

sDiv Workshop
"sTUNDRA: Scaling tundra shrub expansion from site to biome"
24 Feb - 7 Mar 2014
Workshop Summary

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Summary

The sTUNDRA workshop marked the establishment of an international collaboration to scale tundra shrub expansion from site to biome. Our working group has compiled plot-based plant cover data and individual growth records for tundra shrub species from sites around the biome and integrated these records with plant trait data and time series of climate and remotely-sensed greening (NDVI) data. We have amassed these datasets in an online repository (using GitHub) and have begun work on integrated analyses to address our key research goals:

1. To identify patterns of climate sensitivity of shrub growth, abundance and phenology across the tundra biome
2. To test the correspondence among satellite greening and plot-based data
3. To predict species-level climate-sensitivity based on plant traits for the dominant shrub species

This report contains a summary of the accomplishments to date and work plans for 2014.

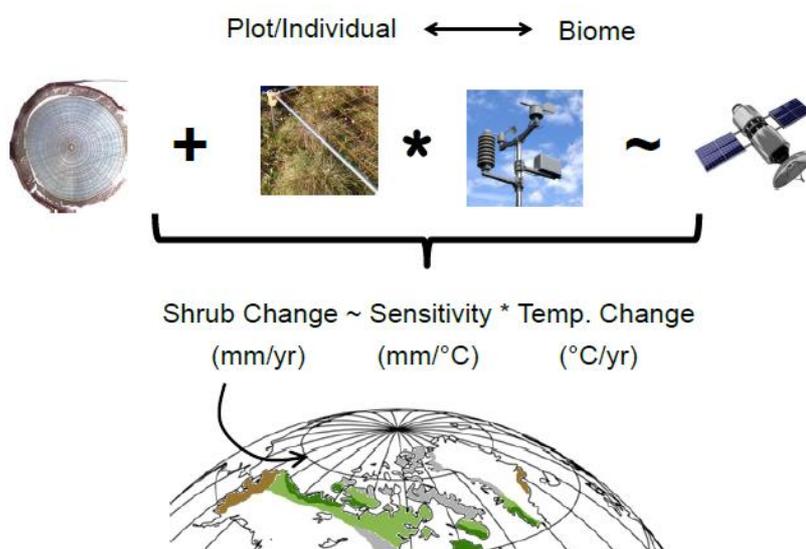


Figure 1. This is the conceptual idea behind the working group, to combine local-scale measures of shrub growth, cover change and plant traits to test for correspondence between these local-scale changes and remotely-sensed greening and to link these changes to climate.

Workshop accomplishments

The sTUNDRA workshop was conducted over a two weeks from 24 Feb - 7 Mar 2014. The first week involved the participation of all working group members to discuss the overall research approach, assembled datasets and specific research questions and hypotheses. The second week involved participation of a core group of participants who began to carry out the planned analyses, put together the preliminary findings and develop the future work plans.

Week1: All participants

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| Day 1 | – Introduction to the workshop, introduction to the database and repository |
| Day 2 | – Discussion of skill sets and expertise brought to the workshop |
| Day 3 | – Breakout group discussions of the primary manuscript relating shrub growth and cover change with NDVI greening across the tundra biome |
| Day 4 | – Breakout group discussions of how to combine plant traits, climate envelopes and biodiversity metrics with the tundra shrub change question |
| Day 5 | – Refinement of identified research questions into manuscript outlines and development of work plans for week 2 of the workshop |
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Week2: Core group

Discussion of analyses, development of work plans, server set up, coding of Bayesian models, compilation of trait database, calculation of community-weighted trait means, calculation of additional climate variables, scripts developed to test climate sensitivity of greenness

Workshop presentations

- Introduction to sTUNDRA: Scaling tundra shrub expansion from site to biome – I. Myers-Smith, UEdinburgh
- Summary of the ShrubHub synthesis – I. Myers-Smith, UEdinburgh
- Overview of the ITEX datasets and syntheses – Plot-scale shrubification – S. Elmendorf, NEON
- High-latitude remote sensing and the greening of the Arctic – P. Beck, JRC

- Climate Warming, Vegetation Change, Plant Traits and Tundra Function – H. Cornelissen, VU and W. Cornwell, UNSW
- TRY - Plant traits in the context of sTundra – J. Kattge, MPIB
- Predicting light sensitivity of tree growth based on functional traits – N. Rüger, iDiv
- Climate envelope modelling in tundra ecosystems – S. Normand, AarhusU
- Climate sensitivity of tree growth at range edges - Janekke HillRisLambers, UW
- Divergence and other issues: What “shrubocalyptists” might learn from treering people – M. Wilmking, UGreifswald
- Effect of shrubification on shortwave radiation fluxes in the Siberian Arctic – I. Juszak, A. Erb, M. Iturrate, and G. Schaepman-Strub, UZurich

