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Development and evaluation of an explicit sulfur oxidation scheme in the aerosol module of the CNRM climate model (CAMS43 framework)

Josué Bock, Martine Michou, and Pierre Nabat
Météo France, CNRM, Centre National de Recherches Météorologiques, UMR3589, Toulouse, France

Atmospheric aerosols play a major role in the Earth's radiative budget, and lead to one of the largest source of uncertainties in climate models. To reduce these uncertainties, a better understanding of all processes involved in the aerosol lifecycle is necessary. For example, secondary aerosols such as sulfate are produced in the atmosphere by the oxidation of precursor gases, and the implementation of these processes in models leads to a more accurate representation of reality. In the framework of the Copernicus Atmospheric Monitoring Service 43 (CAMS-43), namely "Development of Global Aerosol Aspects", we implemented an updated sulfur oxidation scheme in the TACTIC aerosol module of the CNRM climate model. Oxidation in the gas phase by OH, and in the aqueous phase by O_3 and H_2O_2 are both taken into account. The concentrations of these oxidants as modelled by C-IFS have been averaged as monthly climatologies and are used as input to the scheme. We performed a range of simulations and sensitivity analyses to study the impact of this updated oxidation scheme on the aerosols. Overall, the total optical depth is smaller in the new simulations, which is due to a slower oxidation rate. Surface concentration of SO_2 and sulfate are also compared to several gas and aerosol measurement network datasets from various regions. While the new simulations are in better agreement with the observations in some regions such as Northern America, degraded performance is also observed in other places such as Europe. The comparison of vertical profiles of SO_2 concentration with airborne measurements will also be presented, and the sensitivity of the oxidation scheme to various input parameters (sulfate precursor concentration, oxidant concentration, and cloud droplet pH) will be discussed. Finally, preliminary work on the sensitivity of sulfate to the parameterization of wet deposition of aerosols will be shown.