CONFESS

Consistent representation of temporal variations of boundary forcings in reanalyses and seasonal forecasts

Tropospheric and volcanic aerosol developments

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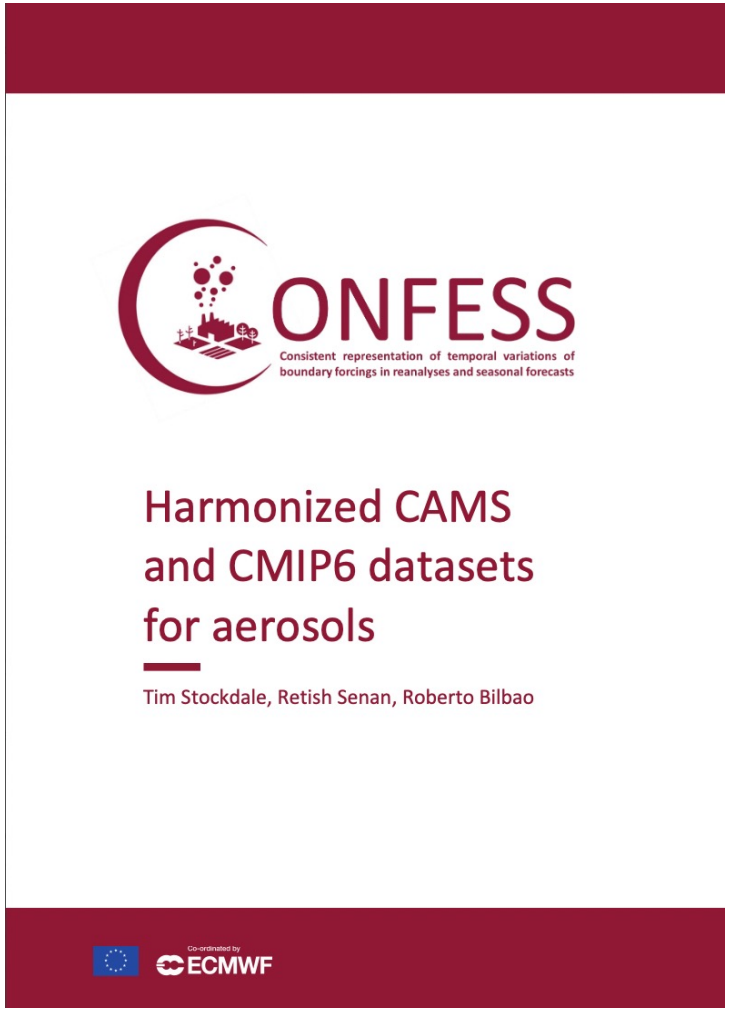
WP2 – tropospheric aerosols

- Original methodology was changed, to allow better quality of product
- New approach – essentially a pseudo-reanalysis using CAMS aerosol model – much more complex, took longer
- So deliverable delayed from October 2021 to June 2022

- Deliverable completed on time



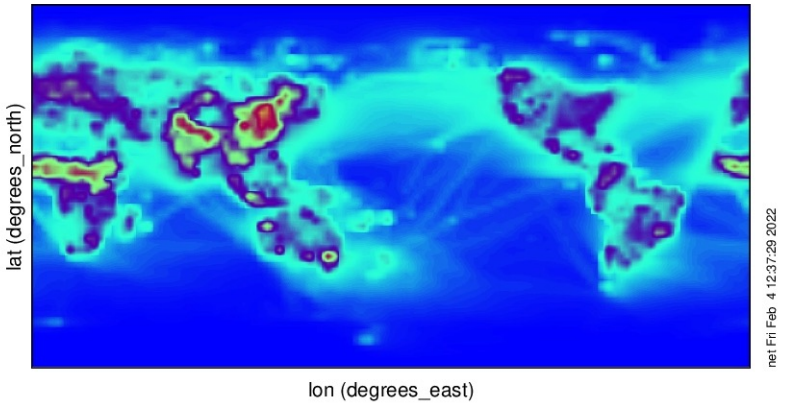
Time-varying tropospheric aerosol climatology

- Generate a new aerosol climatology by running latest CAMS system with specified emissions
  - Gives an updated climatology for recent period, for use in NWP
  - Allows a time-varying climatology (anthropogenic related species) from the 1960s to present, for use in ERA6 and SEAS6
  - Consistent with CMIP6 and subsequent enhancements to emissions data

- Complications
  - Spin-up of stratosphere, overlapping production periods
  - Biomass burning emission heights not available for CMIP6, so emit at surface
  - CH4 time-variation, perturbs OH, perturbs aerosols, so want to represent properly
  - Uncertainties in aerosol modelling, big differences between CAMS cycles
  - Turns out that 47r3 does not produce mineral dust aerosol with appropriate optical properties
  - Short-term fix: scale (by up to factor 20!), but want to re-run with 48r1 for use in 49r1/SEAS6

