Biogeosciences Discussions

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Comment on bg-2021-200

Anonymous Referee #2

Referee comment on "Climate, land cover and topography: essential ingredients in predicting wetland permanence" by Jody Daniel et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-200-RC2, 2021

Overall, the topic of this research effort is very important. Understanding the relationship between climate, topographgy, and land use/cover are critical for forecasting how critical migratory bird habitat in the future and helping management agencies strategize their conservation planning investments. The approach this group took is unique and uses large data sets to try and determine climate, land use, and topography variables that might correlate with the permanence class of a wetland. The lack of detail given in this manuscript makes it hard for me to understand the exact reasoning behind including such a large amount of covariates in this modeling exercise and the authors need to do a better job of explaining the proposed mechanisms of why and how different covariates would impact a wetland's permanence class. Currently the results presented have little utility for other researchers or managers.

Defining pond permanence is critical for establishing the utility of such a metric for managers and for creating more direct links between your plethora of statistical covariates and your response variable (categorical and static wetland permanence class). In your introduction you define hydroperiod (L20, L26), mention wetland water levels (L24) as well as ponded frequency (L22), and declines in pond permanence (L28), wetland sensistivity (L29), and wetland permanence (L57). You then skip to mentioning wetland permanence class (L62) without first defining that term or how wetlands are categorized into these different classes. In L70-71 you introduce Stewart and Kantrud's wetland pond permanence classes, but bury the details in the appendix. Please define those classes in the methods and move Appendix 1 to the main body of the manuscript. Or, at least some version of that appendix that allows the reader to understand what variables could influence a wetland from being defined in one permanence class or another. This would make a much more clear link between your model covariates and response variable.

Use of the term climate when only considering 11 months of temperature, precipitation, and one winter's snowpack data. There is a temporal mismatch between your response variable that is a very statically defined permanence class of a that is the result of many centuries of wetland ecosystem development in response to long-term (>30 years)

climate variables as well as the topographic and land use/cover setting of each wetland. I have a hard time making this connection and the methods and discussion do not go into enough detail for me to be convinced that the data used to develop your covariates could sufficiently explain mechanisms of how climate can determine the permanence class of a given wetland.

L89 2018 excludes a rapidly growing body of research

L29- semiperms most sensitive…confusing and potentially irrelevant

L30 – change will to may experience as much as….there are many different accepted models for the future, see

McKenna, O. P., Mushet, D. M., Kucia, S. R., and McCulloch-Huseby, E. C.. 2021. Limited shifts in the distribution of migratory bird breeding habitat density in response to future changes in climate. Ecological Applications 00(00):e02428. 10.1002/eap.2428

L31 -wetlands "may be lost forever" unless this is talking about draining/filling the wetlands are not lost it is the ponded water that is lost. Depressional wetland basins persist if wet or dry.

L40-41 different font "areas lower in the watershed"

L57- This wording is a bit too strong. There are other examples of this in the southern PPR:

McKenna, O.P., Renton, D.A., Mushet, D.M., DeKeyser, E.S. 2021, Upland burning and grazing as strategies to offset climate-change effects on wetlands: Wetlands Ecology and Management, https://doi.org/10.1007/s11273-020-09778-1

McKenna, O.P., Mushet, D.M., Anteau, M.J., Wiltermuth, M.T., Kucia, S.R. (2019) Synergistic Interaction of Climate and Land-Use Drivers Alter the Function of North American, Prairie- Pothole Wetlands: Sustainability [Special Issue "The Importance of Wetlands to Sustainable Landscapes"], https://doi.org/10.3390/su11236581

Methods

Overall, much more detail is needed to understand how your response variable and your covariates are defined. By defining these with more detail and citation then the reader can better understand the mechanisms by which the different continuous covariates could potentially influence or correlate with a categorical permanence class

L70 write out the permanence classes and what criteria are involved with classifying wetlands

L73 add a citation for “Natural Region” boundaries.

L81 add citation for your spatial layers used to map those boundaries in figure 1.

L84-85 please explain why no wetlands were within 1000m of each other. This is potentially a huge limitation of this modeling approach. In some areas of the density of PPR wetland basins can be almost 10 wetlands per sq km See McKenna, O. P., Mushet, D. M., Kucia, S. R., and McCulloch-Huseby, E. C.. 2021. Limited shifts in the distribution of migratory bird breeding habitat density in response to future changes in climate. Ecological Applications 00(00):e02428. 10.1002/eap.2428. Prairie-pothole wetlands also can be connected to each other via surface flows that create wetland complexes. To only choose one wetland in a complex without classifying the rest of the wetlands seems to not have much utility for scientists or managers studying these systems.

