

Statistical Investigation of Meteorological Data at Syowa Base

Hiroshi NAKASHIMA*

昭和基地気象観測値の統計的調査

中 島 博*

1957年3月から1958年2月までの昭和基地の風向、風速、気温について、毎時の観測値を整理した結果を報告する。

(1) 風向 最多風向は3, 4, 5の各月はNEで、その他の月はNNE, 南よりの風(SE—SW)は4, 5, 9, 12, 2の各月に多く、静穏は7, 8, 9の3ヶ月に多い。1年を通じては、全観測回数の約60%はNNE—ENEの風である。(2) 風速 風力9以上(20.8 m/s以上)は3, 7, 8の各月に多く、そ

れぞれの月の約6%, 風力3以下(3.4 m/s以下)は8, 9, 10, 12, 2の各月に多く、それぞれの月の60%を越す。風速の日変化は、10月から2月までは規則的で、最大は5時前後、最小は20時前後である。(3) 気温 1年を通じ、0°C以上は全観測回数の8%, -30°C以下は1%で、0.0—-9.9°Cが45%を占める。旬平均値によると、低温と弱風速および南よりの風がよく対応してい

1. Introduction

The investigations of wind direction, speed and air-temperature, observed at Syowa Base by the First Wintering Party of the Japanese Antarctic Research Expedition during the period from March, 1957 to February, 1958, are described. The hourly data of these elements are obtained by self-recording instruments and 3 measurement times.

2. Wind Direction

The frequency of wind direction in the 16 points of the compass for each month and its ratio to all data are shown in Table 1. Also a wind-rose based upon these ratios is given in Fig. 1, which shows the characteristic trend for monthly wind direction. Namely, NE wind is predominant during March, April and May, and NNE wind during the other months; i.e., from June to February of the next year. Especially the NE wind is pronounced in March being 61% of total frequency; and NNE represents 51% of total wind in January. On the other hand, rather large frequency of southerly wind; between SE and SW wind, is found in April, May, September, December and February; that is about 25% of total frequency in each month.

In July, August and September, the calm wind which is 0.2 m/sec or less, occurs in rather high frequency than the others; that is 9%, 18% and 16% of total frequency respectively.

* Japan Meteorological Agency.

Table 1. Frequency of wind direction.

Wind direction		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm	
Month																			
1957	3	0 0.0	4 0.6	423 60.8	95 13.7	28 4.0	4 0.6	8 1.2	29 4.2	23 3.3	13 1.9	10 1.4	1 0.1	4 0.6	9 1.3	27 3.9	0 0.0	17 2.4	
	4	24 3.3	115 16.0	159 22.1	116 16.1	57 7.9	17 2.4	32 4.4	94 13.1	25 3.5	13 1.8	7 1.0	0 0.0	6 0.8	5 0.7	2 0.3	11 1.5	37 5.1	
	5	51 6.9	117 15.7	145 19.5	104 14.0	43 5.8	19 2.6	21 2.8	110 14.8	33 4.4	21 2.8	13 1.7	4 0.5	5 0.7	8 1.1	4 0.5	16 2.2	30 4.0	
	6	12 1.7	226 31.4	131 18.2	199 27.6	20 2.8	18 2.5	15 2.1	25 3.5	18 2.5	6 0.8	3 0.4	1 0.1	0 0.0	9 1.3	3 0.4	11 1.5	23 3.2	
	7	33 4.5	244 33.0	35 4.7	109 14.8	19 2.6	27 3.7	28 3.8	70 9.5	34 4.6	15 2.0	13 1.8	3 0.4	3 0.4	9 1.2	5 0.7	22 3.0	70 9.5	
	8	34 3.2	200 26.9	91 12.2	56 7.5	40 5.4	18 2.4	17 2.3	58 7.8	17 2.3	8 1.1	9 1.2	10 1.3	4 0.5	14 1.9	6 0.8	36 4.8	136 18.3	
	9	19 2.9	201 27.9	30 4.2	77 10.7	25 3.5	32 4.4	42 5.8	93 12.9	30 4.2	19 2.6	6 0.8	4 0.6	3 0.4	3 0.4	2 0.3	19 2.6	115 16.0	
	10	1 0.1	312 41.9	9 1.2	131 17.6	11 1.5	10 1.3	21 2.8	80 10.8	27 3.6	13 1.7	12 1.6	7 0.9	11 0.5	11 1.5	11 1.5	47 6.3	30 4.0	
	11	26 3.6	339 47.1	54 7.5	83 11.5	20 2.8	16 2.2	16 2.2	43 6.0	14 1.9	19 2.6	14 1.9	9 1.3	2 0.3	6 0.8	1 0.1	42 5.8	16 2.2	
	12	22 3.0	270 36.3	64 8.6	62 8.3	17 2.3	4 0.5	12 1.6	97 13.0	17 2.3	30 4.0	23 3.1	17 2.3	10 1.3	24 3.2	7 0.9	60 8.1	8 1.1	
	1958	1	27 3.6	383 51.4	62 8.3	91 12.2	22 3.0	13 1.7	8 1.1	34 4.6	12 1.6	15 2.0	6 0.8	2 0.3	8 1.1	13 1.7	5 0.7	32 4.3	11 1.5
		2	47 7.0	224 33.3	80 11.9	39 5.8	5 0.7	8 1.2	10 1.5	63 9.4	34 5.1	37 5.5	26 3.9	9 1.3	15 2.2	13 1.9	9 1.3	45 6.7	8 1.2
Total		286 5.8	2635 30.3	1283 14.7	1162 13.3	307 3.5	186 2.1	230 2.6	796 9.1	284 3.3	209 2.4	142 1.6	67 0.8	71 0.8	124 1.4	82 0.9	341 3.9	501 3.3	

