Measurements of Snowdrifts and Wind Profiles around the Huts at Syowa Station in Antarctica

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南極昭和基地における建物周辺の雪の吹溜りと風速鉛直分布の実測

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要旨: 第 19 次南極地域観測隊に参加して，昭和基地主要部の実在高床式建物(観測棟・電離棟) 周辺に形成されるスノードリフトの形態ならびに吹溜量について測定を行った．また主に強風時を対象とし，建物近傍での粗度長やべき指数を求め風速鉛直分布特性の検討を行った．実測結果から次のことが得られた．

(1) 高床式建物周辺に形成されるスノードリフトの形態は，建物周辺にウィンドスクープを形成し，風下側の形態は鋭い稜線を持つ馬蹄型となった．また 1 年間の吹溜量を風下側測定区間で求めると，観測棟では 78.3 m^3，電離棟では 181.7 m^3 となった．

(2) 風速鉛直分布特性は比較的対数則に従った．対数則より求めた粗度長 Z_0 は $10^0 \sim 10^{-4}$ (m) の範囲で平均値は 2.2×10^{-2} (m) となった．べき指数 α は 1/2.9～1/7 の範囲で平均値は 1/4.9 となった．

Abstract: The author joined in the 19th Japanese Antarctic Research Expedition and measured the forms and quantities of snowdrifts accumulated around the existing high floor huts (Observation Hut and Ionosphere Hut) located in the major part of Syowa Station. He also investigated the characteristics of the wind profile near the huts selectively on days when strong wind was blowing by obtaining the roughness length and power index of mean wind profile on the snow-covered ground. The results of measurement are summarized as follows:

(1) The snowdrifts around the high floor huts formed a wind-scoop and changed into U type with a sharp ridge line on the lee side. The annual cumulative quantities of snowdrifts, measured in the measuring section on the lee side, were 78.3 m^3 and 181.7 m^3 around Observation Hut and Ionosphere Hut respectively.

(2) The characteristics of the wind profile conformed to the logarithmic law comparatively. The roughness length, Z_0, was in the range from 10^0 to 10^{-4} with 2.2×10^{-2} (m) as the mean value. The power index α ranged from 1/2.9 to 1/7 with 1/4.9 as the mean value.

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1. Introduction

The design of buildings for the Antarctic Expedition party is confronted with many difficulties because of the severe meteorological conditions in the Antarctic and the constructional and transporting conditions. Particularly, wind-proof design of buildings against blizzard is an important subject, as well as protection against snowdrifts accumulated around the buildings in blizzard.

As a countermeasure to snowdrifts, many countries including Japan generally adopt high floor buildings which are designed to allow the wind to pass through under the floor. In Syowa Station, low floor buildings were designed and constructed at the initial stage, but they were improved later on the basis of the field experience of the party, and high floor buildings came to be designed and constructed for the 8th and the succeeding Japanese Antarctic Research Expedition (JARE) parties.

Concerning the results of observation of snowdrifts in Antarctica, there are reports by MAKI (1975) dealing with simple obstacles, KOBAYASHI and MAKINO (1975), KOBAYASHI (1978a), NARUSE (1970) and INOUE and FUJINO (1977) regarding the quantity and transport of snowdrifts, and STYLES and MELBOURNE (1968). On the other hand, studies on the prediction of the forms of snowdrifts using a wind tunnel were made by SATO and HANNUKI (1978).

Studies on huts were made by KOBAYASHI (1976) and experimental studies of snowdrifts around the huts using a wind tunnel were made by KIMURA and YOSHIZAKA (1942a, b, c, d).

The wind profile on the snow-covered ground in blizzard is also an important problem for the study of its effect on snowdrift and for the windproof design of buildings. Concerning the wind profile in Syowa Station, the results of measurement were reported by MAKI (1971) and ADACHI (1973) from the meteorological viewpoint. The results of observation in inland areas were reported by KOBAYASHI (1978b) and SASAKI (1979). Regarding the observation in Japan, the reports of ÔURA *et al.* (1967, 1968) are available.

Purpose of this study is to investigate the development process and influence area of snowdrift around buildings in order to define the appropriate floor height and the plot planning of the buildings. The result of measurement is utilized in comparison with experimental results of wind-tunnel test. Also results of wind profile measurement is utilized as a standard of wind profile in planning wind-tunnel test.

The author joined in the 19th Japanese Antarctic Research Expedition Wintering Party (1977–1979) and measured the forms and quantities of the snowdrifts accumulated around the existing high floor buildings. He also investigated the characteristics of the wind profile near the buildings selectively on days when strong wind was blowing by obtaining the roughness length and the power index on the snow-covered ground. The following is a brief description of the results of measurement.

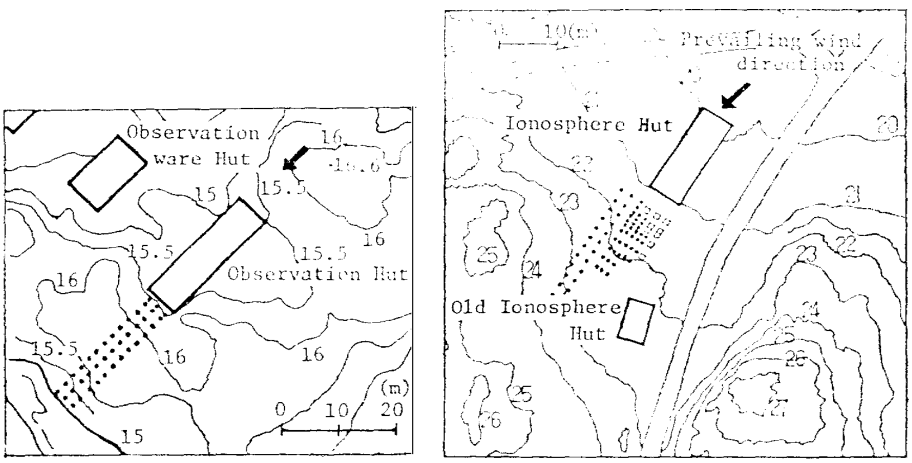
2. Measurement of Snowdrifts around the High Floor Buildings

2.1. Place for measurement and method of measurement

As places for measurement, two existing high floor buildings, *i.e.* Observation Hut (steel pipe trussed hut) and Ionosphere Hut (concrete pillar supported hut) were selected and the quantities of the snowdrifts accumulated on the lee side of these huts were measured. The features of peripheral topography of the huts are shown in Fig. 1 and the points of measurement and outlines of the huts are shown in Figs. 2 and 3. As the points for measurements, 29 points were selected around Observation Hut and 91 points around Ionosphere Hut. About the measuring pole, there were three kinds, namely bamboo, L-shaped steel, and construction fabricated with L-shaped steel (1 m×1 m×2 m).

The two huts are of the same high floor construction, but differ in length, high floor part structure and piloties height. Besides, they are much different in location and features of peripheral topography. Particularly, in the case of Ionosphere Hut, there is a difference of about 4 m in height between the point for measurement on the windward side and that on the leeward side. Measurement was made after blizzard in each case and the quantity of snowdrift was obtained from the reading of the measuring poles. The forms of the snowdrifts were photographed.

