

Response to the Reviewer #1 comments for the manuscript “Erythematul ultraviolet irradiation trends in the Iberian Peninsula from 1950 to 2011” By R. Román et al. in ACPD

First, we are really grateful for the effort of Reviewer #1 and her/his review in detail. Reviewer comments are in black font (RC), and author comments (AC) in red font.

Author’s answer to Reviewer

RC: 1. The present paper presents a reconstruction of erythematul ultraviolet radiation for the Iberian peninsula for the period 1950 to 2011. The authors mention in the introduction that in previous investigations UV ER irradiation was only reconstructed at Valladolid since 1991 and at two other sites for a time period starting in 1950 but only for the summer months. The present reconstruction was performed for 9 spanish locations and showed an increase of 6.5% between 1950 and 2011. The UVER irradiation over the open human body was also calculated by multiplying daily UVER irradiation by the daily open body fraction which is a function of air temperature and wind. An increase of 12.5% between 1950 and 2011 was obtained. Considering the fact that already existing reconstructions from literature performed for the Iberian peninsula for the period from 1950 to now were only performed for the summer months, the present paper could contain some new innovative results. The authors should however stress more on the new findings of the present work as compared to the papers by Bilbao et al. (2011) and Anton et al. (2011).

AC: We are agreed with the reviewer, the present paper could contain some new innovative results because the previous analyses were not done from 1950 at annual, winter, spring and autumn. A comparison with the results of Bilbao et al. (2011) and Antón et al. (2011) was carried out at Section 4.1.4 (UVER trends: Other periods) in the previous version. The new findings are also mentioned in the text (especially Section 4.1.4); in fact reviewer summarized some of them, hence, in order to stress more on the new findings, we include in the introduction (in the objectives paragraph) the next sentence:

“The annual and seasonal (not only summer) UVER trends at the Iberian Peninsula from 1950 are a novel issue of this paper, since these trends were not yet calculated in previous studies.”

RC: 2. The present study is one of the few studies, that I know, that include the open body fraction in the trend analysis. It is for me however still questionable how to interpret the open body erythemal UV values: the relevance of this quantity mainly pertains to the vitamin D production of the body and not to other uv related risks, since as soon as one part of the body is not covered by clothes it is at risk. It does not matter how much of the body is not protected in this case.

AC: We would like point out that the reviewer comment evidences the novelty of the paper, since this paper is the first using the open body fraction with erythemal UV radiation. Reviewer is right, as soon as one part of the body is not covered by clothes it is at risk, but on the other hand, if all body is covered (open body fraction equal to 0), the risk is null even for extreme high UV-Index.

WHO (2002) indicated that the risk of adverse health effects from UV radiation exposure is cumulative, hence we don't try to quantify the risk to produce sunburn (like UV-Index) but we want to quantify the UVER dose received by human skin. The portion of damaged skin will be higher when the open body fraction will be higher. As an example, we know the case of a 69-year-old man presented with a 25-year history of gradual, asymptomatic thickening and wrinkling of the skin on the left side of his face (Gordon and Brieva, 2012); his left side was exposed to UV radiation causing skin damage due to the cumulative UV effect, but if a more portion of his skin was also exposed to the same radiation, then more skin will be damaged. $UVER_{ob}$ evidences in a certain way how much portion of the skin is damaged.

We also assume that the size of sunburn is important; for example, two persons in a beach, one with a t-shirt but the other without t-shirt; both irresponsibly decided take a nap leaving their backs exposed to the same UV radiation; after the nap both had sunburn but the redness skin of the person with t-shirt was the arms while the person without t-shirt had redness skin in the arms and his full back. We considered that the damage of UV radiation over the person without t-shirt (more redness area) was higher, and it happened because the $UVER_{ob}$ received by the person without t-shirt was also higher.

In order to clarify this issue, we have changed some sentences of Section 4.2.2:

“UVER irradiation quantifies the toxicity of solar radiation over human skin. However, if the human body is totally covered by clothes or anything else, the skin will not be affected by sun exposure even for high UVER irradiation values. Therefore, in order to find a new variable which quantifies the UVER dose received by human skin, the UVER

over open body (UVER_{ob}) is defined as the UVER radiation multiplied by the open body fraction. UVER_{ob} irradiation, measured in Jm⁻² per open body unit, physically means the daily UVER irradiation received over the naked skin of a human who is exposed to sun the whole day. The open body fraction is usually multiplied by the UV radiation weighted by the vitamin D synthesis action spectrum (e.g., Chubarova and Zhdanova, 2013), but not by UVER radiation. The damage of UV over human skin is cumulative (WHO, 2002), and UVER_{ob} can be used to evidences how much portion of skin is damaged or how much bigger is the redness skin after an overexposure to sun.”

