Forest Soil Temperature and Moisture Monitoring

The Soil Climate Analysis Network (SCAN) of the Natural Resources Conservation Service (NRCS) is a cooperative nationwide data collection system designed to support natural resource assessments and conservation activities. It is designed to collect soil moisture, soil temperature, and local climate information on a real-time basis using existing sites and through the establishment of new sites through partnerships with other entities. http://www.wcc.nrcs.usda.gov/

Soil Temperature

The soils at the two SCAN sites have similar temperature characteristics. There are several features that are worth noting. *Excerpts from:* 10 Year Report - http://www.uvm.edu/vmc/research/documents.php?id=109

1. Spring and fall turnover – like lakes and other water bodies, the soils have a spring and fall turnover. In the summer, the upper layers of soil are the warmest, but in the winter, the deeper layers are warmest. At some point in the month of April, the soil has virtually the same temperature throughout the 40 inch profile as the upper layers begin to warm up. In September, the same temperature equalization happens as the upper layers begin to cool down.
2. Winter "hibernation" – there is very little change in soil temperature between the months of December and April, with the soils appearing to "sleep" through the winter months. They gradually drop in temperature to near 0 degrees C, with deeper layers being slightly warmer than surface layers. The coldest soil temperatures are in April, although on an average monthly basis, March has the coldest soil temperatures. This is two to three months later than the coldest average monthly air temperature, which occurs in January. Very few soil temperature readings of below 0 C have been recorded, which raises the question of whether these soils actually freeze in winter, as is commonly believed. The data suggests that they do not.
3. Surface layers have daily temperature fluctuations in the summer, while deeper layers do not. Daily temperature fluctuations of up to 3 degrees C occur at the surface, while at 40 inches, daily temperature changes are on the order of about 0.1 degree C or less in July and August.

4. Soils are cooler in the shade than in the sun, based on the limited record of data at Lye Brook. Mean annual soil temperature is 6.8 deg C in the shade and 7.2 deg C in the forest opening. Mean summer soil temperature is 11.8 deg C in the shade and 12.7 deg C, almost one whole degree warmer, in the sunnier forest opening.

Soil Moisture

Like soil temperature, the soils at the two SCAN sites also have similar moisture characteristics.

1. Spring Moisture Peak – all soils have the highest moisture content reading in the spring, typically in April. This seems to be more attributable to snowmelt than increased precipitation. The moisture peaks are more equalized throughout the soil profile in the soils in more sunny forest openings, while the shaded site at Lye Brook has a more diffuse moisture peak, which may be due to a slower rate of snowmelt. However, this site also has the shortest period of record, which may have some influence. It is interesting to note that the Spring Moisture Peak coincides with the Spring Turnover. Perhaps the soil temperature is equalized by the temperature of the soil water throughout the profile.
2. Summer moisture drawdown – all soils exhibit a drying-out in the summer months, irregardless of precipitation levels.
3. The 8 inch depth has the highest moisture levels – this is consistent in virtually all months of the year at both sites.
4. Winter moisture drawdown – although not as distinct as in summer, there is a noticeable drop in soil moisture in winter. At Lye Brook, it is most distinct at the 20 and 40 inch depths. At Mount Mansfield, it is not as pronounced, but also occurs.
5. Effects of storms – the availability of hourly readings makes it possible to track the effect of individual rainfall events. Graphs portray the effects of Hurricane Katrina as it passed over the Mount Mansfield station in late August – early September, 2005. It covers a 44 hour period, including before and after the storm came through. Hurricane Katrina was not a hurricane by the time it reached Vermont, but it still dropped enough rainfall to have a noticeable and sudden impact on soil moisture levels.

Soil Taxonomy Soil Temperature Classification Table, 2001-2005 All temperatures Celsius - measured at 50 cm (20 inch) depth Numbers in parentheses indicates years of data for that site				
Location	**Mean Annual Soil Temp.**	**Mean Summer Soil Temp.**	**Mean Winter Soil Temp.**	**Difference between Mean Summer and Mean Winter Soil Temp.**
Lye Brook – in opening Elevation – 2435 ft.	**7.2 (*Frigid*)**	**12.7 (3-5)**	**3.2 (2-3)**	**9.5**
Lye Brook – under canopy Elevation – 2430 ft.	**6.8 (*Frigid*)**	**11.8 (1-3)**	**2.9 (1-2)**	**8.9**
Mount Mansfield – in opening Elevation – 2236 ft.	**7.3 (*Frigid*)**	**12.9 (5)**	**2.8 (5)**	**10.1**