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Atmospheric Measurement Techniques Discussions

Interactive comment on "Re-construction of global solar radiation time series from 1933 to 2013 at the Izaña Atmospheric Observatory" *by* R. D. García et al.

Anonymous Referee #1

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The paper is acceptable for publication. In this paper "Re-construction of global solar radiation time series from 1933 to 2013 at the IZO" the global solar radiation has been re-constructed combining Global solar radiation estimates from sunshine duration measurements using the Angström-Prescott method. The resulting annual time series confirms an early brightening period (30-50), a period of dimming (1950-90), followed by a period of brightening in the most recent decades. The present manuscript contains useful results, which are of great concern in the scientific community. The presentation is well structured and clear, all in all, this is an excellent paper and I recommend publication. But, In my opinion the "estimation of global SDR from SD" section

4, must be revised.

Specific Comments

In the paper the term Shortwave Downward Radiation SDR added the two components of solar radiation come to the Earth surface. One component comes directly from the Sun (direct solar radiation) and the other the diffuse solar radiation. Global solar radiation consists of direct and diffuse solar radiation. I prefer the term global solar radiation.

In Angström-Prescott formulation H/Ho = a + b (n/N). Where H and Ho are, respectively the global solar radiation (MJ x m-2 x day-1) and the extraterrestrial solar radiation (Angot's value); n and N are, respectively, actual sunshine hours and maximum possible sunshine hours; and a and b are regression constants determined empirically. The sky is overcast when the ratio n/N is zero, so (a x Ho) represents the diffuse radiance, and therefore "a" may be considered as the fraction of the extraterrestrial solar radiation received during that day; whilst the term (b x Ho x(n/N)] is a measure of the direct radiance. The angstrom –Precott formula use bright sunshine duration data, this are readily available in many parts of the world (measured mainly by simple Campbell-Stokes sunshine recorders). The CS and CSD instrument produces similar sunshine duration data, however the electronic sensor tends to show more "sunshine hours n" than the Campbell-Stokes. The difference may amount higher, especially on days with maximum global solar radiation. The CSD sensor reacts quickly to radiation, especially for the first hour after sunrise and before sunset. Differences in sunshine duration depend on the nature and thick of clouds. The threshold sensitivity of the Campbell-Stokes recorder of 120 W/m2 which results in underestimates of n (sunshine hours), in in the recorders based on photoelectric measuring techniques the threshold value of 120 W/m2 is implemented artificially to meet a WMO convection. In my opinion, for the Angstrom-Prescott formulation the Campbell Stokes sunshine recorder remains the best instrument for measurements.

As I see it the variations of solar constant (and extraterrestrial solar radiation) are not adequate for explaining, in the last 10000 years, abrupt climate shifts. But it only should be applied to short periods the transitions of solar irradiance can be considered. The solar constant, Isc = 1367 W/m2, recommended by the World Radiometric Center (WRC), is the generally accepted one for estimating solar radiation and evaluating empirical, the solar constant, but is variable . The intensity of the Sun varies along with the 11-year sunspot cycle; when sunspots are numerous the solar constant is high (about 1367 W/m2); when sunspots are scarce the value is low (about 1365 W/m2). The solar constant can fluctuate by 0.2% to 0.6% over 100 years. The solar radiation at the entrance into the Earth atmosphere is known as extraterrestrial radiation. The intesity of extraterrestrial solar radiation is variables because of the change in distance between the Earth and Sun and because of the Sun activity.

Minor comments:

p.364 reference Prescott and Rietveld . Is better only Prescott 1940. The first author who employed a linear relationship between global radiation and sunshine duration was Angström (1924): H/Hc = k + (1- k) (n/N) where H: amount of global radiation; Hc: global radiation under a real atmosphere in completely clear days; k: empirical constant, determined by Angström as k= 0,25 from Stockholm data; n: number of hours measured by a sunshine recorder; and N: maximum possible number of hours of sunshine. The modified version of the Angstrom's correlation has been the most convenient and widely used correlation for estimating the global radiation (Prescott, 1940): H/H0 = a + b (n/N) where H0: extraterrestrial solar radiation on a horizontal surface (MJ x m-2 x day-1), and a and b: empirically determined regression constants.

p. 381 is 0.00148? Declin. = (180/3.1415926) (0.006918 - 0.399912 cosR + 0.070257 sinR - 0.006758 cos2R + 0.000907 sin2R - 0.002697 cos3R + 0.00148 sin3R). The solar declination in degrees can be computed from the Spencer formula (Spencer, 1971): where the day angle R (radians) is given by R = 6.283185 (nday-1)/365 where nday is the number of the Julian day of the year, starting from the first of January. I

prefer, for the eccentricity correction factor, the expression (Spencer, 1971)

E0= 1.00011 + 00034221 cos R + 0.00128 sin R + 0.000719 cos 2R + 0.000077 sin R

In your manuscript: How does one calculate the maximum daily sunshine hours on a horizontal surface at a given location?

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 4191, 2014.