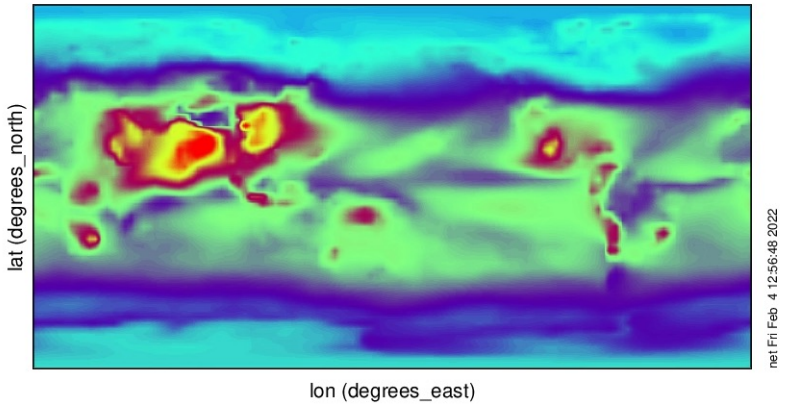
Comparisons of new (top) vs old (bottom)

Black_Carbon_hydrophobic aerosol mass mixing ratio (kg/kg)



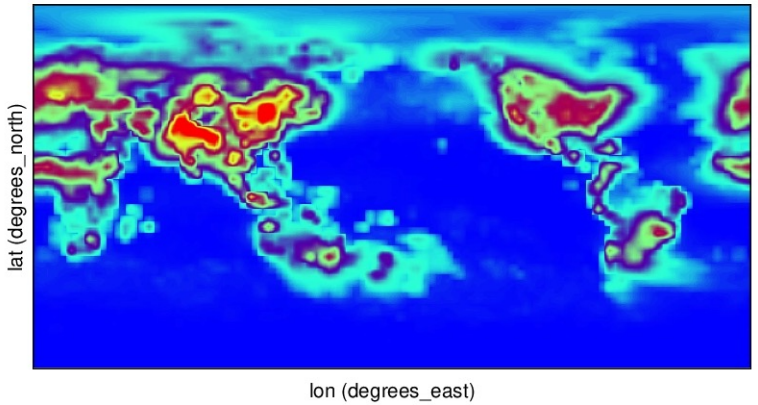
Climatological monthly mean layer-averaged mass mixing ratio
Range of Black_Carbon_hydrophobic aerosol mass mixing ratio: 0 to 1e-08 kg/kg

Sulfates aerosol mass mixing ratio (kg/kg)



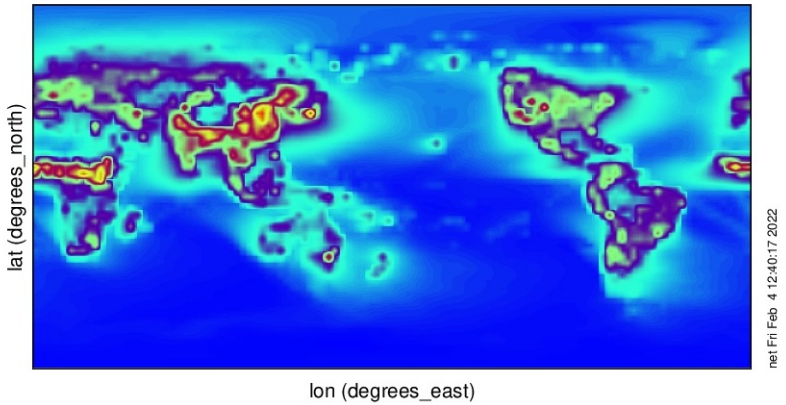
Climatological monthly mean layer-averaged mass mixing ratio
Range of Sulfates aerosol mass mixing ratio: 0 to 1e-08 kg/kg

Nitrate_fine aerosol mass mixing ratio (kg/kg)



Climatological monthly mean layer-averaged mass mixing ratio
Range of Nitrate_fine aerosol mass mixing ratio: 0 to 1e-08 kg/kg

Black_Carbon_hydrophobic aerosol mass mixing ratio (kg/kg)



