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# Atmospheric circulation characteristics favouring the development of desert dust storms in the Mediterranean

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Dust is the major component of aerosol burden in the Mediterranean, with the Sahara desert being its main source area. The transport of dust particles exhibits a significant spatial and temporal variability, primarily driven by the prevailing synoptic conditions. In the present work, the evolution of atmospheric circulation favouring intense dust episodes in the Mediterranean is examined for the period 2000-2007. An objective and dynamic algorithm is set up in order to identify desert dust (DD) episodes, and classify them to strong and extreme ones, according to their aerosol optical depth values at 550nm (AOD550nm). The algorithm identifies the DD episodes, based on the synergistic use of aerosol optical properties (e.g. Ångström Exponent) derived by MODIS-Terra, Earth Probe and OMI satellite databases. Strong and extreme DD episodes are determined at the geographical cell (1ox1o) level, on a daily basis, over the entire Mediterranean, for the study period. A desert aerosol episode day (DAED) is defined whenever DD episodes occur in at least 30 pixels, provided that AOD data are available for at least 300 pixels (50% of the study region), to ensure adequate spatial coverage. According to our method, 62 DAEDs are finally found during the 7-year period, taking into account that consecutive DAEDs are considered as a unique day. The corresponding atmospheric circulation before, during and after the DAEDs are objectively classified into 6 representative types of atmospheric circulation (clusters), by applying S-mode Factor Analysis and Cluster Analysis to mean sea level pressure (MSLP) and 700 hPa geopotential height (Z700) data, obtained from the NCEP/NCAR Reanalysis Project.

According to Cluster 1 (8% of 62 DAEDs), a 700hPa trough is moving south-eastwards across the eastern Mediterranean, getting steeper, inducing DD episodes in the eastern coasts. In Cluster 2 (5%), a 700hPa trough is moving from the Iberian Peninsula over W. Sahara, inducing a strong southwesterly airflow, carrying dust particles towards the E. Mediterranean. Cluster 3 is the most frequent (53%) and prevails during summer, with dust being transported towards the W. Mediterranean. In Cluster 4 (8%), an eastward shift of a 700hPa trough from the Atlantic towards W. Sahara and a combination of a depression over Algeria and an anticyclone over the Black Sea at the surface induce a strong southerly flow, transporting massive dust loads towards the C. Mediterranean. In Cluster 5 (5%), the central and, secondarily, the eastern part of the Mediterranean are affected by intense dust outflows from Sahara, because of a southwesterly flow at 700hPa, getting more pronounced from DAED-2 to DAED, while a surface southerly flow is induced by the combination of a depression centered over Algeria and a high pressure system in the eastern part of the study region. Finally, in Cluster 6 (18%), a 700hPa trough is moving eastwards, from the Iberian Peninsula, while the combination between a depression over the C. Mediterranean and an anticyclone over the E. Mediterranean is getting stronger. The southeasterly and southerly flows at Z700 and MSLP, respectively, favour the dust transport towards the E. Mediterranean.