Nonlinear Processes
in Geophysics

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Discussions

Interactive comment on "Chaotic Signatures and Global Solar Radiation model estimate over Nigeria, a Tropical region" *by* Adedayo Adelakuna and Folasade Adelakun

Anonymous Referee #1

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The manuscript investigates the use of a reconstruction model for daily solar global radiation based on temperature and relative humidity over 4 locations in Nigeria.

The topic of the manuscript is of great interests given the possible applications of such a model in the region. The merit of the paper is to study the application of the model through advanced mathematical techniques. The methodology applied is not original and poorly introduced by the authors, nonetheless the information derived can potentially be useful for other researchers working on the same topic over the same region or in other parts of the world. On the other hand, the manuscript in its present form has too many weaknesses for being considered for publication. It is my opinion that

the author should completely revise the manuscript and re-submit it for another review round. In its present form, the manuscript is not suitable for publication.

The most significant weakness is the organization of the manuscript. The Introduction is a mere review of the scientific literature, without mentioning authors motivations and highlighting the original part of this work. The method is very poorly presented. The scores used in the evaluation are not properly introduced and I suspect the equations defining them are wrong. The section on chaotic quantifiers comes as a surprise, since it is quite demanding from a mathematical point of view and poorly introduced, it is so disconnected from the rest of the paper that I was left wondering "Why do they do that?" for all the time I was reading it. The discussion of results is not easy to follow, given all the weaknesses reported above. The conclusions are very hard to follow, since statements like "the availability of solar irradiance in all selected zones has been discovered with the highest irradiance observed in Sahel savanna zone, which shows that the zone exhibit more complex solar irradiance than the other selected regions." I can not really understand them. The authors should make an effort to better communicate their findings. The way the study is communicated leaves much to be desired. Specific comments follow.

I hope the author would be willing to spend some more time rewriting the manuscript, such that this interesting work will get the attention it deserves.

Comments:

Title: remove "a Tropical region". "Over Nigeria" is fine.

Abstract: revise the text. Abbreviations are used without explaining their meaning (e.g. PV, RPs, RQA), you should explain them in the text and not only as Keywords. You should not use phrases like "the well-known statistical tools" without introducing them. The reader should not be left to guess the meaning of your statements. Try to be more specific.

Introduction: good review of scientific literature. The concise introduction on your own research must be rewritten. For example, by reading your introduction I'm not sure whether you have developed a statistical model for spatial analysis of solar global radiation or a model to forecast it. You should be more specific about your motivations, implementation choices (e.g. why not use solar radiation from reanalysis directly?) and methods.

Page 2. Lines 12-14. "The source [solar energy] has been capable of reducing climate and weather events". Not sure what this means. Please rephrase it or delete.

Page 2. Lines 21-23. I think here you are mixing processes that are very different from each other, giving the impression that they are all the same process. Statistical techniques are not methods to collect data. Statistical techniques can be used to estimate values of an observable quantity between locations where these values are known from other processes (e.g. observations, models). You should make it clear that there are measurements and models. They both return estimates of a quantity, though with very different properties.

Page 2. Lines 34-35. "various atmospheric situations have been applied to the field of science and engineering." the meaning is not clear.

Page 2. Lines 37-48 I do not get your point here "the complexity of the global solar radiation and the inherent irregularities occurrence in space can be identified to be chaotic or hyperchaotic based on the availability of climatological data which has been enriched with the theory of nonlinear dynamics." What do you mean when you state that global solar radiation is chaotic? Are you thinking at the forecasts and the fact that is dependent on initial conditions? The text jumps from saying that solar global radiation is highly variable in space to defining it as "chaotic", a definition of the term is needed here.

Page 2. Line 44. "And revealed." Please continue the statement

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Page 3. Lines 28-31. Please check the units (W/m^2 instead of W-Delta-m^2). Add the units to E0.

Sec. 2.1. This is the core of your paper. Here you present your model for the reconstruction of solar global radiation, given daily temperature and humidity. However, the title of this section is "study area and data analysis", which do not even mention the fact that here you are presenting your model. In addition, the reader gets the impression that Eqs.(1)-(2) have not been used before, which is not true. Please, specify your references for these equations. How did you get the idea to use them? Why not use directly the solar radiation one can derive from reanalysis? I can not answer this question, because you should have better specified in the Introduction your motivations. I think your objective is to estimate solar global radiation from a very reduced set of meteorological parameters (temperature and relative humidity), which are commonly measured by weather stations. In this way, it would not be necessary to install several expensive instruments in the regions to measure solar radiation, since it could be extracted from less expensive measurements. If this is your objective, then state it clearly in the Introduction.

Page 4. Section 2.2. Define the meanings of the abbreviations RMSE, SSE and R^2. I guess that they are:

- RMSE: root mean squared error, even though your definition in Eq.(9) multiplies the conventional RMSE by 100. Why so? In addition, the summation under the square root should have an index.

- SSE: it seems that Eq.(10) is a weird definition of a cumulation of squared deviations. Is this really needed, since you have defined RMSE. Why the two summations?

- R^2: I think this is the mean‐squared error skill score (MSESS) and not a correlation. See for example: Isotta, F. A., Begert, M., & Frei, C. (2019). Long‐term consistent monthly temperature and precipitation grid data sets for Switzerland over the past 150 years. Journal of Geophysical Research: Atmospheres, 124, 3783–3799.

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As all skill scores, it is positively oriented with the perfect score being 1. Please correct the text.

Section 3. The whole purpose of this section is obscure to me. I understand that the authors introduce advanced mathematical tools as diagnostics of the model they have presented in sec. 2.1. Your model for solar radiation is not too complex. Please explain in plain word what are the benefits of conducting an analysis on the chaotic properties of the parameter space. How this analysis is used to improve your model presented in Sec. 2.1? Eq.(12). A new operator is introduced <...> without explanation.

Page 8. Line 13. "The global solar radiation has been estimated using the least square regression". This is not true and it creates confusion about your method. You are applying the method presented in Sec. 2.1. Why are you mentioning least square regression?