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Exploring Spatiotemporal Patterns of Holocene Carbon Dynamics in Northern Peatlands by Incorporating Bayesian Age-Depth Modeling into Monte-Carlo EOF Analysis

Charly Massa (1), Zicheng Yu (1), Maarten Blaauw (2), and Julie Loisel (1)

(1) Earth and Environmental Sciences, Lehigh University, Bethlehem, PA, United States., (2) School of Geography, Archaeology and Palaeoecology, Queen's University, Belfast, United Kingdom.

EOF (Empirical Orthogonal Functions) analysis is a common tool for exploring the spatiotemporal modes of instrumental climate data. Although rarely applied to paleo proxy records, the EOF method is an efficient tool for the detection and analysis of broad-scale patterns of centennial to millennial-scale climate variability. But most paleoclimate records are not annually resolved and have inherent chronological uncertainties that may be problematic using ordinary EOF. Anchukaitis et al. (2012) provided a major step forward in paleo proxy data analysis by adapting EOF to time-uncertain paleoclimate proxy records (Monte-Carlo EOF). However, additional problems may arise for analyzing flux-based paleo parameters, such as peat C accumulation rates, which are strongly dependent to age-depth modeling, that is, small uncertainties in ages may lead to large differences in accumulation rates. Here we present a new approach that combines Bayesian age modeling and Monte-Carlo EOF to analyze flux-based paleo-datasets by thoroughly addressing both chronological and flux measurement uncertainties. This approach, implemented as a suit of linked R functions, overcomes a number of technical challenges, such as the effective handling of large datasets, the reduction of computational requirements for calculating hundreds of thousands of iterations, standardization issues, and EOF computation of gappy data. As a case study we explored the recently published Holocene circum-Arctic peatland database with >100 sites (Loisel et al. in press) to investigate the spatiotemporal patterns and climate controls of peat C accumulation. The approach can be used for other flux-based proxies, such as charcoal influx, erosion rates or atmospheric depositions. Our preliminary results reveal different temporal patterns of C accumulation in major peatland regions, as controlled by various regional climate histories and other bioclimatic factors. For instance, peatlands in continental vs. oceanic settings seem to have responded differently to temperature changes, due probably to contrast moisture responses in coastal and inland regions. To further our understanding of controls of Holocene peat C sequestration, we plan to compare the spatiotemporal patterns of peat C accumulation with other climate datasets (instrumental and paleo) on the basis of their leading EOF modes, including the Arctic Holocene proxy climate database (Sundqvist et al. 2014).

References

Anchukaitis, K. et al. (2012) Climate Dynamics, 41: 1291-1306.
Loisel, J. et al. (2014) The Holocene (in press).
Sundqvist, H.S. et al. (2014) Climate of the Past Discussions, 10: 1-63.