## Editor decision: Publish subject to minor revisions (review by editor)

Dear authors,

The reviewers have made some technical suggestions to your revision.

I invite you consider them and submit a new revision for my consideration.

Best wishes

Bob Su

Thank you for the opportunity to revise our manuscript. We appreciate the constructive feedback provided by the reviewers, which has helped us to improve the clarity, transparency, and robustness of our study. Below, we provide detailed responses to each comment and outline the corresponding amendments made to the manuscript.

## Report #1

**Comment 1. Comment 7: I could not find citation in line 119 in version 2, only saw it in tracked change version.**

Response 1. We have now cited the figure on line 119.

**Comment 2. The tracked change version and the version 2 is not the same. For example, in lines 18-19 in version 2, and lines 19-20 in tracked change version. The first one is "five archetypes", but the second file has six archetypes. And I saw the analysis and figures in both versions are five archetypes. Please could you confirm this? Because in version 1, there was six archetypes. I could not find any comments or explanation why you changed to five archetypes. If it's correct, please check the final version before publish, make sure everything is consistent.**

Response 2. The reviewer is correct that the revised manuscript presents five archetypes, whereas the earlier version included six. This change arose from re-running the cluster analysis during the first review round. In that process, we identified that DeepAqua underestimated wetland water extent for some wetlands between August and October 2023, which led to around 12 wetlands being misclassified as 'autumn drying wetlands'. After removing these affected dates and repeating the cluster analysis, this archetype was no longer present, and the optimal number of clusters was reduced to five. We have carefully ensured that all figures, tables, and text are consistent with this updated result.

## Report #2

**Comment 3. This is an innovative and timely paper that proposes a globally applicable hydrological classification of wetlands. The concept of archetypes offers a useful tool for understanding and comparing wetland regimes. However, several areas, particularly methodology transparency, contextual comparisons, and limitation acknowledgment, need to be strengthened. I recommend major revision before publication.**

Response 3. Thank you. Please find below the improvements that we have applied concerning each of the "areas" mentioned by the reviewer in Comment 3:

**Methodology transparency -** To improve clarity in our site filtering, we now define 'low SAR data availability' and outline its causes (Lines 97-99). For the surface water detection, we added the DeepAqua model version and noted that no fine-tuning was performed, ensuring that the same openly available model can reproduce our results (Lines 146-147). We also clarified the source and preprocessing of the Sentinel-1 SAR imagery on Google Earth Engine. (Lines 154-156), ensuring results can be directly replicated.

For validation, we describe the site selection (Lines 168-170) and confirm that delineation was conducted independently of DeepAqua predictions by an experienced interpreter (Lines 170-171). In the cluster analysis (Subsection 2.4), we also specify setting a random seed of 42 for reproducibility (Lines 183-184).

Finally, the supplementary information now includes an Excel file listing all SAR scene IDs per wetland, and we emphasise that all data are openly available on Zenodo (Line 162-163). Likewise, all processing code is openly available on GitHub, as noted in the manuscript assets.

**Contextual comparisons –** To strengthen contextual comparisons of hydrological regime and their links to ecosystem services, we have added and re-emphasised key citations. We now reference Lane et al. (2018) and Matti et al. (2017) to support the occurrence of slow-drying wetlands in temperature landscapes and Swedish catchments (Lines 480-484). To highlight the role of hydroclimatic variability, we include Park et al. (2022) and Prigent et al. (2001), which distinguish snow-affected northern Sweden from rain-fed central and southern regions (Lines 489-493).

We expand on the flood control role of spring-surging wetlands with a case study of wetland-rich headwaters in central Europe (Votrubova et al., 2017; Lines 523-525) and add Opperman et al. (2010) to support flood attenuation by floodplains (Line 530). Finally, we re-emphasise Åhlén et al. (2022), showing that downstream wetlands in central Sweden remain relatively dry and retain their flood-buffering capacity compared to headwater wetlands (Lines 532-535).

**Limitation acknowledgment** - To more clearly acknowledge the limitations of our study, we added a dedicated subsection (4.2: Methodological considerations). In addition to noting possible improvements, we now explicitly state that our observation period does not capture the full range of long-term hydrological variability (Lines 438-439).

The paragraph on Lines 442-451 has been revised to focus on sensor-related limitations, emphasising the exclusion of smaller wetlands and suggesting future use of longer-wavelength SAR (e.g., NISAR). A new paragraph (Lines 453-458) discusses the constraints of using DeepAqua, including why predictions could not extend beyond our study period and how the model could be improved. Finally, we acknowledge (Lines 467-471) that incorporating additional variables could strengthen the explanatory power of the archetypes and address winter observational gaps.

**References**

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