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Change in the Mineral Dust Budget of the Mediterranean Region with a Future Climate

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Amount of mineral dust transport and its impacts may change due to the anthropogenic and climatic modifications of land use. Meteorological conditions are the main driving factor of the emissions and transport of mineral dust from Sahara and Middle East to the Mediterranean region. In this model study, we consider only the climate change aspect affecting the mineral dust sources and its transport pathways.

The dust budget components (surface emissions, dry deposition, wet deposition and column burden) are simulated for the present, near future and end of century in order to compare them in present climate and future climate projections. 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 dust distribution, optical properties, direct radiative forcing and 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.

Mineral dust emissions will shift towards southern latitudes of Saharan Desert in the future compared to present climate. Dust emissions are increasing by 15% and 20% in 2040s and 2090s in the southern part of the domain. This occurs because of the general pattern of surface winds, which are strengthening at lower latitudes, associated to a strengthening and relocation of the Azores anticyclone towards north in future climate conditions. This leads to an increase (8%) in dust burden in the west of the domain and a decrease (10%) in the east of the domain. Aerosol optical depth also changes similarly to the dust burden. In the 2040s, AOD is increasing by 15% in the Western Mediterranean and decreasing by up to 10% in the Eastern Mediterranean. Similar changes are also simulated for the end of the 21st century.

In another presentation, we compare two sets of simulations, respectively with and without mineral dust, to check the mineral dust direct radiative impact and its effect on the regional climate. Results will be briefly summarized here.