Characterization of vegetation biomass and structure along a gradient from tundra to forest at treeline in Council, Alaska

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Introduction

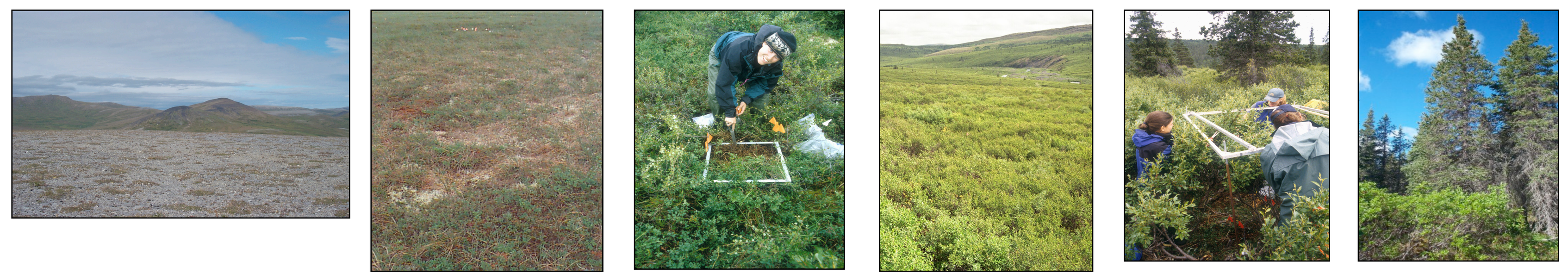
Climate change has the potential to influence vegetation dynamics in high latitude ecosystems, which may affect the climate system through changes in water, energy, and carbon dynamics. To improve the capability to make projections about the response of these land surface processes to climate change, we need to improve our understanding of how species composition influences these dynamics. Our research focuses on improving our understanding of the role of species, or groupings of species (plant functional types) in the water, energy, and carbon exchange of ecosystems located at sites near Council on the Seward Peninsula.

Methods

In the Council sites, sampling grids (100 x 100m) (see pictures right) were centered on the eddy covariance towers, which measured energy, water and CO_2 fluxes. All vegetation sampling occurred at peak biomass, mid-July through mid-August in 1999 and 2000.

- Leaf Area Index (LAI) measurements were taken every 10 meters within the grid (n=121) using a Licor 2000.
- The characterization of vegetation took place within these grids in randomly selected 20/50 cm quadrats stratified by cover type. Aboveground vascular plant biomass was harvested to the top of the moss or lichen layer, which was collected separately. Tall *Betula* and *Salix* were sampled in 1m^2 plots, with the 20/50cm quadrat subsampling the understory.

The Council sites represent a structural transition from tundra to forest, which is analogous to transitions of arctic ecosystems that might occur in response to climatic warming



Barren Tundra Low Shrub Shrub Woodland Forest

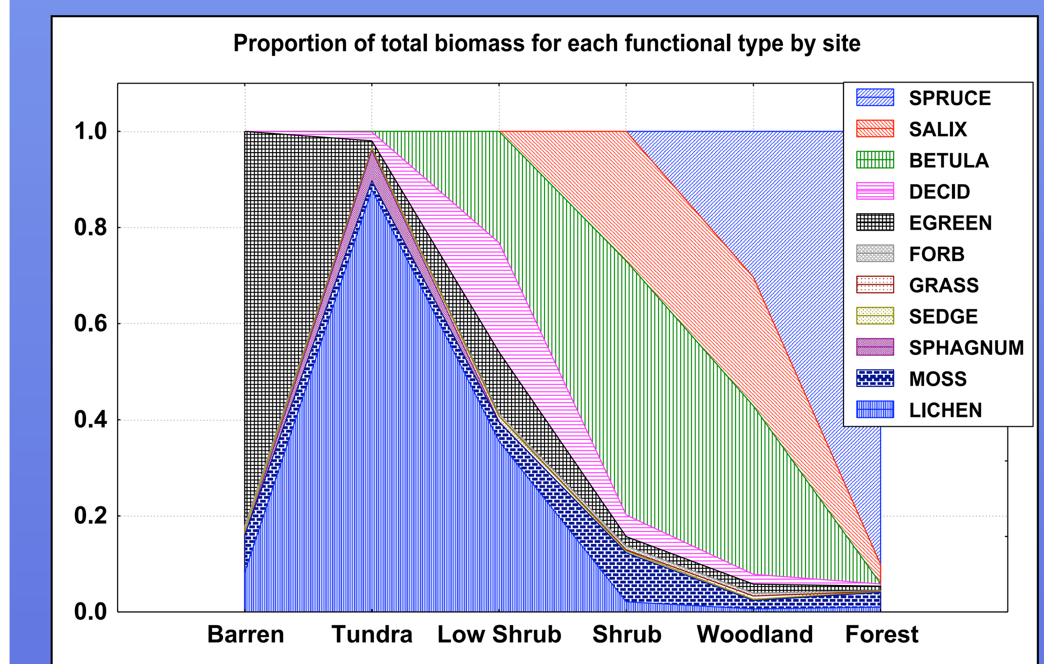


Figure 1

Along the gradient, the relative proportions of the functional types change with the addition of a new dominant functional type.

