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Biomass burning influences on atmospheric composition: A case study to assess the impact of aerosol data assimilation

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The C-IFS (Composition Integrated Forecast System) developed under the MACC series of projects and to be continued under the Copernicus Atmospheric Monitoring System, provides global operational forecasts and re-analyses of atmospheric composition at high spatial resolution (T255, ∼80km). Currently there are 2 aerosol schemes implemented within C-IFS, a mass-based scheme with externally mixed particle types and an aerosol microphysics scheme (GLOMAP-mode). The simpler mass-based scheme is the current operational system, also used in the existing system to assimilate satellite measurements of aerosol optical depth (AOD) for improved forecast capability. The microphysical GLOMAP scheme has now been implemented and evaluated in the latest C-IFS cycle alongside the mass-based scheme. The upgrade to the microphysical scheme provides for higher fidelity aerosol-radiation and aerosol-cloud interactions, accounting for global variations in size distribution and mixing state, and additional aerosol properties such as cloud condensation nuclei concentrations. The new scheme will also provide increased aerosol information when used as lateral boundary conditions for regional air quality models.

Here we present a series of experiments highlighting the influence and accuracy of the two different aerosol schemes and the impact of MODIS AOD assimilation. In particular, we focus on the influence of biomass burning emissions on aerosol properties in the Amazon, comparing to ground-based and aircraft observations from the 2012 SAMBBA campaign. Biomass burning can affect regional air quality, human health, regional weather and the local energy budget. Tropical biomass burning generates particles primarily composed of particulate organic matter (POM) and black carbon (BC), the local ratio of these two different constituents often determining the properties and subsequent impacts of the aerosol particles. Therefore, the model's ability to capture the concentrations of these two carbonaceous aerosol types, during the tropical dry season, is essential for quantifying these wide ranging impacts.

Comparisons to SAMBBA aircraft observations show that while both schemes underestimate POM and BC mass concentrations, the GLOMAP scheme provides a more accurate simulation. When satellite AOD is assimilated into the GEMS-AER scheme, the model is successfully adjusted, capturing observed mass concentrations to a good degree of accuracy.