Title	北海道東部における夏の天気分布について
Author(s)	深石，一夫
Citation	北海道教育大学紀要．第二部．B，生物学,地学,農学編，29(2)：5-17
Issue Date	1979-02
URL	http://s-ir.sap.hokkyodai.ac.jp/dspace/handle/123456789/6362
Rights	

Journal of Hokkaido University of Education (Section II) Vol. 29, No. 2 February 1979
北海道教育大学紀要（第2部B）第29巻 第2号 昭和54年2月

On the Weather Distribution in Summer in Eastern Hokkaido, Japan

Kazuo FUKAISHI
Geography Laboratory, Kushiro College, Hokkaido University of Education
Kushiro 085

深石一夫：北海道東部における夏の天気分布について

北海道教育大学釧路分校地理学教室

1. Introduction

The climate of Japan is strongly influenced by the monsoon, especially in winter, and a striking contrast can be found with respect to the weather condition between the regions along the Pacific Ocean and the Japan Sea. Much research on the weather divide in winter has been carried out in various ways and in various districts or on the whole of the Japanese Islands (Fukui, 1938, 1966; Shitara, 1958, 1966; Suzuki, 1962; M. Takahashi, 1954, 1961). However, there is little research concerning about those in summer, such examples as the weather distribution in the Tohoku region during the Baiu season (Shitara, 1969) and the weather divide in the Kamikawa District in Hokkaido in summer (Kushizaki, et al, 1965). In this paper, the weather distribution and the geographical distribution of weather divide based on the frequency of its occurrence in summer in eastern Hokkaido are discussed.

The topography of eastern Hokkaido is roughly shown in Figure 1. The studied area is limited to the west by the Hidaka, Taisetsu and Kitami Mountains. The Chishima Volcanic Zone extending from the Shiretoko Peninsula to the Akan Mountains makes the backbone mountain range of the district which divides into the Pacific and Okhotsk sides. Rivers flowing from these montains cross such large plains as the Tokachi, Konsen and Kitami Plains. The Tokachi Plain, mainly consisting of uplands, lies to the east of the Hidaka Mountains. In the eastern part of the studied area, the Kushiro Plain and Konsen Upland lie behind Kushiro City. The former is a marshy lowland and the latter is covered with volcanic ashes from the Chishima Volcanic Zone. Between these two large plains lies the Shiranuka Hillock, with a height of 500 to 700m above sea level extending from Akan Mountains towards the south.

Influnced by these topographical features and a prevailing southerly wind, a conspicuous weather contrast can be found in eastern Hokkaido in summer. Generally, the climate of coastal regions of the Konsen and Tokachi Districts is characterized by an advective fog from the Pacific, which results in relatively low temperature, high humidity and insufficient sunshine (Fukaishi, 1973, b). In the inland regions of the Tokachi and Konsen Districts air temperature gradually

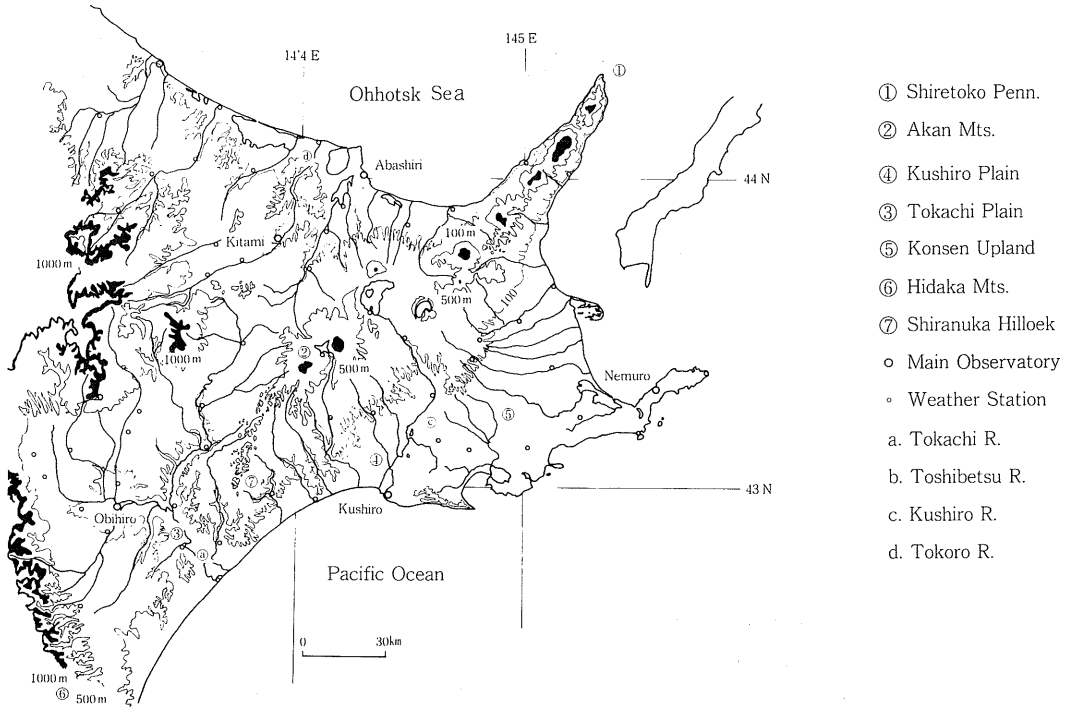

Figure 1. Index map.