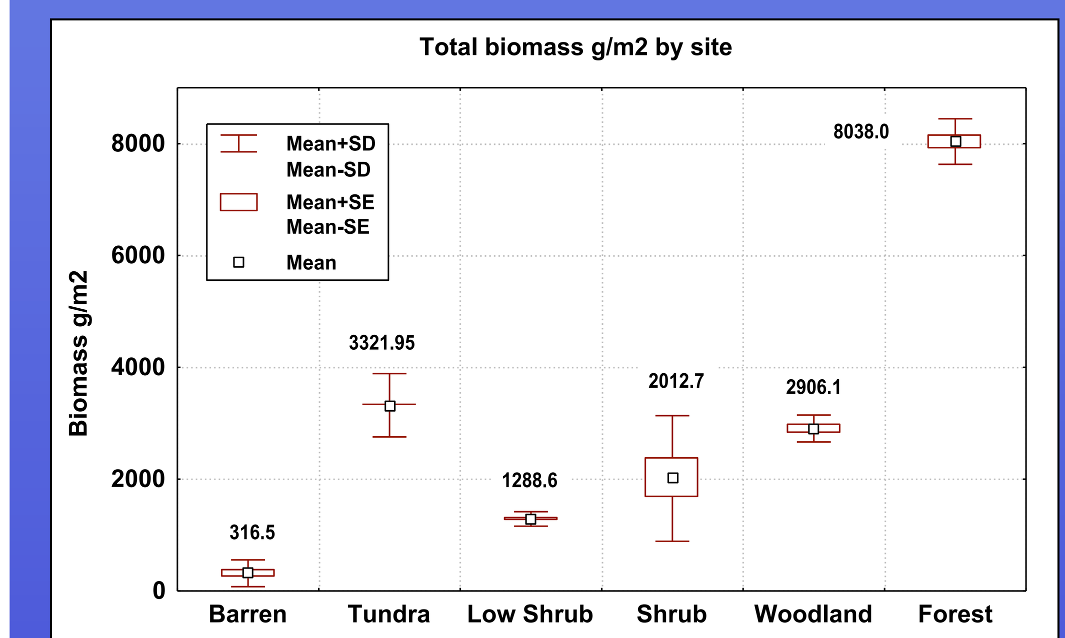


Figure 2

Figure 2

Total biomass increases along the gradient, with the exception of the tundra site, because of the high lichen biomass

