

Responses to Anonymous Referee #2

Below are our point-by-point responses to the comments of Referee #2.

General comments:

The paper submitted by the Authors demonstrates the application of the Ecosystem Demography (ED2) Model which has been improved by including a river routing routine. The model was applied to the Tapajós River Basin. While the model shows improvements, the approach is not particularly novel and I believe that the value of the paper could be improved by providing more detail on the input parameters and variables used in the model. By considering the input parameters, the discussion could be improved by describing them in light of understanding the hydrological processes in the Basin and therefore improve the interpretation of the results. In its present form, the results only really illustrate that the model improved the simulation and gives little hydrological interpretation as to why. I think the introduction could be improved by giving a brief review of the significance of river-routing routines in hydrological modeling as well as what the “state-of-the-art” is in terms of large scale river basin model development.

Response: We thank the referee for the constructive comments and feedback on the manuscript.

General comment 1: *“By considering the input parameters, the discussion could be improved by describing them in light of understanding the hydrological processes in the Basin and therefore improve the interpretation of the results. In its present form, the results only really illustrate that the model improved the simulation and gives little hydrological interpretation as to why.”*

Response: We will improve the presentation of the input parameters and variables used in the model, and to explain their practical implications for the hydrological process. As suggested in the Referee 2’s subsequent specific comments, Annex B will be incorporated in section 4 and Annex A eliminated (this was also suggested by Referee 1).

We will focus more on the interpretation, filling the gaps related to the comment *“the results only really illustrate that the model improved the simulation and gives little hydrological interpretation as to why”*

General comment: 2: *“I think the introduction could be improved by giving a brief review of the significance of river-routing routines in hydrological modeling as well as what the “state-of-the-art” is in terms of large scale river basin model development.”*

Response: We will revise and expand the description of the river routing routines and their significance in hydrological modeling and clarify what is the current state-of-the-art in large scale river basin model development.

Specific Comments:

Specific technical corrections are listed below:

1. Pg 3 L22 *Remove the word “of” after . . .investigating of how. . .*

Response: The sentence will be modified as suggested.

2. Pg 4 L23 *What is the word heterogeneity referring to? Is it the landuse, rainfall, soils etc.?*

Response: The heterogeneity being referred to here is the heterogeneity in ecosystem composition and structure within the climatological grid cells. The sentence will be revised to clarify this point.

3. Pg 4 Sect. 2 *As mentioned earlier, I believe a brief description of the model parameters and variables would be useful. This would add value to the paper so that the results could be reproduced by other researchers. In the papers present form, the reader would certainly not be able to reproduce the results. The parameters/variables used could be presented in a table format.*

Response: As suggested, a table summarizing the main hydrological parameters will be added into the manuscript to enable the results to be reproduced by other researchers

4. Pg 5 L26 *the IPH-MGB model routing routine forms the foundation for the ED2+R model. This needs to be briefly expanded on and mentioned in the Introduction of the paper.*

Response: As suggested, a more detailed description of the MGB-IPH routing scheme used will be added.

5. Pg 5 L27 *move the word “used” in front of the word “extensively” (i.e. ...used extensively. . . rather than extensively used.)*

Response: This sentence will be modified as suggested.

6. Pg 6 L9 *I don’t think Annex A is required in this paper. Therefore, the reference to Annex A can be removed.*

Response: This Annex will be deleted as suggested.

7. Pg 6 Sect 4. *The catchment characteristics need to be described. For example, what is the landuse, altitude, geology, slope, soil depth and texture etc., as well as a climate description such as rainfall, evaporation temperature, seasonality etc.*

Response: As suggested, we will add a more detailed description of the basin (land use, altitude, geology, slope, soil depth and texture etc., as well as a climate description such as rainfall, evaporation, temperature, seasonality etc.) and stress more the reasons why we are interested in the Tapajós.