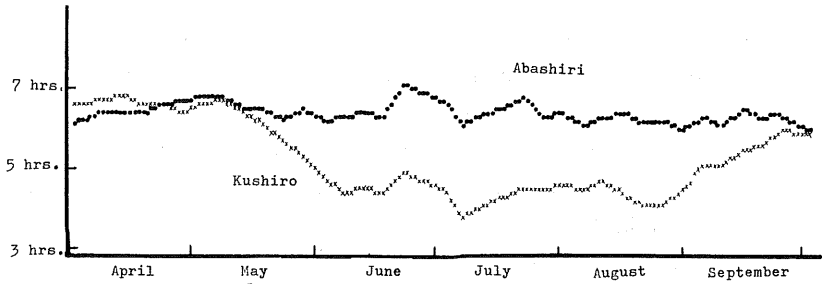

Figure 2 Daily sunshine hours in summer at Kushiro and Abashiri.

increases even under insufficient sunshine. On the other hand, high temperature and sunny weather prevail in the Kitami Plain or the regions of the Okhotsk seaside except when the Okhotsk High (mP ; Maritime Polar Airmass) is strong enough to cover this district in summer. The average number of days with a daily maximum temperature above 25℃ are few on the Pacific side ; i.e., 5.5 days at Kushiro and 7.8 days at Nemuro during 1941−1970. The number increases in the inland region and the Okhotsk side ; i.e.,45.4 days at Obihiro and 23.1 days at Abashiri during the same period. The difference in daily sunshine hours in summer between Kushiro and Abashiri is shown in Figure 2. In this study, the author tries to clarify the regional

characteristics of differences of weather in the district.

2. Data and method of analysis

In this study, the weather distribution maps at 9h. of every day from May 1 to August 31 for 5 years, 1969−1973, were constructed by the use of the daily weather records at each weather station distributed in the studied area as is shown in Figure 1. These 615 sheets of weather distribution map were classified into the following three types according to distribution patterns, and the boundary line of weather was drawn on each sheet. The characteristics of weather for these types are as follows;

S−type·····On the Pacific side or southern side of the backbone mountain range, bad weather such as cloudy, foggy or drizzly weather prevails. On the other side or the Okhotsk side, fair weather such as high overcast, partly cloudy or clear weather prevails.

N−type·····Reverse of the S−type weather pattern. Fair weather prevails on the Pacific side and bad weather on the Okhotsk side.

M−type·····The weather pattern other than S−and N−types. This type includes the bad weather caused by trough, front or cyclone with precipitation.

The relation between the number of days for each weather type and wind direction at the 850mb level at Nemuro is shown in Table 1. As is shown in the table, the S−type appears frequently under the wind direction mainly between E and SW. On the other hand, the N−type weather pattern appears frequently under the wind direction between W and N. The relation between the S and N−types, and the wind at the 850mb level at Nemuro is shown in detail in Figure 3. From this figure, the following features are pointed out. At the time when the wind speed is below 10m/sec, the S−type is predminant. The N−type is limited to the wind di-

Table 1 The relation between number of days for each weather type and 850mb level wind direction at Nemuro in summer for 5 years (1969-1973).

Wind direction at Nemuro, 850mb	Weather type			Total
	S-type	N-type	M-type	
N	15	22	28	65
NE	6	5	13	24
E	14	1	12	27
SE	12	1	19	32
S	36	0	20	56
SW	101	8	59	168
W	30	34	71	135
NW	17	32	40	89
Calm	10	1	8	19
Total	241	104	270	615

rection between 260°and 40°counted clockwise. When the wind speed is above 15m/sec, the S—type distributes in the range of the wind direction between 160°and 230°, and the N—type appears between 230°and 360°. The relation between the northerly air flow and bad weather in the Abashiri District was discussed by Chishima (1965) as mentioned later.

A weather divide is defined as a boundary where the weather differs between two adjacent points which can be expressed by a line or zone on the weather distribution map. Although there

