SOIL TEMPERATURE GRADIENTS IN A NORTHERN HARDWOOD FOREST

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ABSTRACT

A study was initiated in January 1993 to continuously monitor soil temperature, at several depths, in a northern hardwood forest located at the Proctor Maple Research Center in Underhill, VT. In 1993-97 treatments applied to these plots were designed to examine the effects of snow cover on soil temperature within a hardwood forest. Overall seasonal trends were similar in all four years with soil temperatures decreasing with increasing soil depth in spring and summer and increasing with increasing soil depth during fall and winter. That is, in winter soil temperatures were generally warmer at -30 cm than at -15 or -5 cm. When snow accumulated early in the winter (Dec.) and remained at a depth of 30 cm or greater throughout winter, soil temperatures gradually drifted down, but remain above freezing at all soil depths. When snow-cover was absent, daily average soil temperatures dropped below freezing at all soil depths and reached -2° C at -30 cm between mid January and late March. When snow was present, minor changes in soil temperatures in response to changes in ambient temperatures sometimes occurred, but these responses were delayed by as much as a day or more due to the insulating properties of snow. Soil temperatures under snow-free conditions changed more rapidly and dramatically in response to ambient air temperatures, although, there was still a slight delay in soil temperature responses. Under both conditions responses to changes in ambient temperatures were generally greater at more shallow depths. When actual differences between the two treatments were calculated, by subtracting daily average soil temperatures for snow-free plots from those of snow-covered plots, for each day, and each soil depth, differences were greater at more shallow soil depths. For example, at -5 cm daily average soil temperatures were as much as 12° C warmer, while at -30 cm they were 4° C warmer when snow cover was present. This study showed that the presence, timing, and amount of snow cover does influence winter soil temperatures. In addition, changes in snowfall patterns may be a reality of Global Warming, and will affect soil temperatures and influence the entire forest ecosystem.