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Evaluation of the Delta-T SPN1 radiometer for the measurement of solar irradiance components

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In this study we analyse the performance of an SPN1 radiometer built by Delta-T Devices Ltd. to retrieve global solar irradiance at ground and its components (diffuse, direct) in comparison with measurements from two Kipp&Zonen CMP21 radiometers and a Kipp&Zonen CHP1 pirheliometer, mounted on an active Solys-2 suntracker at the Burjassot site (Valencia, Spain) using data acquired every minute during years 2013 - 2015. The measurement site is close to sea level (60 m a.s.l.), near the Mediterranean coast (10 km) and within the metropolitan area of Valencia City (over 1.500.000 inhabitants).

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. The SPN1 pyranometer measures the irradiance between 400 and 2700 nm, and the nominal uncertainty for the individual readings is about 8% $\pm$ 10 W/m2 (5% for the daily averages).

The pyranometer Kipp&Zonen CMP21 model is a secondary standard for the measurement of broadband solar global irradiance in horizontal planes. Two ventilated CMP21 are used for the measurement of the global and diffuse irradiances. The expected total daily uncertainty of the radiometer is estimated to be 2%. The pirheliometer Kipp&Zonen CHP1 is designed for the measurement of the direct irradiance. The principles are similar to the CMP21 pyranometer.

The results of the comparison show that the global irradiance from the SPN1 compares very well with the CMP21, with absolute RMSD and MBD differences below the combined uncertainties (15 W/m2 and -5.4 W/m2, respectively; relative RMSD of 3.1%). Both datasets are very well correlated, with a correlation coefficient higher than 0.997 and a slope and intercept very close to 1 and 0, respectively. The diffuse and direct irradiances do not compare as well as the global irradiance, although the deviations are below or close to the combined uncertainties. The diffuse irradiances have a RMSD and MBD of 15 W/m2 and 12 W/m2, similar to the global irradiance; the direct irradiance RMSD and MBD are 57 W/m2 and -44 W/m2. Both cases have a relative RMSD about 7.7-18%. Linearity is lower but still high (R=0.96).

In conclusion, the SPN1 radiometer is a compact, robust and easy to maintain instrument that provides good results for the different solar irradiance components.