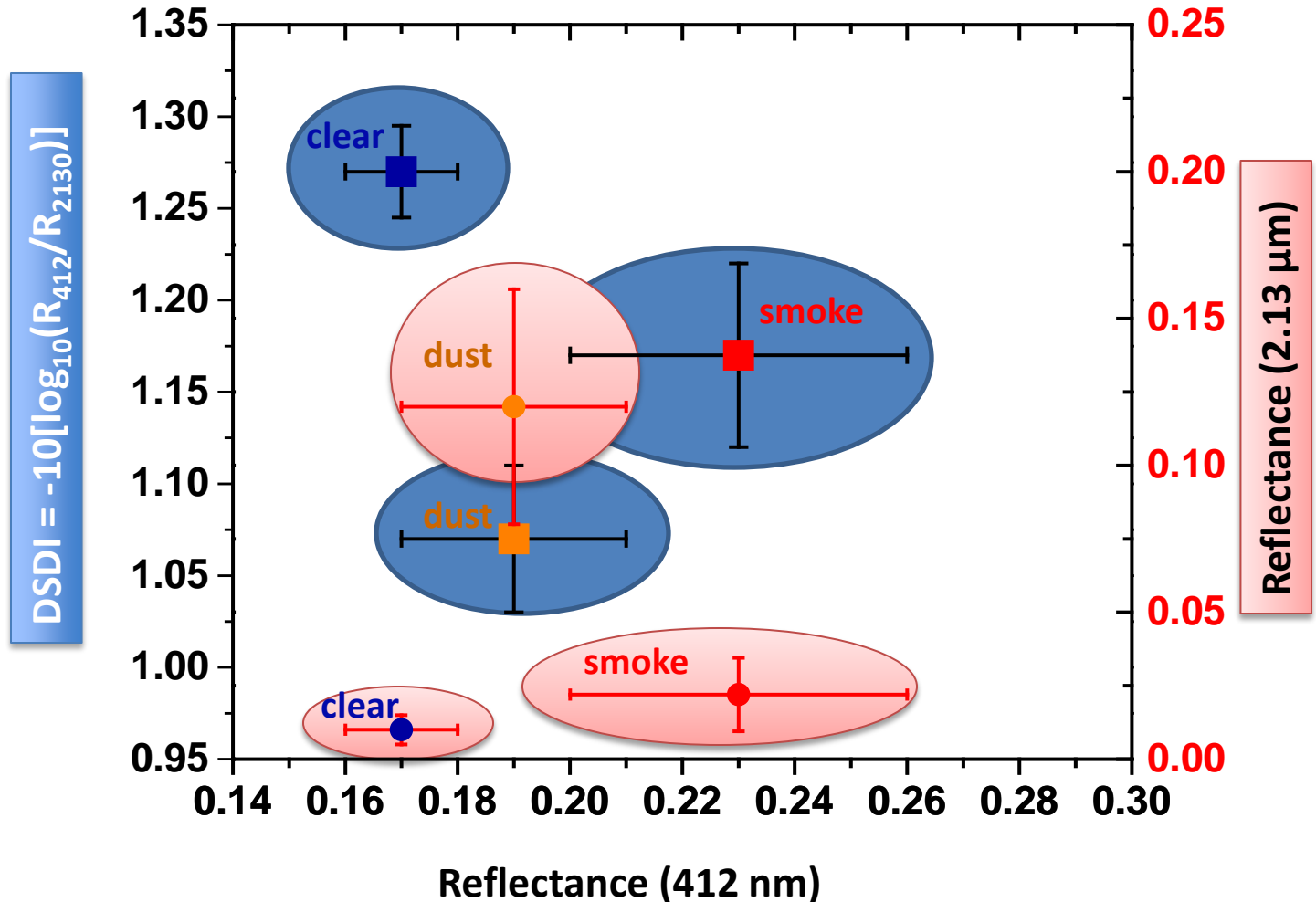
*Dust Smoke Discrimination Index (DSDI) separates smoke from dust (next slide)*