Measurement for Observation Hut was made for a total of 25 times, starting from



(a) (b)

Fig. 1. (a) Features of peripheral topography around Observation Hut. (b) Features of peripheral topography around Ionosphere Hut.

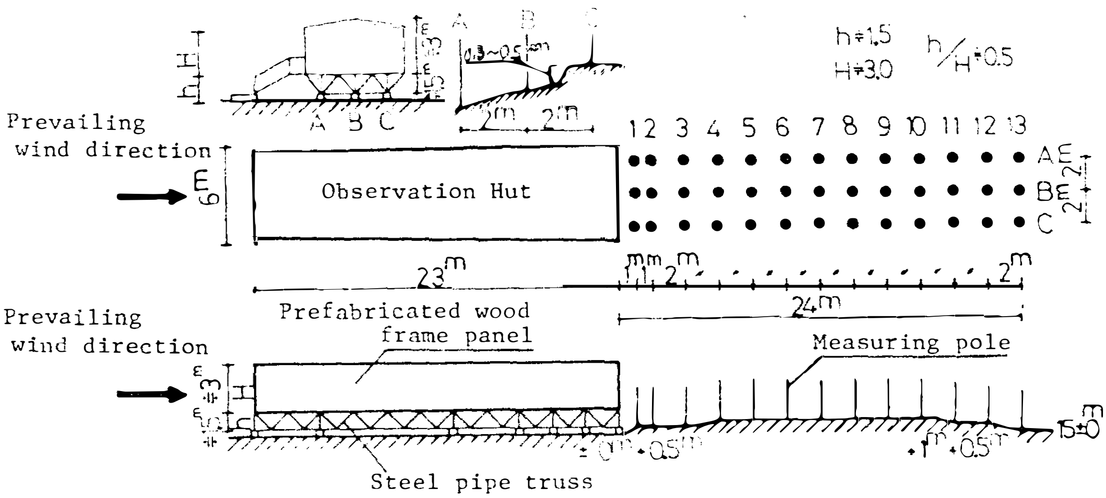


Fig. 2. Points for measurement and outline of Observation Hut.

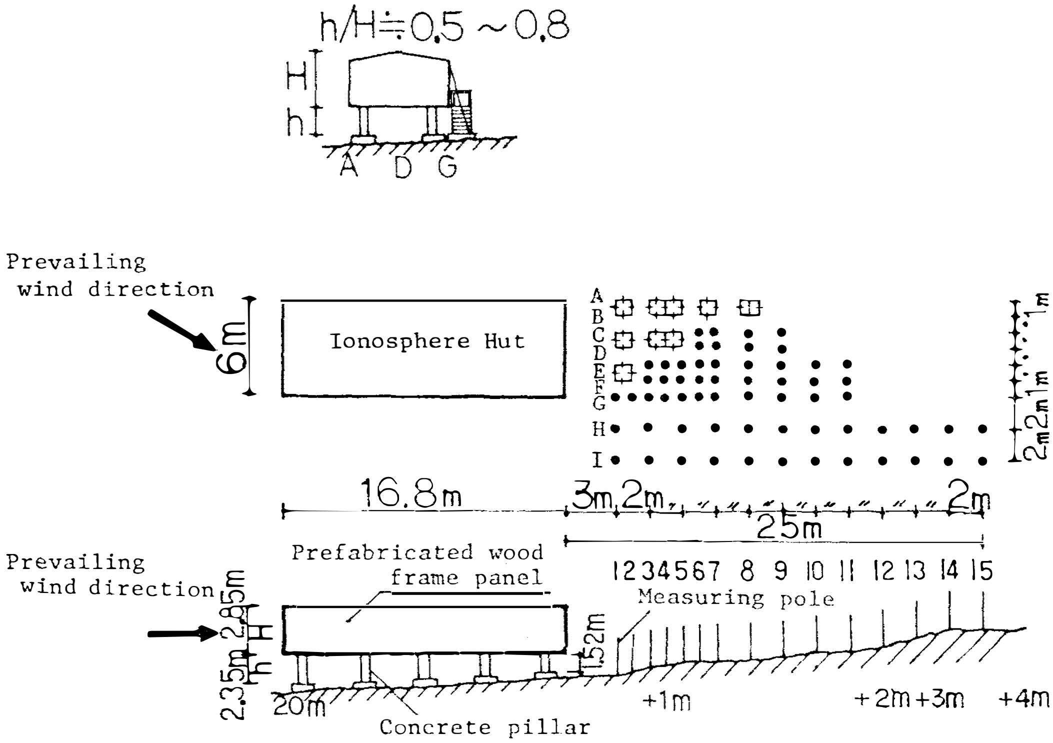


Fig. 3. Points for measurement and outline of Ionosphere Hut.

March 1978 (Table 1) and that for Ionosphere Hut, for a total of 19 times from April of the same year (Table 2). In each case, there was a little snow at the start of measurement.

Table 1. The relation between the duration of snowstorm (time) and the quantity of snowdrifts obtained from the measurement of Observation Hut.

T (hours): The duration of snowstorm.
U (m/s): The daily mean of wind speed during snowstorm.
H (m): The average height of snowdrift.
Q (m³): The quantity of snowdrifts.

$$Q=H\times A \quad \begin{pmatrix} A=96\ \text{m}^2\ \text{Observation Hut} \\ A=82\ \text{m}^2\ \text{Ionosphere Hut} \end{pmatrix}$$

ΣQ (m³): The cumulative quantity of snowdrifts.
*: ΣT (hours): The cumulative duration of snowstorm.

No.	Measuring date	Depth of snowdrift H (m)	Quantity Q (m³)	Cumulative quantity ΣQ (m³)	Duration T (hours)	Wind speed U (m/s)
0	26 Mar.	0.074	7.104			
1	3 Apr.	+0.142	+13.632	20.736	82.75	4.8–17.0
2	5 Apr.	−0.027	− 2.592	18.144	22.67	13.6–14.2
3	13 Apr.	+0.201	+19.296	37.440	88.83	4.8–16.3
4	17 Apr.	+0.043	+ 4.128	41.568	50.33	4.6–16.4
5	24 Apr.	−0.184	−17.664	23.904	33.00	14.8–18.9
6	28 May	+0.020	+ 1.920	25.824	282.33	2.7–24.5
7	1 June	+0.052	+ 4.992	30.816	41.67	9.9–22.1
8	20 June	−0.023	− 2.208	28.608	201.33	2.0–22.6
9	5 July	+0.050	+ 4.800	33.408	165.33	2.7–15.7
10	18 July	+0.029	+ 2.784	36.192	171.50	8.1–30.7
11	29 July	+0.017	+ 1.632	37.824	116.33	1.8–24.3
12	6 Aug.	+0.286	+27.456	65.280	106.17	10.1–23.4
13	6 Sep.	−0.004	− 0.384	64.896	262.75	1.0–15.3
14	13 Sep.	−0.003	− 0.288	64.608	48.83	2.0–11.5
15	15 Sep.	−0.014	− 1.344	63.264	35.67	2.0–21.7
16	22 Sep.	−0.002	− 0.192	63.072	82.67	5.2–19.1
17	1 Oct.	+0.083	+ 7.968	71.040	160.17	7.1–25.7
18	14 Oct.	+0.058	+ 5.568	76.608	172.83	0.5–18.5
19	22 Oct.	+0.032	+ 3.072	79.680	82.08	0.8–10.1
20	25 Oct.	−0.084	− 8.064	71.616	54.50	3.4–25.7
21	29 Oct.	+0.055	+ 5.280	76.896	6.17	6.8
22	5 Nov.	+0.030	+ 2.880	79.776	47.17	0.7– 3.2
23	12 Nov.	+0.073	+ 7.008	86.784	36.50	3.6–11.3
24	26 Nov.	−0.088	− 8.448	78.336	81.75	3.7–12.2
		+0.816		78.336	2433.33*	

Table 2. The relation between the duration of snowstorm (time) and the quantity of snowdrifts obtained from the measurement of Ionosphere Hut.

