Range Mapper: An adaptable process for making and using interactive and animated web maps of Late-Quaternary open palynological data

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Visit Range Mapper!

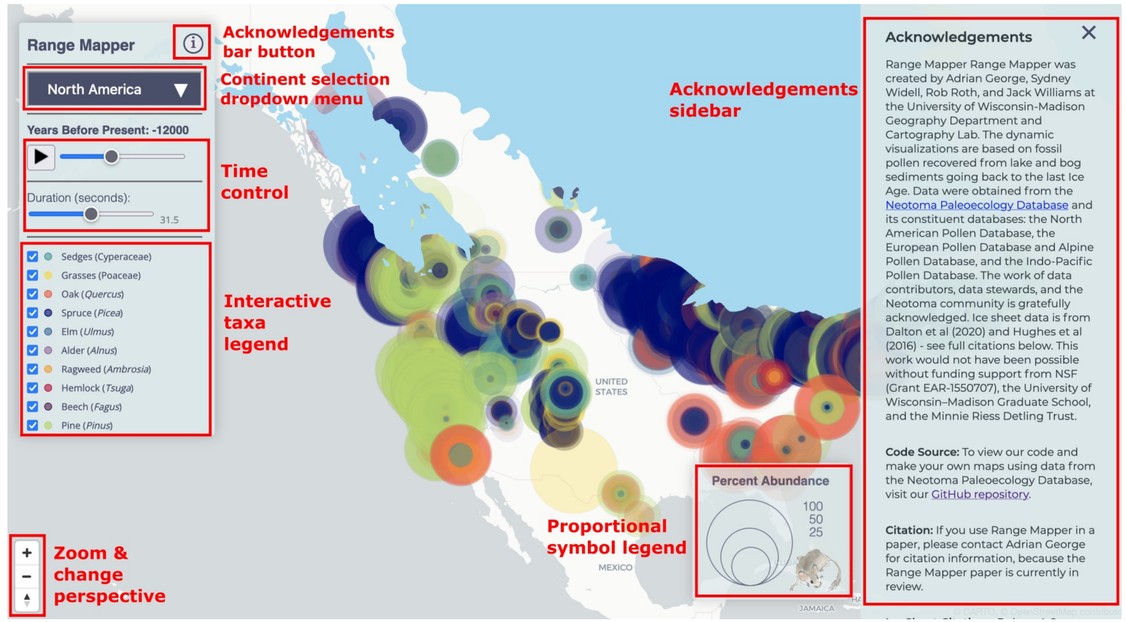
Introduction

- This is Range Mapper, a new set of online animated visualizations of plant taxon range shifts since the Last Glacial Maximum.
- Lakes are excellent archives for paleoecology records, such as pollen, which is the best data source for understanding vegetation response to climate change.
- The Neotoma Paleoecology Database (www.neotomadb.org) is an open-access, community-curated data resource for paleoenvironmental and paleoecology data.[1]
- Prior generations of Neotoma-based animations were not easy to update, and the underlying software no longer meets internet security standards.[2]
- New Software-as-a-Service cloud-based resources allow quick visualizations of the spatial and temporal patterns of large data and lower barriers to developing new visualizations by reducing the level of expertise required to generate high-quality dynamic maps and other visualizations.

Interface Implementation

- Using the Neotoma R package, we downloaded, processed, and temporally interpolated georeferenced pollen records from Neotoma from 21 ka BP to present.[3,4]
- We used Carto VL's web mapping features to build the spatiotemporal animated sequences, define visual design parameters, and add interaction controls, with maps created for North America, Europe, and the Indo-Pacific.
- Workflows are publicly available on GitHub.