$$AAI = -100[\log_{10}(R_{412}/R_{440}) - \log_{10}(R'_{412}/R'_{440})]$$



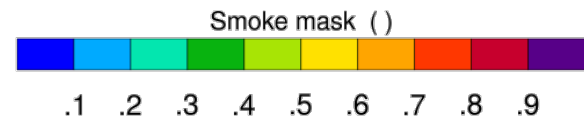
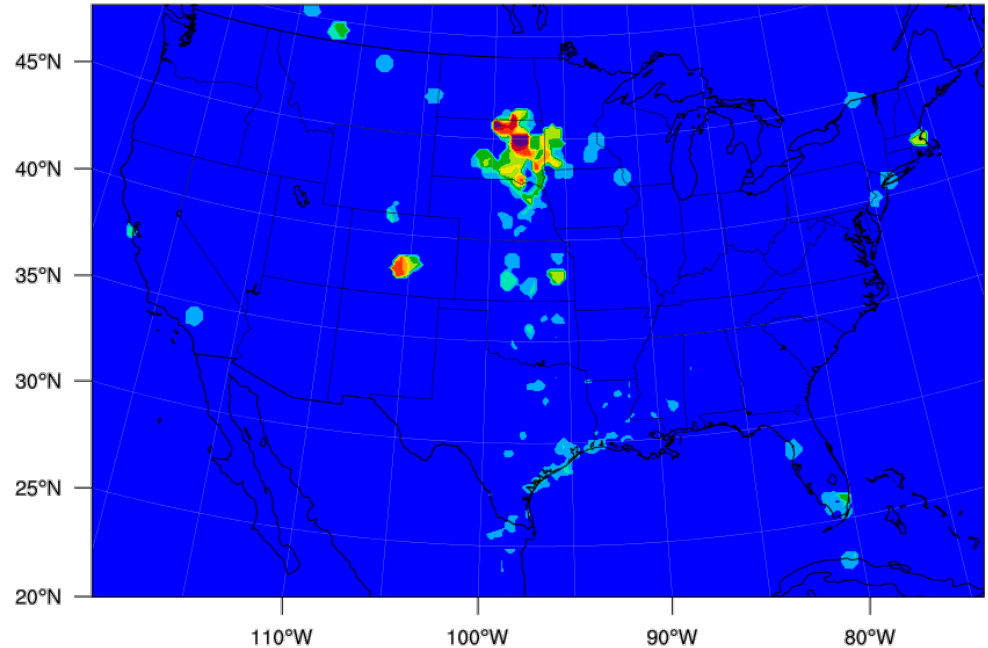
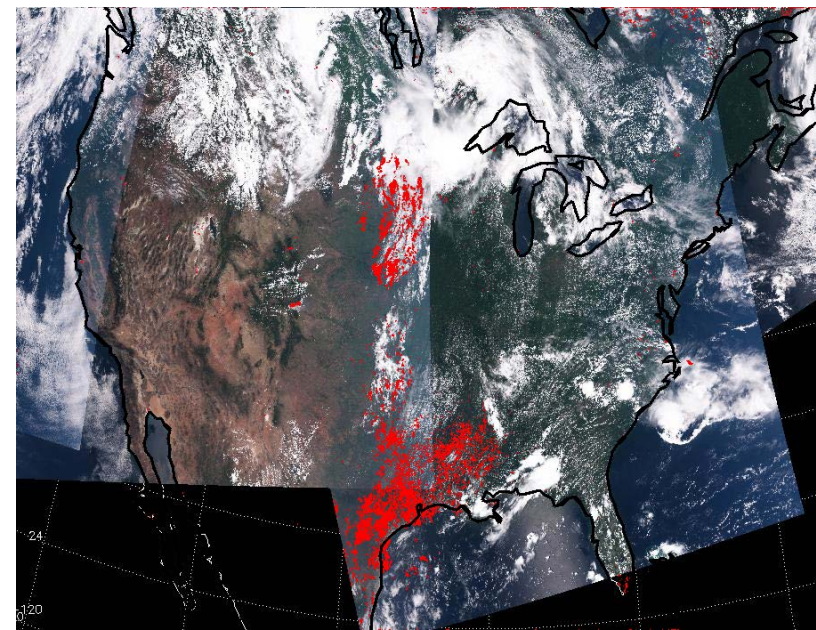
Dust Smoke Discrimination Index (DSDI) separates the absorbing aerosol into **dust** or **smoke**