No.	Measuring date	Depth of snowdrift H (m)	Quantity Q (m³)	Cumulative quantity ΣQ (m³)	Duration T (hours)	Wind speed U (m/s)
0	7 Apr.	0.292	23.994	23.994		
1	8 Apr.	+0.062	+ 5.034	29.028	16.33	6.4–11.0
2	13 Apr.	+0.263	+21.566	50.594	67.00	4.8–16.3
3	20 Apr.	+0.044	+ 3.608	54.202	50.33	4.6–16.4
4	24 Apr.	−0.062	− 5.084	49.118	33.00	14.8–18.9
5	28 May	+0.311	+25.502	74.620	282.33	2.7–24.5
6	1 June	+0.047	+ 3.854	78.474	41.67	9.9–22.1
7	21 June	+0.130	+10.660	89.134	201.33	2.0–22.6
8	4 July	+0.108	+ 8.856	97.990	165.33	2.7–15.7
9	22 July	+0.425	+34.850	132.840	229.17	1.8–30.7
10	29 July	+0.086	+ 7.052	139.892	58.67	2.6–24.3
11	10 Aug.	+0.047	+ 3.854	143.746	165.50	2.1–23.4
12	15 Sep.	+0.306	+25.092	168.838	287.92	1.0–21.7
13	22 Sep.	+0.006	+ 0.492	169.330	82.67	5.2–19.1
14	3 Oct.	+0.208	+17.056	186.386	170.00	0.5–25.7
15	14 Oct.	−0.001	− 0.082	186.304	163.00	4.7–18.5
16	25 Oct.	−0.029	− 2.378	183.926	136.58	0.8–25.7
17	29 Oct.	−0.013	− 1.066	182.860	6.17	6.8
18	26 Nov.	−0.014	− 1.148	181.712	165.42	0.7–12.2
		+2.216		181.712	2322.42*	

2.2. Results of measurement and considerations

2.2.1. Observation Hut

The results of measurement of snowdrifts, classified by months, are shown in Fig. 4 and the condition of snowdrifts is shown in Fig. 5. The snowdrift around the hut with a high floor took the form of wind-scoop (Fig. 9). The quantity of snow decreased sometimes under the influence of the wind direction or some other factors, but its cumulative quantity made a gradual increase. It increased to a large extent in July and reached the peak in October. There were no snowdrifts within the range about 1.5 m from the wall surface of the hut.

The snowdrift on the leeward side formed a sharp ridge line along the principal wind direction. The peak point of the snowdrift on the ridge was located at about 6 m from the rear of the hut from April till June and was 1 m high. From July to August, the highest point shifted to about 4 m point from the rear part of the hut and was 2.5 m high. In October it shifted to about 1 to 2 m point from the rear part and was 2.6 to 2.9 m high. The ridge was gentle mountain-shaped from April till September,

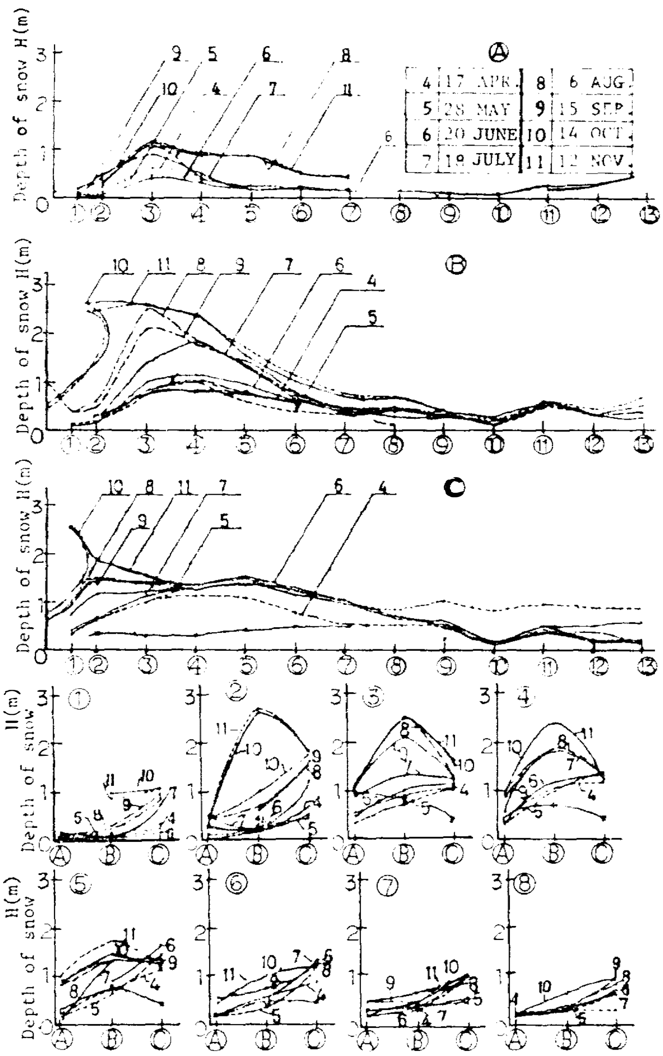
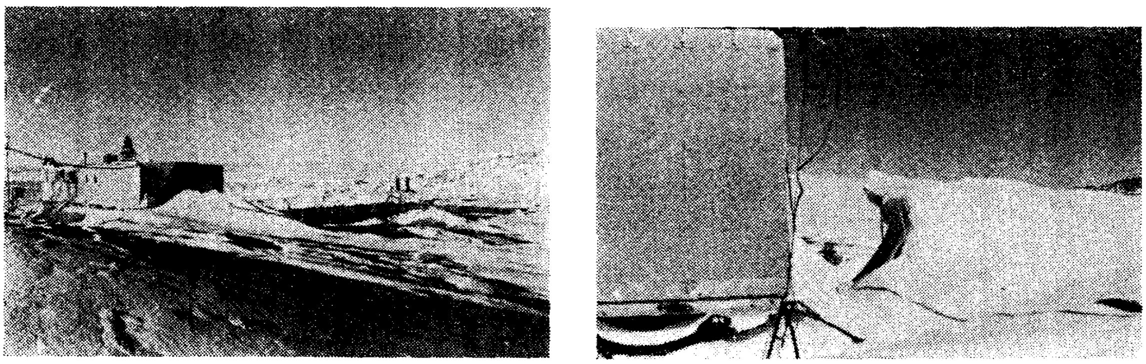


Fig. 4. Examples of variation in depth of snowdrifts measured along leeward against Observation Hut.



