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ABSTRACT

A large number of tables and charts with temperature-, wind-, wave-, visibility-, air pressure-, cloud cover- and precipitation data has been assembled revealing information about the climate of the North Sea. The data are based mainly on observations made on board voluntary observing ships during the period 1961-1980.

This report which gives a selection of these data can be regarded as a continuation of an earlier report (KNMI scientific reports WR 87-9) giving a selection of climatological data for the Netherlands lightvessels over the period 1949-1980.

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1. Introduction.

The purpose of this publication is to present a selection of the data used to provide information about the climate of the North Sea, which is based on observations by voluntary observing ships (also called selected ships) during the period 1961-1980. The emphasis lies on wind and wave data but also some characteristic data on air and sea temperature, sea level pressure, cloud cover, precipitation, visibility and superstructure icing are given.

This publication can be considered as a continuation of the earlier publication (Korevaar 1987) on climatological data of the Netherlands lightvessels over the period 1949-1980. The lightvessels are all situated near the coast. For information about the central and northern part of the North Sea the observations of the selected ships are more suitable. Both the lightvessels and the selected ships belong to the global observing network of the World Meteorological Organization (WMO). The most important difference is that the observations of the lightvessels are taken at fixed positions and those of the selected ships, mostly merchant ships plowing from port to port, at variable positions. They have in common the way of observing. On both the wind and wave data are estimated visually in most cases.

The number of Netherlands selected ships observations kept in the KNMI data base was too small to give a homogeneous distribution in space and time. Therefore use has been made of the WMO system for collection of ships weather reports of maritime nations. According to this system, also known as the Marine Climatological Summaries Scheme, a number of countries has the responsibility for the collection of ships observations for certain areas since the year 1961. According to this scheme the Netherlands is responsible for the collection of ships observations in the Mediterranean and the southern part of the Indian Ocean, and Great Britain for the eastern part of the North Atlantic, including the North Sea. By mutual exchange with Great Britain we got the disposal of about 700 000 ships observations for the North Sea area between 51°N and 60°N over the period 1961-1980.
With these observations a reasonably good coverage in space and time is

obtained with an average number of at least one observation per day for a great number of one degree squares (squares of one degree latitude by one degree longitude) and for most other one degree squares an average of at least one observation in two days.

The observations are stored on magnetic tape. They have been subjected to a quality control programme. Among others it has been checked if the data in one observation is internally consistent (for example, it is not allowed that at low wind speed a high sea is reported or that the present weather code indicates fog, while the visibility code gives good visibility). Next to this it has been checked if certain physical and climatological limits have not been exceeded.

The observations of the selected ships are mostly made at six-hourly intervals (standard times are 00, 06, 12 and 18 hours GMT). Most observations are found along the main shipping routes. According to the definition of the WMO a selected ship station is a mobile ship station that is equipped with sufficient certified meteorological instruments for making observations and that transmits the required observation in the appropriate code form for ships. The observations have been made and reported by the crew on board, particularly by the mates. Although they are no professional observers, at the nautical schools they get training in meteorology and by making the observations they have built up a lot of experience. The computer programmes for the processing of the data have been written by J.M. Koopstra and R.R. Broersma.

1.1 Processed parameters.

KNMI receives many questions concerning the climate of the North Sea. The greater part of these questions are related to wind and wave data, firstly for selecting workable periods and secondly for determining design criteria of maritime structures.

Next to wind and waves there is a main interest in air and water temperature and visibility. Therefore the processing has been mainly confined to these parameters. However, also some information is given in brief about sea level pressure, cloud cover, precipitation and superstructure icing. Current and salinity data are not given; these are not included in the ship's observations, see below.

1.2. Methods of observation and reporting.

The observations belong to the global observing network of the WMO. In the first place they serve for the preparation of weather charts. Next to this they are collected, quality controlled and stored for climatological purposes. Some elements are observed instrumentally such as air pressure and air and water temperature. Some phenomena such as rain, snow, thunderstorms, cloud types are simply determined. Finally there are a number of elements which must be estimated from visual observations. To this category belong cloud cover, visibility, wind and waves.

In the following, the method of observation of the most important elements will be described in brief.

1.2.1 Air temperature (and humidity).

Air temperature (dry bulb temperature) and wet bulb temperature are measured with a sling psychrometer or an aspirated psychrometer which are preferably exposed on the windward side of the bridge in a stream of air, fresh from the sea, which has not been in contact with, or passed over, the ship and is adequately shielded from radiation, precipitation and spray. The air temperature is reported in tenths of degrees.

1.2.2 Sea surface temperature.

The temperature of the water in the near surface layer may be observed by several methods. Most common methods are: taking a sample with a specially designed sea-bucket or reading the temperature of the condenser intake water. Some ships have electrical thermometers which measure either directly or through the hull. Comparative investigations of the various techniques are collected by Terziev (1981). The sea surface temperature is reported in tenths of degrees Celsius.

1.2.3 Air pressure.

The air pressure is measured either by a precision aneroid or by a mercury barometer. After reducing the measurements to sea level they are reported in tenths of hectopascals.

1.2.4 Cloud cover.

The total amount of cloud is estimated by considering how much of the sky is covered by cloud and is reported in oktas (one okta means one-eighth of the sky dome as seen by the observer). The reporting code is as follows.

0 = none
1 = 1 okta or less, but not zero
2 = 2 oktas
3 = 3 oktas
4 = 4 oktas
5 = 5 oktas
6 = 6 oktas
7 = 7 oktas
8 = 8 oktas
9 = sky obscured or cloud amount cannot be estimated.

1.2.5 Precipitation.

The occurrence of precipitation is simply determined and reported by the present weather (ww) code (WMO code 4677). By this code 100 kinds of weather at the time of observation can be reported. The first figure of the scale ww indicates a division of the scale in ten deciles, which corresponds to ten principal categories of weather at the time of observation; e.g. with ww = 50-59 various kinds of drizzle can be indicated, while ww = 60-69 means rain, ww = 70 - 79: solid precipitation not in shower, ww = 80 - 99: showery precipitation.

1.2.6 Visibility.

Visibility describes the degree of transparency of the atmosphere and is defined as the maximum distance at which an object can be seen, for example: in normal daylight, the distance at which an object such as a ship can just be discerned as such by an observer with normal eyes and in darkness, the distance at which a light of certain intensity and color is just visible.

On board ships the horizontal visibility is almost always estimated. At sea a detailed determination of visibility is mostly not possible. For this reason a rather coarse scale is used for the reporting code (VV), which is as follows:

90	< 50 m	95	2 - 4 km
91	50 - 200 m	96	4 - 10 km
92	200 - 500 m	97	10 - 20 km
93	500 -1000 m	98	20 - 50 km
94	1 - 2 km	99	> 50 km

If the horizontal visibility is not the same in different directions with VV the smallest visibility is reported.

1.2.7 Wind.

Most wind observations are estimates. In the period 1961-1970 only about 10% were measurements. In the decade 1971-1980 the number of measurements has increased considerably in some areas, often to about 30% and sometimes even more. In both decades in the German Bight about 70% of the observations consisted of measurements.

In the case of estimates the wind direction (the direction from which the wind comes) is determined by means of the compass from the direction of the crests of the sea waves (the wind direction is perpendicular to this) or from the direction of the foam streaks, which are blown in the direction of the wind. The wind direction is reported in tens of degrees.

The wind force is estimated using the Beaufort Scale. According to this scale the wind force can be given in 13 numbers, from 0 to 12. The number 0 corresponds to calm (no wind at all), while the number 12 corresponds to hurricane force.

This scale has been developed by the British admiral Sir Francis Beaufort in 1805 and is based on the speed a full-rigged frigate could make for the lower wind speeds and on the quantity of sails the ship could carry for the higher wind speeds. Later when the time of sailing vessels was over, the German captain P. Petersen has added to each scale number a description of the visible effect of the wind force on the sea surface. In this way it became possible to estimate the wind force from the appearance of the sea. Since 1946 there is an official WMO conversion scale in which to each scale number an interval of equivalent wind speeds (in knots and for a height of 10 metres above the sea surface) has been assigned. This scale is given in appendix 1.

Although it has appeared from several studies (Verploegh 1956, Dury 1970, Kaufeld 1981) that in reality the relation between Beaufort numbers and wind speed deviates considerably from the official WMO conversion table all efforts in the WMO Commission for Marine Meteorology to change it have been unsuccessful. Only for scientific use, other equivalent wind speeds have been accepted. This so-called scientific scale can be found in appendix 2.

To avoid ambiguity, in this study mainly Beaufort numbers have been used, in agreement with the observational data.

The accuracy of the estimates is influenced among others by the fact that the appearance of the sea is not only determined by the wind. Other phenomena which play a part are: the influence of the plankton content of sea water on the formation of foam; the influence of the current and bottom depth on the form of the waves; the influence of the air stability on the steepness of the waves; the influence of heavy rainfall or oil pollution; the influence of the wind fetch. Nevertheless the accuracy of a wind estimate is still reasonable.

Verploegh (1967) found for the standard deviation 0.58 I (I being the width of the scale interval) for each of the steps 1 to 10 of the Beaufort scale. This means that the standard deviation of an individual wind speed observation varies from 0.76 metres per second at step one (mean wind speed of 2.0 m/s) to 1.34 metres per second at step five (mean wind speed of 10.2 m/s) and 2.6 metres per second at step ten (mean wind speed of 24.2 m/s).

The averaging or representative time for these observations is not really known. In a study by Graham (1982) in which the winds estimated on board voluntary observing ships are compared with instrumental measurements at fixed positions it has been taken as equivalent to an hour. Owing to the relatively slow response of the sea to changes in wind speed this seems reasonable.

Winds measured by means of an anemometer on board ship give an accurate representation of the speed and direction of the air flow over the ship at the location of the anemometer. In order to determine the actual wind over the sea, the measured wind should be corrected to allow for the ship's movement by means of a vector diagram. The main problem with measuring wind on board a ship or a platform is that a fixed anemometer often cannot be sufficiently freely exposed to all wind directions and consequently the readings from it may not be representative of the true undisturbed air flow over the structure. Errors in the derived true wind thus occur, which may be appreciable, particularly with following winds. On big ships and on oil rigs, anemometers are usually installed at great heights; heights of 40 metres above the surface of the sea are by no means uncommon. The wind speed normally increases with height, the height variation depending on the air stability. Routine observations are, however, not corrected for heights and this is yet another source of error.
Errors of measured winds in ship reports can be so large that one should not automatically accept such a report as being accurate. When errors occur, they are often of the same order of magnitude as those in a visual observation; errors of about two metres per second may occur at all wind speeds.

1.2.8 Waves.

Ships observations of waves are always done visually. The parameters which are estimated are direction, period and height. The direction of the sea is taken to be equal to the direction of the wind. If a separate swell can be distinguished this is also reported.

The mean direction from which the waves are coming is reported in tens of degrees with respect to true North and can be estimated easily by means of the compass since the direction is perpendicular to the wave crests.

The average period is determined by counting the seconds between the passing of a number of well-developed wave crests. Until 1 January 1968 the period has been reported as a code figure Pw (WMO code 1955) as follows.

2 = 5 seconds or less	7 = 14 or 15 seconds
3 = 6 or 7 seconds	8 = 16 or 17 seconds
4 = 8 or 9 seconds	9 = 18 or 19 seconds
5 = 10 or 11 seconds	0 = 20 or 21 seconds
6 = 12 or 13 seconds	1 = 22 seconds or more

From 1 January 1968 the meteorological code for ships' observations was changed. Starting from that date the period of the sea has been reported in seconds and the period of the swell according WMO code 3155 which is as follows.

0 = 10 seconds	5 = 5 seconds or less
1 = 11 seconds	6 = 6 seconds
2 = 12 seconds	7 = 7 seconds
3 = 13 seconds	8 = 8 seconds
4 = 14 seconds or more	9 = 9 seconds

For the reporting of the wave height an estimate in half metres is made of the average height of the higher, well-developed waves in the central part of wave groups. Several studies have shown that this height is a fair approximation of the so-called significant wave height, which is defined as the average height of the highest one third part of the waves in the system (cf. section 2.10.8 and Nordenstrøm, 1969, Laing, 1985).

With respect to the accuracy of visual wave height observations Verploegh (1961) found that the standard error of an individual observation varies from 0.3 m at 1.5 m wave height to one metre at a 6 m wave height.

The visually estimated wave period is - unlike what applies to the wave height - not equal to the significant period (the mean period of the highest one third part of the waves) but is generally smaller. This is due to the bias of a visual observation towards those waves which are steepest.

2. Climatological data.

2.1. Air temperature.

In figure 2 for a number of subareas (shown in figure 1) the monthly and annual mean air temperature (in degrees Celsius) are given together with the standard deviations for the periods 1961-1970 and 1971-1980. Owing to the current system in the North Atlantic Ocean with branches of the so called North Atlantic current (which is the continuation of the warm Gulf Stream) through the English Channel and around the north of Scotland the mean annual temperatures over the North Sea are above the average compared with other sea areas at the same latitude elsewhere. The mean annual temperatures do not differ very much from place to place. In the northern areas they lie between 8 and 10 degrees centigrade and in the southern areas between 9 and 11 degrees. The month with the highest mean temperature is August, while the lowest mean temperature mostly occurs in February, which is a month later than on the continent.

Figures 3-14 show means of monthly means and means of monthly maxima and minima for one degree squares for the months February, May, August and November over the period 1961-1980. In the geographical distribution of the temperatures the influence of the ocean in the north-west and of the continent in the east can be seen. Namely, the mean temperatures in February are highest in the western areas with values of about 5 degrees and lowest in the German Bight with values of about 1 degree, while to the contrary in August the lowest mean temperatures occur in the north-west (about 13°) and the highest mean temperatures in the south-east (about 17°). The greater range in the south-east part of the region reflects the climate influence of the continent. While isotherms in February and August have a more north-south orientation, in the months May and November they are more directed like the parallels of latitude. In practically the whole North Sea the mean monthly minimum and maximum temperatures are respectively roughly 3-4 degrees lower and higher than the mean temperatures.

2.2. Sea surface temperature.

In figure 15 the monthly and annual mean sea surface temperatures are given for the same subareas as for the air-temperature (for subareas see figure 1) together with the standard deviations for the two decades 1961-1970 and 1971-1980. The mean annual sea surface temperatures lie between 9 and 10°C in the northern areas and between 10 and 12°C in the southern areas. The month with the highest mean temperature is - like for the air temperature - August, while the lowest mean sea surface temperature mostly occurs in March (which was February for the air temperature). The sea surface temperature shows less variation (smaller standard deviations) than the air temperature. The variations are smallest in the north-west, while the greatest variations occur in the German Bight.

Figures 16-27 show means of monthly means and means of monthly maxima and minima for one degree squares for the months February, May, August and November over the period 1961-1980. Due to the supply of warmer water through the English Channel and around the north of Scotland the mean temperatures in February are highest with values of about 7°C in a tongue of warmer water in the central part of the southern North Sea and in the north-western part of the North Sea. As for the air temperature the lowest mean sea surface temperature (2-3°C) occurs in the German Bight. August gives a same pattern as for the air temperature with the lowest mean temperature (about 12.5°C) in the north-west and the highest mean temperature (about 17.5°C) in the south-east along the Danish, German and Dutch coasts. May and November are transition months in which the mean sea surface temperature in the North Sea does not vary very much from place to place.
In practically the whole North Sea the mean monthly minimum and maximum temperatures differ roughly 2-3 degrees with the mean temperatures.

2.3. Air-sea surface temperature difference.

In figure 28 the monthly and annual mean differences between the air- and the sea surface temperatures are given for the same subareas as for the air temperature and the sea surface temperature (for subareas see figure 1) together with the standard deviations for the two decades 1961-1970 and 1971-1980. The annual differences are all negative, which means that on the average the air is colder than the sea surface water, especially during night time. From April to July, however the sea is slightly colder than the overlying air, which is one of the conditions that are favourable for the development of sea fog.

2.4. Sea level pressure (figure 29).

In agreement with the general pressure distribution with an Icelandic Low and an Azores High the mean annual pressure increases from north to south from about 1011 hPa to about 1015 hPa. The mean pressure is generally higher in the summer months and lower in the winter months, but there is no smooth seasonal variation. In some areas also in the months January or February the pressure is above the average.

2.5. Cloud cover.

In general, cloud amounts are high over the North Sea. Figure 30 shows for selected areas (see figure 1) the monthly and annual percentages of surface observations having a cloud cover of 2/8 or less and 6/8 or more. The mean annual percentages lie between 11 and 21% for a cloud cover of 2/8 or less and between 60 and 71% for a cloud cover of 6/8 or more.

The cloud cover varies little from place to place. Generally, the cloud cover decreases a little from north to south and from west to east. The total cloud cover also varies with the seasons. The percentages with a cloud cover of 2/8 or less are highest (about 20-30%) during the months April, May and June and lowest (about 10-20% during the months November, December and January, while on the contrary the percentages with a cloud cover of 6/8 or more are highest (70-80%) in the months December, January and February and lowest (50-60%) in the months April, May and June. It is remarkable that during the summer season there often is a secundary maximum in cloud cover in July.

2.6. Precipitation.

In figure 31 the mean monthly and annual percentages of observations with precipitation are given for selected subareas (figure 1) for the decades 1961-1970 and 1971-1980. The mean annual percentages lie between 6 and 14%. They are higher in the north than in the south. There are no distinct wet or dry seasons, but there is a well-marked seasonal variation. The months May, June and July are the driest (percentages of about 4-11) and the months November, December and January are the wettest (percentages of about 11-23). Most of the precipitation falls in the form of rain or drizzle but especially in the months January and February an important part is formed by snow.

2.7. Visibility.

Figure 32 shows the monthly and annual percentages of surface observations having visibilities of less than 1 km and 10 km or more for 8 selected areas of figure 1. The mean annual percentages for visibility less than 1 km (such as in fog) are rather small (2-4%) and for visibility of 10 km or more great (70-83%). However, the occurrence of fog varies from place to place and with the seasons. The months of maximum fog in the northern areas are April, May and June (in these months the sea is on the average slightly colder than the overlying air) and January to June in the southern areas when about 5-10% of the observations have a visibility of less than 1 km. During the autumn months fhe frequency of fog is generally low due to the relatively warm water with respect to the temperature of the air.
The frequencies of observations with a visibility of 10 km or more are higher in the last six months of the year than in the first six months.

Figures 33-44 give frequencies of visibilities less than 4000 m, 1000 m and 200 m for one degree squares for the months January, April, July and October over the period 1961-1980. One remarkable feature is that in January the maximum occurrence of fog is in the German Bight and the minimum in the north-west of the North Sea, while this situation is reversed in July.

2.8. Superstructure icing.

Ice accretion on ships due to the freezing of spray can occur with air temperatures below -2°C (with normal salinity sea spray freezes when the sea temperature is -1.9°C). The severity of this phenomenon increases with lower sea surface temperatures and higher wind speeds. There are no observations available of ice accretion on ships. Instead figure 45 gives frequencies of observations with simultaneously air temperatures ≤ -2°C and winds of ≥ 6 Beaufort, under which circumstances a potentiality exists of moderate or severe superstructure icing due to the freezing of spray. As figure 45 shows these circumstances do occur sometimes in the North Sea, especially in the eastern areas, mostly during the months January and February.

2.9. Wind.

2.9.1 General remarks.

The North Sea lies in the zone between the Icelandic Low and the Azores High in which normally depressions with their frontal systems are moving eastwards. Only sometimes a blocking high occurs in or near the region. Therefore winds from westerly directions are prevailing, although winds from all directions are possible.

The prevailing wind direction is the resultant vector mean direction with each speed set equal to 1, while the steadiness (or constancy) is the ratio of the mean resultant wind speed to the mean wind speed irrespective of direction; in other words the ratio of the vector mean to the scalar mean. In regions where the wind always has about the same direction the ratio will be near 1. For example in the trade winds steadinesses of more than 0.8 occur. The smaller the ratio the more variable the winds are.

In figure 46 prevailing monthly and annual wind directions are shown together with the steadiness of the wind for a number of selected areas (figure 1) for the two decades 1961-1970 and 1971-1980. As figure 46 shows the prevailing annual wind direction lies between SW and WNW with a steadiness of 0.2. However, there is a seasonal variation. During the summer months, especially June and July the prevailing direction in most areas is between WNW and NW with sometimes a rather high steadiness (0.3 - 0.5). In the period from September to December in most areas the prevailing wind direction is between SW and W. Remarkable is that in the decade 1971-1980 the steadiness in October is much less and in November and December much greater than in the decade 1961-1970. In January the prevailing wind direction is mostly SSW. February and March are transition months with prevailing winds from several directions. In April and May just northerly directions are prevailing, especially in the period 1971-1980.

2.9.2 Median wind speed.

The median wind speed is the speed exceeded in 50% of the observations. In figure 47 the monthly and annual median windspeeds are given for the 8 selected areas. The annual median windspeeds mostly fall within force 4 of the Beaufort scale. In November, December and January the median windspeed mostly falls in the speed interval of force 5, in June mostly in force 3 and in the rest of the months mostly in force 4.

2.9.3 Frequencies of gales, light and strong winds.

The frequencies of gales (wind force 8 or more) and their prevailing directions in the different months of the year are given in figure 48 for 8 selected areas (figure 1) during the decades 1961-1970 and 1971-1980. Gales are most frequent in November, December and January and least frequent from May to August. During the summer months the differences in occurrence between the northern and the southern areas are small. In the winter months however the frequency in the north with percentages of 10-20% is much greater than in the south with percentages of about 5-10%. The prevailing directions of the gales mostly are the same as for all winds.

In figure 49 the frequencies of light winds (wind force 2 or less) and strong winds (force 6 or more) are shown for the same selected areas.

2.9.4 Exceedance percentages.

For each one degree square of the North Sea between 51°N and 60°N monthly percentages of wind forces of respectively greater than Beaufort 5, 6, 7, 8 and 9 and less than Beaufort 3, 4 and 5 have been determined for the period 1961-1980. In figures 50-61 a selection is given in the form of charts with frequencies of wind forces of greater than 5 and 7 Beaufort and less than 4 Beaufort for the months January, April, July and October which months can be thought to be representative for the 4 seasons. The upper figure in each one degree square gives the frequency and the lower figure the number of observations on which the calculation is based. Some isolines of equal frequencies have been drawn. As there are sometimes large differences between the numbers of observations available for each one degree square the data have to be considered with some care. The influence of the land where the frictional effect on the wind is greater than over sea is reflected in the pictures. In the charts with wind forces greater than 5 or 7 Beaufort the maximum frequencies occur in the centre of the northern part of the area while the frequencies gradually decrease towards the coasts. For example the January chart for wind force > 7 (gale force or more) given in figure 51 shows a maximum of greater than 20%, while the percentages decrease to about 10% near the British and Norwegian coasts. They also decrease southwards to less than 5% but with a secondary maximum of greater than 5% in the southern North Sea. Probably this is caused by the tongue of warmer water coming through the English Channel into the North Sea, while also the prevailing SW-ly wind of which the fetch is relatively long can contribute to this phenomenon.
The January chart for windforce < 4 Beaufort given in figure 52 shows the opposite with a minimum in the centre of the northern part of the area and an increasing of the percentages to the coasts and to the south. Now a secundary minimum occurs over the warmer water in the southern North Sea.

During the whole year the maximum frequency of gale force occurrences (> 7 Beaufort) is situated in the centre of the northern part of the area. In January there is a highest isoline of 20%; in February only of 10%, in March 15%, April 5%, May 2%, while June is the quietest month with only 1%, in July and August 2%, September 5%, October 10%, November 15% and December 20%. The secondary maximum in the south of the North Sea is only present in January and February.

2.9.5 Wind roses.

Information about wind force depending on wind direction is given in figures 62-89. For seven selected areas wind roses are shown for the months January, April, July and October over the period 1961-1980. Roses are given for 4 classes of wind force, namely Beaufort 1-3, Beaufort 4-5, Beaufort 6-7 and Beaufort 8-12. The percentage of calms is given in the centre of the first rose. The roses clearly show that all directions occur. At higher wind force however, there are clearer preferences for certain directions than in the case of light winds. In the southern areas directions between SW and NW are occuring the most (SW in the wintermonths, while in the summer months NW is occurring more frequently). The frequency of N-ly and NE-ly winds is relatively high in April, May and June and low in October, November and December. SE-ly wind directions occur least, especially from April to August.
This picture changes gradually with increasing latitude. SE-ly directions are getting higher percentages, especially during the winter months, while from April to August NW-ly and N-ly directions have relatively high percentages, while during October, November and December directions between SW and NW score high. In the northern areas NE-ly wind directions occur least.

2.9.6 Probabilities of extreme high wind speeds.

Extreme values of wind speeds in m/s with return periods of respectively 10, 50 and 100 years have been determined for each one degree square of the North Sea between 51°N and 60°N. The data have been determined from the cumulative frequency distributions of all available wind speed observations made by selected ships over the period 1961-1980, irrespective of direction or season. The equivalent values belonging to the so-called scientific scale have been assigned to the estimates according to the Beaufort scale (cf. Appendix 2). Such values can be interpreted as hourly mean wind speeds. After this the return values have been estimated by extrapolation on Weibull diagram paper. The results are given in figures 90, 91 and 92. As could be expected the highest values occur in the centre of the northern part of the area. The values decrease towards the coasts and the south.

2.10 Waves.

2.10.1 General remarks.

Except for swell the directional distribution of the waves corresponds to that of the wind. Differences occur in the roses. This is caused by the fact that in making the wave roses always from each observation the highest system (either sea or swell) has been used. In the case of equal height the system with the longer period was chosen. The height of the sea waves corresponds to the wind speed. Limiting factors for the growth of the waves are duration, fetch and water depth. In the North Sea only NW-ly winds may have very long fetches. If the duration in this situation is long enough very high waves develop, but the height of the waves is more often limited by the short duration of the wind from this direction. The limiting factor with winds from other directions is mostly the fetch. Especially in the southern North Sea also the water depth is another limiting factor.

2.10.2 Median wave height.

The median wave height is the height exceeded in 50% of the observations. In figure 93 the monthly and annual median wave heights are given for 8 selected areas (see figure 1). For the determination of the median wave height from each observation the highest of sea or swell has been used. The annual median wave heights vary between 1 and 2 m in the north and between 0.5 and 1 m in the south. The values are slightly higher during the period 1971-1980 than during the period 1961-1970. This is most pronounced in the north. During the winter months the median wave heights vary there from 2-3 m in the period 1971-1980 and from 1.5 - 2 m in the period 1961-1970. During the summer months they vary from 1 - 1.5 m in the period 1971-1980 and from 0.5 - 1 m in the period 1961-1970.

2.10.3 Frequencies of wave heights of 4 and 6 m or more and of 1.5 m or less.

The monthly and annual frequencies of wave heights of 4 m or more and 6 m or more are given in figure 94 for 8 selected areas (figure 1) during the decades 1961-1970 and 1971-1980. There is a well-marked annual variation with the highest frequencies in November, December and January and the lowest frequencies from May to August. There are large differences between the north and the south with of course the higher percentages in the north. In most cases the frequencies in the period 1971-1980 are higher than those in the period 1961-1970. In figure 95 the frequencies of low waves(heights 1.5 m or less) are shown for the same selected areas.

2.10.4 Wave periods of 6 seconds or more.

From the visually estimated wave parameters the period is the least reliable. Therefore in this report the only period data given are the monthly and annual percentages of observations with wave periods of six seconds or more for the 8 selected areas (figure 1) and the two decades 1961-1970 and 1971-1980. The data are shown in figure 96. The choice of six seconds or more is more or less arbitrary but is related to the fact that in the reporting code all periods of 5 seconds or less were indicated by one code figure.

2.10.5 Prevailing swell direction.

In figure 97 the prevailing monthly and annual swell directions are given for the 8 selected areas (figure 1) and for the two decades 1961-1970 and 1971-1980. In contrast with the prevailing wind direction (figure 46) the prevailing swell is almost always from a northerly direction.

2.10.6 Exceedance percentages.

For each one degree square (a square of one degree latitude by one degree longitude) of the North Sea between 51°N and 60°N monthly percentages of wave heights of respectively greater than 1 3/4, 2 3/4, 3 3/4, 4 3/4 and 5 3/4 metres and less than ¼, 3/4 and 1¼ metres have been determined for the period 1961-1980. From each observation the highest of sea or swell has been used. In figures 98-109 a selection is given in the form of charts with frequencies of wave heights of greater than 1 3/4 and 3 3/4 m and less than 1¼ m for the months January, April, July and October, which months can be thought to be representative for the 4 seasons. The upper figure in each one degree square gives the frequency and the lower figure the number of observations on which the calculation is based. Some isolines of equal frequencies have been drawn. As there are sometimes large differences between the numbers of observations available for each one degree square the data have to be interpreted with some care. Both because the wind is stronger in the open sea and because of the longer fetches in the charts with waveheights greater than 1 3/4 m and 3 3/4 m the maximum frequencies occur in the centre of the northern part of the area while the frequencies gradually decrease towards the coasts. For example the January chart for wave heights of greater than 3 3/4 m, given in figure 99 shows a maximum of more than 30%, while the percentages decrease to about 10% near the British and Norwegian coasts. They also decrease southwards to less than 5%, but with a secondary maximum south of the Dogger Bank of more than 5%. The January chart for wave heights of less than 1¼ m shows the opposite with a minimum in the centre of the northern part of the area and an increasing of the percentages to the coasts and to the south, while a secondary maximum occurs at the Dogger Bank. During the whole year the maximum frequency of wave heights of greater than 3 3/4 m occurs in the centre of the northern part of the area. In January there is a highest isoline of 30%, in February only of 20%, in March 30%, April 10%, May 5%, June 5%, July 5%, August 5%, September 10%, October 20%, November 25% and December 30%.

2.10.7 Wave roses.

Information about wave height depending on wave direction is given in figures 110-137. For seven selected areas wave roses are shown for the months January, April, July and October over the period 1961-1980. Roses are given for 4 classes of wave height in 0.5 metre values, namely 0-3 (0-1½ m), 4-7 (2-3½ m), 8-11 (4-5½ m) and greater than 11 (5½ m). The percentage of observations with a calm sea is given in the

centre of the first rose. In making the wave roses always from each observation the highest system (either sea or swell) has been used. In the case of equal heights the system with the longer period was chosen. The higher waves show clearer preference for certain directions compared to the lower waves, in analogy with wind directions at greater wind force.
In the southern areas in the case of the higher waves NW-ly directions are occurring the most, while more to the north also SE-ly directions are getting higher percentages of occurrence.

