Altering *Pinus sylvestris* climate-establishment pattern and forest cover changes at the forest-tundra zone of northern Fennoscandia

Ingrid E. Mathisen[1], Annika Hofgaard[1] and Lars Söderström[2]

[1]Norwegian Institute for Nature Research, NO-7485 Trondheim, Norway

[2]Norwegian University of Science and Technology, NO-7491 Trondheim, Norway

Background

The state of the arctic forest-tundra zone (location and structure) is considered a major indicator of past and present climatic conditions. This circumpolar zone has significance at local to global scales for its role in land-atmosphere interactions, biodiversity and human land use. In Fennoscandia, Scots pine form the arctic conifer forest-tundra zone, which has been in a continuous but varying stage of change through the history. Present study address the spatial variation of the zone's response to climate change; through analyses of age structures, growth characteristics and climate-growth correspondence.

Main aims

- Identify establishment patterns of pine across the forest-tundra zone, and along the Atlantic-Arctic climatic gradient.
- Explore the climate-establishment relation for current pine populations, and the cause-response diversity among sites.
- Examine forest cover response under given climate scenarios.

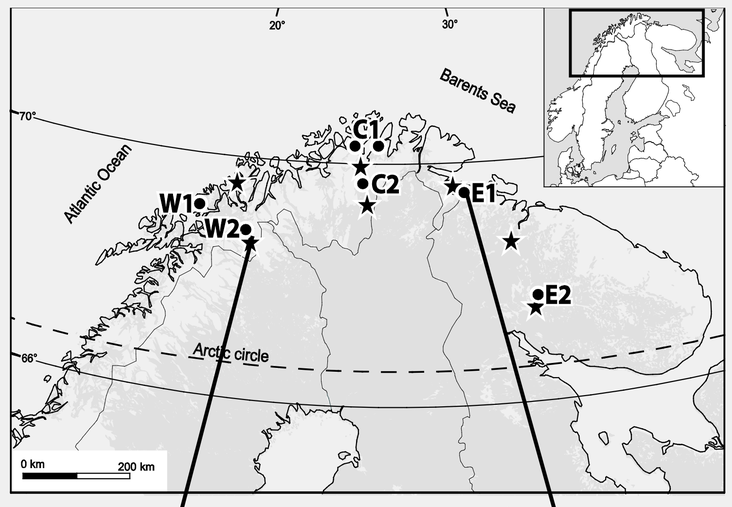

Fig 1. Study sites ; climate stations ★

121 year old krummholz individual above the treeline at W2 and a ca 3 year old pine seedling at the treeline site of E1.

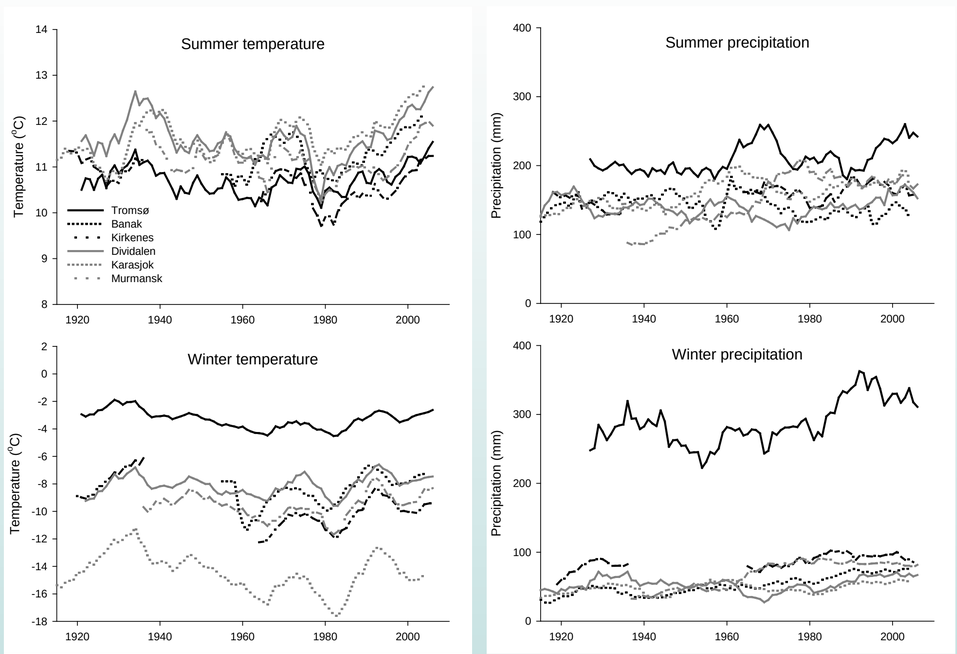

Fig 2. *Ten year running mean for summer and winter temperature and precipitation. Data from the meteorological stations representing each study site. Note that the x-axes are different from Figure 3.*

