Poster #9-4

Whole Ecosystem Warming Induces Divergent Ecophysiological Responses in Co-Occurring Boreal Tree and Shrub Species – Observations and Model Simulations

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Southern boreal peatlands are considered vulnerable to projected increases in warming and the potential for environment-driven changes in seasonal patterns of net carbon uptake has strong implications for atmospheric feedbacks. At the SPRUCE whole-ecosystem warming □ CO_2 site in a Minnesota peatland, extensive interannual pretreatment gas exchange campaigns revealed significant interspecific seasonal differences in specific leaf area, nitrogen content and photosynthetic parameters (i.e., maximum rates of Rubisco carboxylation (Vcmax25 °C), electron transport (Jmax25 °C) and dark respiration (Rd25 °C)). ELM-SPRUCE was sensitive to the inclusion of observed interspecific seasonality in Vcmax25°C, Jmax25 °C and Rd25°C, leading to enhancement of simulated net primary production (NPP) using seasonally dynamic parameters as compared with static parameters. Since the initiation of warming treatments, measurements at the site indicate the active season has increased by up to 10+ weeks, with sapflow beginning earlier in spring and lasting later into the fall. Warming has increased the atmospheric vapor pressure deficit and there is evidence of heat or drought-related damage in the warmest plots. Plant responses include species-specific shifts in seasonal ontogeny (developmental rates), chemistry (non-structural carbohydrates, pigments), physiology (photosynthesis, respiration) and morphology (foliar display, leaf size). The two dominant tree species displayed divergent responses to warming. In *Picea mariana*, stomatal conductance declined to reduce water loss in warmer plots, which resulted in homeostatic sapflow and leaf water potentials, and constant net photosynthesis despite increases in N content. In contrast, *Larix laricina* increased stomatal conductance and sapflow that together with increased N content led to enhanced net photosynthesis, but with dangerously low leaf water potentials. In addition, the two dominant shrub species displayed seasonally variable responses to warming and CO_2 with a wide thermal optimum for photosynthesis and differential responses of respiration. Species-specific seasonal physiological responses to warming and CO_2 treatments including shifts in the active season, ontogeny and thermal acclimation will necessitate novel model parameterization in order to improve simulation of real ecosystem-level NPP.