IV. DRIFTING SNOW AT SYOWA STATION AND MIZUHO CAMP IN 1971 - 1972

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1. Drifting Snow at Syowa Station in 1971 (Observer: T. Yamada)

An observation site was located on a sea ice, about 200m in the north-east of Syowa Station, where the sea ice was covered by a flat snow cover. Two parallel trenches (2.5m long, 1.5m wide and 60cm deep for each) were excavated at the snow surface, so that their long axes were perpendicular to the wind direction and a distance between them along the wind direction was 1m, as shown in Fig.1. Kobayashi (1972) pointed out the collection factor of a trench in such a size for low-drifting snow as 1.0 for a wind slower than 7m/s, and 0.8 - 0.9 for a wind faster than that. Snow drifting rate (g/cm·min: amount of drifting snow through a vertical plane with unit width perpendicular to the wind direction, per unit time) was calculated from the amount of captured snow in the windward trench during a certain time period, as it was observed that the collection factor of the windward trench was considerably close to 1.0 even by a wind of 11m/s. The result of the observation is given in Table 1.

2. Drifting Snow at Mizuho Camp in 1971 (Observer: T. Yamada)

Two kinds of cyclone-type drift collectors (Fig.2) were used to measure the mass flux of drifting snow ($g/cm^2 \cdot min$: amount of drifting snow through unit area, perpendicular to the wind direction at a certain height from the snow surface, per unit time). The inner diameter of the inlet tube of the type-1 and the type-2 drift collector was 3cm and 2cm, respectively, and the collection factor was estimated as 0.6 for both (Naruse, 1970). The observation area was selected so that it was fairly flat and smooth (without big sastrugis and snow dunes) for a wide extension. Several drift collectors were set at different heights from the snow surface. Measurements were made when the direction and speed of wind were fairly constant. The result of the observation is given in Table 2.

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3. Wind Speed and Air Temperature in 1971

The wind speed and air temperature were measured as important parameters of snow drifting, during the drift observation at the following locations and heights:

Snow drift observation site		Location and height at which (A) wind speed and (B) air temperature were measured	
		Location	Height
Syowa Station area	200m NE of Syowa Station	Syowa Station (14.5m above sea level)	A: 10m above the ground B: 1.5m above the ground
Mizuho Camp area	30 m ENE of Mizuho Camp	by the observation site	A: 4.5m above the snow surface B: 1.8m above the snow surface

The result is given in Tables 1 and 2.

4. Drifting Snow at Mizuho Camp in 1972 (Ovserver: H. Narita)

A box-type drift gauge (a combination of 10 small cabinets in a series, as shown in Fig.3: Kobayashi, 1972) was placed at the snow surface so that the upper side (open side) of the cabinets was properly level with the surrounding snow surface without a gap between the gauge and snow, whereby the lengthwise side of the gauge was directed in parallel to the wind direction. The amount of drifting snow captured in each cabinet was weighed, and the drifting rate Q(g/cm·sec), the average saltation length $\bar{L}$(cm), and the rebounding mass of drifting snow G(g/cm^2·sec) were calculated as follows: the x-axis was taken in parallel to the wind direction with the origin at the windward edge of the gauge, as shown in Fig. 3; then the amount of drifted snow $F(x)$ is given as,

$$F(x) = G\left\{\int_0^{\infty} g(1)d1 - \int_0^{x} g(1)d1\right\}$$

$$= G\left\{1 - \int_0^{x} g(1)d1\right\}, \quad \cdots\cdots\cdots\cdots\cdots \quad (1)$$

where F(x) : amount of drifted snow onto a unit area ($g/cm^2 \cdot sec$), the center of which is located at x,

G : rebounding mass of drifting snow, $G = F(x)_{x=0}$ ($g/cm^2 \cdot sec$),

1 : saltation length of a snow particle (cm),

g(1) : distribution function of saltation length.

The amount of drifting snow Q is given as,

$$Q = \int_0^\infty F(x)dx = \bar{L} \cdot G,$$

where Q : mass of drifting snow which passes through a unit width perpendicular to the wind direction in a unit time ($g/cm \cdot sec$),

$\bar{L}$: mean length of saltation of drifting snow particles (cm), ($\bar{L}$ and G are functions of wind velocity, respectively.)

The wind velocity was measured at a level of 1m above the snow surface. The result is given in Table 3.

References

Kobayashi, D.(1972): Studies of snow transport in low-level drifting snow. Contr. Inst. Low Temp. Sci., Ser. A, 24, 1-58.

Naruse, R.(1970): Measurement of drifting snow on the coastal region of Antarctica, near Syowa Station. Low Temp. Sci., Ser. A, 28. 147-153 (in Japanese).

