Seasonal variability and North-South gradients of aerosol optical, microphysical and radiative properties in the western Mediterranean

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In the framework of the ChArMEx (the Chemistry-Aerosol Mediterranean Experiment, http://charmex.lsce.ipsl.fr/) program, the seasonal variability of the aerosol optical, microphysical and radiative properties derived from AERONET (Aerosol Robotic Network; http://aeronet.gsfc.nasa.gov/) is examined in two regional background insular sites in the western Mediterranean Basin: Ersa (Corsica Island, France) and Palma de Mallorca (Mallorca 25 Island, Spain). A third site, Alborán (Alborán Island, Spain), with only a few months of data is considered for examining possible Northeast–Southwest (NE–SW) gradients of the aforementioned aerosol properties.

The AERONET dataset is exclusively composed of level 2.0 inversion products available during the five-year period 2011-2015. Properties such as the aerosol optical depth, the Ångström exponent, the fine mode fraction, the volume size distribution, the absorption aerosol optical depth, the absorption Ångström exponent, the refractive index, the single scattering albedo and the asymmetry factor are analysed seasonally. The graphical method from Gobbi et al. (2007) is used to classify the aerosols according to their optical depth, Ångström exponent and Ångström exponent difference.

AERONET solar radiative fluxes are validated with ground- and satellite-based flux measurements. To the best of our knowledge this is the first time that AERONET fluxes are validated at the top of the atmosphere. The monthly variations of the solar aerosol radiative forcing and of the solar aerosol radiative forcing efficiency are discussed and compared to the literature.

The main drivers of the observed annual cycles and NE–SW gradients are 1) mineral dust outbreaks in spring in the North and in summer in the South, and 2) European pollution episodes in autumn. A NE–SW gradient exists in the western Mediterranean Basin for the aerosol optical depth and especially its coarse mode fraction, which all together produces a similar gradient for the aerosol direct radiative forcing. The aerosol fine mode is rather homogeneously distributed. Absorption properties are quite variable because of the many and different sources of anthropogenic particles in and around the western Mediterranean Basin: North African and European urban areas, the Iberian and Italian Peninsulas, forest fires and ship emissions. As a result the aerosol direct forcing efficiency, more dependent to absorption than the absolute forcing, has no marked gradient.

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