Characteristics of Weather and Climate over the Okhotsk Sea

Young Seup KIM, Young Ho HAN, Hyeong Bin CHEONG,
Nina A. DASHKO*, Nina M. PESTEREVA* and Sergey M. VARLAMOV**
Department of Atmospheric Sciences, Pukyong National University, Pusan 608-737, Korea
**Department of Meteorology, Far Eastern State University, Vladivostok 690600, Russia*
***Far-Eastern Regional Hydrometeorological Research Institute, Vladivostok 690600, Russia*

The Okhotsk Sea is unique natural object with climatic peculiarities. The climate of the Okhotsk Sea results from the general distribution of solar radiation during a year, and the characteristics of the atmospheric circulation that varies through a year: In cold half year the main pressure formations are Siberian high and Aleutian low. Asian low centered on Afghanistan dominates over the Asian continent in summer. The North-Pacific sea surface is under effect of permanent North Pacific high. The changes in their position from year to year are very significant.

The anticyclonic activity over the Far Eastern Seas is one of the main factors for the formation of weather anomalies over the adjacent territories. The analysis of summer weather characteristics over the coast of Okhotsk and East Sea using the data obtained from Hydrometeorological stations during 1949~1990 showed that, to a great extent, distribution of the air temperature depends on thermal state of the Okhotsk Sea and atmospheric circulation over it. We show some relations between weather characteristics and the intensity of atmospheric action center for the North Pacific high in summer when its ridge propagates to Okhotsk Sea. Correlation coefficients between air pressure over the Okhotsk Sea and air temperature for the coastal areas reach up to 0.7. Analysis of the spatial-temporal distribution of main meteorological values over the Okhotsk Sea such as air pressure, and air temperature are also performed.

Key words : Okhotsk Sea, siberian high, aleutian low, asian low, north pacific high, anticyclonic activity

Introduction

The first visual weather observations over the Okhotsk Sea were conducted about 350 years ago. They are the descriptions by the first travelers at the beginning of the 17th century, marine logs during 18~19 century which contain the detailed meteorological conditions of navigation at the Okhotsk Sea. The instrumental observations over the Okhotsk Sea area have been conducted for about 100 years. The systematic generalization of hydrometeorological information started in the early 1950s.

The Okhotsk Sea climate depends on the zonal distribution of solar radiation and atmospheric circulation, as well as the existence of Asian continent at the edge of which it is located. In addition, many climatic peculiarities of their own exist. The most important one of them is the topographic condition and its proximity to the Pacific Ocean, complicated circulation current system in the basin and sea coast orography. Since the great part of the Okhotsk Sea is located in the eastern boundary of the Asian continent where the winter is very cold and long, its climate is very similar to those of the Arctic sea. In summer over the Okhotsk Sea the cloudy weather with a drizzling and dense fog is most frequently observed, and it exerts a great influence on the navigation and fishing. This is due to high pressure field formation over the Okhotsk Sea.

The ideas of the interaction of the weather and the centers of atmospheric action intensity were stated by many scientists at the end of last century and were supported by many researches (Girs, 1974; Asakura, 1974; Okawa, 1974; Baydal et al. 1990). The analysis of intensity in the centers of climatic pressure systems of Asian-Pacific region shows a tendency to increase of center pressure: for the North Pacific high in a period from April to August, and for the Siberian high and the Aleutian low from November to February (or March) with a significance level of 5%.

The objective of this study is to analysis of the weather and climate over the Okhotsk Sea using the data obtained from hydrometeorological stations. The study will be emphasized on the spatial-temporal variation of air pressure and temperature over the Okhotsk Sea.

Data and Methods

The intensity and geographical localization of atmospheric action centers were analyzed during the period of 1890 to 1990 (Baydal and Neushkin, 1990). We used ocean data collected by vessels (1970~1980), and daily weather maps (1988~1992). The summer weather characteristics analysis over the Far Eastern region was conducted based on the information obtained from the hydrometeorological stations (Synoptical Report, 1949~1990). We constructed the correlation matrix for the monthly mean air temperature at stations on the Okhotsk and the East Sea (Japan Sea) coasts, the monthly mean meteorological values (pressure, air temperature, and characteristics of atmospheric circulation at 500 hPa surface), and their derivatives for the 30 points over the Okhotsk Sea and adjacent regions. The location of stations analyzed in this study is presented in Table 1.

