Major Comments:

- **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?**

<u>*Answer :*</u>

Thank you for your comment. You are correct in noting that the simulation period ends in 2009, and we appreciate the opportunity to clarify our decision regarding the precipitation data. Our choice to use Hybam precipitation data was indeed influenced by the availability and quality of the data. Specifically, we replaced the precipitation data originally used in the PCRGLOB-SET model (ERA-40 CRU data), which exhibited a dry bias, leading to inaccuracies in the simulation of hydrological and sediment dynamics, particularly in the Amazon region.
As explained in the manuscript (lines 135–139):
"Hoch et al. (2017) found that the simulated hydrology is highly sensitive to the precipitation input. For the Amazon, existing global datasets often have a dry bias, leading to underestimation of the discharge. In order to remove this bias, precipitation data were taken from the Hybam database, which provides daily raster precipitation maps with a $1 \times 1^{\circ}$ spatial resolution. The data used in this study is presented in table F1."
Model performance depends on input data quality, so any additional data used in the future would need to have a similar quality to HYBAM to enable similar performance.

- **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.

Answer:

Thank you for the comment. After revisiting Bouchez et al. (2011), the profiles of suspended particulate matter (SPM) concentrations near Óbidos gauge station were indeed derived from discrete depth-profile measurements across several river sections, not daily samples.

The paper highlights that only a limited number of vertical profiles (one to five per location) were used for their analysis, with observations focused on two distinct water stages. While this approach provides valuable insights into depth variability, it may not fully capture temporal fluctuations in SPM concentrations across different hydrological cycles. As such, we will not be able to directly compare these findings with the daily data used in our model.

We will integrate these findings into our paper to address the biases in our model. Additionally, we will emphasize that our simulations account for these vertical profiles but may lack daily variability representation due to limited continuous data. This adjustment aligns our work with Bouchez et al.'s findings while acknowledging potential limitations in cross-sectional and temporal sediment concentration estimations.

- **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.**

Answer :

Thank you for pointing out the concern regarding the assumption that measurements from limited days are representative of longer periods, such as months or years. We acknowledge that this assumption introduces uncertainties, especially in the context of sediment concentration, which can exhibit high temporal variability.

As mentioned in the manuscript (lines 252-258):

“In the Hybam dataset, the observed sediment concentration was typically sampled every ten days or three times a month at fixed positions near the middle of the river. However, the overall number of samples was sparse, and not all stations are covered at all times, sometimes creating wide gaps in the coverage. For example, Tabatinga has one 255 sample in 1995 and one in 1997, while there were no samples in 1996, 2008 and 2009. Moreover, there was a low number of samples for each year at Tabatinga ranging between 0 and 4, and at Manacapuru in 1995. On the other hand, near-continuous daily discharge values are available for all seven stations, except the Manacapuru station having some missing data for 2003 and 2004”

Since there are no daily measurements for sediment concentrations available, we applied scaling methods to approximate monthly and yearly sediment loads based on the available sample data. For monthly loads, the calculation is as follows:

$$SL_{monthly} = {N_{monthly}}/{Ns_{\,monthly}} * \sum S_{id}$$

Where :

N $_{monthly}$: Total number of days in the month,

Ns $_{monthly}$: Number of sediment samples available in the month,

S_{id} : daily sediment concentrations (ten days).

For yearly sediment loads, we applied a similar approach

$$SL_y = {N_{yearly}}/{N_{s\,yearly}} * \sum S_{im}$$

Where :

N $_{yearly}$: Total number of days in the year,

Ns $_{yearly}$: Number of sediment samples available in the year,

S_{im} : monthly sediment concentrations.

These methods utilize proportional scaling to estimate total loads from limited sample data, thereby reducing the impact of data sparsity. While this approach helps to bridge gaps, we recognize its limitations, particularly the assumption of temporal uniformity within the sampling periods.

We hope this clarifies the methodology used and the inherent limitations of the assumptions we made to estimate sediment loads from sparse data.

- **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?

Answer:

Thank you for raising these important points. We agree that floodplains and backwater effects play a crucial role in sediment dynamics, particularly in large, flat regions like the Amazon basin. While we used the kinematic wave to route river discharge, the RDSM model does incorporate floodplain processes to some extent. Specifically, we included the floodplain fraction and floodplain velocity, as these factors significantly influence sediment deposition and uptake.

