

Forest responses to last-millennium hydroclimate variability are governed by spatial variations in ecosystem sensitivity

Christine Rollinson¹, Andria Dawson², Ann Raiho³, John Williams⁴, Michael Dietze⁵, Thomas Hickler⁶, Stephen Jackson⁷, Jason McLachlan³, David Moore⁸, Ben Poulter⁹, Tristan Quaife¹⁰, Jörg Steinkamp¹¹, and Mathias Trachsel¹²

¹Morton Arboretum

²Mount Royal University

³University of Notre Dame

⁴University of Wisconsin

⁵Boston University

⁶Senckenberg Research Institutes and Natural History Museum

⁷DOI Southwest Climate Science Center

⁸University of Arizona

⁹NASA Goddard Space Flight Center

¹⁰University of Reading

¹¹Senckenberg Society for Nature Research

¹²University of Wisconsin-Madison

September 25, 2020

Abstract

Forecasts of forest responses to climate variability are governed by climate exposure and ecosystem sensitivity, but ecosystem model projections and process representations are under-constrained by data at multidecadal and longer timescales. Here, we assess ecosystem sensitivity to centennial-scale hydroclimate variability, by comparing dendroclimatic and pollen-inferred reconstructions of drought, forest composition and biomass for the last millennium with five ecosystem model simulations. In both observations and models, spatial patterns in ecosystem responses to hydroclimate variability are strongly governed by ecosystem sensitivity rather than climate exposure. Ecosystem sensitivity was highest in simpler models and higher than observations, suggesting that interactions among biodiversity, demography, and ecophysiology processes dampen the sensitivity of forest composition and biomass to climate variability and change. By integrating ecosystem models with observations from timescales extending beyond the instrumental record, we can better understand and forecast the mechanisms regulating forest sensitivity to climate variability in a complex and changing world.

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