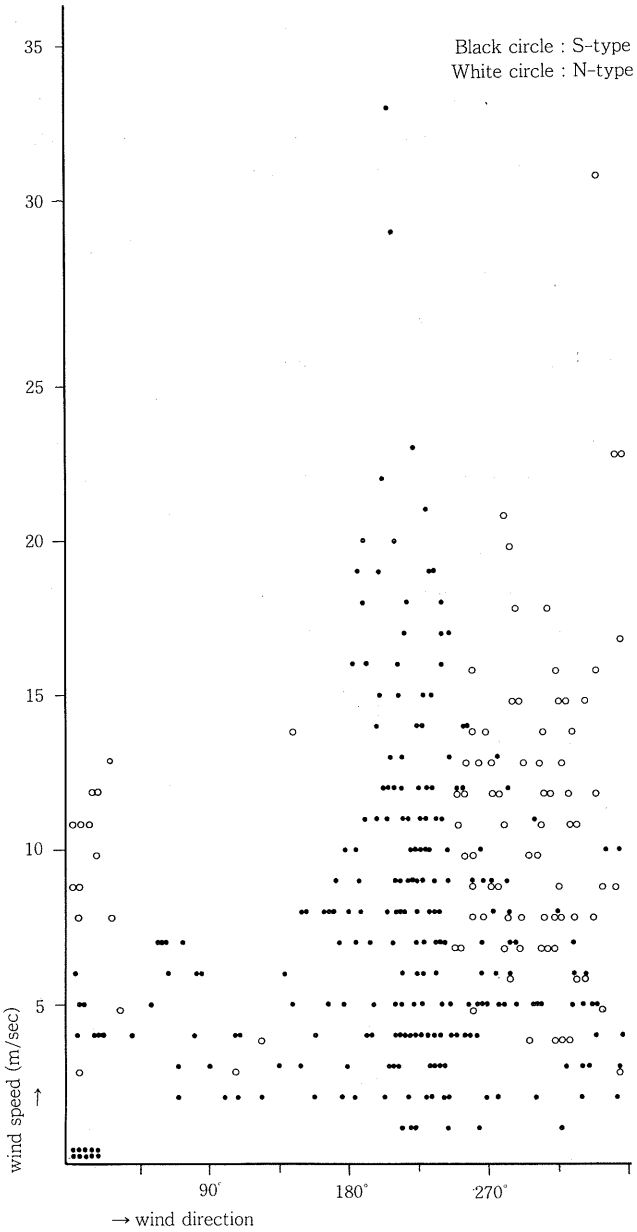

Figure 3. The relation between weather types and the 850mb wind at Nemuro.

are many ways to draw the weather divide (Fukui, 1938, Shitara, 1960), the following method was adopted after Shitara (1958) by the use of frequency of the occurrence of the boundary.

(1) Two points adjacent to each other are linked with a straight line on a base map as is shown in Figure 4.

(2) Frequencies of the weather divide grouped by the weather types and the wind at Nemuro are obtained for every segmental line.

(3) The obtained values on each line are reduced to a unit distance (10km in this case), and the numerical figure is placed at the middle point on each line as a weather divide density.

(4) In this way, the distribution of the weather divide density can be obtained. Then the isoplethes are drawn on each map.

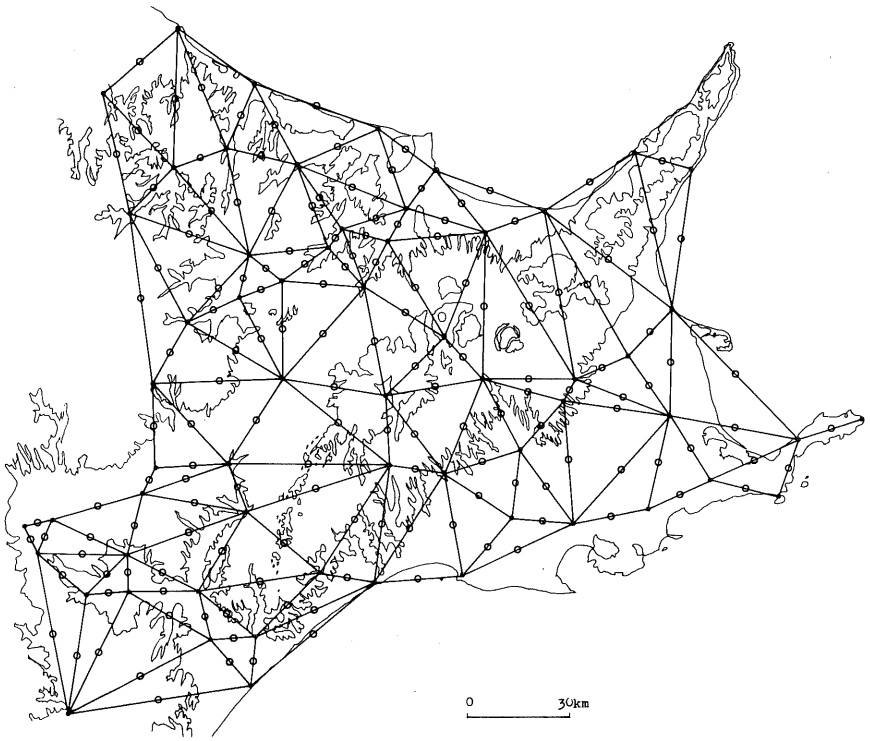

Figure 4. Weather stations linked each segmental line and its middle point (white circle).

3. Results

From the many previous studies on the weather divide, it has been pointed out that the frequency of the weather divide depends mainly upon the prevailing wind and the backbone mountain range (Yoshino, 1975). Considering this result, the distribution maps of the weather divide density were made with respect to the 850mb wind direction at Nemuro for each three types of the weather distribution pattern mentioned in Section 2. Some of these distribution

maps on the weather divide density are shown in Figures 5—10.

