

Predicting the impacts of climate variability and change on ecosystem structure, composition, and function in the Northeastern United States

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ABSTRACT

Statement, in broad scientific terms, of the project objectives: The United States National Assessment of Climate Change conducted by the National Science and Technology Council concluded that, in order to inform our understanding of humanity's impacts on climate and climate's impacts on us, further research is needed to improve our understanding of the ecological processes that are sensitive to climate change. The research described in this proposal is designed to determine how changing climate, climate variability, atmospheric composition and disturbance forcing will affect the composition, structure, and functioning of the forested ecosystems in the Northeastern United States.

List of the specific hypotheses to be tested or science questions to be answered: The objective of this research is to test the hypothesis that the forested ecosystems in the Northeastern United States are likely to experience profound non-linear changes in vegetation structure, composition and function in response to forcing by multiple factors associated with changing climate, climate variability, atmospheric composition and disturbance history.

Statement of the location(s) of the research activities: The research will be conducted at Harvard University, located in Cambridge Massachusetts.

Brief outline, in general terms, of the approach to be used: Our approach is to use a diverse and comprehensive array of long- and short-term observations to construct a constrained implementation of the ED2 terrestrial biosphere model for the Northeastern United States. The constrained model will then be used to predict changes in ecosystem structure, composition and function over the coming decades. AmeriFlux tower measurements, observations from Free Air CO₂ Enrichment (FACE) experiments, and long-term forest inventory data throughout the Northeastern US will be assimilated into a regional model optimization that will be used to constrain both regional patterns of canopy carbon and water fluxes, and regional-scale patterns of growth and mortality of different functional groups across the region, and inter-annual variability in these dynamics. The constrained biosphere model will then be used to forecast the consequences of changes in climate and atmospheric CO₂ for the composition, structure and functioning of terrestrial ecosystems of the Northeastern US.

Statement of what the research is intended to accomplish, including expected deliverables: The above research will deliver a constrained, state-of-the-art biosphere model for the Northeastern US and accompanying model forecasts for how the composition, structure and function of Northeastern forests will change over the coming century in response to changes climate and atmospheric CO₂ forcing, and identify key remaining sources of uncertainty regarding their future fate.