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Evaluation of aerosol properties simulated by the high resolution global coupled chemistry-aerosol-microphysics model C-IFS-GLOMAP

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The EU Framework Programme GEMS and MACC consortium projects co-ordinated by the European Centre for Medium-range Weather Forecasts (ECMWF) have developed an operational global forecasting and reanalysis system (Composition-IFS) for atmospheric composition including greenhouse gases, reactive gases and aerosol.

The current operational C-IFS system uses a mass-based aerosol model coupled to data assimilation of Aerosol Optical Depth measured by satellite (MODIS) to predict global aerosol properties. During MACC, the GLOMAP-mode aerosol microphysics scheme was added to the system, providing information on aerosol size and number for improved representation of aerosol-radiation and aerosol-cloud interactions, accounting also for simulated global variations in size distribution and internally-mixed particle composition.

The IFS-GLOMAP system has recently been upgraded to couple with the sulphur cycle simulated in the online TM5 tropospheric chemistry module for global reactive gases. This C-IFS-GLOMAP system is also being upgraded to use a new “nitrate-extended” version of GLOMAP which realistically treats the size-resolved gas-particle partitioning of semi volatile gases ammonia and nitric acid.

In this poster we described C-IFS-GLOMAP and present an evaluation of the global sulphate aerosol distribution simulated in this coupled aerosol-chemistry C-IFS-GLOMAP, comparing to surface observations in Europe, North America and the North Atlantic and contrasting to the fixed timescale sulphate production scheme developed in GEMS.

We show that the coupling to the TM5 sulphur chemistry improves the seasonal cycle of sulphate aerosol, for example addressing a persistent wintertime sulphate high bias in northern Europe. The improved skill in simulated sulphate aerosol seasonal cycle is a pre-requisite to realistically characterise nitrate aerosol since biases in sulphate affect the amount of free ammonia available to form ammonium nitrate.