Response to Editor comment:

Dear Authors,

The first reviewer is happy with the paper as it is. The second referee however not and ask for some additional justification of statements and methods. I therefore advice minor revisions.

Dear Editor,

We sincerely thank you and the two anonymous reviewers for dedicating your time and expertise to reviewing our revised manuscript. Your feedback and constructive comments have been valuable in improving the quality of our work.

We are grateful to reviewer #2 for expressing satisfaction with our response and the modifications we made. In response to the valuable feedback raised by reviewer #1, we are hoping that our following response is sufficient.

Best regards,

Awad M. Ali (on behalf of the authors)

Response to referee comment: Anonymous Referee #1

* Please note that page and line numbers in the response are based on the updated manuscript!

Comment: The paper contributes a reconstruction of the filling strategy of the Grand Ethiopian Renaissance Dam (GERD) in Ethiopia based on a combination of hydrological modeling and satellite data processing. The authors have improved their original submission but my major comment related to the water management implications of their results has not been adequately addressed.

In their replies and the associated revision of the manuscripts, the authors argue that "No other study has presented quantitative information about the impact of GERD on downstream discharge, which is crucial for water managers in Sudan to optimize the operation of the dams for food security and hydropower generation. With the information provided in our manuscript, it is possible, for example, to reschedule the filling of the Roseires dam to align with agricultural requirements in the coming years". And also "Moreover, hydrological modelling allows to investigate future scenarios under different management strategies". I think both these arguments are potentially questionable and would invite the authors to better elaborate on this important point.

About the first reply, while I agree about the timely contribution of quantitative analysis related to the GERD filling, it's important to notice that this analysis indeed captures the initial phase of a transient period – the filling – which is not informative on how the rest of the filling and the regime operation of the GERD will be. As a consequence, the results provide an interesting retrospective analysis but I don't think can inform a reoperation of the Roseires dam.

We do agree that our evidence not fully supports our first claim in its current form:

"With the information provided in our manuscript, it is possible, for example, to reschedule the filling of the Roseires dam to align with agricultural requirements in the coming years"

Therefore, we have edited our paragraph to include the sentences that are underlined:

P23 L432: "The operation of downstream dams (i.e., Roseires and Sennar) depends on the management of the GERD dam. Thus, the outcomes of this approach provide information that can support downstream dam operations. This study creates an opportunity, for instance, to adjust the scheduling of the Roseires dam filling to coincide with agricultural needs in the upcoming years, specifically during the filling phase. Upon examining Figure 10, one could speculate that the 4th filling might occur around July and August, encompassing approximately 40% (potentially up to 50%) of the monthly inflow. In addition, the findings of this study indicate that lower discharge levels were observed during July and August, while higher discharge rates were observed during other periods. It suggests that additional water should be stored during GERD-non-filling periods to achieve the targeted monthly elevation of the Roseires reservoir. A substantial increase in discharge is noted during March-June and October-December. We propose that effective management of Roseires and Sennar should involve storing additional water during these months to compensate for shortages during filling periods. Additionally, for adaptive management of Sudanese reservoirs, the existing model should be expanded to include the Lower Blue Nile basin and used to evaluate alternative operation scenarios for Roseires and Sennar dams. This approach will enable a comprehensive understanding of the implications of various management decisions and facilitate the development of optimized reservoir management plans. Moreover, our method has the potential to predict upcoming reservoir management by integrating our developed hydrological model with forthcoming discharge measurements, allowing for the reconstruction of operational strategies."

As for the second reply, the hydrological model developed by the authors actually reproduces the hydrology of the Blue Nile Basin without the GERD, with the comparison of the simulated natural discharge against the observed values providing information about the implemented filling strategy. How can you use this model for investigating scenarios with different management strategies if the GERD is not part of the model?

Overall, I would suggest the need for another round of revision to allow the authors to clarify these important points before accepting the paper for publication.

Concerning our second statement: "Moreover, hydrological modelling allows to investigate future scenarios under different management strategies"

In this context, we are not specifically referring to our hydrological model. What we intend to convey is that hydrological modelling in general, unlike the utilization of satellite imagery, offers the capability to simulate potential future scenarios, assess their impacts, and explore alternative management strategies. Returning to the core objective stated in lines 5-7, our study aims to introduce an innovative approach for obtaining reservoir filling information. Our findings indicate that our approach holds promise for inferring reservoir filling patterns. We accordingly acknowledge that our approach necessitates further research to validate its forecasting skilfulness (including reservoir filling and operational dynamics).

Hence, we have revised our paragraph to enhance clarity, as outlined below:

P23 L447: "It is worth mentioning the main advantages of the proposed approach. Besides the approach discussed here, the downstream analysis can also be based on satellite images using, for example, the method proposed by Vu et al. (2022). However, relying on the latter approach for real-time operation presents certain challenges. Firstly, given the current availability of free satellite data (such as Sentinel and Landsat), it is not feasible to achieve daily time steps, unlike in the case of relying on hydrological modelling. Secondly, waiting for a few days to acquire satellite data can be problematic, particularly during flood events, such as those experienced in Sudan in 2020. Moreover, hydrological modelling in general offers the capability to simulate potential future scenarios, assess their impacts, and explore alternative management strategies. However, our proposed approach relies on outflow observations, which may not always be available or accessible. As such, both satellite imagery and hydrological modelling have their respective advantages and limitations. Furthermore, our approach necessitates further research to validate its forecasting skilfulness (including reservoir filling and operational dynamics)."