ABSTRACT: Identification of critical environmental response functions for terrestrial organisms, communities, and ecosystems to rapidly changing climate conditions are needed to evaluate ecological consequences and feedbacks. We are constructing an experimental platform to address climate change response mechanisms in a Picea/Larix/Sphagnum ombrotrophic bog ecosystem located in northern Minnesota. This ecosystem located at the southern extent of the spatially expansive boreal peatland forests is hypothesized to be especially vulnerable to climate change and to have important feedbacks on the atmosphere and climate. Preparations are being made for a replicated experiment to test mechanisms controlling vulnerability of organisms and ecosystem processes changes for multiple levels of warming (up to +9°C) combined with elevated CO2 exposures (900 ppm).

Through the execution of this experiment we will quantify changing greenhouse gas emissions to the atmosphere, thresholds for organism decline or mortality, limitations to regeneration, and biogeochemical limitations to productivity. The experiment will allow for the evaluation of responses across multiple spatial scales including: microbial communities, bryophyte populations, various higher plant types, and some faunal groups. Direct and indirect effects of these experimental perturbations will be tracked and analyzed over a decade for the development and refinement of models needed for full Earth system analyses.

Pretreatment simulations of anticipated ecosystem responses to the range of warming and elevated CO₂ treatments have been undertaken. Those simulations shed light on important interactions taking place between primary carbon cycle processes and productivity driven changes in element cycles that allow for fertilization of the dominant vegetation. Long-term carbon cycle changes in such high-carbon systems will be driven by the success or failure of a all vegetation types, but the interplay between Sphagnum communities at the ground surface vs. the success of overtopping shrub and tree species will drive long term community composition and net C flux.