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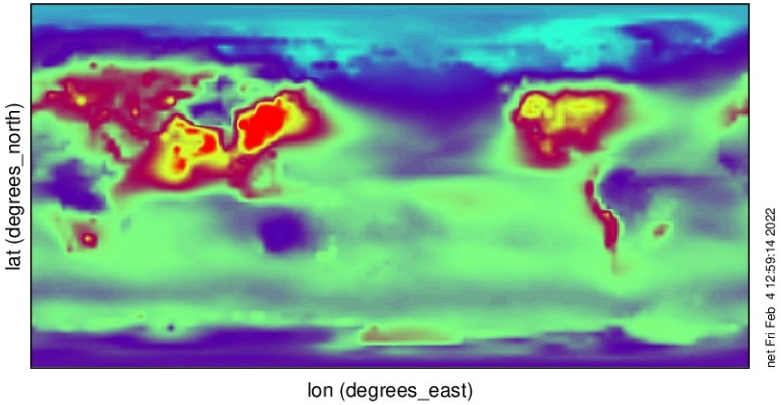
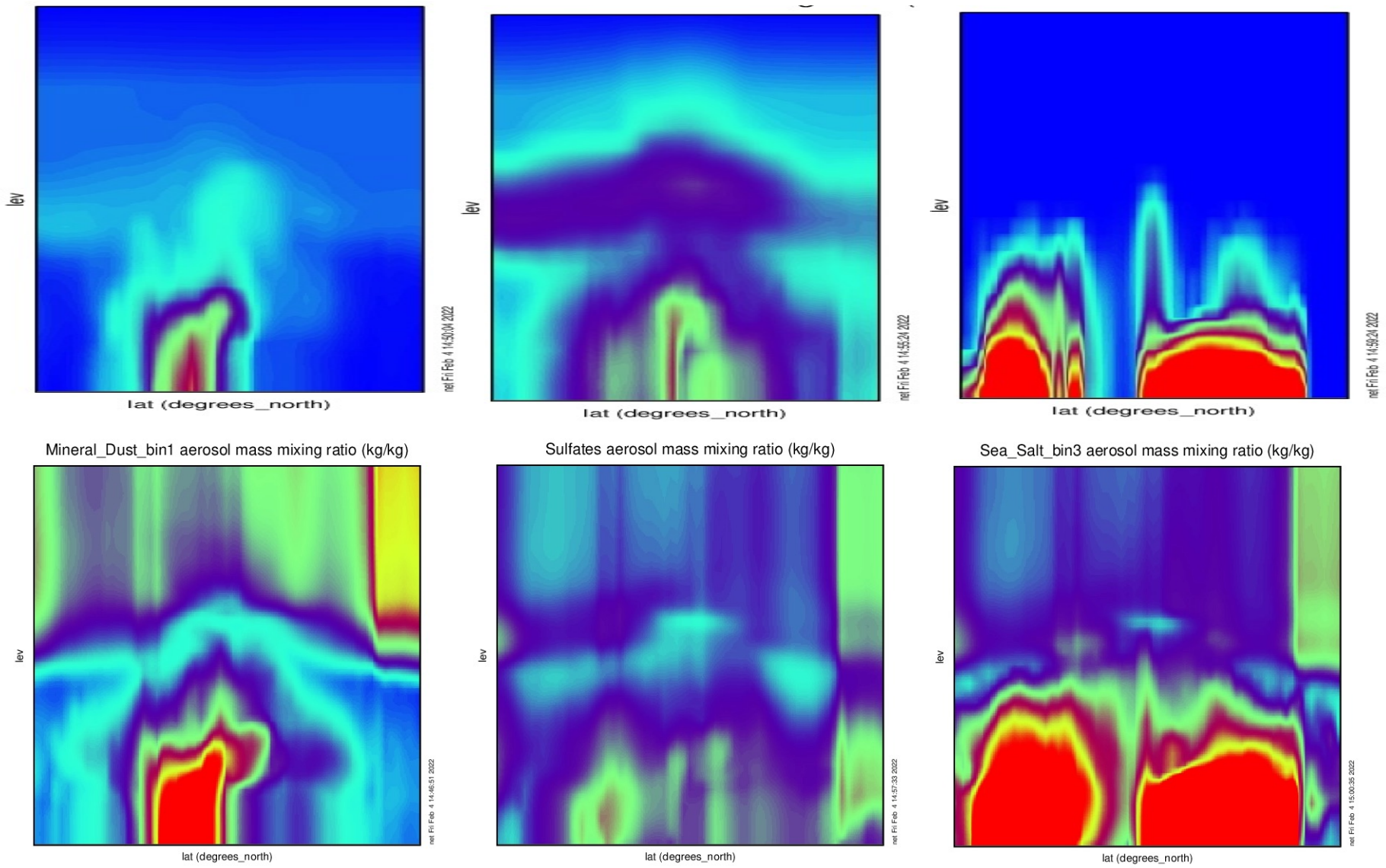
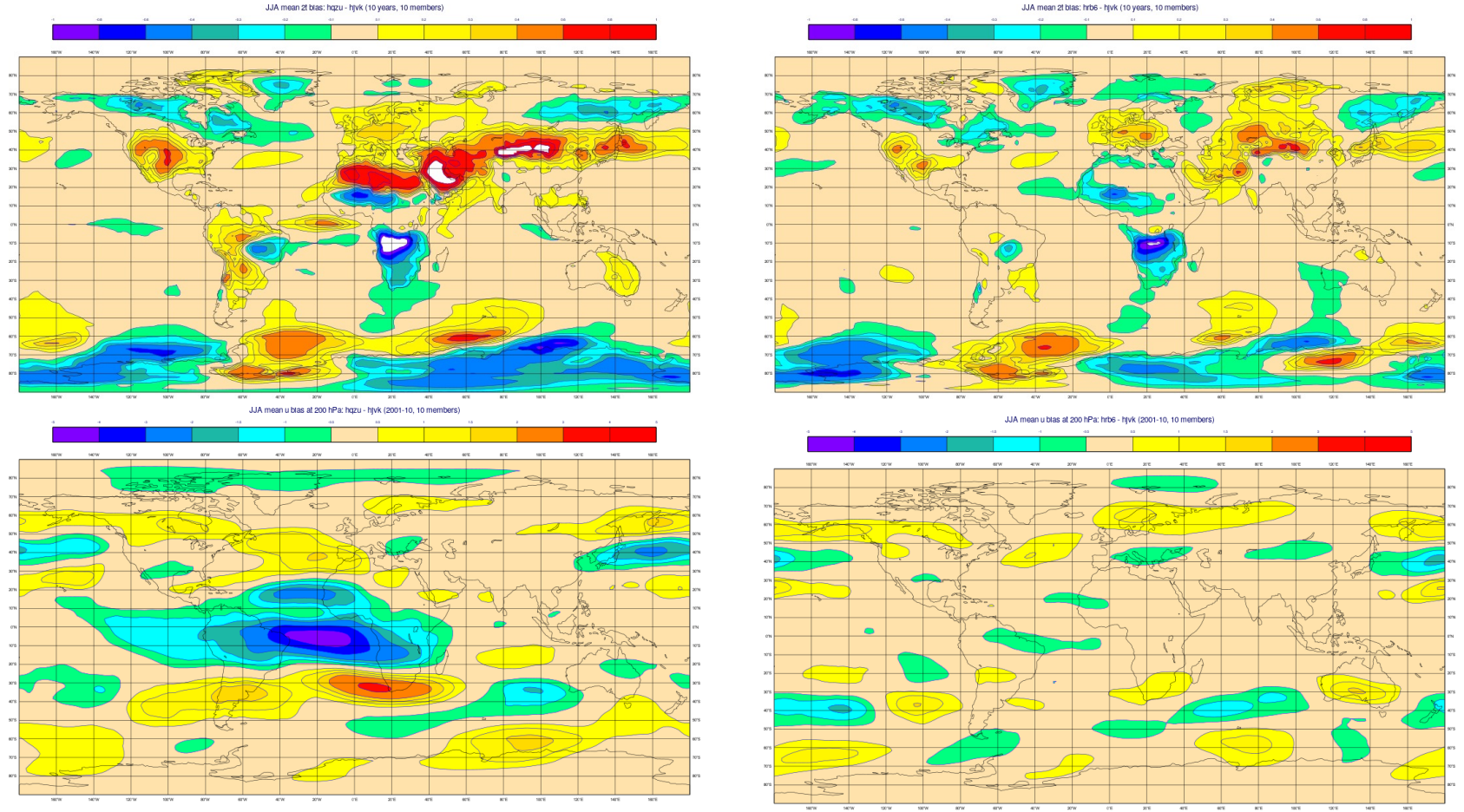


