Analogous Tree Growth Pattern in Contrary Climate Regions Along the Arctic Margin

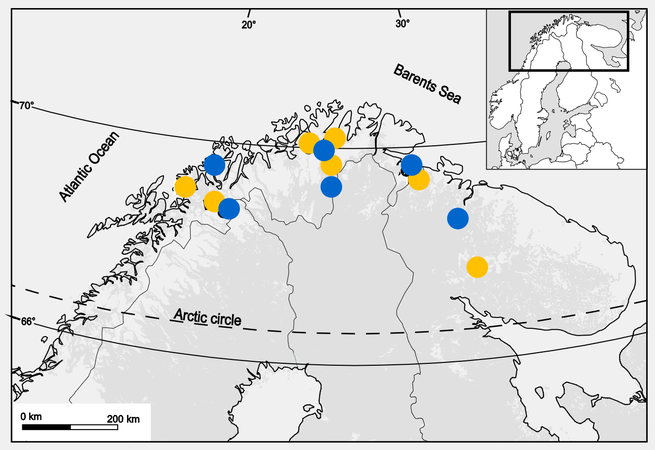
Ingrid E. Mathisen and Annika Hofgaard
Norwegian Institute for Nature Research, Trondheim, Norway

Background

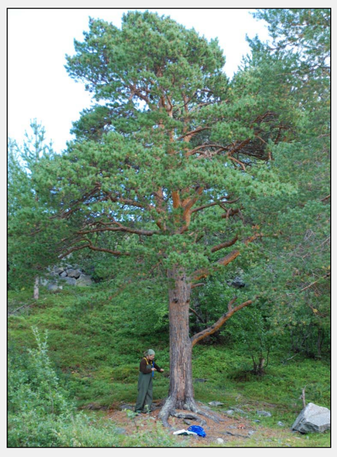
The northern distribution limit of Scots pine, *Pinus sylvestris,* is predominantly controlled by climate and as temperature increase, a northward shift and more vigorous growth is expected. Implications of changed forest cover include changed carbon sequestration, changed land-atmosphere energy balance and ecosystem changes. Understanding of climate related height- and diameter-growth patterns across geographical regions is therefore essential. The study analyses between region (Atlantic vs. Arctic) and within region (coast vs. inland) variation in climate-growth relations for pine in the forest-tundra zone, northern Norway and Kola Peninsula.

Questions asked

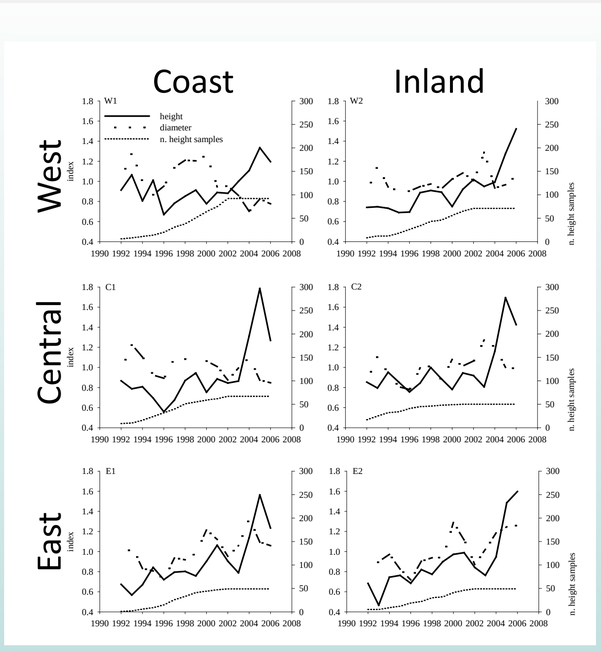
- How has height and diameter growth of Scots pine, at its northern distribution margin, responded to climate variability during recent decades?
- Do growth responses vary among regional climate sectors of the forest-tundra zone?
- Are short-term height and diameter growth-climate relations good measures in predicting long-term forest cover change?



