Vegetation Growth May Quickly Raise Arctic Temperatures

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Warming in the Arctic is stimulating the growth of vegetation and could affect the delicate energy balance there, causing an additional climate warming of several degrees over the next few decades.

A new study indicates that as the number of dark-colored shrubs in the otherwise stark Arctic tundra rises, the amount of solar energy absorbed could increase winter heating by up to 70 percent.

The research will be published 7 September in the first issue of the Journal of Geophysical Research-Biogeosciences, published by the American Geophysical Union.

The study in western Alaska during the winters in 2000-2002 shows how the increasing abundance of high-latitude vegetation, particularly shrubs, interacts with the snow and affects Earth's albedo, or the reflection of the Sun's rays from the surface.

The paper, which also analyzes the ramifications of continued plant growth in the tundra regions, written by researchers at the U.S. Army Cold Regions Research and Engineering Laboratory and at Colorado State University. It presents the first evidence that shrub growth could alter the winter energy balance of the Arctic and subarctic tundra in a substantial way.

The authors measured five adjacent sites in subarctic Alaska. They included areas covered by continuous forest canopy, others dotted with

shrubs, and some of barren tundra. They found that mid-winter albedo was greatly reduced where shrubs were exposed and that melting began several weeks earlier in the spring at these locations, as compared to snow-covered terrain.

The researchers note, however, that the shrubs' branches produced shade that slowed the rate of melting, so that the snowmelt finished at approximately the same time for all the sites they examined.

Matthew Sturm, lead author of the study, notes that warming in the region seems to have stimulated shrub growth, which further warms the area and creates a feedback effect that can promote higher temperatures and even more growth. This feedback could, in turn, accelerate increases in the shrubs' range and size over the four million square kilometer [1.5 million square mile] tundra and effect significant changes over the region.

"Basically, if tundra is converted to shrubland, more solar energy will be absorbed in the winter than before," Sturm says. And while previous research has shown that warmer temperatures during the Arctic summer enhance shrub growth, "our study is important because it suggests that the winter processes could also contribute to and amplify the rate of the [growth]."

Sturm cites satellite and photographic evidence showing increasing plant growth across the Alaskan, Canadian, and Euro-Asian Arctic and notes that continued warming will likely produce thicker stands of brush that protrude above the snow. The new, brushy landscape would replace the smooth, white environment that currently dominates the Arctic during its 8-10 month winter.

In addition, the increasing shrub cover would impact more than just the energy balance in the Arctic. With nearly 40 percent of the world's soil

carbon is stored in Arctic soils, any change in vegetation and energy is likely to trigger a response in the Arctic carbon budget.

Scientists are still trying to understand the nature of this response, but Sturm and his coauthors conclude that the feedback effects they describe would undoubtedly accelerate its rate. They conclude that combined effects of increasing shrubs on both energy and carbon could change the Arctic in a way that affects the rest of the world.