Forest Cover Change and Treeline Advance-Rates along the Arctic Margin at Latitude 68-70N in Norway and Western Russia: Causes, Consequences and Predictions

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Latitudinal and altitudinal relocation of treelines and forest covered areas, have implications for terrestrial carbon sequestration, land-atmosphere energy balance, and regional biodiversity. Hence information on potential rates and causes of change are essential in scenarios for climate change responses. However, such data are scarce but can be obtained from a combination of site-based age structures and tree growth patterns, and region-wide mapping of current and historical forest cover and distribution limits.

The presentation reviews results from the bilateral Norwegian-Russian part of the IPY core project PPS Arctic (http://ppsarctic.nina.no). The research group has used multiple sites and study approaches.

- Recruitment pattern beyond the treeline generally corresponded with non-growing season climate variables, with emphasis on precipitation, indicating importance of a protecting snow cover throughout the winter. This importance of non-growing season factors for tree growth at high latitudes, together with the role of short-term climate variation are often overlooked. Future climate scenarios predict moister and milder winters for large areas of high latitude regions. Thus, detailed analyses of region-specific climate-growth relations that focus on growing season vs. non-growing season effects are essential in the evaluation of future forest cover response to climate change.
- In regions with historical and current high grazing pressure an herbivore-driven concealing of expected climate-driven tree expansion is evident, with climate as a secondary force. This emphasizes the necessity to consider changes in grazing regimes along with climate change, in order to avoid misleading interpretations regarding climate-driven tundra encroachment.
- Greatly deviating treeline response patterns, representing advancing-, stationary-, and retreating treelines, are shown among climate regions (Arctic vs. Atlantic; coast vs. inland). Advance appears to prevail in regions affected by moist air masses and characterized by high annual precipitation, while regions dominated by dry arctic air show stationary or retreating treelines. Recessions of treelines are also observed in areas influenced by industrial activities and local air pollution.
- The combination of remote sensing and tree community data proved useful for detailed monitoring of the subtle changes characterizing the treeline ecotone at high latitudes. Remote sensing data offer precise information on the total rate of changes while the establishment data give detailed information on the dynamics of changes and indications of underlying causes. This is necessary information for fine-tuning tundra encroachment scenarios into empirical based predictions. Accurate mapping of the treeline ecotone and local/ regional casual backgrounds is important when coarser resolution remote sensing data are to be used to analyse and monitor the circumpolar extension of the ecotone.

The results highlight the important interplay between abiotic and biotic control over tundra encroachment and treeline dynamics, and the importance of multi-site studies when addressing forest-tundra ecotone responses to global warming. A stronger focus on factors limiting forest-tundra ecotone response to climate change is needed. This would take us closer to explaining the mismatch between model predictions and site based empirical results.