Submitted Abstract

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Abstract

The Arctic has been warming faster than the global average during the last decades, resulting in the temporal and spatial expansions of vegetation, termed “Arctic Greening”. This process arises from higher temperatures, prolonged season length and greater plant productivity. At the same time, an increasing number of non-native plants is being recorded in Arctic ecosystems. On Svalbard, 98 alien species have already been identified, especially in disturbed and nutrient enriched soils near settlements.

Previous research has focused on climatic factors as the main cause of Arctic Greening. However, an accelerated rate of soil development (e.g. accumulation of soil C) could also play a key role in shifting vegetation patterns. Thus, variation in the responses of plants to a warmer Arctic may be controlled not only by temperature, but also by an interplay of soil development, the associated soil microbial community, human disturbance and novel plant introductions, as well as the ability of native plants to adapt genetically to these changes. With time, we might therefore see dramatic shifts in the composition of Arctic plant communities, with range-expanding and non-native species outcompeting highly specialized tundra species. Current slow processes due to limited soil development concomitant with restricted plant growth, might accelerate with ongoing warming.

We hypothesize that the modification of environmental conditions, soil properties and biological processes will play a key role in plant community composition, the spread of plant species and their functional variability. To disentangle these different components, we will conduct vegetation surveys, trait measurements and identify soil characteristics on different geologies and elevations on Svalbard. Due to its high variability in surface geology, topography and soil nutrient status in a relatively small spatial scale, Svalbard offers ideal conditions to examine how the interplay between geology, species interactions and soil development might influence Arctic Greening. Furthermore, we will conduct a fully factorial experiment at ETH Zurich, to dissect the effects of plant competition between non-native, range-expanding and native tundra species and the role of different soil characteristics and microbial communities in this context. To assess the ability of native species to respond to the new climate, we will additionally examine the genetic architecture of adaptation and estimate the evolutionary potential of functional traits in the model species Silene acaulis. Here, we present a partial overview of this interdisciplinary project, which began in spring 2022 to help improve our understanding of how sensitive Arctic ecosystems might change in the future.