The S—type weather pattern appears mostly under the conditions of south, southwest and west atmospheric flows, especially under the southwest flow which is the most frequent during May and August (27.3%; as is shown in Table 1). For these flows mentioned above, the distribution maps of the weather divide density were prepared. The distribution of the weather divide density of the S—type under the southerly wind is shown in Figure 5. The low density areas on the Pacific side extend towards the inland in the western part of the Tokachi Plain and eastern part of the Konsen Upland. High density areas are found in the Shiretoko Peninsula (*Station 1* in Figure 5), the upper reaches of the Toshibetsu and the Tokoro Rivers, the southern part of the Akan and Mashu Mountains (*Station 2* in Figure 5). Although the S—type is characterized by bad weather in the southern part of the district, the expanse of high density in the upper Tokoro River region in Figure 5 means that the figure includes the case of bad weather on the Okhotsk side as well.

The distribution of the weather divide density of the S—type under the southwesterly wind, which is the most frequent among the S—type(41.5% of the total of 241 as is shown in Table 1) is shown in Figure 6. Low density areas are found in the eastern Konsen Upland and the Tokachi Plain on the Pacific side. It is significant that the high density zone nearly coincides with the geomorphological divide of the backbone mountains. However, the weather divide does not

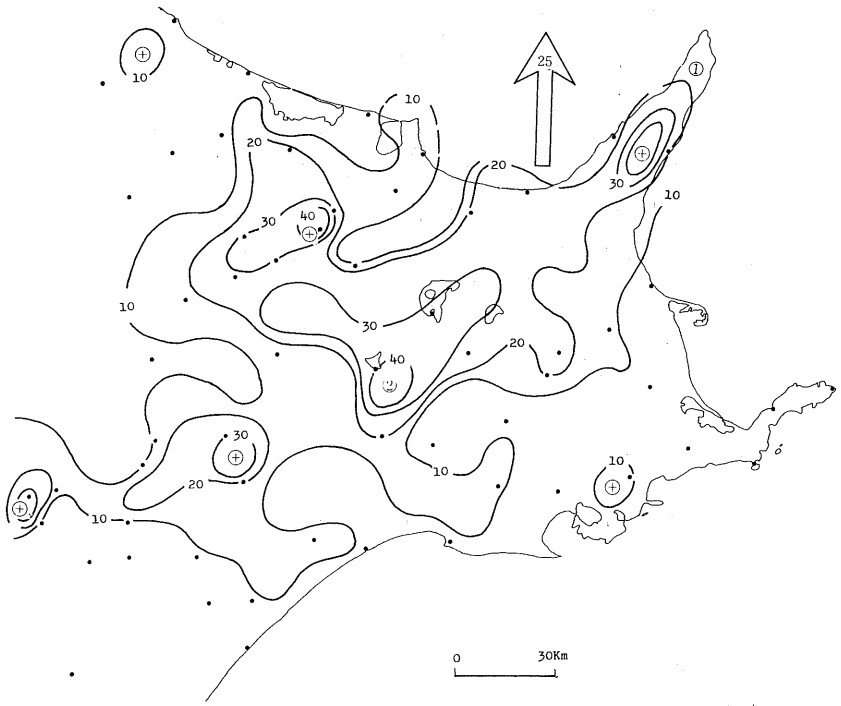

Figure 5. Distribution of weather divide density of S-type under southerly wind (0.1 unit per 10km. The arrow represents wind direction at Nemuro and the numeral in it means the total number of weather distribution maps concerned with this figure).

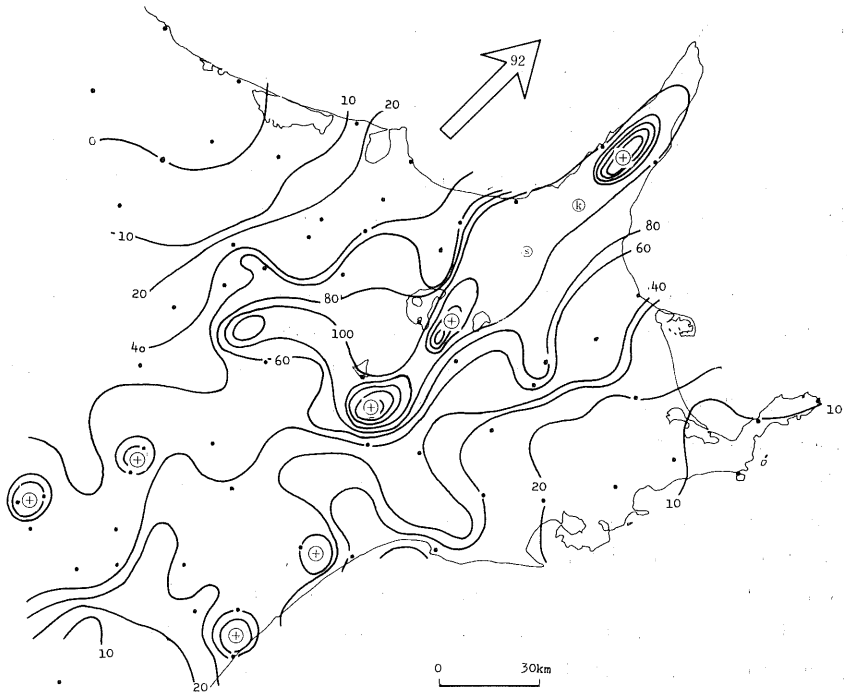

Figure 6. Distribution of weather divide density of S-type under southwesterly wind (K;Mt. Kaibetsu, S;Mt. Shari).

always agree with the backbone mountains in detail. A high density area extends to the north crossing the mountain ridge at the pass between Mt. Kaibetsu (1,419m) and Mt. Shari (1,546m). It means that the bad weather on the Pacific side stretches to the Okhotsk side. Another high density area south of the Akan and Mashu Mountains shifts southward for 10 or 20km from the center of the backbone mountain range. The distance from the seashore in this case is longer than that in the case at Nemuro, so that the advective fog or low stratus cloud invading from the Pacific disappears in the piedmont belt of the Kushiro District by the influence of the heated land surface. As is shown in the figure, the Shiranuka Hillock does not act to form the weather divide under this flow. In the west of Mts. Akan, the main high density area bends towards the north along the mountain ridge in this part.