2.10.8 Probabilities of extreme wave heights.

Extreme wave heights in metres with return periods of respectively 10, 50 and 100 years have been determined for each one degree square of the North Sea between 51°N and 60°N. The data have been determined from the cumulative frequency distributions of all available visually estimated wave heights by voluntary observing ships over the period 1961-1980, irrespective of direction or season. The return periods have been estimated by extrapolation on Weibull diagram paper. In making the cumulative frequency distributions from each individual observation the highest of sea or swell has been used. The results are given in figures 138, 139 and 140. As could be expected the highest values occur in the centre of the northern part of the area. The values decrease towards the coasts and the south.

Of course measurements are more suitable than estimates for determining extreme wave heights. However sufficiently long series of measurements are hardly available. In general it is the opinion that the statistics based on large enough numbers of visual observations are sufficiently reliable. Particularly related with estimating extreme wave heights a matter of concern is the relation between significant wave height H_s from measured records and the visually estimated wave height H_v. The relation between H_v and H_s has been studied by several authors. In case of low waves values for the ratio H_s/H_v are usually given between 1.0 and 1.1. For higher waves the following relationships have been found, based on weathership data:

$H_s = 1.68\ H_v^{0.75}$ (Nordenstrøm, 1969)

or $H_v = 0.98\ H_s + 0.5$ (Jardine, 1979)

or $H_s = 2.33 + 0.75\ H_v$ (Soares, 1986).

Such relations must be looked at with some caution. For example for $H_v = 10$ m according to Nordenstrøm $H_s = 9.4$ m, according to Jardine $H_s = 9.7$ m and according to Soares $H_s = 9.8$ m. These results are close together,but for $H_v = 15$ m there are already great differences. The results for H_s then are respectively 12.8 m, 14.8 m and 13.6 m. Anyway, this suggests a certain overestimation in extreme conditions. On the other hand, such relations only refer to observations, not to extrapolations like the return period values as given in figures 138-140.

Another complicating factor is the increasing influence of bottom depth on extreme wave heights, suggesting that straightforward extrapolation of the observed distribution of wave heights does not hold fully for shallow areas like the southern North Sea (see Bouws, 1978).

References.

E. Bouws (1978). Wind and wave climate in the Netherlands sector of the North Sea between 53° and 54° north latitude. KNMI scientific reports WR 78-9.

J.M. Dury (1970). The Beaufort scale of wind force. WMO Reports on Marine Science Affairs No. 3, Genève.

A.E. Graham (1982). Winds estimated by the Voluntary Observing Fleet compared with instrumental measurements at fixed positions. The Meteorological Magazine 111: 312-327.

T.P. Jardine (1979). The reliability of visually observed wave heights. Coastal engineering 3: 33-38.

L. Kaufeld (1981). The development of a new Beaufort equivalent scale. Meteorologische Rundschau 34: 17-23.

C.G. Korevaar (1987). Climatological data of the Netherlands lightvessels over the period 1949-1980. KNMI scientific reports WR 87-9.

A.K. Laing (1985). An Assessment of Wave Observations from Ships in Southern Oceans. Journal of climate and Applied Meteorology, 24: 481-494.

N. Nordenstrøm (1969). Methods for predicting long-term distributions of wave loads and probability of failure for ships, Appendix II: Relationships between visually estimated and theoretical wave heights and periods. Rep. 69-22 S, Det Norske Veritas.

C.G. Soares (1986). Assessment of the uncertainty in visual observations of wave height. Ocean Engineering, 13: 37-56.

F.S. Terziev (1981). Investigation of contemporary methods of measuring sea surface and surface-layer temperatures. WMO Marine Meteorology and related oceanographic activities Report No. 2.

G. Verploegh (1956). The equivalent velocities for the Beaufort estimates of the wind force at sea. KNMI mededelingen en Verhandelingen 66, 's-Gravenhage.

G. Verploegh (1961). On the accuracy and the interpretation of wave observations from selected ships. Working paper, CMM Working group for Technical problems, WMO, Genève.

G. Verploegh (1967). Observation and analysis of the surface wind over the ocean. KNMI Mededelingen en Verhandelingen 89, 's-Gravenhage.

Figure captions.

Figure 1	Selected areas for which statistical data are given in figures 2, 15, 28-32, 45-49 and 93-97.
Figure 2	Mean air temperature with standard deviations for areas indicated in figure 1.
Figures 3-14	Means of monthly means and means of monthly maxima and minima of the air temperature for the months February, May, August and November over the period 1961-1980.
Figure 15	Mean sea surface temperature with standard deviations for areas indicated in figure 1.
Figures 16-27	Means of monthly means and means of monthly maxima and minima of the sea surface temperature for the months February, May, August and November over the period 1961-1980.
Figure 28	Mean air-sea temperature differences with standard deviations for areas indicated in figure 1.
Figure 29	Mean sea-level pressures for areas indicated in figure 1.
Figure 30	Percentages of observations with total cloud amount $\leq 2/8$ and $\geq 6/8$ for areas indicated in figure 1.
Figure 31	Percentages of observations with precipitation for areas indicated in figure 1.
Figure 32	Percentages of observations with visibility < 1 km and ≥ 10 km for areas indicated in figure 1.
Figures 33-44	Frequencies of visibility less than 4000 m, 1000 m and 200 m for the months January, April, July and October over the period 1961-1980.

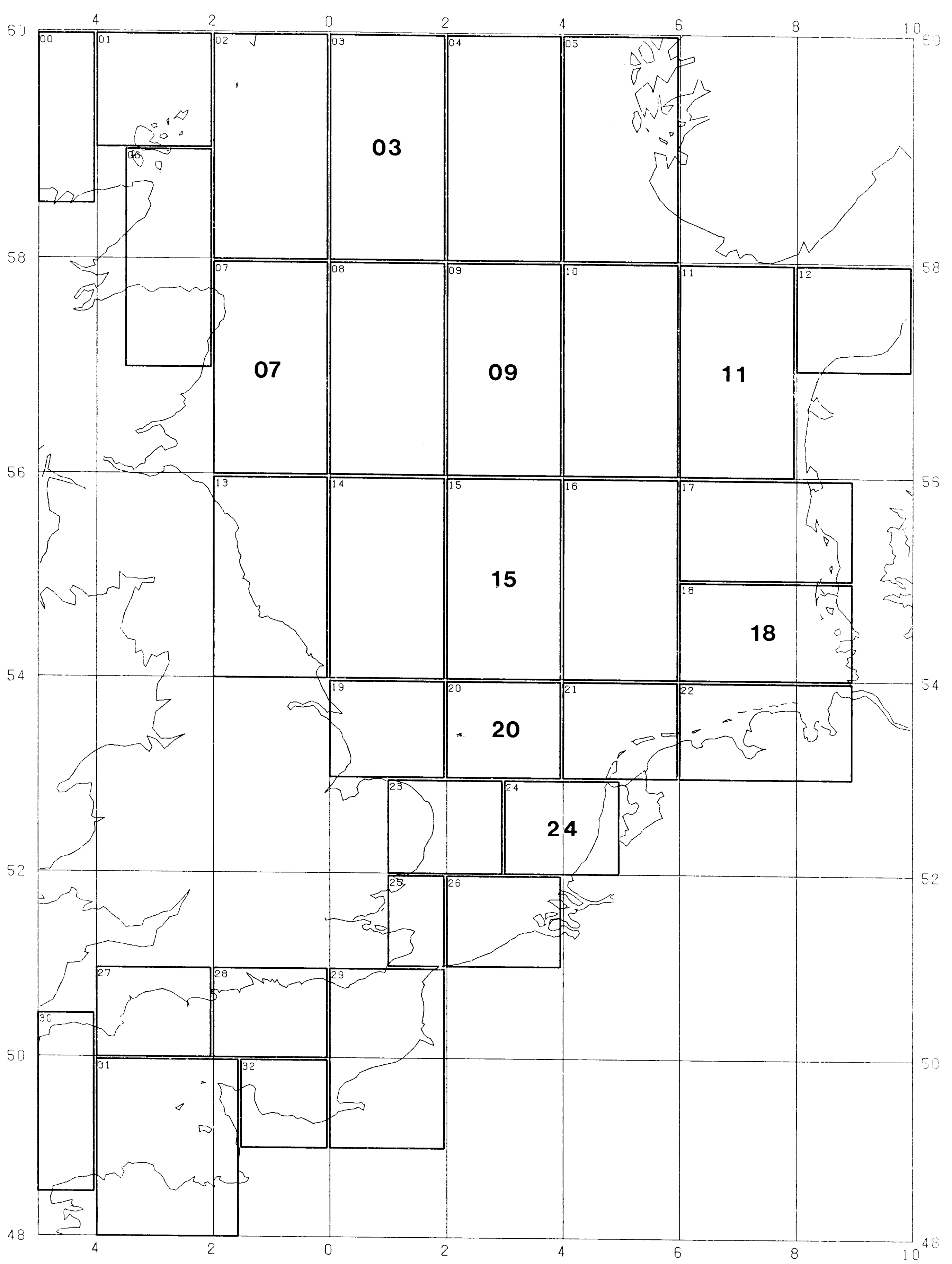


Figure 1 Selected areas for which statistical data are given in figures 2, 15, 28-32, 45-49, 62-89, 93-97 and 110-137.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	5.7	5.4	5.4	6.4	8.3	10.9	13.0	14.1	12.4	9.9	7.9	6.6	8.7
	1.9	1.8	1.7	1.3	1.6	1.4	1.7	1.8	1.5	1.7	1.8	2.0	3.4
07	5.7	5.4	5.8	6.6	9.0	11.2	13.4	13.8	12.4	10.9	8.2	7.0	9.7
	2.1	2.2	1.5	1.9	1.8	1.8	2.1	1.7	1.6	2.3	2.4	2.4	3.5
09	5.7	5.0	5.0	6.1	8.6	11.8	14.1	14.9	13.1	10.8	8.1	6.7	8.8
	1.9	2.0	1.8	1.3	1.9	1.7	1.9	1.6	1.5	1.8	2.0	1.9	3.8
11	3.8	3.3	3.6	5.8	9.5	12.9	14.8	16.0	13.2	10.7	7.9	5.6	9.0
	2.8	3.0	2.6	2.0	2.3	2.4	2.4	2.0	1.8	2.3	2.7	2.7	5.1
15	5.7	4.9	5.1	6.5	9.3	12.8	14.9	15.8	14.1	12.1	8.9	7.1	9.5
	2.1	2.0	2.0	1.4	1.9	1.9	2.0	1.7	1.7	2.1	2.3	2.4	4.4
18	3.1	4.0	3.2	6.0	10.5	13.1	16.3	17.0	14.9	11.9	8.4	6.7	9.5
	3.3	2.1	3.0	1.7	2.3	2.1	2.2	1.6	1.6	2.7	3.1	2.1	5.4
20	5.8	5.2	5.7	7.2	9.9	13.1	15.0	16.4	15.1	12.2	9.4	7.6	10.4
	2.2	2.1	2.3	1.6	1.8	1.9	1.9	1.7	1.6	2.0	2.5	2.0	4.4
24	5.4	4.8	6.4	7.8	10.6	13.8	15.9	17.0	15.9	13.1	9.6	7.4	10.8
	2.7	2.5	2.2	2.1	2.2	2.4	2.2	1.7	1.7	2.5	2.3	2.7	4.9

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	5.3	3.9	4.9	6.4	8.2	11.8	12.5	13.5	12.6	10.7	7.5	6.1	9.1
	2.0	2.6	2.0	2.2	1.8	2.1	1.9	2.2	1.8	1.9	2.2	2.1	3.9
07	5.5	4.7	5.3	6.5	8.6	11.3	12.9	13.1	12.7	11.2	7.6	6.2	9.8
	2.0	2.2	2.0	1.9	1.9	1.6	1.8	1.5	1.5	1.7	2.3	2.1	3.6
09	4.8	4.1	4.9	5.9	8.1	12.2	13.6	14.5	13.7	11.2	7.7	5.9	8.3
	2.2	2.4	1.9	1.9	1.7	2.0	1.9	1.8	1.7	1.7	2.0	1.9	4.0
11	2.9	2.2	3.8	5.5	8.9	13.5	14.8	15.9	14.1	11.5	7.4	4.4	8.9
	3.1	3.1	2.3	2.3	2.4	2.6	2.2	2.5	2.0	2.0	2.8	2.8	5.4
15	4.9	4.0	4.7	6.1	9.0	12.7	14.4	15.3	14.3	12.5	8.7	6.1	10.2
	2.2	2.4	2.0	2.0	1.9	2.1	2.0	1.8	1.7	1.9	2.2	2.1	4.6
18	1.8	1.7	2.9	5.6	10.4	14.4	15.6	16.5	15.0	11.9	7.1	4.0	8.5
	2.9	2.9	2.5	2.7	2.4	2.4	2.0	1.8	1.7	2.3	2.9	3.1	6.1
20	4.6	4.1	4.8	6.5	9.7	13.0	14.7	15.8	15.0	12.9	9.1	6.2	10.2
	2.6	2.4	2.2	2.0	2.0	2.2	1.9	1.7	1.7	2.1	2.6	2.7	4.8
24	4.0	4.0	5.3	8.0	10.5	14.1	15.8	16.8	16.2	13.4	9.5	5.7	10.4
	3.6	2.9	2.5	2.5	2.4	2.3	2.4	1.7	1.9	2.6	2.8	3.1	5.3

Figure 2: Mean air temperatures (upper figures) in degrees Celsius with standard deviations (lower figures) for areas indicated in figure 1.

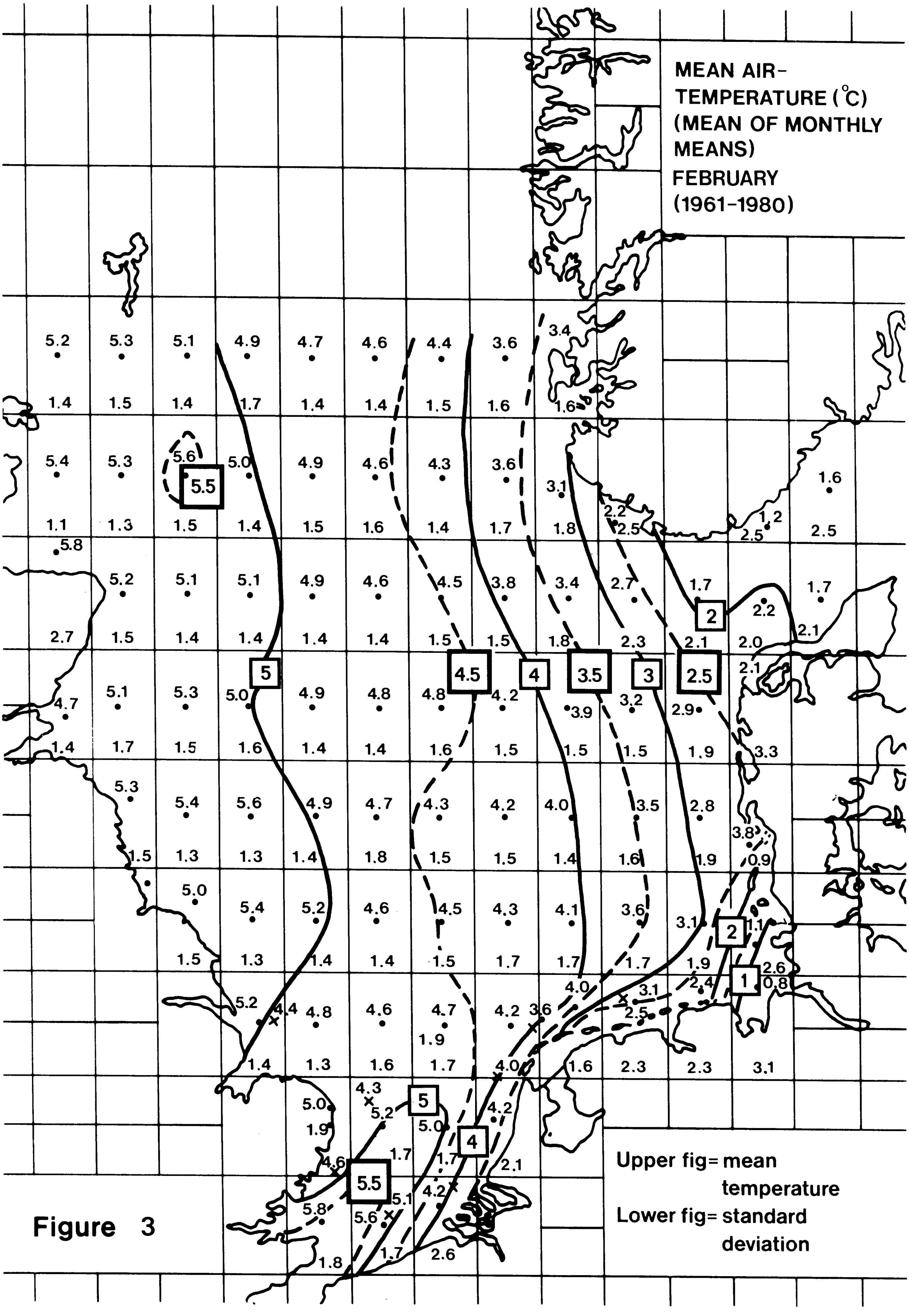

MEAN AIR-TEMPERATURE (°C)
(MEAN OF MONTHLY MEANS)
FEBRUARY
(1961-1980)
Upper fig= mean temperature
Lower fig= standard deviation

Figure 3

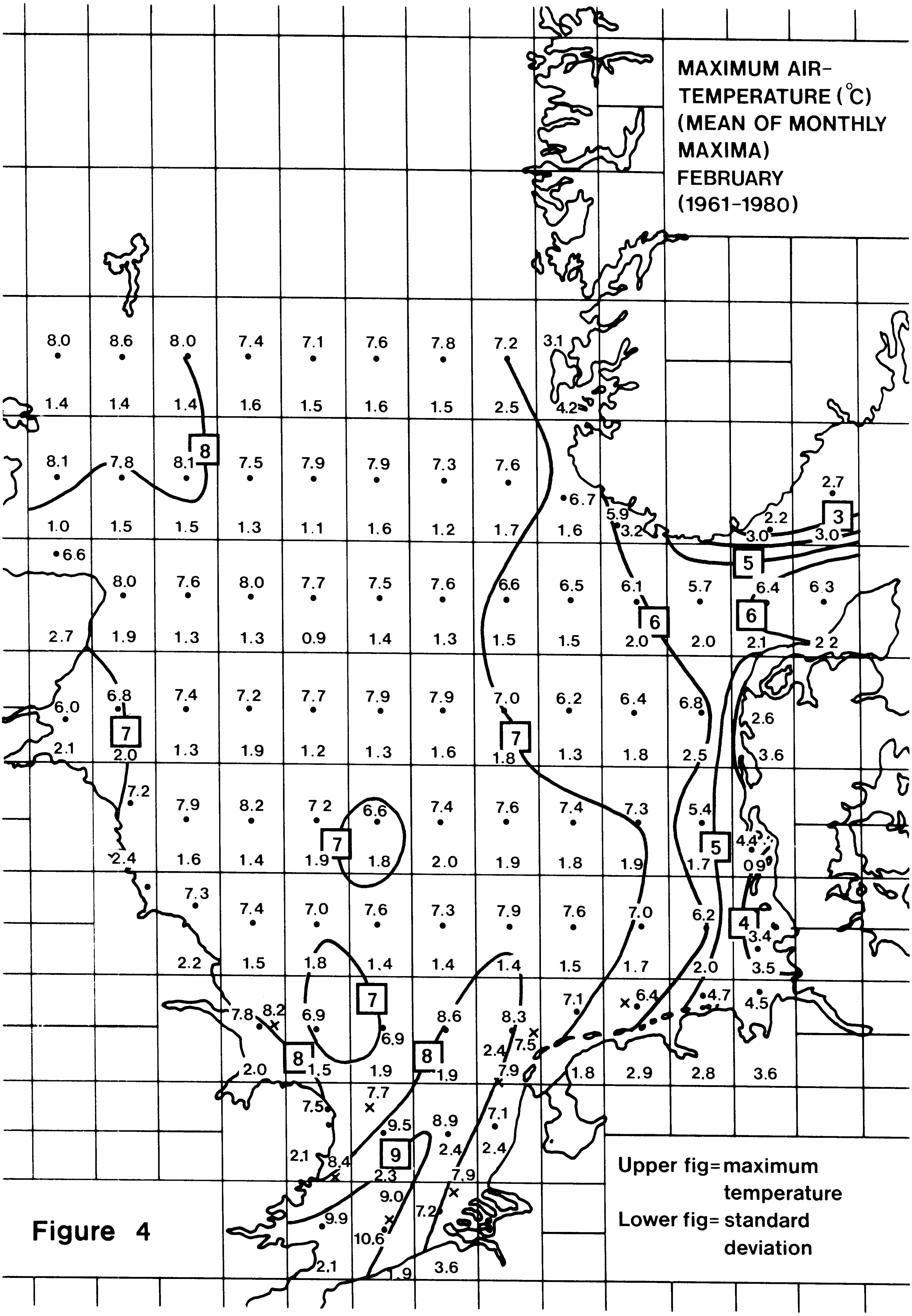

MAXIMUM AIR-
TEMPERATURE (°C)
(MEAN OF MONTHLY
MAXIMA)
FEBRUARY
(1961-1980)
Upper fig=maximum
temperature
Lower fig= standard
deviation

Figure 4

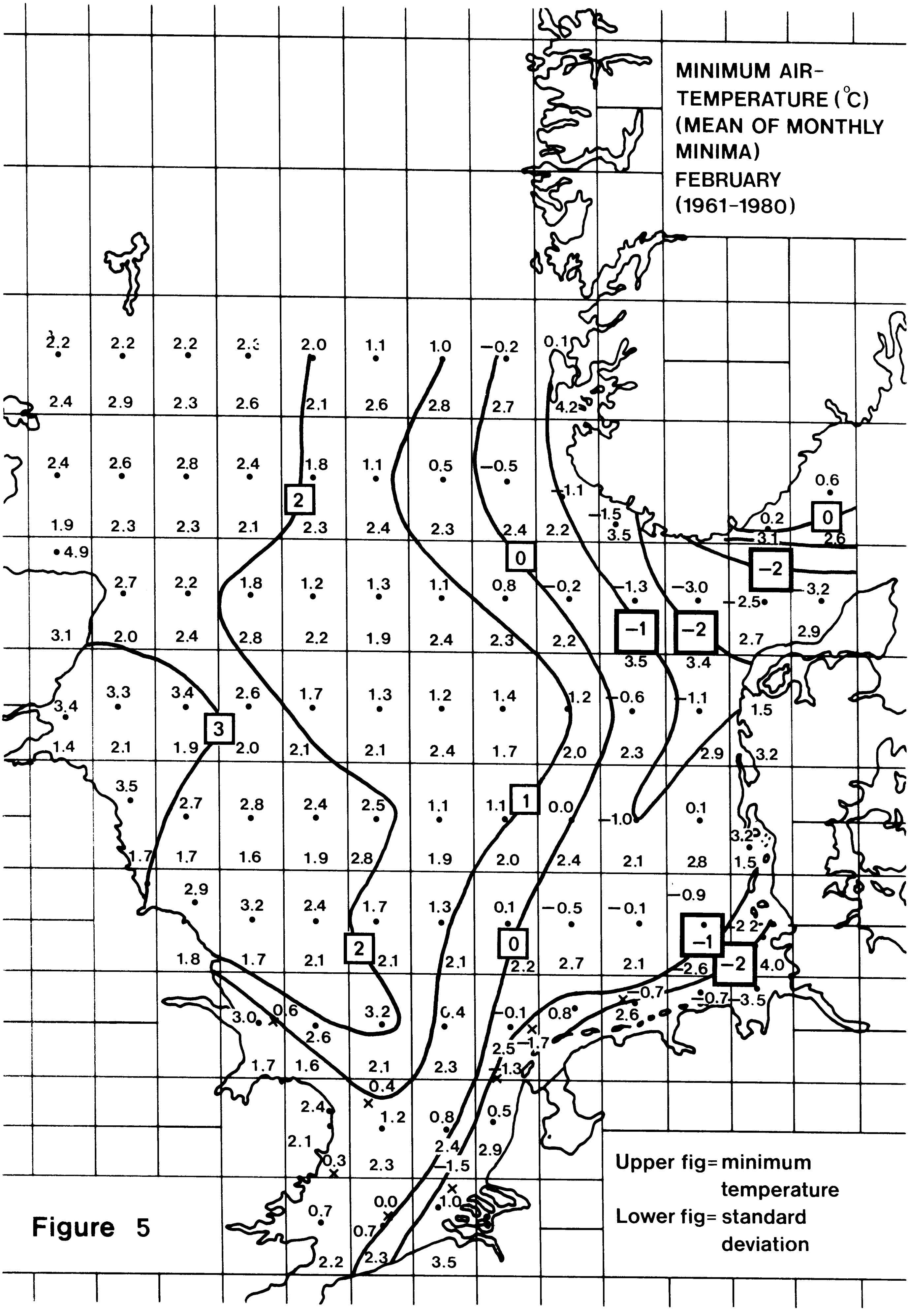

MINIMUM AIR-TEMPERATURE (°C) (MEAN OF MONTHLY MINIMA) FEBRUARY (1961-1980)
Upper fig= minimum temperature
Lower fig= standard deviation

Figure 5

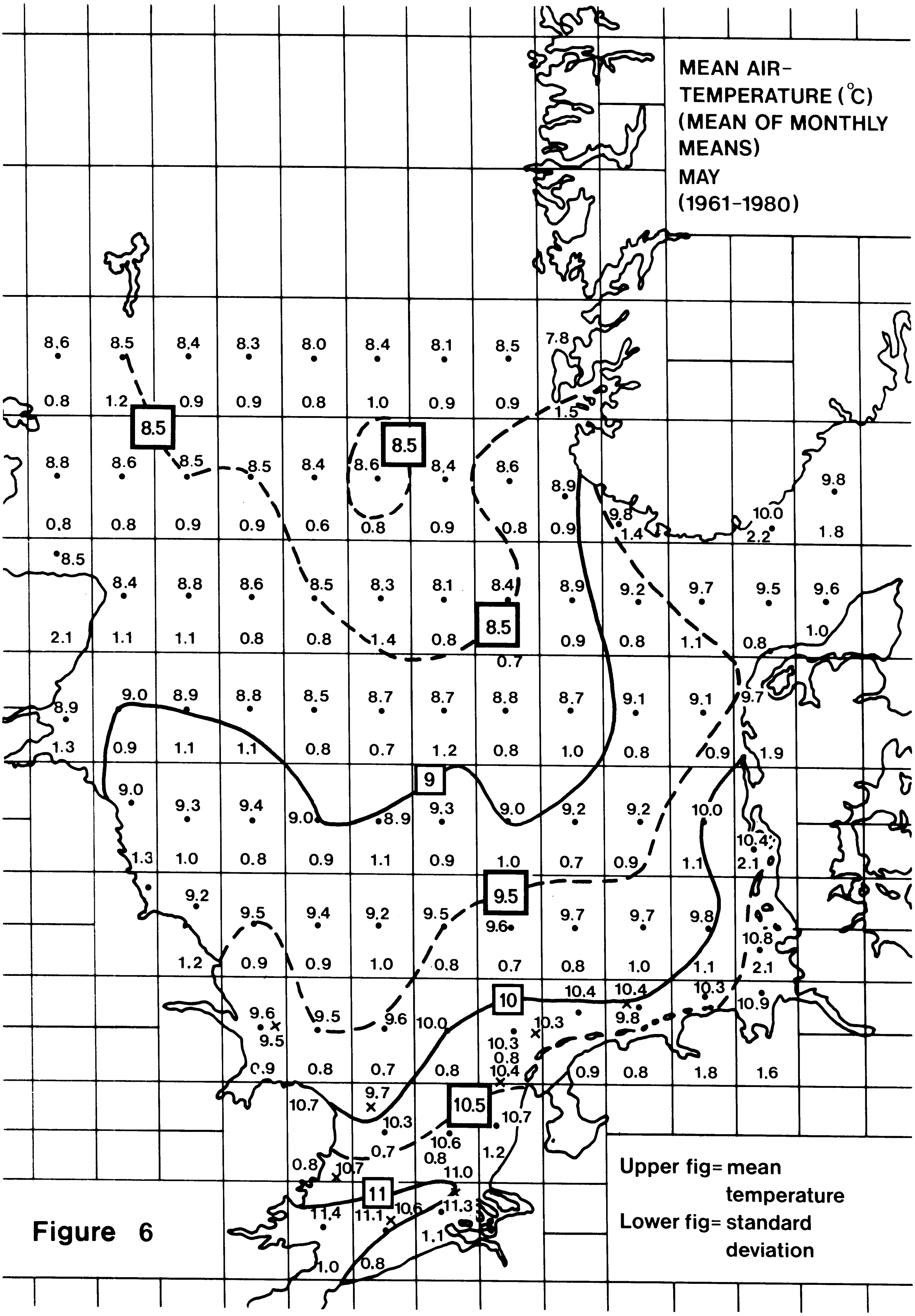

MEAN AIR-
TEMPERATURE (°C)
(MEAN OF MONTHLY
MEANS)
MAY
(1961-1980)
Upper fig= mean
temperature
Lower fig= standard
deviation