Table 1. Information about location of Meteorological Stations

Station Name	Index Number	Latitude	Longitude	Country
Ajan	31168	56°7′	138°9′	Russia
Harbin	50953	45°5′	126°6′	China
Juzno-Kurilšk	32165	44°1′	145°9′	Russia
Icha	32411	55°2′	155°8′	Russia
Mys Vasilěva	32217	50°0′	155°3′	Russia
Nagaevo	25913	59°5′	150°7′	Russia
Okhotsk	31088	59°2′	143°2′	Russia
Oktiabrškaya	32564	52°0′	156°4′	Russia
Seoul	47108	37°4′	126°8′	Korea
Urup	32186	46°2′	150°0′	Russia
Vladivostok	31960	43°7′	131°4′	Russia

Synoptical centers of atmospheric action of the Asian-Pacific region

From season to season the pressure field over the Okhotsk Sea undergoes a great change due to the effects of the Asian Continent and Pacific Ocean, which create the conditions for significant redistribution of temperature from one season to another. In the cold half year, main pressure formations are Siberian high and Aleutian low. In summer Asian low with a center over Afghanistan dominates. The North Pacific sea surface is under the effect of the permanent North Pacific high. Siberian high is observed from September to May with a greatest intensity in winter, when it is under the significant thermal influence of a cold land, as well as under the influence of East and Central Asian mountain systems, as shown in Table 2.

Permanent North Pacific high is more active in summer season when the thermal factors make the important contribution to the formation of tropospheric pressure fields in middle latitudes. The normal air pressure at the sea level in the center of North Pacific high exceeds 1020 hPa in January when it shifts to the America shores. And in July when its offset directs to the Asian coast, the air pressure increases up to 1025 hPa. Its monthly-mean intensity changed from 1014 hPa (in

Table 2. Statistical values of air pressure in the centers of high and low pressure (1891~1990). Air pressure minimum, maximum, mean square deviation, asymmetry, and exess are denoted by Min, Max, MSD, As and E, respectively

Period	Statistical value (hPa)							
	Min	Max	Mean	Median	Mode	MSD	As	E
				North Pacific high				
January	1014.0	1034.8	1021.3	1019.2	1019.7	3.7	1.2	2.6
July	1018.3	1033.3	1025.7	1025.8	1028.4	4.3	−0.3	−0.9
				Siberia high				
January	1025.1	1060.0	1037.2	1033.8	1034.7	7.7	1.1	0.8
June	1007.3	1022.4	1011.6	1009.6	1009.9	2.9	1.3	2.3
				Aleutian low				
January	985.0	1014.9	997.9	998.5	999.2	7.1	0.1	−0.2
June	1003.0	1015.3	1010.1	1010.4	1012.5	3.0	−0.4	−0.4
				Asian low				
March	1000.1	1015.0	1009.7	1009.8	1010.2	2.1	−1.7	6.0
July	992.1	1005.4	997.0	995.4	995.8	2.6	1.0	1.0

January 1916) up to 1034 hPa (in January 1937) for the period of 1891~1990. The changes in position of high or low pressure centers from year to year are very significant. The latitudes of action centers of North Pacific high are more steady in comparison with longitudes during a year (Fig. 1).

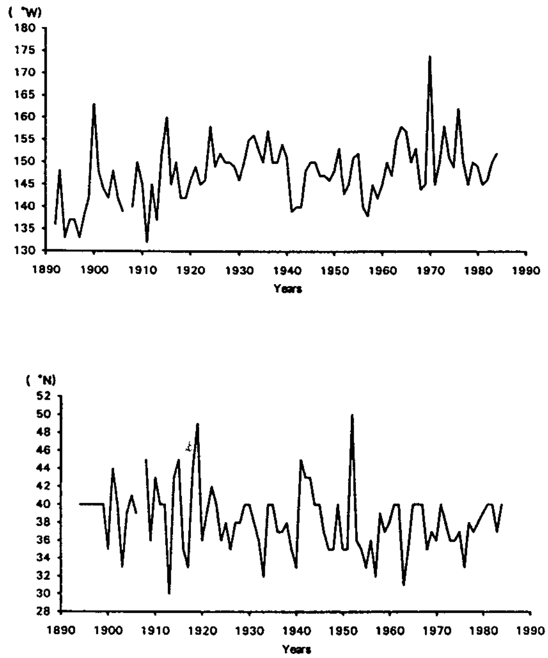

Fig. 1. Longitudinal and latitudinal variations of North Pacific high action center.
(the upper: original data, the lower: linear trend is removed)

The normal air pressure at the sea level in the center of Siberian high in January exceeds 1037 hPa (in May: 1017.7 hPa, in October: 1024 hPa), and daily mean exceeds 1084 hPa (Dashko, 1991). Siberian high disappears in the late summer. Monthly mean air pressure minimum in the center of Siberian high in January was 1025 hPa in 1905, and the maximum was 1060 hPa in 1977.