The bad weather on the Pacific side is composed of two types; i.e., cloudy weather and foggy or drizzly weather. The high density in the Tokachi Plain is mostly the result of discontinuity between cloudy weather in the southern part and fine weather in the northern part, whereas that in the Konsen Upland is the boundary between foggy or drizzly weather and cloudy or fine weather. In many cases the weather distribution is of the S−type, three weather zones can be distinguished: fog or drizzly; cloudy; and fine weather belts, from the Pacific coast to the inland regions in the Abashiri District. In order to make clear the inland limit of the fog invasion from the Pacific, the weather divide density for fog in the case of the S−type under the southwesterly wind was examined. The result is shown in Figure 7. The high density area in the Tokachi

Plain is limited to the downstream region of the Tokachi River (*Station 1* in Figure 7). In the Konsen Upland, high density areas are found in the Kushiro Marshes (Shitsugen, *Station 2* in Figure 7) and near the root of the Nemuro Peninsula (*Station 3* in Figure 7). Since all of these areas are lowland facing the Pacific, the advective fog can easily invade the land from the sea. Generally, in the inland area, the density in the Konsen Upland is higher than that in the Tokachi Plain. The fact coincides well with the former research on the distribution of lower temperature on foggy weather in the same district (Fukaishi, 1973,c). By the influences of topographical features, surface temperature of the sea and atmospheric conditions, the advancing invasion of sea fog into the land is more observable in the Konsen Upland than in the Tokachi Plain.

On the north of the backbone mountain range, fine weather prevails, but it does not always spread on to the Okhotsk coast and bad weather appears again over the Okhotsk coastal region. The weather divide for the northern limit of clear weather in the inland is shown in Figure 8, by the distribution of its density in the case of the S−type under the southwesterly wind. Bad weather along the Okhotsk coast is restricted within a zone about 30km from the seashore. The bad weather may be regarded as a result of advection from the Okhotsk Sea like the bad weather on the Pacific side. The case of the S−type under the westerly wind is shown in Figure 9. The distribution of high density areas is almost similar to that shown in Figures 5 and 6. However, there appear some isolated high density areas in the inland in the Tokachi and Nemuro Districts. The Shiranuka Hillock and hilly coastal region in the Tokachi District tend to form a high density

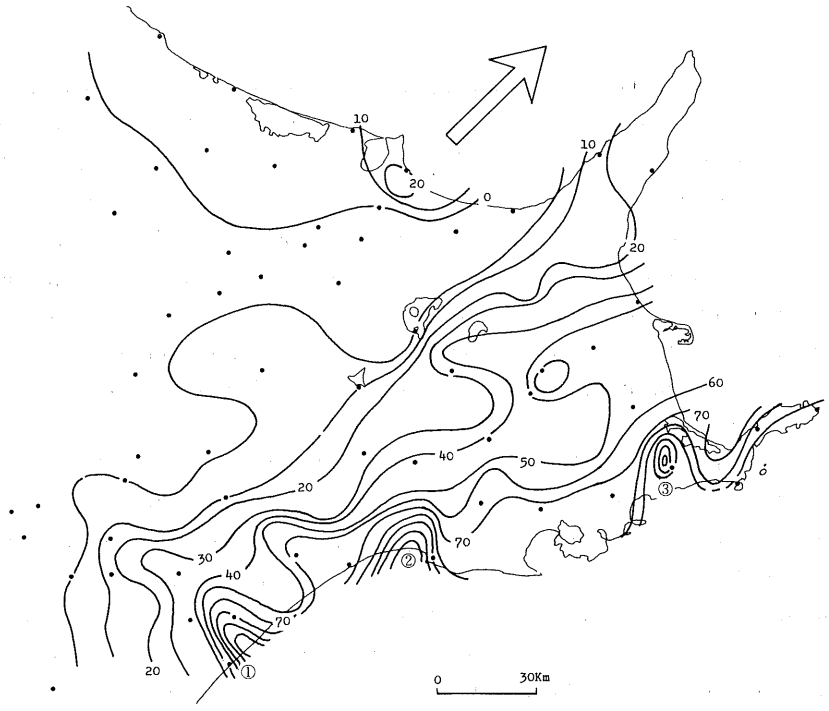

Figure 7. Distribution of weather density for inland limit for foggy weather, S-type under southwesterly wind.