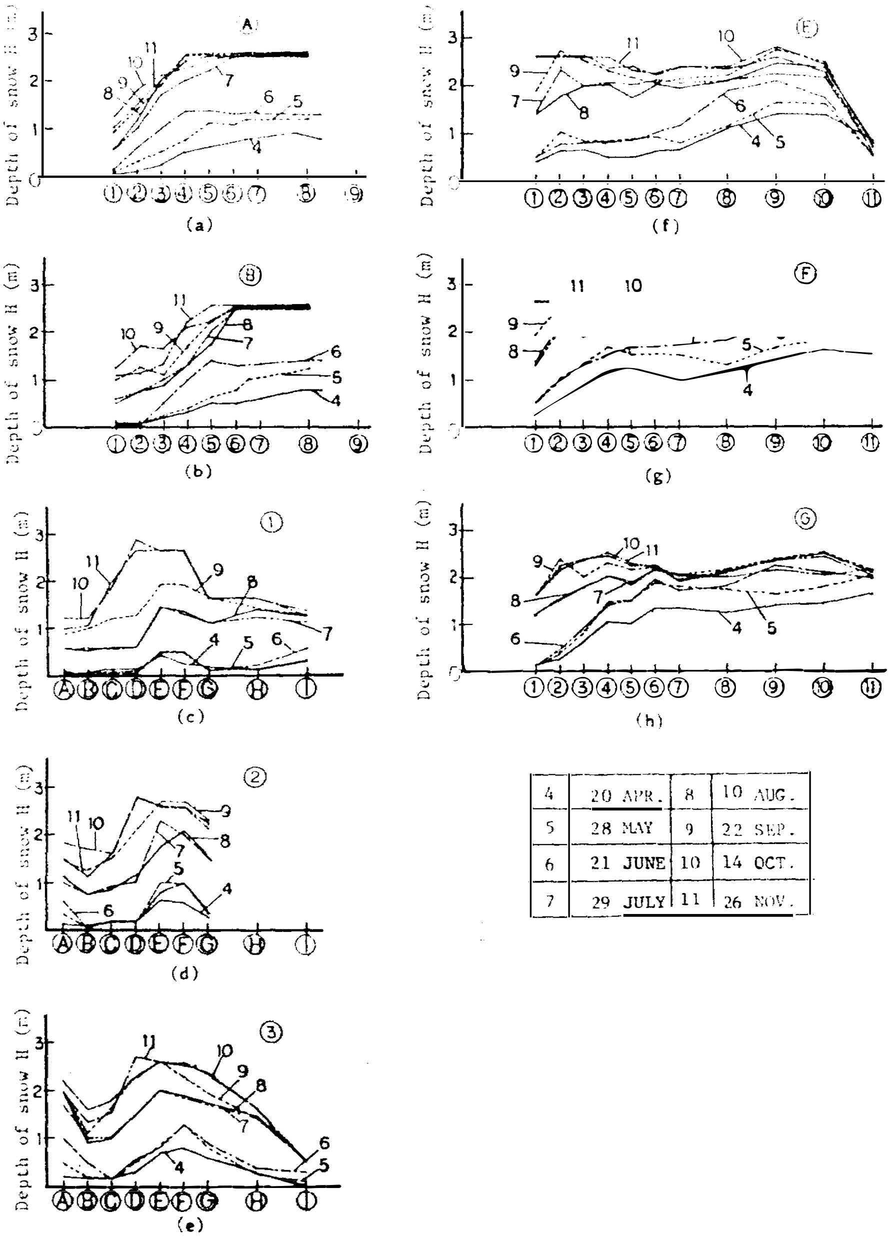
(a) (b)

Fig. 5. Photos of snowdrifts around Observation Hut. (a) On August 27, 1978. (b) On October 24, 1978.

but the form of snowdrift in the leeward area just behind the hut became an inward-curved wave shape, since drifting snow was blown off by strong wind passing through under the floor. And this peak point of snowdrift has a tendency to approach to the hut gradually with increase of drifting snow (Fig. 8).

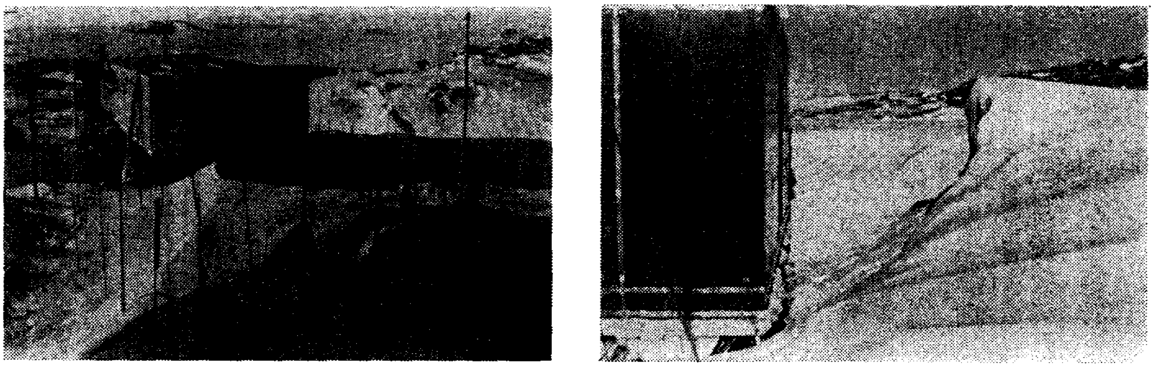
2.2.2. Ionosphere Hut

The results of measurement of snowdrifts, classified by months, are shown in Fig. 6 and the condition of snow drifts is shown in Fig. 7. Snowdrifts increased remarkably



4	20 APR.	8	10 AUG.
5	28 MAY	9	22 SEP.
6	21 JUNE	10	14 OCT.
7	29 JULY	11	26 NOV.

Fig. 6. Examples of variation in depth of snowdrifts measured along leeward against Ionosphere Hut.



(a) (b)

Fig. 7. Photos of snowdrifts around Ionosphere Hut. (a) On April 24, 1978. (b) On October 20, 1978.

in and after July and reached the peak in October as in the case of Observation Hut. The snowdrifts on the leeward side formed a sharp ridge line along the principal wind direction.

From April till June, the snowdrift increased at a gentle incline from the rear part of the hut, and reached the highest point at about 11 m from the rear wall of the hut. Its highest point shifted to about 5 m in August and to near 3 m from the rear wall of the hut and its height was 2.9 m in October. The behavior of the form of the snowdrift near the hut on the leeward side was similar to that near Observation Hut (Fig. 9).