The Aleutian low is observed on the weather maps from August to June of the next year, with the greatest intensity in winter. In the process of its formation the effect of a warm North Pacific sea surface is very important. The normal air pressure at sea level in the center of the Aleutian low is approximately 1000 hPa, however, on the mean pressure maps at the sea level the Aleutian low is not observed in July. Monthly mean pressure minimum and maximum in the center of Aleutian low is nearly 980 hPa and 1015 hPa, respectively.

Cyclonic activity over the Asian continent dominates from March to October with the greatest intensity in July. It has hollows one of which is directed on regions of the north-east China and average current of the Amour river. In summer the normal air pressure at sea level is near 995 hPa varying from 991.7 hPa in June 1927 up to 1015 hPa in March 1947.

The linear trend estimation of pressure in the center of climatic pressure systems in the period from 1891 to 1990 shows a significant increase of pressure (Fig. 2): for the North Pacific high from April to August (4.5 hPa/100 years in August up to 9.9 hPa/100 years in May), for the Siberian high from November to February (10.1 hPa/100 years in November up to 17.3 hPa/100 years in January), and significant drop for the Aleutian low from November to March (−8.9 hPa/100 years in November up to −11.6 hPa/100 years in February).

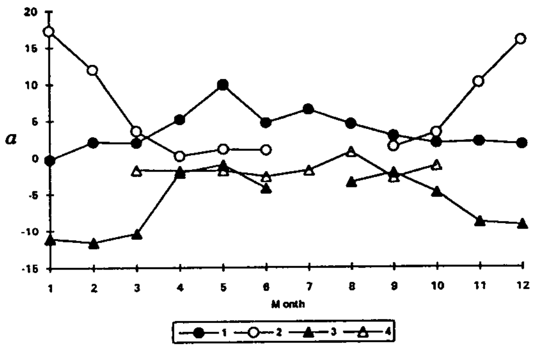

Fig. 2. Linear trend a (hPa/100 years) for the air pressure in the centers of atmospheric action, 1: North Pacific high, 2: Siberian high, 3: Aleutian low, 4: Asian low).

These estimations are statistically significant with 5% importance level Dashko et al., 1996). However on this background of general increase of pressure in specified periods, it is possible to note that the intensity of centers of atmospheric action differs by a wavy pattern. The periods of lowered activity are replaced by short-period waves with decreased amplitude (Fig. 3).

The wavy pattern of pressure is observed for other centers of atmospheric action. There is an increase of air pressure in Siberian high during 70~90s with maxima in the beginning of 80s. The periods of an increased air pressure in North Pacific high center are from middle

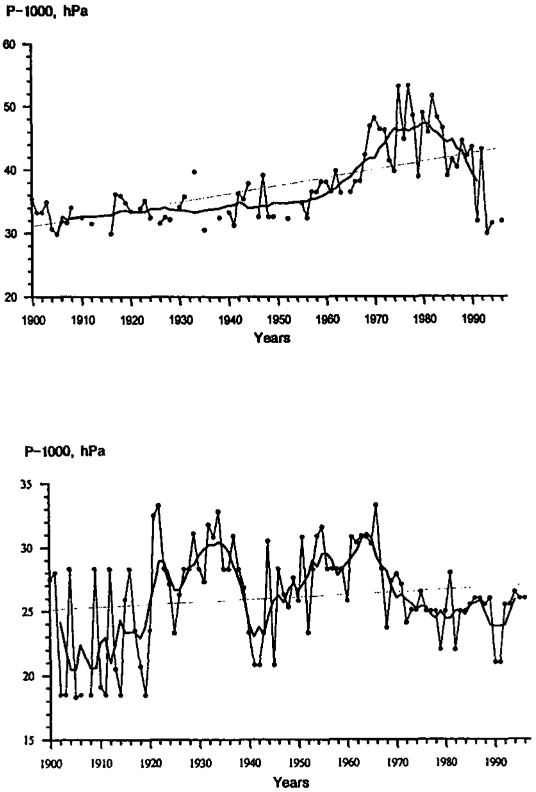

Fig. 3. Siberian high intensity in January (the upper) and North Pacific high intensity in July (the lower) and its 5 years running mean and linear trend.

40s up to 70s, and the beginning of 80s. The similar features of Siberian high and North Pacific high intensity take place in other months. The wavy pattern of pressure is also observed for others centers of atmospheric action.