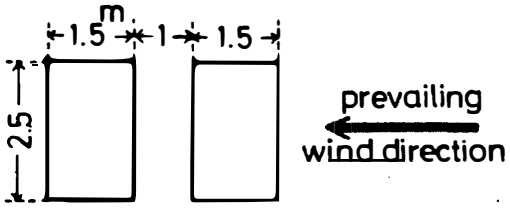

Fig. 1. Trenches for measuring drift rate of snow, in Syowa Station area.

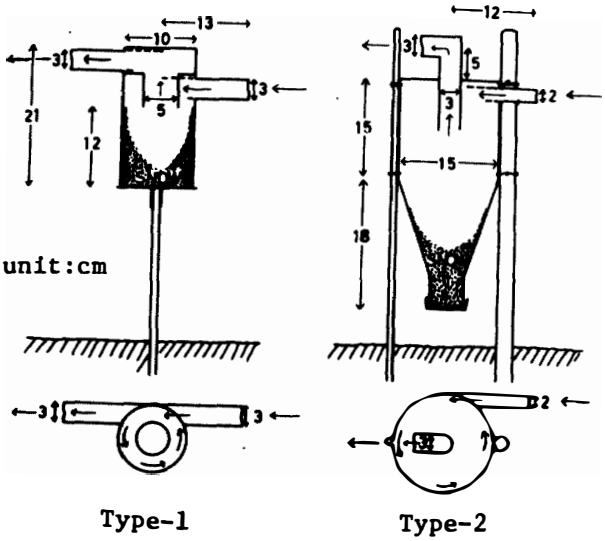

Fig. 2. Cyclone-type drift collectors (from Naruse, 1970).

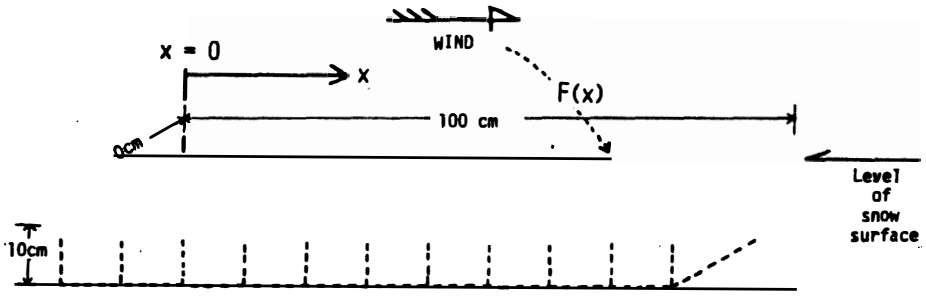

Fig. 3. Box-type drift gauge.

Table 1. Measurement of drifting snow by a trench method at Syowa Station in 1971.

Date	Time			Mean wind speed (m/sec)	Mean air temperature (°C)	Amount of snow drift (g/cm)	Drift rate (g/cm·min)
	from	to	(min)				
24 Aug.	1130	1230	60	10.0	-12.2	427	7.1
	1233	1427	114	11.0	-12.0	718	6.3
	1432	1548	76	11.0	-11.6	824	10.8
	1618	1716	58	11.5	-11.0	864	14.9
	1724	1750	26	11.0	-11.2	160	6.2
25 Aug.	1116	1200	44	11.2	-10.5	276	6.3
	1408	1440	32	11.0	-9.6	278	8.7
	1457	1538	41	9.9	-11.5	369	9.0
	1546	1622	36	10.5	-12.0	274	7.6
	1628	1706	38	8.0	-13.0	204	5.4
26 Aug	1002	1050	48	9.3	-17.1	293	6.1
	1056	1136	40	10.7	-17.5	642	16.1
	1143	1222	39	9.0	-17.2	312	8.0

Table 2. Measurement of drifting snow by cyclone-type drift collectors at Mizuho Camp in 1971. (Level of collector was measured from the snow surface)