L89 I understand that limitations of this approach and the challenge of summarizing pertinent literature, but I think there are some key papers missed that are summarized in McKenna, O.P., Mushet, D.M., Anteau, M.J., Wiltermuth, M.T., Kucia, S.R. (2019) Synergistic Interaction of Climate and Land-Use Drivers Alter the Function of North American, Prairie- Pothole Wetlands: Sustainability [Special Issue "The Importance of Wetlands to Sustainable Landscapes"], https://doi.org/10.3390/su11236581.

The inclusion of some of these papers might have allowed for inclusion of soil moisture/drought indices variables that are much more appropriate uses of the term “climate” that the 11 months of precipitation and temperature variables currently included in the model. The current “climate” covariates may be decent predictors of the current year wetland inundation status, but do not seem to me to be appropriate for predicting a static categorical permanence class of a wetland.

L105 similarly, land cover data from one year (2014) seems to be on the wrong temporal scale of the wetland permanence class. I would suggest something more stable like a multi-decadal average

L106 more detail is needed to understand why distance to road would be included as a covariate in your model. I do not see the direct connection between that and permanence class. Much more detail could be made in your selecting variables section as well as in your introduction as you hypothesize how climate, land use, and topography

L110-111: List a range of the size wetland basins and the catchments somewhere so the reader can determine if 25m DEM is high enough resolution compared to the size of the wetlands. In my experience 3m DEM is a much more appropriate resolution for prairie pothole wetlands. Also, list the different terrain variables here and allude to why they may influence wetland permanence class.

L114: which variables are global? At 100m resolution how can you relate that elevation,slope, etc. to an individual wetland basin?

L117: Since this is a stats model and not a mechanistic model my understanding is that you did not quantify relative contribution, you quantified correlation strength. Also, when you say, "land cover/land use and terrain for different wetland permanence classes" you need something between for and different.

Also, in this data analysis section please describe the relative importance methods and what the relative gains metric used in figure 2 means.

2.4.1 Predicting wetland permanence class: This section could use more defense of why you used the covariates you did and help elucidate the mechanisms of how they could influence permanence class.

Results

Overall, much more detail is needed. Currently, the results as presented in the figures 4-8 are extremely hard to interpret. More work is needed to consolidate results to communicate the most pertinent findings to the readers.

L142-143: How can you point this error to lack of correlation between covariates and response variable and not a mismatch of spatial and temporal scales between covariates

and response variable? I would love to see this model re-run with improvements on selection of covariates and the inclusion of wetlands close to each other with better elevation data to map wetlands of different permanence classes in the same wetland complex.

L147-148: explain the directionality of this relationship between spring temp and permanence class.

L152-153: move last sentence to the discussion.

L159: instead of "is sensitive" should read "correlates to observed differences in"

L161: higher snowpack amounts? There was only one season of snowpack, how is this plural?

Discussion

Explore more what your results mean for your different climate, land use, and topography variables. There is much lacking for linking correlations to causality.

L168: This is a very bold leap based on your data to say, "our findings support the assertion that climate change will affect wetland hydroperiod" Your model does not simulate wetland hydroperiod and it only used 11 months of precipitation and temperature data.

L171: climate is not the only element driving. Replace with "element correlated with"

L173: unpack the term "terrain" what aspects about terrain specifically were related to permanence class of a wetland?

L176 see previous comment

L185: Figure 3B is Max temp in winter

L187: your modeling exercise does not include future changes in climate and does not explicitly explore sensitivity to climate change

L199: the “natural frequency” I think this should read the “classified frequency”

L224. This fires sentence is misleading. All depressional wetlands occur in topographic lows by definition.

L233: “which aligns with our model results” How does this align? I need a lot more description here to be convinced of that.

4.5 Model Error: Need to explicitly address how mismatch in “climate” variables, only one year of land-cover classification, and overly coarse elevation data could all contribute to model error.

Figures

Overall, these figures need to be distilled to better visualize the main takeaway and results of your study. In Figure 3 it would also help to convert to a fractional frequency to standardize the differences in number of wetlands between Natural Regions and avoid visualizing differences in frequency distribution that are not relevant to your analysis.