Response to Referee #2

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Our response to the further comments of **Referee #2** is below

4. This is one of the main issues I signaled, and the Authors are not providing any satisfactory response. This was a question about uncertainty of the model estimates. I am slightly confused by their statement that the second (physical) model is not calibrated with any solar radiation data presented in this study. The un-calibrated model fit will be poorer than if the model was calibrated using these radiation data. I cannot see why this has not been done. Normally the uncertainty data would have been a by-product of such model fitting/calibration. Given the third party calibration, perhaps the Authors could generate a set of Monte Carlo simulations (model responses) given the estimated parameter uncertainties that came with the calibrated model?

Response: Thank you for your comment! We try to answer the uncertainty of the estimated trend by the hybrid model in the following. The uncertainty of the model is from the calibrated parameters a and b in the following expression (other parts are essential physical, which will not be discussed):

$$\tau_c = a + b(n/N) + (1 - a - b)(n/N)^2$$

The parameters is calibrated as: $a = 0.2505 \pm 0.0181$; $b = 1.1468 \pm 0.0529$ at 95% confidence level. In the first submission, we used $\tau_c = 0.2505 + 1.1468(n/N) - 0.3974(n/N)^2$ to calculate the surface solar radiation. Before deciding the necessity to generate a set of Monte Carlo simulations by this model, which need huge computational time as we have more 700 stations and many of them have more than 40-years records, we choose the four extreme conditions (taking the upper and lower bounds of parameters a and b) to re-calculate the surface solar radiation at 716 stations. The original and the four extreme conditions expression are given as follows:

Case0: $\tau_c = 0.2505 + 1.1468(n/N) - 0.3974(n/N)^2$ (default case)

Case1: $\tau_c = 0.2324 + 1.0939(n/N) - 0.3263(n/N)^2$

Case2: $\tau_c = 0.2324 + 1.1997(n/N) - 0.4321(n/N)^2$

Case3: $\tau_c = 0.2686 + 1.0939(n/N) - 0.3625(n/N)^2$

Case4: $\tau_c = 0.2686 + 1.1997(n/N) - 0.4683(n/N)^2$

Figure 1 shows the comparison among the five cases for time series during 1961-2006

averaged over all the stations. It can be found that the uncertainty of the hybrid model has little effect on the trend of the predicted solar radiation, though the magnitude of solar radiation has an uncertainty of several W m^{-2}. Therefore, a local calibration and a Monte Carlo test look not so necessary when our target is the trend of solar radiation.
We will input this discussion into the revised version.

