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A Reconnaissance Survey on the Climate of the Nasuno-Basin (1)

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A preliminary study is carried out in the present paper for the purpose of obtaining a general view on the climate of the Nasuno-basin. Data for temperature and precipitation in this paper has been obtained from the Otawara Meteorological Station which is situated in the southern part of the basin, while data in connection with wind has been obtained from the Jiyû-Gakuen farm situated in the central portion of the basin. The local topographic position of the Otawara Meteorological Station being quite close to a hill to the northwest prevents the author from using the data concerning wind as representative of the basin as a whole.

Monthly Wind Direction and Velocity

Table 1 shows the monthly relative frequencies concerning wind direction and velocity at its daily maximum during the ten years from 1956 to 1965 observed by the Jiyû-Gakuen farm. In this and the following tables N- and S-directions, i. e. northerly and southerly directions, represent a group of WNW, NW, NNW, N, NNE, NE and ENE on the one hand and a group of WSW, SW, SSW, S, SSE, SE and ESE on the other. The monthly relative frequencies of N- and S- are tabulated in column A. Column B shows the same frequencies, divid-

Table 1. Monthly Relative Frequencies (in %) of Wind Direction and Velocity (in m/sec) at Jiyû-Gakuen Farm

			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
A	N-		68	78	64	45	41	26	18	21	31	61	66	70
	S-		21	14	26	46	50	65	70	66	56	25	26	19
B	N-	5.0-	56	63	56	40	27	17	7	8	13	26	41	48
		-4.9	12	15	8	5	14	9	11	13	18	35	25	22
	S-	5.0-	9	7	16	35	28	17	7	15	10	6	4	6
		-4.9	12	7	10	11	22	48	62	51	46	19	22	13
C	5.0-		73	75	80	80	61	37	17	26	26	37	48	59

ing the wind velocity into two classes, i.e. under 4.9 m/sec and over 5.0 m/sec. In column C the monthly relative frequencies of the wind with the velocity of over 5.0 m/sec are tabulated, regardless of the wind direction, i.e. including those directions W and E.

Four periods are distinguished in a year in regard to the wind direction and velocity, i.e. (1) December, January, February and March, (2) June, July, August and September, (3) April and May and (4) October and November.

From December to March the frequencies of N- with the velocity of over 5.0 m/sec occupy half or even more than half of the total.

When compared with March, the frequency of S- increases remarkably in April with the result that the frequencies of N- and S- become almost identical. In April the frequency of S- with the velocity of over 5.0 m/sec attains its maximum for the year and is followed by May. Although in May the frequencies of N- and S- still remain very similar to those frequencies in April, the velocity, however, reduces considerably for both N- and S-.

From June to September the predominant directions are S- and especially those with the velocity of under 4.9 m/sec, which exhibit a striking contrast to those directions and velocity from December to March.

The predominant directions change markedly from S- in September to N- in October, neverthless in October the velocity of under 4.9m/sec is still comparatively frequent as in September. In November the frequencies of N- and S- remain almost the same as in October, whereas the velocity increases to a certain extent, i.e. the frequency of N- with the velocity of over 5.0 m/sec occupies already about 40 per cent of the total. In December, as mentioned above, it amounts to about 50 per cent.

These general characteristics concerning the relative frequencies of wind direction and velocity will be analysed in greater detail as necessity arises, in the course of the following discussions on temperature and precipitation regime.

Temperature Regime

Table 2 shows the annual regime of temperature observed during the ten years from 1956 to 1965 by the Otawara Meteorological Station. The same result is illustrated in Fig. 1. The annual regime of temperature is represented here by the mean values for the successive decades, i.e. 1–10, 11–20 and 21–30 or 31 days of the 12 months.

Through January and February the mean temperatures for a decade remain below 2.5°C with the minimum 1.3°C in the second and the third decades of January.

