THE NATURE OF ABLATION AND AGGREGATION ON THE DUSTED SNOW SURFACE

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INTRODUCTION

Actual glacier surfaces in the Himalayas are contaminated by natural dust which control the ablation of glaciers. Hence, it is important to understand the role of dust in glacier mass balance. It has been experimented on by several researchers in the past and it has been proved that dark material on the snow/ice surface increases melting in dust amount and, again, retards the melting beyond that limit. The amount of dark material on the snow/ice which exhibits exactly the same ablation as that yielded by bare snow/ice surfaces is called "critical amount". A satisfactory quantitative estimate of ablation under different meteorological conditions has not been achieved. To obtain comprehensive knowledge, snow dusting experiments were performed on the snow surface at Saiho, Nigata Prefecture, Japan, in March 1995. The two main purposes of the experiments are: (i) to get a better understanding of the relationship between the rate of dusting, meteorological conditions, and ablation rate; and (ii) to observe the nature of the aggregation of dust and examine its relation to the meteorological condition.

METHOD

Black soils having the same grain size range ($0.35 \geq \phi > 0.15$ mm), dry albedo (0.08), and dry density (448 kg/m^3) were uniformly spread in different amounts on 25 square centimetre snow surfaces. After making the plots, non-flexible graduated strings were fixed above all the plots. The depression at the plots were measured at gradations on the strings every one to two hours. To

investigate the aggregation, photos of every plot together with a colour scale were taken at one to three hours intervals. Ten minutes averaged meteorological data such as air temperature, relative humidity, incoming solar radiation, and preciptation have been utilised for the analysis.

RESULTS

Solar radiation is the most effective energy source which melts the snow/ice surface. Fig.1(a) illustrates total ablation under different solar radiation inputs. The ablation never shows a linear increase with increasing solar radiation. With more energy than 5.8 MJm^{-2}, the ablation is large but the increasing trend is gentle. The ablation was highest on the plot with 0.008g/cm^2 on each day it was checked. The critical amount for each experiment appeared to be different and showed a linear relation to the total incoming solar radiation, as Nakawo and Takashi (1982) have predicted from a modelling study.

The series of experiments show that particles of soil-dust change their location in a short time after melting starts. Due to the movement of particles on the melting crust, soil-dust had started to aggregate. In Fig.1(b), the areal fraction of the black part on each plot has been drawn against total incoming solar radiation. Areal fraction of black parts rapidly decreased for small inputs of energy of up to about 5.8 MJm^{-2}. At higher inputs of energy, where the melting rate is high, the aggregation becomes intense, causing an increase in albedo, and hence the increasing trend in ablation rate is suppressed. Therefore, it is considered that the aggregation of particles could be negative for melting. These results are quite encouraging and useful for studying the nature of ablation and aggregation of dust on glacier ice as well.

Fig. 1;(a) Relationship between total incoming solar radiation and total ablation with several dusting rates. (b) Dependency of the aggregation of the dust to the total incoming solar radiation