

ON THE SCATTER OF SNOW ACCUMULATION MEASURED AT A GIVEN PLACE ON THE MIZUHO PLATEAU

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Abstract: The scatter of annual snow accumulation in 1981 at a given place was studied within ten meters in horizontal scale at ten 36-stake farms on the Mizuho Plateau. The coefficient of variation S/M , where M is the average of thirty-six values of annual accumulation and S is the standard deviation, was small (less than 1.0) on the ice sheet with a few exceptions. The S/M value did not depend on snow surface roughness.

1. Introduction

Some characteristics of net snow accumulation of the Mizuho Plateau have been clarified by the activities of Japanese Antarctic Research Expeditions. Mizuho Plateau is usually divided into three different accumulation zones: a 'high accumulation zone' about 2000 m a.s.l. and below, an 'irregular accumulation zone' between about 2000 and 3000 m a.s.l. and a 'low but uniform accumulation zone' 3000–3200 m a.s.l. and higher (WATANABE, 1978).

Using snow accumulation data obtained in 1968 by stake method at intervals of 2 km along Route S, YAMADA and WAKAHAMA (1981) calculated running averages of ten values of annual accumulation, M , and the coefficient of variation defined by S/M , in which S is the standard deviation of the ten values. These three values were obtained at 20 km intervals. Generally S/M is relatively small in a 'high accumulation zone' and a 'low but uniform accumulation zone', but it is greater in an 'irregular accumulation zone'. These characteristics are dominated by the weather and surface conditions on the ice sheet.

While snow accumulation mentioned above is measured in the range of tens and hundreds of kilometers, this paper discusses the scatter of annual accumulation within tens of meters in horizontal scale at a given place in 1981. The scatter of annual accumulation is closely related with the representativeness of values; the accumulation value measured at one snow stake and some physical and chemical values analyzed in one firn core at a given place, for example.

2. Measurements

Measurements of annual snow accumulation, during the period between the austral autumn and summer in 1981, by stake method were made at ten places on the Mizuho Plateau (Fig. 1). Stake farms, each consisting of 36 stakes 10 m apart in a square, were set up. Every stake farm was arranged in the same pattern in regard to

