Referee #3

This article generates GLWD version 2 by integrating the latest ground and satellite data products into one database. GLWD v2 mapped 33 wetland categories worldwide with a minimum resolution of 10m. This database has successfully overcome the differences caused by inconsistent regional or national data sources, filling the gap between field surveys and globally applicable classifications. Beneficial for promoting large-scale hydrological, ecological, biogeochemical, and conservation applications, supporting research and protection of wetland ecosystems around the world.

RESPONSE: We thank the Referee for this positive feedback recognizing the beneficial value of the GLWD v2 database.

Although GLWD v2 has made significant progress in global wetland classification and representation, it may require careful consideration of the following issues:

(1) GLWD v2 combined different datasets to map a total of 33 wetland categories, including wetlands and water body types. However, how to eliminate the temporal differences in wetland types extracted from different datasets? That is to say, the increase or decrease of wetlands may have biases in different statistical time differences, especially in areas where human activities have a significant impact on wetland area disturbance. How to consider this?

RESPONSE: We appreciate the concern raised by the Referee. In fact, in the original manuscript, we comment on this issue in the discussion of limitations (original lines 821-825): "*Rather than being a time-resolved product, GLWD v2 depicts contemporary conditions and limited aspects of inundation periodicity (seasonal, ephemeral, etc.) as a static map. As such, it represents a long-term baseline and should not be used to directly infer or monitor trends over time in global wetland distribution. The input sources are limited to data without explicit temporality, and in many cases there may be mismatches between sources due to different temporal snapshots or time integrated summaries (e.g., flood frequencies).*" Therefore, other than by aiming to select input data sources that represent contemporary situations within a comparable time period, loosely defined as "1984-2020" (original line 169; now reiterated several times in the revised manuscript to add clarity), we have not applied any methods to extrapolate wetland extents to a particular timeline or for pre-anthropogenic conditions.

Nonetheless, in our major revision of the manuscript (and also in response to comments from the other Referees), we expanded Table 1, which describes all input data sources, by adding information on the representative time period of each input dataset. Furthermore, we carefully revisited the Discussion section and made some adjustments to improve the explanations which describe our database as a static product, including the limitations that are caused by this characteristic.

(2) There are still doubts about the clear definition of wetlands, such as whether wetlands in high dynamic change areas can be defined as wetlands? Is the statistical analysis of the high dynamic change area accurate? And this is difficult to accurately model and obtain for wetlands that exist intermittently or in the short term.

RESPONSE: We agree with the Referee that there are particular challenges in accurately defining and mapping highly dynamic wetland areas. Due to the high uncertainties in interpreting inundation frequencies (which are mostly derived from the two input datasets of GIEMS-D3 and GSW; Table 1), we chose to simplify the classification of dynamic wetland types into only 4 categories: regularly flooded,

seasonally flooded, seasonally saturated, and ephemeral (Fig. 2). To be transparent, we also summarized all frequency thresholds that we applied in Table 2.

However, we admit that in the Discussion section we were not clearly expressing our own concerns regarding the limited accuracy of these particular class distinctions related to temporality. Therefore, in our revision we expanded the discussion of uncertainties regarding inundation frequencies in section 5.3 (Limitations and uncertainties), now ending in this statement: "*Overall, we expect that the sub-class distinctions derived from the connectivity and flood frequency analyses for riverine, lacustrine, palustrine, and ephemeral categories are the most uncertain within GLWD v2, and caution should be exercised in applications that rely on their individual characteristics.*" Finally, we would like to note that in the major revision, we added several validation and comparison assessments (new sections 4.3.3 to 4.3.5) in which we discuss the reliability of the highly dynamic wetland classes and their observed uncertainties in more detail.

(3) What is the significance of distinguishing lakes, saltwater lakes, and reservoirs based on the classification criteria for 33 wetland types? Is the source of the third-party dataset used reliable? How are subcategories specifically classified?