- Contrast between VIIRS-measured reflectance at 412 nm and 2.13  $\mu\text{m}$  for **clear** sky (Rayleigh atmosphere) is reduced for **smoke** and **dust**.
- VIIRS measured reflectance at 2.13  $\mu\text{m}$  is higher for dust (due to scattering) than **smoke** (transparent)



# Smoke assimilation

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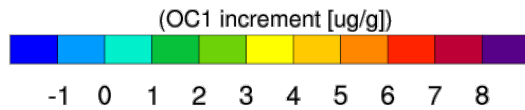
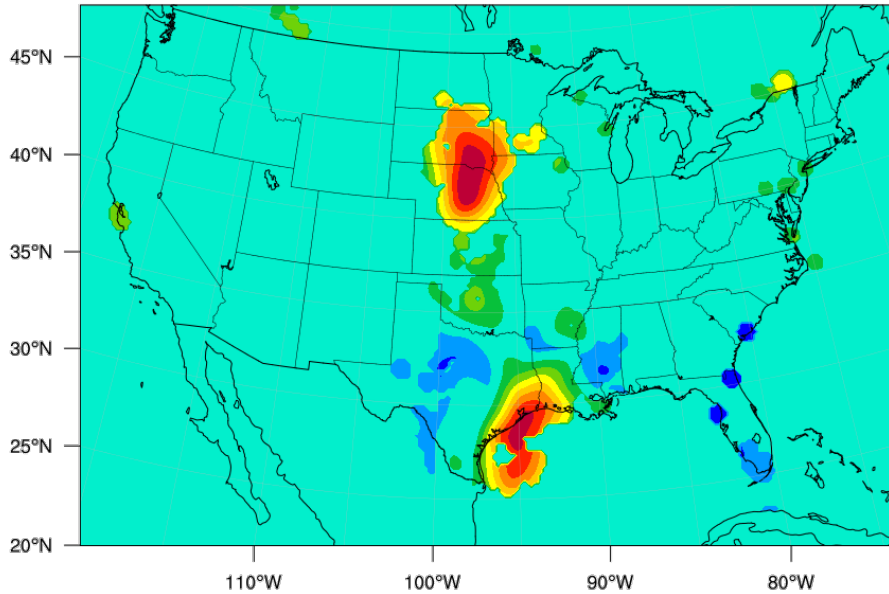
Smoke mask (not AOD i.e. neither intensity nor dust/smoke index); composition of three satellite passes from ~17 UTC to ~21 UTC.

Smoke index interpolated in model space

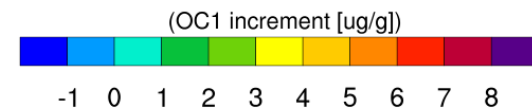
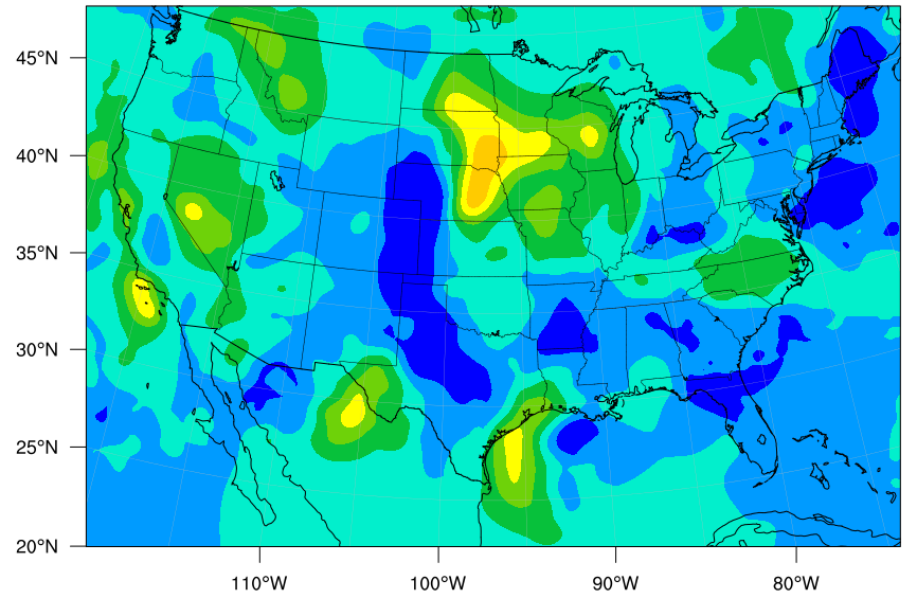
# Smoke assimilation

Assimilation of AOD at 550 nm centered at 1800 UTC with 3-hr window.

