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The boreal forest region experiences one of the most naturally variable climates in the world. Warmth advected into the region from the south causes strong positive temperature anomalies, especially during El Nino conditions, and enhanced movement of air south from the polar region results in negative temperature anomalies. Intensification of this wave in the largely west to east air mass circulatory system increases these anomalies, which are negatively correlated across opposite margins of both northern hemisphere continents. In central Alaska summer temperature and growth year precipitation are strongly associated in alternating warm/dry or cool/moist conditions. Carbon 13 stable isotope content and maximum latewood density in annual wood of white spruce were calibrated with 20$^{th}$ century recorded May through August mean temperature at Fairbanks. These tree-ring records have been used to reconstruct summer temperature at Fairbanks for the 19$^{th}$ century, a period lacking instrument-based records. Warm - not cold - summers are reconstructed in Fairbanks in mid-1800s. Ecological events and processes triggered or enhanced by summer warmth should have been happening at maximum for 19th century during periods 1834-51 and 1862-79.

Climate variability exerts a major level of control over white spruce growth and reproduction. In white spruce stands on upland sites in the Interior and southcentral Alaska, warm/dry periods are characterized by low radial growth, and cool/wet climates by high radial growth. A model of the key events associated with infrequent large white spruce cone/seed crops identifies 6 critical gateways or key environmental influences. The first gateway is high radial growth reserves, a product of two or more years of high radial growth from the cool/wet climate phase. Two of the later gateways are sustained periods of early summer warm/dry weather. The warm/dry phase weather is strongly associated with El Nino conditions, which in turn represent the years of high wildfire area burned. The entire system of environmental cues appears to be evolved to maximize the probability that white spruce will time the production and release of infrequent large seed crops into an environment in which fires have recently occurred.

Upland white spruce maintain a consistent response to climate across much of Interior Alaska at low elevations, but white spruce radial growth displays both positive and negative relationships to summer temperature at sites near treeline in the Brooks Range and Alaska Range and at coastal southcentral Alaska locations. Radial growth records are being compared to gradients of environmental change at the plot, watershed, and regional scales in the Alaska Range and Brooks Range. Environmental factors currently associated with tree limit are being compared with current distribution limits and an explanation of treeline dynamics is being reconstructed.

Black spruce grows on several different site types including valley bottoms, north-facing slopes and ridgetops. Black spruce is a challenging species to measure because annual growth rings are small and growth can be eccentric. The relationship of black spruce radial growth to climate has been examined from disk samples. Site sampled include CPCRW, BNZ, Fairbanks, and sites east and west of Fairbanks. The measurement of annual radial growth from multiple radii averaged provides a good estimator of tree growth. Black spruce radial growth displays several different statistically significant responses to temperature including high negative relationship to mid summer, positive to winter, and negative to late spring. Good predictive relationships of growth from temperature have been developed.

Future growth of white and black spruce, derived from empirical relationships of growth with past temperature, have been developed for 5 GCM scenarios. The scenarios include the Canadian Climate Center and Hadley Center models used in the U.S. National Climate Change Assessment, and the Max Plank ECHAM model, the NCAR CSM model, and the GFDL model. Model results were downloaded for monthly variables for grid cells containing 13 stations around the circumpolar north for the period 2001-2099. Model outputs were adjusted to each station record for the 1990-2000 period of overlap. Various models fail to reproduce a range of variability consistent with recorded data, and some models produced novel results such as a systematic divergence in seasonal temperatures not present in the recorded data. In the Fairbanks/BNZ grid cell the results suggest empirical rates of tree growth would approach zero within 70-100 years, suggesting the trees would not survive (on current sites) the environment the models produce in the late 21st century.