As detailed in the Methods section of the manuscript (lines 114–117), when the bankfull capacity of the channel is exceeded, river water spills onto the floodplain, reducing the flow velocity. This reduction in velocity in turn affects the deposition and uptake of sediment in the river. Additionally, the model accounts for the outflow of water bodies, such as lakes and reservoirs, where the flow is dampened by lower velocities, which also impacts sediment transport and deposition dynamics. Further elaboration on this is provided in the Annex (lines 539–540), where we clarify that "the floodplain velocity Vfp is equal to the velocity of the channel Vc" and that although floodplain deposition and bank erosion were not included, the floodplain is still connected to the channel, affecting sediment movement.

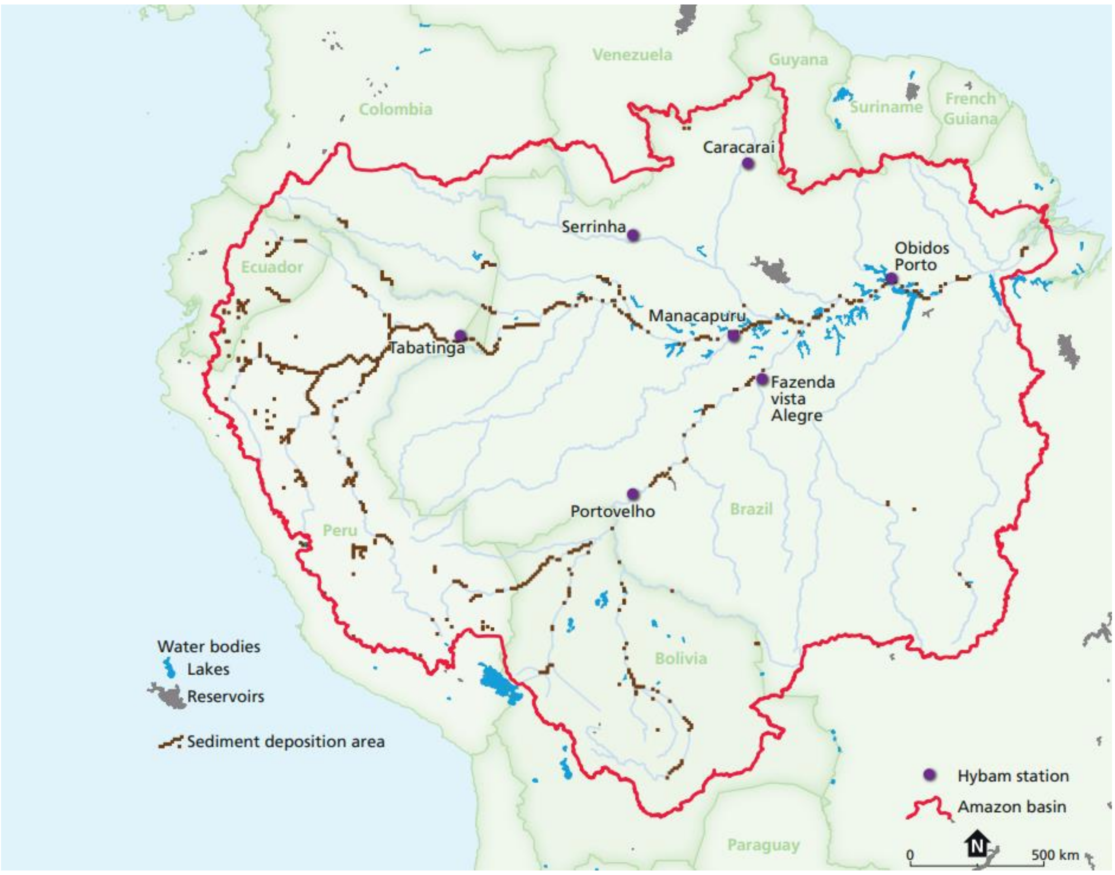
The method used to compute evapotranspiration is explained in detail in the work of van Beek and Bierkens (2009). We did not include the full description in this manuscript to avoid making it overly lengthy, as the methodology is already thoroughly covered in the cited literature. We have referenced this work in the manuscript to provide the necessary context for readers interested in the specifics of the evapotranspiration calculation.