2.2.3. Study of the quantity and form of snowdrifts

According to MAKI's report (1975) which deals with simple bodies, some effect is given on the form of snowdrift within a range up to 20 to 30 times of the height of the body on the lee side. A strict comparison of the present case with MAKI's case is impossible since the measuring range was only 24 m in the case of the existing Observation

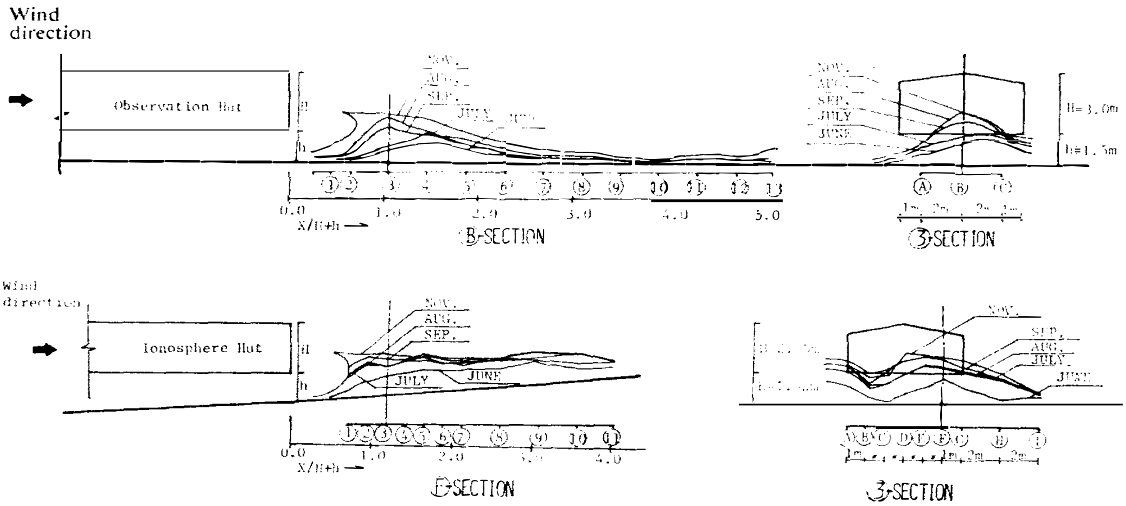


Fig. 8. Variation and effective distance of snowdrift in leeward side of the huts.

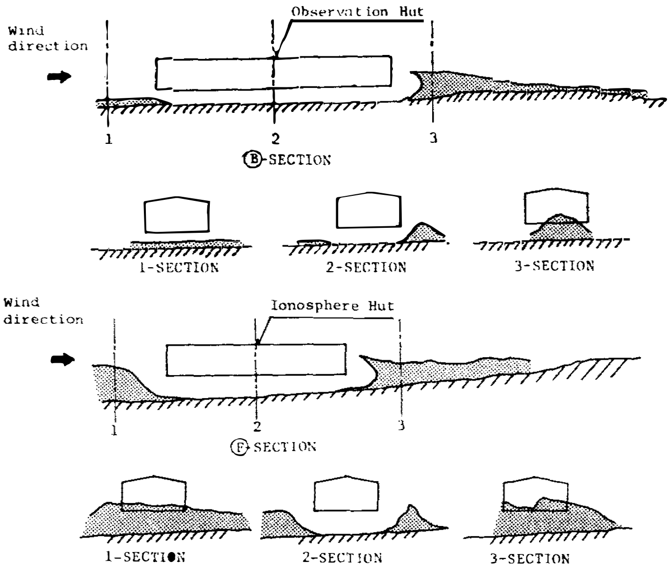


Fig. 9. Forms of snowdrift in leeward and windward sides, and at the section of the huts.

Hut, for example. It was found, however, that the range where a prominent effect was produced on the form of snowdrifts was up to 20 m in the rear of the hut. This length corresponds to about five times the height of Observation Hut, which is about 4.5 m. Also the same characteristic was found as MAKI's (1975) that the formed snowdrifts show the sharp ridge line (peaks).

The relation between the duration of snowstorm (time) and the quantity of snowdrifts is shown in Tables 1 and 2, which were obtained respectively from the measurements of Observation Hut and Ionosphere Hut. (In this measurement, snowfall and drifting snow were counted as snowstorm.) The cumulative quantities of snowdrifts, classified by months, are shown in Fig. 10. The quantities of snowdrifts increased on the whole after increasing or decreasing depending on circumstances. In the case of Observation Hut, the annual duration of snowstorm was 2433.3 hours, the quantity of snowdrifts in the measuring section ($4\times 24=96\ m^2$) was 78.3 m^3, and the average height of snow was 0.82 m. In the case of Ionosphere Hut, on the other hand, the duration of snowstorm was 2322.4 hours, the quantity of snowdrifts in the measuring section ($6\times 8+2\times 6+4\times 2=68\ m^2$) was approximately 181.7 m^3 and the average height of snow was 2.2 m.

A strict comparison of the two huts is impossible because they are different in scale, in the height and shape of piloties, in the topographical features of peripheries and in the conditions of location. However, the annual quantities of the snowdrifts accumulated around the two huts are compared with the length and area of the measuring section on the leeward side put nearly on the same basis, *i.e.*, $4\times 8=32\ m^2$, we

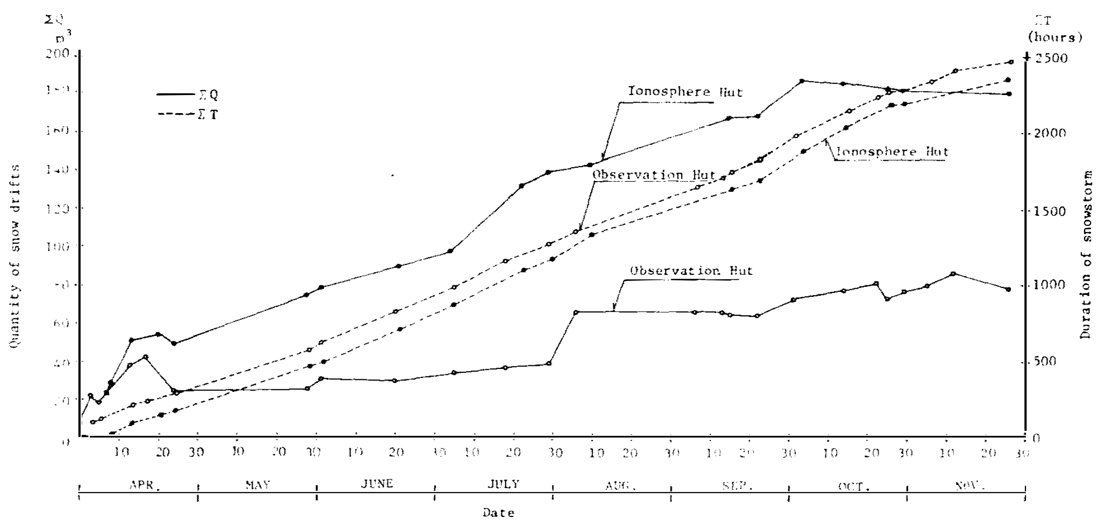


Fig. 10. Variation by month of the accumulative quantities of snowdrifts and duration of snowstorm.

obtain 2.2 m (Ionosphere Hut) and 1.4 m (Observation Hut) in terms of average height, indicating that the annual quantity of snowdrifts around the Ionosphere Hut is about 1.6 times larger than that around Observation Hut.

3. Measurement of the Wind Profile near the Hut

3.1. Place for measurement and method of measurement

The place for measurement was located on a bare rock (22 m above the sea level) in the major part of Syowa Station and at a distance of about 300 m from the sea ice. It is at a distance of only 25 m from Ionosphere Hut. The location of the wind measuring pole is shown in Fig. 11. The sensing part is equipped with three-cup type anemometers (anemometer transmitters) of the wind run pulse transmission system, capable of withstanding strong wind up to 60 m/s in speed. One pulse corresponds to about 1.4 m of wind run as a standard.

