



Trends of reconstructed surface radiation in Europe since late 19th century

A. Sanchez-Lorenzo (1), M. Wild (1), E.J.M. van den Besselaar (2), G. Stanhill (3), C.J. Butler (4), A.M.G. Klein Tank (2), and E. Pallé (5)

(1) Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland (arturo.sanchez@env.ethz.ch), (2) Royal Netherlands Meteorological Institute (KNMI), KS/KA, De Bilt, Netherlands, (3) Department of Environmental Physics and Irrigation, The Volcani Center, Israel, (4) Armagh Observatory, Armagh, Northern Ireland, (5) Institute of Astrophysics of the Canary Islands, Spain

In this work we present the reconstructed surface solar radiation (SSR) variations since late 19th century in Europe, which have been estimated using sunshine duration records as proxy for SSR. The dataset contains sunshine duration series over Europe with more than 70 years of data, some of them starting in late 19th century. The dataset have been compiled by the European Climate Assessment and Dataset (ECA&D) project, as well as other sources in the framework of the “SunCloud project” initiative. The reconstructed SSR variations have been estimated by using the relationship found between the sunshine duration series and a satellite-derived SSR dataset (0.03 x 0.03 of spatial resolution), provided by the EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF), during the common 1983-2005 subperiod. The temporal evolution of the mean all-sky SSR annual series is characterized by a general decrease from the 1950s to the early 1980s, in agreement with the well-known global dimming phenomena. This is followed by a positive trend up to the present, which also matches with the brightening worldwide observed. Moreover, an “early brightening” has been detected during the first half of the 20th century, although regional differences are observed with areas over Europe where the all-sky SSR show no increase in this subperiod. In order to study the direct effect of the aerosols, we also estimated clear-sky SSR series for a subset of the sites with collocated cloud cover observations. The results show strong decadal variations in clear-sky SSR, in line with anthropogenic aerosol emissions over Europe. These results confirm the suitability of traditional sunshine duration records to detect changes in SSR under all-sky and clear-sky conditions.