Response to Reviewers

Reviewer 1

Reviewer comments are parsed and presented as hgher-level bullets, our responses follow in italics:

- The title works really well. The ms is missing an abstract.
  - *We have modified the paper and added an abstract.*
- The first half of the paper is well-organized – but the second half (beginning with the "Programmatic Access" section) is very disorganized. There's (1) a lot of repetition, (2) missing sections, and (3) an unrelated section (see below for more detail). The second half of the paper will need quite a bit of revision before resubmission.
  - *We have heavily edited this section, removing duplication and streamlining the text throughout. We believe that this editing will resolve many of the issues the reviewer has raised.*
- Yes—with the exception of the "Programmatic Access" section. The "Introduction to Neotoma" and "More Exploration" sections are particularly well-presented and high quality.
  - *Thank you, we believe that with these edits we have improved the "Programmatic access" section as well to raise it to the level of the other sections.*
- 1-2 figures could be added to illustrate the ideas in the "Educational Modules" and "Flyover" sections
  - *We have added a figure for the FlyOver Country section to show the user interface.*
- All of the figures need to be removed from the ms, saved as separate image files, and reformatted to match the Cambridge University Press requirements.
  - *We have moved all figures to a separate document as instructed.*
- Figure captions will also need to be removed and listed at the end of the ms
  - *We have moved all captions to a separate document as instructed.*
- The authors will need to ask for copyright permission to include the already published figures in Fig 1
  - *All of these figures have been heavily adapted and abstracted from the original publications. We believe that this resolves any copyright issue.*
- Figure 4 is a bit pixilated and fuzzy. Resolution could be improved.
  - *We have improved the resolution of this figure.*
- The ms is a little light on references, especially those relating to educational concepts. The authors haven't delved into the educational literature very deeply—and there are quite a few sources that they could cite relating to authentic research in the classroom.
  - *We have introduced a number of references to pedagogical research in*

the Earth sciences. as well as elsewhere in the paper, both to improve the paper, and to act as sources for educators who wish to further explore some of the topics discussed.

- The introduction includes shockingly few references—need to cite sources for all of the background info on Quaternary geology that the authors present.
    - *We recognize this and have provided further support for our statements here.*
- Can the paper be reduced in length? How? No, although the second half of the paper needs to be re-organized and rewritten to reduce repetition.
    - *As noted above we have improved the paper, re-organized and reduced duplication.*

GENERAL COMMENTS

- Right now, the text is written for paleontologists, or specifically Quaternary paleoecologists. I'd recommend broadening your audience to include two year college faculty and geologists teaching introductory courses (including historical geology). To do this, you'll need to define a bit more of your vocab and think about how a naïve user (e.g., non-major student in an intro course) might approach this dbase.
    - *We have added more references to introductory and review literature, and explained terms more extensively where neccessary.*
- Right now, the authors really only walk through one teaching activity. Would be really useful to provide 1-2 more to fully illustrate some of the resources that have been developed.
    - *We provide a set of linked exercises and describe additional exercises more thoroughly now.*
- A lot of us teach students who are climate deniers. Might be useful to provide resources re. how to use Neotoma and do these activities with that audience.
    - *While we agree, we believe this is beyond the scope of this paper as it stands. Neotoma does have digital resources to show the ways in which climate has changed, but cannot be used alone to show attribution for climate change.*
- The "Programmatic Access" section has several issues with it (repetition, missing section, unrelated section, poor writing)—see below.
    - *This section has been heavily edited and revised.*
- Format needs to be substantially revised to match the requirements from Cambridge Press. This includes font type, margins, line spacing, title page, parenthetical citations, references, placement of figures, and so on.
    - *We have adopted the style guide provided.*