Date	Time			Mean wind speed (m/s)	Mean air temperature (℃)	Drift collector		Mass flux ($g/cm^2 \cdot min \times 10^{-2}$)
	from	to	(min)			Type	Level (cm)	
Nov. 21	1500	1710	130	15	−21.5	1	11	45.33
						1	42	7.10
						2	42	8.49
						2	75	2.41
						1	118	0.29
						2	150	0.41
	1845	2000	75	16	−22.0	1	11	84.01
						1	42	22.77
						1	118	6.04
Nov. 22	1205	1320	75	17	−16.0	1	4	117.86
						1	9	64.20
						1	20	29.91
						2	60	61.57
						2	133	29.79
	1420	1520	60	17	−15.5	1	13	95.42
						1	21	31.61
						1	36	23.87
						2	65	36.00
						2	135	106.07
	1635	1745	70	17	−15.8	1	9	91.19
						1	21	35.45
						1	37	22.47
						2	37	51.49
						2	68	33.67
						2	135	13.27
Nov. 23	1330	1403	33	17	−14.7	1	5	251.63
						1	13	375.30
						1	34	101.51
						2	34	136.72
						2	64	38.12
						2	138	13.99
	1510	1540	30	16	−14.7	1	5	442.71
						1	13	258.79
						1	34	93.58
						2	35	185.42

Date	Time			Mean wind speed (m/s)	Mean air temperature (℃)	Drift collector		Mass flux ($g/cm^2 \cdot min \times 10^{-2}$)
	from	to	(min)			Type	Level (cm)	
Nov. 23						2	62	29.55
						2	137	9.73
	1617	1633	16	15	−15.0	1	8	401.78
	1617	1644	30	15	−15.0	1	16	163.01
						1	35	71.71
						1	34	113.76
						2	62	33.09
						2	137	8.67
	1737	1758	21	18	−16.3	1	7	420.92
	1737	1807	30	18	−16.3	1	15	237.79
						1	36	82.88
						1	36	115.36
						2	62	53.79
						2	137	18.75
	1833	1850	17	18	−17.0	1	7	527.46
	1833	1903	30	18	−17.0	1	15	230.48
						1	36	90.12
						1	36	103.68
						2	62	45.82
						2	137	9.55
Nov. 24	0938	1039	61	12	−15.3	1	9	132.49
						1	19	23.36
						1	36	4.83
						2	37	6.35
						2	62	2.52
						2	137	0.44
	1112	1157	45	13	−13.8	1	9	210.53
						1	17	37.69
						1	36	7.23
Dec. 9	1650	1754	64	9	−16.0	1	10	13.64
						1	18	5.16
						1	40	2.51
						2	40	7.38
						2	72	4.23
						2	147	3.98

Date	Time			Mean wind speed (m/s)	Mean air temperature (℃)	Drift collector		Mass flux ($g/cm^2 \cdot min \times 10^{-2}$)
	from	to	(min)			Type	Level (cm)	
Dec. 18	1525	1625	60	11	−10.1	1	10	166.59
						1	15	57.80
						1	38	2.91
						2	38	2.92
						2	75	0.53
						2	150	0.09
	1701	1801	60	12	−11.3	1	10	154.40
						1	15	91.85
						1	39	3.77
						2	39	3.80
						2	75	0.80
						2	150	—
Dec. 27	1225	1325	60	13	−11.5	1	6	204.69
						1	15	146.89
						1	39	9.24
						2	39	13.27
						2	78	2.21
						2	144	1.24
	1400	1500	60	13	−10.3	1	5	166.12
						1	15	82.61
						1	39	6.05
						2	38	16.90
						2	78	1.95
						2	153	3.18
	1540	1640	60	10	−10.1	1	9	50.40
						1	15	16.51
						1	39	0.86
						2	38	0.27
						2	78	—
						2	153	0.44

Table 3. Measurement of drifting snow by a box-type drift gauge at Mizuho Camp in 1972.

