



## **Using sunshine duration data to reconstruct total solar radiation time series since the late 19th century, for Athens area**

Dimitra Founda (1), Stelios Kazadzis (1), Fragiskos Pierros (1), Nikolaos Mihalopoulos (1,2)

(1) National Observatory of Athens, Athens, Greece (founda@noa.gr), (2) Department of Chemistry, University of Crete, Greece

Due to the scarcity of surface solar radiation measurements and the lack of long term time series of this variable, sunshine duration (SDu) has been widely considered as a useful proxy for surface total solar radiation (TSR) reaching the earth. Numerous relationships between SDu and TSR have been proposed which vary between sites, as a result of the dependence of the two variables from climatic and astronomical components. At the National Observatory of Athens (NOA), measurements of sunshine duration and surface total solar radiation have been conducted continuously since 1897 and 1953 respectively. These are the longest uninterrupted time series of SDu and TSR in the country. The ability of SDu observations at NOA to serve as a proxy for the estimation of TSR and the detection of its interannual and multi decadal variability is examined in the study.

Using the respective time series we have retrieved the relationship between SDu and TSR on a monthly, seasonal and annual basis. To test the retrieved functions we have derived them for the period 1985-2013 and tested them for the period 1953-1984, where synchronous SDu and TSR measurements are available.

A strong linear relationship between the time series of monthly SDu and TSR was found. The two series were highly correlated (correlation coefficient  $> 0.95$ ,  $p < 0.001$ ). On a seasonal basis, stronger correlation between SDu and TSR was detected in winter, autumn and spring, when SDu and TSR exhibit larger variability due to cloudiness. The correlation coefficient was lower in summer, when almost clear sky conditions prevail in Athens. The results showed that SDu observations in Athens can successfully provide quantitative information on shortwave solar radiation, particularly under all-sky conditions. The calculated functions can be used for the reconstruction of TSR back to the late 19th century. This unique 115-yrs SDu and TSR retrieved datasets can provide valuable and unknown information of TSR variability over the past century for Athens area.