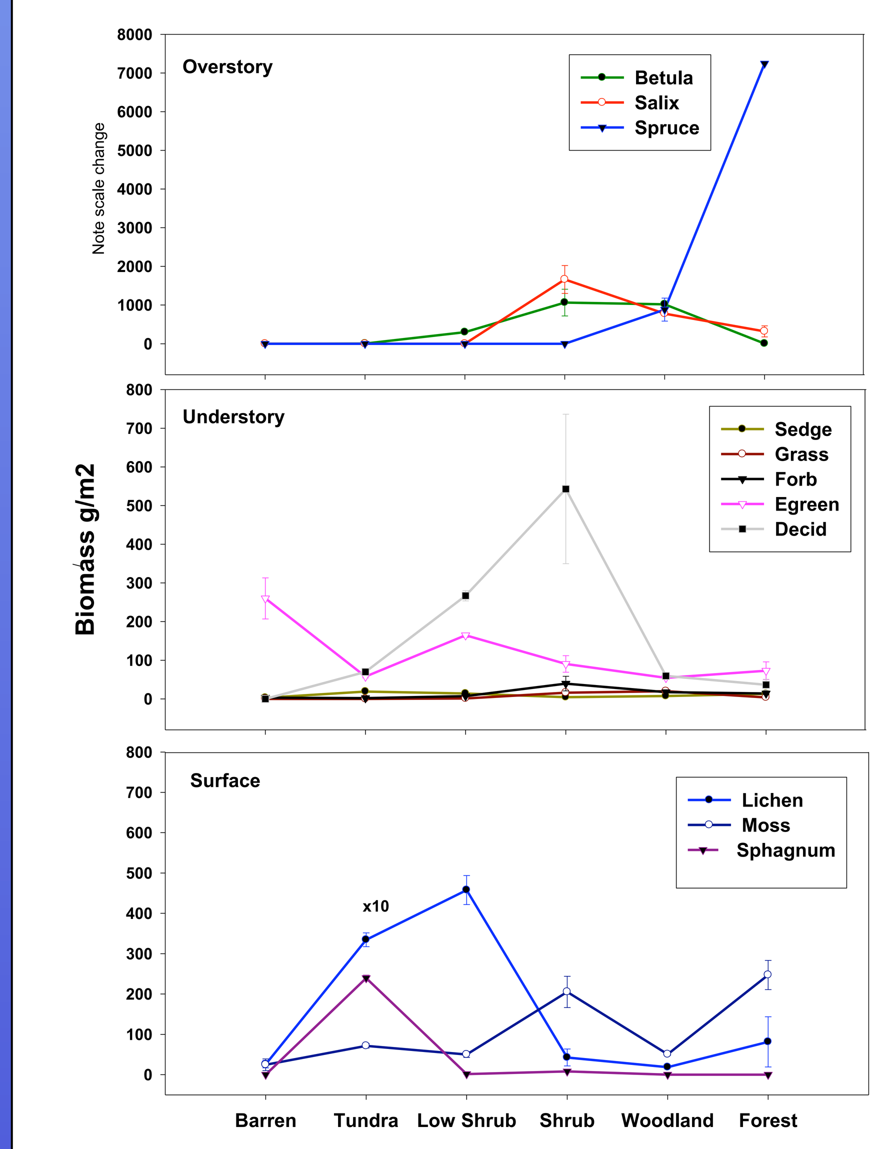


Figure 3

Figures 3 and 4

The development of a closed canopy has a stronger effect on the biomass of the understory deciduous and evergreen shrubs than on graminoid types.

Lichen and sphagnum biomass decreases along the transect, which will affect heat and moisture fluxes from the land surface in these sites.

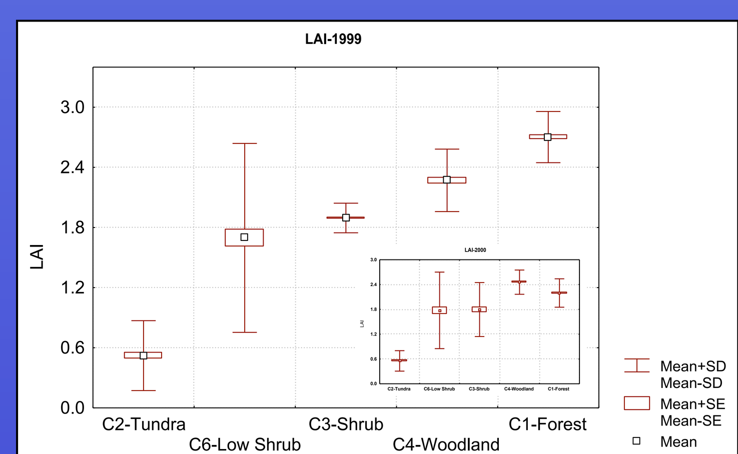


Figure 4

Figure 5

The differences in biomass under the Salix and Betula shrubs in the woodland site is an example of how aggregation to the functional type level might mask interactions between species which might be important at the landscape scale.

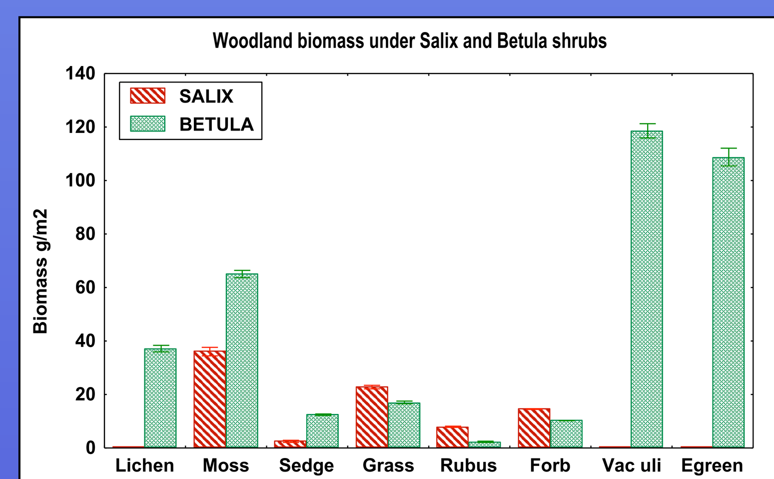


Figure 5

Future Directions

The vegetation data from Council is being used to develop and parameterize a Dynamic Vegetation Model for the Pan-arctic.

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