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REDUCED GROWTH IN ALASKAN WHITE SPRUCE IN THE 20TH CENTURY FROM TEMPERATURE-INDUCED DROUGHT STRESS

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The extension of growing season at high northern latitudes seems increasingly clear from satellite observations of vegetation extent and duration [1, 2]. This extension is also thought to explain the observed increase in amplitude of seasonal variations in atmospheric CO_2 concentration. Increased plant respiration and photosynthesis both correlate well with increases in temperature this century and are therefore the most probable link between vegetation and CO_2 observations [3]. From these observations [1, 2], it has been suggested that increases in temperature have stimulated carbon uptake in high latitudes [1, 2] and for the boreal forest system as a whole [4]. Here we present multi-proxy tree-ring data (ring-width, maximum latewood density, and carbon-isotope composition) from 20 productive stands of white spruce in interior Alaska. The tree-ring records show a strong and consistent relationship over the past 90 years and indicate that, in contrast with earlier predictions, radial growth has decreased with increasing temperature. Our data show that temperature-induced drought stress has disproportionately affected the most rapidly growing white spruce, suggesting that under recent climate warming, drought may have been an important factor limiting carbon uptake in a significant portion of the North American boreal forest. If this limitation in growth due to drought stress is sustained, the future capacity of northern latitudes to sequester carbon may be less than currently expected.