Peculiarity of the hydrometeorological regime over the Okhotsk Sea

1. Distribution of Atmospheric Pressure

The peculiarities of synoptic processes over the East Asia and the adjacent Pacific area are responsible for the annual march of the pressure over the Okhotsk Sea causing the essential differences over the northern and southern parts. The northern Okhotsk Sea part is characterized by the atmospheric pressure type similar to the continental type but with a less annual amplitude if compared with the continental type. In winter the northern part is under the influence of the Siberian high and Lena-Kolyma core, in summer the lower pressure field over the continent shows a great influence on there (Manual, 1965, 1968). Changes of the air pressure are defined by its annual march over the Asian continent-maximum is observed in winter and minimum in summer, respectively. Differences in annual march of the pressure over the north-eastern and north-western parts over the Okhotsk Sea are not so great. Lower air pressure can be noted as an important feature over the north-eastern sea water area if compared with the north-western area.

Over the south-east of Okhotsk Sea, the pressure maximum occurs in summer that is almost similar to the oceanic type in spatial distribution. In this period the southern sea part is under the influence of a vast ridge from the North Pacific high. The pressure minimum is observed in the period of the major development of the cyclonic activity over the Okhotsk Sea and Aleutian regions, i.e. in winter.

Over the south-western sea part, the air pressure has two maxima-in autumn (October) and in spring (April), and minima in winter (December) and in summer (June), respectively. The main tracks of the deep cyclones are found over these region, which make an important contribution in the pressure distribution and decrease of the influence of the nearby continent. In the spring the cyclonic activity over the Far Eastern seas decreases, and the Aleutian low moves to the east and the pressure increases. The summer minimum is closely related to the influence of Asian continent where the cyclonic activity becomes more active.

The autumn pressure increases over the whole oceanic regions. The most pronounced increase is observed over the south-west area. In this period the cyclogenesis weakening takes place over the continent, and the Siberian high begins to form and the pressure in the core of which can reach 1038 hPa and more.

The most essential pressure deviation over the land and sea occurs in winter when pressure difference in the core of the Siberian high and the Aleutian low, on the average, is more than 30 hPa. In winter over the Okhotsk Sea (excluding the north-western part) the pressure is lower than the mean along latitudes. Over the north-western sea part the normal pressure means are 1009~1010 hPa that corresponds to the latitude's mean estimations in this period (1010~1012 hPa). The amplitude of the annual air pressure variation is much larger over the south-eastern sea part. The annual air pressure mean over the whole ocean is about 1011~1013 hPa, but during a year large deviations from these values can be observed.

2. Winds Regime

Especially, intense pressure fields over the Okhotsk Sea is observed during the passage of deepening cyclones in winter with a center pressure 950~960 hPa, making difference of air pressure between continental and sea regions of more than 80 hPa. In summer and autumn the strengthening of wind is associated with passage of tropical cyclones.

The wind from November to February varies from 5 up to 10 m/s (occurrence frequency is 37~46%). In March the number of cases with rather windy weather increases and in April and October frequency of the range 0~5 m/s and 5~10 m/s is practically identical. The significant frequency distribution of wind from 10 up to 15 m/s (more than 10%) in these months is observed. From May to September weak wind prevail and in May and September the weather with weak winds is observed about a half of all supervision, in the majority (73~76%) of observations in June~August. Maximum of the wind speed in north-eastern and western parts of the sea reaches 25~30 m/s, and in the central and east 30~35 m/s and on the south of the sea strengthening up to 35~40 m/s and more are observed frequently.

The wind directions in a northern part of the Okhotsk Sea from October to May resemble the features of a winter wind regime. In the southern part of the sea the atmospheric circulation in April acquires summer monsoon character: southerlies is observed at first in south-western part of the sea, and in June it becomes prevailing over the all sea surface of the Okhotsk Sea. From October a winter wind regime with winds from a continent to the sea is established.

The greatest occurrence in the winter is observed for north-western winds with speeds of 15~19 m/s (14.6%) and up to 9 m/s (12.4%). Wind speeds of 25 m/s and more are not marked for southern directions, and the speeds 30 m/s and more can take place mainly for north-western and western directions. In summer the winds with southern wind speed component from 5 up to 15 m/s are most probable (42.7%). Strong winds with speed 15 m/s and more can be observed with any directions, except the western and northern part, and sometimes it is strengthened up to 20 m/s and more in case of south-western flows.

In winter the strong winds correspond to south-easterlies and easterlies, frequency of which is not large (nearly 3~4%). For prevailing winds of north-westerlies the wind speeds are close to the average. In summer the wind speeds for all directions change slightly.