Each month: Upper line—Number of observations, Lower line—Relative frequency.

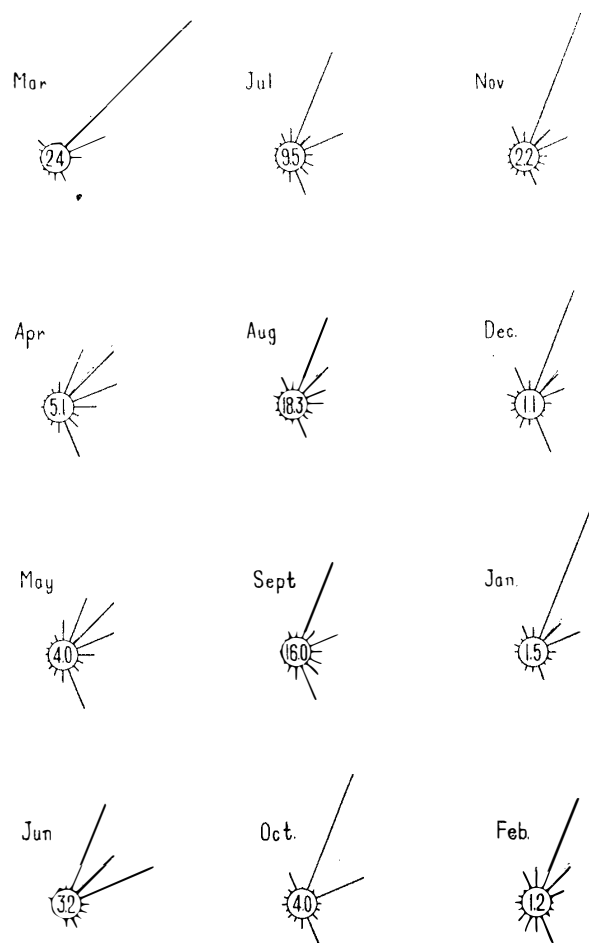


Fig. 1. Wind-rose in each month.

The NNE wind is predominant through the year, and the ratio of frequency of wind from NNE, NE and ENE totals 58% of all data of wind directions.

3. Wind speed.

The frequency of each wind force (Beaufort scale) in each month and its ratio to all data are shown in Table 2. The frequencies of strong wind, a wind force of 9 or more on the Beaufort scale (more than 20.7 m/sec), in March, July and August are about 6% and higher than the others. The lower frequencies of strong wind are only less than 1% and occurred in May and December.

The higher frequencies of weak wind, a wind force of 3 or less on the Beaufort scale (less than 5.5 m/sec), are occurred in August, September, October, December and February. These exceeds 60% of each month's frequency. The frequency of weak wind (less than 5.5 m/sec) are attained to 54% of all through the year.

The diurnal variations of mean wind speed in each month are given in Fig. 2.

During the warm season, October to February, these have a similar trend in which the maximum speed occurs at about 5 h of 45°E Standard Time and minimum at about

Table 2. Frequency of wind force.