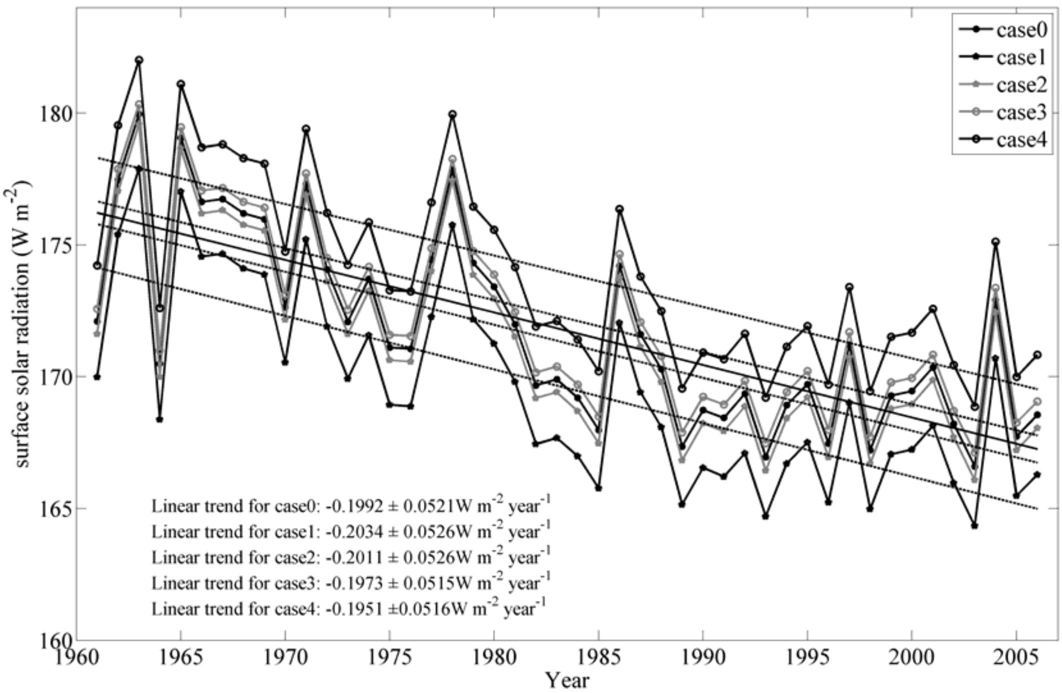

Figure 1: Sensitivity test to the predicted trend of solar radiation by changing calibrated parameter values.

5. The Authors did not respond to this very important comment. If I did not express myself clear, then I would offer explanation, if the Authors would like to contact me through the Handling Editor. It is important for the validity of the results and any comparisons in their discussion to have such uncertainty estimate of the estimates of the trend slope. It is important to the transparency of the communication to use generally accepted statistical terms. It would be advantageous to know why the Authors choose the specific trend forms (linear, quadratic). I do not think that fulfilling this suggestion would be very time consuming.

Response: In our last response, we had supposed that comment 5 and comment 6 raised a single suggestion. In our study, we used linear and quadratic fitting methods to analyze the time series so that our results can be compared with other similar studies in the literature. In reality, linear and/or quadratic fitting methods were usually used in this field. The following shows several examples.

Wild, M., Gilgen, H., and Roesch, A.: From dimming to brightening: decadal changes in solar radiation at earth's surface, ***Science***, 308, 847–850, doi:10.1126/science.1103215, 2005.

Wild, M., Trussel, B., Ohmura, A., et al.: Global dimming and brightening: an update beyond 2000, ***J. Geophys. Res***., 114, D00D13, doi:10.1029/2008JD011382, 2009.

Wild, M.: Global dimming and brightening: a review, ***J. Geophys. Res***., 114, D00D16, doi:10.1029/2008JD011470, 2009.

Pinker, R. T., Zhang, B., and Dutton, E. G.: Do satellites detect trends in surface solar radiation? ***Science***, 308, 850–854, 2005.

Shi, G. Y., Hayasaka, T., Ohmura, A., Chen, Z. H., Wang, B., Zhao, J. Q., Che, H. Z., and Xu, L.: Data quality assessment and the long-term trend of ground solar radiation in China, ***J. Appl. Meteorol. Clim***., 47, 1006–1016, doi:10.1175/2007JAMC1493.1, 2008.

Che, H. Z., Shi, G. Y., Zhang, X. Y., Arimoto, R., Zhao, J. Q., Xu, L., Wang, B., and Chen, Z. H.: Analysis of 40 yr of solar radiation data from China, 1961–2000, ***Geophys. Res. Lett***., 32, L06803, doi:10.1029/2004GL022322, 2005.

Liang, F. and Xia, X. A.: Long-term trends in solar radiation and the associated climatic factors over China for 1961–2000, ***Ann. Geophys.***, 23, 2425–2432, doi:10.5194/angeo-23-2425- 2005, 2005.

It looks that in this community it is a commonly accepted way to quantify climatic change by a simple fitting. Of course, the problem of comment 5 is worth being discussed. We will contact the editor. It would be the best if we can make a balance between the readership and an advanced analysis method.

7. While the title may be consistent with the goal of the paper, in the current form it is not in my view consistent with its contents. I hope that this will change in the revised version.

Response: Thank you! We will do our best to meet you suggestion.