The measuring pole is made of steel pipe, 50 mm in diameter and 8 m high, on which five anemometers were installed at the heights of 1, 1.7, 2.8, 4.8 and 8 m. They were installed 50 cm apart from the measuring pole to be as much free as possible from the effect of the air flow behind the measuring pole caused by a change in the wind direction. The measured values were recorded by a wind run counter installed in Ionosphere Hut. A multiple element frequency automatic recorder was also installed for usual measurement and recording.

3.2. Measurement and meteorological conditions

Measurement was started in February 1978 and ended in December of the same

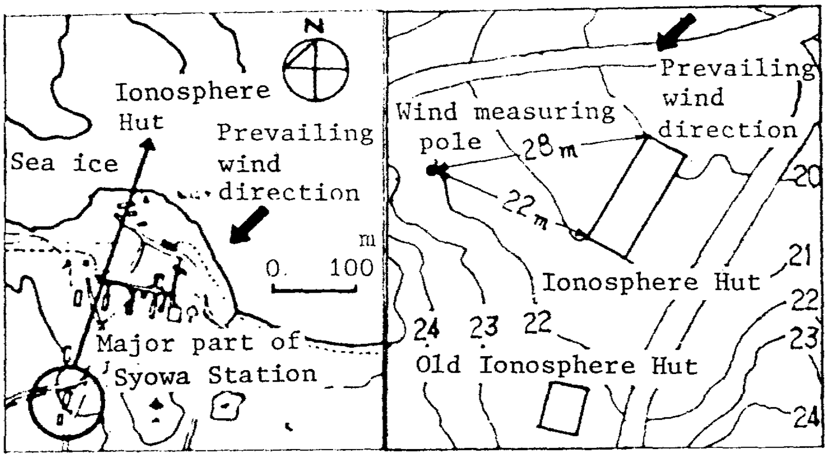


Fig. 11. Location of the wind measuring pole.

year. The time of measurement varied in several ways: 10 minutes, 1 minute, and others (from 2 to 60 minutes), and measurement was carried out selectively on days when strong wind (blizzard) was blowing. The meteorological conditions on the days of measurement are shown in Table 3.

The height of the accumulated snow at the point where the measuring pole was

Table 3. The meteorological data on the days of measurement.
V_m (m/s): Daily mean wind speed.
V_{xx} (m/s): Daily maximum wind speed.
T_m (°C): Daily mean temperature.

Date	Wind direction	V_m (m/s)	V_{xx} (m/s)	T_m (°C)	Date	Wind direction	V_m (m/s)	V_{xx} (m/s)	T_m (°C)
17 Feb.	NE	11.6	15.5	− 1.8	21 July	SW	1.8	6.5	−18.9
18 Feb.	ENE	17.0	21.4	− 0.5	2 Aug.	ENE	23.4	33.6	− 8.6
19 Feb.	E	14.4	22.2	− 1.1	4 Aug.	NE	14.9	25.3	−11.5
20 Feb.	E	23.3	29.2	− 1.5	5 Aug.	ENE	18.8	23.8	− 7.9
4 Mar.	ENE	17.2	23.5	− 3.8	8 Sep.	NE	7.4	18.0	−11.0
5 Mar.	NE	23.2	31.0	− 2.6	9 Sep.	NE	12.9	29.3	−14.1
6 Mar.	ENE	12.1	27.0	− 4.8	17 Sep.	ENE	3.2	7.1	−18.5
11 Apr.	ENE	16.3	28.3	− 8.7	27 Sep.	NNE	9.0	15.3	−11.4
15 Apr.	NE	6.5	11.9	−10.9	6 Oct.	NE	7.4	15.9	−16.2
16 Apr.	ENE	14.1	19.2	− 8.6	8 Oct.	NE	10.9	21.3	−16.4
3 June	ENE	11.2	15.1	−18.9	21 Oct.	NNE	10.1	19.1	−10.0
19 June	ENE	18.8	26.1	− 9.3	10 Nov.	NE	11.3	18.4	− 9.5
4 July	ENE	3.4	12.9	−13.6	25 Nov.	NE	12.2	20.6	− 4.5
12 July	NE	28.3	33.3	− 6.5	17 Dec.	NE	12.2	15.6	− 1.4
13 July	ENE	30.7	35.2	− 5.2					

Table 4. The height of accumulated snow at the measuring pole.

Month	Height (cm)
February, March	0
April, December	20
June, July	40– 50
August, September, October	70– 80
November	90–100

installed, varied as shown in Table 4 due to the snowfall on the ground surface (bare rock) after blizzard; in February and March, there was no snow on the bare rock; in April onward the rock was covered with snow; in November the height of snow reached close to 1 m.

3.3. Results of measurement and considerations

The results of measurement of the wind profile, as arranged by months according to changes in the height of snow at the location of the measuring pole, are shown in Fig. 12. Data obtained from 10-minute measurements are 63 pieces in number, those from 1-minute measurements 212 pieces, and those from other measurements 44 pieces.

Generally viewed, these data are comparatively in conformity to the law of logarithm. There are no striking differences by the time of month of measurement. By wind speeds, the tendency is observed that the effect of height increases with increasing wind speed. But in November, it does not conform to the logarithmic law at the point of 1 m height. This is presumed to be due to the effect of accumulated snow

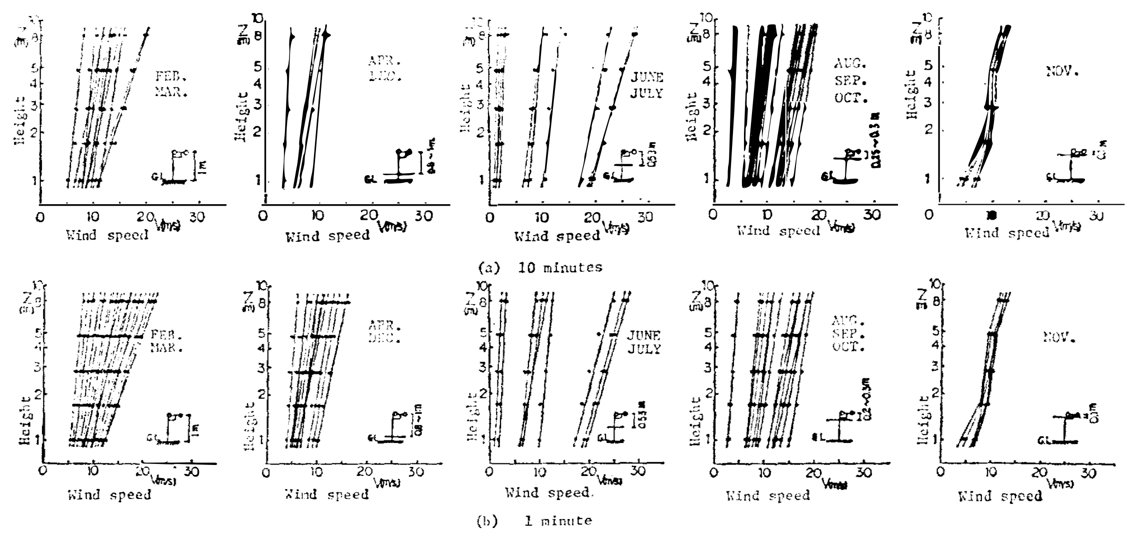


Fig. 12. Results of vertical profile of wind speed. (a) 10-minute measurements. (b) 1-minute measurements.

