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The regime of aerosol asymmetry parameter and Angstrom exponent over Europe, Mediterranean and Middle East based on MODIS satellite data. Intercomparison of MODIS-Aqua C051 and C006 retrievals

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Atmospheric aerosols, both natural and anthropogenic, can cause climate change through their direct, indirect, and semi-direct effects on the radiative energy budget of the Earth-atmosphere system. In the present work, we study two of the most important optical properties of aerosols, the asymmetry parameter (gaer) and the Angstrom exponent (α). Both gaer and α are related with aerosol size, which is a very important parameter for climate and human health. The study region comprises North Africa, the Arabian peninsula, Europe, and the Mediterranean basin. These areas are of great interest, because of the variety of aerosol types they host, both anthropogenic and natural. Urban, industrial or biomass-burning aerosols are usually fine, while desert dust or sea-salt are basically coarse, making thus possible the establishment of a relationship between the type and the size of aerosols. Using satellite data from the collection 051 of MODIS (MODerate resolution Imaging Spectroradiometer, Aqua), we investigate the spatio-temporal characteristics of the asymmetry parameter and Angstrom exponent. We generally find significant spatial variability, with larger gaer values over regions dominated by larger size particles, e.g. outside the Atlantic coasts of north-western Africa, where desert-dust outflow is taking place. The gaer values tend to decrease with increasing wavelength, especially over areas dominated by small particulates. The intra-annual variability is found to be small in desert-dust areas, with maximum values during summer, while in all other areas larger values are reported during the cold season and smaller during the warm. Significant intra-annual and inter-annual variability is observed around the Black Sea. However, the inter-annual trends of gaer are found to be generally small. The geographical distributions for α (given for the pair of wavelengths 550-865 nm) affirm the conclusions drawn from the asymmetry parameter as regards the aerosol size over the study region, with larger α values in regions where the aerosol load is dominated by fine particles. A daily Angstrom exponent intercomparison is also performed between collection 051 and the most recent collection (006). Our results reveal a good agreement between the two datasets, with a correlation coefficient ranging between 0.75 and 0.95 above the study region.