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Direct-normal solar irradiance measurements and turbidity coefficient evaluation in central Spain.

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ABSTRACT

In order to study the characteristics of solar direct radiation and the atmospheric turbidity in Valladolid, Spain, global, diffuse and direct irradiance data were recorded from May 2010 to December 2011, with a frequency of 10 minute.
Measurements used were taken by the Energy and Atmosphere Group (http://www3.uva.es/renova), University of Valladolid, Spain at the Solar Radiometric Station (41,81ºN 4.93ºW, 840m a.s.l.) located on the Atmosphere Researcher Centre, Villalba de los Alcores, Valladolid, Spain. Sensors were installed in a Sun tracker (Solys 2, Kipp & Zonen) that blocks direct solar radiation using a shadow ball. The system consists of two pyranometers CMP-21 and one pyrheliometer CHP-1 (Kipp & Zonen), respectively.
Based on these measurements, the characteristics of direct solar irradiance data were evaluated in order to know the main statistical parameters of the distribution.
Angström turbidity coefficient values, beta, were estimated from direct solar irradiance and clear sky conditions. The beta coefficient values were obtained from MODIS satellite instrument, and the aerosol optical depth values, AOD(550nm), were evaluated. The turbidity coefficient beta shows seasonal variation, with higher values in summer (< 0.15) and lower in winter (< 0.05). It could be due to high temperatures in summer and less rainy days which would induce more atmospheric turbidity, increasing vertical convection and particles enhancement.
The scattered graph of aerosol optical depth from satellite and the obtained from Angström expression has been plotted. The slope presents a value around the unity, 0.96, and the correlation coefficient shows a value of 0.6 .
It was observed that turbidity coefficients increased in April 2011, and in order to now the origin the change, air masses trajectories, deduced from HYSPLIT model (http://ready.arl.noaa.gov/HYSPLIT.php) were studied. From the results it has been obtained that a situation of low pressures in the Atlantic Portuguese coast and high pressure in the North of Spain induced the movement of dust from Sahara desert into the Iberian Peninsula.