8. Pg 7 L13 *what are parameters α and β ? what is there range (i.e. 1-10 or 1-100 etc).*

Response: As described in the annex B, “...the calibration process has two steps, as highlighted in Figure 2. The first step is the partitioning of the flows from the two reservoirs of the ED2 biosphere model to the three reservoirs of the ED2+R routed biosphere model”.

The main point is that the biosphere model ED2 is organized in 2 reservoirs (surface and sub-surface), while the integrated model ED2+R is organized in three reservoirs (surface, intermediate, and base reservoirs). Alpha (ranging from 0 to 1 or 0% to 100%) represents the portion of ED2 surface runoff destined to the ED2+R surface reservoir. The remaining part (1-alpha) goes to the ED2+R intermediate reservoir. Beta represents a similar partitioning coefficient for the ED2 subsurface reservoir to the ED2+R intermediate and base reservoirs.

In the revised paper, we will move the annex B in section 4 and add a better description of the alpha and beta parameters.

9. Pg 7 L15 *change the word “was” to “were”*

Response: the above grammatical error will be corrected.

10. Pg 7 L20 *this is the first time parameters CS, CI and CB are referred to, by no description of what they are is given. The first time they are described is in Annex B.*

Response: In the revised paper, we will move the annex B in section 4 and redraft the parameters description in order to give appropriate information when introducing the CS, CI and CB parameters.

11. Pg 8 L18 *Avoid vague terms like “reasonably well”. Try and quantify such statements.*

Response: We will revise the above sentence in order to provide detailed quantification of the improvements in model performance.

12. Pg 8 L 31 *As above, avoid vague terms such as “excellent match”. Quantify what makes this and excellent match.*

Response: As per response #11 above, we will revise the above sentence in order to provide detailed quantification of the improvements in model performance.

13. Pg 9 L 17 *How much of an impact does deep groundwater have on the streamflow and therefore on the routing routine? This could be determined by doing a sensitivity analysis of CS, CI and CB.*

Response: We agree with the referee that such analysis is important, and that is what we intended to present in the comparison of Cs, Ci, and Cb presented in Fig. B.3. As mentioned above, in the revised manuscript Annex B will be incorporated in section 4. Doing this, we will give more relevance to the findings presented in figure B.3.

14. Pg 9 L26 &27 *What makes the ED2+R models principal advantage its ability to predict the sensitivity to global environmental change? This statements needs to be substantiated and once again, the input parameters need to be described. For example, is the model able to simulated changes in transpiration due to increases in CO2 which has a knock-on effect on streamflow.*

Response: The principal advantage is ED2+R’s ability to predict how the integrated responses of terrestrial ecosystems to changes in climate forcing, increasing atmospheric carbon dioxide concentrations and land-use change will affect streamflow. We will revise this sentence to make this point more clear.

15. Pg 9 L27-29 The sentence “As mentioned. . .modelling framework.” Is repetition. Therefore, this could be deleted.

Response: in the revised paper, this sentence will be deleted as suggested.

16. Pg 10 L3-9 *This sentence does not form part of a conclusion, but is merely a repeat of what is said in the introduction. Therefore, this could be deleted and the conclusion begin from “. . .In this Technical Note. . .”*

Response: in the revised paper, this sentence will be revised as suggested.

17. Pg 10 Sect 7. *As mentioned previously, without some description of the model parameters and inputs, it is difficult to draw hydrological conclusions when there is no transparency as to what has been input into the model. If the input parameters are known, then better conclusions can be drawn as to whether it is the input data that requires attention rather than the parametrisation of another routine, which in this case is the river-routing routine.*

Response: We hope that this concern will be addressed once the table with the

hydrological parameters and inputs are incorporated (see response 3 above).

18. Pg 11 Annex B I think Annex B should be incorporated into the paper rather than as a separate Annex. A chapter on the calibration of the model is important.

Response: Annex B that described the model calibration will be moved into section 4 of the main text as suggested.