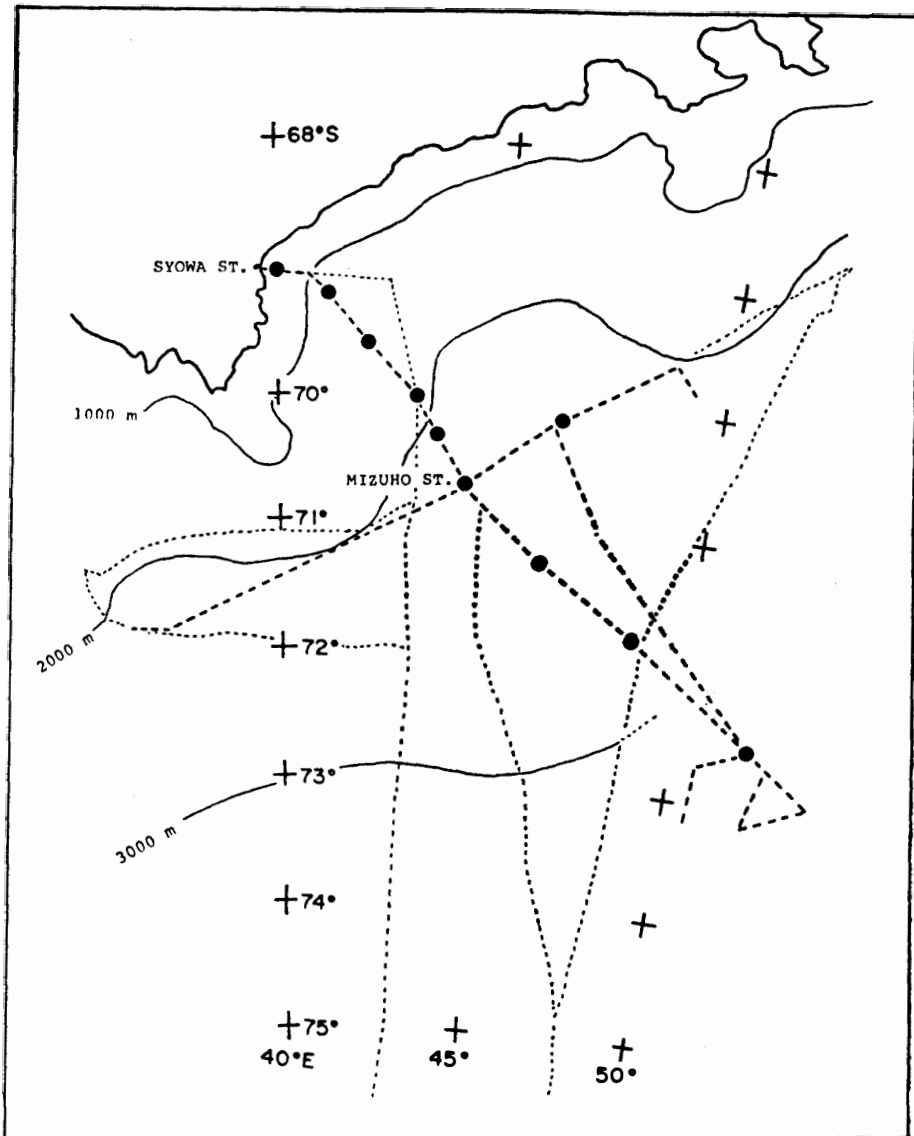


Fig. 1. Locations (solid circles) of 36-stake farms set up on the Mizuho Plateau.

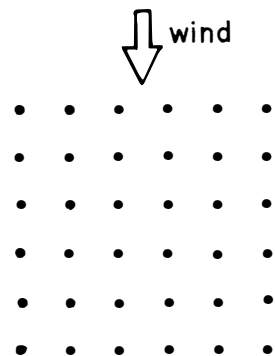


Fig. 2. Relation between the arrangement of a 36-stake farm and the prevailing wind direction at a given place. Stakes were spaced 10 m apart.

the prevailing wind direction, as shown in Fig. 2. The meteorological conditions are excluded here; as for the surface condition, only the snow surface roughness R , defined as follows (Fig. 3), is considered:

$$R = \sqrt{\frac{\sum (h_i - \bar{h})^2}{N}},$$

where h_i is the height reading from the surface to a reference level obtained by leveling survey, \bar{h} is the average of h_i , and N is 36.

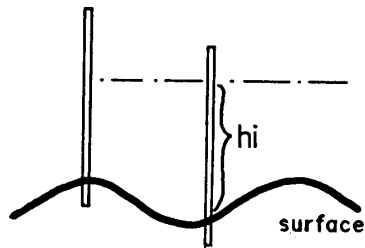


Fig. 3. A sketch for definition of the snow surface roughness R at a 36-stake farm. The horizontal line is a reference level obtained by leveling survey. \bar{h} is the average of h_i , and N is 36.

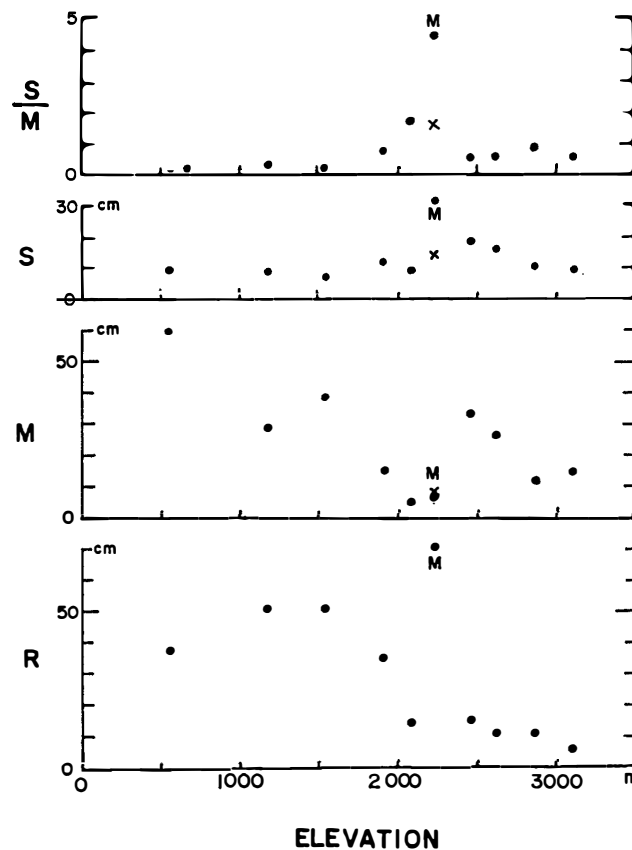


Fig. 4. The surface roughness R , average of thirty-six values of annual accumulation (cm in snow depth) M , standard deviation of the thirty-six values S and coefficient of variation S/M against the elevation of the stake farm. Small 'M' in the figure is the value at Mizuho Station. Mark 'x' indicates the result obtained along 101 stakes set 1 m apart for 100 m at Mizuho Station.

