Canopy Spectral Imaging (NDVI) As A Proxy Measurement Of Shrub Biomass And Ecosystem Carbon Fluxes Across Arctic Tundra Habitats

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There is widespread consensus that climate change is contributing to rapid vegetation shifts in the ecologically sensitive Arctic tundra. These tussock grass dominated systems are shifting to tussock/woody shrub communities leading to likely alterations in carbon sequestration and ecosystem productivity, which in turn can manifest in "greening" and changes in normalized difference vegetation index values (NDVI). While the expansion of woody vegetation is well established, our understanding of the ecosystem dynamics associated with this new habitat remain largely unknown. To untangle how the Arctic tundra may be impacted by these vegetation shifts we paired vegetation measurements (*i.e*. shrub biomass, leaf area, and shrub canopy area) and ecosystem carbon fluxes (*e.g*. net ecosystem exchange, NEE, and ecosystem respiration) with ground-level measurements of NDVI. We conducted these measurements at the Toolik Field Station in dry heath and moist acidic tundra habitats which are representative of the primary habitat types on the North Slope of Alaska. We found strong positive relationships between shrub leaf area and shrub biomass as well as shrub canopy area and shrub biomass, relationships that were corroborated with NDVI measurements (R^2=0.6; P=0.01). This lends support for the use of NDVI as a proxy measurement of not only leaf area but also shrub biomass. Additionally, NDVI was negatively correlated with ecosystem respiration across habitats, with respiratory fluxes consistently higher in the moist acidic tundra relative to the dry heath tundra. Finally, we observed a significant positive relationship between net ecosystem exchange and NDVI (R^2=0.7; P<0.01). The positive relationship between NDVI and NEE highlights the potential shifts in the carbon balance of the Arctic tundra associated with an increased prevalence of woody vegetation. This increased plant productivity may offset greenhouse gas losses from permafrost degradation contributing some resilience to this system otherwise considered a considerable carbon source. Such ground-truthed relationships can facilitate assessments of long-term trends in NDVI and their ramifications on ecosystem C cycling processes. These relationships will enhance our ability to predict shifts in standing carbon mass, carbon cycling, and use historic satellite products to assess change.