Aerosol optical properties and prevailing aerosol type over the Mediterranean

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Atmospheric aerosols, both natural and anthropogenic, can affect the regional and global climate through their direct, indirect, and semi-direct effects on the radiative energy budget of the Earth-atmosphere system. The interaction of aerosols with radiation is strongly dependent on their optical properties (Hatzianastassiou et al., 2004).

In this study we investigate the spatiotemporal variability of two important aerosol optical properties, namely the Aerosol Optical Depth (AOD) and the Fine Fraction (FF) over the broader Mediterranean basin, (from 29.5 to 47.5° N, and from 10.5° W to 42.5° E). The study region has significant sources of both natural and anthropogenic particles and receives large solar radiation fluxes, especially during summer due to predominantly cloud-free conditions (Papadimas et al. 2008). Moreover, parts of the broader Mediterranean basin are threatened by desertification processes (IPCC, 2007).

AOD provides a good measure of the aerosol load over an area, whereas FF is an indicator of the relative contribution of the fine particles to the total AOD. The study is performed using Collection 006 Level-3 mean daily aerosol data from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on board Aqua satellite available in 1° × 1° resolution (ca. 100 km × 100 km) over the period 2002-2014 (Levy et al. 2013). Furthermore, using the aforementioned optical properties we apply the Barnaba and Gobbi (2004) algorithm in order to determine the different aerosol types: continental, desert dust and maritime aerosols.

Our first results indicate a significant geographical and seasonal variation of both AOD and FF (not shown here). The largest AOD values are observed during April in south and south-eastern Mediterranean sea (up to 0.60 in Gulf of Sidra) and in the western Mediterranean (offshore Algeria) during October (AOD up to 0.45). The MODIS data for FF show the predominance of coarse mode particles (small FF values), in spite of a significant north-to-south gradient, with enhanced contributions of fine aerosols over the northern part and coarse aerosols in the southern part of our study region. These results indicate a strong contribution of desert dust particles originating from Sahara desert in the southern Mediterranean and the contribution of fine mode continental particles in northern Mediterranean and the Black Sea. Moreover, lower FF values are observed during winter (down to 0.50) whereas the FF reaches up to 0.85 during summer in the Eastern Mediterranean and the Black Sea.

Figure 1 shows the total prevailing aerosol type frequencies, which are obtained with the implementation of the Barnaba and Gobbi algorithm, for the period 2002-2014. The categorization indicates the enhanced presence of desert dust particles in the south and continental particles in the north. A strong contribution of marine aerosols in the Mediterranean basin is also observed.

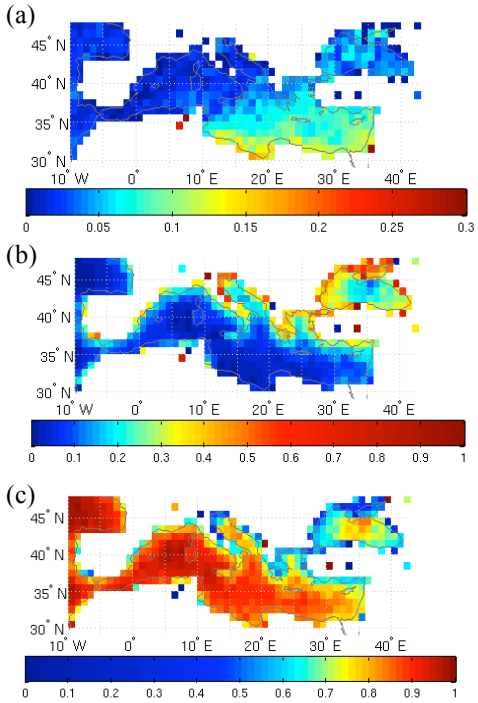

Figure 1. Geographical distributions of frequencies of aerosol type prevalence (a) desert dust, (b) continental and (c) maritime particles for the period 2002-2014.

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