EMS Annual Meeting Abstracts
Vol. 10, EMS2013-253, 2013
13th EMS / 11th ECAM

Solar irradiance on inclined surfaces in Jokioinen, Southern Finland, during snow-covered spring conditions

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We have measured the solar spectral irradiance over the wavelengths 300—1000 nm with two diode array spectroradiometers (CMS Ing. Dr. Schreder GmbH SP-J1009) deployed at the observatory of Jokioinen, Southern Finland. The instrument setup also includes a sun tracker. One of the instruments is equipped with an entrance optics for global irradiance measurements, consisting of a teflon diffuser covered by a quartz dome. The measurement head for global irradiance is installed onto the tracker in a vertical position to monitor vertical global irradiance in the direction of the solar azimuth. The other instrument uses an entrance optics designed for direct irradiance measurements with a field of view of 1.5°. The diode-based radiation detection technique enables recording of photons at all the wavelengths of the solar radiation spectrum simultaneously, with a temporal resolution better than 1 min. In addition to these data, standard meteorological solar radiation measurements of the global downwelling and upwelling irradiance, as well as the diffuse and direct beam irradiance are available together with ancillary data such as snow depth, sunshine duration, and atmospheric soundings. The weather in Jokioinen in March and early April 2013 was characterized by a long-lasting snow cover and sunny conditions. In this study, we attempt to quantify the enhancement of solar radiation availability due to a highly reflective snow cover in conjunction with low to moderate solar elevation angles. This is done by combining the above-described measurements with radiative transfer calculations. We also model how the irradiance behaves at other inclined surfaces than the vertical, aiming to find out what the optimal tilt angle would be for solar energy production in these conditions.