Journal: Atmospheric Chemistry and Physics Discussions
Title: Decadal variations in estimated surface solar radiation over Switzerland since the late 19th century
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Response to Referee #2

The manuscript entitled "Decadal variations in estimated surface solar radiation over Switzerland since the late 19th century", by A. Sanchez-Lorenzo and M. Wild, deals with the analysis of a sunshine duration and total cloud cover data set, covering a very long period, and a surface solar radiation network available for recent decades, with the aim of extending the latter in the past using the former as a proxy. The analysis is rigorous and well done, taking care of the quality and homogeneity of the data. The results are well discussed and the work provides with relevant information concerning a variable not yet well stressed at present in the scientific literature (mainly due to the unexploited data). For these reason I recommend this manuscript for publication.

We really appreciate the reviewer's comments and his/her recommendation for the publication of our manuscript in ACP.

I only suggest some minor improvements/clarifications:

These minor comments are addressed below.

**Section 1**
pag 10817 line 15-17: also Brunetti et al. (2009) (already present in your bibliography) highlighted a disagreement between SD and TCC trends, add it among the quoted references.

The reviewer is right. We have quoted Brunetti et al. (2009) reference in this sentence.

**Section 2**
pag 10819 line 20: replace "missing" with "available"

Done.

**Section 3**
pag 10821 line 10: replace "autocorrelation" with "correlation"

Done.

**Section 4**

pag 10822 lines 5-6 and 15-17: here it is not clear how the RMS errors were evaluated. The correct procedure would be a leave-one-out approach, i.e. reconstructing each SSR station series by evaluating the SSR-SD relationship excluding the station it-self from the analysis, and comparing observed-SSR and reconstructed-SSR. Please, clarify this aspect.

We estimated the RMS error for the mean estimated SSR series, which are based in the correlation of the **mean** SSR and SD series. We are not evaluating individual reconstructions for each station as in this work we propose a method to estimate regional mean time series instead of individual time series. We consider that these individual fitting are more sensitive to remaining inhomogeneities in the series, as well as local peculiarities and noise. Nevertheless, we have slightly changed this section and the Table 2 caption in in order to clarify the method.
On the other hand, we are planning to perform in the future a detailed analysis for the whole Europe in the framework of a project (http://www.iac.ethz.ch/people/arturos/suncloud/), including an estimation of the uncertainties in the estimates of all and clear sky irradiances.

**Section 6**

I am left with the doubt of what the 1931-1980 trend is in clear-sky SSR, i.e. for the longest period as possible before the recent brightening.

The linear trends over the 1931-1980 are not significant. Specifically, the annual and seasonal series (except for winter) show slight non-significant decreases during this period. We have added the sign of the trends in Table 5 in order to include this information in the revised manuscript.