No.	Date	State of snow surface	Wind velocity (m/sec)	Temperature (℃)	Mass of deposited snow in each box (g)										Total amount of snow drift (g)	Duration (sec)	Drift rate (g/cm·s)	Rebound mass ($\times 10^{-2}$ g/cm^2·s)	Saltation length (cm)
					1	2	3	4	5	6	7	8	9	10					
1	May 30	Dune	9.8	− 54.0	359.8	174.3	114.0	102.5	64.5	62.4	60.5	56.9	53.5	55.8	1104.2	60	109.2	2.99	36.5
2	30	〃	10.9	− 54.5	402.0	197.0	97.8	68.8	52.8	39.8	39.8	37.3	26.9	28	990.2	60	89.1	3.55	25.1
3	31	〃	10.2	− 53.0	352.1	123.3	63.5	37.4	30.5	22.3	19.4	19.2	24.6	24.7	717.0	60	61.8	2.93	21.1
4	31	Sastrugi	10.6	− 54.0	4.6	3.1	3.0	3.4	4.2	3.9	4.8	4.7	5.4	4.7	41.8	60	3.8	0.05	76.0
5	June 2	Dune	11.1	− 48.7	420.2	173.1	100.6	57.5	37.4	28.0	24.5	20.1	20.1	21.6	903.1	60	78.9	3.50	22.5
6	2	〃	10.6	− 48.6	381.6	110.9	68.2	46.4	43.0	33.6	31.6	30.9	31.6	58.6	836.4	60	72.4	3.18	22.8
7	3	〃	11.3	− 50.5	426.3	175.2	101.6	71.3	54.6	41.1	44.9	46.7	37.7	34.7	1034.1	60	94.4	3.55	26.6
8	3	Sastrugi	11.6	− 50.0	16.8	17.1	16.8	16.5	16.3	13.5	14.7	13.7	12.4	13.9	151.7	60	13.0	0.14	92.6
9	6	Dune	11.8	− 37.5	426.3	214.3	115.7	78.6	58.7	52.4	37.7	35.0	39.5	48.5	1106.7	60	100.9	3.55	28.4
10	6	〃	11.3	− 37.5	464.2	202.2	130.7	89.0	72.5	55.7	59.4	49.6	49.1	57.7	1230.1	60	108.2	3.87	27.9
11	7	Sastrugi	14.5	− 33.0	17.3	19.1	18.1	19.2	17.7	15.4	21.0	20.4	22.6	24.6	195.4	60	8.1	0.07	115.7
14	12	Dune	10.5	− 45.5	326.5	116.4	78.1	55.8	52.1	49.2	42.9	40.8	35.0	36.9	833.7	60	80.3	2.72	29.5
15	12	〃	10.2	− 45.5	274.9	161.1	96.3	60.3	47.9	41.6	45.7	35.4	28.6	25.1	845.3	60	75.8	2.29	33.1
18	14	Sastrugi	12.0	− 52.0	9.8	8.8	13.6	12.3	13.3	13.4	13.6	12.8	15.8	12.1	125.5	60	10.3	0.08	128.8
20	17	Dune	7.6	− 37.2	40.1	20.9	14.5	8.0	6.5	5.3	4.4	3.1	3.7	3.6	110.1	120	4.9	0.18	27.3
21	17	〃	8.0	− 38.2	41.6	30.4	19.4	12.6	9.4	7.8	6.3	8.0	6.7	6.0	148.2	120	6.5	0.17	38.4
24	30	〃	8.4	− 40.5	297.9	76.7	33.0	18.0	10.8	7.4	4.7	3.5	2.7	2.1	456.8	120	19.1	1.24	15.4
25	30	Sastrugi	7.8	− 41.0	43.2	43.7	32.9	27.4	20.0	16.2	11.4	10.4	8.1	7.0	220.1	120	9.9	0.18	55.0
26	30	〃	7.0	− 40.5	15.0	14.7	12.7	10.1	8.1	7.0	5.2	4.2	3.6	2.9	83.5	120	3.4	0.06	56.7
27	July 1	〃	7.2	− 46.7	28.7	20.9	22.1	17.6	13.7	11.5	10.1	7.6	6.6	6.0	144.8	120	13.7	0.24	57.2
28	1	〃	7.8	− 47.0	27.9	26.8	25.6	18.5	18.4	14.7	12.8	10.4	9.4	8.8	173.3	120	16.6	0.23	72.2
29	2	Dune	6.8	− 53.5	161.4	42.6	27.8	7.0	4.7	3.2	2.7	—	1.6	1.4	252.4	120	9.4	0.67	9.0
30	2	Sastrugi	7.0	− 53.5	10.2	9.1	8.8	7.7	7.3	5.8	6.0	5.2	4.6	4.3	69.0	120	2.9	0.04	72.5
31	6	Dune	9.4	− 34.5	147.6	98.0	44.1	27.0	18.2	13.5	11.3	10.4	8.8	8.4	387.3	60	36.0	1.38	26.1
32	6	〃	9.4	− 34.5	177.5	83.8	39.2	29.0	17.1	13.2	10.2	8.8	8.4	7.7	394.9	60	34.9	1.48	23.6
37	22	〃	7.8	− 32.0	29.8	21.7	18.1	10.5	8.8	6.0	5.9	4.2	3.6	3.4	112.0	120	4.7	0.12	39.2
38	22	〃	7.8	− 32.0	31.2	20.5	18.9	12.5	9.5	8.0	6.1	5.4	4.3	4.1	120.5	120	5.3	0.13	40.9
39	26	Sastrugi	7.5	− 52.0	15.3	21.3	19.9	20.0	17.8	15.3	14.6	14.4	13.2	13.8	165.6	120	6.8	0.06	113.3
40	27	Dune	7.5	− 52.5	134.0	35.4	13.6	7.7	5.4	3.8	3.1	2.5	2.5	2.0	210.0	60	18.2	1.12	16.3