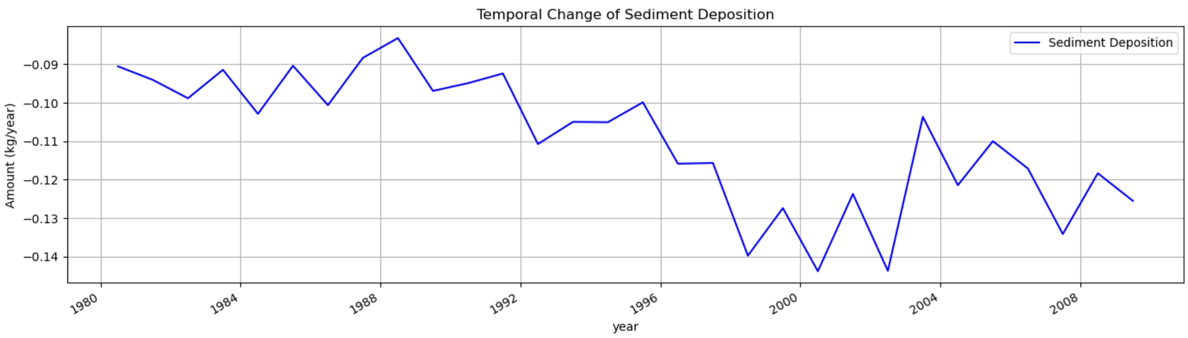
While the model incorporates many of these important dynamics, we acknowledge that there is still room for improvement, particularly in more explicitly capturing floodplain sediment deposition, which is one of the key recommendations in our manuscript for future model refinements.

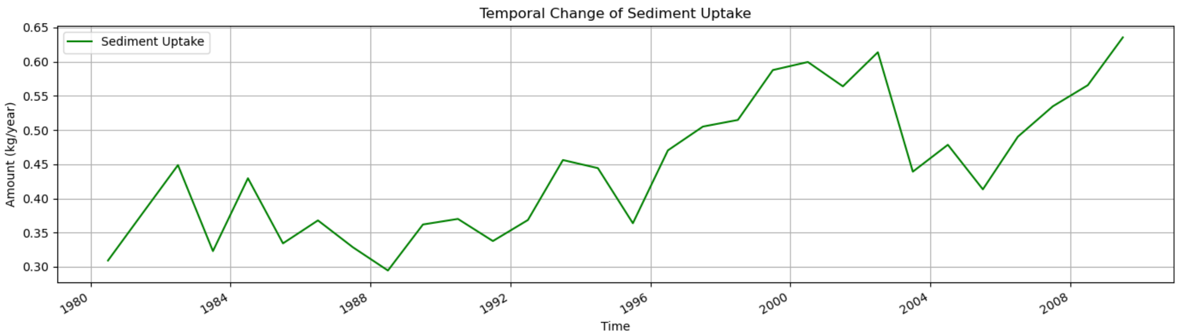
- **The third issue is about the transport capacity for suspended sediment. At first, I thought it was a great idea to represent the erosion/deposition process in the channel, but then I wondered if it made sense to consider that the suspended transport capacity would always be supplied. So, when I saw 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.**

  Answer:

Thank you for your valuable comment. You raise an important point regarding the transport capacity of suspended sediments and the deposition processes in the Amazon Basin. It's indeed true that the floodplains, and not just the channels, play a significant role in sediment retention. As it is mentioned in the previous answer that the process is already included in the model.







The figures effectively support our explanation of how the model represents sediment transport and deposition processes in the Amazon basin. The first figure (spatial distribution map) demonstrates that sediment deposition is primarily concentrated along the main river channels and associated water bodies, such as lakes and reservoirs. This spatial pattern highlights the role of reduced flow velocity in these locations, which the model accounts for through parameters like floodplain fraction and floodplain velocity. While the floodplain processes are not explicitly modeled as distinct deposition zones, the connection between the floodplain and the channel influences sediment movement, as shown by the concentrated deposition along the river network.

