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A satellite based algorithm for identifying dust episodes: the regime of episodes in the Mediterranean basin and evaluation against surface measurements

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An objective and dynamic algorithm was set up, using daily data of various aerosol optical properties from different satellite databases, which identifies the desert dust (DD) episodes and classifies them into strong and extreme ones. The algorithm is applied to derive the regime of DD episodes over the broader Mediterranean basin over the period 2000-2007. First, the algorithm was tested through comparisons against surface based particulate matter (PM) and AERONET measurements from stations distributed across the Mediterranean basin. The comparisons have shown a reasonable ability of the algorithm to detect the DD episodes occurring within the study region, with largest disagreements with PM data in summer, when African dust transport has a great vertical extent restricting the ability of PM measurements to capture them.

The DD episodes in the Mediterranean basin are quite frequent (up to 11.4 episodes/year) having a significant spatial and temporal variability in their frequency of occurrence and intensity. Thus, strong DD episodes occur more frequently in the western Mediterranean basin while extreme ones appear more frequently over the central Mediterranean Sea. In addition, there is a predominant latitudinal variability in both frequency and intensity of DD episodes, both being decreased from south to north. A significant seasonal variation of the frequency of DD episodes was also found. More specifically, both strong and extreme episodes are more frequent during summer in the western Mediterranean basin and during spring in its central and eastern parts. In more than 85% of cases, Mediterranean episodes last a bit more than one day on average, but their duration can be as long as 6 days for strong episodes and 4 days for extreme ones. A noticeable year by year variability of DD episodes has been also found, especially concerning their frequency. The spatial and temporal patterns of Mediterranean DD episodes can be explained by the regional surface pressure and precipitation spatio-temporal patterns, as well as by the variability of North Atlantic Oscillation (NAO). Thus, our results indicate a decreasing frequency of Mediterranean DD episodes over the period 2000-2007, especially over land surfaces, in line with decreasing NAO Index over the same period. The present satellite based tool for identifying DD episodes is useful because it enables a complete spatial coverage, which is necessary for better understanding the larger scale processes that determine the regime of DD episodes in the Mediterranean, and it is planned to be used to other key dust regions of the globe.