Angelica Patterson
+ Kevin Griffin
Columbia
Contact K.G.

TITLE: Temperature tolerance of the physiological processes controlling carbon gain in Northeastern forests

KEYWORDS: *photosynthesis, respiration, range limits, climate change, carbon cycle*

INTRODUCTION: Extensive botanical surveys of long term plots shown that since the early1930's Black Rock Forest, located in the Hudson Highlands of New York, lost three tree species and gained seven[1]. hese results are consistent with a warming climate and suggest the Hudson River Valley may be an important location to study the effects of climate change on Northeastern forests. I propose to explore the mechanistic basis for the observed ecological changes and consider the potential effects on the carbon storage capacity of forest trees under the predicted warmer climates of the coming century.

orecasts predicts global surface air temperature of 2.0 – 5.4□ over the next century[2]. In the NE of the U.S., temperatures have increased 0.8□ in the last 30 years ( ) vidence of the warming effects on ecosystems have been observed growing seasons have lengthened, flowering phenology has shifted earlier and shifted poleward[2,3]. The to increases in air temperature will be observed through changes in geographic distribution (ie. migration to suitable habitat[3-5]), local adaptation[5,6], or extirpation[3,5]. Global vegetation (GV) and species distribution models (SDMs) have shown that 1 km y^{-1} migration rates necessary in regions of rapid climate change[5]. However, fossil records show that tree species may be moving slower than what current models predict[7] and that the short resident times of local or regional climates have narrowed the opportunity for plants to track ecological niches[4,5,8].

Comment [KG1]: This should become a regular numbered reference

Comment [KG2]: Is this the rate of migration predicted by the model, or the required rate as predicted?

Classic GV and SDMs primarily use species presence/absence or presence only distribution with preferred environmental parameters to predict range distributions of plant communities under increasing CO_2 regimes, and thus climate warming[5,9]. Over the past 30 years, modelers have begun to incorporate more physiological data (photosynthesis, stomatal response, and respiration), but these models only incorporate generalized processes, which lack a sophisticated understanding of species specific physiological characteristics and complex interactions within plant communities, particularly species composition and competition[5,10,11]. More experimentation is necessary to validate model assumptions of the mechanisms behind tree response to climate change and narrow the variability of model outputs[10].

I propose to study the physiological response to increasing temperature of tree species that have northern or southern range limits distributed across the Hudson Highlands region (HHR) of the Northeastern U.S. It is critical to evaluate rapid changes in forest stand structure in this region due to this area's high dominance of oak species, which are known sequester large amounts of carbon[1] in a region known to be the one of the largest aboveground terrestrial carbon pools in the world[12]. Climate change in these regions could promote the introduction of new species, either introduced through anthropogenic means or through migration, all of which may negatively influence carbon storage capacity and reduce the set of important ecosystem services oak-dominated forests have provided[1]. Assessing the physiological capacities for carbon gain in a wide array of trees species that are in the center and on the edges of their range limits, will enable us to better understand the temperature tolerances of these processes and assess the ability of forests to persist and sequester carbon in light of changing climate conditions. Through quantitative observational and experimental tests, this research will ask what species can