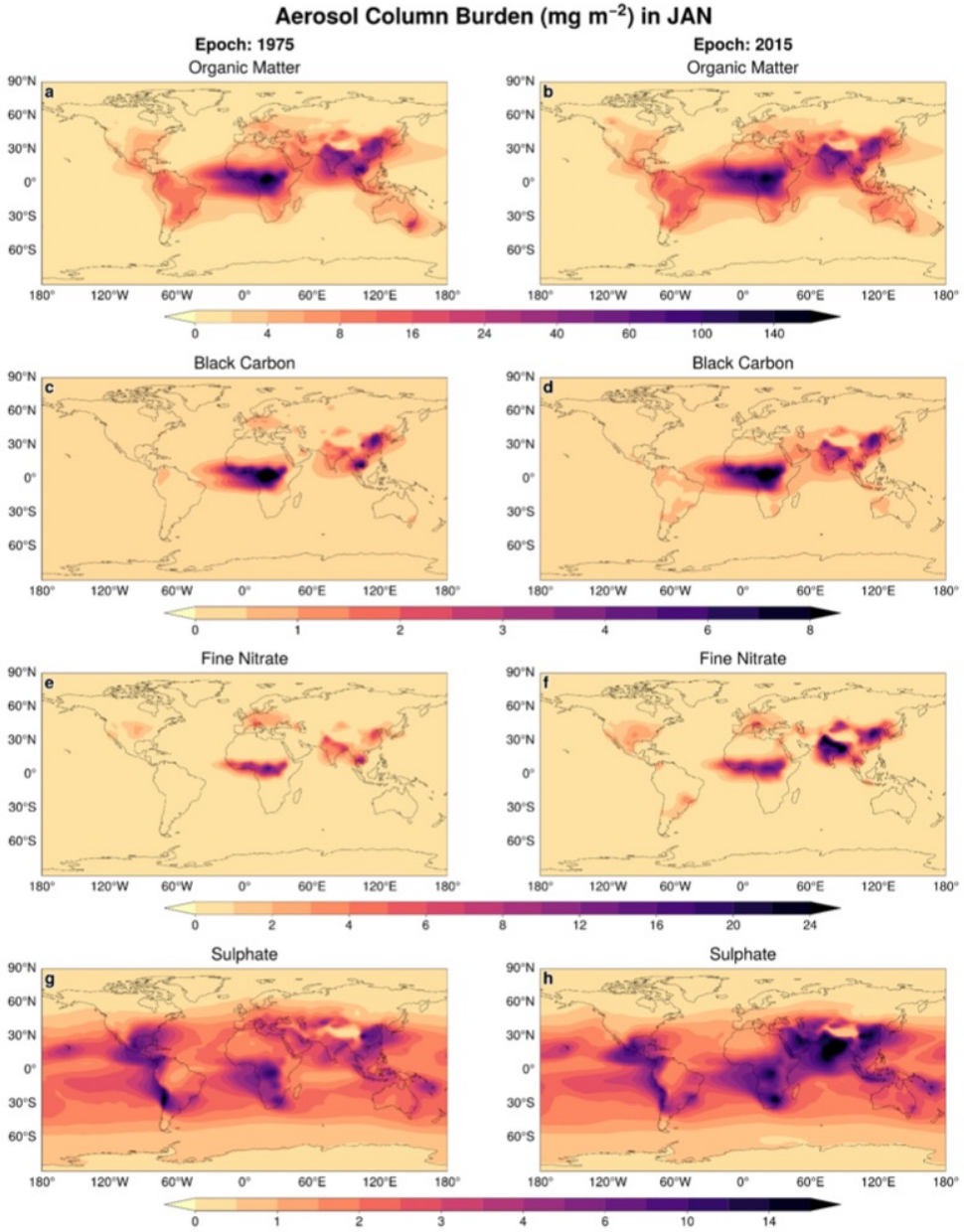
Vertical sections of new (top) and old (bottom)

