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Statistical analysis of the scattering properties of atmospheric aerosols in Valencia (Spain) over a year

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The study of atmospheric aerosols has taken on enormous interest in recent years because of the evidence of their role in climate change. Their interaction with shortwave and terrestrial longwave radiation affects the radiative budget via scattering and absorption phenomena. The scattering properties of aerosols are important for evaluating their importance in the climate radiative forcing and have been previously reported for different locations around the world.

The total aerosol scattering (σ_{sp}) and the backscattering (σ_{bsp}) coefficients were measured using a TSI Model 3563 three-wavelength (λ = 450, 550, 700 nm) integrating nephelometer. The measurements presented in this study were made at the Burjassot (Valencia, Spain) measurement station at the Physics Faculty in the Burjassot campus of the University of Valencia (latitude = 39.508°, longitude = 0.418°, 60 meters above sea level). Calibration of the nephelometer was carried out by using CO_2 as high span gas and filtered air as low span gas. The nephelometer scattering data were adjusted to conditions of standard temperature (0° C) and pressure (1013 hPa). A nephelometer truncation correction was also applied to the data.

Monthly averages were calculated based on daily averages. The monthly average value of σ_{sp} (550 nm) ranged from 64.84 Mm^{-1} in November to 139.59 Mm^{-1} in June (the months of July and August were not considered due to technical problems) with a total average value of 97.36 Mm^{-1} for the entire measurement period. The monthly average value of σ_{bsp} (550 nm) ranged from 7.67 Mm^{-1} in November to 12.98 Mm^{-1} in June with a total average value of 9.81 Mm^{-1} for the entire measurement period.

Daily variation of σ_{sp} (550 nm) has been analyzed based on a "typical" day calculated from the monthly mean of each hour of the day. For all months, the same tendency is observed. At the beginning of the day, σ_{sp} (550 nm) is greater than that of the middle of the day, when it reaches its minimum value, increasing again for the last hours of the day. In spring and summer, σ_{sp} (550 nm) is greater at the beginning of the day than at the end of it, whilst in autumn and winter, the greatest value occurs at the end of the day.

From the measurements of σ_{sp} (550 nm) and σ_{bsp} (550 nm), it is possible to determine the backscatter fraction (b) and the Angström exponent (α). The monthly average value of b ranged from 0.09 in June to 0.12 in December with a total average value of 0.11 for the entire measurement period. The monthly average value of α ranged from 1.26 in March to 1.76 in January with a total average value of 1.54 for the entire measurement period, suggesting that scattering at the site is dominated by fine particles (< 1 μm diameter).