Range Mapper Interface



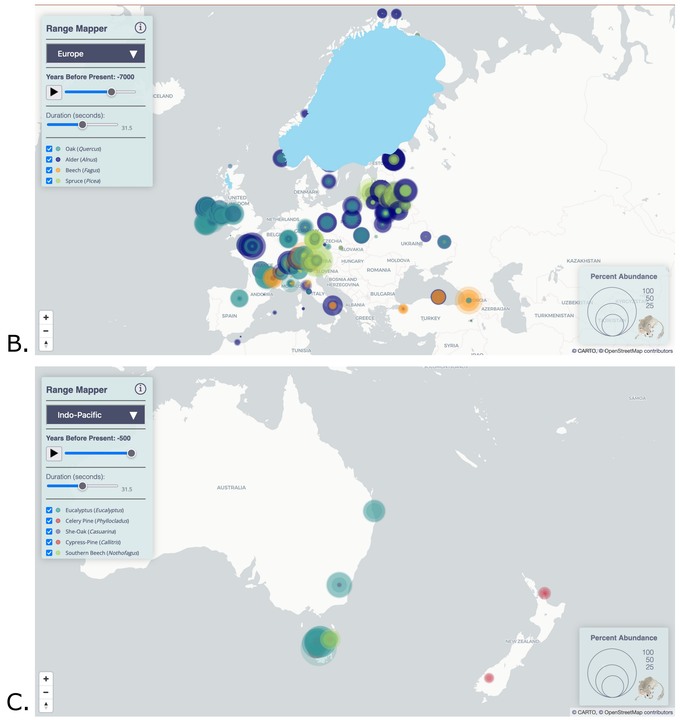
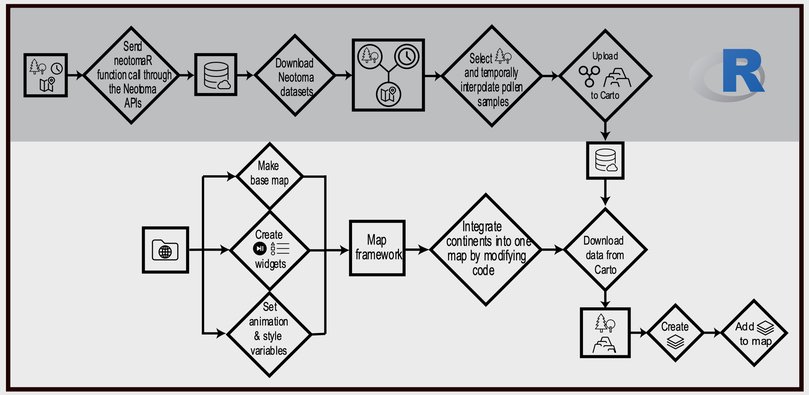


Figure 1: Range Mapper visualizations showing ice sheet extent and plant pollen percentage with map (center), animation controls and taxa legend (left), acknowledgements bar (right) pollen abundance legend (right) of the taxa listed in (a) North America at 12 ka BP, (b) in Europe at 7 ka BP, and (c) Australia and New Zealand at 500 BP.



Conclusions

- The completed visualizations are interactive and clearly illustrate major shifts in taxa distribution on all three continents over the last 21 ka BP in response to deglaciation and warming.[1,5,6]
- These maps will enable users to integrate up-to-date paleoecology data and mapping methods into their research, teaching, and outreach. The workflows, available on Github, support the extension of these animations to undermapped regions or taxa.
- Because the workflows can be quickly rerun as new data come in, the Range Mapper animations can be regularly albeit asynchronously updated as new datasets are added to Neotoma.

Literature Cited

1) J. W. Williams, B. N. Shuman, T. Webb III, P. J. Bartlein, and P. L. Leduc, "Late-Quaternary vegetation dynamics in North America: scaling from taxa to biomes," *Ecological Monographs*, vol. 74, no. 2, pp. 309–334, 2004, doi: https://doi.org/10.1890/02-4045. 2) P. L. Leduc, J. W. Williams, and T. Webb III, "Programs for site selection, tabular display, and interpolation of data from Paradox-based pollen databases.," *INQUA Newsletter*, p. 17, 1998. 3) J. W. Williams *et al.*, "The Neotoma Paleoecology Database, a multiproxy, international, community-curated data resource," *Quaternary Research*, vol. 89, no. 1, pp. 156–177, 2018, doi: https://doi.org/10.1017/qua.2017.105. 4) S. Goring *et al.*, "Neotoma: A programmatic interface to the Neotoma Paleoecological Database," *Open Quaternary*, vol. 1, no. 1, p. Art. 2, 2015, doi: http://doi.org/10.5334/oq.ab. 5) M. A. Adeleye *et al.*, "Long-term drivers of vegetation turnover in Southern Hemisphere temperate ecosystems," *Global Ecology and Biogeography*, vol. 30, no. 2, pp. 557–571, 2021, doi: https://doi.org/10.1111/geb.13232. 6) T. Giesecke, S. Brewer, W. Finsinger, M. Leydet, and R. H. Bradshaw, "Patterns and dynamics of European vegetation change over the last 15,000 years," *Journal of Biogeography*, vol. 44, no. 7, pp. 1441–1456, 2017, doi: https://doi.org/10.1111/jbi.12974.

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