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Impact of Mineral Dust Direct Radiative Effect on Mediterranean Climate

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Saharan desert is an important component of the Mediterranean climate system. Meteorological conditions are the driving factor of the emissions and transport of dust from Sahara, so that climate change can affect the mineral dust sources and its transport pathways. Dust also affects the Mediterranean climate by modifying its radiative budget at regional scale. In this study, the effect of a future climate projection on radiative effect in the Mediterranean is analyzed. Three 10-year time periods (1991-2000, 2041-2050, and 2091-2100) were simulated with the regional climate model RegCM-4.1.1 in order to quantify the changes in direct radiative forcing and related impacts on temperature and precipitations. The model domain covers the entire Mediterranean Basin. The horizontal resolution is 27x27 km2 and grid number is 128x256 with 18 vertical layers from surface to10 hPa. Initial and boundary conditions were obtained from ECHAM5 simulations of the A1B scenario. Two sets of simulations were performed, with and without mineral dust.

Monthly average precipitation and temperature data over 10 years are analyzed on both seasonal and annual time averages. Taylor diagrams (Taylor 2001) that compute the root mean square difference (RMSD), variability and pattern correlation between the model outputs of no-dust simulations and gridded datasets of Climate Research Unit (CRU) observations, allow us to assess the overall model performance.

Short wave net radiation at surface is decreasing up to 20 W/m2 over the source regions and 8 W/m2 over Mediterranean Sea and South Europe and 3 W/m2 over the source region at the top of atmosphere since mineral dust has scattering feature. Also dust causes a decrease in mean temperature around 0.2 Cº over Europe and 0.5 Cº over the African continent for the period 1991-2000. A similar impact is found also for the 2041-2050. Smaller temperature changes are simulated for the end of the 21st century. Finally, our results suggest that precipitations are not changing significantly for the 3 periods.