INTRODUCTION TO NEOTOMA

- The wording for this heading is very similar to the first heading (Introduction). I'd recommend varying it.
    - *We have changed this section to* The Neotoma Paleoecology Database.
- I'd also recommend adding more basic info re. Neotoma. Geographic scope? Number of taxa included? What kinds of taxa (pollen, mollusks, etc.) included? Taxonomic level? Environment? Marine and terrestrial? What type of terrestrial habitats? Number of publications? Does it only include primary lit?
    - *We added further information about the record types and the availability of secondary information.*

More Exploration with Explorer: Additional SERC Teaching Exercises

- I'm confused re. the difference between the 8 SERC activities presented in this section and the 11 modules presented in the next section. Are the 11 modules part of the same SERC resource? If not, why not? How can we access the 11 modules?
    - *We have clarified the differences, both are hosted at SERC, but the original source differs, as does the content of the modules. This information is now contained at the top of the section.*

Educational Modules for Climate Change, Paleoecology, and Biogeography

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I'd recommend adding figures to illustrating some of the trends discussed in the second and third paragraphs.

Programmatic Access for Macro-Scale Paleoecological Research

- The structure of this section is extremely confusing—there's (1) a lot of repetition, (2) missing sections, and (3) an unrelated sections.
    - *We address revisions below*
- I'd recommend checking for repetition through these sections. For example, most of the sections "Accessing Data with neotoma's R package" and "Programmatic Access and Paleoecology" repeat information that was presented earlier in the "Programmatic Access for Macro-Scale Paleoecological Research" section

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- *This was an oversight in the editing process. We heavily edited these two section, the section is now simply* Programmatic Access. . . *and contains most of the original text (although heavily edited.*
- In this section, the authors say "In the remainder of this section, we walk through a common graduate-level introductory exercises for accessing and analyzing Neotoma data." Did you do this? If so, I couldn't find it. It would be a really valuable addition.
  - *We removed the reference to a teaching module directly in this paper, but provide links to HTML tutorials for chronology construction and other common workflow patterns with* `neotoma`*, linking to the GitHub repository.*
- Is the "Chronology Construction & Climate" section related to the rest of this section? I couldn't figure out the connection
  - *In editing this section we made the motivation and connection to the Programmatic Access heading much clearer. We also provided additional publications in this section to strengthen its utility for educators wishing to instruct based on material herein.*
- Writing is a bit weak in this section—compared to the others. I'd recommend editing for awkwardness and flow.
  - *We have edited throughout to improve flow and have dramatically reduced awkwardness of the text, although the authors' own awkwardness likely remains unchanged.*
- I'd recommend combining [the Discussion] section with the one after it "The Role" and deleting the repeated paragraph of info.
  - *We believe that our re-organization of the Discussion now addresses this issue, by partitioning the information more clearly.*

Reviewer 2

- I saw no abstract. I think part of the title "research-outreach nexus" is not delivered on in the chapter. To me, the authors are more exploring its pedagogical uses. I'd consider changing the title.
  - *We have added an abstract, and believe that the paper not more clearly indicates the concept and central idea of the research-outreach nexus.*
- I think the images of Neotoma were helpful, but could easily be reduced in size. Figure 1 could be eliminated, as should the related text as it has little to do with the purpose of the article. I also don't think Figure 6, as it stands is helpful (unless the authors decide to go more into these ideas in the body of the article). Finally, I do not think Figure 5 is very useful.
  - *We have modified the figures throughout and believe that (old Figure six, now figure 7) has been more fully explored and discussed in the paper.*
- Yes, though I wonder if the authors really need to include the trademark and webiste each time the discuss Flyover Country®. Maybe there is

another way to do this!