Figure 6

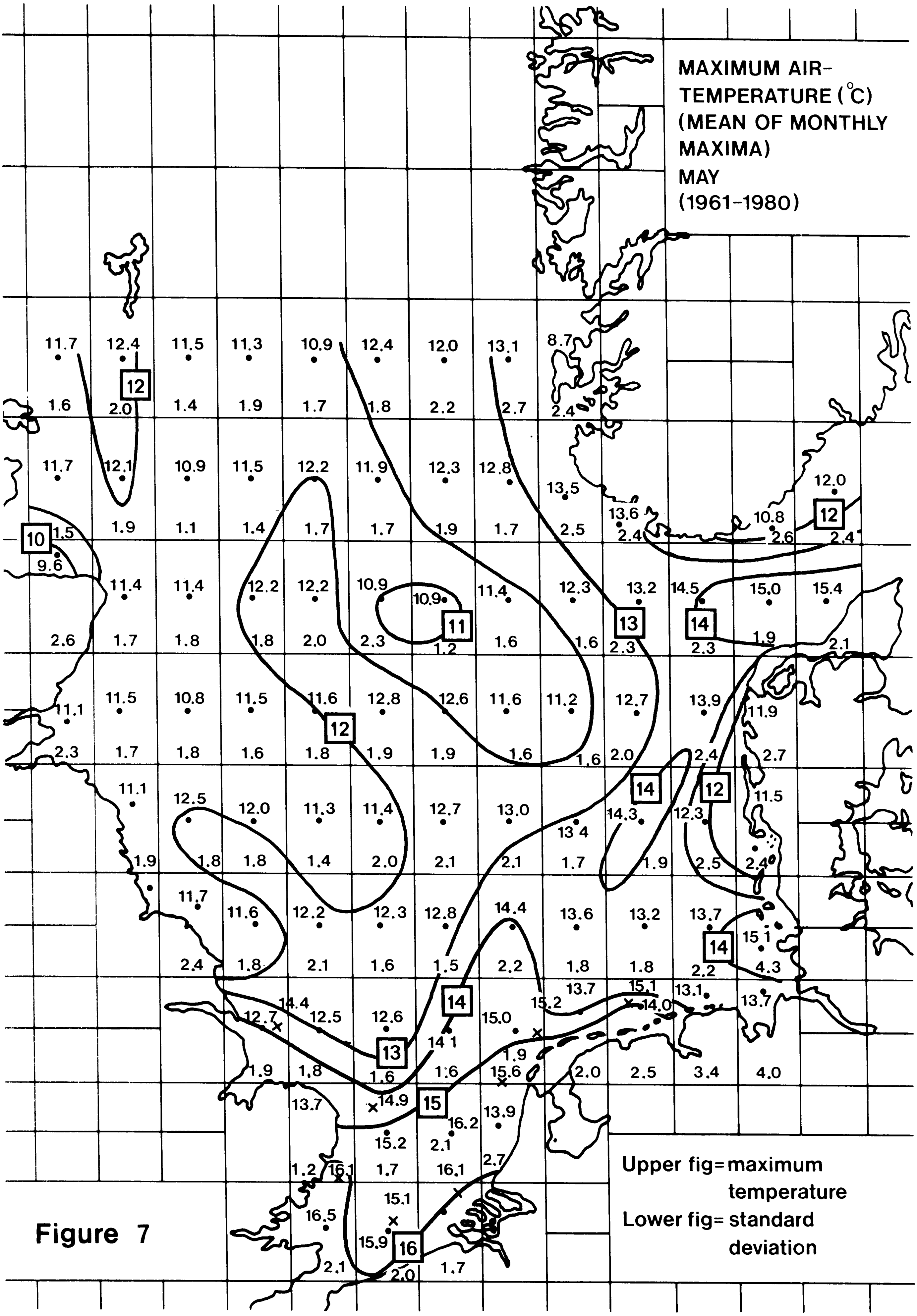

MAXIMUM AIR-TEMPERATURE (°C)
(MEAN OF MONTHLY MAXIMA)
MAY
(1961-1980)
Upper fig=maximum temperature
Lower fig= standard deviation

Figure 7

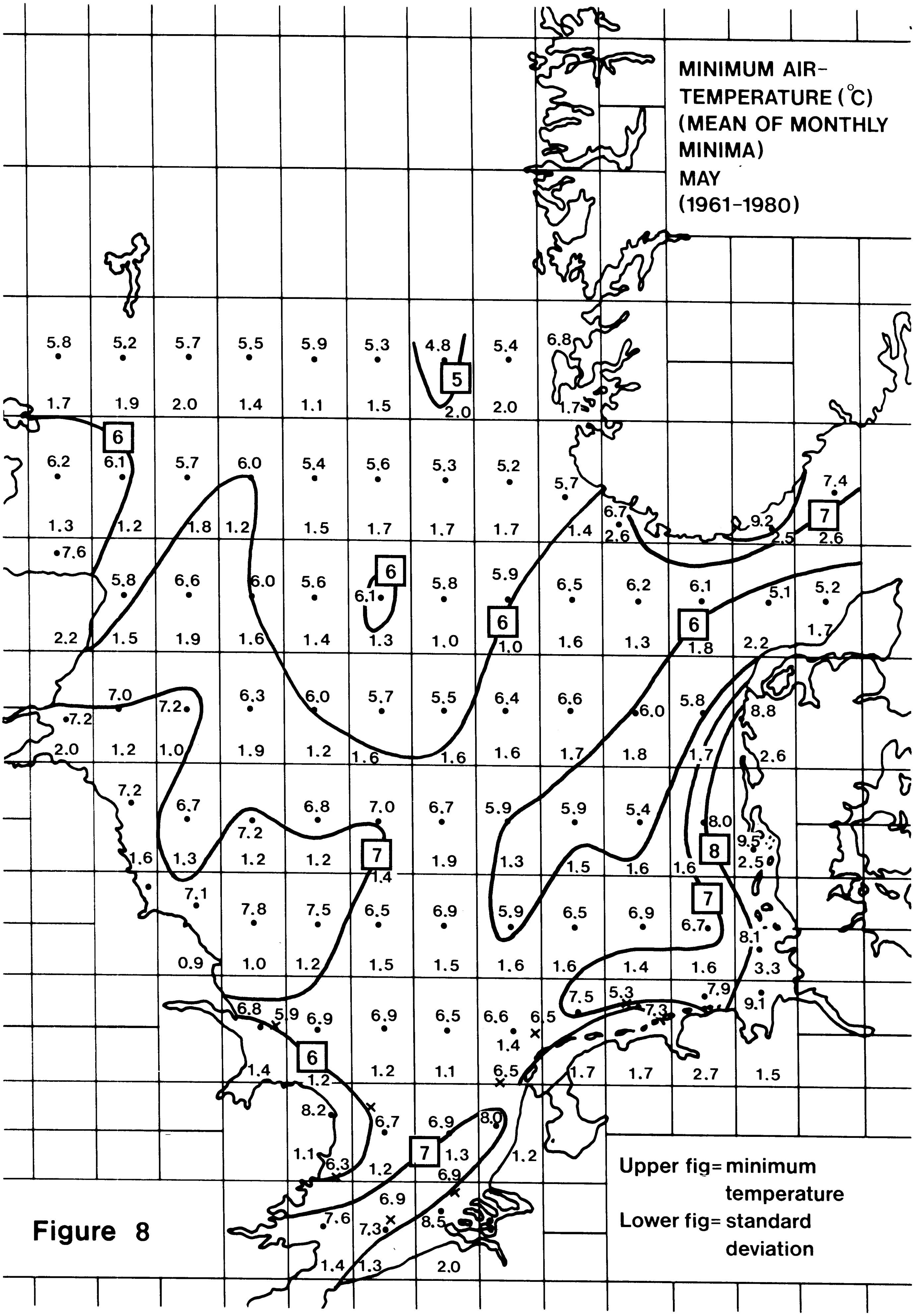
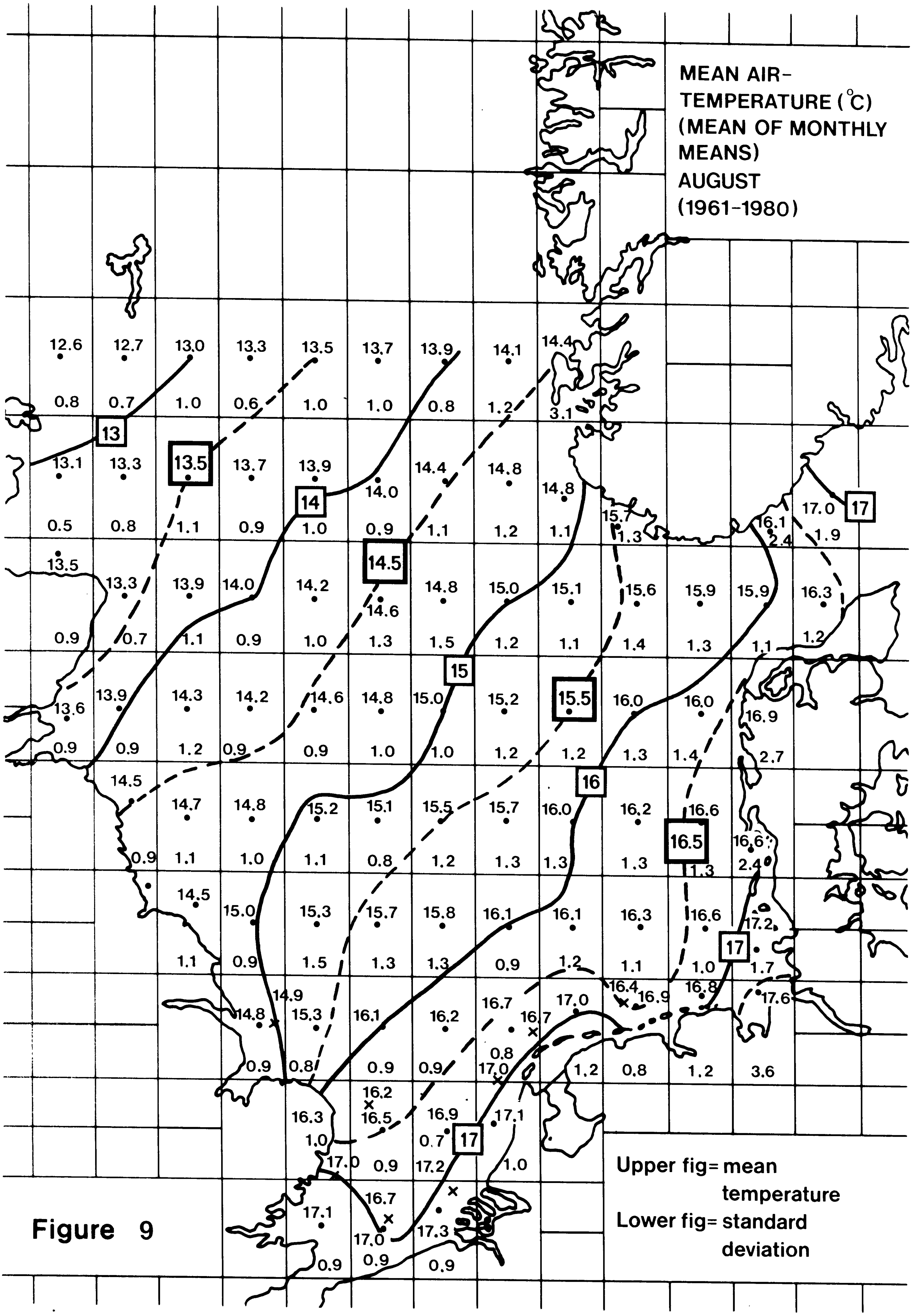

MINIMUM AIR-
TEMPERATURE (°C)
(MEAN OF MONTHLY
MINIMA)
MAY
(1961-1980)
Upper fig= minimum temperature
Lower fig= standard deviation

Figure 8



MEAN AIR-TEMPERATURE (°C)
(MEAN OF MONTHLY MEANS)
AUGUST
(1961-1980)
13
13.5
14
14.5
15
15.5
16
16.5
17
Upper fig= mean temperature
Lower fig= standard deviation

Figure 9

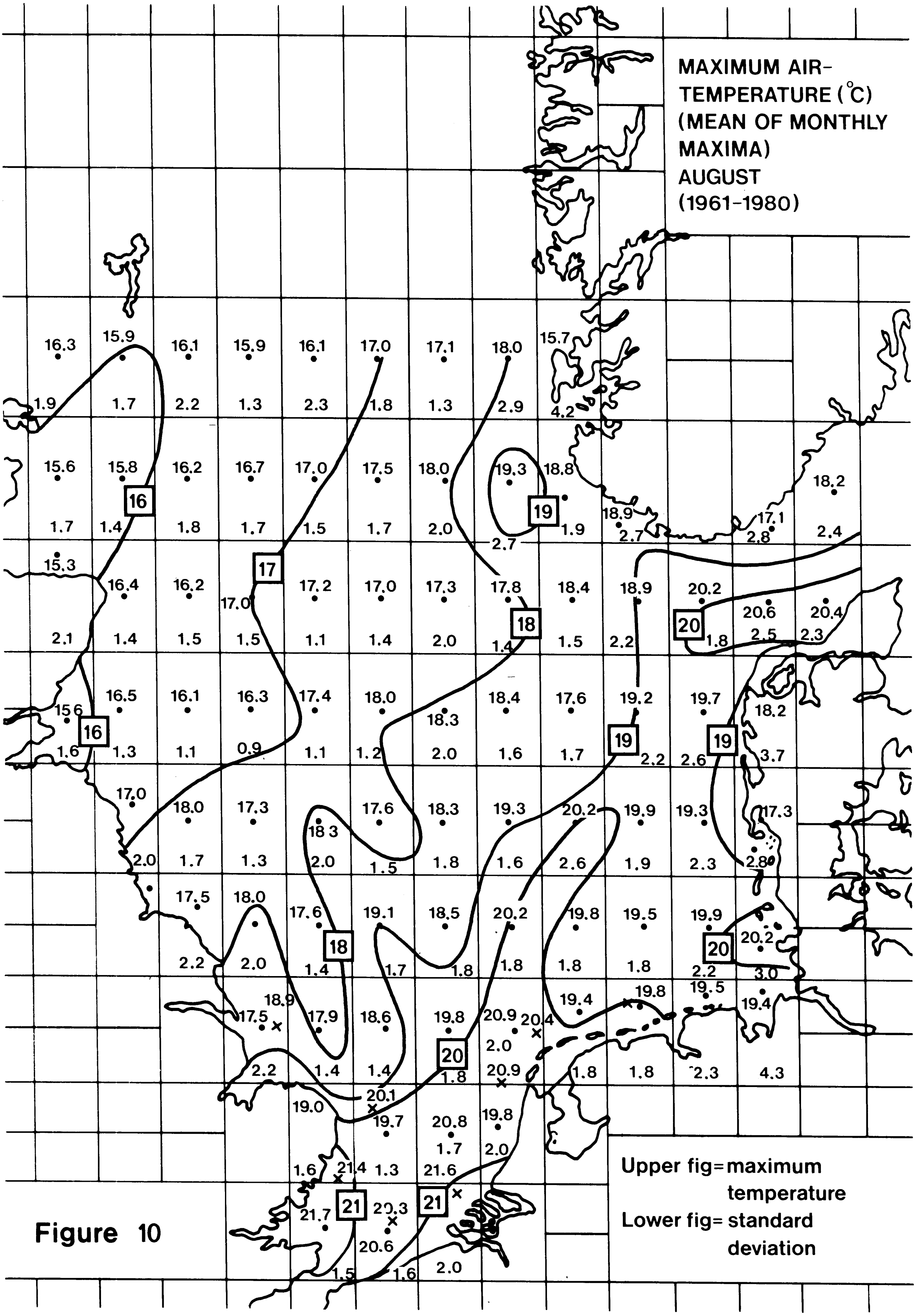
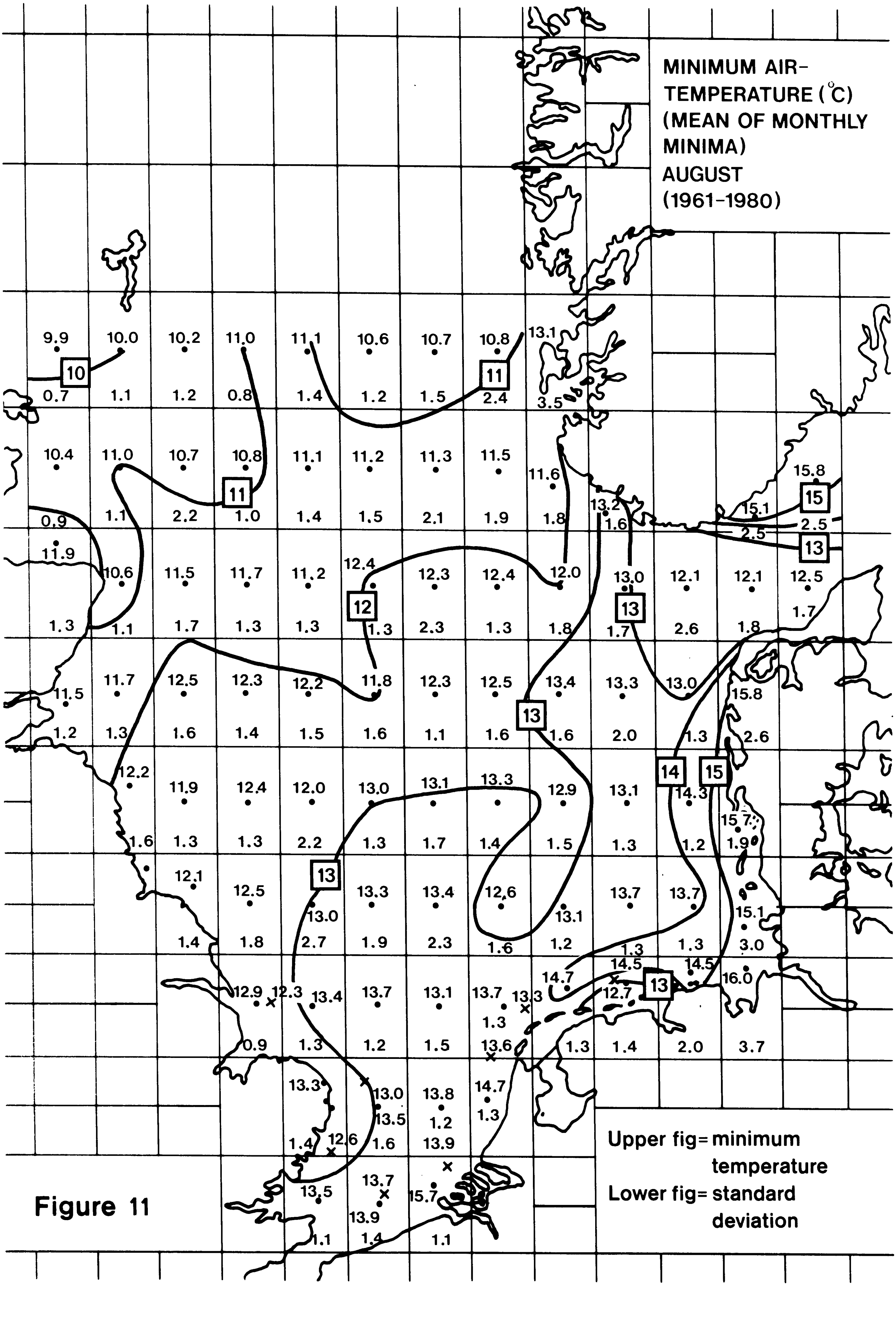

MAXIMUM AIR-TEMPERATURE (°C)
(MEAN OF MONTHLY MAXIMA)
AUGUST
(1961-1980)
Upper fig=maximum temperature
Lower fig= standard deviation

Figure 10



MINIMUM AIR-TEMPERATURE (°C) (MEAN OF MONTHLY MINIMA) AUGUST (1961-1980)
9.9 10.0 10.2 11.0 11.1 10.6 10.7 10.8 13.1
10 11
0.7 1.1 1.2 0.8 1.4 1.2 1.5 2.4 3.5
10.4 11.0 10.7 10.8 11.1 11.2 11.3 11.5 11.6 15.8
11 15
0.9 1.1 2.2 1.0 1.4 1.5 2.1 1.9 1.8 13.2 1.6 15.1 2.5 2.5
13
11.9 10.6 11.5 11.7 11.2 12.4 12.3 12.4 12.0 13.0 12.1 12.1 12.5
12 13
1.3 1.1 1.7 1.3 1.3 1.3 2.3 1.3 1.8 1.7 2.6 1.8 1.7
11.5 11.7 12.5 12.3 12.2 11.8 12.3 12.5 13.4 13.3 13.0 15.8
13
1.2 1.3 1.6 1.4 1.5 1.6 1.1 1.6 1.6 2.0 1.3 2.6
12.2 11.9 12.4 12.0 13.0 13.1 13.3 12.9 13.1 14.3 15.7
14 15
1.6 1.3 1.3 2.2 1.3 1.7 1.4 1.5 1.3 1.2 1.9
12.1 12.5 13 13.3 13.4 12.6 13.7 13.7
13.0 13.1 15.1
1.4 1.8 2.7 1.9 2.3 1.6 1.2 1.3 1.3 3.0
12.9 12.3 13.4 13.7 13.1 13.7 13.3 14.7 14.5 12.7 13 14.5 16.0
1.3
0.9 1.3 1.2 1.5 13.6 1.3 1.4 2.0 3.7
13.3 13.0 13.8 14.7
13.5 1.2 1.3
1.4 12.6 1.6 13.9
13.5 13.7 15.7
13.9
1.1 1.4 1.1
Upper fig= minimum temperature
Lower fig= standard deviation

Figure 11

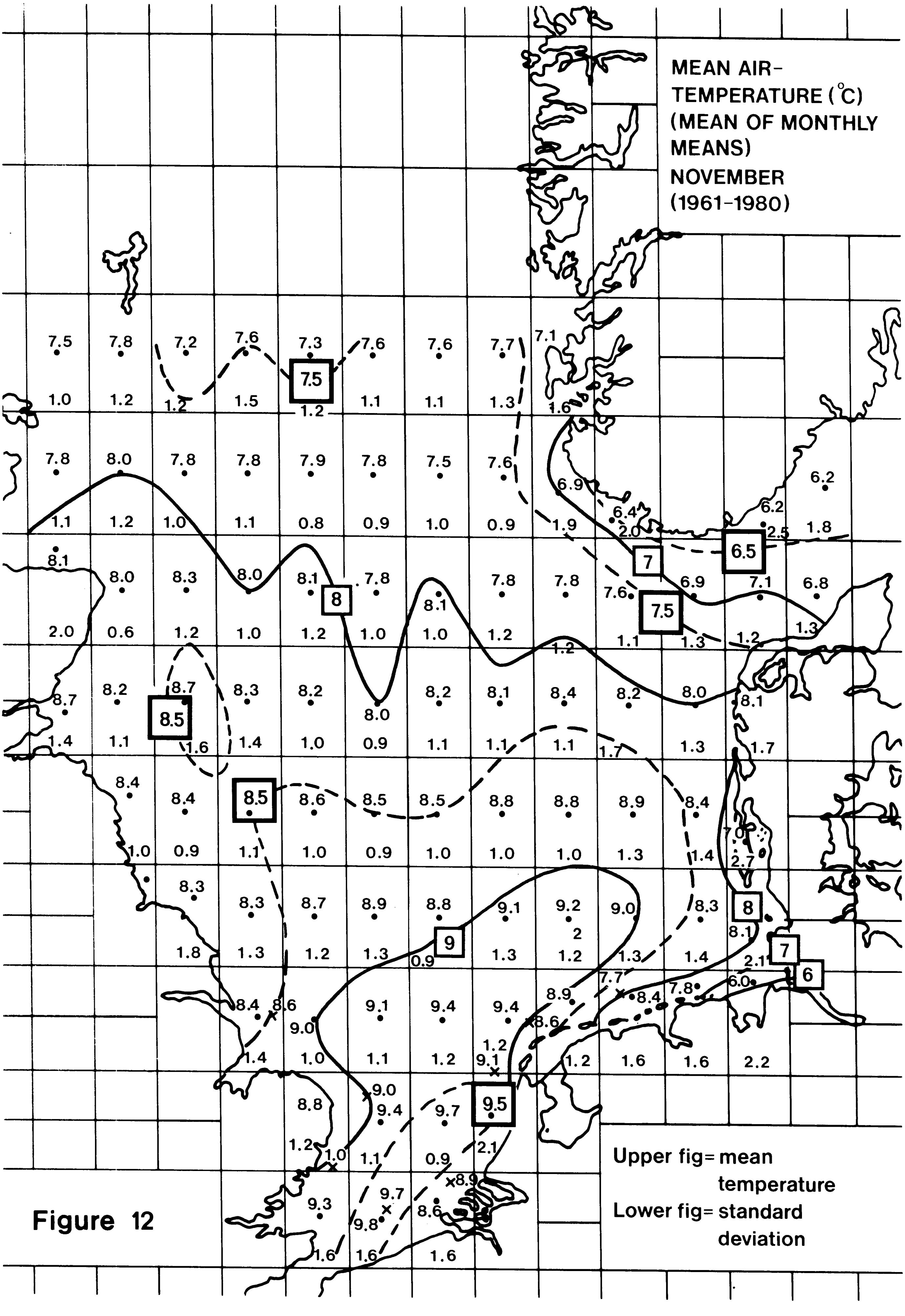

MEAN AIR-TEMPERATURE (°C)
(MEAN OF MONTHLY MEANS)
NOVEMBER
(1961-1980)
Upper fig= mean temperature
Lower fig= standard deviation

Figure 12

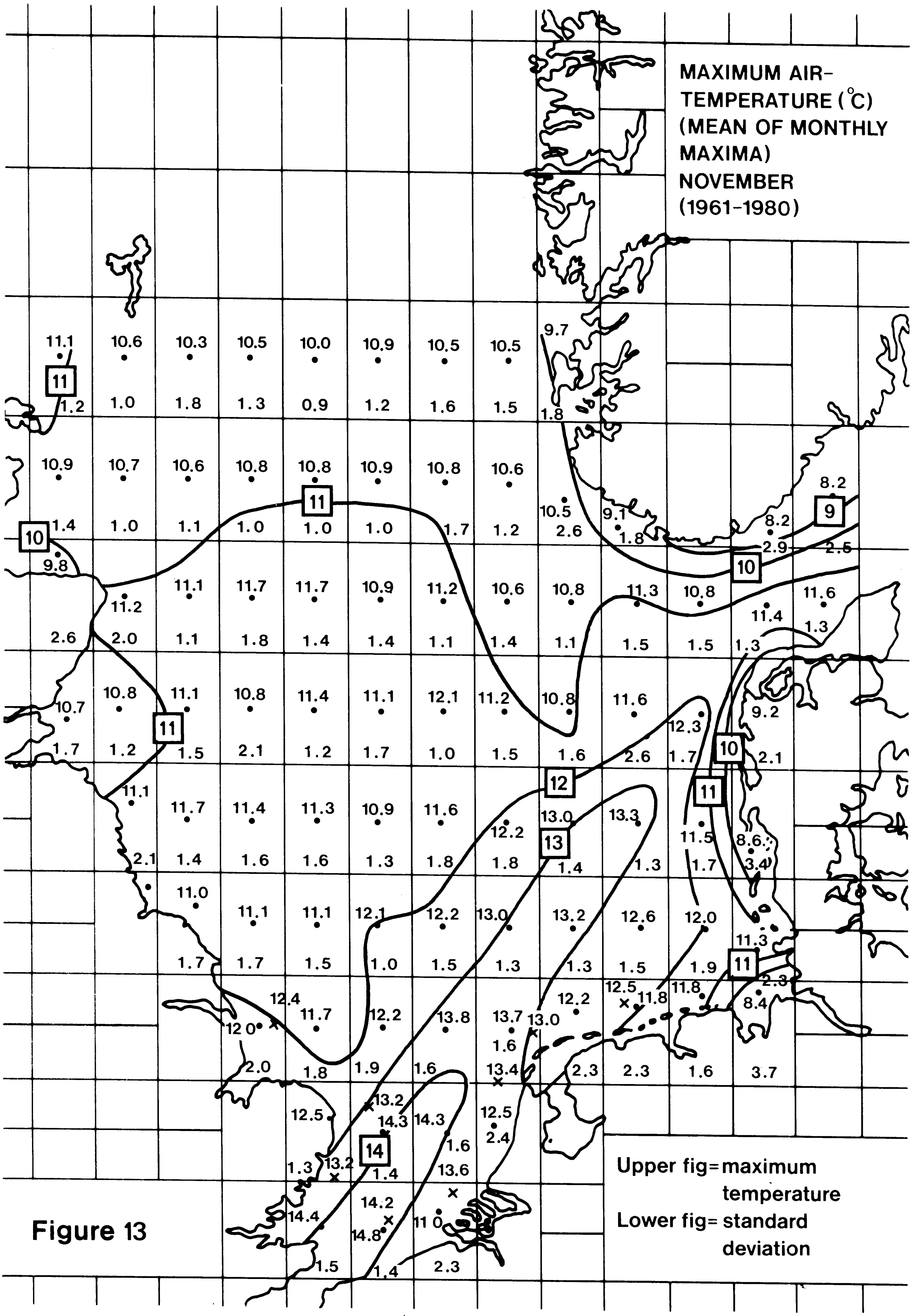

MAXIMUM AIR-TEMPERATURE (°C) (MEAN OF MONTHLY MAXIMA) NOVEMBER (1961-1980)
Upper fig= maximum temperature
Lower fig= standard deviation

Figure 13

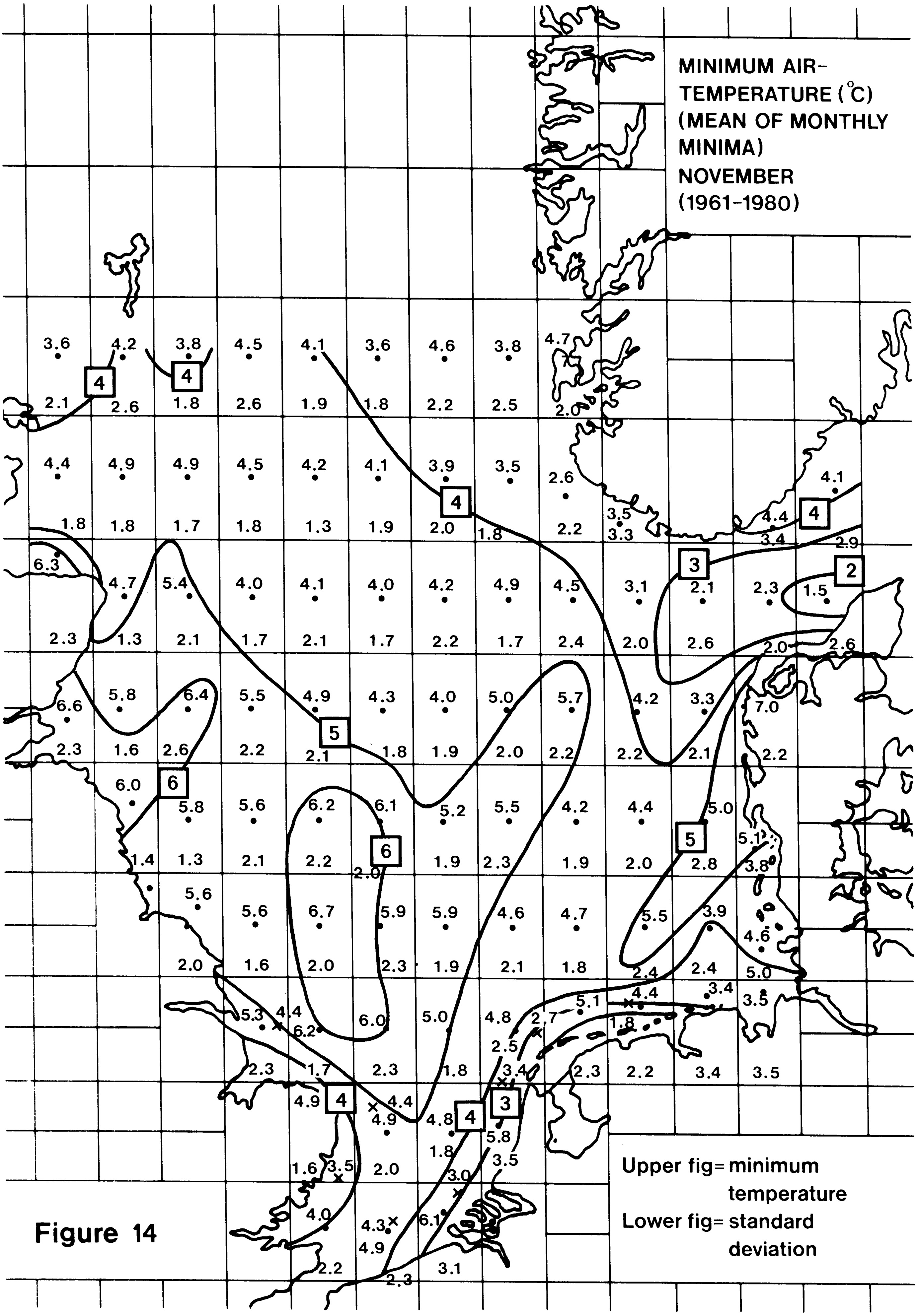

MINIMUM AIR-
TEMPERATURE (°C)
(MEAN OF MONTHLY
MINIMA)
NOVEMBER
(1961-1980)
Upper fig= minimum
temperature
Lower fig= standard
deviation