3. The Thermal Regime

The annual mean air temperature over the northern half of the Okhotsk Sea is negative: zero isotherm passes through central part of the sea from southern Sakhalin to a middle of western coast of Kamchatka. Spatial variation of the annual mean air temperature from south to the north of Okhotsk Sea makes 8~10℃. The cold period with air temperature below zero over the Okhotsk Sea lasts from 120~130 days in the southern up to 210~220 days in the northern part.

The main feature of monthly mean air temperature in winter is a formation of thermal hollows along eastern and western coast of the Okhotsk Sea. The thermal ridges oriented from the Pacific Ocean across the southern part of the Okhotsk Sea to its northern part with branching to the north-east and the north-west. These features are created in October and continue to exist until May. The thermal hollow along western coast of the Okhotsk Sea is a part of extensive cold hollow, directed from a cold pole of northern hemisphere in Yakutia with monthly averaged air temperatures in January about −50℃. These features of a winter thermal regime of the Okhotsk Sea can be related to thaws, which are connected to a passage of southern cyclones with warm air from the Pacific Ocean. At this time the air temperature is positive even in the most cold months actually in all regions of the Okhotsk Sea.

The lower air temperatures are connected with north-westerlies, that is determined by cold air advection from Asian continent or from flows of the north Okhotsk Sea. With the easterlies and south-easterlies (advection from the Pacific Ocean), a rise of air temperature (up to −1.9∼−2.1℃) is observed. Air temperatures below −20 ℃ are marked only for north-westerly and northerly winds. At south-easterlies the air temperature exceed −10℃, and the rare cases with temperatures 5℃ and above are connected with north-easterlies and south-westerlies.

During a warm period the cold zone is located over the Okhotsk Sea. The underlying surface of the Okhotsk Sea plays a great role in its formation. The main feature of monthly mean air temperature field in summer is a formation of the ridge-shaped isotherm along the eastern and western coasts of the Okhotsk Sea and the thermal trough oriented from the Pacific Ocean through the southern areas of the Okhotsk Sea to its northern part (Dashko et al., 1996).

The distribution of mean temperature in the summer months has no distinct structure. In July∼August it is possible to note that the ridge is located over the south-west and the trough is located over the south-east.

The absolute minima of the air temperature are below zero in all months and near 1∼2℃ even in summer. They can reach −36∼−51℃ (January) in northern part of the Okhotsk Sea and even in April sometimes the air temperature is lowered to −34∼−40℃. In southern region of the Okhotsk Sea the air temperature in the winter is lowered below −16℃, and in summer it changed from −2℃ in south-western part up to 0∼1℃ in south-eastern.

Air temperature maximum in all months of a year is actually everywhere above zero. In winter in periods of warm weather connected with the intrusion of maritime air from the Pacific Ocean to the Okhotsk Sea, air temperature over the south of Okhotsk Sea can increase up to 12∼14℃ and over the north of Okhotsk Sea up to 2∼7℃.

An interesting feature is also observed for the march of every day air temperatures at stations. Figure 4 shows a 30-year mean air temperatures for every day at stations of the Okhotsk Sea for period 1960∼1990s. The analysis showed a wave pattern for all stations, especially in the beginning of the year. The appearance of such a wave pattern is connected with a repeating of the similar synoptical situations from year to year in the same periods (the similar waves takes place for the air pressure, winds etc.).

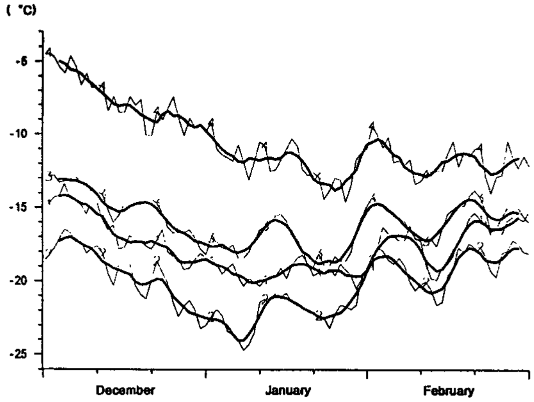

Fig. 4. Multi-year mean daily air temperature and its 5-years running mean at stations of the coast of the Okhotsk Sea, 1: Ajan, 2: Okhotㄴ+, 3: Nagaevo, 4: Oktiabr kaya.

4. Autocorrelation and linear trends

For estimation of the temporal variability of main meteorological values the autocorrelation functions were calculated. For the analysis we have used daily mean air pressure, air temperature and wind for 25 stations at the Okhotsk Sea coast.

To remove a seasonal cycle the least squares method was used to approximate a seasonal course by a curve, $X(t) = A_1 \times sin(2\pi t/T) + A_2 \times cos(2\pi t/T) + A_0$, where, the subscription 0: mean value, T: annual period, $A^2 = (A1^2 + A_2^2)$: amplitude of a annual cycle.