- *Unfortunately we do need to include the trademark, but have removed additional website links.*

- The [J.W. Williams et al. (in press); grimm2008neotoma] citation looks a little odd. Is this correct?
  - *This was an error in the citation formatting in Markdown, and has been corrected.*
- Though well written, and interesting, I really do not think the first two pages or so of the article (i.e., the introduction) are necessary. I'd get rid of them. See notes below to authors!
  - *I believe we have strengthened the article sufficiently that the structure of the paper now represents a much more integrated whole.*

Introduction:

- I felt the introduction, though interesting, is not really needed. In fact, it really drew away from the purpose of the chapter. I might start the chapter with the last part of the paragraph on page 3 which starts, "Understanding largescale spatial phenomena such as the climate-driven range shifts..." After this, the authors could get to the purpose of the chapter on page 4.
  - *The introduction has been significantly restructured.*
- I think it is important to bring in the idea of proxy data in the intro (i.e., define and be clear about it). There are some places where this ideas arises, but I think that understanding this is central to understanding the big ideas that one can learn from Neotoma.
  - *Proxy data is now introduced more explicitly in the introduction. We also relate the use of Neotoma more explicitly to changing species distributions in response to climate.*
- I think neotoma should be capitalized in "neotoma R package".
  - *The package itself is not capitalized.*
- In this section and in other parts of the chapter there is a sense that the context of the Quaternary would help people understand deep time. Why do the authors think this is true? Is it because the Quaternary is not too deep? Emeritus geoscience educator, Kip Ault, would say, humans live about 80 years and have difficulty conceptualizing time beyond a human time frame. Thus, it really doesn't much matter 2 million vs. 100 million. Both are equally abstract! Is there another argument for why the Quaternary would be a useful context? If not, I might leave this out.
  - *The introduction provides a much more forceful explanation of the importance of the Quaternary now.*

Your First Search (and the following, related, sections)

* Overall, I don't think the headings are very useful (particularly "More Searching" and "Mo

* More importantly, I think this entire section could be improved upon if the authors were t

Your First Search

* Related to the Marion Lake Search...To make this clearer, the authors might want to let th

* When I click on the pollen data online, I had to download the data in order to see it. In
  - *This section does not refer to the downloaded data, but rather the window that appears

More Details-

* I'd use the name on the top of the website instead of a description of what the tool looks
  - *Fixed*

* Also, is there a particular taxa the authors would recommend exploring to see something in
  - *We mention Spruce in the last sentence of the section, and indicate how a user might pr

Research Questions

* It seems pretty abrupt to jump to go right into an activity here. There is no set-up for
  - *We have edited this section, and added a sentence to the end of the* Neotoma Explorer *

* In my search for the "Mammut" it was unclear if this a North American search only or worl
  - *See above.*

More Exploration with Explorer...

* I am not quite sure I clearly understand what kind of scaffolding the authors are talking
  - *We have provided a reference and clarified this section, in particular to the use of th

Educational Modules for Climate Change...

* Are these modules discussed in this section the same thing the authors discuss above (i.e.
  - *We have modified the text to indicate where the modules can be found and to distinguish

* Coming back to a big idea from the beginning of this article, I think it might be nice to
  - *This is a challenging comment, here we are discussing not the fossil data as a proxy fo

Programmatic Access for Macro. . . .

* I think this section would be better if the authors were to curate the workshop materials
  - *We have modified this section to provide a broader context for the utility of these pr

Chronology Construction & Climate

* This heading doesn't quite follow the previous two headings as a "point of access" (perhap
  - *We believe that the re-written section about programmatic access now flows more complet

Discussion

* CCDRs at the Research-Outreach Nexus CCDR- This term needs to be defined and delimited!
  - *This has been modified and referenced to the Neotoma Williams paper, where the conept

* The following sentence occurs in this section and next section: Traditionally, CCDRs have
  - *This duplication has been removed.*

Role for CCDRs in Outreach

* If Figure 6 is important the authors should describe it in the text and go into it a litt
  - *We have added more context and more direct references to the figure in this section.*

  - Later in this section: I think it is great to discuss use of this software with
    K-12, but most of this article focuses on university level, thus it seems
    strange to bring in "elementary" here! Is there a reason for this?
    – *This reference has been moved.*