

Comment 1: P1649. Title: I would recommend to fully write out the acronym PAR in the title to make the study clear to newcomers and outsiders to the field.

Response:

The title is now modified to read “Development of a semi-parametric Photosynthetically Active Radiation partitioning model for the Contiguous United States”

Comment 2: P1652. Line 27: ‘removed outliers’. In the remaining of the paragraph some criteria are given. Is this the what you meant with removing outliers, or is this in addition to that? If the former, then please make the clear in the text and if it is in addition, then please clarify what the criteria are to remove outliers.

Response: The removed outliers in this case refer to removal of data points in addition to the criteria mentioned in the text. This removal process was done after visual examination of data to remove points which are physically not possible. Such data points could occur due to electronic noise or instrument malfunction. Since we didn’t do any de-spiking or statistical screening of data, we resorted to such a simple method. More over some of the agricultural sites included center pivot irrigation systems which can affect the sensor performance.

Comment 3: P1653. Line 10: I would like to see somewhere how many years of measurements are available for each station. Maybe this could be included in Table 1.

Response: This data is now included and the modified table is presented below. The sensor name column is also now removed.

Sl. No	Site Name	Location	Ecosystem type	Site Years
1	Bartlett Experimental Forest (US-Bar)	44.0646 -71.2881	Deciduous Broadleaf forest	1.2
2	Flagstaff Managed Forest (US-FmF)	35.1426 -111.7273	Evergreen needleleaf forest	1.11
3	Flagstaff Unmanaged Forest (US-Fuf)	35.0890 -111.7620	Evergreen needleleaf forest	1.23
4	Flagstaff Wildfire (US-Fwf)	35.4454 -111.7718	Woody savannas	1.19
5	Mead Irrigated US-Ne1	41.16506 -96.4766	Croplands	2.09
6	Mead Irrigated Rotation US-Ne2	41.16487 -96.4701	Croplands	2.21
7	Mead Rain fed US-Ne3	41.17967 -96.4396	Croplands	2.19
8	Morgan Monroe State Forest (US-MMS)	39.3231 -86.4131	Deciduous broadleaf	0.34
9	University of Michigan Biological Station (US-UMB)	45.5598 -84.7138	Deciduous broadleaf	0.61

Comment 4: P1653 Eq 1: R_E is not mentioned in the text.

Response: line 11 of page 1653 is modified now to include a definition of R_E "Extraterrestrial PAR (R_E) was calculated with solar elevation angle at a location according to"

Comment 5: P1653, line 22 and Eq. 2: In line 15 the sine of the solar elevation angle is set as $\sin \theta$. I would use the same variables here: thus not S (in the text, or is this actually the albedo?) or just θ (in the equation). Also in the equation, k_t appears twice.

Response:

