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Aerosol optical depth measurements from a multifilter rotating shadowband radiometer at Girona, NE Spain

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Aerosols still remain as one of the major uncertainties in estimating the radiative forcing of climate change, especially if compared with the greenhouse gases. As aerosols are noted for their variability in space and time, a lot of effort is devoted to understand their effects on the climate system, both from ground-based networks (e.g. AERONET) and satellite platforms (e.g. MISR and MODIS).

The most important of aerosol radiative properties is the aerosol optical depth (AOD), which is a measure of the total aerosol burden in the atmosphere. The spectral dependence of AOD, typically described by the Ångström exponent (AE), is an indicator of the particle size. We have analized 2 years of data (from June 2012 to June 2014) of a multifilter rotating shadowband radiometer (MFR7) installed in Girona, Spain, to obtain the AOD and AE from the five 10 nm bandwidth channels between 415 and 870 nm. AOD for each channel is calculated on minute basis, after performing a calibration based on several close Langley plots. Finally, we remove the data that are contaminated by the presence of clouds in front of the Sun (we consider the assumption that when solar beam passes through clouds exhibits much larger temporal variaiblity compared to passing through aerosol particles), average on daily basis, and calculate AE. We estimate an uncertainty of 0.01-0.02 in the 1-minute AOD values and of 0.5 in AE.

The daily values of AOD are relatively low along the year in Girona (annual mean value of 0.14 in 500 nm channel, and a highest value below 0.5), and follow an annual pattern with maximum in summer. The daily averages of AE range within values typical of continental aerosols, despite showing a strong day-to-day variation (annual mean value of 1.25, with highest values below 2.2 and a lowest values greater than 0) and present a maximum value during summer. So, the summer increase in AOD is linked with an increased concentration of fine particles.

The estimated AOD for Girona shows good agreement with measurements from the Cimel sunphotometer of AERONET network located in Barcelona (100 km away from Girona). Though the instruments are not located at the same place, correlation coefficients are about 0.7, slopes range from 0.91-0.97, and offsets are less than 0.01, the exact value depending on specific wavelength. Reasonable agreements are also found with MISR and MODIS products (better results are found for the first one as it has a better algorithm to estimate surface reflectance and higher spatial resolution). The correlations regarding AE are worse, probably due to the higher uncertainty in AE estimation.