Figure 14

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	7.1	6.6	6.3	6.5	7.7	10.6	13.0	14.3	12.9	10.5	9.0	7.9	9.1
03	0.8	0.9	0.7	0.6	1.0	1.2	1.0	1.4	1.0	1.1	0.9	0.8	2.9
	7.2	6.3	6.4	6.8	8.4	10.6	12.9	13.3	12.5	11.4	9.8	8.4	9.9
07	1.1	1.3	0.9	1.0	1.1	1.2	1.6	1.4	1.3	1.0	1.1	1.1	2.8
	6.9	6.1	5.9	6.2	8.4	11.8	14.3	15.3	13.9	11.5	9.1	7.7	9.4
09	0.8	0.9	1.3	1.0	1.7	1.6	1.9	1.2	1.2	1.1	1.1	0.6	3.4
	5.8	4.9	4.5	5.6	8.7	12.4	14.7	16.0	14.2	12.1	9.7	7.4	9.9
11	1.6	1.5	1.4	1.4	2.0	2.1	1.9	1.3	1.5	1.6	1.9	1.5	4.3
	6.4	5.5	5.4	6.3	8.6	12.2	14.6	15.6	14.7	12.9	10.1	7.8	9.9
15	1.1	1.0	1.3	0.8	1.5	1.4	1.6	1.6	1.3	1.4	1.7	1.1	4.0
	4.7	4.4	3.7	5.9	9.4	12.7	16.1	16.9	15.9	13.7	10.2	7.1	10.0
18	1.9	1.1	1.3	1.2	1.9	1.6	1.5	0.8	0.9	1.3	2.4	1.3	4.9
	6.8	5.9	5.9	7.0	9.3	12.4	14.9	16.4	15.8	13.8	11.2	8.5	10.6
20	1.3	1.1	1.2	1.2	1.5	1.5	1.4	1.2	1.1	1.4	1.8	1.4	4.1
	6.6	5.6	6.4	7.6	9.9	13.0	15.6	17.1	16.8	14.7	11.5	8.9	11.4
24	1.7	1.9	1.7	1.4	1.6	1.4	1.7	1.0	1.2	1.8	1.7	1.6	4.5

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	7.3	6.5	6.3	6.7	8.0	11.0	12.5	13.7	12.8	11.2	9.2	8.3	9.9
03	1.5	1.1	1.2	1.2	1.2	1.4	1.4	1.5	1.2	1.2	1.1	1.3	2.9
	7.3	6.3	6.0	6.4	8.1	10.7	12.4	12.9	12.5	11.6	10.0	8.6	10.2
07	1.2	0.9	1.1	1.1	1.5	1.4	1.4	1.3	1.1	1.0	1.1	1.1	2.8
	6.3	5.6	5.3	5.8	7.6	11.6	13.5	14.6	14.0	11.6	9.0	7.5	8.9
09	1.0	1.1	1.1	1.2	1.6	1.8	1.5	1.5	1.4	1.3	1.1	0.9	3.4
	5.4	4.5	4.3	5.5	8.3	13.0	14.8	16.2	14.8	12.6	9.9	7.4	9.9
11	1.7	1.8	1.6	1.7	2.0	2.3	1.8	2.0	1.7	1.5	1.9	1.8	4.5
	6.1	5.0	4.9	5.7	8.5	12.0	14.3	15.5	14.4	13.1	10.4	8.0	10.5
15	1.3	1.4	1.3	1.4	1.5	1.8	1.5	1.6	1.4	1.4	1.4	1.4	4.1
	3.2	2.6	3.0	5.2	9.7	13.9	16.2	17.1	15.9	13.4	9.4	6.2	9.3
18	1.7	1.5	1.4	1.8	1.9	2.0	1.2	1.0	1.0	1.5	2.0	2.0	5.6
	6.0	5.2	4.9	6.2	9.0	12.5	14.7	15.9	15.5	13.9	11.3	8.3	10.8
20	1.6	1.6	1.7	1.6	1.8	1.8	1.6	1.3	1.3	1.4	1.7	1.6	4.3
	5.5	5.3	5.3	7.4	9.7	13.5	15.7	17.0	16.7	14.5	11.7	8.4	11.0
24	2.1	2.0	1.9	2.0	1.9	1.8	1.5	1.3	1.2	1.6	1.7	1.9	4.6

Figure 15. Mean sea-surface temperatures (upper figures) in °C with standard deviation (lower figures) for areas indicated in figure 1.

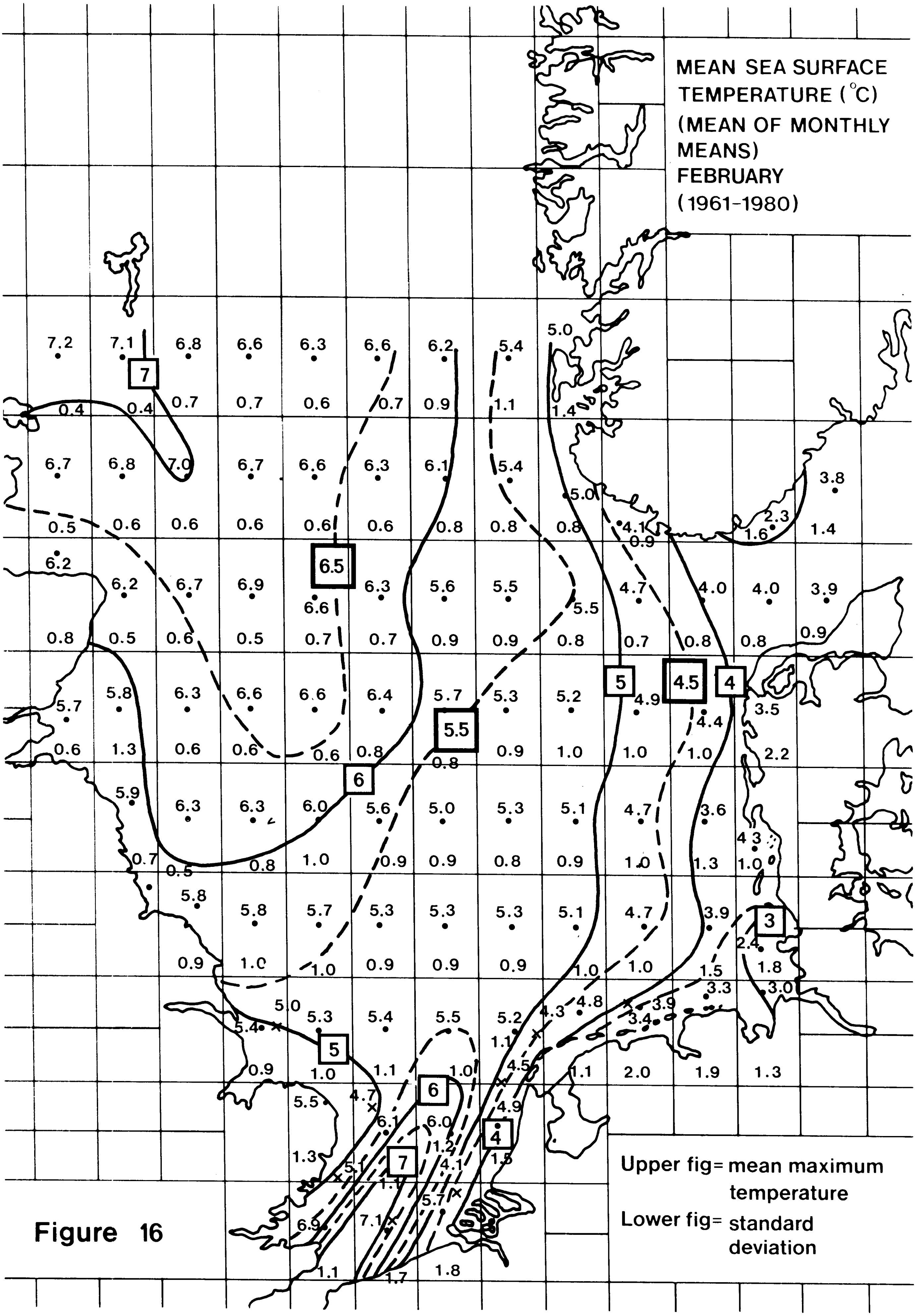

MEAN SEA SURFACE TEMPERATURE (°C)
(MEAN OF MONTHLY MEANS)
FEBRUARY
(1961-1980)
Upper fig= mean maximum temperature
Lower fig= standard deviation

Figure 16

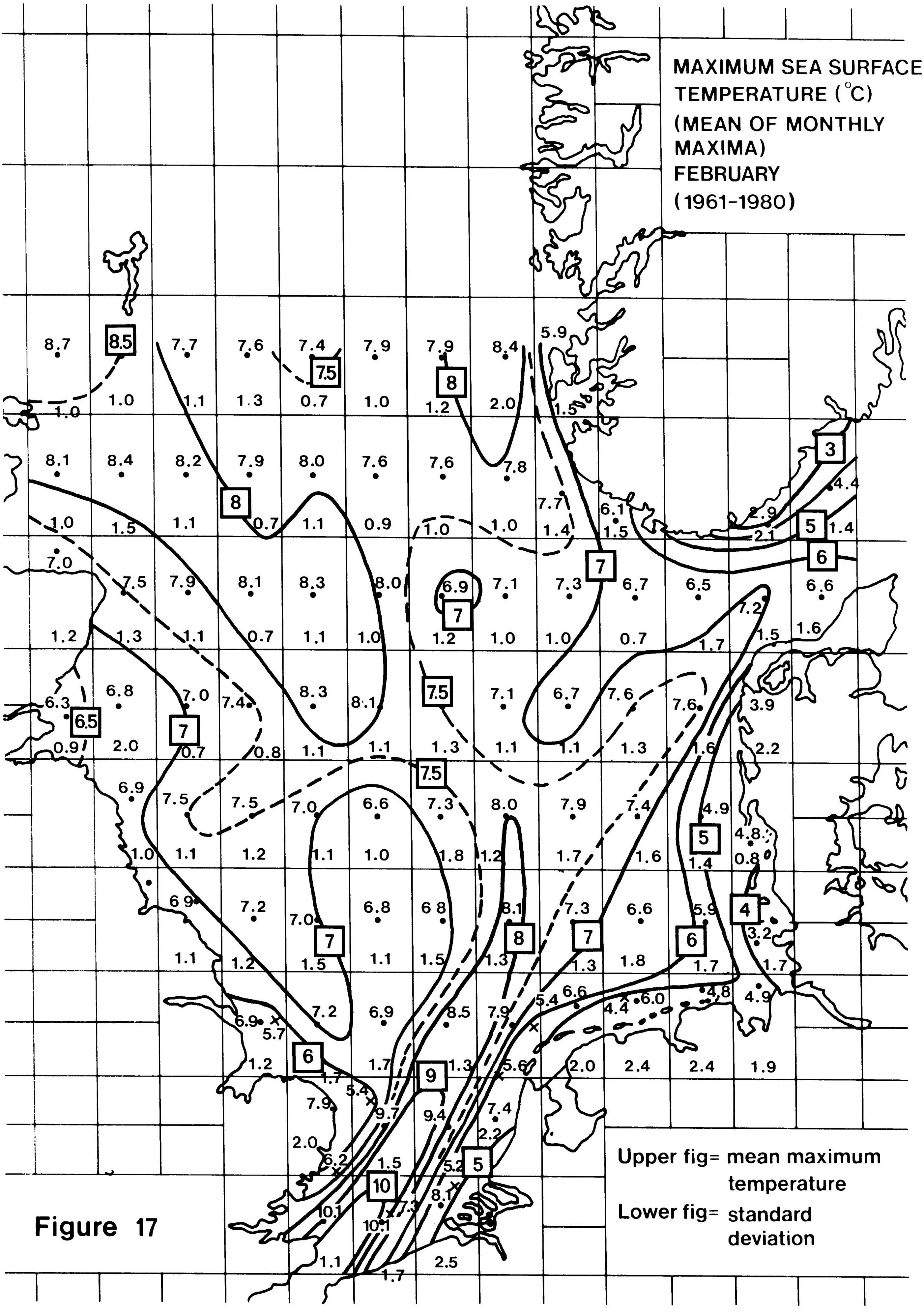

MAXIMUM SEA SURFACE TEMPERATURE (°C) (MEAN OF MONTHLY MAXIMA) FEBRUARY (1961-1980)
Upper fig= mean maximum temperature
Lower fig= standard deviation

Figure 17

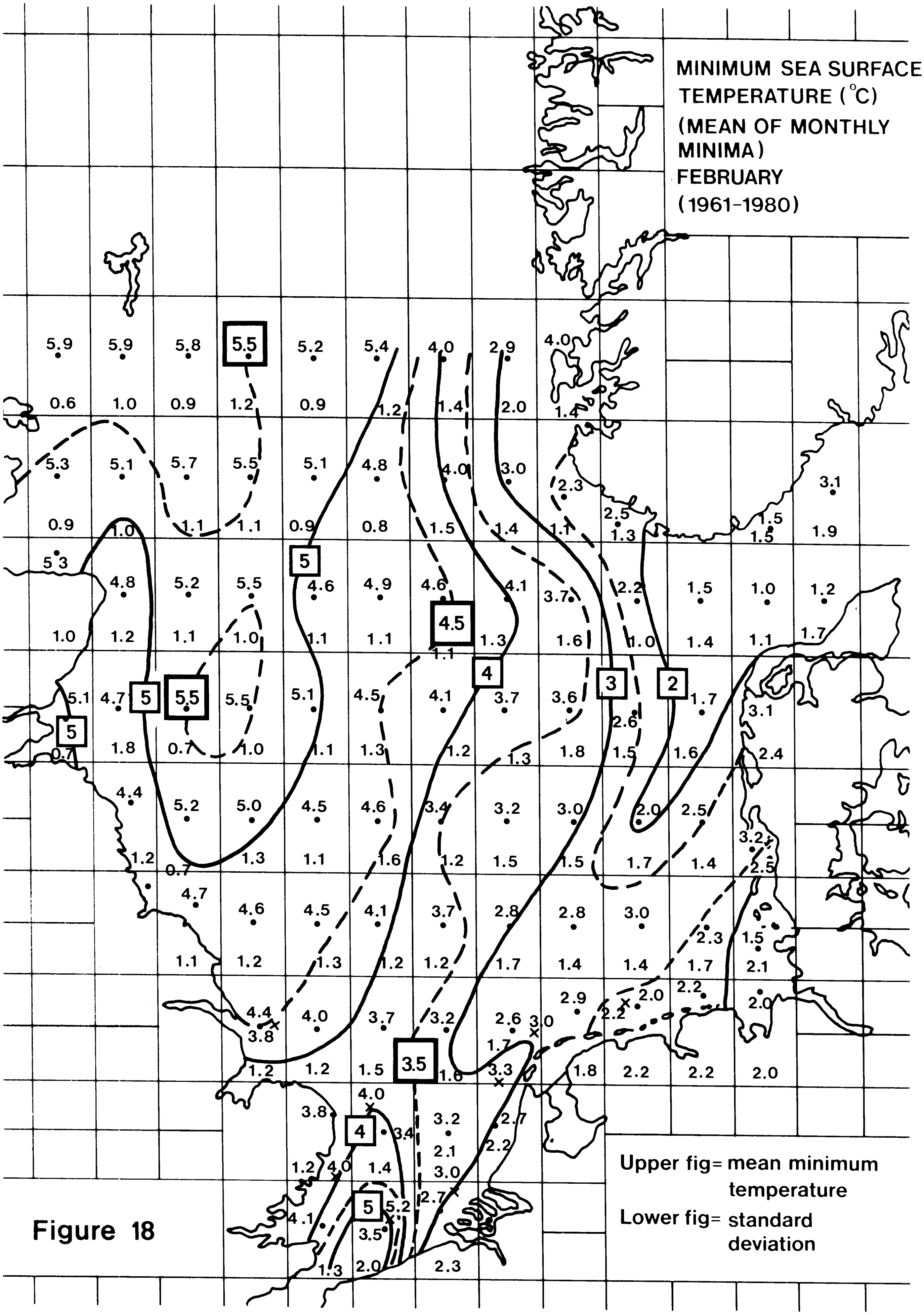

MINIMUM SEA SURFACE TEMPERATURE (°C)
(MEAN OF MONTHLY MINIMA)
FEBRUARY
(1961-1980)
Upper fig= mean minimum temperature
Lower fig= standard deviation

Figure 18

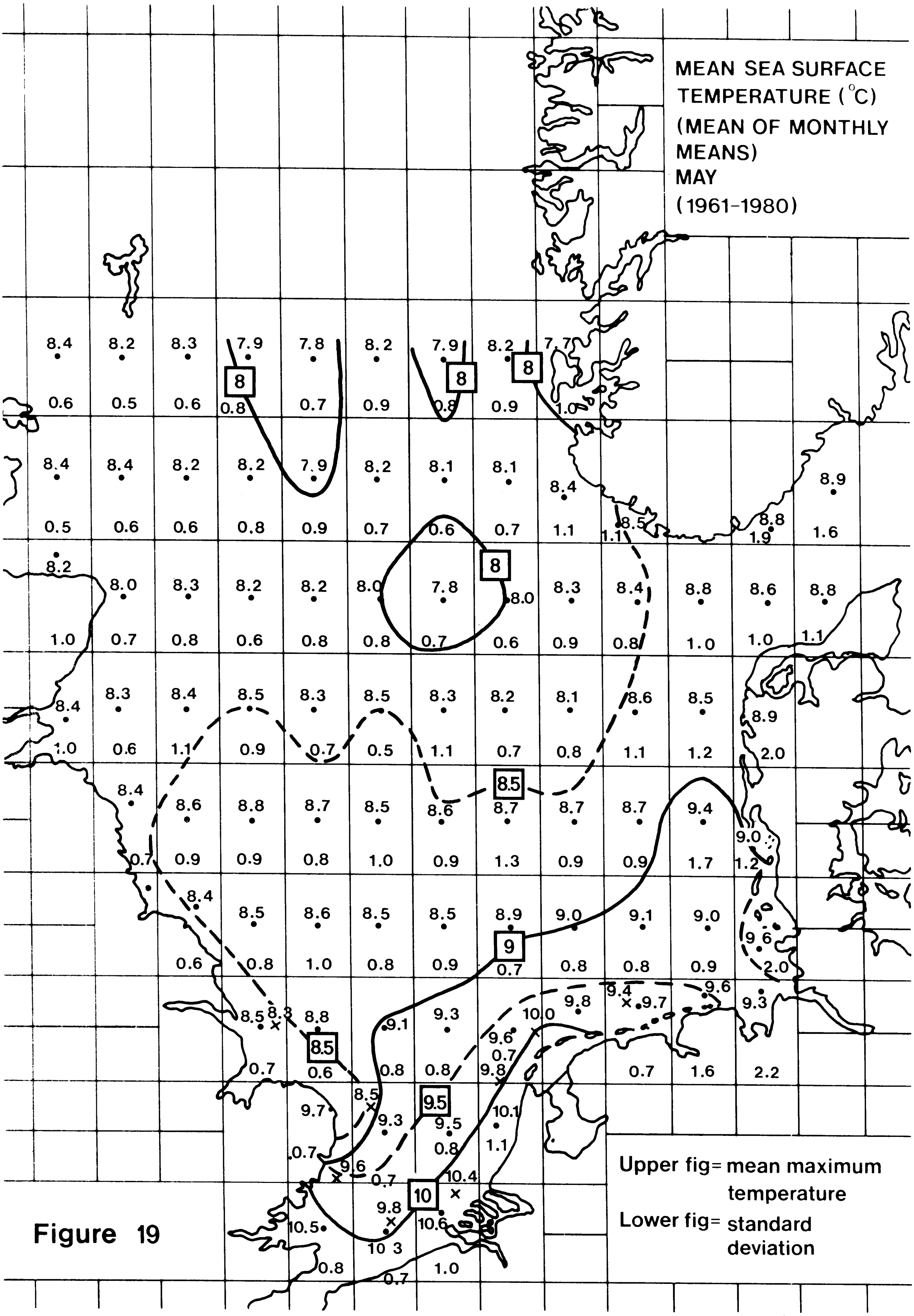

MEAN SEA SURFACE
TEMPERATURE (°C)
(MEAN OF MONTHLY
MEANS)
MAY
(1961-1980)
Upper fig= mean maximum
temperature
Lower fig= standard
deviation

Figure 19

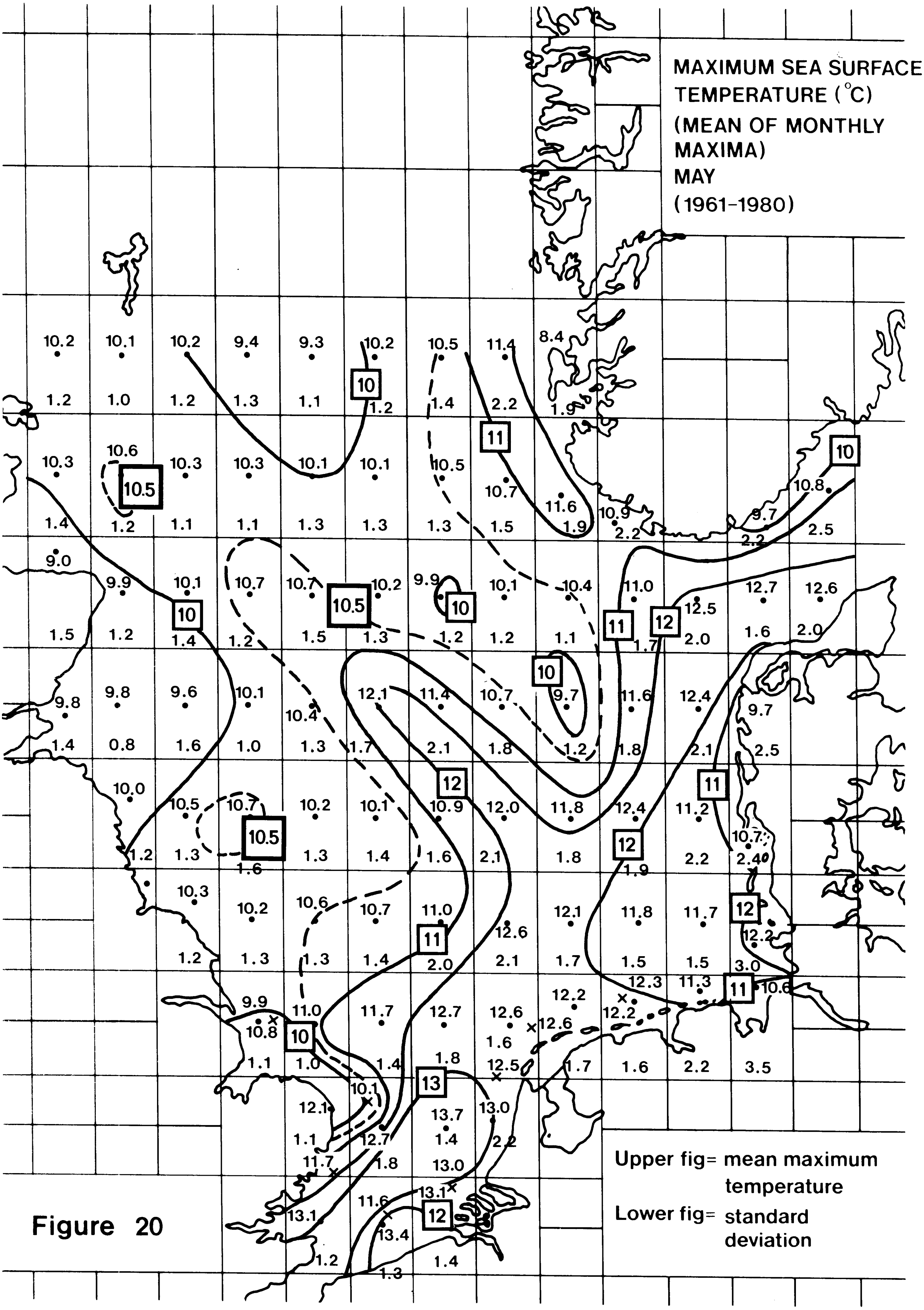

MAXIMUM SEA SURFACE TEMPERATURE (°C)
(MEAN OF MONTHLY MAXIMA)
MAY
(1961-1980)
10.2 10.1 10.2 9.4 9.3 10.2 10.5 11.4 8.4
1.2 1.0 1.2 1.3 1.1 1.2 1.4 2.2 1.9
10 11 10
10.3 10.6 10.3 10.3 10.1 10.1 10.5 10.7 11.6 10.9 9.7 10.8
10.5
1.4 1.2 1.1 1.1 1.3 1.3 1.3 1.5 1.9 2.2 2.2 2.5
9.0 9.9 10.1 10.7 10.7 10.2 9.9 10.1 10.4 11.0 12.5 12.7 12.6
10 10.5 10 11 12
1.5 1.2 1.4 1.2 1.5 1.3 1.2 1.2 1.1 1.7 2.0 1.6 2.0
10
9.8 9.8 9.6 10.1 10.4 12.1 11.4 10.7 9.7 11.6 12.4 9.7
1.4 0.8 1.6 1.0 1.3 1.7 2.1 1.8 1.2 1.8 2.1 2.5
12 11
10.0 10.5 10.7 10.2 10.1 10.9 12.0 11.8 12.4 11.2 10.7
10.5 12
1.2 1.3 1.6 1.3 1.4 1.6 2.1 1.8 1.9 2.2 2.4
10.3 10.2 10.6 10.7 11.0 12.6 12.1 11.8 11.7 12.2
11 12
1.2 1.3 1.3 1.4 2.0 2.1 1.7 1.5 1.5 3.0
12.3 11.3 11 10.6
9.9 11.0 11.7 12.7 12.6 12.2 12.2
10.8 12.6
10
1.1 1.0 1.4 1.8 1.6 12.5 1.7 1.6 2.2 3.5
10.1 13
12.1 13.7 13.0
1.1 12.7 1.4 2.2
11.7 1.8 13.0
13.1
11.6 12
13.1 13.4
1.2 1.4
1.3
Upper fig= mean maximum temperature
Lower fig= standard deviation

Figure 20

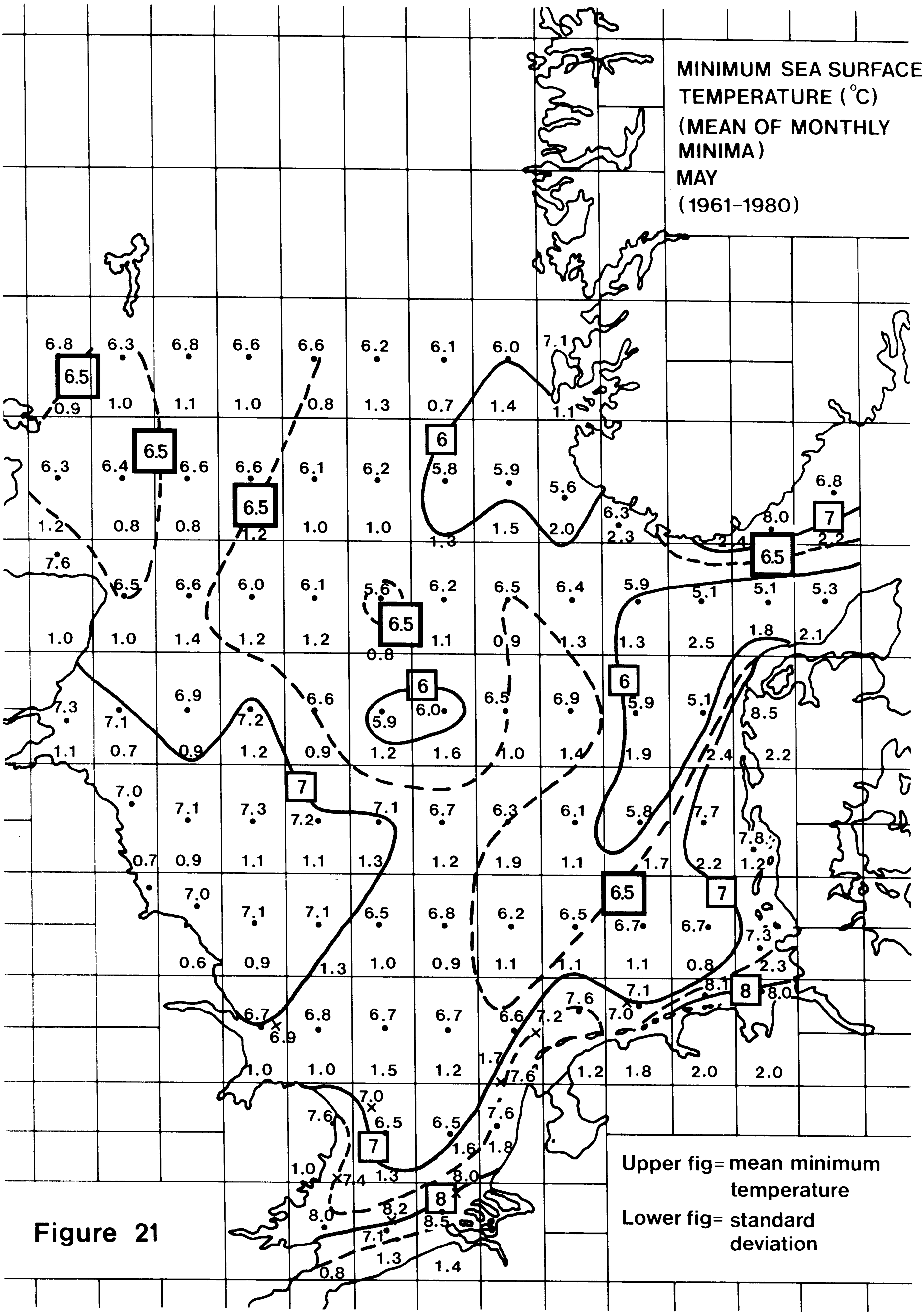

MINIMUM SEA SURFACE TEMPERATURE (°C)
(MEAN OF MONTHLY MINIMA)
MAY
(1961-1980)
Upper fig= mean minimum temperature
Lower fig= standard deviation