Table 2. Mean Decadal Temperatures at Otawara

	Jan.			Apr.			July			Oct.	
2.1	1.3	1.3	9.2	11.4	13.1	21.9	22.6	24.2	16.0	14.3	12.7
	Feb.			May			Aug.			Nov.	
2.4	2.0	2.5	14.7	15.6	17.2	24.8	24.5	23.4	11.7	8.9	6.9
	Mar.			June			Sept.			Dec.	
3.6	5.4	6.4	17.8	19.3	20.7	22.2	20.6	17.8	5.3	4.0	3.3

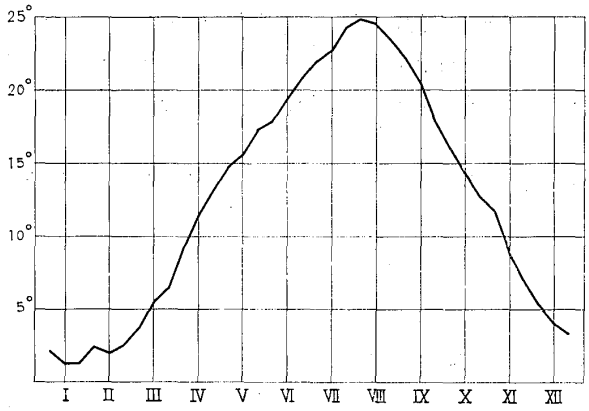

Fig. 1. Mean decadal values of temperature at Otawara

From the third decade of March to the first decade of May a marked rise of temperature is observed, i. e. the mean ascent during this period reaches 2.1°C per decade. This is most likely due to the above mentioned increase of the frequency of S- in April.

The mean maximum 24.8°C appears in the first decade of August. From the first decade of May up to this time the mean ascent remains only 1.2°C per decade, forming a marked contrast to the preceding 2.1°C. The rapid increase of cloudiness and precipitation which will be discussed later may be among those factors in keeping the rate of increase of temperature down since May (Tabs. 8 and 9).

From the first decade of August down to the first decade of September the mean temperature descent per decade remains only 0.9°C. On the contrary, it reaches 2.2°C between the first and the third decade of September. Such temperature descent may probably be due to the change of the prevailing wind directions from S- to N-, which is shown in Table 3, in which I, II and III represents the first, the second and the third decade respectively. In the first decade of September the frequency of

Table 3. Decadal Relative Frequencies (in %) of Wind Direction and Velocity (in m/sec) in September at Jiyû-Gakuen Farm

		I	II	III
N-	5.0-	9	9	21
	-4.9	9	21	22
S-	5.0-	13	10	7
	-4.9	52	50	35

S- with the velocity of under 4.9 m/sec still predominates exactly the same as in August, whereas in the second decade a marked increase of the frequency of N- with the velocity of under 4.9 m/sec is observed, which is followed by the increase of the frequency of N- with the velocity of over 5.0 m/sec in the third decade.

The same tendency of temperature regime is observed during October and November, i. e. the temperature descent per decade reaches 2.4°C between the first and the third decade of November in contrast to 1.5°C per decade which is observed between the third decade of September and the first decade of November. This rapid descent is certainly due to the outbreak of the winter monsoon in November, which is illustrated by Table 4. In October the sum total frequencies

Table 4. Monthly Relative Frequencies (in %) of Wind Direction and Velocity (in m/sec) at Jiyû-Gakuen Farm

		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
NNE NE ENE	5.0–	14	11	6	4	12	10	13	11
	–4.9	22	14	7	4	5	3	4	8
N	5.0–	5	8	10	5	10	8	7	5
	–4.9	6	4	6	3	5	3	0.3	2
NNW NW WNW	5.0–	7	21	31	46	41	38	20	10
	–4.9	7	6	9	5	6	2	1	4

of NNE, NE and ENE occur more than twice as many times as those frequencies of NNW, NW and WNW, whereas in November these latter frequencies increase markedly until in December they exceed more than thrice the former.

Since the third decade of November the temperature descent decreases again and remains 1.2°C per decade in the course of December.

Because of its inland situation in northern Kantô, the temperature regime at Otawara is contrasted with that at Tomisaki which is situated on the coast of the southernmost tip of the Bôsô-peninsula. The mean monthly temperatures of these places are compared in Table 5.

