Geophysical Research Abstracts
Vol. 19, EGU2017-17702, 2017
EGU General Assembly 2017

Cloud effects on the SW radiation at the surface at a mid-latitude site in southwestern Europe

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This work presents a study of cloud radiative effects on shortwave (CRESW) radiation at the surface in Évora region (southwestern Europe) during 2015 and a case study is analyzed. CRESW (in Wm-2) is defined as the difference between the net shortwave irradiance (downward minus upward shortwave irradiance) in cloudy and clear sky conditions. This measure is usually used to translate changes in the SW radiation that reaches the surface due to changes in clouds (type and/or cover).
The CRESW is obtained using measured SW irradiance recorded with a Kipp&Zonen CM 6B pyranometer (broadband 305 – 2800 nm) during the period from January to December 2015, and is related with the cloud liquid water path (LWP) and with cloud ice water path (IWP) showing the importance of the different type of clouds in attenuating the SW radiation at the surface. The cloud modification factor, also a measure of the cloud radiative effects (CMF; ratio between the measured SW irradiance under cloudy conditions and the estimated SW irradiance in clear-sky conditions) is related with the cloud optical thickness (COT; obtained from satellite data). This relation between CMF and COT is shown for different cloud fractions revealing an exponential decreasing of CMF as COT increases. Reductions in the SW radiation of the order of 80% (CMF = 0.2) as well enhancements in the SW radiation larger than 30% (CMF = 1.3) were found for small COT values and for different cloud fractions. A case study to analyse the enhancement events in a cloudy day was considered and the cloud properties, COT and LWP (from satellite and surface measurements), were related with the CRESW.