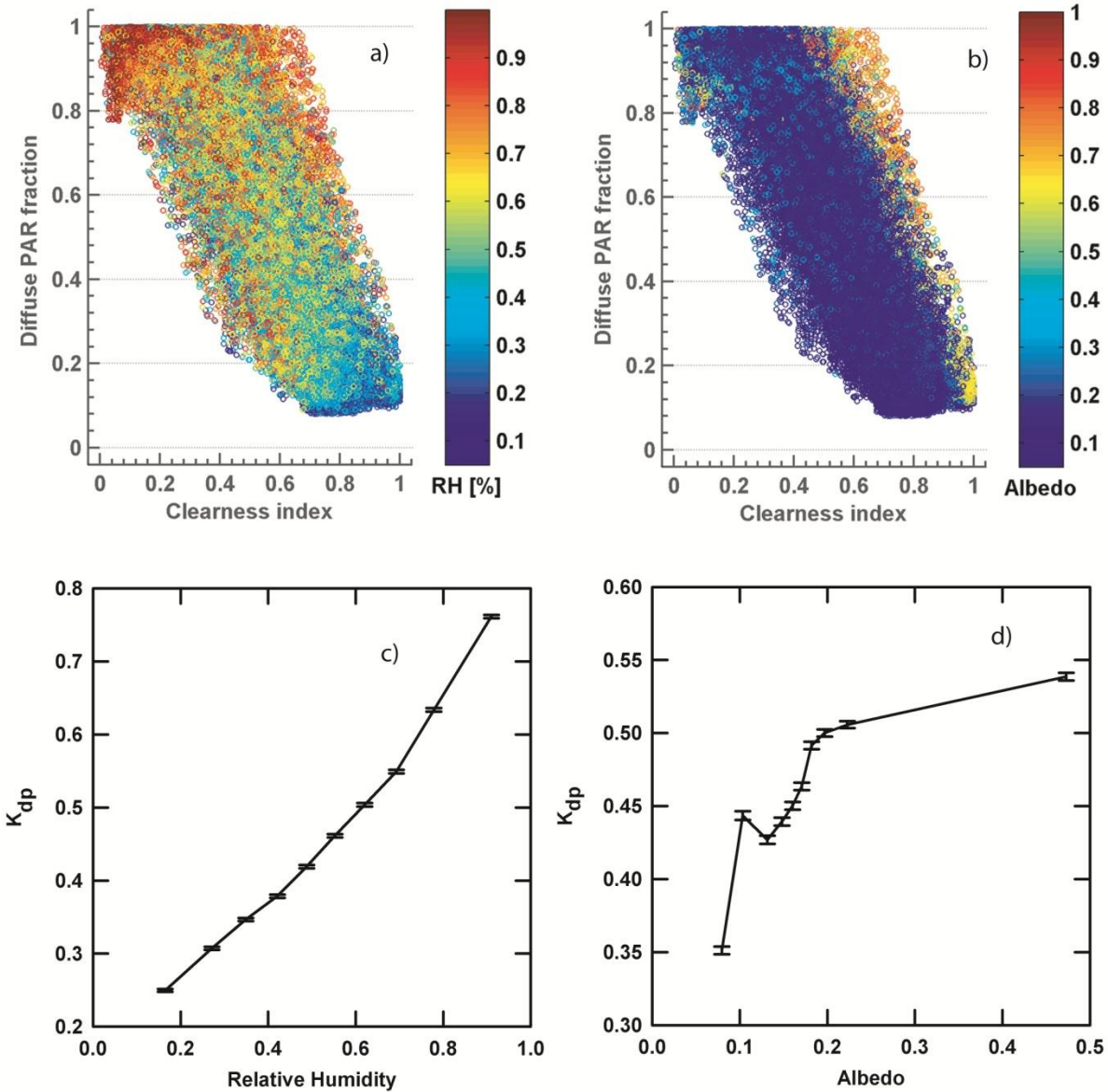
The sine of the solar elevation angle is represented as $\sin \theta$, just in the equation. This same notation is followed in equation 3 and 1. Equation 2 has a different notation, which was the original form the authors used, this will be changed to maintain uniformity and this change will also be made to line 22 of the text on page 1653. The original model of Ridley et al., (2009) has the clearness index (k_t) appearing twice in the denominator.

Comment 6: P1653, line 3: just to be sure; k_t refers to the daily clearness index and k_{tp} to the PAR clearness index, correct?

Response: k_t refers to the daily clearness index as used in the model of Ridley et al., 2009 and k_{tp} in our model is a hourly PAR clearness index.

Comment 7: P1654, line 9 and line 18. The figures are discussed here, but I am not sure I can read the figures fully. There are so many points, that some points may be overlapped by others. So, the order of printing actually matters. I believe that the conclusions in this paragraph are correct, but I am not sure if I can easily read this from the figures.

Response: The figure 1 is now redrawn with 4 panels and the added two panels show the relationship between the diffuse fraction and relative humidity and albedo. The data is now presented after binning albedo and relative humidity into classes of unequal width having equal number of points.



Comment8: P1655, line 20-23. In Fig 2 the measured and modeled values are depicted in one plot and it seems that the modeled values lie nicely in the center of the range of measured values. However in Fig. 3 the differences show only negative values. I am not sure I understand this. I would expect that fitting would result in some positive and some negative values.