Except for the air temperature, a seasonal cycle was found less conspicuous. After removing seasonal cycle autocorrelation functions for meteorological values in stations were constructed. In Fig. 5 an example of autocorrelation functions for coastal stations-Okhotsk, Nagaevo, Mys Vasil va and Juzno-Kuril k is presented.

Autocorrelation of air pressure at sea level sharply decreases on the south of the Okhotsk Sea (Juzno-Kuril k). The correlation drops to a value of 0.3 in 1.5 days. Air temperature is characterized by the greater inertia than the pressure, except for south of the Okhotsk Sea where correlation decreases to a value of 0.3 actually in a day. On other stations correlation drops to a level of

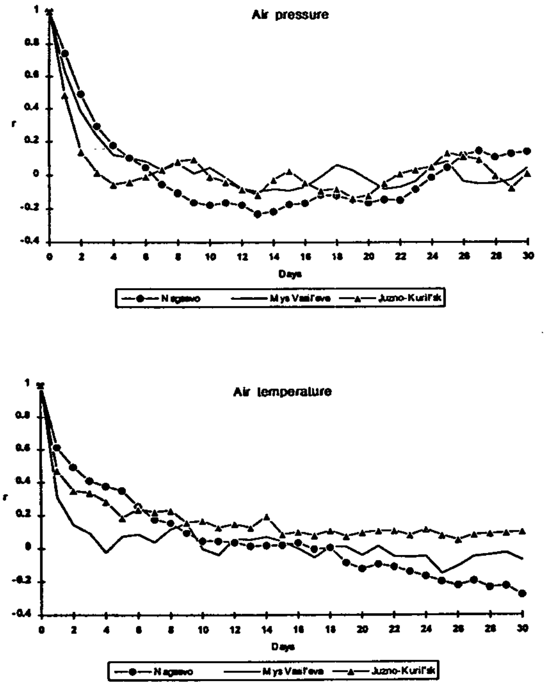

Fig. 5. Air pressure and air temperature autocorrelation function.

Table 3. Estimation of linear trend for monthly mean temperature (℃100 years)

Station	Years	Characteristics in the months		
		December	January	February
		α	α	α
Icha	62	−1.12	−2.10	0.68
Nagaevo	64	−1.71	1.05	4.14
Okhotsk	82	1.74	3.11	3.95
Ajan	65	0.74	−2.04	−2.80
		March	April	May
Icha	62	1.74	0.94	0.77
Nagaevo	64	2.54	1.23	0.74
Okhotsk	82	1.00	1.96	1.33
Ajan	65	−3.38	−3.31	−1.13
		June	July	August
Icha	62	0.86	0.94	-0.11
Nagaevo	64	2.33	−0.31	0.44
Okhotsk	82	2.16	1.38	0.45
Ajan	65	2.25	−1.68	−3.09
		September	October	November
Icha	62	−1.09	0.92	1.41
Nagaevo	64	−0.08	0.77	−1.91
Okhotsk	82	−0.08	1.51	−1.47
Ajan	65	−5.49	−4.98	−2.61

0.3 by 4~5 days.

Using monthly mean air temperature for stations (period : up to 1995, inclusive), we estimated the value of linear trend. Table 3 include estimation of linear approximation for monthly mean temperature trend (℃/100 years) (Dashko et al., 1996).

The analysis of monthly mean air temperature shows significant decreasing of air temperature in March~April (more than −3℃/100 years) and August~October (−3~−5.5℃/100 years) for the Ajan located north-western coast of the Okhotsk Sea. In addition, the significant positive trend in period January~July (exclusive of March) takes place for Okhotsk (1~4℃/100 years).

Peculiarities of the North Pacific high in summer

The permanent North Pacific high is created over the warm sea surface within the limits of high pressure band of the Pacific subtropical and tropical zones (20~40°N) with a center located to the north of the Hawaiian Island. Under the favorable thermodynamic conditions in the troposphere over the Okhotsk Sea in the maritime polar air masses the original anticyclone develops. However, its height extension is not so large.

From May to July a situation with the higher pressure field over the Okhotsk Sea has a frequency from 27 as high as 60 days or, on the average, in a half of all cases (47%), and increases from May (about 39%) to June~July up to 50%. For example, in May it may be from 3 up to 24 days with the anticyclonic isobar curve, in June~July it varies from 6 up to 26 days.