3. Results and Discussion

The surface roughness R , average of thirty-six values of annual accumulation (in cm of snow) M , standard deviation of the thirty-six values S and coefficient of variation S/M are plotted against elevation in Fig. 4. The values of R and M decrease with the increase of elevation, and the general trend of M agrees with that of the results of snow stake measurements made so far along the traverse routes. Values of S and S/M are relatively small (less than 1.0) and uniform, except for the values at Mizuho Station and Station Z40 (adjacent to Mizuho Station). The 36-stake farm at Mizuho Station is located 50 m to the northeast from the main station and the snow accumulation at the stake farm was influenced significantly by the proximity of the station to the farm. For reference, the results obtained along 101 stakes set 1 m apart for 100 m, which were not influenced very much by the station, are shown in Fig. 4.

In Fig. 5, the surface roughness R , standard deviation S and coefficient of variation S/M of annual accumulation are plotted against the mean annual accumulation M at the 36 snow stakes. As noticed above, the values at Mizuho Station are found to be exceptional compared with other values. It can be seen in Fig. 5 that S/M is inversely proportional to M .

Figure 6 shows the relation between S or S/M and R . Except for the value at

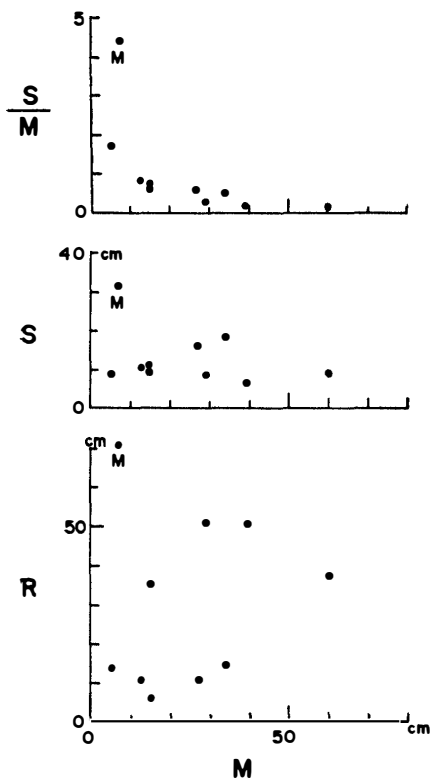


Fig. 5. Relation between R , S , S/M and M . The notations are the same as in Fig. 4.

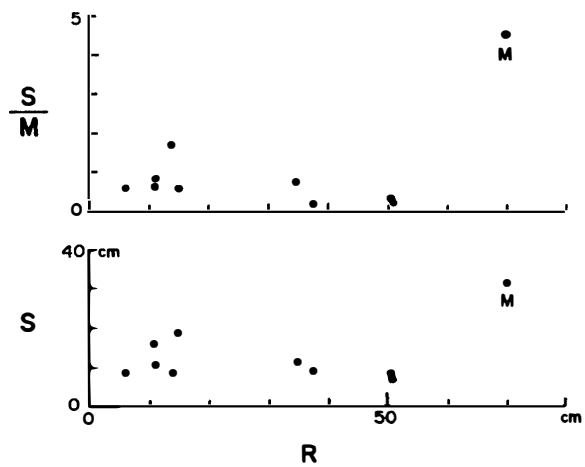


Fig. 6. Relation between S , S/M and R . The notations are the same as in Fig. 4.

Mizuho Station, the values of S or S/M are not especially related to R , though it is assumed that the value of S or S/M increases with increase of R .

The present paper describes only the scatter of snow accumulation at a given place, using measurement data at ten places on the Mizuho Plateau. More detailed and careful discussion will be necessary, especially in regard to analysis of a firn core.

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