

**Title: Discharge and sediment fluxes along the Amazon river: RDSM model concepts and validation.**

The authors developed a new model for estimating sediment transport in large basins, having as a study case the Amazon basin. The new model is based on the large-scale hydrological model PCRGLOB-WB 2 and includes two modules: River Sediment Production Model RSPM and River Sediment Transport Model RSTM. The model was validated for a 30 year period (1980–2009) using suspended sediment data from HYBAM database.

The manuscript is well-written and presents several important previous studies. The authors mentioned that “Unfortunately, sediment production and transport modelling for the Amazon basin is a challenging task due to the complex nature of the soil erosion and sediment transport process.”. In this way, and considering the introduction of the manuscript, the main aim of the study seems to be to overcome the problem of sediment transport estimations in the Amazon basin, with a more complex model that accounts for relevant processes. The methods are clear and well organized. The results are presented properly and the conclusion matches with the results.

#### MAJOR COMMENTS

In fact, improving the model and providing better estimates for this region is a very important and necessary task. However, the manuscript has a lot of important issues that require deeper reflection. After reading the entire work, I believe that there are many conceptual errors that did not achieve the objective of the work. Before I start my comments on this, I would like to reinforce that I carefully look the previous studies presented by the authors as well as the input data and modeling structure.

The first issue that caught my attention was the last paragraph of the introduction. The model is proposed to simulate changes, but the period of simulation ends in 2009. After that, I understood that your decision was based on the availability of the data (precipitation from Hybam). But if you need to change precipitation data in the future because Hybam database is limited, how do you can ensure the same performance of the model? More important than that, HYBAM protocols only allow to achieve total surface suspended solids (organic and inorganic), which is not consistent with the recommended protocol to get cross-sectional suspended sediment (inorganic) mass concentration (see ISO 4363 (2002) protocol). The profile of suspended sediment concentration shows greater values according to the increase of depth. I was looking for some papers about that in the Amazon basin, and Bouchez et al. (2011 - Prediction of depth-integrated fluxes of suspended sediment in the Amazon River: particle aggregation as a complicating factor) showed profiles of suspended particulate matter for several locations of the Amazon basin. At Óbidos gauge station, they showed values ~50-100 mg/L near the water surface and 300-600 mg/L near the river bed. This result shows that surface samples can be underestimated by around six times the traditional methods. In this sense, the validation process is compromised since the “truth” is not the real truth. Another serious flaw was assuming that the value measured on a single day is representative of an entire month. How can I assume that measuring 10% of the year (for example) can be representative of the whole year? The temporal variability is so high when we are talking about sediment concentration.

The second issue is concerning to represent relevant processes. You used the kinematic wave to route river discharge and neglected suspended sediment deposition in floodplains. Amazon basin has large flat areas. Floodplains and backwater effects are very important processes in this basin and should not be neglected in a work that has as one of the main goals to represent relevant processes.

There are some articles about this issue. Do not represent these phenomena will directly affect the results to be obtained. Both discharge and sediment load will have higher peaks and the timing when these peaks occur will be wrong too (which could be seen in your results). I realized that in the dry period, the model RDSM was overestimating the observed results. What evapotranspiration method and which data did you use to compute it?

The third issue is about the transport capacity for suspended sediment. At first, I thought it was a great idea to represent the erosion/deposition process in the channel, but then I wondered if it made sense to consider that the suspended transport capacity would always be supplied. So, when I saw your results and Figure 10, I was sure that the model was not performing well. I am not sure if this result is correct. The most important role in the retention of suspended sediments in the Amazon basin comes from the floodplains, a process that was disregarded by the authors. The lakes play a very minor role, as many are in regions with little sediment production. It is common knowledge that 50% of the suspended sediment is not deposited in the channels. If we were talking about the sand load, it would make more sense, but if we were talking about the suspended load, it wouldn't. In addition, there are other studies, including those cited by the authors, which discuss the processes of sediment deposition in the Amazon basin, both in the region near the Andes and in lakes, rivers, floodplains and reservoirs. It is important to compare the results with the literature. Even for Serrinha and Caracarai, more than 40% is deposited in regions of generation and transportation, where the rivers have greater slopes and higher TC values.

## RESULTS

The first findings are presented in Figure 5 about the sediment production. In the lines 306-308, the authors made a comparison. However, Gomes' work shows those values for the entire Cerrado and only a small part is in the Amazon Basin. this comparison is not fair and right. The results presented in Figure 5 are significantly different from previous studies. No recent work corroborates these results. Look at the works of Riquetti <https://www.sciencedirect.com/science/article/pii/S0301479722015067?via%3Dihub> and Borelli <https://www.nature.com/articles/s41467-017-02142-7>

Table 1 shows that Serrinha produces more sediment per square kilometer than Fazenda Vista Alegre. Madeira River basin is famous for its higher sediment yield while Negro River is famous for lower sediment yield. How is it possible?

In lines 381-383 you mention wrote that “our estimate is robust and centred on the more likely values per station.”. You also said in lines 389 and 390 “Notwithstanding, the sediment transport modelled by RDSM behaves well in terms of its spatial patterns and probably temporal dynamics, which is remarkable as the model is not calibrated.”. I can't see how this is true. In addition to everything that has already been said, it is clear from seeing negative KGE values (more than half of the station) that the results are not robust and need to be reviewed and improved.

## MINOR COMMENTS

Figure 4 provides some results that do not seem to agree with Figure 3. Figure 4 draws attention to what appear to be artificial reservoirs, but looking at Figure 3, we can barely make out these reservoirs, except for Balbina.

In lines 350-352 and lines 358-359 we can read that sediment transport is reduced from upstream to downstream. Where the readers can see this result? From Manacapuru to Obidos, the sediment load is proposed to be increasing because of the supply coming from Madeira River, but you are showing the opposite and claiming that is due to small lakes in an area without connections with the mainstream. The previous knowledge about the basin, cited by you, is in conflict here.

The authors should check the results of Table 5 and if this comparison is fair. Hatono and Yoshimura (2020) and Hock (2014) used the same data as you, and the latter the same model, but the results are so different. Besides, that, they have the same problem using Hybam data. Fagundes et al., 2021 showed a different value than  $37,0 \times 10^8$ . Fagundes et al., 2023 showed 4,06 for total sediment load. Also Mouyen considered all sediment load, not only suspended load. Filizola used suspended data. You need to decide what variable you are comparing to and adjust the text and the elements (Figures, tables, etc.).

As a final comment, I think the authors overlooked many important steps, processes and concepts, such as calibration, the type of data, representation of floodplains, among others. As the work sought to better estimate sediment transport in the Amazon basin, I feel that the objective was not achieved in this scenario.

#### SPECIFIC COMMENTS

- Line 75-77: Amazon's precipitation can range values  $>6000\text{mm/year}$ . Villar et al., 2009
- Equation 1: "P" instead of "Y".
- Line 216: which diameter did you use for each grain class? In the line 240 you mentioned that D was assumed as  $5 \times 10^6$ . However, this is the clay diameter. What is happening with silt and sand both in rivers and lakes/reservoirs?
- Equation 17: what is disd?
- In several parts of the work (e.g. Figure 8) is not clear if you are showing/comparing suspended or total sediment load/concentration. It needs to be clarified.
- Line 397: (Table ??). Check it.
- Line 402: Fagundes instead Filizola?