The second figure, showing the temporal changes in sediment deposition and uptake, further reinforces the model's ability to capture dynamic sediment processes over time. The declining trend in sediment deposition and the concurrent increase in sediment uptake illustrate the model's capacity to represent sediment transport influenced by flow velocity and water body outflows. These temporal trends are consistent with the assumption that sediment deposition decreases as sediment is transported downstream, and uptake becomes more pronounced where flow velocities are lower.

Results major comments:

- **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**

  Answer :

Thank you for pointing out the need to clarify the comparison made in the manuscript. We acknowledge that Gomes' work reports sediment values for the entire Cerrado, which is a small part of the Amazon Basin. However, our comparison was not based on the numerical sediment values but rather on the shared conclusion that higher sediment production originates from this region, even though we used their data as input. This distinction will be explicitly clarified in the revised manuscript to avoid any misinterpretation.

We sincerely thank you for highlighting the works of Riquetti et al. (2022) and Borelli et al. (2017), which provide valuable context for the observed differences in sediment production. The discrepancies between our results (Figure 5) and theirs stem from methodological variations, particularly in the computation of the C and P factors.

In our study, the C factor was calculated using Yang's (2014) equation, which determines monthly values based on ground cover fraction. This approach allowed us to account for the temporal variability in vegetation cover caused by seasonal agricultural practices and phenological changes in natural vegetation. These monthly C values were aggregated as weighted averages for each grid cell, enabling us to represent spatial variability while also capturing seasonal and interannual changes. In contrast, Riquetti et al. and Borelli et al. used region-specific, static C factor values derived from generalized land-use classifications. For instance, Riquetti et al. utilized data from Copernicus Global Land Services, which provides high spatial resolution but does not reflect temporal changes in vegetation cover in time.

Similarly, differences in the P factor also contribute to the variation in results. In our study, we assumed a uniform P factor value of 1 across the Amazon Basin due to the unavailability of detailed data on conservation practices, such as terracing, contour farming, or no-till farming. On the other hand, Riquetti et al. and Borelli et al. incorporated spatially variable P factors informed by regional land management practices.

These differences naturally affect sediment estimates.

- **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?**

Answer:

Thank you for your comment. The sediment production values shown in Table 1 represent sediment production per square kilometer, not the sediment delivered to the river network. This distinction is critical: sediment production refers to the amount of soil eroded from the land surface, while sediment delivery accounts for the fraction of that sediment which actually reaches the river system. The values in the table therefore don't reflect basin sediment output.

Regarding the apparent discrepancy where Serrinha (in the Rio Negro basin) shows higher sediment production per square kilometer than Fazenda Vista Alegre (in the Madeira River basin), this can be explained by the model's grid-based approach, which incorporates input data such as slope, soil type, vegetation cover, and precipitation. Serrinha's higher sediment production may stem from localized factors such as more erodible soils (e.g., sandy or silty soils) or differences in vegetation cover that reduce protection against soil erosion. The Revised Universal Soil Loss Equation (RUSLE) used in the model predicts sediment production based on these variables, meaning regions with inherently erodible soils or less vegetation cover can produce higher sediment even in areas with lower rainfall.

Although the Madeira River basin is generally recognized for higher sediment yields at the basin scale, the model captures variations at finer spatial scales. For example, localized differences in slope angle within the Serrinha catchment may result in higher erosion rates compared to certain areas in the Fazenda Vista Alegre catchment. These variations highlight the importance of topographic and soil properties in influencing sediment production within individual catchments.

We will address this distinction in the manuscript by elaborating on the factors captured by the model—such as soil erodibility, rainfall distribution, vegetation cover, and slope—and their contribution to the observed differences in sediment production. By emphasizing these localized drivers, we can clarify why Serrinha shows higher sediment production per square kilometer despite being part of the Rio Negro basin, which typically has lower sediment yields at the basin scale.

- **In lines 381-383 you mention wrote that "our estimate is robust and centered 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.

Answer :

Thank you for your detailed feedback. In lines 381–383, we stated that “our estimate is robust and centered on the more likely values per station,” which emphasizes the alignment between our model estimates and the range of values reported in prior studies. As shown in Table 4, the model’s simulations fall within the ranges reported in previous research, supporting the robustness of our estimates.