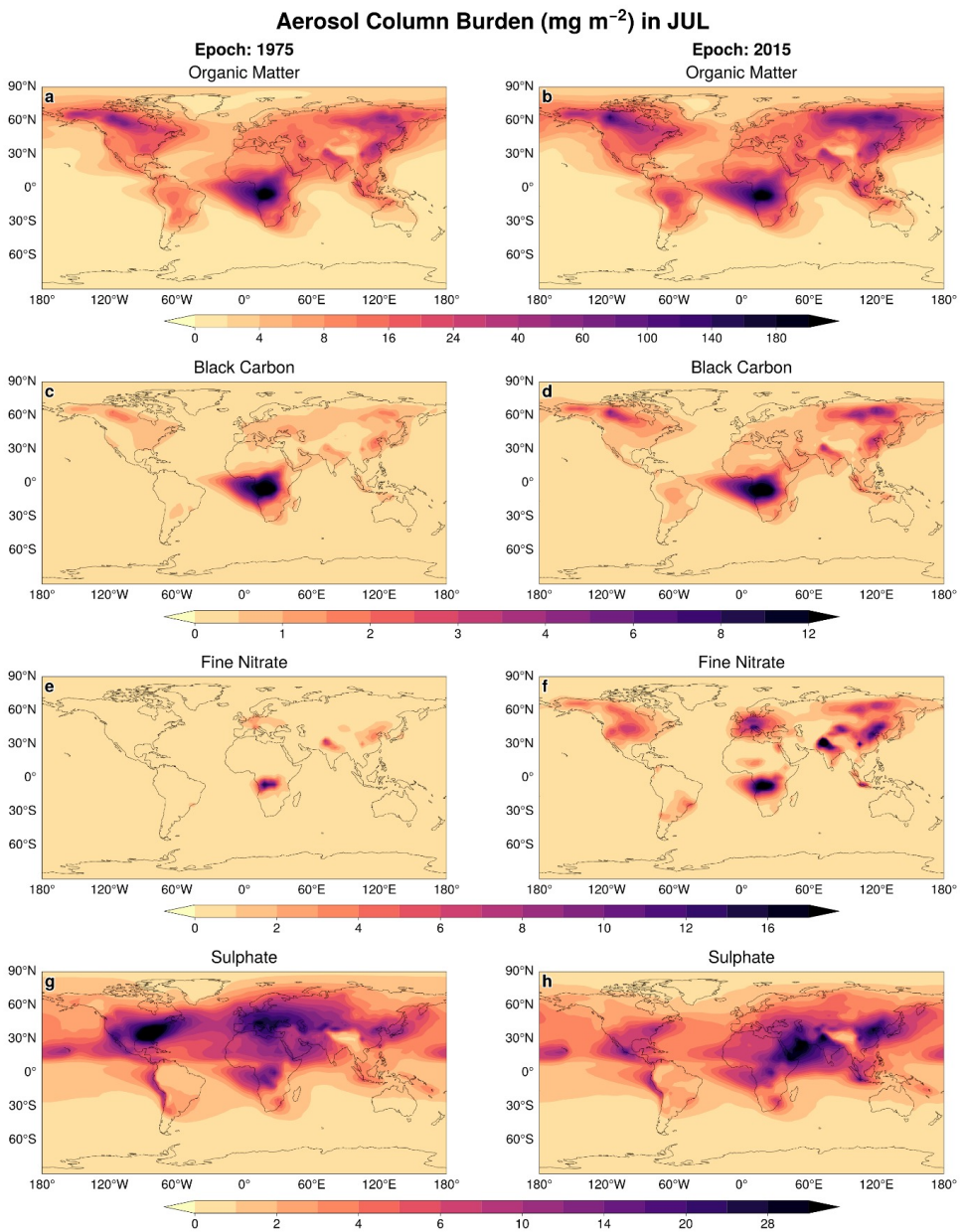


Impact of new aerosol climatology (without and with scaled dust)



Impact of new aerosol climatology on the IFS model climate in JJA, as established from a 10-member ensemble run over the years 2001-10. Figures show the difference CAMS-FORCED – OLD for T2m (top) and U200 (bottom), for the raw version of CAMS-FORCED (left) and the scaled version (right).


