Clear-sky radiation trends derived from ground-based observations of surface solar radiation over Europe

Blanka Bartók (1,2), Maria Z Hakuba (1), Arturo Sanchez-Lorenzo (3), and Martin Wild (1)

(1) Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland, (2) Department of Geography in Hungarian, Babes-Bolyai University, Cluj-Napoca, Romania, (3) Pyrenean Institute of Ecology, Spanish National Research Council (CSIC), Zaragoza, Spain

Trends in clear-sky radiation reflect the changes in the radiatively active components of the atmosphere without considering the effect of clouds. In this way analyzing the long term changes in clear-sky radiation gives a better overview over the changes in aerosol content in the atmosphere, having significant direct radiative effect on surface solar radiation but no long term records of direct aerosol measurements exist. In this study, the linear trends of clear-sky radiation records over Europe are analyzed based on daily observations from 26 stations for the period of 1964-2013, which have been obtained from the Word Radiation Data Center (WRDC). The daily data has been checked for temporal homogeneity by applying the MASH method (Szentimrey, 2003). The separation of clear-sky situation is elaborated using three approaches. In the first approach the clear-sky situations are detected based on a clearness index, namely the ratio of the surface solar radiation to the extraterrestrial solar irradiation. In the second approach the observed values of surface solar radiation are compared to the climatology of clear-sky surface solar radiation calculated by the MAGIC radiation code (Muller et al. 2009). In the third approach clear-sky days are detected based on synoptic cloudiness observations. Overall, in all approaches the trends of clear-sky radiation may also depend on the thresholds of clear-sky days. Consequently, in order to eliminate this methodological error in all cases different thresholds are chosen and the sensitivity of clear-sky radiation trends with respect to the thresholds is quantified. In order to verify the reliability of the empirical thresholds, a verification of clear-sky detection is envisaged through a comparison with the values obtained by a high time resolution clear-sky detection and interpolation algorithm (Long and Ackermann, 2000) making use of the high quality data from the Baseline Surface Radiation Network (BSRN).The trends of clear sky radiation calculated by the different approaches will be compared to estimate the uncertainties introduced by the different methods. Furthermore, trends will be calculated for different periods as well, in order to highlight the changes in aerosol content over the investigated period.

References

Long CN, Ackerman TP. 2000. Identification of clear skies from broadband pyranometer measurements and calculation of downwelling shortwave cloud effects, J. Geophys. Res., 105(D12), 15609–15626, doi:10.1029/2000JD900077.

Mueller R, Matsoukas C, Gratzki A, Behr H, Hollmann R. 2009. The CM-SAF operational scheme for the satellite based retrieval of solar surface irradiance - a LUT based eigenvector hybrid approach, Remote Sensing of Environment, 113 (5), 1012–1024, doi:10.1016/j.rse.2009. 01.012

Szentimrey T. 2003. Multiple analysis of series for homogenization (MASH); Veri?cation procedure for homogenized time series, In: Fourth seminar for homogenization and quality control in climatological databases, Budapest, Hungary, WMO-TD No. 1236, WCDMP No. 56:193–201.