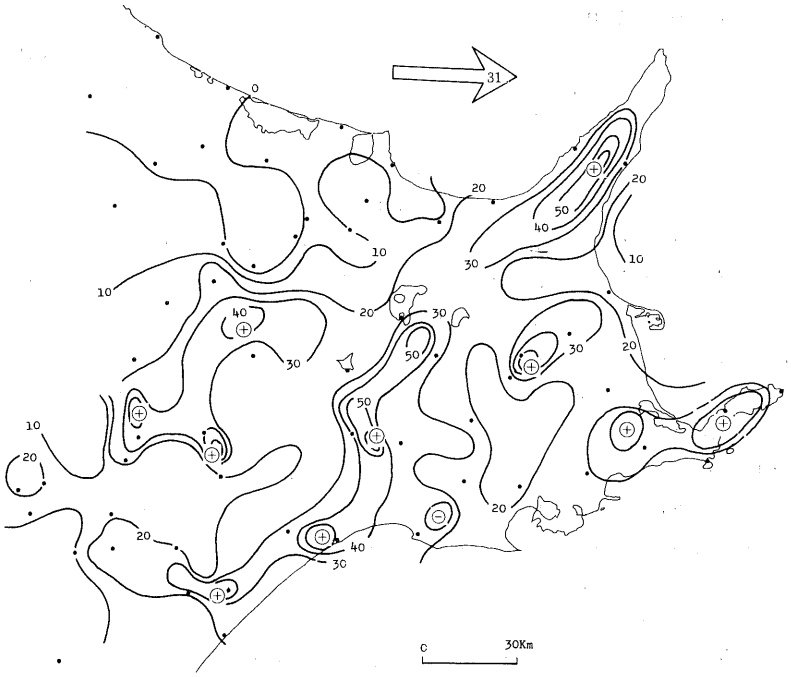

Figure 8. Distribution of weather divide for southern limit of clear weather in the northern part of the studied area, S-type under southwesterly wind.

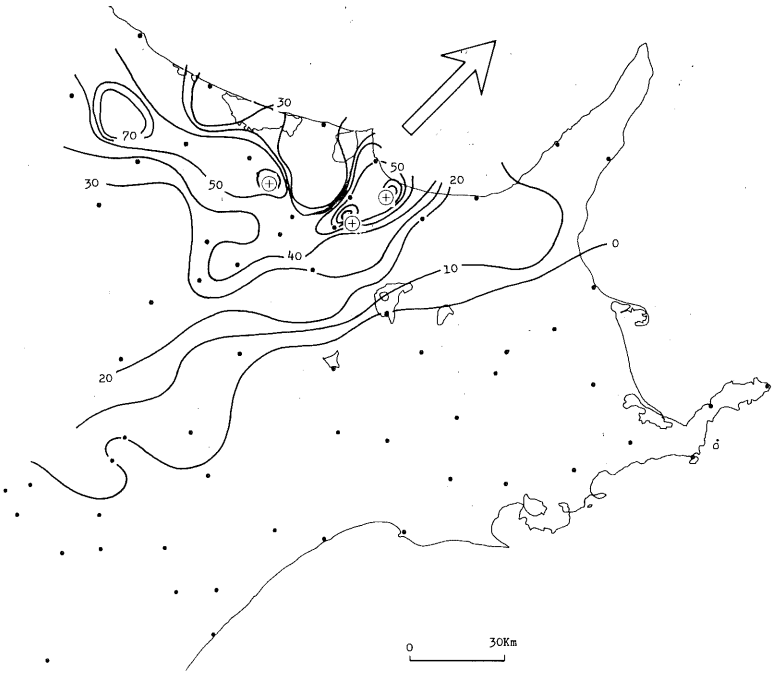

Figure 9. Distibution of weather divide density of S-type under westerly wind.

under this flow by the influence of topography.

The distribution of weather divide density of the N−type under the northwesterly wind, which is the most frequent among the N−type, is shown in Figure 10. The high density area shifts towards the south crossing over the backbone mountain range, and as it extends to the inland area in the Konsen Upland and Tokachi Plain, fine weather is thus limited to a narrow zone on the Pacific coast. In the case of the N−type, bad weather mostly caused by the Okhotsk High extends to the Konsen Upland and the Tokachi Plain. It was reported that the Okhotsk High accompanied with thick stratus clouds and bad weather extends to the Konsen and Tokachi Districts irrespective of the backbone mountain range (Chishima, 1965).

It seems that there are many cases of bad weather associated with the Okhotsk High, classified into M−type, because they affect all parts of this district frequently. Another weather distribution pattern of the M−type mostly results in temporal synoptic conditions. A detailed discussion on the M−type is not given here.

