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Dust sources and atmospheric circulation in concert controlling Saharan dust emission and transport towards the Western Mediterranean Basin

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Dust transported from north African source regions towards Europe is a ubiquitous phenomenon in the Mediterranean region, a geographic region that is in part densely populated. Besides its impacts on the atmospheric radiation budget, dust suspended in the atmosphere results in reduced air quality, which is generally sensed as a reduction in quality of life. Furthermore, the exposure to dust aerosols enhances the prevalence of respiratory diseases, which reduces the general human wellbeing, and ultimately results in an increased loss of working hours due to illness and hospitalization rates.

Characteristics of the atmospheric dust life cycle that determine dust transport will be presented with focus on the ChArMEx special observation period in June and July 2013 using the atmosphere-dust model COSMO-MUSCAT (COSMO: Consortium for Small-scale MOdeling; MUSCAT: MUltiScale Chemistry Aerosol Transport Model). Modes of atmospheric circulation were identified from empirical orthogonal function (EOF) analysis of the geopotential height at 850 hPa for summer 2013 and compared to EOFs calculated from 1979-2015 ERA-Interim reanalysis. Generally, two different phases were identified. They are related to the eastward propagation of the subtropical ridge into the Mediterranean basin, the position of the Saharan heat low, and the predominant Iberian heat low. The relation of these centres of action illustrates a dipole pattern for enhanced (reduced) dust emission fluxes, stronger (weaker) meridional dust transport, and consequent increase (decrease) atmospheric dust concentrations and deposition fluxes.

In concert, the results from this study aim at illustrating the relevance of knowing the dust source locations in concert with the atmospheric circulation. Ultimately, this study addresses the question of what is finally transported towards the Mediterranean basin and Europe from which source regions - and fostered by which atmospheric circulation pattern. Outcomes from this study contribute to the understanding of varying atmospheric mineral dust contributions to the aerosol burden affecting populated areas around Europe.