Wind speed (m/s) Wind force		0.0—0.2	0.3—1.5	1.6—3.3	3.4—5.4	5.5—7.9	8.0—10.7	10.8—13.8	13.9—17.1	17.2—20.7	20.8—24.4	24.5—28.4	28.5—32.6	32.7—36.9	
Month		0	1	2	3	4	5	6	7	8	9	10	11	12	
1957	3	17 2.3	55 7.4	88 11.8	102 13.7	89 12.0	93 12.5	101 13.6	78 10.5	75 10.1	35 4.7	7 0.9	3 0.4	1 0.1	
	4	37 5.1	89 12.4	117 16.3	127 17.6	78 10.8	87 12.1	86 11.9	43 6.0	36 5.0	12 1.7	8 1.1			
	5	30 4.0	81 10.9	131 17.6	116 15.6	107 14.4	101 13.6	93 12.5	52 7.0	29 3.9	4 0.5				
	6	23 3.2	50 6.9	92 12.8	102 14.2	85 11.8	110 15.3	110 15.3	95 13.2	21 2.9	20 2.8	6 0.8	5 0.7	1 0.1	
	7	70 9.4	91 12.2	101 13.6	103 13.8	70 9.4	66 8.9	75 10.1	76 10.2	49 6.6	19 2.6	17 2.3	7 0.9		
	8	136 18.3	93 12.5	106 14.2	118 15.9	82 11.0	46 6.2	65 8.7	32 4.3	20 2.7	19 2.6	12 1.6	15 2.0		
	9	115 16.0	141 19.6	131 18.2	86 12.0	70 9.7	45 6.3	36 5.0	43 6.0	20 2.8	18 2.5	10 1.4	5 0.7		
	10	30 4.0	136 18.3	139 18.7	146 19.6	98 13.2	58 7.8	61 8.2	32 4.3	23 3.1	1.2 1.6	6 0.8	3 0.4		
	11	16 2.2	82 11.4	114 17.2	139 19.3	102 14.2	86 12.0	59 8.2	45 6.3	40 5.6	20 2.8	7 1.0			
	12	8 1.1	73 9.8	157 21.1	228 30.6	109 14.7	65 8.7	35 4.7	31 4.2	33 4.4	5 0.7				
	1958	1	11 1.5	68 9.1	126 16.9	179 24.1	129 17.3	91 12.2	56 7.5	31 4.2	23 3.1	21 2.8	9 1.2		
		2	8 1.2	109 16.2	194 28.9	161 23.9	63 9.4	57 8.5	24 3.6	17 2.5	20 3.0	9 1.3	7 1.0	3 0.4	
Total		515 5.9	1068 12.2	1496 17.1	1603 18.3	1082 12.4	905 10.3	801 9.1	575 6.6	389 4.4	194 2.2	89 1.0	41 0.5	2 0.2	

Each month: Upper line—Number of observations, Lower line—Relative frequency.

20 h. But we can find out no similar trend in the other months, which are rather irregular.

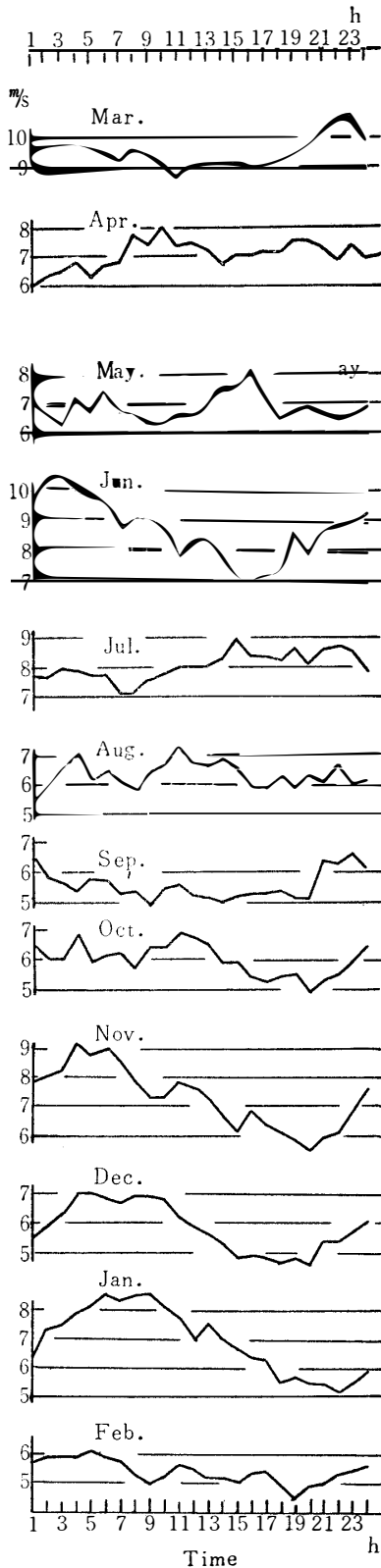


Fig. 2. Diurnal variation of wind speed.

