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Discussions

Interactive comment on "Scaling properties reveal regulation of river flows in the Amazon through a "forest reservoir"" *by* Juan F. Salazar et al.

Anonymous Referee #1

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The authors propose a method to classify large rivers of Amazonia according to their capacity to attenuate low, mean and high flows. Then, they introduce the hypothesis of "forest reservoir" with the premise that land use and land cover changes can induce changes of the river regimes from regulated to unregulated states. The idea is interesting, and can provide new insights on the sensibility of river to land use changes, besides other well-known indexes such as river elasticity. However, I have various concerns about the manuscript and the proposed index, which need to be clarified and analyzed:

1) Regarding the idea of classification of large rivers based on a scaling property defined as the product of LAI and Drainage area, it should be noted that traditional approaches used in hydrology (for instance, Molinier et al. 1996 for the Amazon Basin)

have shown that there are well-known relationships between discharge and drainage area. These relationships stands across scales simply because they are based on the continuity equation. Perhaps the new approach in the manuscript is to compare of regional indexes for low, mean and high flows. Having say so, in my opinion, there is no need to consider the LAI in the scaling parameters, once the drainage area explain most of the variability. In mathematical terms, LAI works like a constant value with no effect on the relationships, because LAI is fixed in each basin

2) In the paper of Molinier et al (1996), regional differences among the response between Amazon tributaries are explained in terms of the rainfall regime. Given the large size of the Amazon, the annual distribution of rainfall varies from northern to southern tributaries. In this context, it is not a surprise that the southern tributaries are generally less regulated than the northern tributaries, considering that the annual distribution of rainfall is relatively regular in northern Amazonia (due to the effect of the ITCZ), while in southern and eastern Amazonia seasonal variability is higher (related to the South American monsoon circulation).

3) Besides the effects of rainfall regimes across the Amazon, the Basin can be divided in contrasting morpho-structural units (Molinier et al 1996). The implication of this is relevant in terms of the ability of the basin to accumulate water in the groundwater system and, consequently, in the capacity of Amazon tributaries for attenuating floods and droughts. This has been explore in detail by Miguez-Macho and Fan (2012), who showed that headwater responses are dominated by the effect of groundwater, while on large floodplains there are a two-way fluxes between surficial water and groundwater. This is why in several areas, such along the Solimoes and Amazonas, the degree of regulation is higher: those areas are characterized by large floodplains in combination with powerful aquifer systems (the Solimoes and Alter-do-Chao Formations). In other words, damping effects on the river main stem are the result of geological and geomorphological processes.

4) Finally, the authors suggest a series of change due to the effect of land use and

land cover changes on the ability of rivers to regulate the response. Although this is a conceptually sound hypothesis, demonstration based on river data observations, rather than modeling, have proven to be quite illusive in large basins. For instance, detailed analysis of trends on rivers (Marengo, 2009; Espinoza et al. 2009) showed that the trends detected are associated to interdecadal variability, instead of the potential effects of land use changes. Moreover, recent trends in the hydrological cycle of the Amazon have also been attributed to the warming of the Atlantic Ocean (Gloor et al. 2015) rather than local-scale changes. If we take into consideration that most of the ability to regulate river regimes is related to rainfall regimes and geological – geomorphological characteristics ,as demonstrated before, it might be challenging to disentangle LUCC effects from those major natural drivers.

In conclusion, it is my opinion that the manuscript should go through a major revision. The authors need to explain better the role of LAI in the relationships they proposed (which I think is unnecessary). Regarding the forest reservoir hypothesis, the concept should be clearer if an example based on observations is brought into the manuscript. I presume that, along the "deforestation arc", several candidate basins undergoing through severe land use and land cover changes in the last decades can be found.

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