RESPONSE: Thank you for this comment. As cited in our manuscript (original lines 175 ff.), the Ramsar Convention on Wetlands (1971) adopted a broad definition of wetlands, comprising nearly all types of aquatic ecosystems including "*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, or salt …*" According to this definition, lakes and reservoirs are part of wetlands. In GLWD v2, we follow this definition, and we break out freshwater lakes, saline lakes, and artificial reservoirs as their own subcategories because a) they are ecologically distinct aquatic systems; and b) because there are readily available datasets and methods which allowed us to make this differentiation globally. The classification of these three subcategories is explained in its own section 3.2.1 in the manuscript (original lines 285-300), and all data sources are referenced in Table 1.

Natural freshwater lakes are depicted from the HydroLAKES dataset, which has been evaluated to be near complete for lakes that exceed 10 ha in size (Messager et al. 2016; Lehner et al. 2022). The distinction of saline lakes from HydroLAKES has been performed using methods that are described in Ding et al. (2024); the results have additionally been verified in our manuscript (see original lines 297-300). Reservoirs are depicted from the GDW database which has just been released as the most comprehensive global database with mapped reservoir extents, mostly complete for reservoirs larger than 10 km^2 and containing many smaller ones (we now updated the citation to *Lehner et al., 2024*). Given the validation results in their respective publications, we believe that these three distinct wetland categories are depicted in reliable quality in their sources and are thus also reasonably represented in GLWD v2. This, however, also depends on the size of the waterbodies as reservoirs below 10 km^2 may be falsely classified as lakes, and lakes or reservoirs below the 10-ha threshold (fresh or saline) are only represented in the lumped class 6 of GLWD v2 as 'Other permanent waterbody'.

Given the comments from other Referees as well, we conducted a major revision of the manuscript in which the explanations of the input datasets in Table 1 were extended (including main shortcomings and time periods) and several validation and comparison assessments were made. We hope that these additions help to sufficiently clarify the quality of the lake, saline lake, and reservoir classes in GLWD v2.

(4) The article uses a hierarchical data processing approach to separately process wetlands, such as high-resolution coastal wetland types, urban and glaciated areas, peatlands, paddy rice class, peatland classes. However, for the extraction of wetland types, only the image data or dataset used to obtain it is introduced, and the specific method needs to be declared or referenced, which further verifies the effectiveness and accuracy of the results. This question also applies to the extraction of lake water bodies.

RESPONSE: If we understand this comment correctly, the Referee wishes to see more explanations regarding how each of the 25 input datasets that are listed in Table 1 (and also mentioned throughout the Methods section) have been generated. In terms of the accuracy (or inaccuracy) that is introduced from these source datasets to GLWD v2, we state in section 5.3 on limitations and uncertainties (original lines 788-790): "*As a composite mapping product, GLWD v2 inherits the uncertainties and shortcomings of its data sources. Given the large diversity of input datasets, we refrain from discussing the quality of each source and instead refer the reader to their original publications.*" In the revision, we slightly modified this explanation which now ends in "*… we refer the reader to the original publications of the source datasets (see Table 1)*" to add clarity on where to find these publications.

As a response to this Referee request, we feel it is going beyond the scope of our manuscript to provide a full review of the 25 input datasets that we used in the production of GLWD v2, in part as some of these products are themselves based on a variety of original data sources with their own characteristics and uncertainties (e.g., derived from multiple remote sensing sources). That said, we agree with the Referee that the explanations provided in Table 1 were, at least in part, too limited to be appreciated by readers who are less familiar with each data source. For that reason, we expanded the explanations of the input datasets presented in Table 1 to briefly describe the main characteristics related to the generation, individual reliability, and/or shortcomings of each source dataset, as well as the time period which they represent.

I think if the author can explain or handle the above issues well, the paper can be published after major revision.

RESPONSE: Besides our direct responses the comments made by Referee #3, we would also like point out the replies that we submitted to the other two Referees, in which we explain how we conducted a major revision of the manuscript. As we substantially expanded on several aspects related to the validation and comparison of GLWD v2, we hope that our updates will also serve to address the raised concerns on data accuracy as stated by Referee #3 above.

With kind regards,

Bernhard Lehner
on behalf of all co-authors