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Aerosol variability and weather regimes over the Mediterranean region

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The Mediterranean region is characterized by the accumulation of aerosols from different sources: industrial and urban aerosols from Europe and North African towns, biomass burning, from Eastern Europe, dust aerosols from Africa, and marine particles from the sea. These aerosols show a strong spatio-temporal variability and a resulting large variety in aerosol optical properties over this basin. Maximal aerosol loads are observed in spring and summer, namely in the dry season favouring a longer residence time for atmospheric aerosols. Besides, dust outbreaks characterized by large plumes of Saharan desert dust particles, are more frequent in this season.

This study realized in the framework of the ChArMEx initiative aims at explaining this aerosol variability and the relationship between aerosol loads and weather conditions. We consider here an approach based on weather regimes and regional modeling. From a multi-year (1979-2013) regional simulation carried out with the ALADIN-climate model (50 km resolution, ERA-Interim forcing) including an interactive aerosol scheme for the main species present in this region (desert dust, sea-salt, sulfates and carbonaceous particles), we have identified typical synoptic conditions that favour high aerosol loads over the Mediterranean, or on the contrary that are opposed to these high aerosol loads. These weather regimes are based on a statistical method of automated classification realized from surface pressure data. They are also related to the North Atlantic Oscillation (NAO). In this work, we characterize the presence of the different aerosol types over the Mediterranean for each weather regime, as well as their effects on climate. Thus, anomalies in the occurrence of the regimes favourable to high aerosol loads could explain the frequent dust outbreaks observed during the ChArMEx campaigns in 2012 and 2013.