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Interactive comment on "Climate change increases riverine carbon outgassing while export to the ocean remains uncertain" *by* F. Langerwisch et al.

Anonymous Referee #2

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This manuscript takes on the rather daunting task of coupling a large scale dynamic vegetation model with a highly aggregated river carbon model to address the potential changes in river carbon fluxes under different climate change scenarios. The plus/minus to doing this are:

Plus. It is very useful to think about developing overall system models, coupling the multiple key sectors. It forces critical thinking, and the mobilization of information from multiple sources. Not an easy task!

Minus. That said, at what point is the aggregation so great and assumptions so broad that there is a little confidence in the output?

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Interactive Discussion
Discussion Paper

BROAD ISSUES 1. The model development discussion is very generic, and shows little understanding of the Amazon itself, at multiple levels. - It starts with the space and time scales of the model, set to 0.5o and monthly. In a month, a parcel of water travels from high in the Andes to the Atlantic. A 50 x 50 km cell covers rather a lot of territory, relative to the scale of stream and river channels. - It seems that all rate terms including in-river are computed within LPJmL, which is purely terrestrial. It would be useful –essential- to evaluate these relative to in-river measurements (literature). - I started to go through the model setup topic-by-topic, and tracking each to output, but don't have enough time to complete that.

2. The analysis breaks the Amazon up into several sectors (northern, western, etc) . Calibration/validation is done very generically for the "export" values cited (which correspond to the station of Óbidos, though not mentioned). That station represents the highly damped integration of so many very different water sources (Madeira vs Negro, for example) and timing that it doesn't represent a robust point of calibration, if the intent is to represent the response of different regions. (see below)

3. It is not at all clear how the values of the different primary pools are established – POC, DOC, (D)IC, other than to say "mobilization." Processes for each are very different. Is IC total DIC or pCO2? DIC includes a significant component of weathering, which is never mentioned. Floodplain autochthonous production is not a negligible component of the river system C cycle.

4. Carbon flux is, of course, a product of discharge and concentration. Any analysis of carbon flux has to start with hydrology. But we have no idea how well LPJmL does for the Amazon, or how it delivers the hydrology commensurate with the change scenarios. It is thus difficult to have a clue about the carbon part of the argument.

5. The abstract states that the model "successfully reproduces observed values. . .." Actually, it doesn't even come close. And even if it did, it wouldn't mean much, at Obidos, given how many different signals are combined there.

ESDD

6, C684–C686, 2015

6. Examination of river outgassing relative to terrestrial misses the point that the river outgassing is relevant to the carbon nominally sequestered by on land, it is not part of the daily 24 hour production/respiration cycle.

7. In an effort to be all-inclusive, enough detail to be convincing is lost.

CONCLUSION: Where does this leave us? At an absolute minimum, the thrust of the manuscript has to be changed. Perhaps start by breaking out by major tributary basin (Negro, Madeira etc)

What it is not. A credible examination of Amazon River carbon outgassing and export to the ocean, under current or future climates. The author's justifications of their results aren't valid. While their idea of serving as a linkage between small-scale observations and global estimates is a good one, it does not justify the large errors between their observed and predicted results in outgassed C or exported OC. The model also does a poor job of predicting outgassed CO2 under current conditions, so it is difficult to rate the significance of the model's predicted increases. (There are grammar issues with this manuscript as well).

What it is/could be. A structure for how to go about developing a modeling framework, for working towards such goals. A useful paper would be to outline the issues involved in doing this. This manuscript could fill a niche in connecting current research on carbon processing in the Amazon with predicted climate change models.

At the end of the day, it depends on what the objectives are, here. I question whether or not such a strategy, with its abstractions and scales, could possibly produce a result that is meaningful to how the Amazon actually functions, under either current or future conditions. If it is to be, much better presentation and justifications are necessary. If the intent is to provide an Amazon module for a global model, perhaps it could get there.

Interactive comment on Earth Syst. Dynam. Discuss., 6, 1445, 2015.