Figure 21

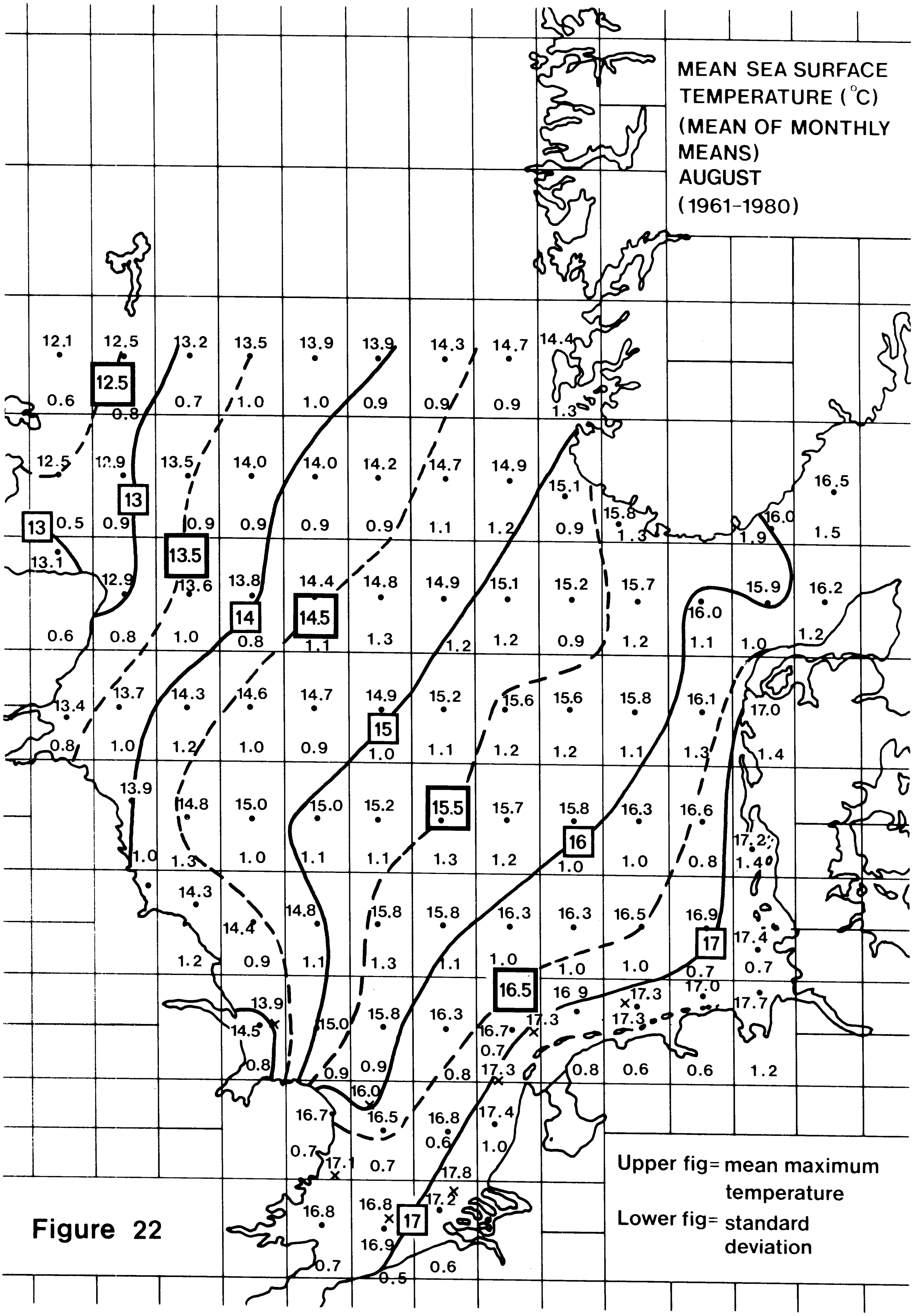

MEAN SEA SURFACE TEMPERATURE (°C)
(MEAN OF MONTHLY MEANS)
AUGUST
(1961-1980)
Upper fig= mean maximum temperature
Lower fig= standard deviation

Figure 22

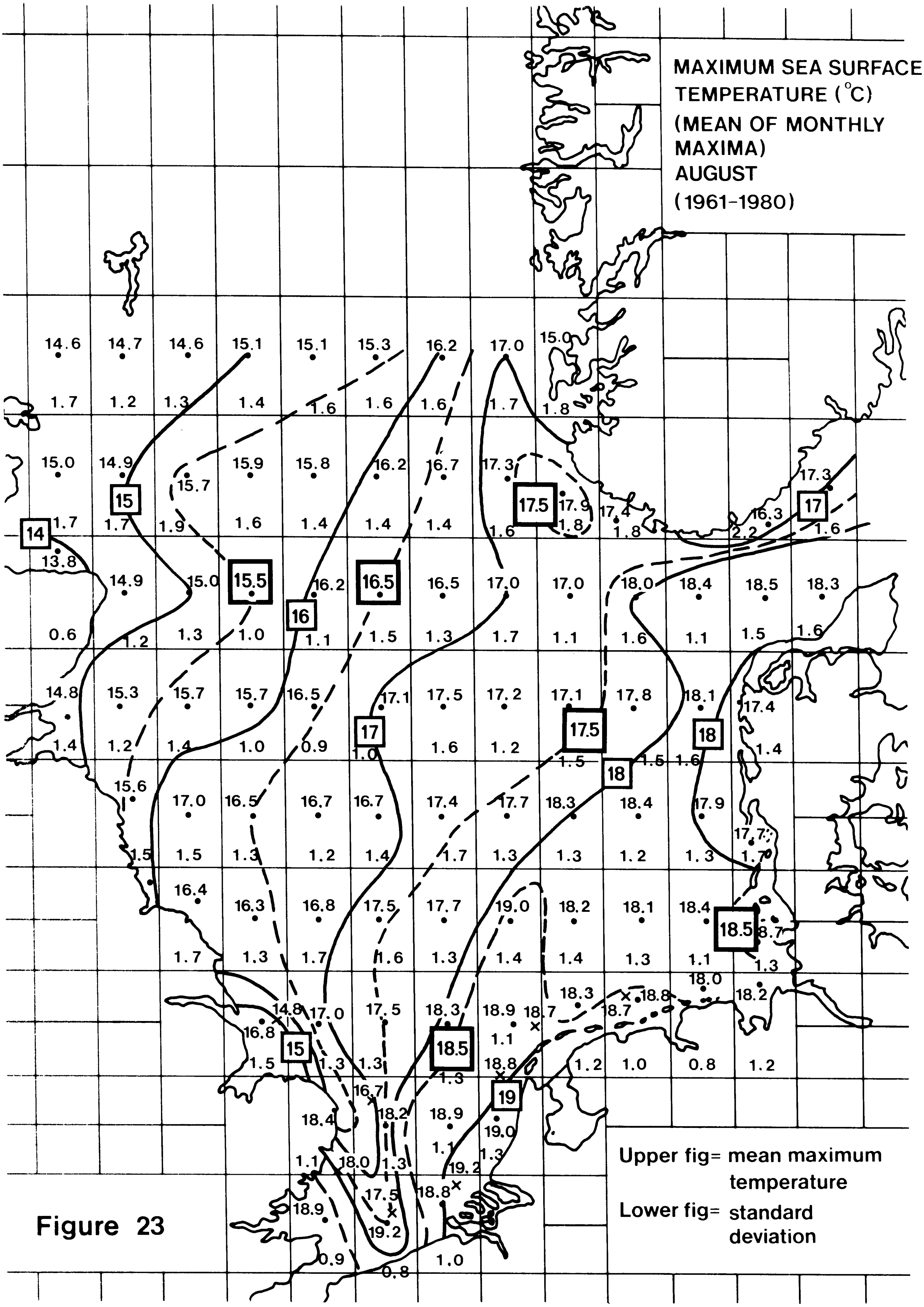

MAXIMUM SEA SURFACE TEMPERATURE (°C)
(MEAN OF MONTHLY MAXIMA)
AUGUST
(1961-1980)
Upper fig= mean maximum temperature
Lower fig= standard deviation

Figure 23

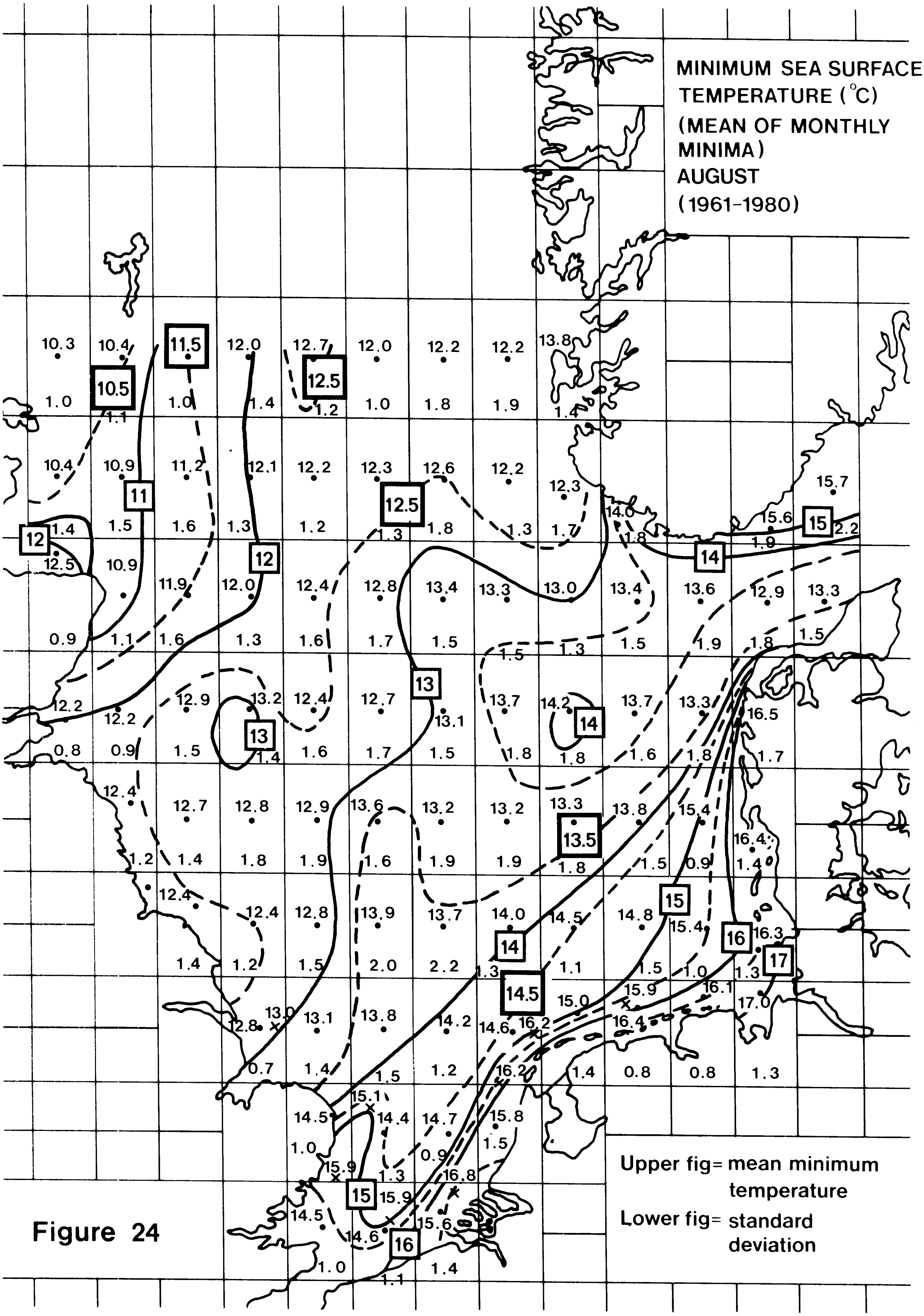
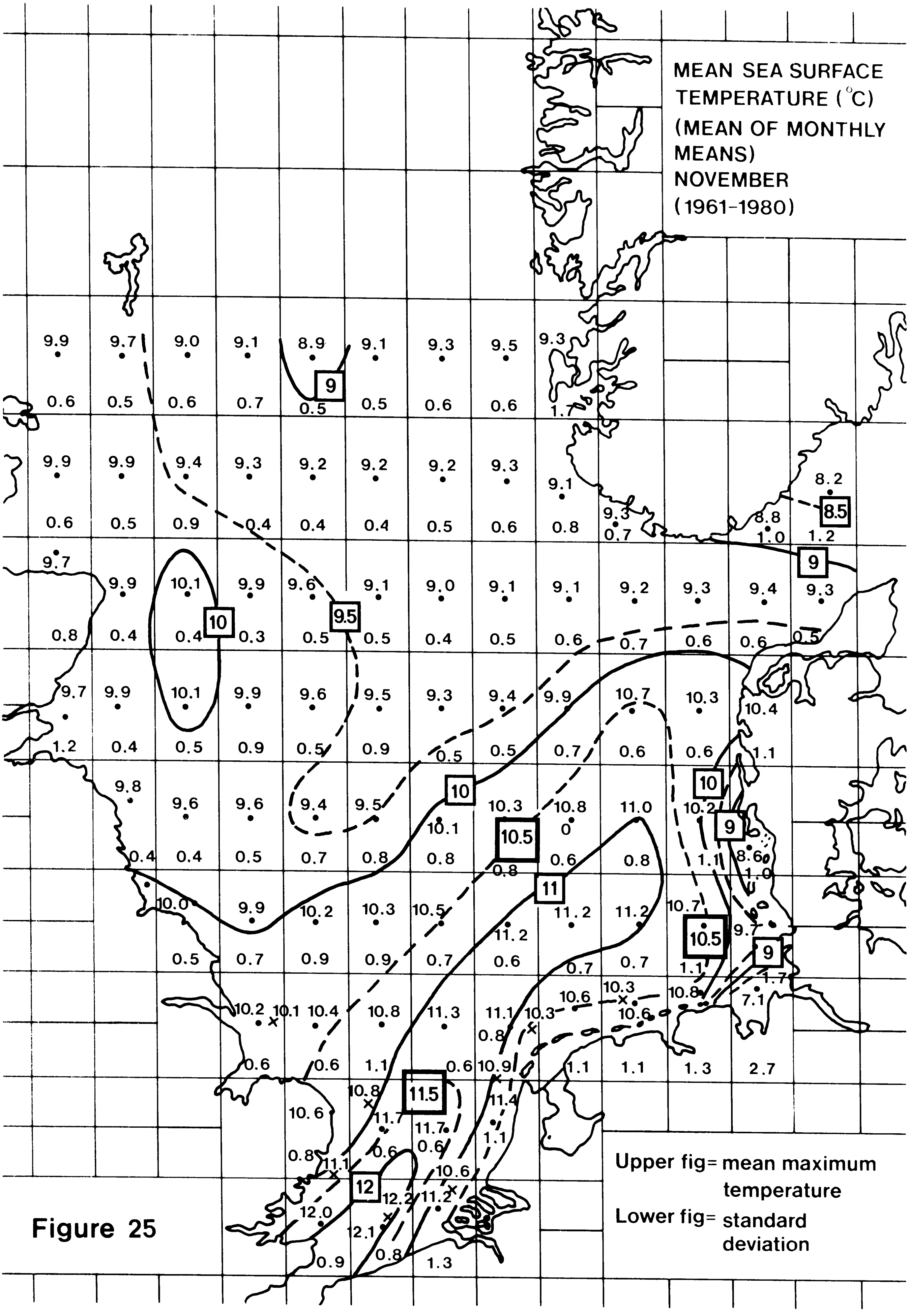

MINIMUM SEA SURFACE
TEMPERATURE (°C)
(MEAN OF MONTHLY
MINIMA)
AUGUST
(1961-1980)
Upper fig= mean minimum
temperature
Lower fig= standard
deviation

Figure 24



MEAN SEA SURFACE
TEMPERATURE (°C)
(MEAN OF MONTHLY
MEANS)
NOVEMBER
(1961-1980)
Upper fig= mean maximum
temperature
Lower fig= standard
deviation

Figure 25

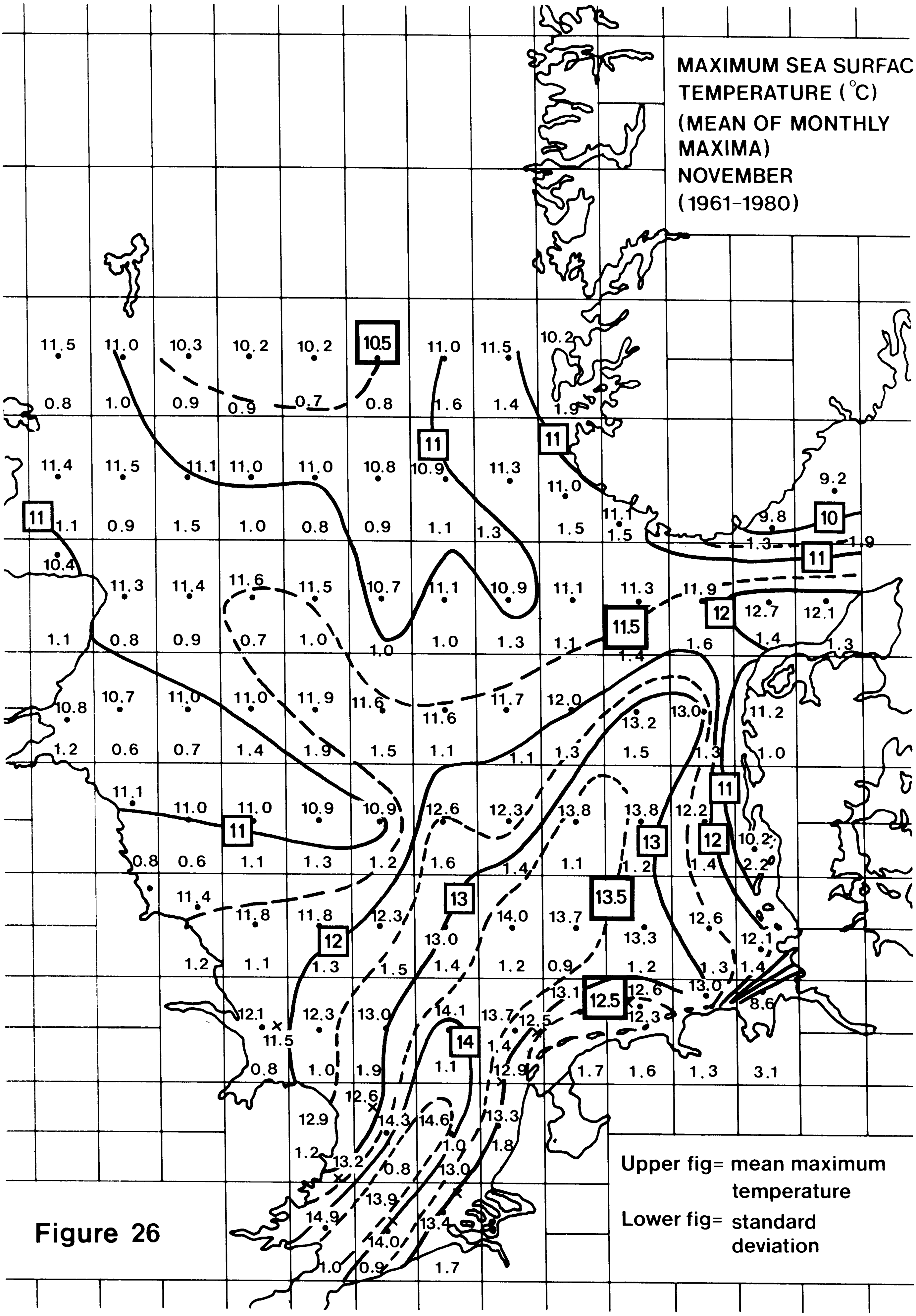

MAXIMUM SEA SURFACE TEMPERATURE (°C)
(MEAN OF MONTHLY MAXIMA)
NOVEMBER
(1961-1980)
Upper fig= mean maximum temperature
Lower fig= standard deviation

Figure 26

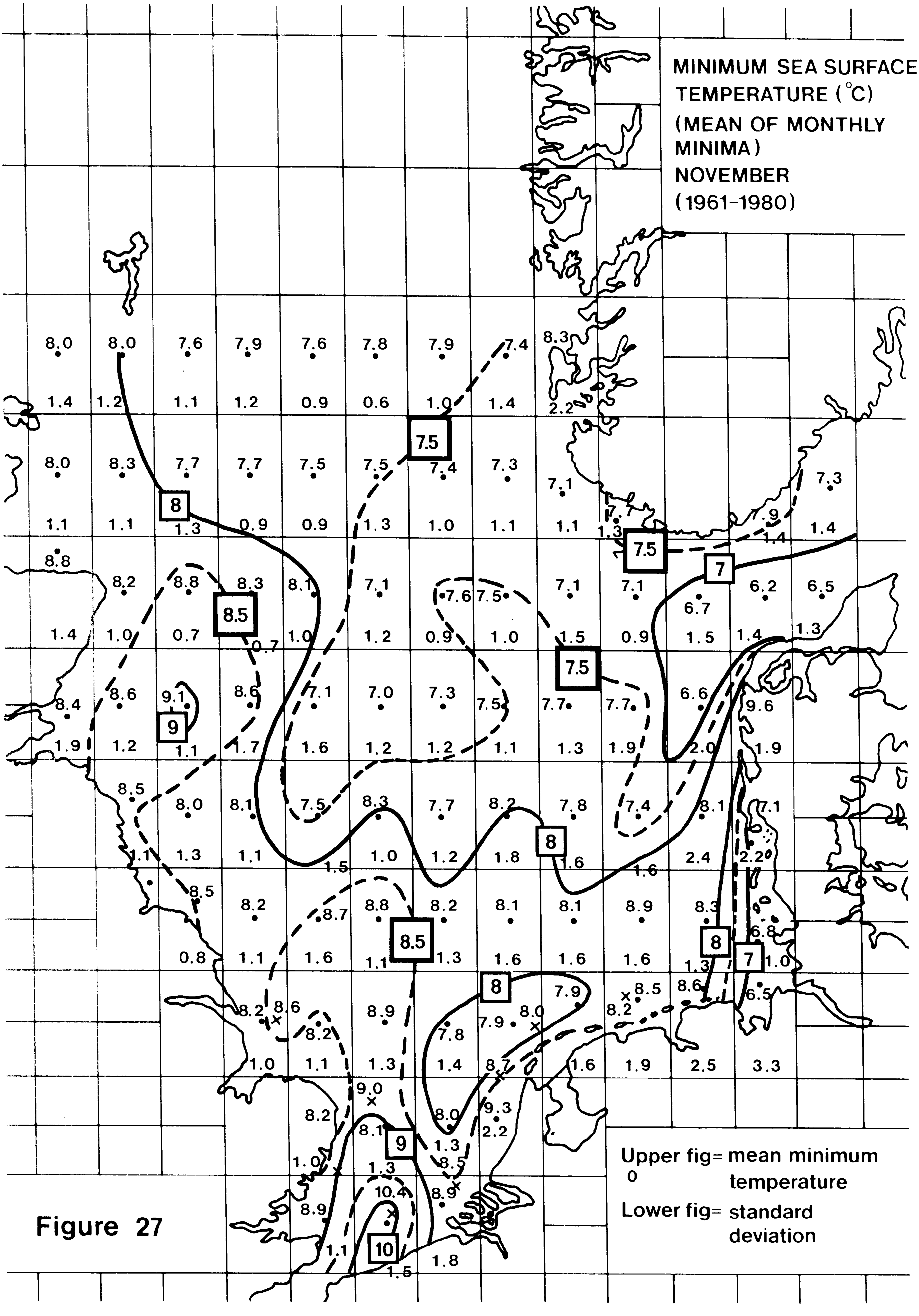

MINIMUM SEA SURFACE TEMPERATURE (°C)
(MEAN OF MONTHLY MINIMA)
NOVEMBER
(1961-1980)
Upper fig= mean minimum temperature
Lower fig= standard deviation

Figure 27

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	-1.3	-1.2	-0.9	-0.1	0.5	0.3	-0.1	-0.2	-0.5	-0.6	-1.1	-1.2	-0.4
03	1.7	1.7	1.6	1.3	1.2	1.2	1.3	1.4	1.3	1.5	1.6	1.9	1.6
	-1.6	-0.8	-0.6	-0.2	0.6	0.6	0.3	0.3	-0.1	-0.7	-1.6	-1.4	-0.2
07	2.2	2.1	1.7	1.8	1.5	1.5	1.6	1.4	1.7	2.0	2.1	2.1	1.9
	-1.2	-1.1	-0.8	-0.2	0.2	0.1	-0.3	-0.5	-0.8	-0.7	-1.1	-1.0	-0.7
09	1.8	1.7	2.2	1.4	1.6	1.4	1.5	1.3	1.4	1.6	1.7	1.8	1.7
	-2.0	-1.6	-0.9	0.2	0.8	0.4	0.0	0.0	-1.0	-1.3	-1.7	-1.8	-0.8
11	2.5	3.0	2.5	1.8	2.0	1.9	1.9	1.6	1.6	2.1	2.5	2.7	2.4
	-0.7	-0.6	-0.3	0.2	0.7	0.5	0.2	0.2	-0.6	-0.8	-1.3	-0.8	-0.3
15	1.9	1.8	1.9	1.4	1.4	1.6	1.6	1.6	1.6	1.6	2.0	2.2	1.8
	-1.6	-0.4	-0.6	0.0	1.1	0.4	0.2	0.1	-1.0	-1.8	-1.8	-0.4	-0.5
18	3.0	2.0	2.7	1.7	1.8	1.8	1.7	1.4	1.4	2.3	2.2	1.8	2.2
	-1.0	-0.7	-0.2	0.2	0.7	0.7	0.3	0.2	-0.8	-1.5	-1.6	-0.9	-0.4
20	1.9	1.9	2.1	1.7	1.5	1.7	1.7	1.4	1.4	1.8	2.0	2.1	1.9
	-1.2	-0.9	0.0	0.2	0.7	0.8	0.3	-0.1	-0.9	-1.6	-1.9	-1.5	-0.5
24	2.4	2.2	2.2	2.0	1.9	2.0	1.7	1.5	1.6	2.4	2.1	2.5	2.2

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	-2.1	-2.7	-1.4	-0.3	0.2	0.8	0.1	-0.2	-0.2	-0.5	-1.7	-2.1	-0.8
03	2.2	2.5	2.0	2.1	1.7	1.9	1.6	2.0	1.6	1.9	2.1	2.3	2.2
	-1.8	-1.6	-0.8	0.1	0.4	0.5	0.4	0.2	0.1	-0.3	-2.4	-2.4	-0.4
07	2.3	2.2	1.9	1.7	1.6	1.3	1.7	1.4	1.4	1.6	2.2	2.2	2.0
	-1.5	-1.5	-0.3	0.0	0.5	0.5	0.1	-0.2	-0.3	-0.3	-1.3	-1.6	-0.7
09	2.1	2.1	1.7	1.8	1.5	1.6	1.7	1.7	1.6	1.6	1.9	1.8	1.9
	-2.6	-2.4	-0.5	0.0	0.6	0.5	0.0	-0.2	-0.6	-1.1	-2.5	-3.0	-1.0
11	3.0	2.9	2.3	2.3	2.2	2.1	2.1	2.1	1.8	2.0	2.5	2.7	2.7
	-1.2	-1.0	-0.2	0.4	0.5	0.7	0.1	-0.2	-0.1	-0.6	-1.6	-1.9	-0.4
15	2.0	2.1	1.8	1.7	1.6	1.9	1.8	1.8	1.5	1.7	2.1	2.2	2.0
	-0.5	-0.9	-0.1	0.4	0.7	0.5	-0.6	-0.5	-0.9	-1.5	-2.3	-2.2	-0.7
18	2.6	2.3	1.8	2.0	1.8	1.9	1.6	1.5	1.4	1.7	2.5	2.7	2.2
	-1.3	-1.1	-0.1	0.3	0.7	0.4	0.0	-0.1	-0.6	-1.1	-2.1	-2.1	-0.5
20	2.3	2.2	1.8	1.8	2.0	2.1	1.8	1.6	1.5	1.8	2.3	2.5	2.1
	-1.6	-1.3	-0.1	0.5	0.8	0.4	0.1	-0.2	-0.5	-0.9	-2.2	-2.7	-0.6
24	3.0	2.7	2.3	2.3	2.3	2.0	2.2	1.6	1.6	2.3	2.6	3.1	2.6

Figure 28. Mean air-sea temperature differences (upper figures) with standard deviation (lower figures) for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	1005.4	1015.6	1008.6	1015.4	1013.6	1014.4	1014.6	1013.6	1013.8	1009.6	1007.2	1005.8	1011.8
07	1009.1	1013.4	1011.6	1016.3	1014.4	1016.5	1014.0	1013.8	1012.4	1013.2	1010.6	1007.6	1013.2
09	1009.8	1013.2	1013.3	1014.5	1016.7	1013.8	1014.9	1015.4	1014.8	1013.5	1007.7	1011.4	1013.1
11	1011.8	1015.4	1014.2	1012.0	1014.9	1012.4	1012.5	1014.8	1012.7	1012.8	1007.8	1008.3	1012.5
15	1013.0	1013.4	1013.4	1013.5	1015.6	1015.0	1015.3	1016.5	1016.9	1012.6	1011.4	1010.4	1014.1
18	1009.8	1016.4	1014.6	1014.1	1015.5	1012.7	1018.3	1014.0	1019.9	1021.0	1008.9	1020.0	1015.4
20	1012.6	1015.0	1013.9	1015.3	1014.7	1015.6	1015.4	1016.8	1017.4	1015.2	1014.3	1012.2	1015.0
24	1012.4	1011.7	1014.2	1014.4	1014.8	1016.2	1015.7	1016.4	1017.7	1015.0	1012.2	1013.6	1014.7