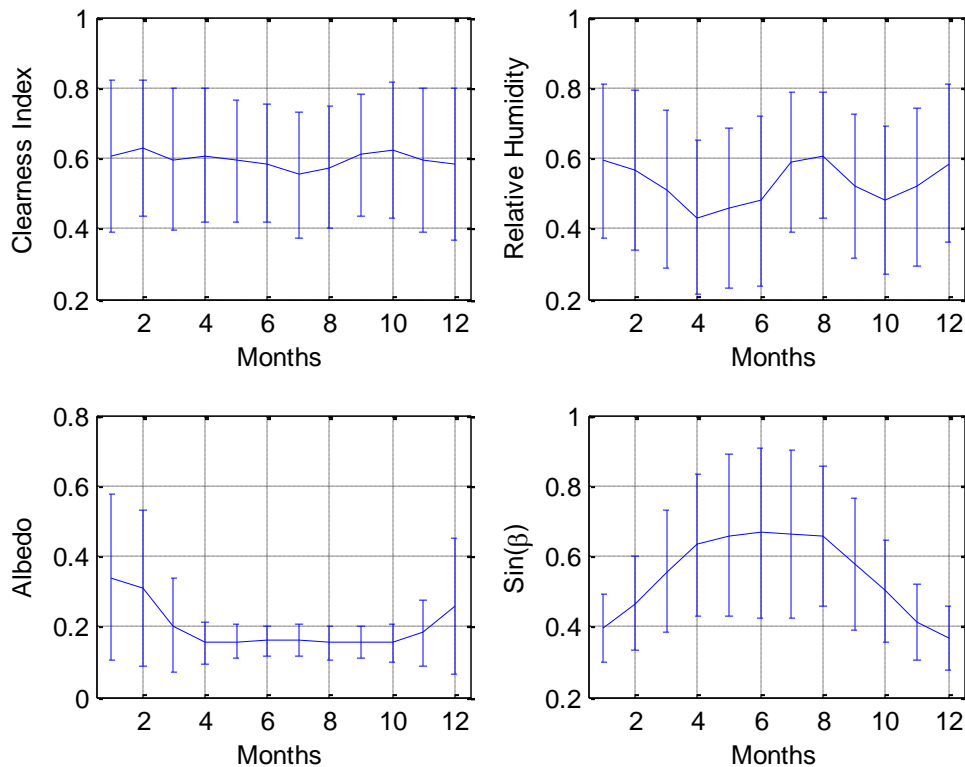
Response: Figure 2 is derived from the data set which is used to estimate the model coefficients (2/3rd of the dataset), whereas figure 4 which shows the fit of the model with coefficients derived from 2/3rd of data to the rest 1/3rd data. This difference in the data sets used for plotting the figures can explain the inconsistencies between figure 2 and figure 4.

Comment9: P1656 line 16. I enjoyed this interpretation of the findings, but I was wondering if there is a physical explanation why it is harder to model these conditions. If so, then please insert that here.

Response: Under clear sky conditions, diffuse fraction is low compared to the total incoming PAR and under such conditions uncertainties in estimation of diffuse fraction are high. Further conditions which limit instrument performance such as lower solar elevation angles and condensing conditions are not included in the study. This could be a reason why errors are more observed under clearer conditions than cloudy conditions. We will include the above paragraph in the manuscript (Discussion Section).

Comment10: P1657 line 3-5: Does one of the parameters show significant different values for Sep-Dec wrt. the rest of the year?

Response: Clearness index shows no seasonal trends, but relative humidity and albedo shows increases during the October to December months. Similar higher values are also observed during the months from January to March. The solar elevation angle shows the highest value during the summer months compared to the fall and winter months as expected.



Comment11: P1662, Table 1: Indicate the total amount of data (measurement points and/or range of years). You might want to consider to remove the sensor column.

Response: The table is now modified; please see response to comment 3

Comment12: P1663, Table 2: The two sets of parameters differ wildly from each other. I presume this is because of strong correlations between certain parameters. Because of these correlations, the 95% confidence interval is of limited value, as you may not freely change all parameters within the corresponding ranges. If the authors have some insight in these correlations, then it may be worthwhile to discuss this in the text.

Response: The parameters included in this model are sine of the solar elevation angle, albedo, and PAR clearness index. The correlation coefficients between these variables from our data set are given below and all correlations are significant at 95% confidence interval, other than the relationship between albedo and PAR clearness index.

<i>Variable</i>	<i>K_{tp}</i>	<i>RH</i>	<i>albedo</i>	<i>Sin(β)</i>
<i>K_{tp}</i>	1.000	-0.489*	0.004	0.192*
<i>RH</i>	-0.489*	1.000	0.289*	-0.210*
<i>albedo</i>	0.004	0.289*	1.000	-0.262*
<i>Sin(β)</i>	0.192*	-0.210*	-0.262*	1.000

A high negative correlation is observed between RH and K_{tp} as increased humidity is often associated with cloudy conditions. Lower correlation coefficients are observed for the relationship among other variables. Under clear sky conditions the diffuse PAR fraction is influenced by the model drivers in a different way than under partially cloudy or cloudy conditions. Hence the model coefficients show a bigger difference above and below a PAR clearness index of 0.78.

Comment13: P1665: Fig 1: I have the impression that I do not see all the points making it hard to interpret these figures. Could the data be presented in a different way, or with a reduced data set?

Response: The figures is now modified, please see response to comment7.

Comment14: P1666: Fig 2: Please explain the difference between panel a and b in the caption.

Response: The caption can be modified to “Model fit for the proposed multi-parameter logistic model (a and b) and cubic model (c). Panel a represents the initial fit to the logistic form and panel b indicates the modification to the initial logistic fit with a second logistic fit”

Comment15: Technical corrections

P1664: Caption: estiamte → estimate

Response:

This error is corrected now.