

RC1: [Comment on essd-2021-174](#), Anonymous Referee #1

*Manuscript handles a very important topic of creating a database for hydrological studies. Authors combined various satellite datasets with an aim to provide consistent output of surface water extent of lakes and rivers, water level of inland water bodies, water storage anomaly of hydrological basins, lakes and reservoirs, and river discharge for large and small rivers. Paper is original and unique. It also consists of huge science behind the output datasets. Despite its advantages, some shortcomings may be found. These are listed below:*

- 1. Paper is very long. It is sometimes hard for the reader to stay focused on the main research idea. I would advise the authors try to shorten the manuscript by putting some less important information into Appendices. It would make the paper more clear.*
- 2. There are too many technical details provided within the manuscript. These could be moved, as mentioned above.*

While we were writing we were very much aware of the length of the manuscript and tried to strike a balance between completeness and conciseness. Your comments mean that our sense of balance is not in line with the reader's senses. Therefore, in the revised version, we have moved several flowcharts and figures to the Supplement and shortened the text so that the revised manuscript is 9 pages shorter.

- 3. I am not really sure why SWOT mission is mentioned several times across the manuscript. It does not bring any new conclusion or outlook on the results the authors provide. I would advise these comments to be removed.*

Indeed, the driving force behind HydroSat at its inception was not the SWOT mission yet. However, the reason for the frequent references to the SWOT mission in the current manuscript is that SWOT did become over time a sort of guiding framework. The added value of the HydroSat products to the SWOT mission is highly relevant, as it was highlighted in the Summary and Conclusion section. Across the rivers, SWOT estimates discharge using several algorithms as well as consensus values calculated from several individual algorithms. Most of the algorithms use Bayesian principles, i.e., they rely on prior data. Hydrologic variables provided by HydroSat can effectively be used as potential prior information for each of the discharge algorithms through available water levels (SR and HR), river width from satellite imagery, and discharge estimates (SR and HR). In the case of lakes and reservoirs, the time series of surface water extent and volume anomaly provided on HydroSat will improve SWOT estimates in terms of both temporal resolution and coverage. This supports studies aimed at understanding the long-term behavior of lakes and reservoirs.

In the revised manuscript, we have made the beneficial role of HydroSat for the SWOT mission more explicit in the introduction.

- 4. I really miss any comparison of dataset to the existing databases. I mean from the Figures you provide it is clear that your dataset is more or less similar to the existing ones, but maybe some statistics would be useful. At least to show why your dataset is unique and why it should be used instead of others.*

We have intentionally refrained from providing statistics in this manuscript for the following reasons:

- Many databases, including HydroSat, are constantly updating their products. Therefore, statistics based on a particular snapshot of the data could yield a misleading conclusion about a database.
- Due to the lack of in situ data, performing a statistical analysis of all available data from all available databases/repositories is not possible. Therefore, providing statistics on a few selected cases would never be representative and could provisionally downgrade or upgrade a particular database.
- The geographic distribution of virtual stations offered by different data providers is also very different. Such comparison will at the end be highly limited to less complicated case studies.
- We believe that the scientific community needs more HydroSat-type data repositories for a better understanding of the freshwater cycle. Lumping them with statistical metrics would lead the activities to a winner-loser game that is definitely not constructive for further development of similar products.
- Finally, we believe that the uniqueness of the HydroSat global data is legitimised by their availability in many ungauged basins and their scientific basis.

5. *Main advantages of database should be pointed in the introduction section. It is now not really clear where the uniqueness of your database is. While I believe it is new, it should be strictly pointed at the beginning of the manuscript.*

Indeed. In the revised manuscript, we have highlighted the main advantage of the HydroSat in the introduction section. Thank you very much for this comment.

6. *I would advise the authors to clearly divide the manuscript into sections covering introduction, datasets, methodology, results and comparisons, conclusions. For now all the above sections are somehow mixed, which made it hard for me to follow the main topic.*

Considering that we have different products with different input data and methods, a classical structure with Introduction, Datasets, Methodology, Results would probably bewilder the readership. But we do acknowledge your point that the manuscript needs a clearer structure. So instead, the revised manuscript is restructured so that we use the same structure (sub-sections) for each product as described below:

- A short introductory text (with references to other existing datasets)
- HydroSat products
- Data and methodology

This indeed made the manuscript much more structured and clear.

7. *It is not really clear which satellite missions are employed for creating individual outputs. (Or maybe I missed it somewhere?). It would be better if all datasets are strictly listed or mentioned/described.*

This is now clear in the subsection “Data and methodology” for each product. Moreover, in the caption of figures with time series we provided the input data (wherever it was not clear).

**RC2:** ['Comment on essd-2021-174'](#),, Anonymous Referee #2

The paper presents a rather unique dataset that provides several hydrological variables obtained with satellite data related to: 1) water level time series of rivers and lakes; 2) surface water extent of rivers and lakes; 3) terrestrial water storage anomaly; 4) water storage anomaly for lakes and reservoirs; 5) river discharge estimates for rivers.

Globally, I found the idea to collect all these variables together quite interesting and useful for hydrological applications even if the dataset is far from to be exhaustive and complete, at least for some variables: for example, water level and water storage anomaly cover quite all the globe, whereas the surface water extent and the river discharge are estimated only for some stations (and sometimes not coincident).

About the paper, it is very long with a lot of information and a few innovative elements. Actually, most (maybe all) of the procedures to derive the hydrological products have been already published. Therefore, the paper shows a collection of already published algorithms and procedures with a remark of the main results and validation. I really appreciated the comparison with other datasets, but I am quite dubious about the general content.

We thank you for your review and sharing your concerns. First of all, the length of the manuscript was also pointed out by another reviewer. So, after transferring some materials to the supplement and restructuring the text, the revised manuscript is shorter and much clearer now.

Regarding the structure of the paper, we would like to point out that we followed the ESSD guidelines for data description papers, in which detailed analysis (as in a research article) remains outside the scope. According to ESSD, articles in the data description category should not focus on instrumentation, methodology, data extraction, or data treatment except when that information helps quantify uncertainties or otherwise facilitates validation of data presented

It is indeed true that there are published papers behind many of these data sets. However, none of these published studies have demonstrated the applicability of their proposed method at a large scale. In the geosciences and remote sensing, applying an existing method to a new case study often brings new scientific challenges that require further modifications. This is exactly the case with most of the HydroSat products. In fact, here the focus is the data itself and the aspect of having unique datasets over many ungauged basins around the world. We describe the methodology to help the readers to understand the caveats and uncertainties involved in the data and also to facilitate comparison and validation of presented data.

In addition, the citation to four unpublished papers (Behnia et al. and Elmi et al.) makes this paper more uncertain for two reasons: first, the content described in the papers is not still accepted by the scientific community, and if from one hand it is good for the originality of the content of this article, on the other hand, no many details are provided on that specific procedures to allow the acceptance; second, no way to check the under review or submitted papers, to verify the originality of the content of this paper.

One of these four unpublished works has now been published. In the revised manuscript, we have excluded the references to the unpublished works. The methods are described in the text and in the Supplement.

So, despite it is a big paper with a lot of science behind, I think it is not good enough to demonstrate the novelty of the datasets.

Please see our response to your first point. We see the novelty of the work in the data itself and the fact that we offer a global dataset for water cycle monitoring. Apart from that, as mentioned above, there are modifications to already existing methods described in this manuscript for the first time (see the previous point), which elevates the novelty of the work.