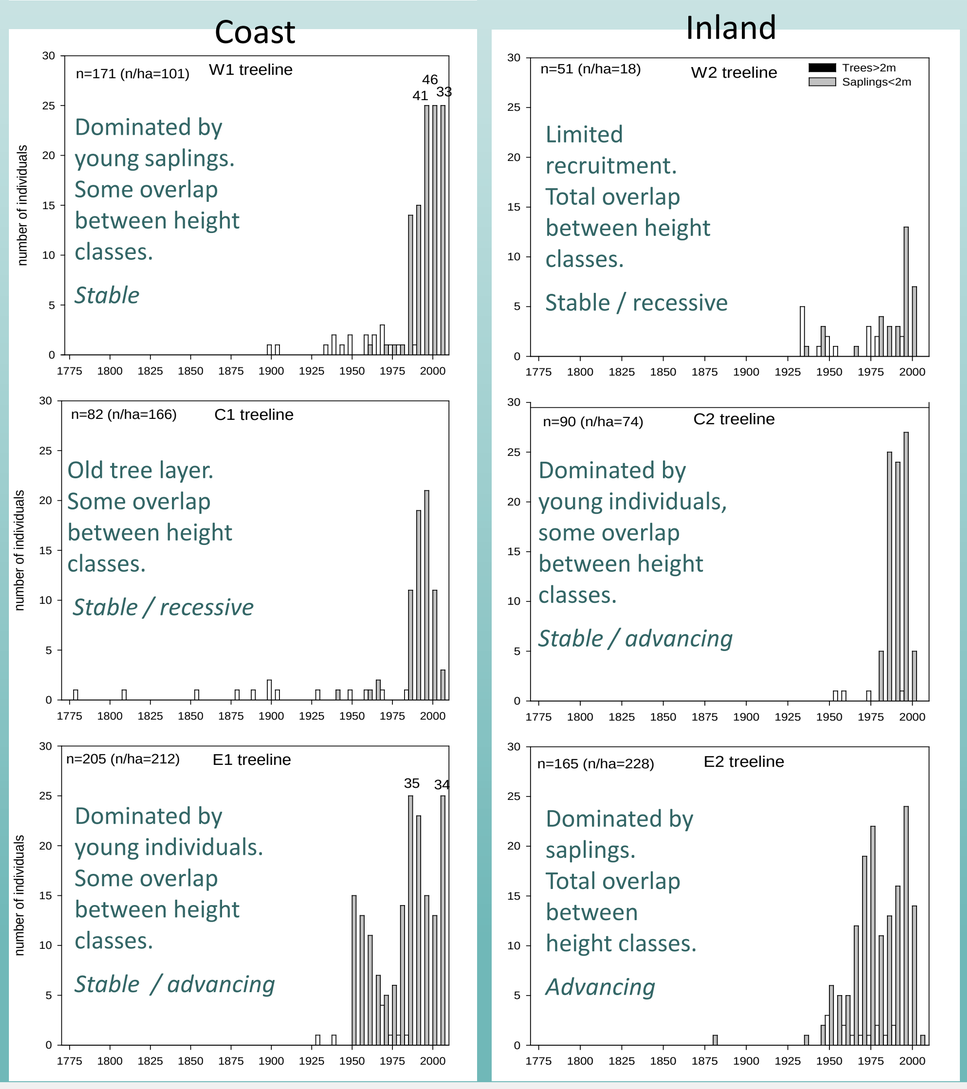

Fig 3. *Age distribution of trees (>2m; black bars) and saplings (<2m; open bars) at the treelines, divided into 5-year classes.*

Preliminary results

The entire study region has experienced a warming trend since the 1980s (Fig 2) and the forest-tundra zone show similar response pattern regarding total age structures. However, when separated on size classes a deviating response pattern is evident. Towards the west, age structure at treeline shows a stable or recessive pattern. While treelines towards the east in general are stable or advancing (Fig 3).

Establishment is in most cases positively correlated with non-growing season climate factors. Facilitation at the forest-tundra zone is closely related to ample snow cover, which provides; protection from winter abrasion and browsing, higher soil temperatures favouring nutrient uptake, and increased early growing season water availability.

Regional differences in age distribution pattern imply deviating response to the ongoing climate changes. Present results highlight the importance of multiple study sites representing a diversity of climate sections of the subarctic region, when addressing cause-response issues. This facilitates testing and adjustment of generalised assumptions for a climate-driven swift northward movement of the arctic forest-tundra zone.

Acknowledgement: *The study is a product under the IPY core project PPS Arctic (http://ppsarctic.nina.no) financially supported by the Research Council of Norway through the grant 176065/S30 to the second author.*

NINA NTNU

Cooperation and expertise for a sustainable future