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	1012.2	1009.0	1009.6	1011.1	1012.4	1013.9	1014.2	1011.3	1011.2	1010.0	1007.6	1008.8	1011.2
07	1007.8	1012.6	1010.2	1011.1	1013.7	1015.5	1013.6	1011.1	1011.2	1011.3	1003.5	1011.1	1011.3
09	1012.0	1010.4	1011.1	1011.8	1013.3	1015.7	1014.1	1013.0	1011.8	1011.9	1008.8	1009.6	1011.5
11	1013.4	1012.2	1011.4	1013.1	1013.8	1014.9	1014.1	1012.4	1013.1	1011.8	1008.8	1010.3	1012.5
15	1013.3	1013.6	1013.4	1013.1	1014.2	1016.0	1015.3	1013.4	1014.4	1014.7	1010.1	1010.8	1013.7
18	1015.6	1011.2	1013.8	1013.3	1015.2	1016.6	1014.9	1014.5	1014.1	1013.5	1012.5	1012.3	1013.9
20	1014.4	1014.4	1013.8	1014.3	1014.5	1016.6	1015.0	1013.9	1013.9	1015.1	1010.2	1012.2	1014.2
24	1015.5	1012.2	1014.2	1013.8	1013.5	1017.6	1017.0	1014.6	1014.1	1016.2	1010.6	1013.4	1014.4

Figure 29. Mean sea-level pressures in hectopascals for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	10	15	14	11	18	14	12	16	12	12	13	11	13
	70	67	66	69	64	67	72	66	69	64	63	65	67
07	14	16	13	13	15	14	15	13	13	13	17	19	14
	70	67	74	70	65	66	68	68	64	68	61	62	67
09	8	12	16	17	29	17	18	18	13	12	10	9	15
	76	71	65	61	56	61	66	61	65	66	63	69	65
11	18	17	23	28	27	26	29	26	16	15	14	15	21
	66	71	62	57	54	51	50	50	58	64	64	69	60
15	8	15	16	20	33	27	22	23	16	13	8	12	18
	77	72	69	62	53	49	60	61	61	67	65	69	64
18	13	12	19	19	35	20	28	23	20	29	10	7	20
	80	77	67	64	49	61	52	58	60	58	76	84	65
20	10	16	20	19	35	29	27	30	21	15	11	19	21
	78	74	69	62	49	56	58	51	55	65	69	65	62
24	12	16	21	23	29	30	23	29	23	21	9	13	21
	74	73	64	56	54	50	60	51	53	60	68	74	61

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	7	9	10	18	15	16	9	11	12	9	8	7	11
	78	77	72	61	70	66	73	70	69	74	69	75	71
07	9	10	14	18	16	15	11	14	13	16	9	12	13
	76	72	65	60	60	64	74	67	69	62	71	70	68
09	10	14	14	22	17	27	12	16	13	12	8	11	14
	74	68	66	58	65	54	70	63	66	67	71	69	67
11	13	18	21	28	25	33	18	26	18	13	9	16	20
	77	67	63	56	59	47	58	53	61	68	75	70	63
15	13	15	15	23	21	22	15	19	16	15	11	12	17
	71	71	66	59	58	59	61	61	64	68	71	69	65
18	15	20	22	28	31	31	20	27	19	17	13	17	21
	75	69	65	55	51	50	61	53	63	67	75	70	63
20	14	13	23	25	28	25	18	22	18	14	10	13	19
	68	72	60	59	53	56	65	58	59	65	70	68	62
24	17	12	20	23	20	28	18	19	17	17	13	15	19
	68	74	64	60	61	53	59	60	59	65	70	71	63

Figure 30. Percentages of observations with total cloud amount $\leq 2/8$ (upper figures) and $\geq 6/8$ (lower figures) for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	23.6	11.8	14.7	14.9	11.0	11.3	9.6	12.7	11.2	13.5	16.8	20.8	14.0
07	11.9	5.9	6.6	6.1	5.7	7.3	8.0	10.6	8.4	10.8	9.0	10.6	8.2
09	19.0	12.7	10.6	8.1	5.8	6.1	6.8	6.1	9.7	11.3	15.3	14.8	10.9
11	16.5	12.8	10.1	9.0	6.6	5.7	7.1	4.5	10.5	11.9	16.6	18.6	10.8
15	7.3	8.8	11.0	6.5	5.3	4.0	5.4	5.3	5.6	8.9	8.5	14.3	7.5
18	13.3	10.3	11.7	6.0	4.8	12.7	5.6	8.8	6.1	7.3	18.6	8.9	9.5
20	12.5	7.8	7.9	5.3	4.5	6.1	6.3	3.0	5.6	10.9	10.6	5.1	7.1
24	11.0	10.8	10.3	4.8	6.3	3.8	5.1	5.1	7.3	9.3	11.6	9.5	7.9

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	13.2	13.8	13.7	7.8	9.9	6.9	7.4	8.4	10.3	10.2	13.8	12.7	10.4
07	14.0	15.4	9.0	10.4	5.3	7.1	8.3	10.3	10.8	7.1	8.7	11.8	9.7
09	19.7	16.8	15.6	9.4	8.1	5.9	8.1	8.2	7.4	12.6	18.8	19.1	13.7
11	12.0	9.2	9.1	8.1	7.7	5.9	7.3	8.9	8.8	11.1	16.0	12.0	9.7
15	9.5	9.0	7.4	9.5	7.6	3.9	6.4	7.5	5.9	7.7	10.6	10.5	7.6
18	13.1	11.4	10.4	12.1	9.4	6.9	10.6	8.2	11.7	13.8	16.5	15.9	11.7
20	10.9	8.9	5.4	9.8	6.4	4.9	6.7	8.1	6.5	6.7	7.7	10.3	7.5
24	9.3	9.9	3.9	7.7	7.7	5.4	4.9	6.2	5.5	6.2	11.0	11.6	7.3

Figure 31. Percentages of observations with precipitation for areas indicated in figure 1.

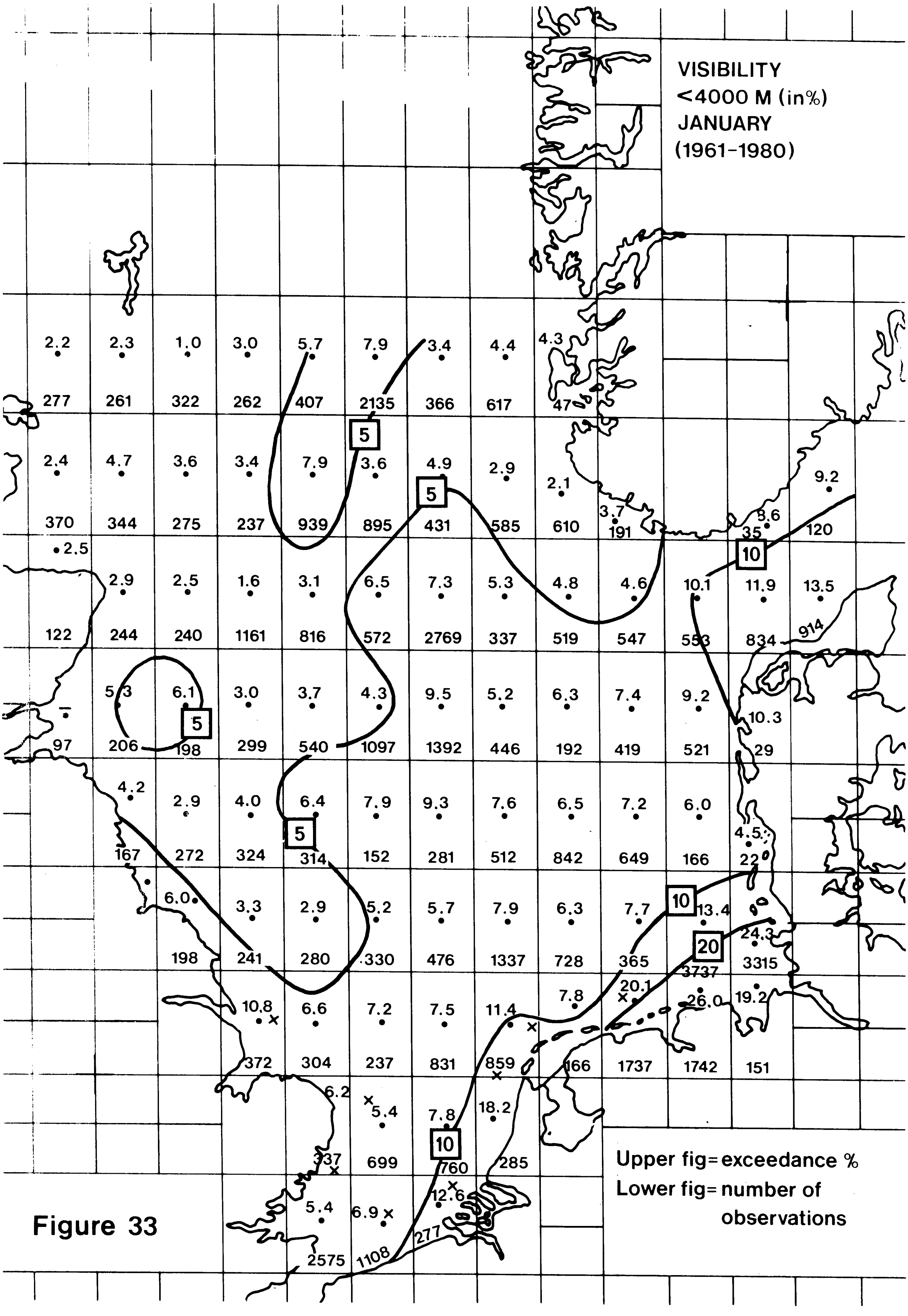
1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	0.5	0.2	3	3	5	3	5	2	4	0.5	0.1	0.4	3
	69	80	76	83	72	83	76	83	80	84	85	84	79
07	0.3	2	2	8	5	4	4	6	1.9	1.7	0.2	0.5	3
	85	83	77	78	78	82	82	78	87	82	91	90	82
09	0.9	2	3	5	7	4	4	3	2	3	0.3	0.7	3
	67	71	70	75	72	73	77	78	80	71	78	77	74
11	4	1.8	2	1.6	5	3	1.7	1.4	1.1	4	0.7	1.3	2
	79	71	76	77	77	81	86	85	85	79	85	81	80
15	3	1.3	3	5	4	3	2.5	1.5	0.8	1.9	0.0	0.4	2
	79	70	71	76	78	81	80	81	87	82	88	84	79
18	8	6	4	10	5	1.9	1.3	1.1	2	4	2	0.8	4
	48	70	74	66	74	85	85	86	78	75	80	77	75
20	0.6	4	6	3	3	7	2.5	0.9	1.3	0.9	0.0	0.4	3
	74	65	60	75	80	77	75	80	79	81	85	86	76
24	3	9	5	3	3	3	2.5	0.4	0.9	2	0.5	2	2
	69	52	65	72	67	74	81	81	84	72	77	74	72

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	0.8	0.5	0.8	3	7	3	4	1.5	2	5	0.4	0.6	3
	82	82	82	82	77	78	86	88	82	77	85	82	82
07	1.0	2	0.0	4	6	7	1.4	2	1.3	3	0.6	0.0	2
	76	84	87	79	75	80	86	85	80	82	92	89	83
09	1.3	2	3	5	11	5	2	2	1.8	3	0.6	0.9	3
	72	76	72	75	68	77	79	79	79	74	77	76	75
11	5	2	3	6	6	2	1.4	0.5	0.9	2	0.3	1.4	2
	73	77	76	76	74	84	84	86	82	79	85	80	80
15	2	3	4	5	3	2.5	0.7	0.7	0.8	5	0.7	1.4	2
	75	79	72	74	72	79	85	87	81	77	88	83	80
18	8	5	5	5	3	0.8	0.5	0.7	1.2	3	3	3	4
	56	71	74	75	81	85	89	89	85	80	78	76	78
20	1.5	2	7	4	3	4	1.1	1.0	1.7	1.2	0.7	1.6	2
	68	78	69	70	73	73	79	80	83	80	84	78	76
24	5	2	11	4	5	4	0.9	0.8	3	4	1.6	4	4
	64	69	59	66	72	72	76	73	75	67	77	66	70

Figure 32. Percentages of observations with visibility < 1 km (upper figures) and ≥ 10 km (lower figures) for areas indicated in figure 1.



VISIBILITY
<4000 M (in%)
JANUARY
(1961-1980)
2.2 2.3 1.0 3.0 5.7 7.9 3.4 4.4 4.3
277 261 322 262 407 2135 366 617 47
2.4 4.7 3.6 3.4 7.9 3.6 4.9 2.9 2.1 3.7 3.6 9.2
370 344 275 237 939 895 431 585 610 191 35 120
2.5 2.9 2.5 1.6 3.1 6.5 7.3 5.3 4.8 4.6 10.1 11.9 13.5
122 244 240 1161 816 572 2769 337 519 547 553 834 914
5.3 6.1 3.0 3.7 4.3 9.5 5.2 6.3 7.4 9.2 10.3
97 206 198 299 540 1097 1392 446 192 419 521 29
4.2 2.9 4.0 6.4 7.9 9.3 7.6 6.5 7.2 6.0 4.5
167 272 324 314 152 281 512 842 649 166 22
6.0 3.3 2.9 5.2 5.7 7.9 6.3 7.7 13.4 24.3
198 241 280 330 476 1337 728 365 3737 3315
10.8 6.6 7.2 7.5 11.4 7.8 20.1 26.0 19.2
372 304 237 831 859 166 1737 1742 151
6.2 5.4 7.8 18.2
337 699 760 285
5.4 6.9 12.6
2575 1108 277
5
5
5
5
10
10
20
10
Upper fig= exceedance %
Lower fig= number of observations

Figure 33

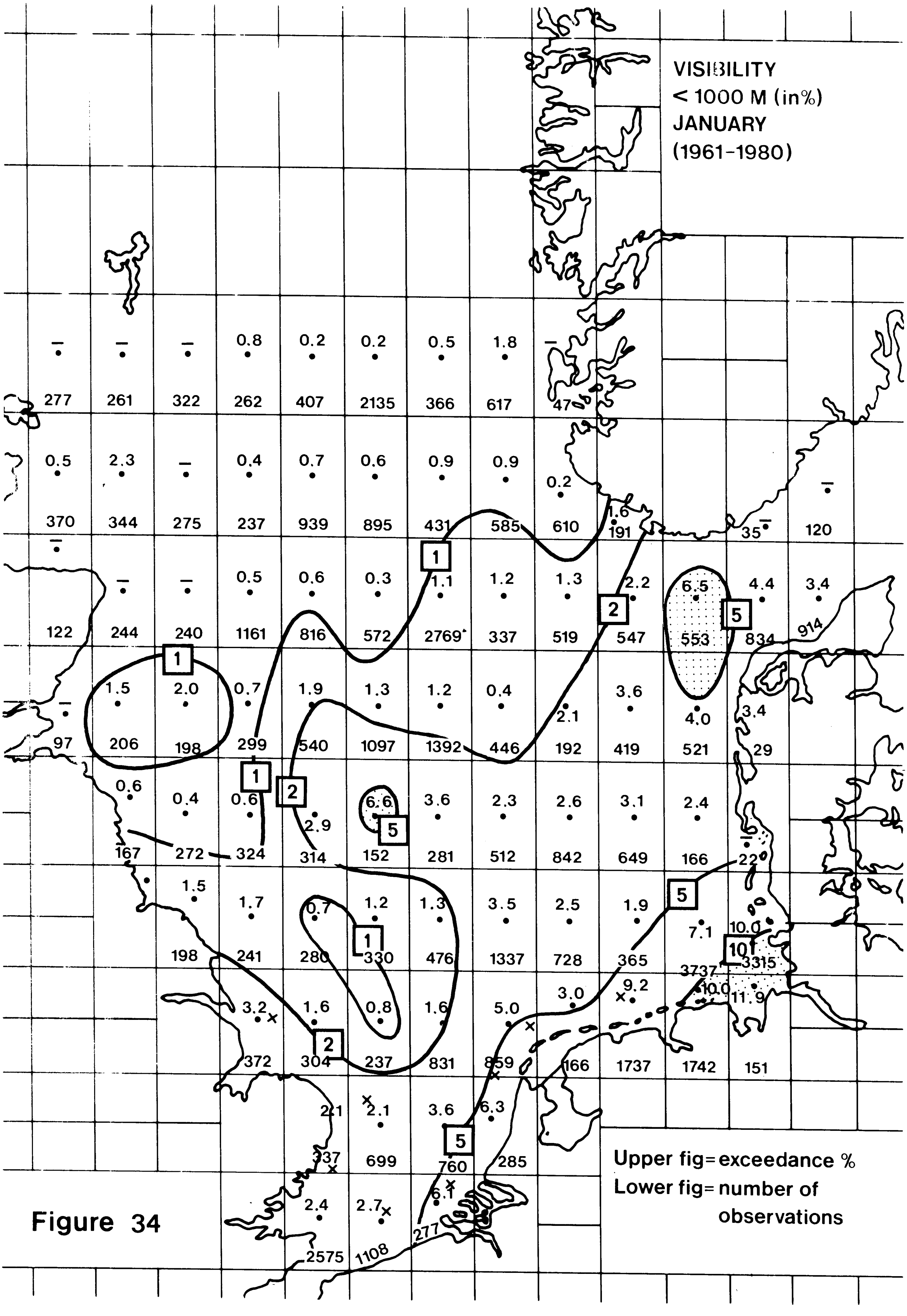

VISIBILITY
< 1000 M (in%)
JANUARY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 34

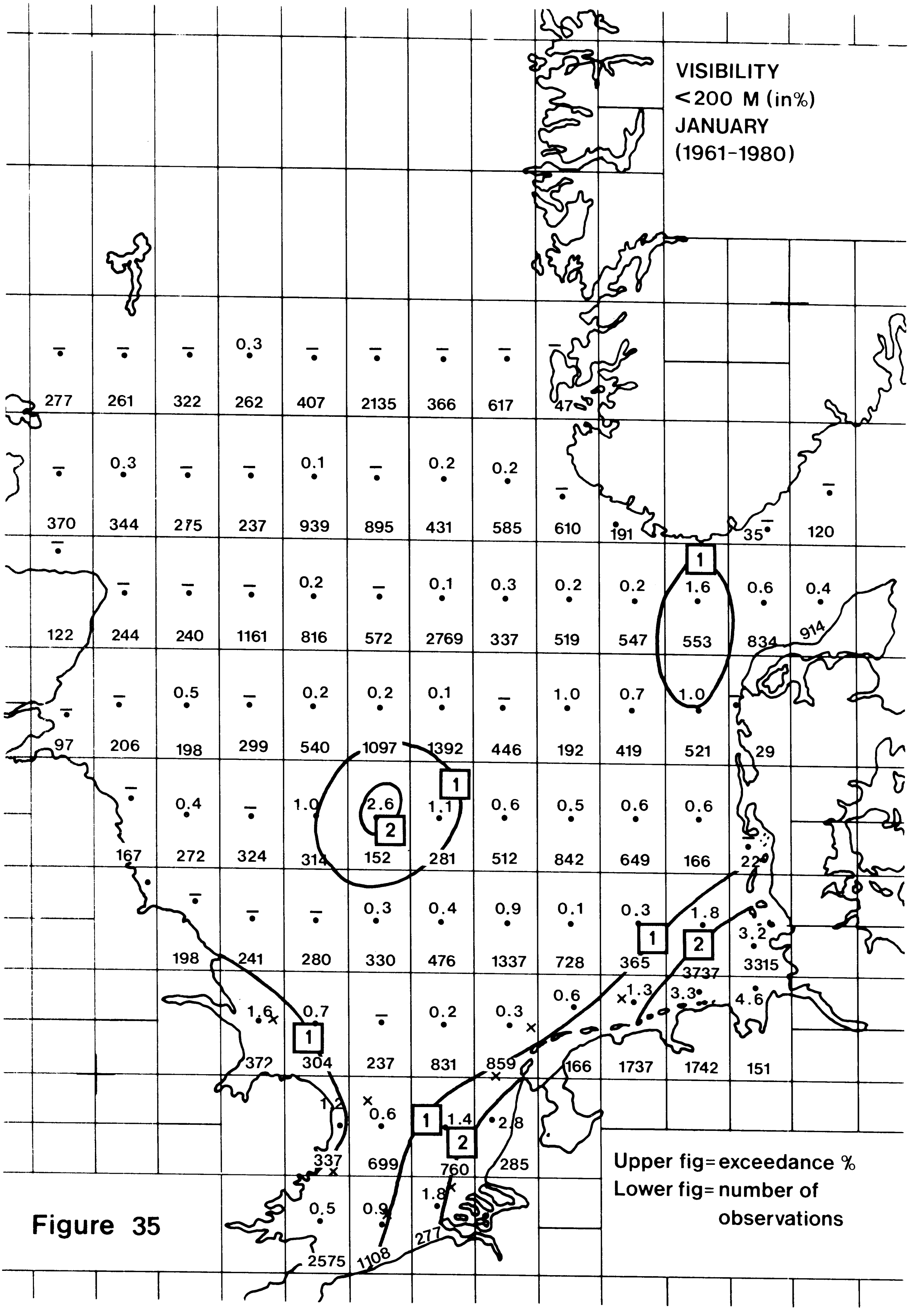

VISIBILITY
<200 M (in%)
JANUARY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 35

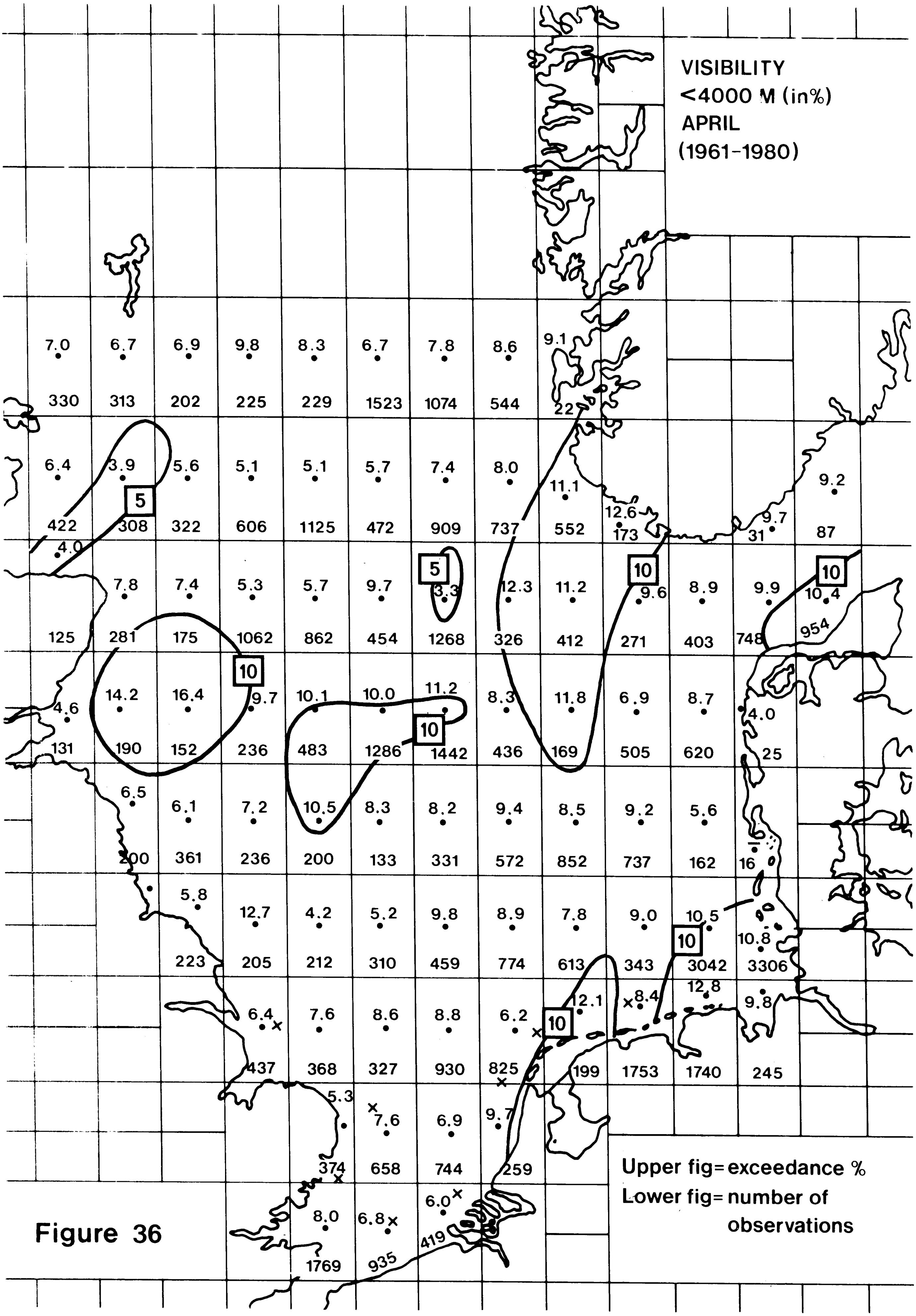
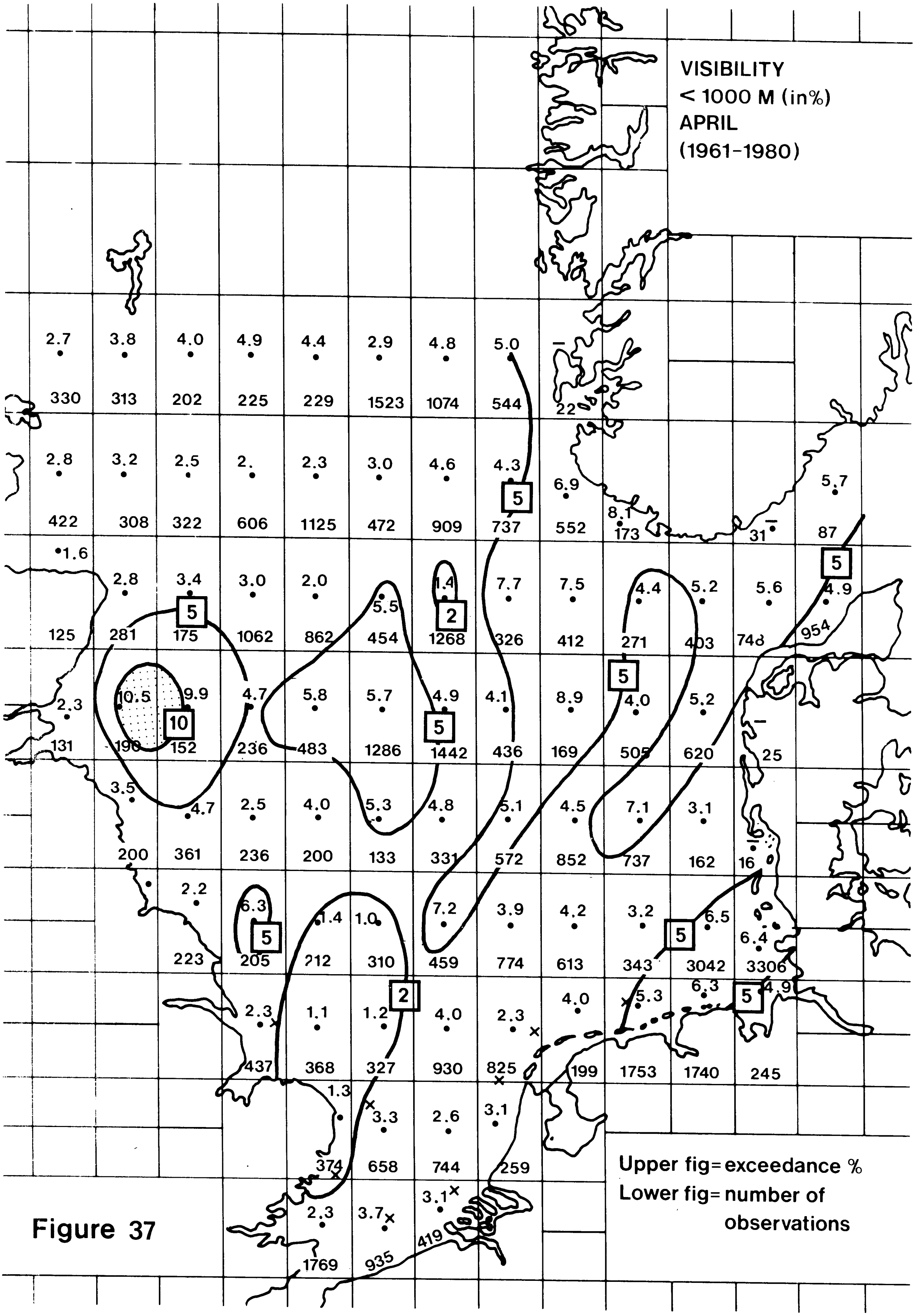

VISIBILITY
<4000 M (in%)
APRIL
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 36



VISIBILITY
< 1000 M (in%)
APRIL
(1961-1980)
2.7 330
3.8 313
4.0 202
4.9 225
4.4 229
2.9 1523
4.8 1074
5.0 544
22
2.8 422
3.2 308
2.5 322
2. 606
2.3 1125
3.0 472
4.6 909
4.3 737
6.9 552
8.1 173
31
5.7 87
1.6 125
2.8 281
3.4 175
3.0 1062
2.0 862
5.5 454
1.4 1268
7.7 326
7.5 412
4.4 271
5.2 403
5.6 748
4.9 954
2.3 131
10.5 190
9.9 152
4.7 236
5.8 483
5.7 1286
4.9 1442
4.1 436
8.9 169
4.0 505
5.2 620
25
3.5 200
4.7 361
2.5 236
4.0 200
5.3 133
4.8 331
5.1 572
4.5 852
7.1 737
3.1 162
16
2.2 223
6.3 205
1.4 212
1.0 310
7.2 459
3.9 774
4.2 613
3.2 343
6.5 3042
6.4 3306
2.3 437
1.1 368
1.2 327
4.0 930
2.3 825
4.0 199
5.3 1753
6.3 1740
4.9 245
1.3 374
3.3 658
2.6 744
3.1 259
2.3 1769
3.7 935
3.1 419
5
5
2
5
10
5
5
5
5
2
5
5
Upper fig= exceedance %
Lower fig= number of observations