Regarding the negative KGE values at some stations, we understand the concern and appreciate the opportunity to clarify. While the model was not explicitly calibrated, RDSM still provides reasonable results in terms of both spatial patterns and temporal dynamics, which is especially important for large-scale models with sparse calibration data. Negative KGE values do not necessarily indicate poor performance, particularly for basin-scale models with coarse-resolution input data and simplified assumptions. For example, studies have shown that a KGE of -0.4 is acceptable for large-scale hydrological models (Gupta et al., 2009). Therefore, while some stations show negative KGE values, the model still captures key spatial patterns and temporal sediment transport peaks, which is a significant achievement.

We recognize the model can be further improved, especially for stations like Tabatinga (KGE = −1.7) and Manacapuru (KGE = −0.54). However, we have provided additional performance metrics (RMSE and bias) in Table 3 to contextualize these results. We also highlight the limitations of the observed data, noting the sparse sampling (e.g., Tabatinga with only 1-4 samples per year and significant gaps in coverage) as mentioned in the manuscript (lines 252-258).

To address your feedback, we propose revising lines 389–390 as follows: “The estimation was reasonable and consistent with previous studies, though discrepancies were observed for some stations, such as Tabatinga and Manacapuru, when compared to the sparse observed data.”

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.**

Answer:

Thank you for your comment. We understand your concern regarding the apparent discrepancy between Figure 3 and Figure 4, particularly in terms of the visibility of artificial reservoirs. To clarify, the differences arise due to the distinct focus and resolution of each figure.

Figure 4 is designed to emphasize specific artificial reservoirs within the Amazon Basin, such as Balbina, and presents a more detailed view of these structures. This figure highlights reservoirs that are significant for hydropower development and their potential impact on sediment transport. However, due to its higher level of detail, some smaller or less prominent reservoirs might appear more clearly, which could lead to the perception of them being "artificial."

On the other hand, Figure 3 provides a broader spatial overview of the region, where the resolution and scale are less focused on individual reservoirs. As a result, while Balbina is clearly visible due to its size and importance, other smaller reservoirs may not stand out as clearly in this figure.

- **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.**

Answer:

Thank you for your comment. We realize that the sentence was confusing, and we appreciate the opportunity to clarify our explanation.

The correct interpretation is as follows: at Manacapuru, sediment transport is reduced due to the trapping efficiency of the reservoirs in the region, particularly the Ria Lake, which captures sediment before it reaches the river. However, at Óbidos, the sediment load increases due to contributions from the Madeira River, which compensates for the sediment trapped in the reservoirs like Curuai Lake. The sediment load at Óbidos is thus higher despite the presence of reservoirs, because the Madeira River supplies additional sediment that increases the overall load downstream.

We will revise the manuscript to reflect this more accurately:

Revised paragraph: "The impacts of the trapping efficiency of water bodies can be observed at Manacapuru, where sediment deposited in Ria Lake reduced the sediment transported to the station. However, at Óbidos Porto, although sediment was also deposited in Curuai Lake and other reservoirs, this was compensated by the increased sediment coming from the Madeira River. Therefore, sediment transport is reduced from Tabatinga to Manacapuru but increases at Óbidos due to the sediment supplied by the Madeira tributary."

- **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 x 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.).**

Answer :

Thank you for your comment. We appreciate the opportunity to clarify the comparison in Table 5. We have carefully reviewed the results you mentioned, and here are the clarifications:

We applied scaling methods to approximate monthly and yearly sediment loads based on the available sample data. Specifically:

- For monthly sediment loads, the calculation is as follows:

$$SL_{monthly} = {N_{monthly}}/{Ns_{\,monthly}} * \sum S_{id}$$

Where :

- $N_{monthly}$: Total number of days in the month,
- $Ns_{monthly}$: Number of sediment samples available in the month,
- S_{id} : daily sediment concentrations (ten days).

For yearly sediment loads, we applied a similar approach

$$SL_{y} = {N_{yearly}}/{N_{s\,yearly}} * \sum S_{im}$$

Where :

- N_{yearly} : Total number of days in the year,
- Ns_{yearly} : Number of sediment samples available in the year,
- S_{im} : monthly sediment concentrations.

These methods utilize proportional scaling to estimate total loads from limited sample data, thereby reducing the impact of data sparsity. While this approach helps to bridge gaps, we acknowledge its limitations, particularly the assumption of temporal uniformity within the sampling periods.