It is noteworthy that the maximum occurs at 3 h, and minimum at 16 h, and the difference of extremes is 3.5 m/sec in June, when the sun sets under the horizon in the whole day of this month. This difference is the biggest one next to 3.6 m/sec in November.

4. Air temperature

In Table 3, the frequencies of temperature classified in each 5°C begin with -39.9°C at the lowest and its

Table 3. Frequency of air temperature.

Month	Temperature (°C)	Frequency											
		-39.9~ -35.0	-34.9~ -30.0	-29.9~ -25.0	-24.9~ -20.0	-19.9~ -15.0	-14.9~ -10.0	-9.9~ -5.0	-4.9~ 0.0	0.1~ 5.0	5.1~ 10.0		
1957	3							56	263	425			
								7.5	35.7	57.1			
	4					104	172	364	80				
						14.4	23.9	50.5	11.1				
	5			28	95	222	246	153					
				3.8	12.8	29.8	33.1	20.6					
	6			4	83	113	295	225					
				0.6	11.5	15.7	40.9	31.2					
	7		12	76	181	231	146	98					
			1.6	10.2	24.3	31.0	19.6	13.2					
	8	1	25	65	229	205	148	47	24				
		0.1	3.4	8.7	30.8	27.5	19.9	6.3	3.2				
9	3	62	151	142	223	79	60						
	0.4	8.6	21.0	19.7	31.0	11.0	8.3						
10				23	158	279	247	37					
				3.1	21.2	37.5	33.2	5.0					
11					25	172	242	280	1				
					3.5	23.9	33.6	38.9	0.1				
12							51	474	219				
							6.9	63.7	29.4				
1958	1						11	290	437	6			
							1.5	39.0	58.7	0.8			
2							60	271	305	36			
							8.9	40.3	45.4	5.4			
Total		4	99	324	753	1281	1653	2032	1915	693	6		
		0.0	1.1	3.7	8.6	14.6	18.9	23.2	21.9	7.9	0.1		

Each month: Upper line—Number of observations, Lower line—Relative frequency.

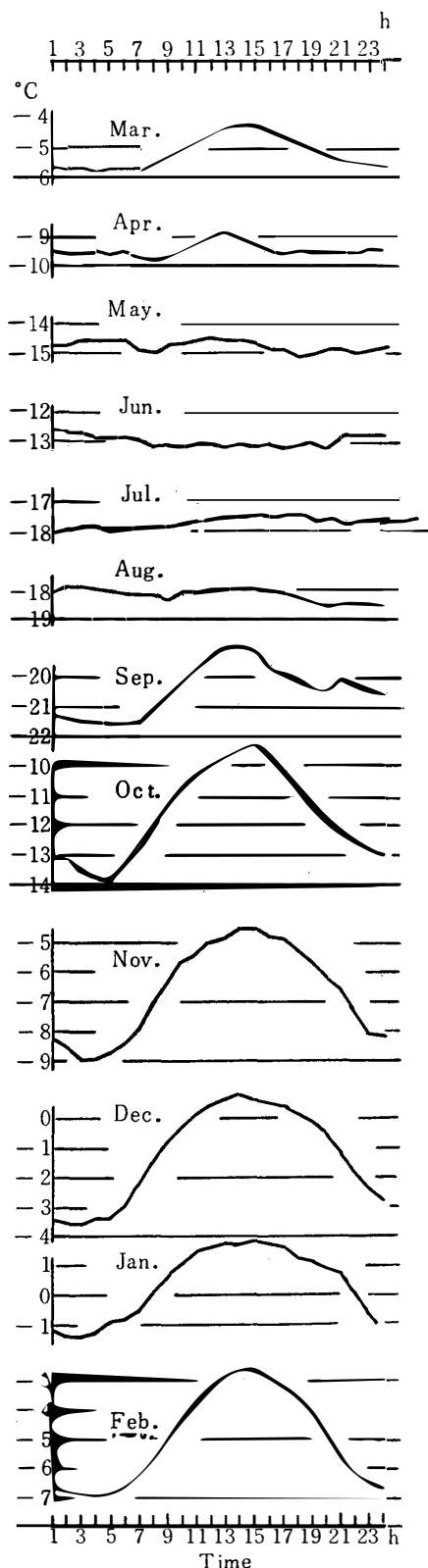


Fig. 3. Diurnal variation of air temperature.

