

EFFECTS OF A SNOW PILLOW ON HEAT AND VAPOR TRANSPORT IN THE  
BLACK SPRUCE/PERMAFROST ENVIRONMENT OF INTERIOR ALASKA

Henry S. Santeford  
Alaskan River Forecast Center  
National Weather Service, NOAA  
Anchorage, Alaska

ABSTRACT

A standard 4 x 5 foot metal snow pillow was installed in the black spruce/permafrost environment of Interior Alaska and instrumented to determine if the presence of the pillow had any appreciable effects on (1) the thermal regime, and (2) the possible migration of water vapor from the thick organic soils into the snowpack during the extended cold winter period. In hopes of separating the two effects, should they both exist, a double layer of 4 mil plastic sheeting of the same size and shape as that of the pillow was installed at the same site.

The results of the first winter's operation indicate that the pillow had minor effects on the temperature profiles from the air/snow interface to a point 30 cm below the soil surface. The primary effect appeared to be one of slowing the rate of temperature fluctuation.

The presence of the pillow and the plastic sheeting had a pronounced effect on the water content and overall structure of the snowpack. With the pillow, the indicated water content of the snowpack was nearly 40% less than that obtained by pit studies for the adjacent natural snowpack. Yet, the upper 15 cm of the organic soil (moss layer) immediately below the pillow contained a much higher crystalline ice content than did the same layer under natural conditions. When this difference in water content of the moss layers was added to the indicated water equivalent of the snowpack above the pillow, it was found that more than half of the indicated difference in snowpack water equivalents could be accounted for.

The indicated water equivalent of the snowpack above the snow pillow agreed favorably with the measured precipitation and also with the measured water equivalent of the natural snowpack in nearby hardwood/non-permafrost settings. Similar results were obtained with the plastic sheeting site.

It is proposed that the thermal migration of water vapor from the thick moss layer into the overlying snowpack in the black spruce/permafrost environment of Interior Alaska is in the order of 20 to 30 percent of the seasonal precipitation. The presence of a snow pillow, or any other similar vapor barrier, interferes with this migration and results in erroneous measurements. Also, other measurements of the snowpack water equivalent in such areas are not necessarily an indication of the accumulated seasonal precipitation, but rather may contain a large contribution of soil moisture which has migrated from the moss layer into the snowpack during the extended winter period.