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A global three-dimensional study of sulphates, black-carbon, dust and sea-salt aerosols

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The Chemistry Transport Model (CTM) of Météo-France, MOCAGE (Modèle de Chimie Atmosphérique de Grande Echelle) was created to simulate atmospheric physics and chemistry. We use this model with a grid resolution of $2^{\circ}\times2^{\circ}$ to study the behaviour of chemically inert aerosols (Black-Carbon (BC), sea-salt, dust) and sulphate aerosols which requires sulphur chemistry.

For aerosols, the model contains physical parameterisations for emissions, advection, convection, turbulent diffusion, sedimentation, dry deposition, in-cloud and below-cloud scavenging. Emissions of dust are simulated in Sahara, Middle-East and central Asia deserts, depending on nature, roughness and moisture of the soil and wind velocity. For BC, we have used as a first step GEIA emissions, representative of the year 1985 and AEROCOM emissions as a second step, representative of the year 2000. Emissions of sea-salt are derived from AEROCOM data.

The sulphur cycle is described with around ten chemical reactions, involving eleven species. As for BC, we use GEIA emissions as a first step and AEROCOM emissions as a second step for anthropogenic sulphur dioxide (SO_2) and hydrogen sulphide (H_2S). Oceanic emissions of dimethyl sulphide (DMS, CH_3SCH_3) are AEROCOM data. OH, H_2O_2, O_3 and NO_3 are prescribed from a previous MOCAGE run including detailed gas-phase chemistry. The oxidation reactions described in the model, both in gaseous and aqueous phases, lead to the formation of sulphates (SO_4^{2-}), which condensate quasi-instantaneously in aerosol.

Global quantity of BC, sulphates, dust and sea-salt are compared with other numerical studies. In addition, modelled aerosol burden and vertical profiles are compared with

observations in different places, both in terms of annual means and seasonal cycle.