Similarities and discrepancies when surface and columnar aerosol data are jointly analysed in a background environment

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One of the most challenging topics in the last years has been the retrieval of particulate matter levels at the surface from remote sensing techniques, which can expand the spatial and temporal coverage of this magnitude; hence the relationships between columnar and surface aerosol properties are not a straightforward problem and are deeply investigated in this study.

Two quantities about aerosol load in the atmosphere are used: columnar Aerosol Optical Depth (AOD) and ground-level particulate matter with aerodynamic diameter below 10 µm (PM_{10}). Other related parameters such as Ångström exponent (AE) and PM ratio (PR = $PM_{2.5}/PM_{10}$) are also used to obtain information about the prevailing particle size. All these measurements are obtained in two nearby background sites belonging to AERONET and EMEP networks in the north-central area of the Iberian Peninsula for the period 2003–2014.

The inter-annual monthly means of PM_{10} present two separated maxima in March and August (local minimum in April) which are not apparently followed by AOD cycle. The inter-annual variability has shown a similar decrease trend for both quantities and a good linear agreement between their yearly means is evident (R = 0.9). At daily or monthly time scales these correlations are worse (R = 0.58 and R = 0.74, respectively). Hence, linear relationships are not always recommended to fit the AOD-PM_{10} relationship. As regards particle size, the daily PR-AE scatterplot displays a rough-bulk correlation due to the prevalence of medium size particles over the study area.

As day-to-day correlation is not systematic (especially for high turbidity events), binned analyses are also carried out to establish consistent relationships among the four quantities mentioned above, as a potential application in climate studies. For instance, Figure 1 shows the PM_{10} vs AOD analysis. In this way the synergy between surface concentration and columnar remote sensing data demonstrates to provide useful information for aerosol characterization under a climatic perspective, but also reveals their limitations.

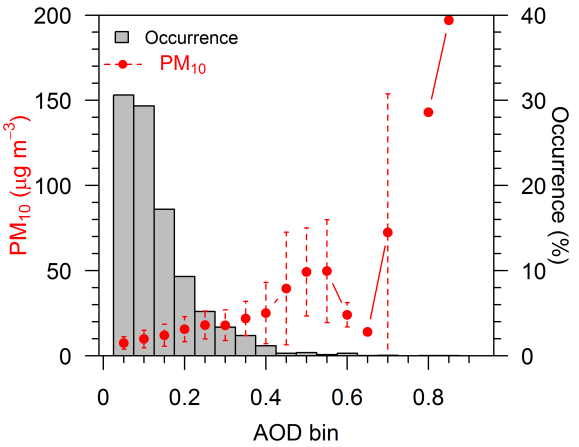

Figure 1. PM_{10} as a function of binned AOD data. The data counts for each bin (relative occurrence) are also shown on the superimposed histogram.

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