

## General comments:

I read the manuscript with interest. The authors implement an estimation of clear sky solar radiation for both direct and diffuse components taking into account the effect of topography. Cloud information is obtained for both components applying a decomposition model to a set of disperse global radiation measurements. This information is then interpolated using kriging, allowing the calculation of shortwave solar radiation in other locations, also considering their topography.

The paper address an important subject and could be considered for publication after addressing the issues pointed out in the specific comments below.

## Specific comments:

The major concern is that further results analysis needs to be done and, in particular, the new concepts or ideas included in the manuscript that represent a contribution to modelling science should be better commented and highlighted. In P4327L24 it is stated that the goal of the paper is to show “how” the components work, keeping the statistical analysis to a simple level. In my opinion, the description of the implemented model should also include a more detailed analysis of its performance, which is certainly important in order to consider the paper for publication. In this sense, section 4.2 together with figures 3 and 4 should be removed or largely reduced to a comment about possible future work, unless results are obtained and presented using the methods described in this section. Other issues are enumerated below.

1. There are several references to the hydrological application of these components, however, no effort has been made to test this application. This is fine, but then, the reference to hydrology should just appear on the Introduction, as a possible application, and it should be removed from the abstract, conclusions and discussion because it is not part of the work presented.
2. Even though “GIS” is a commonly used acronym and will be understood by most readers, it would be recommendable to also define it the first time it appears in the text.
3. P4356L25. First sentence of Introduction must be corrected. Solar radiation at the top of the atmosphere is also function of the distance Sun-Earth, and the solar constant is usually defined at the mean S-E distance, which is why the correction  $E_0$  in Eq. (1) is applied.
4. P4359L15-20. Specify how  $I_{sc}$  is spatially corrected and rephrase why this correction is needed.
5. Ambient temperature and relative humidity are reported as inputs of the model, but they do not appear in any of the equations or elsewhere in the text so please specify in which of the referenced models and/or how are they used.
6. P4363L20-21. Rephrase the unclear sentence “To account for the presence of clouds, some models found in the literature were denominated decomposition models.” and include here the pertinent references.
7. How does the model handle the event of shadowed sites? In this case the clear sky direct irradiance will be zero and  $(c_s)_i$  will not be well defined. This will affect the interpolation at non-shaded sites.

8. Three decomposition models are described for the DEC-MOD's component, namely Erbs et al. (1982); Reindl et al. (1990) and Boland et al. (2001). However only the first two are used in the validation process. In addition and according to P4369L9-11 Reindl model is applied to the sites "Little Washita and Fort Cobb catchments", and Erbs model to site "Piave river basin". But section 3.4.3 states that Reindl model is used for site "Piave river basin". Why are not all the models used in all the sites? This way their performance could be better assessed on complex topography. The reader and potential user of the proposed implementations could also benefit from a recommendation on the use of one of them.
9. Section 3.1 states that the 5 minutes data was summed/accumulated/summarized to an hourly step. Do you mean averaged?, please use the same term for the three sites and expand the description of this process.
10. How was the selection process for the validation data sets?

#### 11. Mathematical formulae, symbols and units

- Several errors and inconsistencies were found throughout the paper.
- Eq 1 defines the direct component as  $R_{sw}$ , also in the comment before the equation, and also in table 8  $R$  is defined as "direct" But in most of the paper  $S$  is used for the direct component and  $R$  for the global shortwave radiation (sum of direct and diffuse). Please fix.
- The shadow index in equation (1)  $\Psi$  is referred as  $\Psi_s$  later in equation (6).
- P4363L7 Please check if  $F_s$  should read  $F_c$ , or define and add  $F_s$  to the list of symbols.
- In Eq. 24,  $k_d$  is missing the subindex  $i$ .
- Please review all the references to equations in the text, most of them seem to be off (e.g. P4365L9 Eq. (22) should be Eq. (28); P4370L5 "...Eq(21) and (22):" should be 33 and 34).
- List of Symbols in Table 8: fix  $k_d$  definition "???" ; remove the value of constant  $C_i$ ; fix both  $S$  symbols sharing the same definition; remove "direct" from the  $R$  symbols; exchange the formula with a name/description for the symbol  $\tau_{as}$ .
- Units are missing for the Latitude and Longitude columns in tables 2, 3, and 4.
- Table 7 is also missing units for the MAE column.
- Please remove the decimal point and digit for the Elevation column in tables 2 and 3.

#### 12. Figures

- Fig. 1. Enlarge the figure font as it is difficult to read. What do G.C. And F.C. Stand for? There is a sentence "Geomorphic features refer to..." but no "Geomorphic features" appearance in the figure.
- Fig. 2. Change "between" to "for". Also in the caption the stations named are 146 and 159, but in the sub-figure titles the numbers are 146 and 153.
- Figs. 3 and 4 could be removed.
- Figs. 5-7. Expand the captions. Add Latitude/Longitude grids, scale, and north arrow to the maps. Specify in the legend what do the triangle and circle stand for, according to figures 6 and 7 it seems to be a distinction between the C-set and the V-set but this does not stand for figure 5. Add the total area covered to the description of the three sites. Remove the ".0" from station ids in figure 6.
- A map of Direct and Diffuse radiation, or maybe simply a map of global radiation must be added to demonstrate the results of the method, and a description and analysis of the map will throw some light about the goodness of the methodology when applied to complex topography in addition to the utilized statistics.