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Solar shortwave radiation in the Iberian Peninsula along the last six decades

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The solar total shortwave radiation (SW, 305-2,800 nm) reaching the Earth surface is a key factor in the Earth energy balance and in the climate change. A decrease in SW levels has a cooling effect over the Earth. The SW changes are of interest in order to know the possible climatic effects. However long-term measured SW series are scarce, for example the oldest SW measurements in Spain are from 1973. The main objective of this work is to reconstruct and analyze nine long-term SW series from 1950 to 2011 in nine Spanish places located in the Iberian Peninsula.

The data from different satellite retrievals were downloaded at the nine places: Total ozone column from different databases, spectral surface albedo and water vapour column from MODIS instrument, aerosol optical depth at 443 nm and Angström Exponent (between 443 nm and 670 nm) from MISR instrument onboard Terra satellite, and single scattering albedo from OMI instrument onboard Aura satellite. Moreover, sunshine duration records taken in the places were used.

The UVSPEC/Libradtran radiative transfer model was run to obtain the daily SW irradiation under cloudless conditions in each location using as inputs monthly climatology tables calculated with the mentioned satellite retrievals. A model to obtain SW irradiation through the cloudless simulations and the sunshine records was developed, finding a great agreement with the monthly averaged SW measurements: a root mean square error of 5% and a mean bias error of 0.7%.

The proposed model was used to obtain the daily SW irradiation, and the monthly, seasonal and annual averages, on the nine locations from 1950 to 2011. The homogeneity of these series was tested obtaining that all series are homogeneous. The anomalies of the series were calculated and a new series (Iberian Peninsula) of anomalies were obtained as an average of the nine locations.

The annual SW on the Iberian Peninsula (the averaged series) shown a negative and statistically significant (99% confidence) trend of -1.70%dc-1 during the 1950-1984 period, which is the well-known “global dimming” period, and a positive and statistically significant (99% confidence) trend of 1.55%dc-1 during the 1985-2011 period (“global brightening”). As a consequence of the first decrease and then increase in SW, the balance of the annual SW irradiation in the Iberian Peninsula from 1950 to 2011 didn’t show any statistically significant trend.

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