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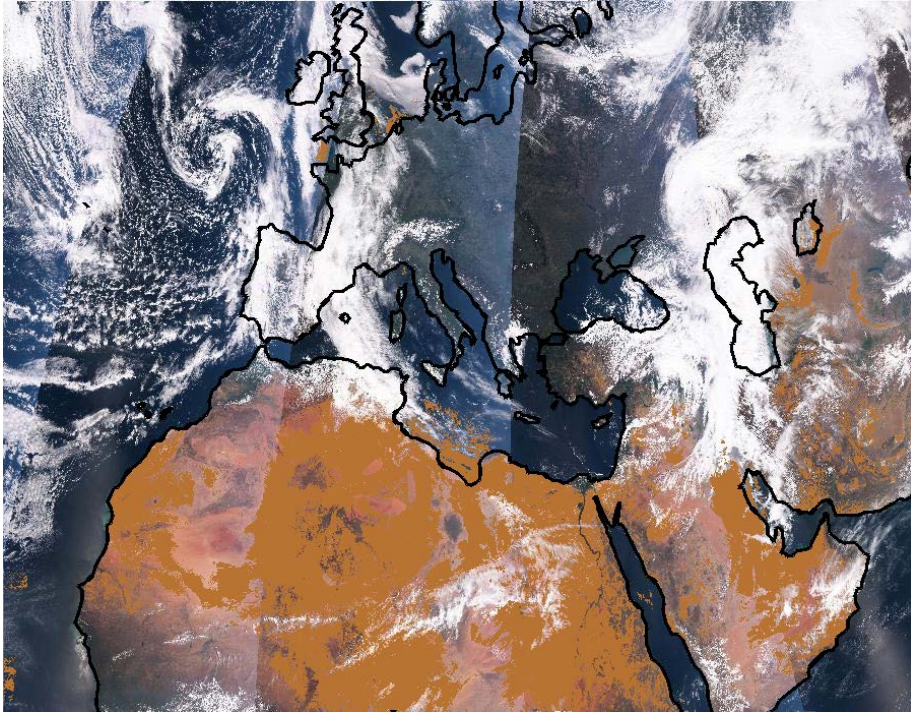