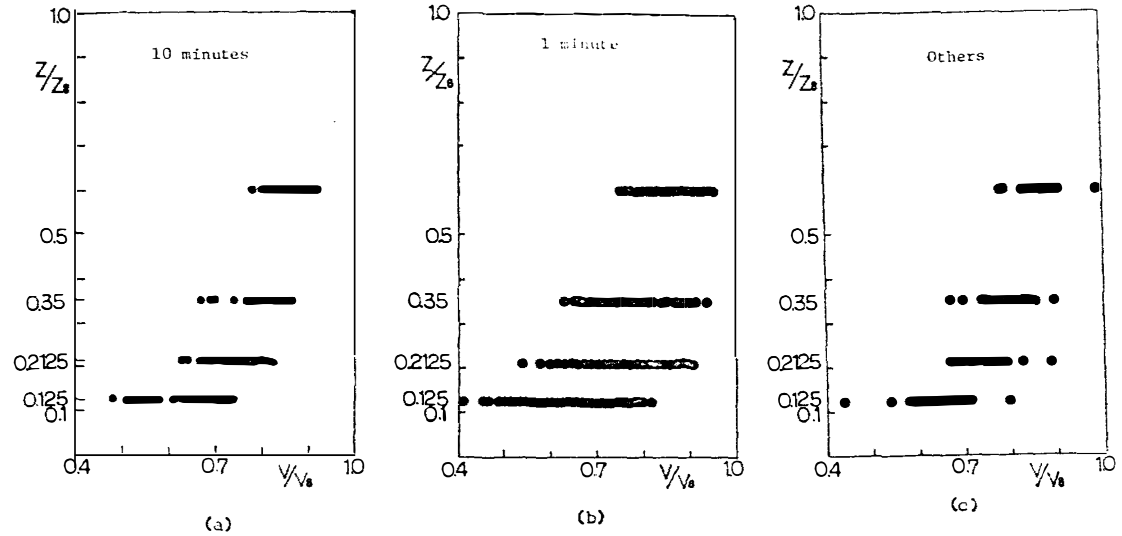


Fig. 13. Dimensionless expressions of the data. (a) 10-minute measurements. (b) 1-minute measurements. (c) Others.

at the measuring pole.

Fig. 13 is dimensionless expressions of the data, which indicates the effect of height in relation to wind speed.

3.4. Roughness length Z_0 and power index α

The wind profile in the lower part of the boundary layer can be expressed by the law of logarithm.———eq. (1):

$$V_z=\frac{V_*}{\kappa}\ln\left(\frac{Z}{Z_0}\right), \qquad (1)$$

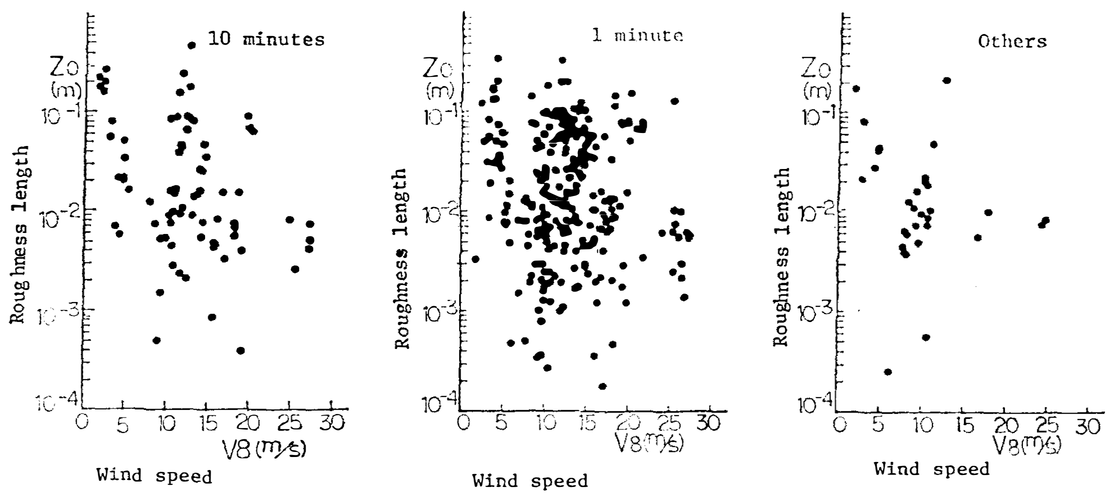


Fig. 14. Relation between roughness length Z_0 and wind speed. (a) 10-minute measurements. (b) 1-minute measurements. (c) Others.

Table 5. The power index α obtained by the power law of index, eq. (2), from the measured values.

	Month	Wind speed (m/s)					
		<5	5~10	10~15	15~20	20<	Average
10 minutes	Feb.	—	1/5.7	1/4.6	1/3.4	—	1/4.5
	Mar.	—	—	1/6.3	1/6.1	—	1/6.2
	Apr.	—	1/5.7	1/7.2	—	—	1/6.3
	June	—	—	1/5.9	—	—	1/5.9
	July	1/3.0	—	—	—	1/6.2	1/4.0
	Aug.	—	—	1/5.6	1/6.2	—	1/6.1
	Sep.	1/4.4	1/6.1	—	1/6.4	—	1/5.4
	Oct.	—	—	1/6.0	—	—	1/6.0
	Nov.	—	—	1/2.9	—	—	1/2.9
	Dec.	—	—	1/3.6	—	—	1/3.6
	Average	1/3.5	1/5.9	1/4.2	1/5.5	1/6.2	1/4.9
1 minute	Feb.	—	1/5.9	1/4.4	1/3.5	1/3.5	1/4.2
	Mar.	—	—	1/6.4	1/5.9	—	1/6.2
	Apr.	—	1/7.6	1/5.9	1/4.1	—	1/5.8
	June	—	1/5.5	1/4.3	—	—	1/4.6
	July	1/3.2	—	—	—	1/6.4	1/4.0
	Aug.	—	1/6.8	1/6.3	1/6.0	—	1/6.1
	Sep.	1/4.2	1/5.8	1/6.8	1/6.5	—	1/5.6
	Oct.	—	1/6.4	1/6.0	—	—	1/6.1
	Nov.	—	—	1/2.9	—	—	1/2.9
	Dec.	—	1/3.9	1/3.6	—	—	1/3.7
	Average	1/3.6	1/5.9	1/4.5	1/5.3	1/4.4	1/5.0
Others	Feb.	—	1/6.5	1/4.2	1/4.1	—	1/4.7
	Apr.	—	1/9.4	—	—	—	1/9.4
	June	—	1/5.7	1/5.3	—	—	1/5.4
	July	1/3.4	—	—	—	1/6.0	1/4.1
	Aug.	—	—	—	1/6.0	—	1/6.0
	Sep.	1/4.4	1/5.9	—	—	—	1/5.1
	Average	1/3.9	1/6.3	1/4.5	1/4.6	1/6.0	1/4.8

where V_* is friction velocity, Z_0 is a surface roughness length and $\kappa(=0.4)$ is von Karman's constant. However, in the wind-proof design of structures, the power law of index———eq. (2), is applied in many cases.

$$\frac{V_Z}{V_G}=\left(\frac{Z}{Z_G}\right)^{\alpha}, \tag{2}$$

In this case, Z_0 was obtained by the law of logarithm and power index α by the power

Table 6. The past values of measurement regarding the roughness length (Z_0).