The anticyclonic activity over the Far Eastern seas is one of the reasons for maintaining the weather anomalies over the most adjacent territory. The high pressure ridge propagation to Far Eastern seas is associated with the strong southerlies or south-easterlies with rain or drizzle, fogs and decreasing air temperature. For example, in Vladivostok in June when Okhotsk ridge begins to form daily air temperatures reach near 6℃ (while the normal daily means air temperatures in June is above 12℃) (Dashko et al., 1991, 1996).

The process and mechanism of high pressure field formation over the Okhotsk Sea, including the anticyclone, are not clear. In the beginning of a century in connection with Baiu (Jangma) season study Okada (1910) suggested that the cold surface of the Okhotsk Sea in the summer is the controlling factor, favorable for establishment of high pressure. Later it was accepted in works done by Yagi (1969) and Okawa (1974), but role of a cold sea surface as the secondary factor was emphasized. In the Far East of Russia Il nskii (Manual, 1965) in the early sixties has noted that the field of high pressure over the Okhotsk Sea is originated at the Arctic region.

It has long been known that the formation and amplification of anticyclonic circulation over the Okhotsk Sea can be created under influence of a complex factors. On our sight, it is necessary to separate processes of an entrance and passage of anticyclones and ridges through the Okhotsk Sea and of anticyclogenesis. The mechanism of formation and amplification of the Okhotsk ridge or anticyclone was considered by Sutcliff (1947), and is confirmed later by results of numerical modeling by Katayama, Arakawa, and Mintz which were discussed in the work of Asakura (1974). Processes of warming of the Asian continent in the beginning of the summer result in formation of high pressure in troposphere over the East Siberia. The role of a cold source over the Bering Sea is more significant in combination with a warm source over an Asian continent (Asakura, 1974). The Okhotsk Sea appears in the convergence zone in the rear of a low pressure where large geopotential gradients are created with an increase of cyclonic curvature on a flow. It stimulates formation or strenthening of low anticyclone or ridge over the Okhotsk Sea, and becomes a main cause of a cool and humid weather over the northern part of East Sea (Japan Sea) and its coast.

The summer weather characteristics analysis showed that distribution of the air temperature fields depends on the circulation peculiarities and thermal state of the Okhotsk Sea. There is the inverse relation between the daily air temperature of the Okhotsk and East Sea coasts and number of days with anticyclonic circulation (and intensity of ridge) over the Okhotsk Sea (Fig. 6, 7).

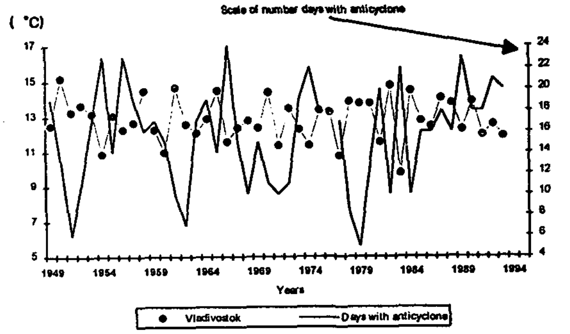

Fig. 6. The number of days with anticyclonic circulation over the Okhotsk Sea and monthly mean air temperature in June in Vladivostok.

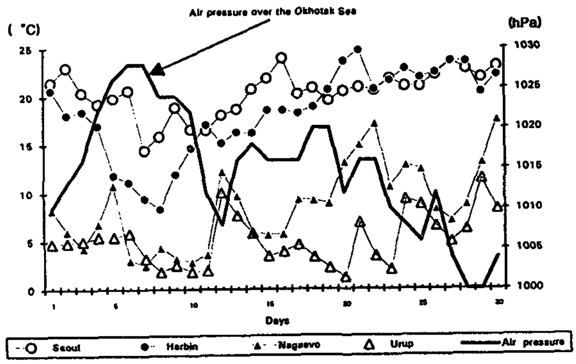

Fig. 7. The air temperature in Stations and air pressure over the Okhotsk Sea in June 1992.

There is a close relation between monthly mean air temperature and intensity of pressure fields over the Okhotsk Sea. We calculated the correlation fields of meteorological values for the 30 points over the Okhotsk Sea and adjacent regions (from 40° to 65°N and 130~170° E) during 1949~1990 with meteorological parameters at station. There is a close relation between the monthly mean air temperature in Primorye, Sakhalin, Korea, North East China and thermobaric parameters in atmosphere over the Okhotsk Sea in June (air pressure and geopotential and it's derivatives).