Workshop discussion

Several key discussion points were raised during the working group including:

1. *How to best test the correspondence among tundra vegetation change datasets from different spatial scales?*
2. *How to best calculate the climate sensitivity of growth and cover change?*
3. *Can we detect growth trends over time using annual growth ring data?*
4. *How do we account for non-stationary trends when testing the climate sensitivity of growth, cover and greening?*
5. *How to we incorporate lag relationships between climate and cover change?*
6. *Can we account for the differences in growth form when testing the responses of tundra vegetation to warming?*

Some of the major outcomes of the working group surround the development of novel methods and approaches required to address these challenges in scaling tundra vegetation change from plot to biome.

Papers outlined

During the course of the workshop we identified two key manuscript ideas:

- Manuscript 1: Scaling the climate sensitivity of shrub growth and greenness trends across the tundra biome (lead I. Myers-Smith, S. Elmendorf and P. Beck)
- Manuscript 2: Predicting climate sensitivity of shrub (and other species) growth using plant traits (lead A. Bjorkman)

Seven additional papers were outlined on topics spanning tundra plant diversity changes over time, phenological mismatch, mapping of shrub change in climate space and a summary review paper of challenges in tundra scaling. The analyses for these papers were outlined during the workshop and will be further developed over 2014 by lead authors from within the group.

Future work plans and preliminary results

Trends and climate sensitivity of growth, cover and greening

In our analysis, we plan to explore both trends in shrub growth and cover and the climate sensitivity of growth and cover change and to compare this to the climate sensitivity of greenness trends (NDVI). Previous studies indicate climate sensitivity of change in plant species cover (Elmendorf et al. 2012) and shrub growth (Myers-Smith et al. in prep.) across the tundra biome. Building from these previous studies, we are working to design the analyses that will explicitly allow us to test the correspondence among trends and climate sensitivities (inter-annual variability) across these datasets from different sites across the tundra biome.

Predicting climate sensitivity using plant traits

We plan to use plant trait data to predict the climate sensitivity of shrub species. We will compare trends in growth/cover and the climate sensitivity of growth/cover across variation in key plant traits. Preliminary analyses indicate that greater climate sensitivity of shrub growth is found for species with a taller maximum canopy height, but these analyses have yet to be extended to all the traits in our database. We additionally plan to integrate the climate niche and plant traits of different tundra species to understand how tundra vegetation change might progress under future warming scenarios.

New Collaborations

A new collaboration between members of the ITEX and ShrubHub research networks and experts in satellite remote sensing (S. Goetz, WHRC and P. Beck, JRC), plant trait data (J. Kattge, TRY and H. Cornelissen, VU) and climate niche modelling (S. Normand, AarhusU) have arisen from the establishment of this working group. Our plans to implement hierarchical Bayesian analysis of our different datasets to address some of our research questions involve the integration of methods developed in grassland (J. HilleRisLambers, UW) tropical forest ecology (N. Rüger, iDiv). The workshop has led to the development of a new team of early career participants including A. Bjorkman (iDiv postdoc), J. Prevey (WSL/SLF postdoc) and others that will work together to lead key analyses and manuscripts and move progress forward during 2014.

Feedback on sDiv support

Support from sDiv for a two-week workshop allowed for both face-to-face discussion of research ideas and preliminary analysis of the compiled data. The sDiv team facilitated the progress over the workshop and will continue to advance our work plans through providing access to computing facilities. We have secured server space from iDiv for the rest of 2014 allowing participants to remotely work with the assembled dataset and run computer-intensive analyses. Our online data and code repository on GitHub will allow for all participants to contribute to code development and analyses and keep up-to-date with preliminary results as the working group progresses.

The workshop organizers including leaders I. Myers-Smith, S. Elmendorf, P. Beck and iDiv postdoc A. Bjorkman will carry forward work plans over 2014. We aim to reconvene a year from now to wrap up the two primary manuscripts and continue progress on the additional projects established by the group at the first sTUNDRA workshop. For more information on outputs from the sTUNDRA workshop please contact Isla Myers-Smith (isla.myers-smith@ed.ac.uk).

References:

- Elmendorf, S. C. et al. 2012. Plot-scale evidence of tundra vegetation change and links to recent summer warming. - Nat. Clim. Change 2: 453–457.
- Myers-Smith, I. H. et al. Climate sensitivity of shrub expansion across the tundra biome. - In Prep.

Participant List

Workshop Coordinators:

- Isla Myers-Smith, University of Edinburgh
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- Sarah Elmendorf, NEON
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Workshop Participants:

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- Greg Henry, University of British Columbia
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