Figure 37

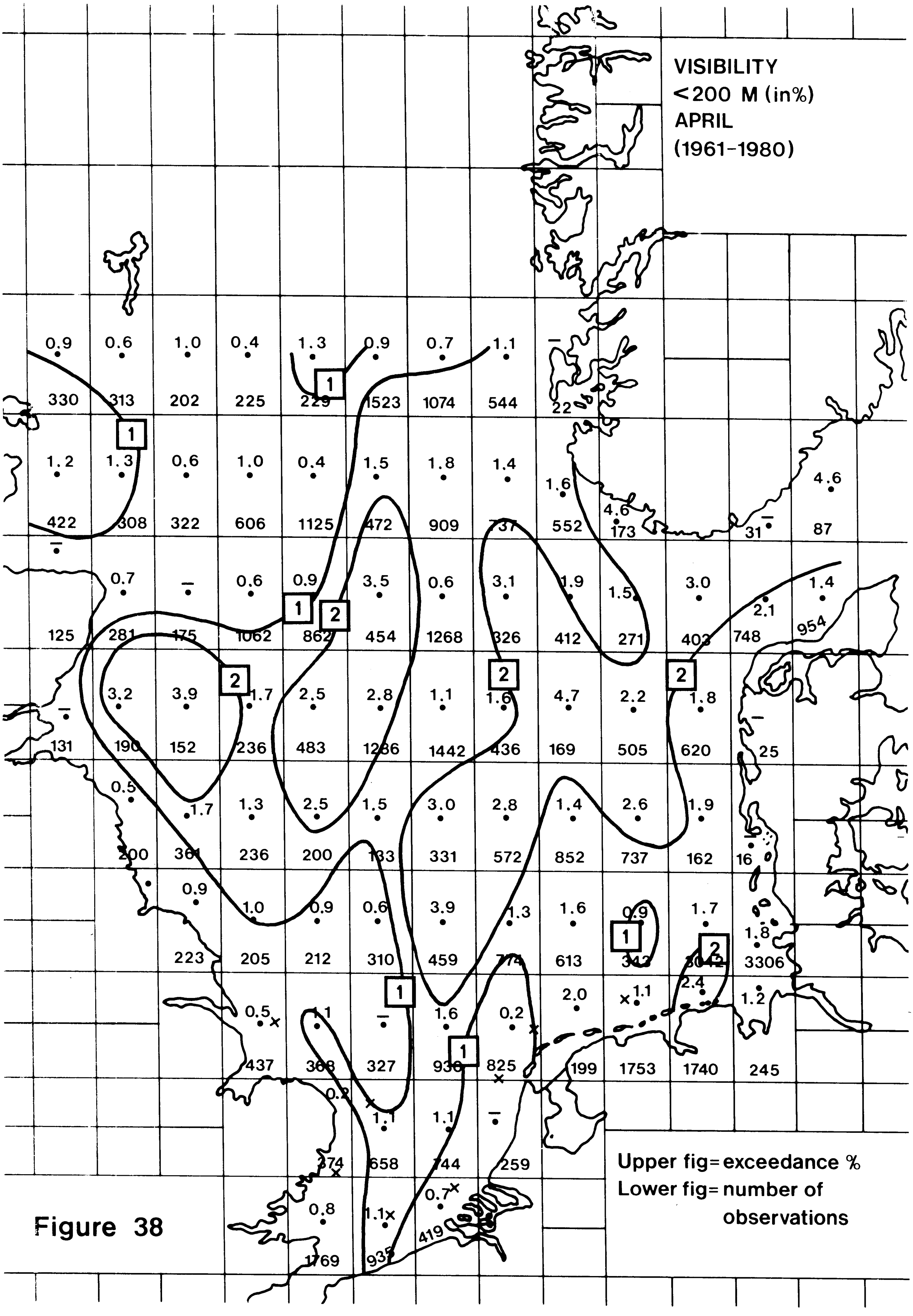

VISIBILITY
<200 M (in%)
APRIL
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 38

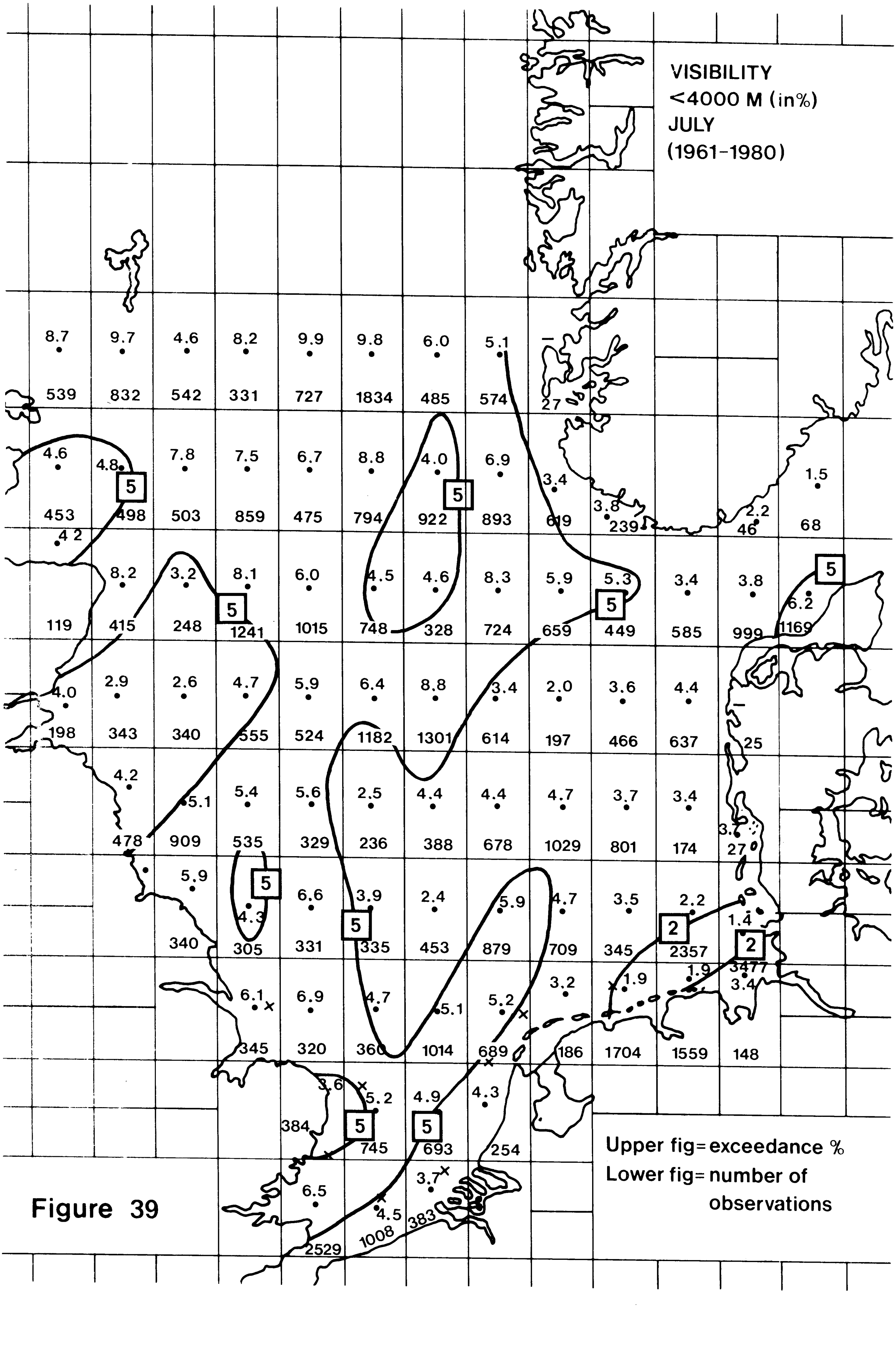

VISIBILITY
<4000 M (in%)
JULY
(1961-1980)
Upper fig=exceedance %
Lower fig=number of observations

Figure 39

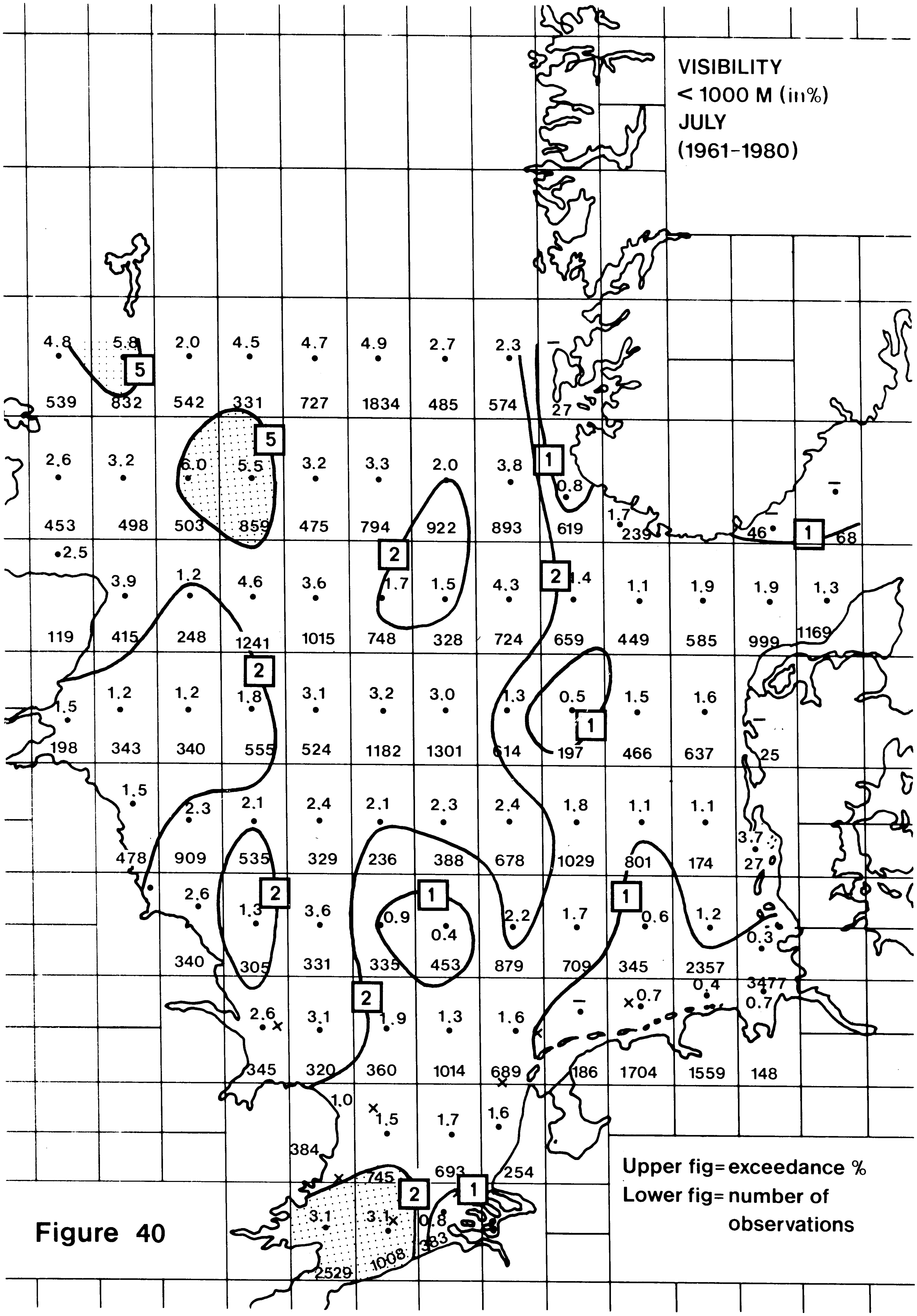

VISIBILITY
< 1000 M (in%)
JULY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 40

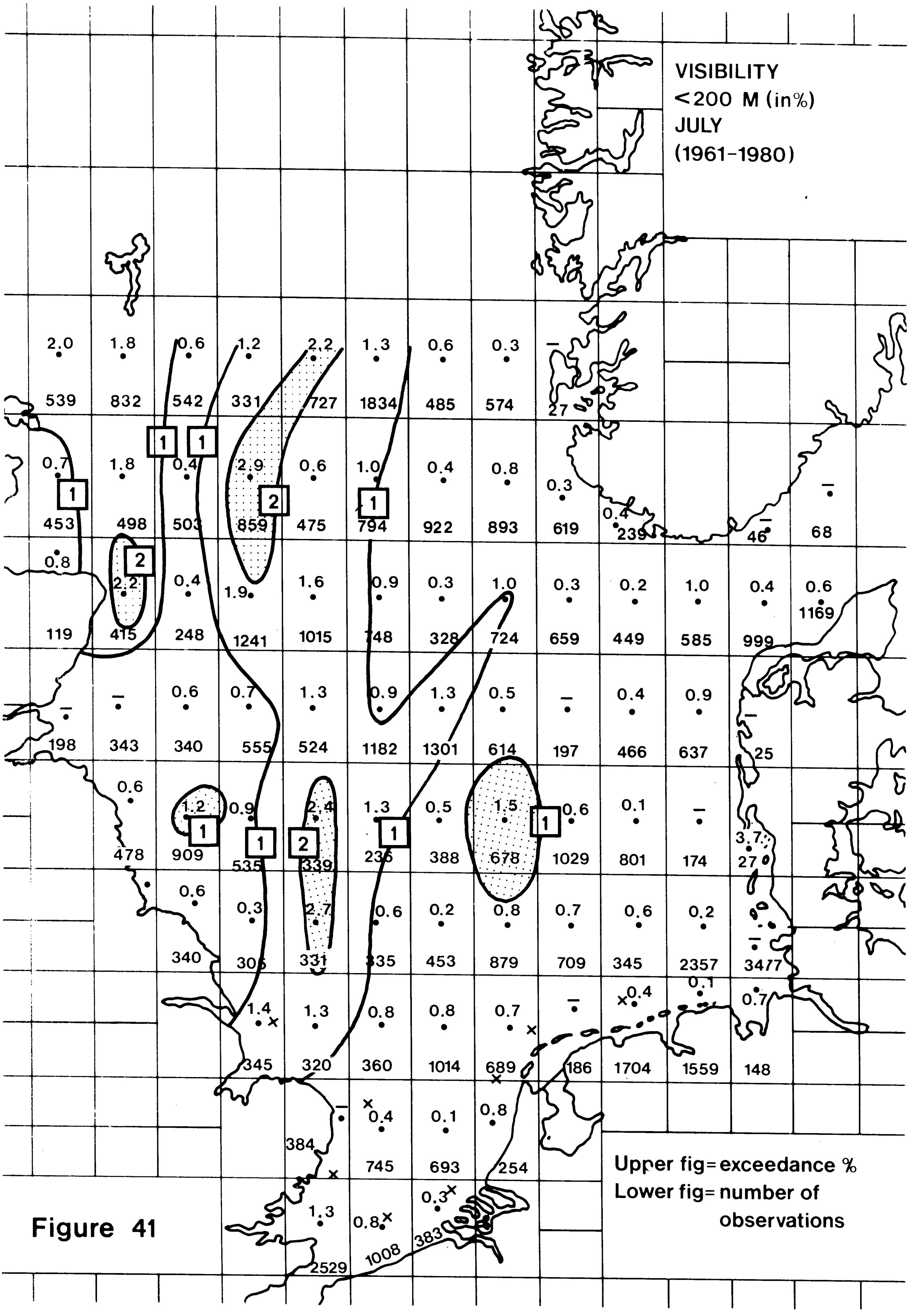

VISIBILITY
<200 M (in%)
JULY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of
observations

Figure 41

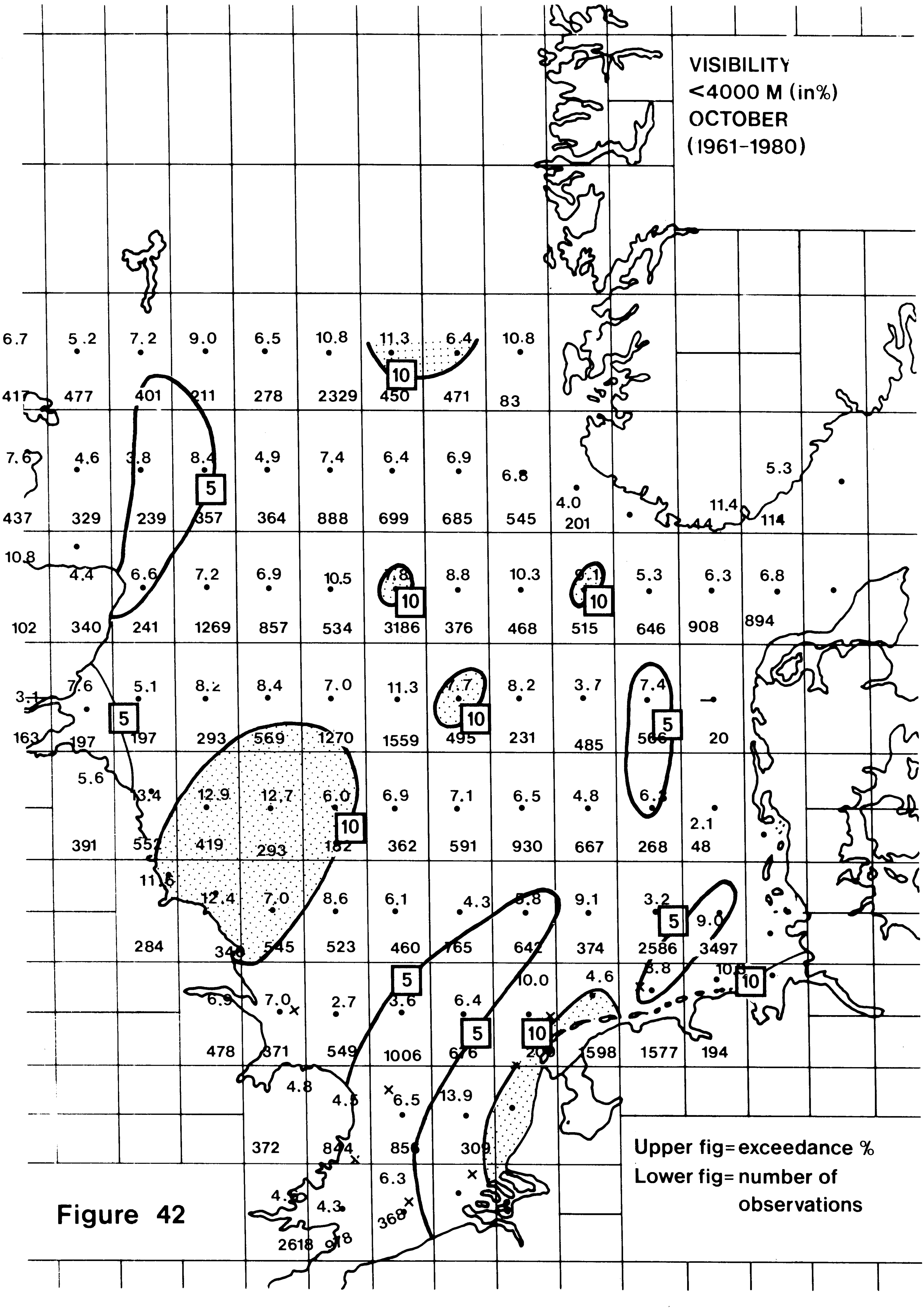
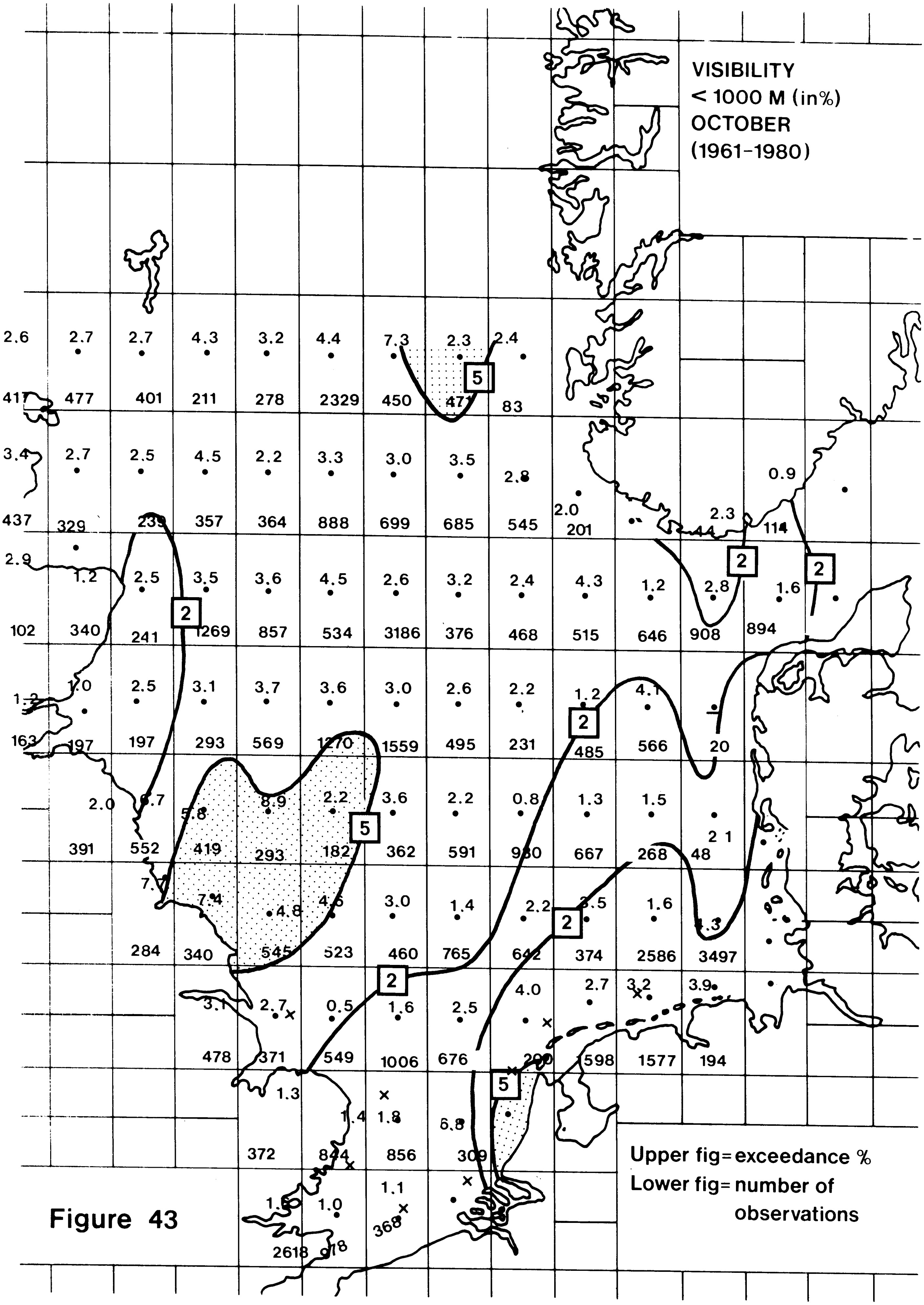

VISIBILITY
<4000 M (in%)
OCTOBER
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 42



VISIBILITY
< 1000 M (in%)
OCTOBER
(1961-1980)
Upper fig=exceedance %
Lower fig= number of observations

Figure 43

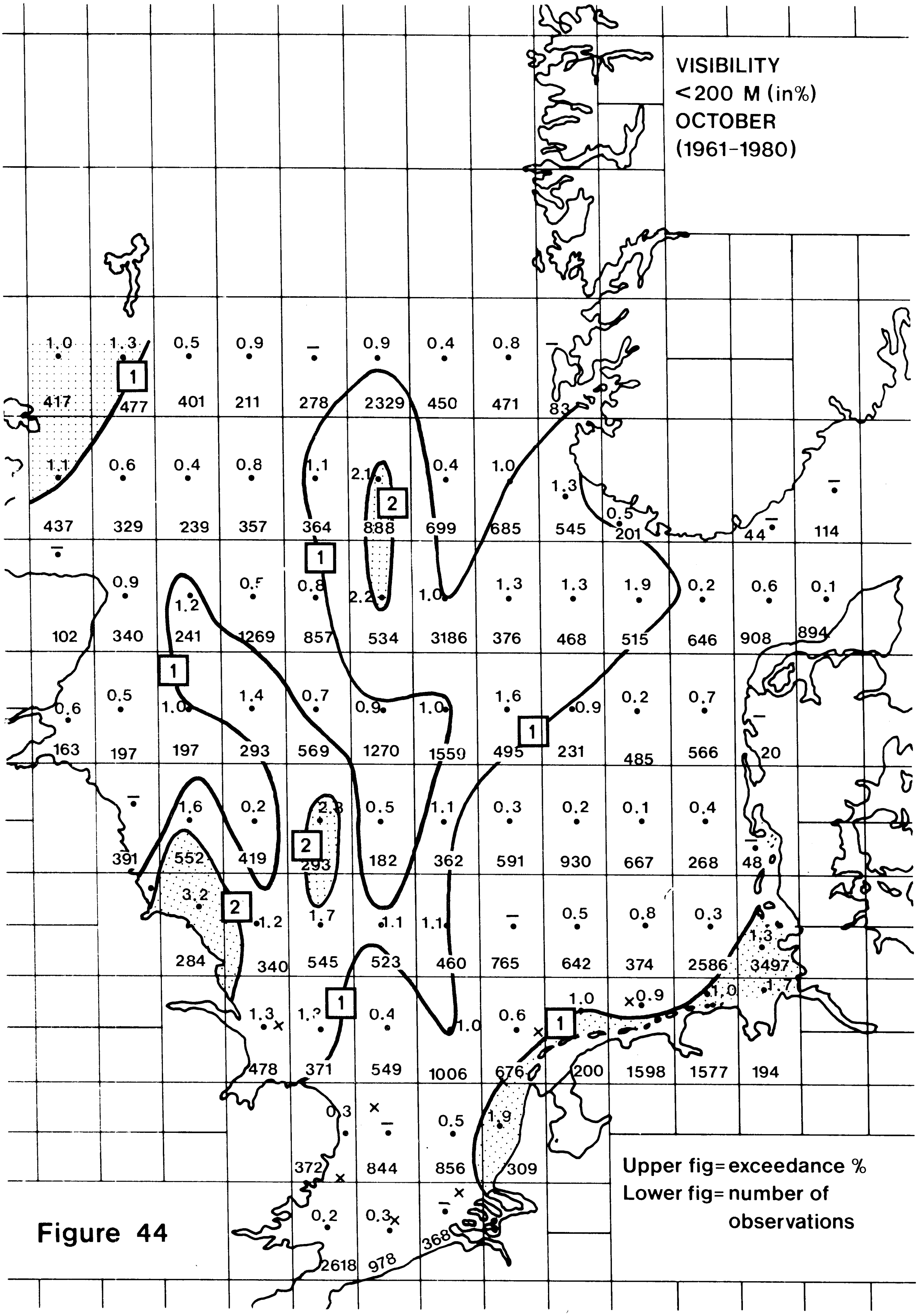

VISIBILITY
<200 M (in%)
OCTOBER
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 44

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
07	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1
09	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1
11	3.2	2.2	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
15	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.1
18	0.7	0.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
20	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
24	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
09	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2
15	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	4.6	5.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	1.1
20	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
24	3.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.4

Figure 45. Percentages of observations with potential moderate or severe superstructure icing for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	0.3	0.4	0.3	0.2	0.1	0.2	0.2	0.2	0.4	0.2	0.3	0.3	0.2
07	0.3	0.3	0.3	0.2	0.1	0.2	0.1	0.2	0.3	0.2	0.4	0.3	0.2
09	0.3	0.3	0.2	0.2	0.1	0.4	0.4	0.2	0.3	0.2	0.4	0.4	0.2
11	0.1	0.2	0.2	0.3	0.1	0.5	0.6	0.2	0.4	0.1	0.4	0.2	0.2
15	0.4	0.2	0.2	0.3	0.3	0.3	0.4	0.1	0.4	0.3	0.5	0.4	0.2
18	0.6	0.3	0.0	0.3	0.5	0.3	0.5	0.2	0.3	0.3	0.5	0.5	0.2
20	0.4	0.1	0.1	0.4	0.3	0.3	0.3	0.2	0.4	0.2	0.3	0.5	0.1
24	0.4	0.2	0.3	0.3	0.2	0.3	0.4	0.2	0.4	0.1	0.5	0.4	0.2

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	0.2	0.2	0.2	0.1	0.1	0.2	0.3	0.2	0.3	0.4	0.1	0.2	0.2
07	0.3	0.1	0.3	0.2	0.0	0.2	0.3	0.2	0.3	0.4	0.2	0.3	0.2
09	0.2	0.1	0.3	0.1	0.1	0.2	0.4	0.3	0.3	0.4	0.1	0.1	0.2
11	0.1	0.1	0.3	0.1	0.1	0.3	0.5	0.3	0.3	0.4	0.0	0.1	0.2
15	0.1	0.1	0.2	0.0	0.1	0.3	0.4	0.3	0.4	0.4	0.2	0.2	0.2
18	0.2	0.1	0.1	0.1	0.0	0.2	0.4	0.2	0.3	0.5	0.3	0.2	0.2
20	0.1	0.2	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.2	0.3	0.2
24	0.1	0.2	0.2	0.2	0.3	0.2	0.4	0.3	0.5	0.3	0.2	0.2	0.2

Figure 46. Prevailing wind directions and steadiness of the wind for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	12.4	8.2	9.8	8.2	6.7	6.7	6.2	6.7	6.7	9.8	10.3	12.4	8.2
	6.1	5.5	5.2	4.6	4.4	4.0	4.0	4.4	4.6	6.1	5.7	6.3	5.4
07	10.1	7.2	8.2	5.7	5.1	5.1	4.6	5.1	6.7	6.7	10.3	10.3	6.7
	5.4	4.6	5.1	4.5	3.7	3.6	3.7	3.9	4.7	4.8	4.9	5.8	4.8
09	10.3	8.2	8.2	7.2	6.2	6.7	6.7	6.7	7.2	8.8	9.8	11.3	8.2
	6.0	5.1	4.9	4.9	4.1	4.0	4.2	4.4	4.7	5.0	5.6	5.7	5.2
11	9.3	8.2	8.2	6.7	5.7	6.7	6.7	5.7	6.7	8.2	9.3	10.3	7.2
	6.1	4.7	5.1	4.6	4.6	4.3	4.5	4.3	4.9	5.0	5.3	6.2	5.2
15	6.7	6.7	7.7	6.7	6.7	5.7	4.6	5.7	6.7	8.8	12.4	9.3	6.7
	5.0	4.2	5.2	6.3	4.3	3.7	4.0	4.7	4.4	5.7	5.4	5.7	5.1
18	7.7	7.7	7.7	6.7	5.7	6.7	5.7	7.2	7.2	8.2	10.8	10.3	7.7
	3.8	3.9	3.7	4.6	3.4	3.0	3.7	3.6	3.8	4.7	5.0	4.1	4.2
20	7.2	5.7	6.7	7.2	6.7	5.1	6.2	5.1	7.2	8.8	9.3	9.8	6.7
	5.1	4.2	5.3	4.7	4.3	4.0	4.5	4.6	4.7	5.9	5.6	5.2	5.0
24	7.7	6.7	7.2	6.7	5.7	5.1	5.7	6.2	6.2	7.7	10.3	8.8	6.7
	4.4	3.9	4.5	4.5	3.8	3.8	3.9	4.1	4.1	4.6	4.9	5.3	4.5

