22 Sept. 2016

Editor's comment on

F. Langerwisch, A. Walz, A. Rammig, B. Tietjen, K. Thonicke, and W. Cramer.
"Deforestation in Amazonia impacts riverine carbon dynamics"
submitted to Earth System Dynamics, esd-2015-66.

Dear Mrs. Langerwisch,

thank you for your revised manuscript. The referee's comments are well accounted for. Nevertheless, I think that the scientific relevance of the paper could be improved.

Currently the paper reads like an engineering study, where one is only interested in the outcome, but not in improvement of understanding. Such papers can be published in ESD, but as an editor such papers are not my first choice. Modeling terrigenous carbon losses from inundation is a quite new subject. Hence there are large uncertainties involved in how to model the relevant processes and one cannot expect that with your study the last word has been spoken, particularly with respect to the numbers obtained from your simulations. But your insights in understanding the relevant processes may well survive future developments of the subject. Therefore, I would very much appreciate if this process insight is well explained in the paper so that your study stays worth reading even after new studies have appeared that may revise your numbers.

Adding more explanation would be helpful in two directions. First, the new aspect beyond the contents of your just published study in ESD is deforestation. To model this, you developed quite some process understanding how deforestation may affect the terrigenous carbon losses. It would be very helpful, if your process understanding could be made explicit in the paper. Currently there is no introductory passage in the paper explaining how you model deforestation and why you model it that way. There is one remark in lines 244-246 where you say that you assume 15% soy bean and 85% pasture for beef production on the deforested area, but it is left to the reader to imagine what this means for your study. And in section 4.1 "Shortcomings" you add some hints that would have been useful to be introduced early in the paper, and not as shortcomings, but as features of your model.

For me as a reader of your paper it would be very helpful to add answers to the following questions early in the paper when introducing your model:

- What is specific about agricultural lands for terrigenous carbon losses into rivers compared to natural grasslands or forests?
- How do the particular types of agriculture that you assume (soy bean farming, ranching) enter your calculations?
- In line 390 you talk about "deforestation-induced increase in discharge" -- how is this modeled?
- What happens to the carbon cleared upon deforestation?
- There is a huge amount of literature on water erosion and it is well known that agriculture and overgrazing enhances soil losses to neighboring grounds and rivers permanently (see e.g. [1,2,3]). This is different from the temporary effect of deforestation that you discuss in lines 488-491. How do such processes affect the results of your study? That you consider only the effects of inundation must be made explicit already early in your study.
- Generally I would expect that deforestation for farming happens outside the areas subject to inundation. What are your assumptions on the overlap of deforestated and inundated areas? Would it be helpful to add a map showing this overlap?

Second, your results and discussion sections are mostly descriptive, without much explanation why things happen the way you see them in your simulations. Here are some suggestions to improve the paper in this respect:

- The effect of deforestation must be related to the overlap of deforested an inundated areas in your model. Hence shifting the original Fig. 2 showing the distribution of deforestation into the supplement (Fig. S1) is in my opinion not a good idea. I understand that you did this in reaction to a remark by referee #1, but he wanted only a different way of presenting the deforestation data (which is disputable). That the deforestation information is already published elsewhere doesn't matter, since having Figs. S1 (formerly Fig 2) and 2 (formerly Fig 3) alongside has much value for the readability of your paper because it nicely demonstrates that the deforestation pattern explains e.g. the pattern of outgassing CO2. It also makes very obvious important differences in the intensity of deforestation in the selected regions. But: to which scenario refers Fig S1? It would probably be good to see the structure of deforestation also for the other scenario – or are the spatial structures so identical? And I think it would also be helpful for the interpretation of Fig. 5 to see how deforestation develops in time.
- In Fig. 2 the POC pattern also largely follows the deforestation pattern shown in Fig S1. But there are many white spots in the eastern part where deforestation is strong – what does this mean?
- In Fig 2 inorganic carbon (IC) is affected only at the margins of Amazonia, but not in inner Amazonia. How can this be explained? Why does the IC pattern not follow the deforestation pattern?
- Interpreting what you say in section 3.2, I guess that Fig. 5 shows the combined effect of deforestation and climate change (E_CCDefor). Since your paper is primarily about deforestation it would be good to see also a similar plot on the temporal development of E_Defor and discuss differences in the temporal behaviour with and without climate change.
- I cannot really follow your explanation for the drop in POC and outgassed C in R2 and R3, seen in Fig. 5 happening only in the BAU scenario (your lines 477-483). Why do the scenarios behave so differently? And in region R3 this drop already starts before 2050 – is this also explained by your "shortcoming"? Also your explanation to Reviewer #1 on this point is not comprehensible to me. Moreover, if this drop after 2050 is really an artefact of the artificial scenario extensions, why at all then showing results after 2050 (this concerns all figures)? And why then mentioning results for times beyond 2050 in the abstract?
- If I understand Figs. 2 and 4 right, they show according to Eqs. (3) and (4) the effect for 2070-2099. Hence this includes the artificial stop of deforestation in 2050. Wouldn't it be more interesting to see the effects in 2050 because the scenarios you use are maybe of regional political interest?

Further remarks:
- Figs. 2 and 4: What do the white grid cells mean? Outside Amazonia its clear, but not inside Amazonia.
- Grammar error in line 36.
- You say in line 189 that only "relative changes in in the carbon can be assessed by the model". What means "relative" here? I fear that since total carbon mass is conserved, even relative numbers may not be trustable, because an overestimation of a relative change in one carbon variable may imply an underestimation in the relative change in another carbon variable.
- I do not really understand what you want to say with lines 437-447: Why do you start with global NPP in line 437? Has it any relevance for your question? The sentence starting in line 438 is also not clear: I guess that you get the 6 PgC/yr NPP by multiplying the per square-km NPP value from the next line with the area of Amazonia. If so, the 0.25 PgC/yr exported

to the Atlantic ocean make only 4% of Amazonian NPP – this is much less than any accuracy in NPP that can be obtained for Amazonia and thus is unimportant for any assessment in contrast to what you say in lines 445-447.

- In lines 225-226 you explain how you handle deforestation after 2050. Do I understand this right that you stop deforestation in 2051? I find this sentence a bit confusing, first because of the word "while" which indicates some temporal parallelism which is probably not meant here, and second because you say that you "neglect" further deforestation as if you would know what happens after 2050.
- In lines 225-226 you note as reason for the artificial extension of the deforestation scenarios "to show the long term effects of deforestation". But in the remainder of the paper you do not discuss these "long term effects". So, what are the "long term effects"?
- I guess the nice new insets to Fig. 4 are computed on the basis of the D-measures introduced in (5) and (6)? If so this should be mentioned in the caption.
- Line 382: changeS --> change.
- Line 482: What do you mean by "as it is"?

With best regards,
Christian Reick

Literature

[1] Yang, Dawen, et al. "Global potential soil erosion with reference to land use and climate changes." Hydrological processes 17.14 (2003): 2913-2928.
[2] Walling, Desmond E. The impact of global change on erosion and sediment transport by rivers: current progress and future challenges. Unesco, 2009.
[3] Bork, Hans-Rudolf, and Andreas Lang. "Quantification of past soil erosion and land use/land cover changes in Germany." Long term hillslope and fluvial system modelling. Springer Berlin Heidelberg, 2003. 231-239.