Figure 8 shows distribution of correlation coefficient between monthly mean air temperature in Harbin, Vladivostok and Seoul and monthly mean air pressure at sea level over the Okhotsk Sea and adjacent regions in June. The pressure field over Okhotsk Sea has a pronounced effect on air temperature of coast stations far to the south. For example, for the Vladivostok correlation coefficients reach 0.6 and more. The high correlation is also found between monthly mean air temperature in stations and air temperature over the Okhotsk Sea and

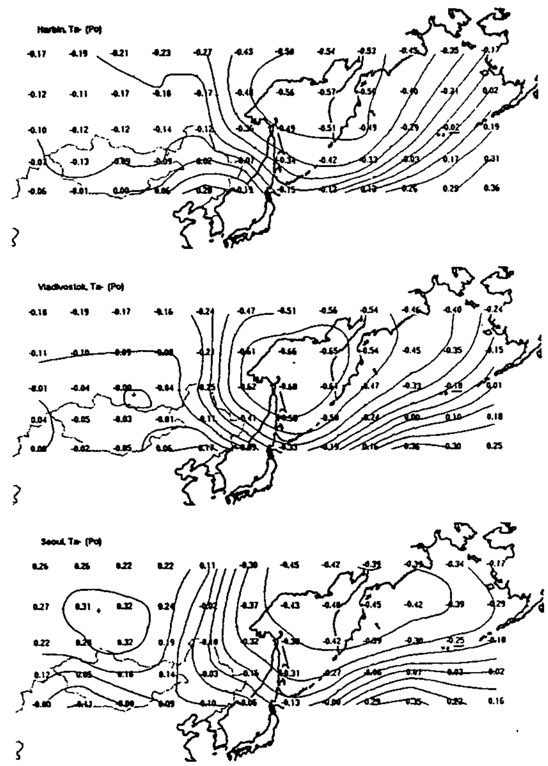

Fig. 8. Cross-correlation of monthly mean air temperature in Harbin, Vladivostok and Seoul, and monthly mean air pressure (sea level) over the Okhotsk Sea in June.

derivatives *dS/dy*, d^2S/d^2y and Laplacians for the field of air pressure at sea level and geopotential at 500 hPa level.

It should be noted that in the years of active anticyclogenesis over the Okhotsk Sea the air temperature over Primorye, Sakhalin, and the western Kamchatka coast show a decreased activity. On the contrary, precipitation over Primorye are above the normal and that over Sakhalin and Kamchatka are below the normal.

Conclusions and Remarks

Unfortunately, it is difficult to give the complete analysis of climate characteristics for the Okhotsk Sea. It would be interesting to discuss such questions as existence of synchronous and asynchronous relations between the atmospheric action centers (including, Canadian and Azores highs, Icelandic low) as well as the characteristics of an air pressure daily march during a period of their activity. For better understanding of these, the analysis of long-term variability of parameters of the ocean-atmosphere system is indispensable. The tentative estimations of hydrometeorological values trends and heat exchange between surface of the ocean and atmosphere show a great change in the last decade. It would be necessary to show a distribution of meteorological characteristics of high pressure anomaly over the Okhotsk Sea and their relations with the characteristics of sea surface condition, distributions of meridional, and zonal wind speeds.

It is important to develop the regional models of the forecast of main meteorological characteristics on the basis of methods of mathematical statistics; decomposition fields by natural orthogonal functions, correlation, regression, and discriminant analyses on the basis of perfect prognoses methods (PP) and model output statistics methods (MOS).

We analyzed the geographical localization and intensity of atmospheric pressure anomalies and their influence on the weather peculiarities, the temporal and spatial distribution of air pressure, and temperature. From one season to another significant changes in pressure fields are shown to be caused by the effect of Asian continent and Pacific Ocean which create conditions for significant redistribution of temperature from one season to another.

The analysis of winter wind distribution shows the existence of bimodal distribution of wind speed with a local minimum for speeds 6~9 m/s and maxima for the strong (15~19 m/s), and weak (1~5 m/s) winds.

Under the complex influence of the orographic factors and thermal non-homogeneity of the Asian continent and the Pacific Ocean, the seasonal distribution of meteorological characteristics is created. For example, the thermal conditions over the oceanic surface in summer favour to a shift of the North Pacific high by 6~7 degrees to the north and its ridge propagate towards the Far Eastern seas, in particular, to Okhotsk Sea where in the maritime temperate air the original anticyclone develops.

In the summer period the Okhotsk Sea exerts an great influence as a cooling factor on the air mass transformation and creates the lower temperature field even in warmest months. This influence propagates along the maritime regions where the air temperature is slightly higher than over the open sea part. There is significant relations between the monthly mean air temperature in Primorye and Sakhalin and thermobaric parameters of atmosphere over the Okhotsk Sea in summer.

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