It is remarkable that at Otawara the temperatures remain lower than at Tomisaki throughout the year, as far as the mean monthly values are concerned. While the differences are as much as from 3.6°C to 5.3°C from October to March or during the winter half-year, they remain only between 1.0°C and 2.9°C from April to September or during the summer half-year.

The marked temperature difference between Otawara and Tomisaki during the winter half-year is most probably due to the dominance of land-and-water control which is strengthened by the basin topography

Table 5. Mean Monthly Temperatures at Otawara and at Tomisaki

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	mean annual	annual range
Otawara (A)	1.6	2.3	5.2	11.2	15.9	19.3	23.1	24.2	20.2	14.3	9.1	4.2	12.6	22.6
Tomisaki (B)	6.8	6.6	9.3	13.7	17.5	20.6	24.1	25.7	23.1	17.9	13.5	9.5	15.7	19.1
B—A	5.2	4.3	4.1	2.5	1.6	1.3	1.0	1.5	2.9	3.6	4.4	5.3	3.1	−3.5

Table 6. Mean Monthly Values of Daily Maximum Temperature at Otawara and at Tomisaki

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Otawara (A)	7.2	8.2	11.2	17.2	21.5	24.1	27.6	29.3	25.1	19.6	15.0	10.3
Tomisaki (B)	11.2	11.0	13.6	17.5	21.0	23.7	27.1	29.1	26.6	21.8	17.7	13.7
B—A	4.0	2.8	2.4	0.3	−0.5	−0.4	−0.5	−0.2	1.5	2.2	2.7	3.4

Table 7. Mean Monthly Values of Daily Minimum Temperature at Otawara and at Tomisaki

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Otawara (A)	−3.5	−2.7	−0.2	5.7	10.8	15.4	19.8	20.6	16.6	10.2	4.4	−0.9
Tomisaki (B)	2.9	2.8	5.4	10.3	14.5	18.1	21.8	23.4	20.6	15.0	10.2	5.8
B—A	6.4	5.5	5.6	4.6	3.7	2.7	2.0	2.8	4.0	4.8	5.8	6.7

Table 8. Mean Monthly Amounts of Cloudiness (in %) at Otawara and at Tomisaki

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	annual
Otawara (A)	54	57	62	69	75	87	84	78	81	69	57	50	69
Tomisaki (B)	50	57	63	64	70	79	71	58	70	68	59	48	63
B—A	−4	0	1	−5	−5	−8	−13	−20	−11	−1	2	−2	−6

around Otawara and also by comparatively small amounts of cloudiness there during this period of the year (Tab. 8). This fact is clearly seen if comparison is made between the monthly mean of the daily minimum and the daily maximum temperatures which are represented in Tables 6 and 7. The difference in monthly mean of the daily minimum temperatures between Otawara and Tomisaki is greater than the difference in monthly mean of the daily maximum temperatures between the same places. The cooling effect of the inland basin which is more powerful than the warming effect of the ocean may be the chief factor in keeping the difference in monthly mean temperatures between Otawara and Tomisaki considerably great during the winter half-year.

In April when the frequency of S- increases rapidly, as has been mentioned, the temperature difference between Otawara and Tomisaki represents a marked decrease because of the more rapid ascent in temperature at Otawara reflecting the inland situation as compared with that ascent at Tomisaki, which is clearly noticed especially when the monthly mean of the daily maximum temperature at Otawara is compared with that at Tomisaki (Tab. 6). The former becomes almost the same as the latter in April.

In June, July and August, however, in spite of the inland situation associated with basin topography, the temperatures at Otawara still remain lower than that at Tomisaki. The minimum difference which is about 1.0°C occurs in July (Tab. 5). Such relatively low temperatures during June, July and August at Otawara are undoubtedly in part owing to its elevation; here the Meteorological Station stands at an altitude of 213 m. As for the daily maximum temperatures, one of those factors which lower the values may certainly be the large amounts of cloudiness and precipitation during this period of the year at Otawara, both of which exceed considerably those at Tomisaki (Tabs. 6, 8 and 9). Nothing certain can be said, however, concerning the other factors which keep the temperature comparatively low at Otawara from June to August.