We still think that the UVER over open body is an interesting, novel and relevant magnitude, but it can be controversial. Anyway, we would like remark that if the reviewers still think that UVER_{ob} is not useful or necessary in this paper, we can remove this part (Section 4.2) in a second review process.

WHO (World Health Organization): Global Solar UV Index: A Practical Guide, 28 pp., ISBN 92-4-159007-6, Geneva, Switzerland, 2002.

Gordon, J. R. S. and Brieva, J. C.: Unilateral Dermatoheliosis, N. Engl. J. Med., 366:e25, doi:10.1056/NEJMicm1104059, 2012.

RC: 3. P.11: You should clearly mention what could be the result of a homogeneity test e.g. to find instrumentation/measurement problems, or is it only to find some trends such as the global dimming? When looking at fig. 2: at the station of A Coruna the end of 70ths and beginning of 80ths look very strange. The same remark applies to the peak in Madrid in the 70ths.

AC: The main purpose of the homogeneity tests is to obtain a statistical reference about the quality of the series. These tests give information about changes in instrumentation or any problem; we mainly look for this information in order to know if the series are useful or we need apply any correction. But we are lucky because these tests also give information about break points and changes in trends, and we use this information too. Therefore we use the tests mainly to study the quality of the series but also to detect changes in trends, like the reviewer mentioned. In order to clarify this, we added the next sentence in the new manuscript:

“The homogeneity tests are mainly applied in order to know whether the series are valid for trend studies or, on the contrary, they are not valid due to instrumentation/measurement problems; additionally, the homogeneity tests can provide information about break points in some climatic trends.”

Regarding the peaks of A Coruña and Madrid, they can look strange, but the homogeneity tests indicate that the annual UVER series from 1950-2011 at Madrid is inhomogeneity-free; for A Coruña just one month shows inhomogeneity in the 1950-1984 period (none for 1985-2011). In fact, the inhomogeneity detected at A Coruña could be related to the lack of data from the beginning of 70s to mid 70s. Therefore, these results point out that UVER series have the enough homogeneity to be considered as quality series (independently of their strange shape).

Other minor comments

RC: P.2, line 28: “Changes in aerosols led to alterations in the presence and microphysical properties of clouds: : :..”???

AC: This sentence has been replaced by:

“Changes in aerosols can modify the microphysical properties of clouds”

RC: P.4 line 3: “A further aim is to propose and study a new variable to quantify the UVER dose that reaches the naked human body exposed to sun” I would suggest to change “the naked human body exposed to sun” with “ the body parts exposed to the sun (not covered by clothes)”

AC: The sentence has been replaced as reviewer suggests.

RC: P5 line 10: up the present => up to the present

AC: Done.

RC: P.6 line 4 and 6: Chuvaroba => Chubarova

AC: Done.

RC: P.6 line 25: Roman(2014) which one of the Roman(2014) publications?

AC: It has been corrected. The reference of Román (2014) is a PhD thesis which is not any Román et al. (2014a, b, c, or d) previously cited.

RC: P.8, line 17: bins => intervals

AC: Done.

RC: P.13 line 29: please say in one sentence in what consists the methodology of Walker (2010).

AC: It has been explained adding the next sentence:

“...the methodology used by Walker (2010), who plotted the trends as points which type depends on the trend significance and he also added the 95% confidence intervals as error bars.”

RC: I do not think that you need to show figure 4. There is no difference between the trend of these three quantities because mean wind speed has probably not changed very much during this period. It would be enough to mention this in one sentence

AC: We are agreed with reviewer, hence we removed the effective temperature, and the open body fraction panels of the new paper, but we still think that the plot with mean temperature can be interesting. Mean temperature evolution is useful to understand the variation in the UVER irradiation over open body. How there is no difference between the trend of these three quantities, we show just one: mean temperature, and the remaining are mentioned in the text:

“The behaviour of t_{eff} and S (not shown) is similar since S is directly connected with t_{eff} and t_{eff} with T_m (Sect. 2).”