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AN EXPERIMENTAL STUDY ON THE INFLUENCE OF DARKENING MATERIALS ON RADIATION AND MELTING RATE ON AN ICE-SNOW SURFACE AND THE RESULTS OF THEIR PRACTICAL APPLICATION

Abstract

by

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The vast irrigated region in arid basin of Northwest China periodically suffers from insufficiency of water resources. Hence study on the artificial regulation of ice and snow melting will be of great practical importance for agricultural production. During 1958-77, experimental investigations were carried out on the influence of darkening material on melting intensity and radiation balance on ice-snow surfaces. Results of field investigations and artificial dusting of glaciers and stream icing in the mountainous regions of Northwest China, carried out by the Chinese Academy of Sciences, are summarized.

(1) Dusting effectiveness, using various albedo-reducing materials, appears mainly as a decrease in albedo and depends on the colour, specific weight (r), particle diameter (d) and rate of dusting (G) of the material used. In spring or autumn coal dust and carbon-black applied to a snow surface at a rate of 50-100 gm/m^2 decreased albedo by 54% and 45%, effecting a net increase of radiation balance at 76.5% and 140%. In the summer, during intensive ablation, the effective radiation decreases with the increase in the rate of dusting. Spreading of darkening materials on the augeis ice gives similar results.

(2) As the rate of dusting increases, the radiation effect tends towards a limit value, probably governed by the variation of albedo of the dusted surface. Hence, various dusting materials all have their most effective rate of dusting, such as 5 gm/m^2-10 gm/m^2 for carbon-black, 50-70 gm/m^2 for coal-dust, 160-200 gm/m^2 for plant-ash, 250-300 gm/m^2 for black soil, 300-350 gm/m^2 for moraine soil, 3500-4000 gm/m^2 for debris of granite.

(3) Through computation and analysis of the effect of darkening on radiation and meltwater, we have found that the change of intensity of melting is determined at the first approach by the changes of albedo and effective radiation., heat output (from 56.4-97.0%, mean about 83.9%), while evaporation only 15.8% (3.0-41.5%). On higher slopes, aridity of the glacier climate increases, evaporation increases gradually and melting decreases. In the arid mountainous region, high evaporation is important in mass balance and provides the foundations for glacial nourishment.

(4) When the glacier is covered with a debris layer, constitution of the heat budget takes another form. The heat consumed in ablation decreases to 20-40%, the rest being consumed in evaporation and in diffusion into the adjacent layer of air by turbulent exchange.

Differences in the variations of heat balance mainly relate to topography (including direction and angle of the slopes of glacier, screening effect of the mountains, etc) and albedo for advanced studies; we take the No 1 Glacier of Ürümqi River, Tianshan mountains as an example. The spatial distribution and time history of albedo and radiation over the glacier surface have been carefully estimated and charts of variations in distribution drawn. Calculations presented here show that the screening effect of the mountain, and differences in heat balance, are very important to the maintenance of glaciers in particular valleys and explain why, at the same time, other places at similar altitudes are without glacier development.

SNOW MOISTURE METERS

Abstract

by

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Various instruments and techniques for the determination of snow wetness, for example calorimeters, centrifuges, chemical devices, dielectric devices and also tensiometers are in use. Problems in measuring the liquid water content with these techniques are discussed by Colbeck (1978). Dielectric measuring methods of liquid water content in snow make use of the large difference between the relative permittivity of ice (3.15) and of water (87.7) in the high-frequency regime. Various dielectric devices using air gap condensers and open resonators have been tested and compared recently (Denoth and others 1984). Here, new developments of dielectric sensors with operating frequencies in the range of 10 MHz to 1 GHz are presented: a plate condenser, a cylindrical condenser, a coaxial sample holder and a monopole antenna were used as sensors to measure the average dielectric constant in a snow volume of approximately 1000 cm^3; a flat condenser in strip-line

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