ratio to all are shown. The temperature more than 0.1°C accounted for only 8% of all, and less than -30.0°C for 1%, while the temperatures in the range from 0.0°C to ratio to all are shown. The temperatures more than 0.1°C accounted for only 8% of all, and less than -30.0°C for 1%, while the temperatures in the range from 0.0°C to -9.9°C , -10.0°C to -19.9°C and -20.0°C to -29.9°C accounted for 45%, 34% and 12%, respectively.

The diurnal variations of mean temperature for each month are given in Fig. 3. It shows that difference of extremes is not exceeded 1°C , and an irregular variation during 5 months from April to August, while either the sun sets under the horizon or in low elevation in these months. On the other hand, it shows rather regular variation, which the maximum occurs during the period from 14 to 15 h of 45°E Standard Time and minimum during the period from 3 to 4 h, in March and from September to February. The differences of extremes become larger during the period from October to February; viz. 4.6°C in October, 4.4°C in November and December, 3.3°C in January and 4.4°C in February.

5. The correlation between temperature and wind speed.

The each 10 days mean of temperature and wind speed through the year are plotted in Fig. 4.

In this figure, a particularity can be found; the lower points of temperature occurred in the middle part of May, of July and the first part of September which correspond to the lower wind speed.

The following shows the frequency of weak wind occurring in these periods.

Hence, the lowest point of 10 days mean temperature occurred in the first part of September are correlated to the most of calm frequency through the year.

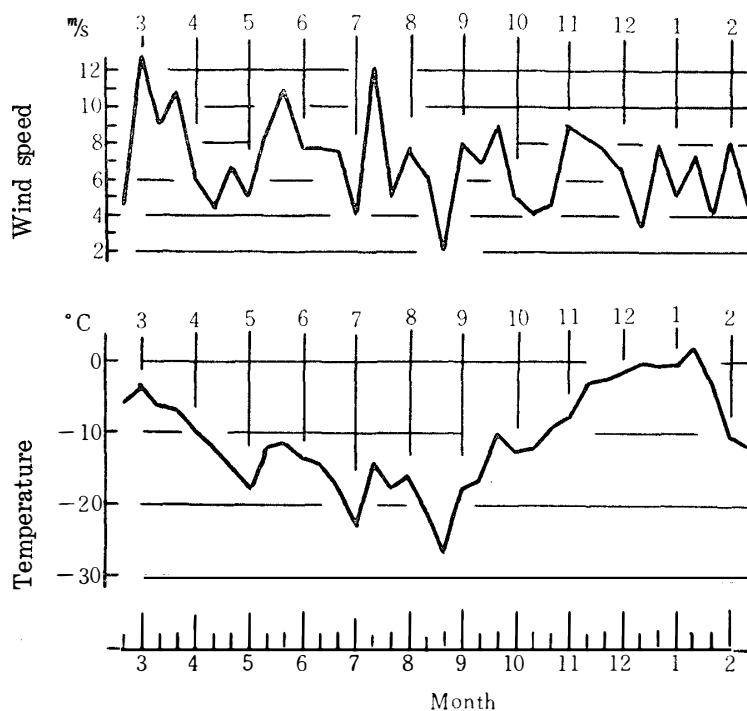


Fig. 4. 10 days mean of temperature and wind speed.

Table 4.

	in the middle of May	in the middle of July	in the middle of September
The ratio of frequency of southerly wind (SE-SW) to all wind direction data in the period.	27%	22%	27%
The ratio of frequency of weak wind (less than 3.4 m/sec) to all wind speed data in the period.	42%	40%	54%
The ratio of frequency of calm (less than 0.3 m/sec) to all wind speed data in the period.	8%	20%	31%

6. Conclusion

Mr. Nozomi MURAKOSHI (Japan Meteorological Agency) was in charge of the meteorological observation at Syowa Base through this period. This is an additional report from the Publication titled Meteorological Observation at Syowa Base during the period from March 1957 to February 1958, which contains the whole data of his observation.

The work reported here was done under the direction of Mr. Yasutaro MORITA who I thank for his interest.