In October when the prevailing wind directions shift from S- to N-, bringing the most remarkable temperature descent both at Otawara and at Tomisaki, the descent at Otawara which is mainly due to the descent in daily minimum temperatures (Tab. 7) is more rapid than at Tomisaki where mild air is occasionally imported from the ocean under certain synoptic situations, e. g. those situations characterized by passing cyclones. The temperature difference between these two places is as much as 3.6°C in October (Tab. 5).

Regarding the annual range of temperature, though it remains 19.1°C at Tomisaki, it reaches 22.6°C at Otawara (Tab. 5). In spite

of the lower summer temperatures at Otawara, the winter cold is severe enough to develop a larger annual range.

Precipitation Regime

Fig. 2 and Table 9 represent mean monthly amounts of precipitation at Otawara in the course of the ten years from 1956 to 1965. The annual precipitation which averages 1439 mm is very unevenly distributed throughout the year. While in January and February the monthly amount remains about 30 mm respectively, in June, July and August the respective amount exceeds 200 mm. The maximum precipitation of 251 mm falls in August, which is 9.3 times as large as the minimum being 27 mm in February. About 70 per cent of the annual precipitation concentrates within the period from May to October. The precipitation regime which is classified into Köppen's *f* is, neverthless, quite close to the same author's *w*.

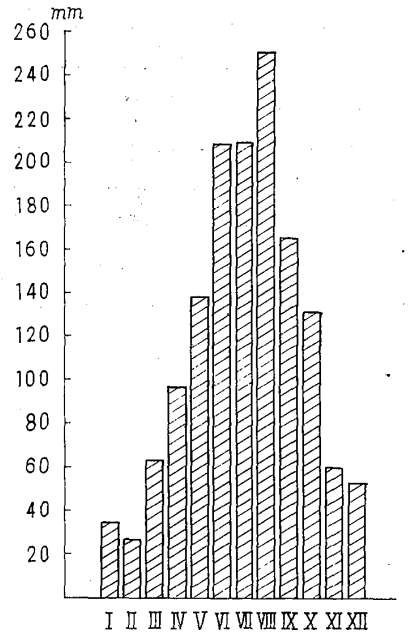

Fig. 2. Mean monthly amounts of precipitation at Otawara

Another distinctive characteristic concerning the mean monthly precipitation is the increase from May to June, the decrease from August to September and the decrease from October to November, all of which exceed as much as 70 mm.

Table 9. Mean Monthly Amounts of Precipitation at Otawara and at Tomisaki

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	annual
Otawara (A)	35	27	64	97	138	209	210	251	165	131	60	53	1439
Tomisaki (B)	84	113	129	139	138	167	119	131	196	250	159	91	1715
B—A	49	86	65	42	0	−42	−91	−120	31	119	99	38	276

Compared with the precipitation regime at Otawara, the regime at Tomisaki is considerably different. At Tomisaki the annual precipitation is greater than that at Otawara (Tab. 9). The rainfall maximum at Tomisaki occurs twice during the year, i. e. in June and in October, forming a contrast to the one-maximum type at Otawara. From June to August, the amount of monthly precipitation is greater at Otawara than at Tomisaki, the difference being greatest in August with 120 mm. From September to April, on the contrary, Tomisaki receives greater amount of monthly precipitation than Otawara ; the difference being as much as 120 mm and 100 mm respectively in Octo-

ber and in November. In May considerable increase in precipitation at Otawara reduces the difference to almost zero.

As for the annual regime of precipitation at Tomisaki, the increase from August to September, the decrease from October to November and the further decrease from November to December, all of which exceed 65 mm, are remarkable. When compared with Otawara, the annual regime is in the opposite direction from August to September, whereas it moves in the same direction from October to November.

The precipitation regime will be investigated from the point of view of the synoptic situations in the following paper.

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