It is likely that weather represents a kind of total climatic elements. The relation between the frequency of weather types and the deviations of mean temperature and sunshine hours from their average every ten days for 3 years (1969−1971) is shown in Figure 11. In the case of high frequency of the N−type, for example May and August in 1969, low temperature and insufficient sunshine are predominant both at Kushiro and Abashiri, especially at the latter. In the case of high frequency of the S−type, for example May and June in 1971, temperature and sunshine keep

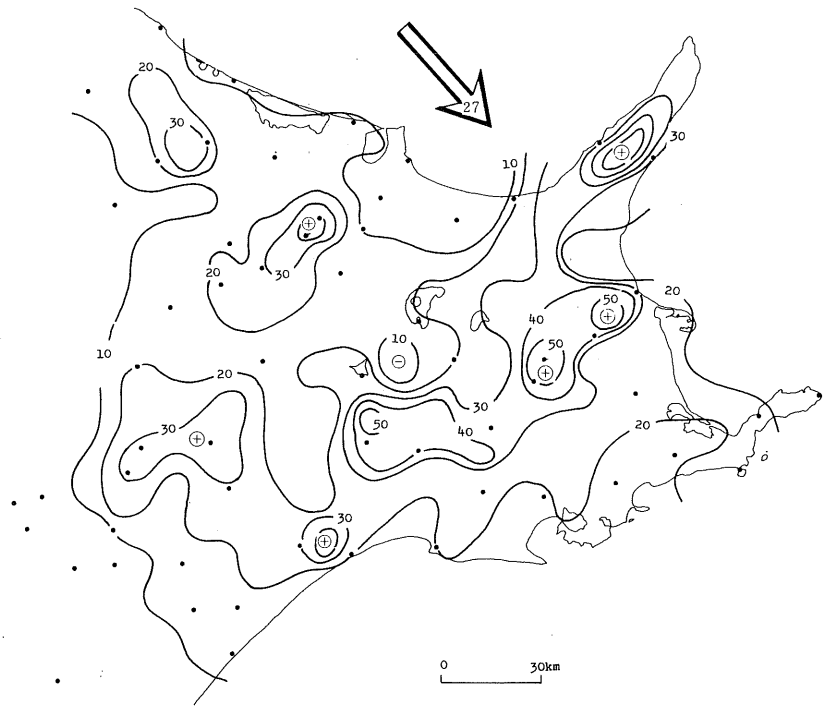

Figure 10. Distribution of weather divide density of N-type under northwesterly wind.

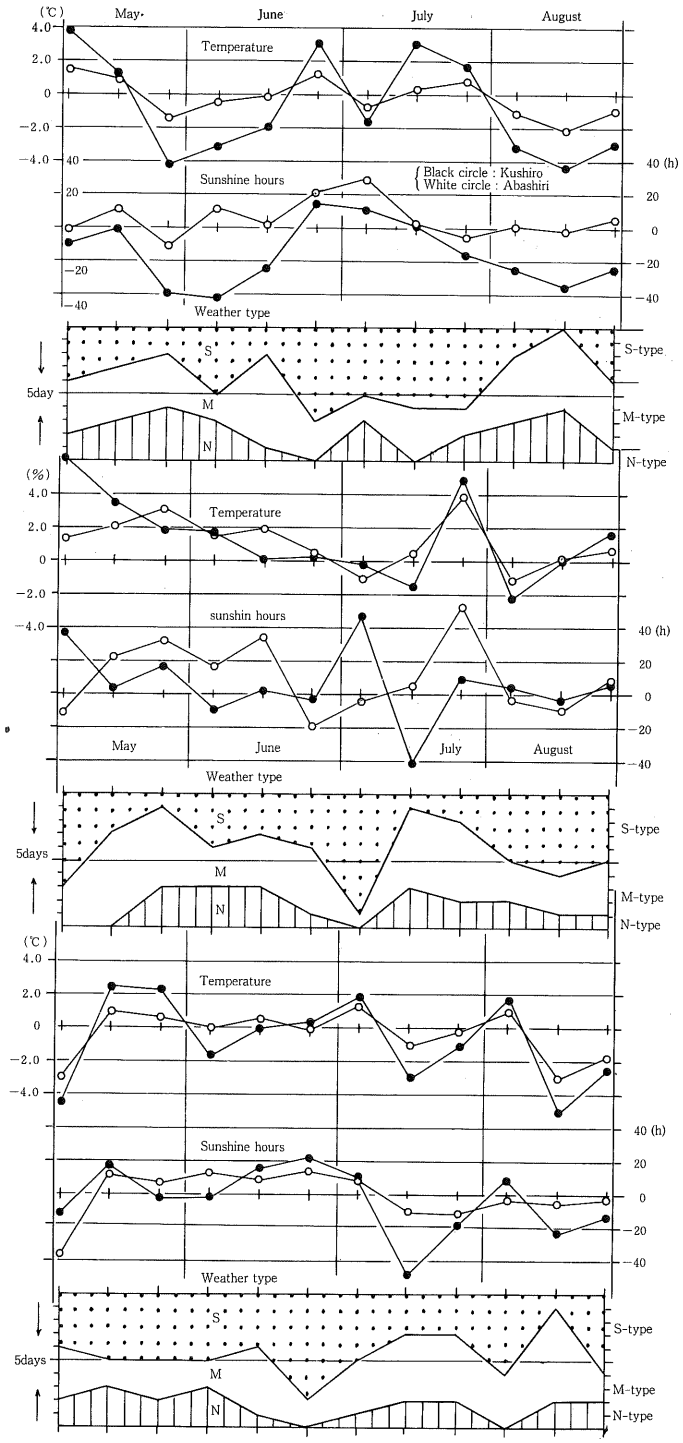

Figure 11. The relation between frequency of weather types and the deviations of mean temperature and sunshine hours every ten days for 3 years (1969—1971).

nearly their average level at Kushiro, but those at Abashiri fluctuate in positive side.