Aerosol Column Burden (mg m^{-2}) in JAN
Epoch: 1975
Epoch: 2015
Organic Matter
Black Carbon
Fine Nitrate
Sulphate
a
b
c
d
e
f
g
h
90°N
60°N
30°N
0°
30°S
60°S
180° 120°W 60°W 0° 60°E 120°E 180°
0 4 8 16 24 40 60 100 140
0 1 2 3 4 6 8
0 2 4 6 8 12 16 20 24
0 1 2 3 4 6 10 14


Aerosol Column Burden (mg m^{-2}) in JUL
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Organic Matter
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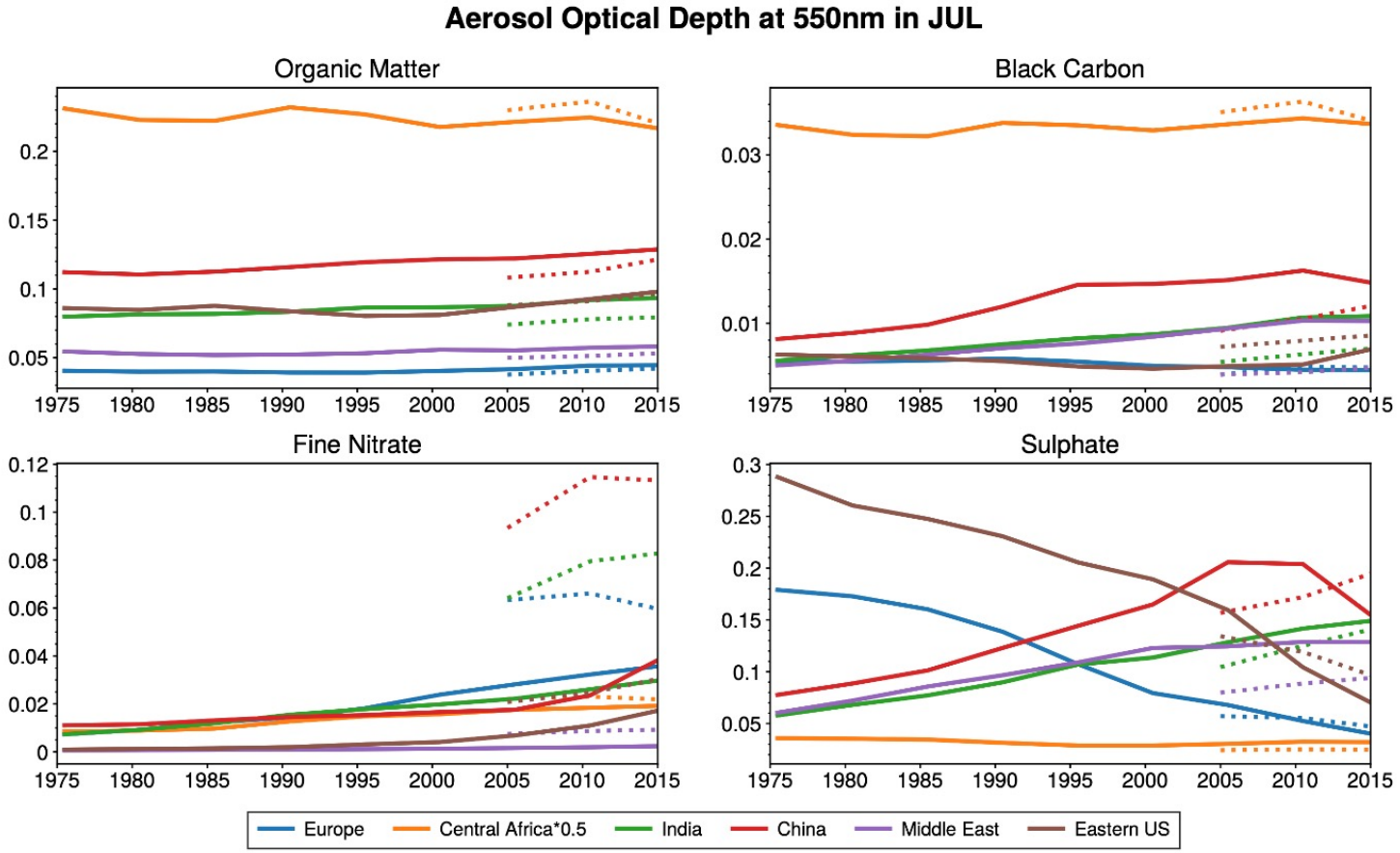
30°N
0°
30°S
60°S
180° 120°W 60°W 0° 60°E 120°E 180°
0 4 8 16 24 40 60 100 140 180
0 1 2 3 4 6 8 12
0 2 4 6 8 10 12 16
0 2 4 6 10 14 20 28

Time-variation of aerosol climatology (July)