Report	Roughness length Z_0	Wind speed U (m/s)	Place
1971 MAKI, T.	10^{-2} (cm) $\log Z_0 = 0.001\, U_6 - 3.30$	13 (m/s)< 13 (m/s)>	Syowa Station, Antarctica
1973 ADACHI, T.	$10^{-2.06}$ (cm)	0–28 (m/s)	
1967 KOBAYASHI, S. KOBAYASHI, D. ŌURA, H.	10^{-5}–10^{-1} (cm) 10^{-5}–10^{-2} (cm)	Blowing snow No blowing snow	Sapporo, Japan
1978 KOBAYASHI, S.	0.087 (cm)		Yamato Mountains, Antarctica
1979 SASAKI, H.	0.24 (cm)		Mizuho Plateau

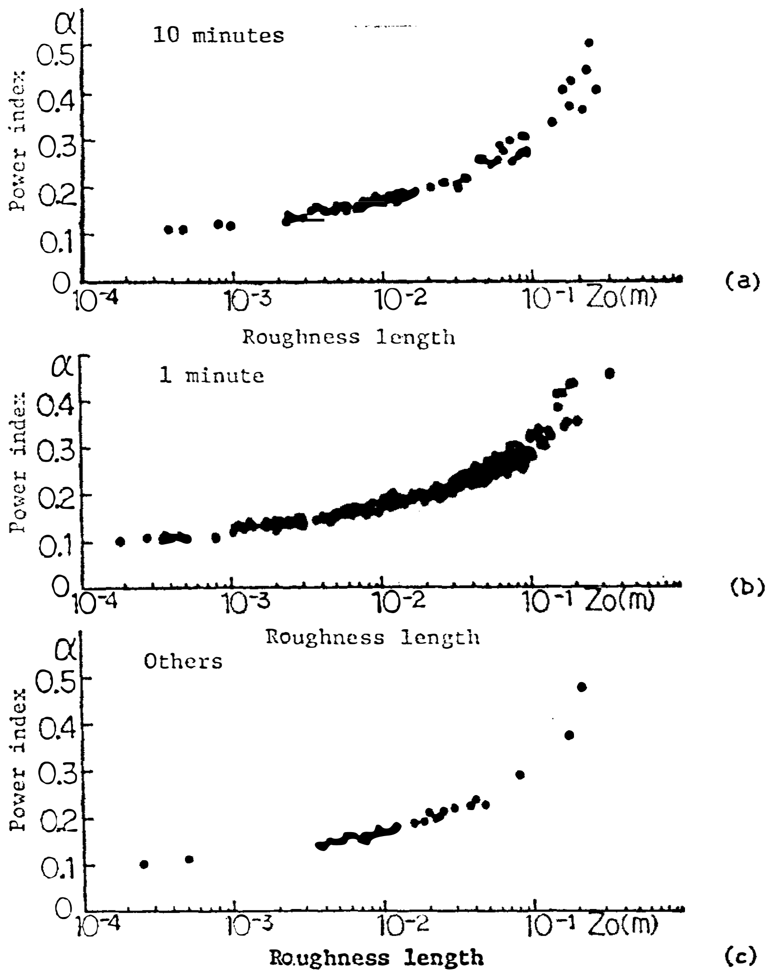


Fig. 15. Relation between roughness length Z_0 and power index α. (a) 10-minute measurements. (b) 1-minute measurements. (c) Others.

law of index from the measured values. The results are shown in Fig. 14 and Table 5.

Roughness length Z_0 ranged from 10^0 to 10^{-4} (m) with considerable scatters. The overall mean value for 10-minute measurements is 2.1×10^{-2} (m) and that for 1-minute measurements is 2.2×10^{-2} (m). The overall mean value for other measurements is 2.8×10^{-2} (m). The characteristics of mean wind profiles followed the logarithmic law comparatively and they were not sensitive to measuring time and seasons.

A strict comparison between the measured data and the data of MAKI (1971) and ADACHI (1973) in Table 6 is impossible because the place of measurement; *i.e.*, sea ice in the case of MAKI and ADACHI's data, environment, etc., are different. However, the measured values are slightly on the larger side as compared with MAKI and ADACHI's values. MAKI (1971) also states that Z_0 increases to a great extent with increasing wind speed; this is not clear because of a large amount of scatters in their data. On the other hand, the measured values are nearly within the same range as the values obtained by Ôura (1968) and others (Table 6) in the measurement of drifting snow in Japan.

The measured values of power index α ranged from 1/2.9 to 1/7.2, which are intermediate between the generally reported values on flat ground, *i.e.*, 1/10 to 1/8, and those in central parts of cities, *i.e.*, 1/3 to 1/2. The overall mean value of α for 10-minute measurements is 1/4.9, that for 1-minute measurements 1/5.0, and that for other measurements 1/4.8. By wind speeds, the measured value is about 1/3.5 at speeds below 5 m and 1/4 to 1/6 at speeds over 5 m. By months, the measured value is 1/2.9 in November, which is larger as compared with the other months. This is presumable because the height of the measuring pole on the snow-covered ground became the highest due to accumulated snow. The relation between the measured values of roughness length Z_0 and power index α is plotted in Fig. 15, indicating a tendency that α increases with the increase of Z_0. It is presumed that changes in the height of the snow on the ground surface, wind direction and atmospheric temperature are responsible for this tendency.

4. Conclusion

A series of measurements performed in the recent study have shown the forms and quantities of snowdrifts accumulated around the high floor huts and the characteristics of the wind profile near the huts as follows:

(1) The snowdrift around the hut with the high floor at Syowa Station took the from of wind-scoop. The cumulative snow in the leeward of the hut was maximum at the distance of (2—3) *h* (*h*: the floor height) from the side wall of the hut and it became long along the principal wind direction. And this peak point of snowdrift tended to approach to the hut gradually with the increase of drifting snow.

The snowdrift around the huts was maximum in November and it had the form with the sharp ridge along the dominant wind direction. The form of snowdrift in the leeward area just behind the huts became U-shaped in the section, since drifting snow was blown off by strong wind passing through under the floor.

The range where remarkable drift could be observed was about 5 times of the height of the huts in the leeward of the huts.

(2) During the observation at Syowa Staion, the duration of snowstorm and the quantities of drifting snow measured in the leeward area were 2433.3 hours and 78.3 m^3 for Observation Hut, and 2322.4 hours and 181.7 m^3 for Ionosphere Hut respectively.

(3) The characteristics of mean wind profiles followed the logarithmic law comparatively and they were not sensitive to measuring times and seasons.

(4) The surface roughness length calculated by the logarithmic law ranged from 1 m to 10^{-4} m and the mean value was about 2.2×10^{-2} m. The power indices in the exponential fomula were evaluated to be from 1/2.9 to 1/7.2 and the mean value was about 1/4.9.

In this paper, the results of measurements only are presented, which in the near future will be followed by the studies of simulation in wind tunnel test, and appropriate floor heights and prediction of snowdrifts.

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