Solar radiation controls the energy radiative balance in the Earth and, thus, our weather and climate. For this reason, its study has been one of the main objectives of the research community during the last decades. Recently, the focus is on evaluating the long-term trends of solar radiation reaching the Earth’s surface as well as on identifying the variability driven by the climate change. Observational evidences of changes on global solar radiation (GSR) trends have already been reported at a global scale. In this context, the goal of this work is to perform a reconstruction of the GSR time series between 1933 and 2013 at the subtropical high-mountain Izaña Atmospheric Observatory (IZA) located in Tenerife (28.3°N, 16.3°W, 2373 m a.s.l., Spain). For this purpose, we combine GSR estimates from sunshine duration (SD) data using the Ångström-Prescott method over the 1933/1991 period, and GSR observations directly performed by different pyranometers between 1992 and 2013. These results have been recently published (García et al., 2014).

The GSR time series between 1933 and 2013 has been successfully reconstructed combining:
1) GSR estimations from SD measurements (1933-1991)
2) GSR observations performed by different pyranometers at IZA between 1992 and 2013.

The reconstructed IZA GSR time series between 1933 and 2013 confirms change points and periods of increases in solar radiation at Earth’s surface observed at a global scale, such as the early 1960s, dimming and brightening (Figures 2 and 4).

CONCLUSIONS

The results show that using the Ångström-Prescott’s method can be reconstructed with a notable accuracy time series of GSR from measurements SD at IZA. We obtain an overall root mean square error (RMSE) of 2.16 MJm⁻² (9.2%), and an agreement between the variances of SDR estimations and SDR measurements within 92% (correlation coefficient of 0.96).

The resulting annual time series GSR confirms a period of early brightening from the 1950s to the early 1960s, a period of dimming from the 1960s to the end of the 1990s followed by a period of brightening in the most recent decades. However, we observe a delay of between 5 and 10 years for the transition from early brightening, dimming and brightening. All of these findings indicate the consistency of the IZA GSR time series presented in this work, which may be a reference for solar radiation studies in the Subtropical North Atlantic Region. These results are comparable with those of other studies carried out in other regions.

Figure 4: Time series of the annual means of the (a) GSR and (b) GSR anomalies from 1933 to 2013 at IZA. The error bars indicate ±1 SEM (standard error of the mean) The arrows indicate the eruptions of Arenal and Fernandina (1968), Chichón (1982) and Pinatubo (1991). Five-year moving average is shown in red. (Time series has been deseasonalised by subtracting the averaged GSR annual cycle, obtaining the annual mean anomalies time series).