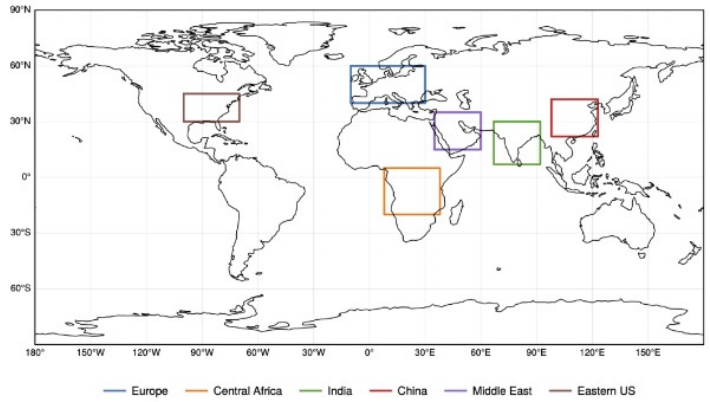
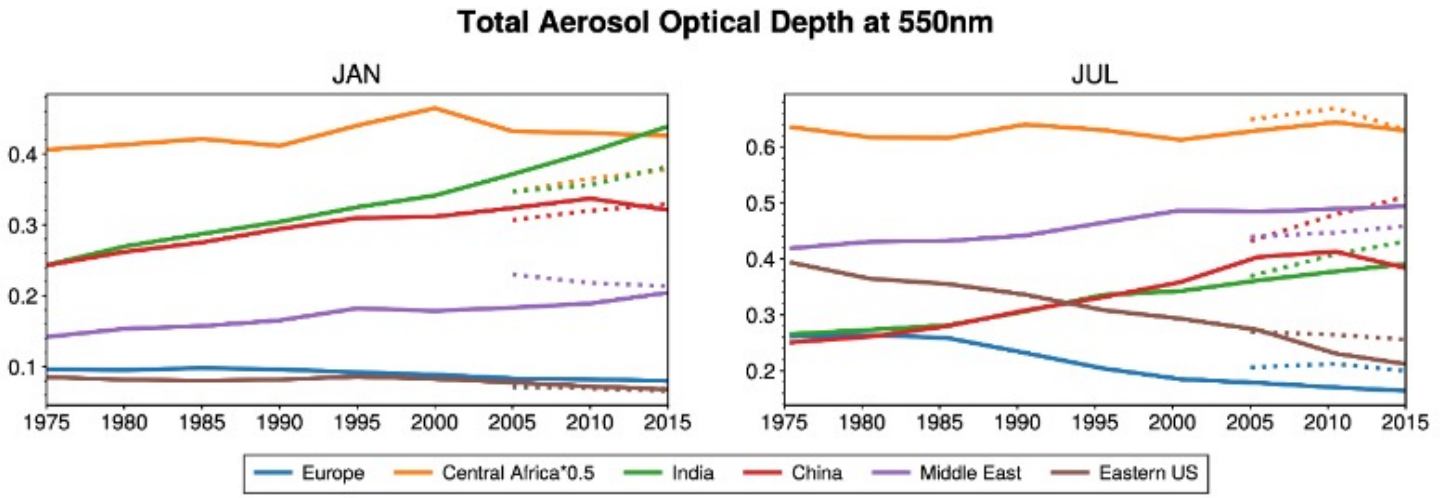


Figure 5: Map showing locations and boundaries of regions used for time-series plots

Time-evolution of area-averaged species-AOD for various regions. The dotted lines are from an experiment using the CAMS standard forcing, which does not use the latest data over China (dark red) showing that sulphate emissions have already peaked.

Comparisons with HARMONIZED-CMIP6 from BSC



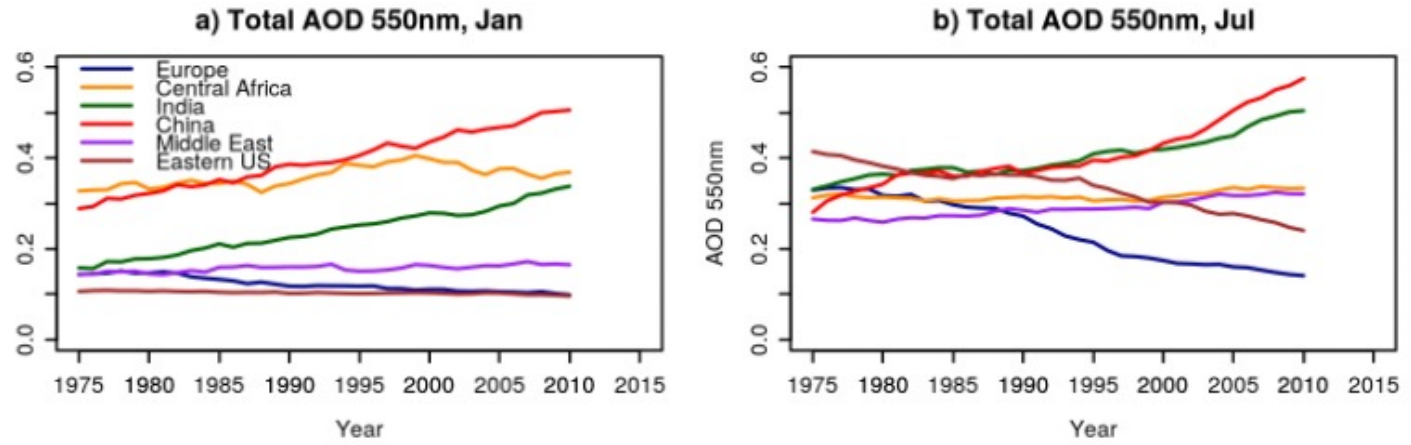


Figure 12: Time-variation of the total AOD from HARMONIZED-CMIP6 and CAMS-FORCED (above) and EC-Earth3-AerChem (below), details as for previous figures.

