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Optical depth retrievals from Delta-T SPN1 measurements of broadband solar irradiance at ground

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The SPN1 radiometer, manufactured by Delta-T Devices Ltd., is an instrument designed for the measurement of global solar irradiance and its components (diffuse, direct) at ground level. In the present study, the direct irradiance component has been used to retrieve an effective total optical depth, by applying the Beer-Lambert law to the broadband measurements. The results have been compared with spectral total optical depths derived from two Cimel CE318 and Prede POM01 sun-sky radiometers, located at the Burjassot site in Valencia (Spain), during years 2013 – 2015.

The SPN1 is an inexpensive and versatile instrument for the measurement of the three components of the solar radiation without any mobile part and without any need to azimuthally align the instrument to track the sun (http://www.delta-t.co.uk). The three components of the solar radiation are estimated from a combination of measurements performed by 7 different miniature thermopiles. In turn, the Beer-Lambert law has been applied to the broadband direct solar component to obtain an effective total optical depth, representative of the total extinction in the atmosphere.

For the assessment of the total optical depth values retrieved with the SPN1, two different sun-sky radiometers (Cimel CE318 and Prede POM01L) have been employed. Both instruments belong to the international networks AERONET and SKYNET. The modified SUNRAD package has been applied in both Cimel and Prede instruments. Cloud affected data has been removed by applying the Smirnov cloud-screening procedure in the SUNRAD algorithm.

The broadband SPN1 total optical depth has been analysed by comparison with the spectral total optical depth from the sun-sky radiometer measurements at wavelengths 440, 500, 675, 870 and 1020 nm. The slopes and intercepts have been estimated to be 0.47 – 0.98 and 0.055 – 0.16 with increasing wavelength. The average correlation coefficients and RMSD were 0.80 – 0.83 and 0.034 – 0.036 for all the channels. The analysis shows that the SPN1 instrument underestimates the TOD increasingly with wavelength, for higher TOD. This observation is in agreement with the already known effect of a larger effective field of view in the SPN1, as the aureole radiation increase. In any case, these results are promising and would be useful as a determination of the total atmospheric extinction, mainly for users of the SPN1 in the solar radiation field.