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Comment on essd-2022-180

Anonymous Referee #3

Referee comment on "GWL_FCS30: a global 30□m wetland map with a fine classification system using multi-sourced and time-series remote sensing imagery in 2020" by Xiao Zhang et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2022-180-RC3, 2022

The authors developed a global wetland mapping product based on multiple approaches in the GEE environment, called the GWL_FCS30. They reported some 3.6 million km2 of global wetlands, making the data freely available. The authors' efforts are laudable, yet I have many concerns about the presentation and the analyses themselves that preclude my acceptance of this paper for publication. For the presentation, I would argue that the paper itself is overly long and dense. The approaches could be more clearly articulated and sign-posted for the readers. Parts that are results are introduced in the Discussion section (e.g., some validation data, as I note below) and the length of the paper makes it a long slog. However, my main issues are with the analytical approaches and base assumption. First, the authors introduce wetlands in the very first sentence using the Ramsar Convention definition to include waters up to 6 m in depth. Then, they go on to conduct their analysis but exclude any and all inland open waters as they are assumed to be greater than 6 m in depth. They backstop their findings on global wetland abundance by stating at L535 "the estimated total wetland area in this study was more reasonable [than four previous analyses] because permanent water bodies with depths of more than six meters were not considered wetlands, according to the RAMSAR (sic) Convention…". The assumption that any and all open water on the global landmass is >6m in depth – and hence not possibly a wetland – does not resonate. Yes, larger and deeper lakes could be greater than 6m. But open waters, especially smaller ones are frequently considered wetlands and are typically <6m in water depth (see, e.g., China's State Forestry Administration [www.forestry.gov.cn] or a recent paper by Ye et al. (2022, https://doi.org/10.3390/w14071152); see also the Canadian Wetland Inventory [https://open.canada.ca/data/en/dataset/09f46d71-6feb-4f8f-8eb5-a58a58b06af5] or the United States National Wetlands Inventory [https://www.fws.gov/program/national-wetlands-inventory] identifying open waters as a wetland type). The point is that the Ramsar definition of wetlands is used, but then a major type of wetlands are excluded. The authors must acknowledge this in their study. For instance, it could be noted in the title and should definitely be noted in the abstract. I do wish that the authors would redo their analysis and incorporate open waters as a wetland type to include a major wetland

type in their global analysis, alas.

A further issue I have with this paper is that the data are considered mis-classified if they occur as wetlands in an area outside the [wetland type] maximum extent. However, this max extent assumes that all the previous analyses had zero omission error. Another concern of mine is that their error assessment was done using a relatively paltry number of wetlands for the global extent of their analysis. For instance, they have ~8,000 wetland validation points to cover seven different wetland types. From Figure 2, it appears that ~7,000 of these points are inland "wetlands" versus coastal systems. Even with 7000 points for validation, that seems small considering the global extent of inland systems (swamps, marshes, flooded flats). And ~1000 points are used to validate the global population of saline, salt marsh, mangrove, and tidal flats. Their validation points were visually validated – though the authors explain five experts had to agree on the typology, the disagreements or data supporting those validations are also not presented. I would argue that there exist multiple independent data layers that could be used to provide a much greater assessment of their relative accuracy (perhaps in addition their visual validation). For instance, the Chinese SFA, Canadian CWI, US NWI are all available datasets for validation. Within the US, there's also the National Land Cover Data (e.g., Wickham et al. 2018 that has the contiguous US land cover at 30 m pixel resolution, including both wetlands AND permanent water; https://doi.org/10.1080/01431161.2017.1410298).

Lastly, the Discussion section should focus on their position in the data libraries of the world and not have more results within (e.g., why do they have relatively few wetlands versus other global data?). Ultimately, there's excitement and possibility with these data – the inclusion of multiple data layers and stacks in a random forest analysis within the GEE is exciting, especially considering the abundance of spatial data available for analyses. Yet while the authors have presented a welcome analysis, I find they leave enough to be desired to suggest a major revision to a) shorten, b) clarify approaches so that they can be repeated, c) appropriately and abundantly defend their approach to not include any open waters as a wetland type (which I do not agree with), d) place their findings against other datasets through accuracy analyses (e.g., CWI, NLCD, NWI, etc.) such that readers can determine that this data layer is better to use than those that have come before. We're lacking that confidence at this juncture, at least from my point of view.

