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RESEARCH ON THE SEASONAL SNOW OF THE ARCTIC SLOPE

from

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The 1984-85, 1985-86 and 1986-87 seasonal snow was measured to determine its total quantity, its physical structure and its distribution as a function of wind and topography. Observations of meteorological parameters and snowpack characteristics during winter and spring have yielded information on the seasonal evolution of the snow in quantitative terms. A method of determining melt rates over large regions was developed and is being refined, progress was made on a model describing energy flux sources which control snow melting. A strong control is exerted by air mass advection on a broad scale.

We are continuing to devote attention to the sources of energy and energy transfer mechanisms which control snow melt. The 1986 snow melt was two weeks later than the 1987 and 1985 meltouts. The delay was caused by advection of cold air from the Arctic Ocean. When it did get underway melting was very rapid and the snow pack disappeared in only half the time taken in 1985.
However, the melt rates in 1987 were fastest of the three years. The amount of the snowpack lost by evaporation varies from year to year but exceeds 40% over the entire area and varies from 10% to over 60% in individual test plots. In some ridge crest areas with shallow snow cover it probably exceeds 90%. Our methods of determining melt rates over large areas are being refined and we are beginning to apply remote sensing, digital techniques to the problem. This should enable us to extrapolate to other areas on the Arctic Slope.

Distribution of snow across the R4D area was measured by combining several techniques. Snow depths were measured along selected traverses and pit studies were made to measure snow density, temperature and hardness profiles. In addition to providing water equivalent of the snow pack, the pit studies allowed us to measure extreme snow types such as wind-slab and depth-hoar layers. Photographs were taken from control points at selected time intervals during each melt season. Three or four sets of oblique aerial photos were also taken during each melt season. The photography permitted us to extrapolate detailed measurements made at points and on traverses to broad areas. By this means, maps of the maximum end-of-winter snow cover were made for 1985, 1986 and 1987. The maps are being digitized as discussed above. The photos, combined with ground measurements, enable us to determine the rate of exposure of bare ground during the melt process as well. Examples of sequential snow cover maps made in 1985 are shown in Figure 2a,b,c. Similar sets are being prepared by 1987.

There was significant difference in strength of wind action from year to year at the R4D site, 1985 showed maximum wind slab formation. However, the direction of wind transport did not vary significantly. The sensitivity of snow distribution to topography is pronounced. Accumulation on lee slopes was
about 65% more than on windward slopes, even though the slope angles were only 2 to 3 degrees. Some of the variability would not have been so clearly related to topography if our detailed topographic maps were not available.

Snow in the R4D area is transported by winds from the south. Southerly winds from the Brooks Range are felt in the northern foothills for a variable distance across the entire east-west extent of the range. The predominant, and much stronger, winds that affect most of the Arctic Slope (all of the coastal plain) are from the east or west as discussed on page 3. We have been devoting attention to the flux of windblown snow and to the boundary which separates the south flow from the prevailing east-west flows farther north. This is being done by making aircraft observations of drift directions and by measurements on the ground at Prudhoe Bay, Barrow, Wainwright and Atkasuk. These observation have been combined with our flights to do oblique aerial photography over the R4D site.

A few vegetation types have clear correlations with snow depth. An excellent example is moist dwarf-shrub, fruticose-lichen tundra (cassiope tetragona or salix rotundifolia) which has about 53% of its occurrences in areas with >30 cm of snow water equivalent although only about 1% of the total map area is in this snow class. This aspect of the program is being carried out cooperatively with D. Walker and B. Evans and makes use of the digitized map products (Evans, et al., 1987).

The research done so far contributed to the M.S. Thesis of Glen Liston (completed in September 1986) and is now part of Matthew Zukowski's M.S. program. Chemical analyses of the snow and the rates of removal of various ions from the snow during the melting process were begun by Zukowski in the Spring of 1987. The analyses are being carried out during the present winter. Of the 83 samples taken between 9 and 22 May, 72 were triplicate
samples from three distinct horizons in the snow pack to determine the elution rates of several ions as the snow melted. The other samples were channel samples to determine bulk chemistry; 5 of these were taken 8 km SE of GAL to eliminate influence from the haul road. Most haul road dust goes north from the road.

Products from this research include:

1. Orthophoto and topographic maps of the R4D research area: Two sheets at 1:6000 scale with 5 m contours, covering the entire R4D area. Four sheets at 1:1000 scale with 1 m contours, covering the intensive area (see text).


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