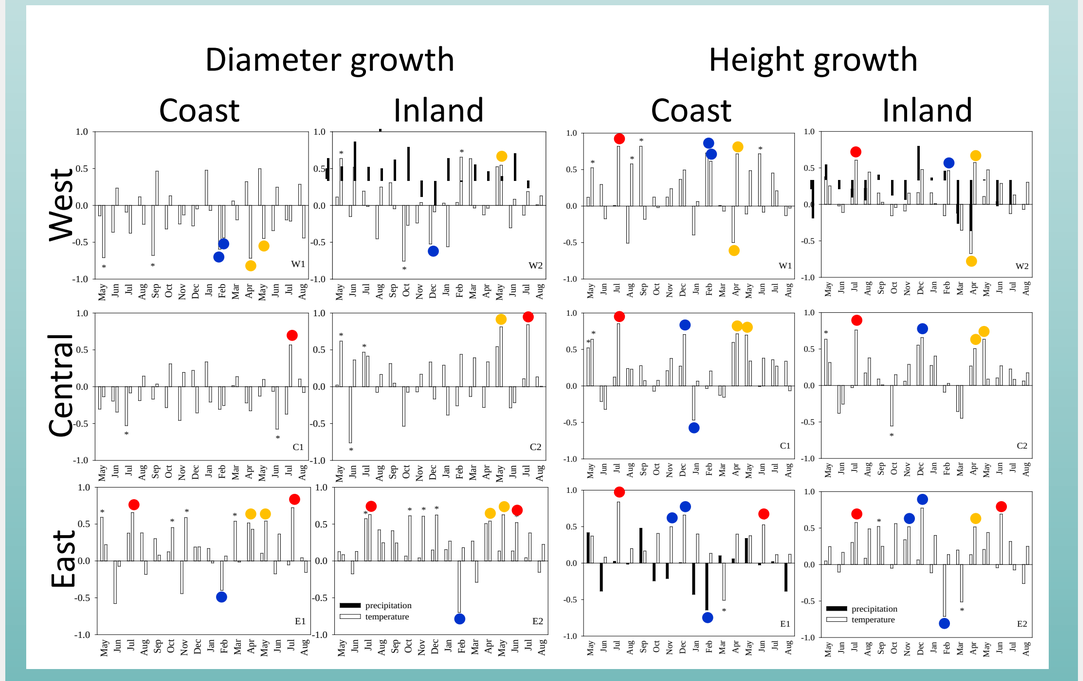
Study sites ●; climate stations ●



152 adult pines and 378 pine saplings from six climate regions across sub-arctic western Europe, were analyzed for climate related diameter and height growth pattern, respectively,.



Height growth and diameter growth chronologies for the six sites along the coast-inland and Atlantic-Arctic gradients. Dotted lines showing number of height growth samples refers to the right hand y-axis. Number of diameter growth measures are constant over time.



*Correlation functions, based on indexed chronologies from all six sites, showing the effect of monthly precipitation and monthly mean temperature on diameter and height growth for May$_{(t-1)}$ to August$_{(t)}$ during the common period 1996-2006. * & ●●● significant.*

Results and Conclusions

Height growth correlated strongly among all sites while diameter growth showed limited correlation among sites. However, an inter-annual pattern with common growth peaks among sites is evident for both height and diameter growth.

Although summer temperature is the most important factor(s) with generally positive correspondence (●) to both diameter growth (July$_{t-1}$, June$_t$, July$_t$) and height growth (July$_{t-1}$, June$_t$), also winter (November-February; ●) and late non-growing season (April-May; ●) temperature and precipitation showed significant importance to both diameter and height growth.

Growth-climate relations vary among regions depending on analysed variable: importance of current summer temperature is emphasised towards east; previous summer temperature is emphasised for height growth; spring conditions for diameter growth in the east and height growth towards the west; above average winter precipitation is generally negative.

The results highlight the importance of generally overseen precipitation and non-growing season factors to growth at northern distribution limits. Detailed data on climate-growth relations is essential to feed models for forest cover change. However, short-term generated data may be of sub-ordinate long-term value due to high inter-annual climate variability at the Arctic margin and occurrence of infrequent severe climate events.

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