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TEMPERATURE, SNOW, PERMAFROST: HETEROGENEITY OF CHANGE IN SHRUB GROWTH ON THE ARCTIC TUNDRA

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The most significant terrestrial change underway in the Arctic over the last four decades is the expansion of shrubs into tundra areas. Repeat photography shows that, since 1950, some shrub patches on the Alaskan North Slope have increased rapidly (expanding), while others have increased little or not at all (stable). In our study, we try to elucidate why these two groups of shrub patches different dynamics although they are often to be found in close proximity to each other. Dendroecological sampling of expanding and stable shrub patches was conducted in the treeless tundra of the North Slope foothills in Alaska. Shrub patches were located on river slopes and consisted of 0.5 to 3 m tall alder, willow and birch shrubs. Expanding patches were characterized by different vegetation composition, deeper thaw depth, higher mean annual ground and mean growing season temperature, lower soil moisture, less carbon in the mineral soil, and lower C/N values in shrub leaves. All three species showed consistently stronger annual radial growth in expanding patches compared to stagnant ones. The recent radial growth trend of shrubs in expanding alder and willow patches has been increasing; the growth trend of shrubs in birch patches has been decreasing, irrelevant of their assignment to the expanding/stable category. Shrubs in expanding shrub patches had significant positive correlations to summer and spring warming. Although shrubs growing in stagnant patches were sometimes not more than 100 m away from the expanding ones, they did show nearly no significant correlations with temperature or precipitation. Our analyses indicate that thaw depth, soil temperature, soil nitrogen content and soil moisture are the main factors influencing the magnitude of shrub ring formation and that permafrost conditions and increased amounts of snow may result in water saturated soil conditions that might hinder shrubs in stable patches to take advantage of the current warming.