Poster #1-30

Arctic Shrub Expansion, Plant Functional Trait Variation, and Effects on Belowground Carbon Cycling

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Arctic plant communities are changing in response to climate warming, as evidenced by the widely documented increase in woody-shrub growth and "greening" across much of the Arctic tundra biome. This vegetation shift may offset or amplify warming by altering carbon cycling. We are investigating how above- and belowground plant functional traits respond to environmental conditions and affect belowground carbon stocks and fluxes. In summer 2017, we measured the traits of three shrub species, *Alnus viridis* ssp. *fruticosa*, *Salix richardsonii* and *Betula nana*, in five sites spanning a climate gradient in northern Alaska. Within each site, we collected leaf and root samples from ten individuals per species along a thaw gradient, from riverside to upland, moist tussock tundra. Preliminary findings demonstrate a hierarchy of controls on leaf traits. Regionally, shrub SLA was negatively related to number of growing degree days (P=0.02), indicating that investment in leaf construction increases with growing season length, as expected for leaves with a longer life-span. Given that SLA and net photosynthetic rate are positively correlated, our findings suggest that net C assimilation rates of shrubs will decrease with sustained summer warming. Locally, however, shrub SLA varied with active layer thickness, climate zone, and species. In warmer southern sites, we observed a positive relationship between alder SLA and active layer thickness (P=0.08), and no relationship for birch or willow. In the cooler northern sites, we observed a positive relationship between SLA and active layer thickness for willow (P=0.03), a weak negative relationship for birch (P=0.09), and no relationship for alder. We observed a negative relationship between SLA and specific root length (SRL) at the regional scale (P<0.001), but patterns of trait covariation differed with climate and by species. In the north sites, we found no evidence that shrub SLA varied with SRL. Covariation between SLA and SRL was stronger in the southern sites, where active layers were deeper. Collectively, our shrub trait data demonstrate that species within the shrub PFT respond differently to environmental variation, resulting in above- and belowground trait distributions that differ considerably across space. This underscores the limitations of using fixed trait values to characterize tundra PFTs. The results of this work will help to improve the parameterization and formulation of the Terrestrial Ecosystem Model, which will be used to evaluate how differences in plant functional traits affect carbon dynamics, and explore approaches to accounting for this variability in models.