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Aerosol radiative impact on the Mediterranean climate in coupled atmosphere-ocean-land-river regional climate simulations

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Various natural and anthropogenic aerosols observed over the Mediterranean region show a strong spatio-temporal variability and a large variety in aerosol physical-chemical and optical properties. Through their interactions with solar and thermal radiations, they have significant effects on the regional climate in one of the most climatically sensitive areas. In order to better understand the influence of aerosols on the Mediterranean climate, we consider in the present work a regional climate system modelling (RCSM) approach, using the ALADIN-climate model. This regional climate model can be coupled to the regional ocean model NEMOMED8, the land surface model ISBA and the river routine scheme TRIP. This RCSM approach enables to take into account the high-frequency feedback of the sea surface temperature (SST) on the atmosphere, as well as the river-ocean-atmosphere feedback. Aerosols are included in ALADIN through monthly interannual climatologies, coming from a combination of satellite-derived and model-simulated products, and considered as the most possible relevant estimation of the atmospheric aerosol content for the five most relevant species (sea salt, desert dust, sulfates, black and organic carbon aerosols). Ensemble simulations have been carried out over the period 2003-2009 both in a forced mode (only the atmospheric model ALADIN) and in a coupled mode (ALADIN with NEMOMED8), with and without aerosols. The first results of these simulations confirm the strong impact of aerosols due to absorption and scattering of the incident radiation, and also show contrasts between different regions. Regional climate response to aerosols is all the more complex in a region where local winds, complex coastlines and orography interact with the atmospheric flow. We will present the aerosol direct effect in both modes (forced and coupled) on shortwave and longwave radiation, and the resulting effects on atmospheric parameters such as temperature, dynamics and precipitation. For coupled atmosphere-ocean simulations, the decrease of SST due to aerosol forcing is observed, as well as changes in ocean-atmosphere fluxes and deep water formation.