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Geoscientific Model Development Discussions

Interactive comment on "How to reconstruct diffuse radiation scenario for simulating GPP in land surface models?" *by* Yuan Zhang et al.

Anonymous Referee #1

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Yuan Zhang et al. "How to reconstruct diffuse radiation scenario for simulating GPP in land surface models?"

Recommendation to editor: Major

GENERAL: This paper compared different methods on reconducting spatiotemporal distribution of diffuse radiative fraction and explored the GPP responses to different diffuse conditions. Results show that the reconstruction of Fdf forcing fields need to be synchronous with aerosols and clouds amount. The topic is important and timely for exploring the diffuse fertilization effects. However, there are some important problems need to be solved on this paper:

(1) The whole study does not present any observations to validate the model and to

testify the importance of some Fdf modifications. The sensitivity of GPP to the changes of diffuse radiation should be validated against available observations. Mercado et al. (2009) provided a good example on how to perform such validations. Furthermore, several sensitivity experiments are performed with different settings of Fdf and show the consequent changes in GPP. However, such changes in GPP should be compared against observations to show which method can largely reduce modeling uncertainties.

(2) Figure 2a: the historical global mean Fdf are around 0.6-0.7 during 1900-2010, which is significantly vary from the results (0.4-0.5) from figure 3a by Mercado et al. (2009). What are the causes of such differences? Moreover, please show daily, seasonal and annual Fdf changes in supplement information so as to better validate predictions from different model. The global Fdf of DF-PI-ENS should be also added in Figure 1.

(3) Line 201: "This generally explains the spatial pattern of $\triangle$GPP detected in this study (Fig. 3a)." Fig.3a shows DF-PI-AERO underestimates significantly global GPP than DF-HIST, especially East Asia, Amazon and west Africa. Why do the different results appear? There are very small differences in Fdf between DF-HIST and DF-PI-AERO as shown in Figs 1a and 1d.

(4) Some of the conclusions are model dependent. For example, Lines 244-245, "This difference implies that the mismatch between Fdf and radiation is more important than the mean diffuse radiation over a long period." It remains unclear whether other models also support this conclusion. Again, the missing of observational validations makes this conclusion unconvincing.

SPECIFIC

Lines 38-45: Please add some recent references on aerosol-induced diffuse effects, such as Rap et al. (2018) and Yue and Unger (2018).

Lines 100-104: Are you using SW as input and calculate PAR for vegetation model?

Please explain how PAR and SW is connected in the model.

Figure 2: if possible, the interannual variations of Fdf from four reconstructions can be shown in Fig 2a.

Line 175: “dGPP” should be replaced as “ΔGPP”.

Lines 207-209: “Because the solar zenith angle is large due to longer light path in atmosphere in the morning and afternoon, the Fdf is usually large in the morning and afternoon but low at midday (Iziomon and Aro , 1998).” These are conflicting with lines 124-125, which say: “This method accounts for the periodical diurnal increase of Fdf from morning to mid-day and its decrease from mid-day to afternoon.”

Reference: Mercado, L.M., Bellouin, N., Sitch, S., Boucher, O., Huntingford, C., Wild, M., Cox, P.M., 2009. Impact of changes in diffuse radiation on the global land carbon sink. Nature 458, 1014-U1087. Rap, A., Scott, C.E., Reddington, C.L., Mercado, L., Ellis, R.J., Garraway, S., Evans, M.J., Beerling, D.J., MacKenzie, A.R., Hewitt, C.N., Spracklen, D.V., 2018. Enhanced global primary production by biogenic aerosol via diffuse radiation fertilization. Nature Geoscience 11, 640-+. Yue, X., Unger, N., 2018. Fire air pollution reduces global terrestrial productivity. Nature Communications 9.

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