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Aerosol modeling in CNRM-CM: evaluation of recent developments on natural aerosols and implications for aerosol radiative forcing

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Aerosols interact with shortwave and longwave radiation with ensuing consequences on the radiative budget and climate. Their representation in climate models is consequently essential to estimate their radiative forcing and their role in the climate system. However, up to now, the evaluation of these aerosol schemes is often limited to the integrated atmospheric aerosol content given by the aerosol optical depth (AOD). In the climate model CNRM-CM, the TACTIC (Tropospheric Aerosols for ClimaTe in CNRM-CM, Michou et al., 2015) aerosol scheme includes the five main aerosol species (desert dust, sea-salt, sulfate, black carbon and organic matter). Recent developments have been carried out to improve the representation of natural aerosols, namely the inclusion of the parameterization of Grythe et al. (2014) for sea-salt emissions, the revision of the size distribution of sea-salt aerosols, and the increase of the number of bins to represent dust aerosols.
The objective of this work is to evaluate the contribution of these developments to the representation of aerosols in CNRM-CM, using not only AOD from satellite data, but also aerosol vertical distribution and concentrations from in-situ measurements. Simulations have thus been carried out using different configurations of the aerosol scheme over the period 2000-2015, to allow for an evaluation against available measurements. The results show a relatively good performance of the model, but also reveal some discrepancies in the aerosol vertical distribution. The impact on the radiative budget of these changes in aerosol loads has been estimated, and shows the importance of the representation of natural aerosols for the estimation of aerosol radiative forcing.