WP2 – Volcanic aerosols ECMWF

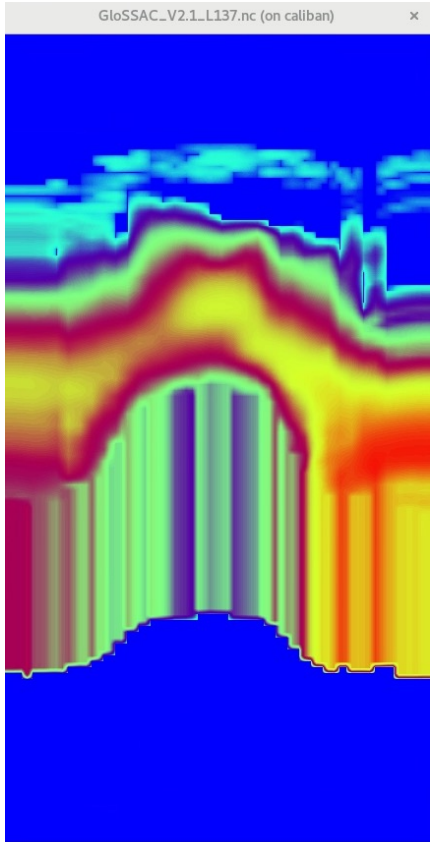
Delayed due to overrun of tropospheric aerosol task ; catch up was delayed to migration of SEAS5 to new HPC.

- New vertical structure read-in to IFS
  - Work in progress. Involves new data structures (OOPS compatibility, removal and rationalization of previous data structures and methods), file read methods (netcdf, distributed memory) and control logic.

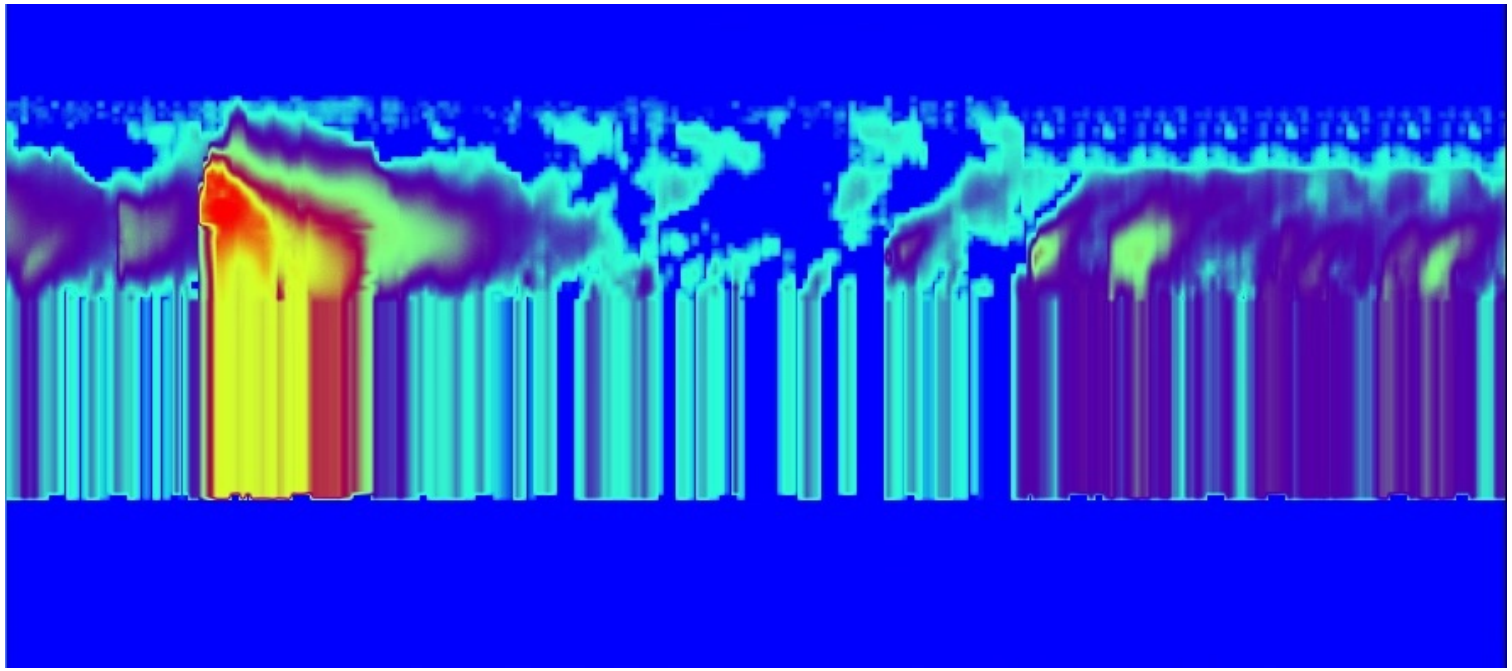
- EVA_H
  - Python version downloaded, analysed, modifications identified.
  - Will run at script level and provide intput via new vertical strucutrue interface.
  - Work to be finished (inc test runs and handover to WP3) by end of January.

- Deliverable D2.3 (implementation and validation) by end of February 2023

GLOSSAC 2,1 data, interpolated from geocentric height to (time-varying) IFS L137 model levels. Stratospheric background removed. Tropospheric data removed, stratospheric values extrapolated down into troposphere, ready to be used by IFS (intrusions of stratospheric air into the troposphere will take stratospheric values, so these need to be defined below the climatological tropopause).



Snapshot, post-Pinatubo, showing vertical and latitudinal structure



Time-series showing extinction vs height at the equator, including Pinatubo, its aftermath, years with low aerosol loading, and then the 2000's with small volcanoes.