Regarding Hatono and Yoshimura (2020), their methodology for approximating the observation data differs from ours. Hatono and Yoshimura applied a scaling factor approach based on annual sediment estimates, adjusting for missing data by using long-term average sediment concentrations. This method contrasts with our approach, which scales sediment concentrations based on available sample data at a finer temporal resolution (monthly and yearly), rather than relying solely on annual averages. This difference in methodology explains some of the variations between their results and ours.

To prevent any potential misunderstanding of the methods and results, we will add the following explanation to the manuscript:

"It is important to note that the methodology applied in this study for estimating sediment loads is based on scaling available sample data at monthly and yearly temporal resolutions. This differs from approaches such as that of Hatono and Yoshimura (2020), which rely on long-term average sediment concentrations and annual scaling factors. Our approach provides finer temporal estimates but assumes uniformity within sampling intervals, which may introduce some degree of variability in comparison to other studies."

Regarding the comparison of sediment load estimates and the need to differentiate between suspended and total sediment loads, we have reviewed the referenced studies carefully, and the following clarifications are provided:

- Fagundes et al. (2021): This study reported a total sediment load of 39 × 10^8 tonnes/year for the Amazon Basin, which includes both suspended sediment and bedload components. In our manuscript, we cited this as 37 × 10^8 tonnes/year, which is slightly lower. We acknowledge this discrepancy and will revise our text and Table 5 to correctly reflect the value reported by Fagundes et al. (2021)
- Fagundes et al. (2023): This study estimated a suspended sediment load of 4.06 × 10^8 tonnes/year near the Amazon River's mouth, which is correctly cited in our manuscript and reflects suspended sediment only, excluding bedload.
- Mouyen et al. (2018): The study reported a total sediment load of 610 ± 170 Mt/year (6.1 × 10^8 tonnes/year) at Óbidos using GRACE satellite gravimetry data. This estimate includes both suspended sediment and bedload. However, in Table 1 of their study, Mouyen et al. (2018) also reference an in situ measured sediment discharge value of 7.78 × 10^8 tonnes/year at the mouth of the Amazon. This value is not a direct model estimate but rather an observed value reported in previous studies. We mistakenly referenced this observed value in our manuscript as if it were derived from Mouyen's model. We will correct this by referencing the model estimate of 6.1 × 10^8 tonnes/year as Mouyen's sediment load estimate and clarify that the 7.78 × 10^8 tonnes/year value is an observed measurement from prior studies.
- Filizola et al.**:** These studies focus exclusively on suspended sediment load, which explains the lower estimates compared to studies incorporating total sediment load.
- Our study focused exclusively on suspended sediment load. This choice aligns with studies such as Fagundes et al. (2023) and Filizola, which provide a comparable methodological framework for analyzing suspended sediment dynamics.

  To address the concerns related to the suspended sediment load and total sediment load:

We will clearly specify in the text, Table 5, and relevant figures whether each value represents suspended sediment load or total sediment load. For example: (Fagundes et al. (2021): Total Sediment Load, Fagundes et al. (2023): Suspended Sediment Load, Mouyen et al. (2018): Total Sediment Load, Filizola: Suspended Sediment Load).

We will clarify the use of Mouyen et al. (2018) value: As noted, We referenced the 7.78×10^8 tonnes/year value from Mouyen et al. (2018) as their model estimate. This value is actually an observed sediment load from previous studies. We will revise our manuscript to clearly state that this value is from prior observations, not from Mouyen's model estimate. We will update the reference.

We will include a discussion explicitly addressing the methodological differences between the cited studies, explaining how they contribute to variability in sediment load estimates. For example:

> "It is important to note that studies such as Mouyen et al. (2018) and Fagundes et al. (2021) estimate total sediment load, which includes both suspended sediment and bedload. In contrast, studies like Fagundes et al. (2023) and Filizola focus solely on suspended sediment load. This distinction in methodology and sediment type explains the variability in reported sediment load values."

We will ensure that Table 5 and related figures accurately reflect the type of sediment load for each study. Where necessary, annotations or footnotes will clarify whether values represent suspended or total sediment load.