L43 Ramsar is a city in Iran and not an abbreviation to be capitalized.

L108: Is there indeed "…no 30-m dataset covering both inland and coastal wetlands" until now? One could argue that the authors introduce ~8 different data layers doing that. For instance, the ESA products, the CCI, etc. Tootchi et al. (2019), referenced in this paper, have Table 1, "Summary of water body, wetland, and related proxy maps and datasets from the literature" that summarize the state of the literature in 2019, too. ESA recently released a worldcover database at 10-m – how does this contrast to the authors' analyses (and ESA includes herbaceous wetlands and mangroves as specific land covers; https://esa-worldcover.org/en).

L119 Why 2019-2021? I recognize that the authors ended up with nearly 800,000 LS images, yet since the GEE can handle so much, why stop there? It's not a fault, but the authors should explain why this time period was selected versus any other available time period.

L123 what are saturated pixels? How does CFMask assist w that (vs cloud, cloud shadow, and snow)?

L124 Which Landsat platforms were used? Which LS satellite data were used? What sort of processing was done on the LS images? Which bands were used? Etc. etc.

L125 LS images were used to select the "water level" or the presence of inundation as inferred from reflectance values?

L126 These are not necessarily clear sky, but they are images that passed through the CFMask filter. Please clarify in text.

L135 How did the authors discern what were sufficient Sentinel-1 images to "capture the temporal dynamics of wetlands"? What are those temporal dynamics? Seasonal? Intermittent inundation from rainstorms? Please clarify in text.

L138 How were the ASTER data used as ancillary information? Please specify how these data on slope, aspect, etc. were used here for the purposes of the paper. As I see later that it was used in the random forest, the authors need to introduce to the readers that a random forest approach is used (and conduct a literature review noting the utility of random forest and limitations).

L142 Figure 1 would be much clearer if it were a vertical panel of a) over b) versus a) next to b). Please modify. Also please change the caption to clarify that that images were not necessarily 'clear sky' but did otherwise pass the CFMask filter. See, e.g., L395.

L165 The JRC_GSW data layer does not identify wetlands per se but identifies inundated pixels. Therefore it is inaccurate to say that the JRC captured "wetlands around rivers, ponds, etc." because the data layer would include rivers and ponds – or any pixel that was deemed to be inundated by the Pekel et al. (2016) algorithm. Please revise to acknowledge these data from Pekel identify inundated pixels. Note this also comes up with L281 wherein the authors state they are "excluding permanent water bodies". Why? Permanent water bodies are a massive abundance of the global wetland data layers (e.g., in addition to the Ramsar Convention definition used earlier, see also

Davidson, N. C. 2014. How much wetland has the world lost? Long-term and recent trends in global wetland area. Marine and Freshwater Research **65:** 934-941

Dixon, M. J. R. *et al.* 2016. Tracking global change in ecosystem area: the Wetland Extent Trends index. Biological Conservation **193**: 27-35

Hu, S. *et al.* 2017. Global wetlands: Potential distribution, wetland loss, and status. Science of the Total Environment **586**: 319-327

L169 Table 1 – considering this product is a global data layer, it would be useful to the readers to see the relative abundance of wetlands that each of these named datasets have identified. Furthermore, it's important to note if indeed these are global products (versus near-global products, such as those within the latitudinal bands of 60N and 60S, for instance). Also convert the arc-seconds to meters (at the equator) for consistency between the data products.

L189 How many of the 18,701 data validation points did NOT have complete agreement between the five validation experts? Noting here that 8,355 points were used to discern amongst the seven classes of wetlands. Relative to the other possible ways to assess their study – and convince people to use it – this number of validation points is very small. Too small, by my assessment.

