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Changes to the IFS-COMPO atmospheric composition mode in support to the CAMS update to cycle 51R1

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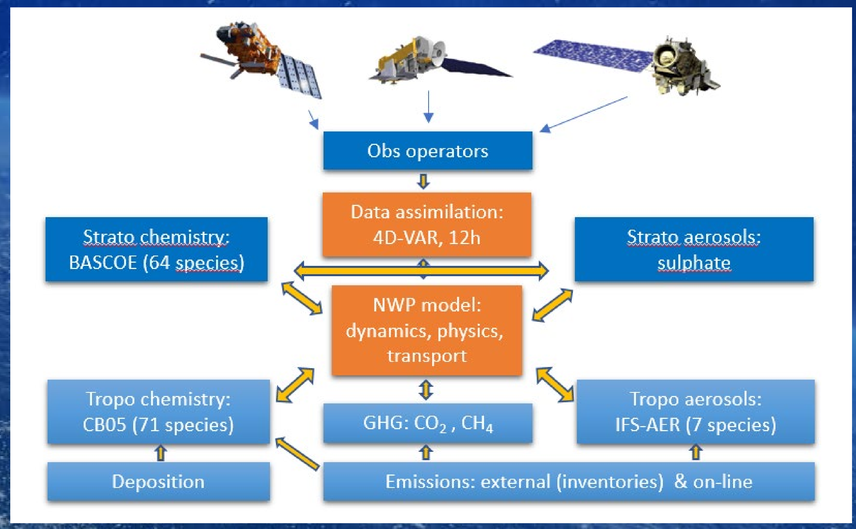
The Integrated Forecasting System with atmospheric composition extension (IFS-COMPO) of ECMWF is used in the Copernicus Atmosphere Monitoring Service (CAMS) to provide global analyses and forecasts of atmospheric composition, including reactive gases, as well as aerosol and greenhouse gases. The IFS-COMPO system is composed of tropospheric and stratospheric aerosol and chemistry components. The composition model is updated regularly, aligned with updates of ECMWF's operational meteorological model.

11/2024 CY49R1 — **12/5/2026** CY50R1 — **Q2 2027, tbc** CY51R1

CY49R1
- EQSAM4Clim module for gas-aerosol partitioning,
- Use of a temperature dependent activation in aerosol wet deposition
- Update of aerosol optics
- Implementation of stratospheric sulfate life cycle
- Use of climatological SAD from CMIP6 in strato

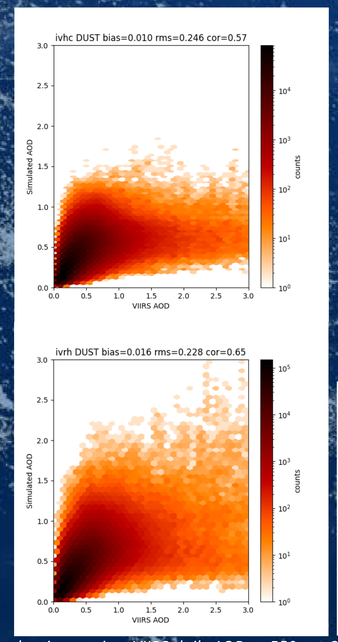
CY50R1
- Online BVOC emissions
- Weekly cycle in emissions
- Use of CAMS-GLOB-ANT MOSAIC emissions
- Update het. chem in troposphere
- Sedimentation velocity from Stokes formula
- Updated SOA/Am./Nitrate growth factors

CY51R1
- HDD modulation of residential sector emissions
- 6 bin dust scheme
- New dust emission scheme from CAMAERA
- Updated aerosol dry deposition
- Updated aerosol optics for desert dust
- Updated VOC chemistry
- Improved photolysis in stratosphere
- coupling of aerosol SAD in strato het. chem

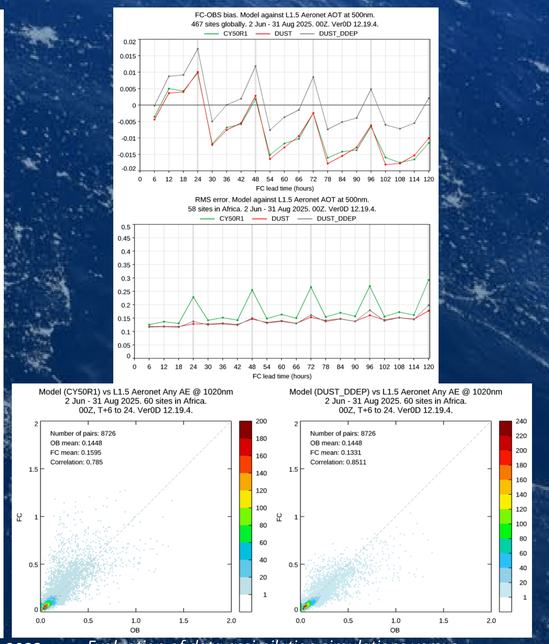


- Dust bins have been defined in IFS-COMPO as [0.03 – 0.5] , [0.5 – 0.9] , [0.9 – 20] micron radius since the model conception. Originally, the simulated dust mass and emissions were evenly distributed between the three bins
- Since cycle 46R1 (2019), Brittle Fragmentation Theory (Kok et al 2011, Meng et al 2022) is used for the size distribution of dust emissions in IFS-COMPO, leading to a much coarser assumed size distribution of dust at emissions
- 6 desert dust bins are proposed for a more balanced distribution of simulated dust mass and emissions : as [0.03 – 0.5] , [0.5 – 0.9] , [0.9 – 2.5], [2.5-5], [5-10] and [10-20] micron radius

- A new dust emission scheme adapted from SILAM has been implemented
- Use of roughness length from ASCAT and of threshold veloty from Pu et al (2020, ACP)
- Update of aerosol dry deposition to use Pleim et al (2022) following a 0D dry deposition intercomparison carried out in CAMAERA
- Update of PM formula to account for geometric versus aerodynamic diameter as in Zhang et al (2025)



evaluation against VIIRS daily AOD at 550nm, 2023 over Sahara + Middle East. Top, reference, bottom, with new dust emission scheme



Evaluation of data assimilation simulations versus AERONET level 1.5

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