- **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.**

Answer:

Thank you for highlighting this point. The statement in the abstract, "The RDSM model facilitates future estimation of sedimentation impact in reservoirs incorporating water resource management and will so contribute to a better understanding of the complexity of the Amazon Basin," reflects the potential applications and long-term goals of the RDSM model rather than the immediate objectives of the manuscript. While this sentence demonstrates the broader value of the model, we recognize the need to clarify its connection to the main objective of the current study.

The primary objective of this study was to develop and validate the RDSM model as a tool for estimating sediment transport in the Amazon Basin, using the available data and methods. The focus was on creating a framework that captures the key dynamics of sediment transport across large spatial scales and validates the model using observed data where available

The need for a scalable tool that can be adapted for future applications, such as assessing sedimentation impacts in reservoirs or understanding the interplay between natural and anthropogenic factors.

By designing the RDSM model, we aim to address these gaps and provide a foundation for improving sediment transport modeling in the Amazon Basin. While the model's immediate focus is validation, it also provides the potential for future extensions, such as incorporating reservoir management and floodplain processes.

Including the statement about the RDSM model's future potential reflects its flexibility and adaptability for addressing sediment-related challenges in the Amazon Basin. This is particularly relevant for regions where water resource management and reservoir sedimentation are critical concerns. While this capability is not fully implemented in the current study, its mention highlights the broader impact and importance of the RDSM model beyond the initial development and validation stage.

To make the abstract clearer and align it with the manuscript's main objective, we propose revising the statement as follows:

"The RDSM model was developed and validated as a tool to estimate sediment transport in the Amazon Basin, addressing challenges of data sparsity and large-scale dynamics. While the current study focuses on validation, the model also facilitates future assessments of sedimentation impacts in reservoirs and contributes to understanding the basin's complexity."

SPECIFIC COMMENTS:

- **Line 75-77: Amazon’s precipitation can range values >6000mm/year. Villar et al., 2009**

Answer:

We will revise the paragraph to include the findings from Villar et al. (2009)

“Its tropical location results in high annual rainfall, varying spatially from 3000 mm in the west to 1700 mm in the southeast. The wet season differs by region, occurring from April to August in the north, January to May in the west, and October to April in the south. Precipitation in some areas can exceed 6000 mm/year, with substantial spatio-temporal variability influenced by regional factors like ENSO (Villar et al., (2009), Ronchail et al. (2002))."

- **Equation 1: “P” instead of “Y”.**

Answer:

Thank you for your comment. We will update Equation 1 by replacing “Y” with “P” as suggested

- **Line 216: which diameter did you use for each grain class? In the line 240 you mentioned that D was assumed as 5x10^6. However, this is the clay diameter. What is happening with silt and sand both in rivers and lakes/reservoirs?**
- Thank you for your comment. In our model, we employed a one-sided distribution, focusing on the dominant clay-sized particles due to their higher proportion in the suspended sediment load. This approach is consistent with studies on sediment dynamics in large rivers like the Amazon, where fine-grained sediments dominate the suspended load, making up 85–95% of the transported material. Specifically, the Amazon River's suspended sediment discharge is largely composed of silt and clay (<63 µm), with median grain sizes of 10–20 µm during peak sediment discharge and 20–40 µm during peak water discharge.
- The use of a clay median diameter of $D=5\times10^{-6}$ m in our model reflects the dominant role of fine particles in transport and deposition processes. Furthermore, the model incorporates an effective particle density that

accounts for both the intrinsic properties of the sediment and their behavior in suspension, including aggregation and flocculation. This is critical as these processes significantly influence settling velocities and sedimentation patterns, aligning well with the dynamics observed in the Amazon and similar fluvial systems.

- **Equation 17: what is disd?**

Answer:

disd in Equation 17 refers to daily discharge. We will update the manuscript to clearly define this term in the text.

- **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.**

Answer:

That will be clarified as it is mentioned in the previous question to clarify which type of sediment load is being presented.

- **Line 397: (Table ??). Check it.**

Answer:

The reference to Table ?? in line 397 was an issue with the LaTeX formatting, which did not properly recognize the table. This has now been fixed, and the correct table reference will appear in the updated manuscript.

- **Line 402: Fagundes instead Filizola?**

Answer:

The reference to Filizola in Line 402 will be corrected to Fagundes, as that is the appropriate author for the relevant context. This will be updated in the manuscript to ensure the correct attribution.