Geophysical Research Abstracts
Vol. 18, EGU2016-13785, 2016
EGU General Assembly 2016

Recent updates in the aerosol model of C-IFS and their impact on skill scores

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The Composition-Integrated Forecast System (C-IFS) is a global atmospheric composition forecasting tool, run by ECMWF within the framework of the Copernicus Atmospheric Monitoring Services (CAMS). The aerosol model of C-IFS is a simple bulk scheme that forecasts 5 species: dust, sea-salt, black carbon, organic matter and sulfates. Three bins represent the dust and sea-salt, for the super-coarse, coarse and fine mode of these species (Morcrette et al., 2009). This talk will present recent updates of the aerosol model, and also introduce coming upgrades. It will also present evaluations of these scores against AERONET observations.

Next cycle of the C-IFS will include a mass fixer, because the semi-Lagrangian advection scheme used in C-IFS is not mass-conservative. This modification has a negligible impact for most species except for black carbon and organic matter; it allows to close the budgets between sources and sinks in the diagnostics. Dust emissions have been tuned to favor the emissions of large particles, which were under-represented. This brought an overall decrease of the burden of dust aerosol and improved scores especially close to source regions. The biomass-burning aerosol emissions are now emitted at an injection height that is provided by a new version of the Global Fire Assimilation System (GFAS). This brought a small increase in biomass burning aerosols, and a better representation of some large fire events. Lastly, SO_2 emissions are now provided by the MACCity dataset instead of and older version of the EDGAR dataset. The seasonal and yearly variability of SO_2 emissions are better captured by the MACCity dataset; the use of which brought significant improvements of the forecasts against observations.

Upcoming upgrades of the aerosol model of C-IFS consist mainly in the overhaul of the representation of secondary aerosols. Secondary Organic Aerosols (SOA) production will be dynamically estimated by scaling them on CO fluxes. This approach has been recommended by recent studies (Spracklen et al., 2011) and brought a notable improvement of scores as compared to using a SOA climatology. Lastly, a nitrate and ammonium module has been implemented, with two bins (fine and coarse) for nitrate. Nitrate and ammonium sulfate particle formation from gaseous precursors is represented following Hauglustaine et al. (2014); formation of coarse nitrate over pre-existing sea-salt or dust particles is also represented. This extension of the forward model improved scores over heavily populated areas such as Europe, China and Eastern United States.