L207 There are many wetland definitions. That the Ramsar definition is quoted, noting that it includes waters to the depth of 6 m, suggests that open waters should be a wetland type in this analysis. I recognize that flooded flats – located along rivers and lakes – are included. But what of lakes themselves? Ponds? Smaller waters that are important to the global wetland data layer? Are these considered lakes? This is an important factor to

consider when assessing global wetland coverage. Another consideration would be submergent vegetation. The marsh class is noted as including grasses, herbs, and low shrubs. What about, say, ponds covered with *Nymphaea* spp (lily pads)? What about *Potamogeton* spp. growing submersed in the water? Are these not wetland species? Wetland scientists would say they are. Here's a good reference in re: this discussion:

Richardson, D. C., *et al.* 2022. A functional definition to distinguish ponds from lakes and wetlands. Scientific Reports 12(1): 10472.

L252 Provide a number of LS images used for this analysis.

L257 Clarify – 50 km buffer along the coastal zone between 60N – 90N are salt marsh? That seems to be quite excessive, a 50 km buffer. Please clarify.

L258 What's the proportion of overlap between the different data layers? A spatial correlation table/matrix should be presented to the readers (see, e.g., Tootchi et al. 2019, supplemental information Table S1).

L270 These data were imported…and what was done with them?

L296 The GLWD data are at 1 km pixel. How did the authors include 1 km data plus all the 30-m data products? What's the final resolution of these data? Also, what's the proportion of the overlap between them (a spatial correlation table/matrix would be interesting here).

L338 This is the first time that the use of random forest was noted. In L138, I questioned how the ASTER data were used – I suggest revising the methods to introduce the reader early on to the overall approach (i.e., letting them know that the RF algorithm was used).

L341 Figure 4 the use of the ASTER DEM includes slope and aspect? Or was slope and DEM used? If the DEM was used, what information within the DEM was used? See, e.g., L400. Furthermore, the Landsat and Sentinel data were used for identifying inundated pixels. NOT for identifying water levels. I recommend changing the heading title in 4.1 as

well.

L393 Ultimately, why were five LS clusters chosen versus three or just the one? Was parsimony considered in the analyses?

L404 This assumes that the maximum extent of the coastal wetlands (equation 1 for mangroves) has zero omission error. I understand why this was done, yet it requires explanation and accounting for the reader here and possibly in the Discussion section as well.

L410 The local adaptive modeling section is too quickly glossed over. Explain more on how this was done. How were the data trained? How many of the 961 5x5 tiles had zero coverage of wetlands (e.g., mid-ocean tiles)? What were the specifications of the training here? It would be hard for others to replicate the process based on the data provided thus far.

L413 What statistical program was used to conduct the RF analyses? Furthermore, while RF may have advantageous, it also has detractions. Please introduce the "obvious advantageous" for those who are not aware as well as mention some of the drawbacks.

L435 Note that 18k samples were analyzed across the globe. Consider the relative dearth noted in Figure 2 (see summary above).

L461 The authors need to introduce Figures 7-10 before introducing Figure 11.

L538 The point behind the Ramsar Convention's of 6 m was to address depths that diving birds were expected/known to use aquatic systems. It is disingenuous to state that all permanent water bodies have depths >=6 m. This is a possibly fatal flaw in this analysis.

L555 It would be good to see the analyses done in Table 4 for these two areas shown in Figure 10. For instance, the authors have chosen to not include permanent water as a wetland type but yet show 'water body' in their panel map, which implies it was correctly mapped yet it is not a land use type they map.

L576 Figure 10 the panel caption for GWL_FCS30 doesn't match the panel (GWM_FCS30).

L630 These selected training sample results should be in the Results section, not here.

L634 Was this inclusion of steps noted in the methods? I don’t recall it.

L675 These are results and need to be in that section explaining the outcomes of the RF analysis.