4. Summary

In order to make clear the weather distribution in eastern Hokkaido in summer, the distribution maps of the weather divide density were made for every wind direction at the 850mb level at Nemuro and the weather distribution types (Figures 5—10), by using daily weather records at 9h. from May 1 to August 31 for 5 years (1969—1973). The results obtained are summarized as follows:

(1) In the case of bad weather on the Pacific side, which occurs under a weak wind or southerly wind the high density of the weather divide appears most clearly in the Shiretoko Peninsula and on the windward side of the Akan Mountains. However, through the passes of the Shiretoko Mountains and the western part of the Akan Mountains, bad weather extends to the north crossing over the mountain ridge.

(2) Foggy weather on the Pacific side is restricted to the lower reaches of the Tokachi River and the narrow coastal zone in the Tokachi District, but an advective fog invades deeply into the inland in the Konsem Upland influenced by topographical features. Bad weather appears again on the Okhotsk side within a zone about 30km from the seashore even under the southerly wind.

(3) In the case of bad weather on the Okhotsk side, which occurs under the northerly wind and the influence of the Okhotsk High (mP Airmass), the high density of the weather divide appears in the inland regions in the Tokachi Plain and Konsen Upland irrespective of the backbone mountain range.

REFERENCES

Chishima, S, (1965) : Relation between the weather of north-eastern Hokkaido and Okhotsk Sea High. Jour. Met. Res. 17 (5) 336—345 (in Japanese).

Fukaishi, K. (1971) : On summer fogs of eastern part of Hokkaido (Part I). Kushiro Ronshu (2) 17—55 (in Japanese).

Fukaishi, K. (1973,a) : On summer fogs of eastern part of Hokkaido (PartII). Kushiro Ronshu (4) 63—87 (in Japanese).

Fukaishi, K. (1973, b) : On the summer fog in Kushiro District. Geogr. Rev. Jap.46 (11) 741—754 (in Japanese with English abstract).

Fukaishi, K. (1973, c) : On the distribution of the temperature at the time of advection fog invasion. Climatological Notes Hosei Univ. (13) 30—37 (in Japanese).

Fukaishi, K. (1974) Distribution of summer wind in Kushiro District. Geogr. Rev. Jap. 47 (12) 733—747 (in Japanese with English abstract).

Fukui, E. (1938) : The weather divide around Joetsu-Kokkyo in winter. Geography. 1, 345—359 (in Japanese).

Fukui, E. (1966) : Further studies on the climatic boundary dividing the Japan Sea coast and the Pacific Side of Japan. Geogr. Rev. Japan. 39 (10) 643—655 (in Japanese with English abstract).

Honma, T., Tamura, K. and Okita, T. (1962) : Observation of sea fog and drizzle at Nemuro. Jour. Met. Res. 14 (2) 72—79 (in Japanese with English abstract).

Kushizaki, R. and Kudo, M. (1965) : On the weather divide at Kamikawa District in Hokkaido. Jour. Met. Res. 17 (11) 746—750 (in Japanese).

Miwa, K. (1963) : Sea fog in the Tokachi District in summer season. Jour. Met. Res. 15 (3) 85—88 (in Japanese).

Owada, M. (1973) : Prevailing winds in the Konsen Genya, southeastern Hokkaido. Geogr. Rev. Jap. 46 (8) 505—515 (in Japanese with English abstract).

Patton, C. P. (1956) : Climatology of summer fogs in the San Francisco Bay Area. Univ. of California Press. 1—200.

Saito, M. (1963) : Fog in the Yufutsu Plains. Jour. Met. Res. 15 (5) 333—353 (in Japanese with English abstract).

Sapporo District Meterological Observatory (1964) : Investigation on the fog in the Yufutsu Plains. Jour. Met. Res. 16 (2) 69—83 (in Japanese with English abstract).

Shitara, H. (1958) : On the winter weather divide in the Chugoku Region. Geogr. Rev. Japan 31 (11) 655—665 (in Japanese with English abstract).

Shitara, H. (1960) : On the measurement of the frequencies belt of weather divide. Ann. Tohoku Geogr. Ass. (12) 115—119 (in Japanese).

Shitara, H. (1966) : A climatological analysis of the weather distribution in Tohoku District in winter. Sci. Rep. Tohoku Univ. 15, 35—54.

Shitara, H. (1969) : Distribution of cloudy or rainy weather in the Northern Tohoku under the easterly wind in Baiu season. Ann. Tohoku Geogr. Ass. 21 (4) 220 (in Japanese with English abstract).

Suzuki, H. (1962) : On the climatic boundaries of Northern and Southern Japan. Jour. Geogr. 71 (1) 7—16 (in Japanese with English abstract).

Takahashi, M. (1954) : The weather divide around the boundary between Hokuriku and Tokai. Rep. Gifu Univ. (2) 1—5(in Japanese).

Takahashi, M. (1961) : Researches on the distribution of winter weather divide in Japan. Rep. Gifu Univ.(5) 577—594 (in Japanese with English abstract).

Yoshino, M. M. (1975) : Climate in a small area. Univ. Tokyo Press. 328—330.