With smoke mask

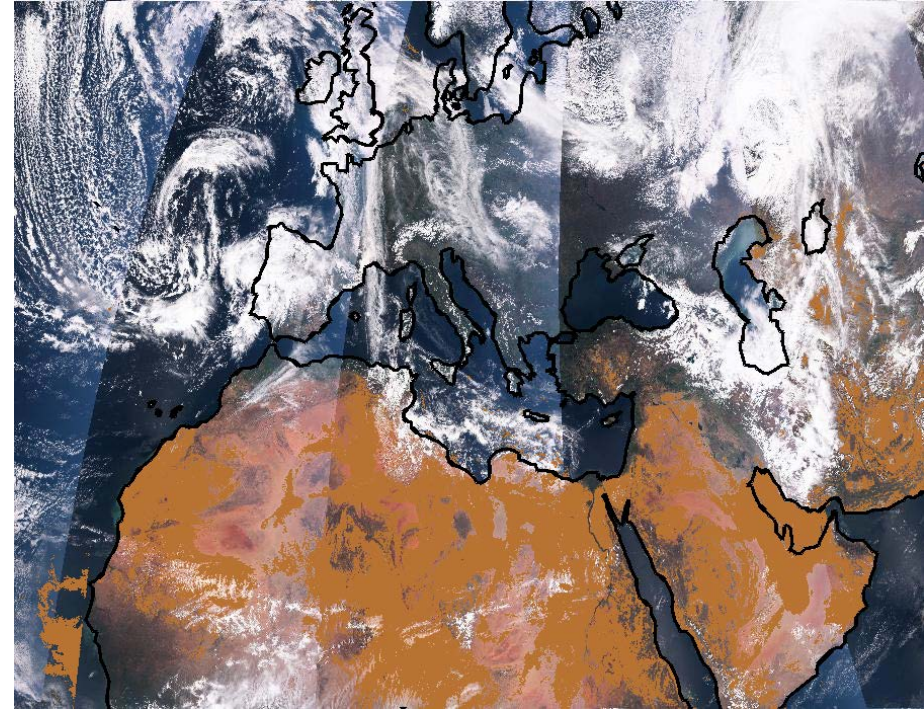


Without smoke mask

# Data assimilation



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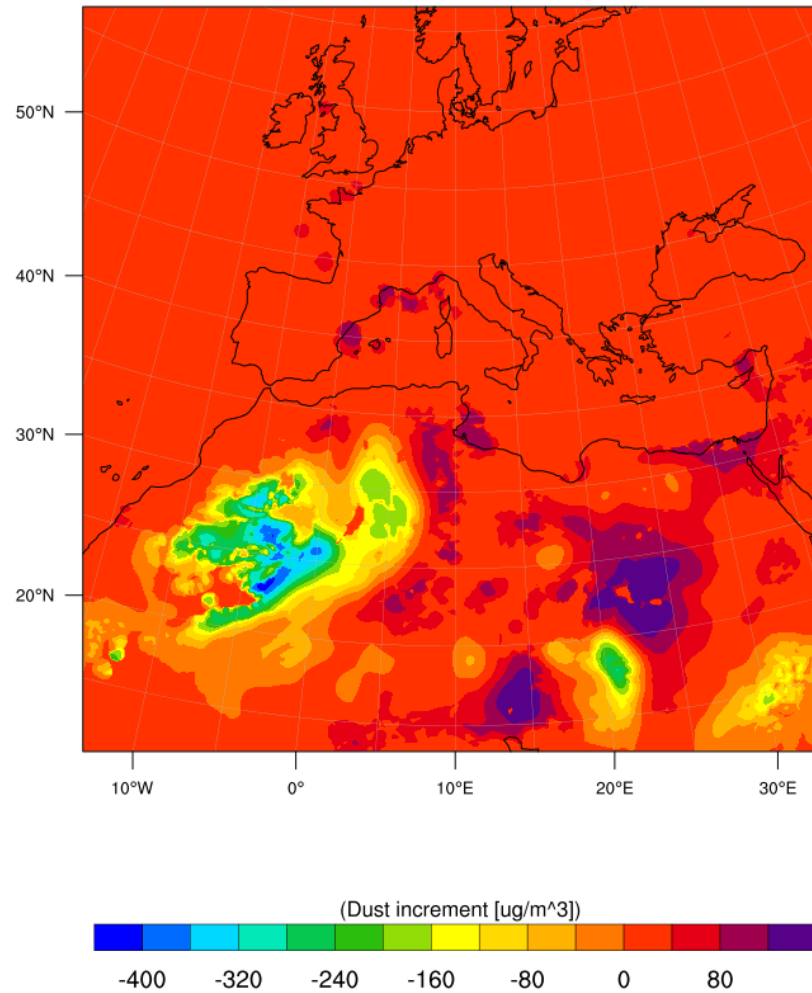
Dust mask (not AOD i.e. not intensity).

Composition of five satellite passes from ~09 UTC to ~16 UTC.

Assimilation of AOD at 550 nm centered at 1200 UTC with 3-hr window.

# Data Assimilation

Increment of total dust at the surface at 2014033012  
due to the assimilation of VIIRS AOD at 550 nm with dust mask





# Conclusions

- Testing of assimilation of VIIRS AOD 550nm and masks and their influence on aerosols forecasts is underway for possible application in r-t RAP-Chem and HRRR-Smoke.
- We are be developing a chemical global model for NGGPS with VIIRS AOD data assimilation as a component.
- In our opinion AOD assimilation in global domain more impactful because dor regional domains satellite coverage limited and also because of dependence on lateral conditions.