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	9.3	8.2	9.3	6.7	5.1	4.6	6.7	5.1	6.7	6.7	7.7	9.3	6.7
	5.7	5.7	6.4	4.5	4.3	3.6	3.9	4.3	4.7	4.9	5.6	6.3	5.2
07	9.3	7.7	8.8	5.7	4.6	4.6	4.6	4.6	6.7	6.7	8.8	9.3	6.7
	5.1	4.9	5.4	4.3	3.6	3.3	3.7	3.9	4.2	5.0	5.0	4.7	4.5
09	9.3	6.7	9.3	6.7	6.7	5.1	6.7	6.7	6.7	6.7	8.8	9.3	6.7
	5.2	5.3	5.8	4.5	4.2	3.7	4.2	4.1	5.2	5.1	5.3	5.4	5.2
11	7.7	6.7	7.7	5.7	4.6	5.1	6.2	6.7	6.7	6.7	8.8	7.7	6.7
	5.1	5.5	5.3	4.3	3.9	3.8	4.3	4.3	4.7	5.2	5.5	5.6	4.9
15	9.3	7.2	6.7	6.7	6.2	5.1	4.6	6.2	6.2	6.2	8.2	7.2	6.7
	4.8	5.0	5.4	4.3	3.7	3.5	3.4	4.0	4.6	4.9	5.2	4.8	4.7
18	8.8	9.3	9.8	7.7	6.7	6.7	7.2	6.7	7.7	8.8	9.3	9.3	8.2
	3.9	4.1	4.2	3.7	3.5	3.2	3.5	3.5	4.0	4.4	4.5	4.2	4.0
20	9.3	6.7	6.7	5.7	5.1	4.6	4.6	5.7	5.1	6.2	7.7	6.7	6.7
	4.7	4.5	4.3	4.2	3.3	3.6	3.8	3.7	4.1	4.6	5.3	4.8	4.4
24	9.3	7.2	7.2	5.7	6.2	4.6	6.2	6.7	5.7	6.2	6.7	7.2	6.2
	4.8	4.3	4.6	3.8	3.6	3.3	3.9	3.5	4.4	4.3	4.7	5.2	4.4

Figure 47. Median wind speeds (upper figures) with standard deviations (lower figures) for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	23.3	10.1	12.2	4.6	3.2	1.4	1.2	3.1	5.4	16.9	17.3	25.8	9.3
07	12.9	4.5	6.8	2.7	0.7	0.6	0.7	1.1	4.5	6.6	10.6	15.2	4.7
09	17.0	7.4	6.9	5.1	1.7	1.3	2.1	2.5	5.2	7.3	13.8	19.2	8.0
11	14.4	4.9	8.2	4.2	2.9	2.4	2.3	2.5	6.5	6.6	12.2	19.2	7.0
15	6.3	3.1	5.9	8.2	4.5	0.2	0.7	3.1	3.6	11.6	19.2	15.7	6.3
18	2.4	1.4	1.3	3.2	0.4	0.1	1.2	0.4	1.2	7.4	13.5	4.4	3.1
20	5.9	2.2	7.3	4.7	3.1	1.2	3.4	3.7	4.5	12.7	16.7	12.9	6.0
24	4.7	1.5	3.9	3.5	0.8	0.9	1.4	1.2	2.0	4.1	11.3	9.7	3.4

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	13.6	8.8	17.9	3.4	2.0	0.5	0.8	1.6	4.6	6.0	9.6	16.9	6.1
07	8.3	6.2	9.6	2.0	0.8	0.1	0.6	0.9	2.3	6.1	7.1	7.4	3.3
09	9.5	7.9	10.8	3.2	2.0	0.6	1.7	1.5	5.5	6.0	9.3	9.1	6.5
11	7.0	7.6	7.9	3.0	0.4	0.8	1.8	1.6	4.2	6.2	9.1	7.9	4.6
15	7.5	7.0	9.7	2.4	1.1	0.7	0.4	1.8	3.4	5.7	8.1	5.7	4.3
18	2.4	3.2	5.6	1.1	0.8	0.5	0.6	0.6	2.9	4.6	6.0	4.4	2.8
20	6.6	3.8	2.9	1.1	0.1	0.6	1.2	0.4	2.3	4.3	7.9	6.6	2.9
24	7.8	4.0	2.1	0.5	0.1	0.1	0.8	0.5	2.7	2.5	4.6	7.1	2.6

Figure 48. Percentages of gales (≥ Beaufort 8) with prevailing directions for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	5	16	6	11	20	20	24	18	11	9	6	7	13
	54	33	42	27	18	14	13	18	24	45	47	55	31
07	7	15	11	25	23	27	29	27	14	13	6	8	19
	43	23	31	14	9	6	9	10	18	23	41	42	20
09	7	12	10	14	22	20	21	21	13	10	8	5	13
	45	31	31	25	14	14	16	16	26	32	44	50	30
11	10	13	13	15	25	22	19	20	10	13	6	8	14
	35	28	30	21	13	17	19	16	25	27	38	47	26
15	12	9	12	13	17	22	31	21	18	9	3	6	14
	28	20	25	24	16	13	12	12	20	30	53	42	24
18	6	11	10	17	19	13	15	11	12	8	5	3	11
	22	24	18	18	9	8	12	16	16	31	49	41	22
20	12	18	13	11	14	23	20	24	13	8	4	7	14
	25	14	23	21	17	13	16	15	22	34	43	43	23
24	8	17	14	19	21	28	20	18	16	13	5	10	16
	27	17	22	18	12	8	11	13	15	24	46	35	20

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	13	18	13	24	28	34	24	30	20	20	19	14	23
	40	34	42	16	14	8	10	13	18	19	35	43	22
07	12	11	12	23	27	30	27	26	16	17	14	8	21
	34	26	32	18	8	5	9	13	18	24	31	36	18
09	11	16	14	19	22	26	24	22	18	16	11	12	16
	39	30	34	20	16	10	14	14	25	25	36	37	28
11	17	18	15	24	36	28	25	25	15	21	15	20	22
	28	28	33	14	9	9	15	17	25	25	33	31	22
15	9	13	14	18	20	23	30	21	25	23	13	13	19
	35	27	28	21	11	8	6	14	19	18	32	26	20
18	6	6	5	9	11	11	10	11	9	8	7	6	8
	28	32	37	20	13	10	17	16	24	31	34	34	25
20	9	14	14	25	25	31	28	24	24	21	12	13	21
	34	21	19	18	6	6	9	12	13	18	31	23	17
24	8	11	20	26	24	31	26	16	24	17	12	16	19
	34	19	20	12	7	5	10	10	15	18	23	27	16

Figure 49. Percentages of observations with light winds, ≤ Beaufort 2 (upper figures) and strong winds, ≥ Beaufort 6 (lower figures) for areas indicated in figure 1.

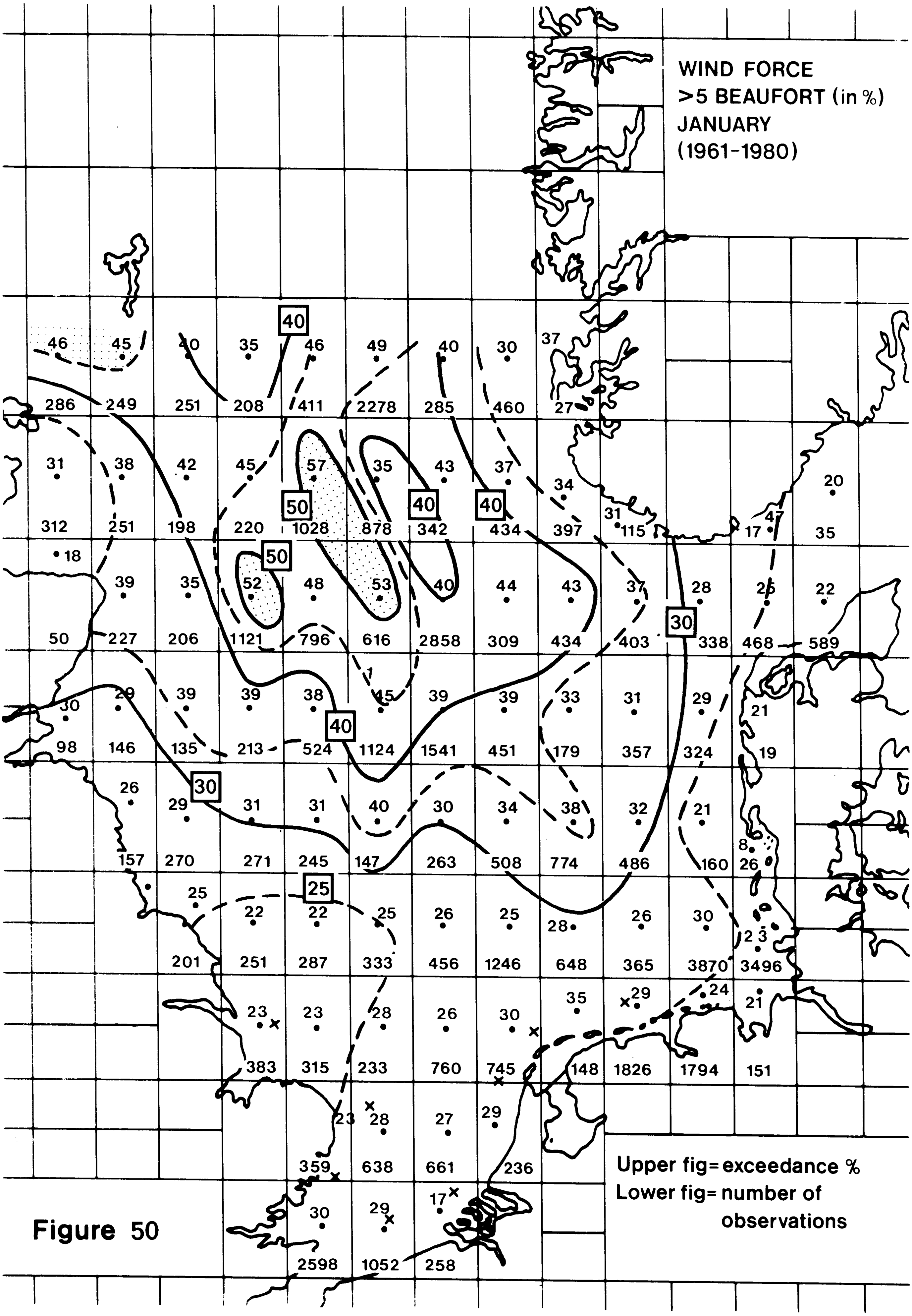

WIND FORCE
>5 BEAUFORT (in %)
JANUARY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 50

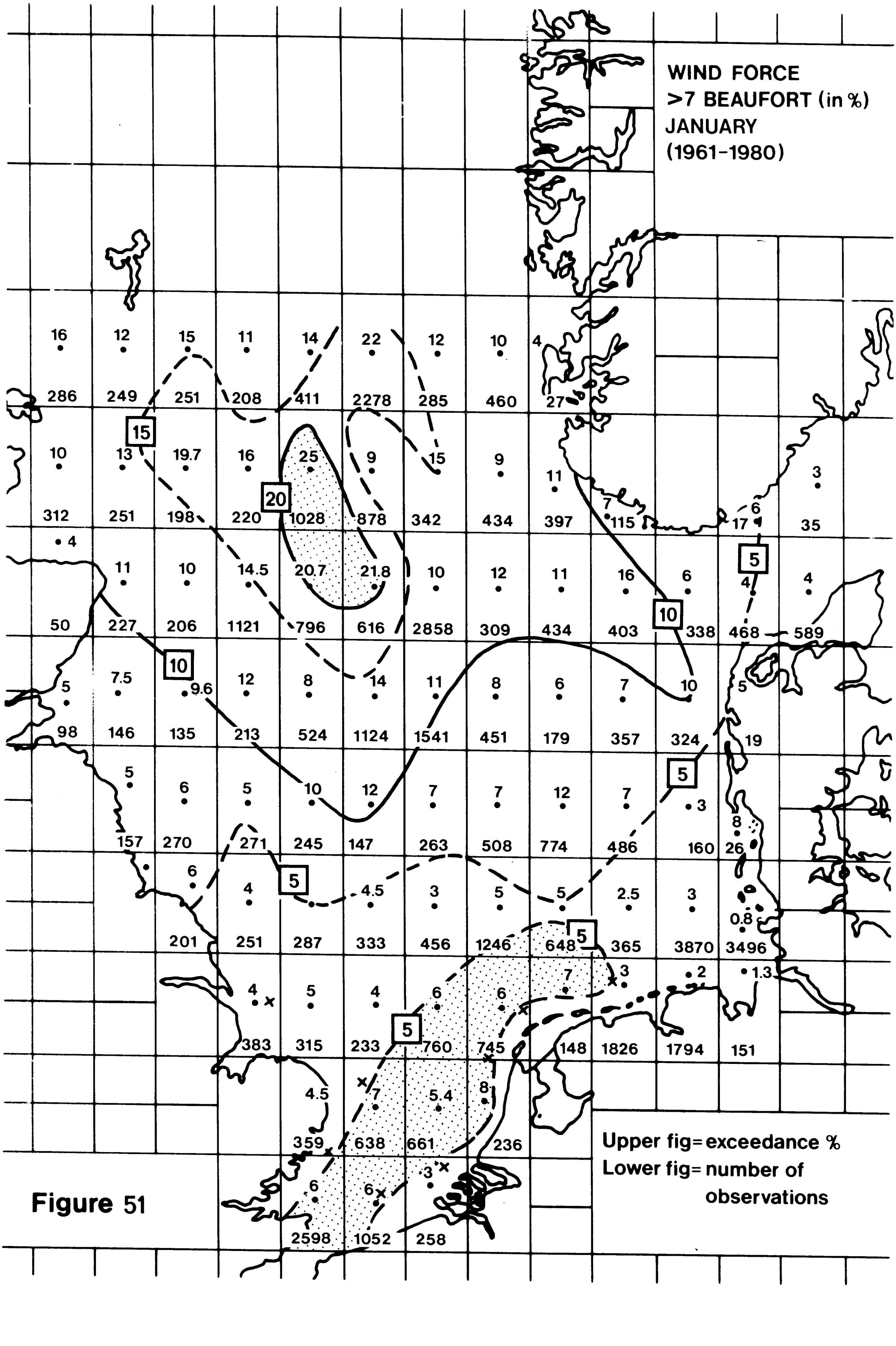

WIND FORCE
>7 BEAUFORT (in %)
JANUARY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 51

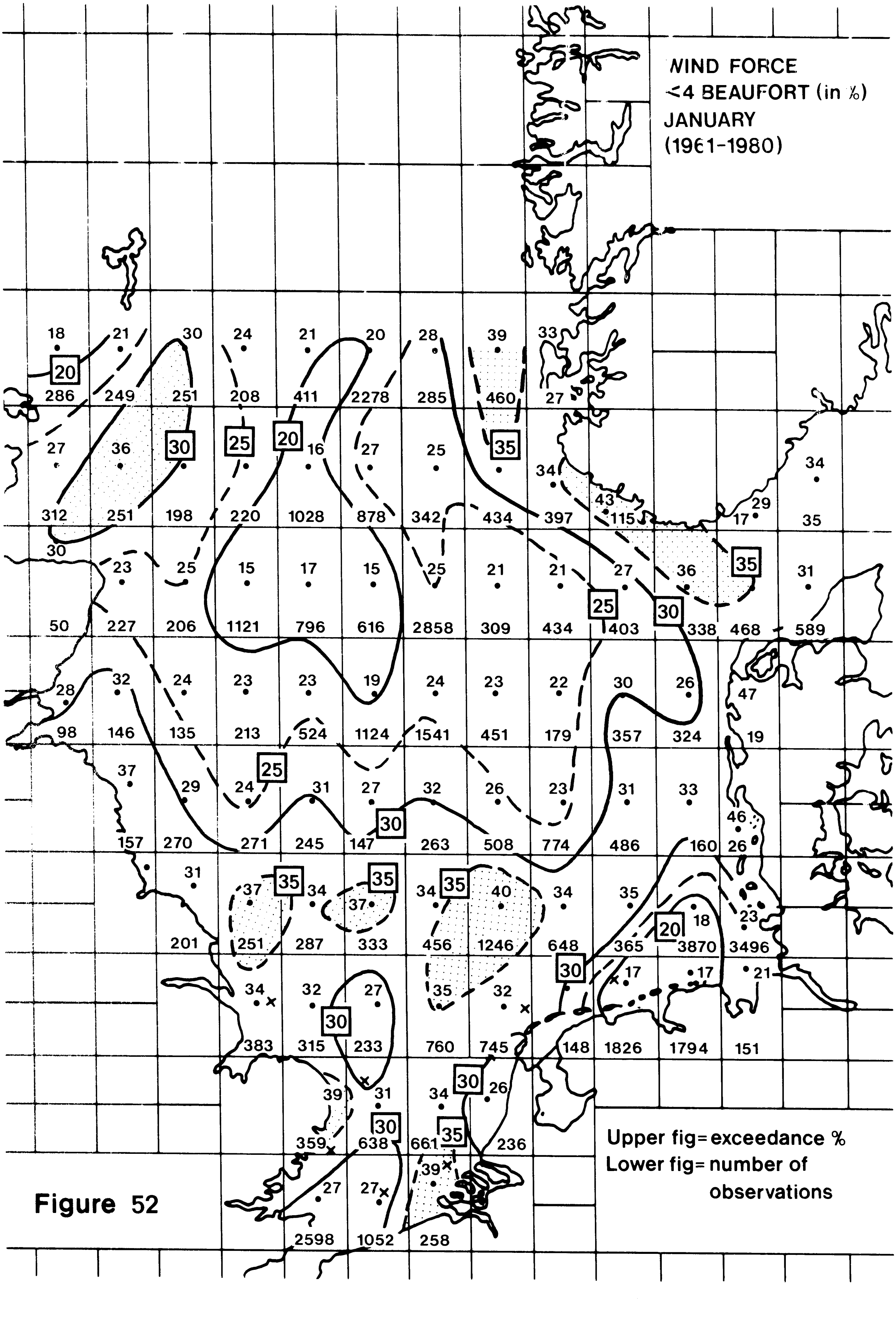

WIND FORCE
≤4 BEAUFORT (in %)
JANUARY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 52

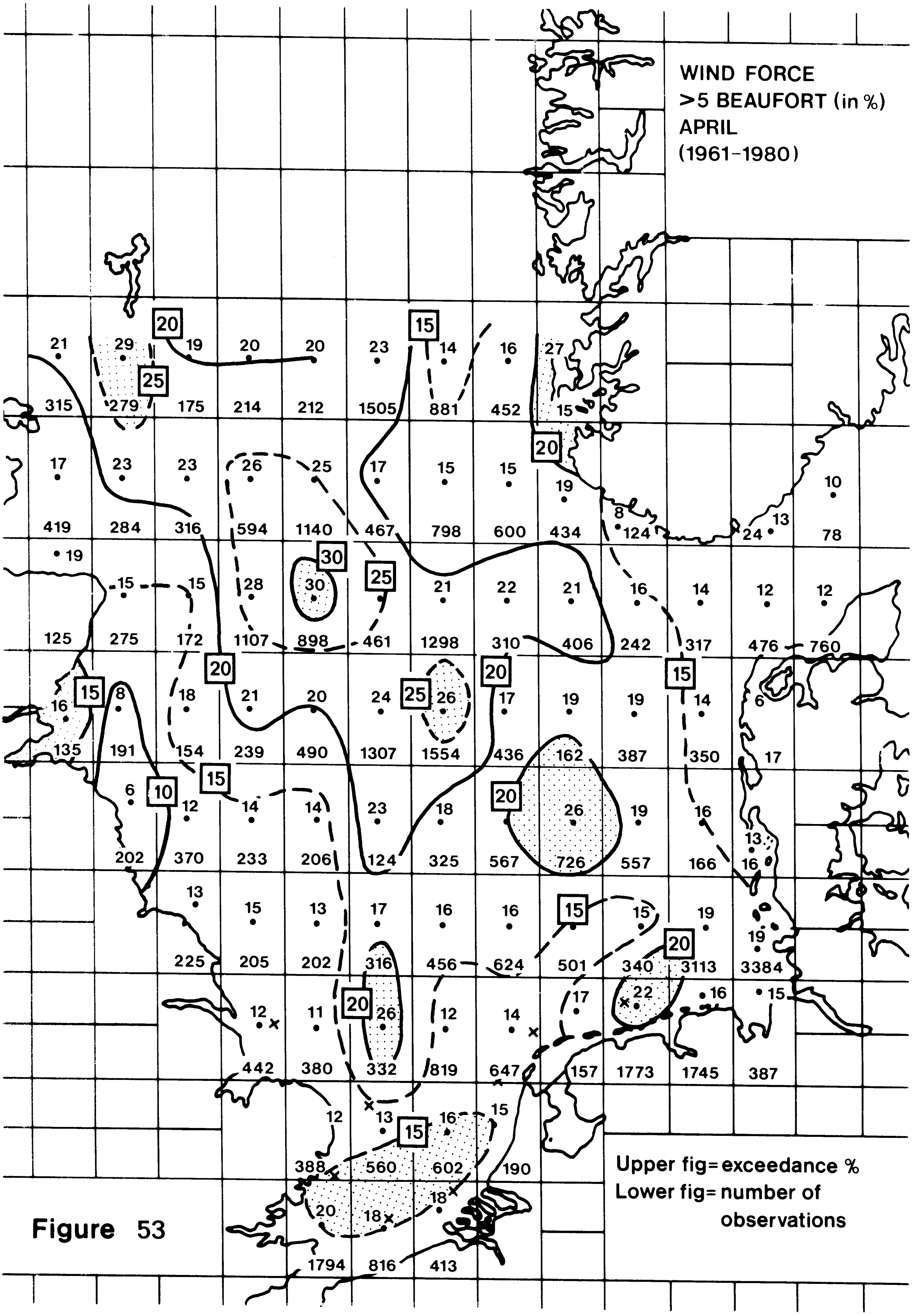

WIND FORCE
>5 BEAUFORT (in %)
APRIL
(1961-1980)
Upper fig= exceedance %
Lower fig= number of
observations

Figure 53

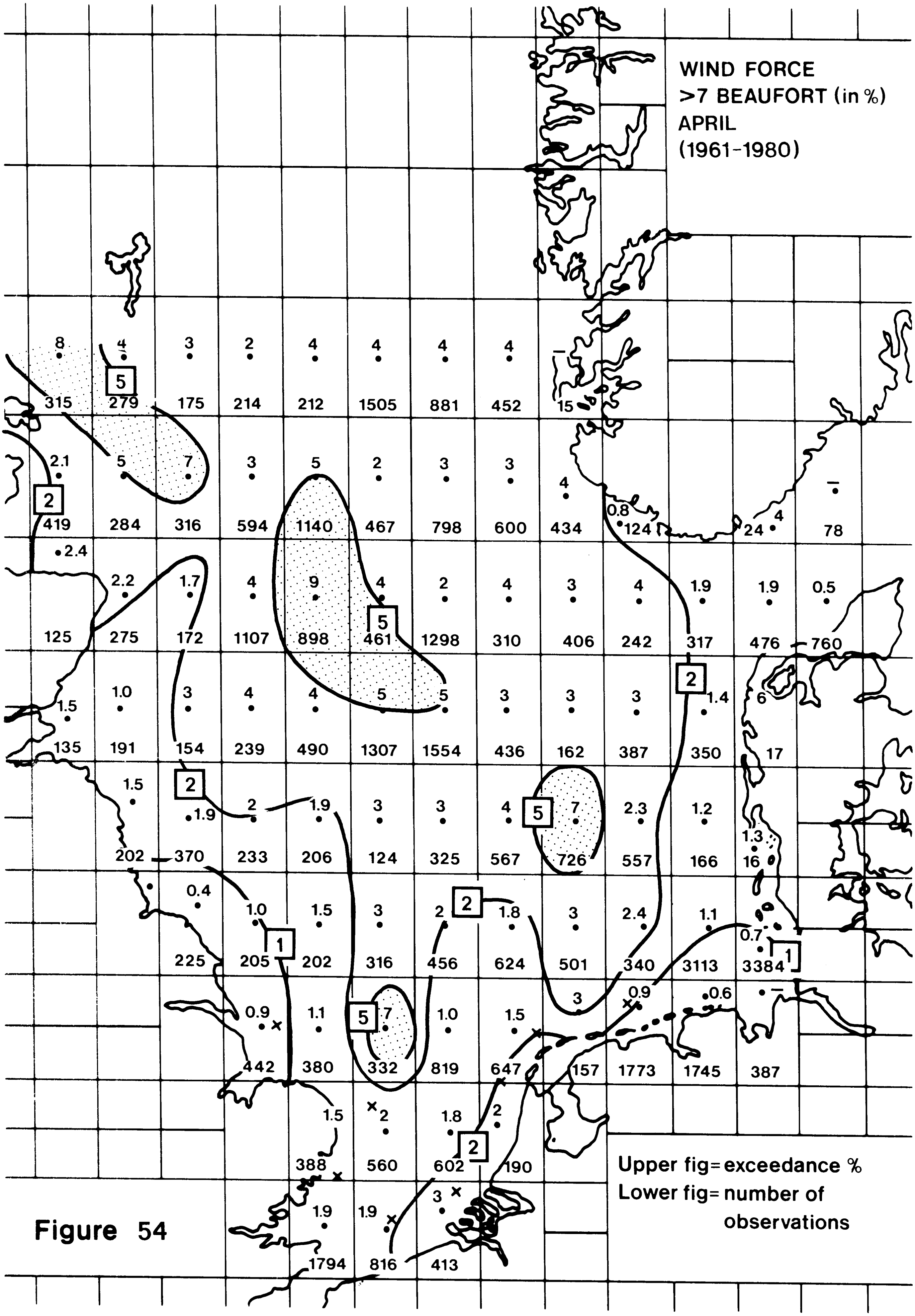

WIND FORCE
>7 BEAUFORT (in %)
APRIL
(1961-1980)
Upper fig=exceedance %
Lower fig=number of
observations

Figure 54

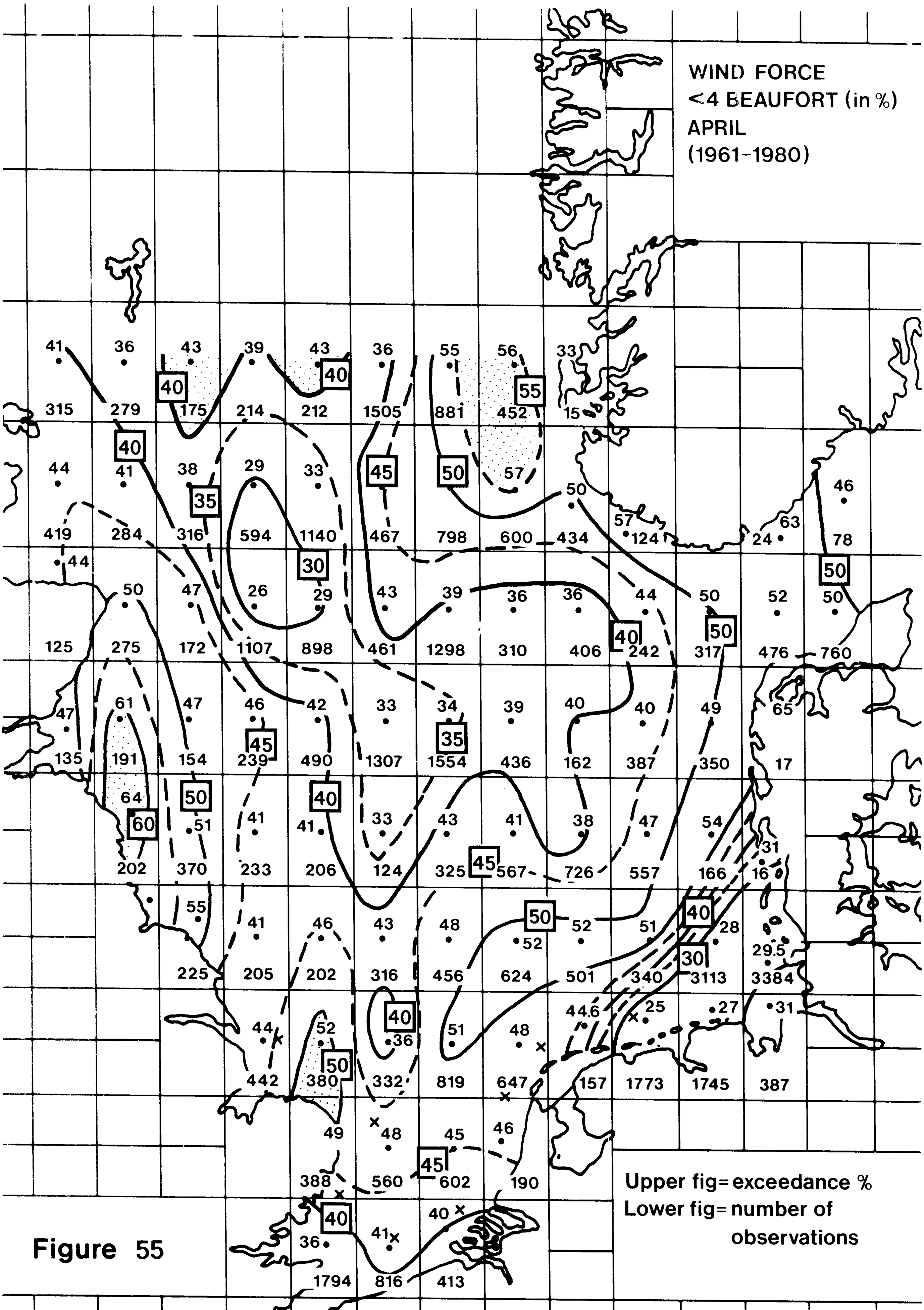

WIND FORCE
<4 BEAUFORT (in %)
APRIL
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 55

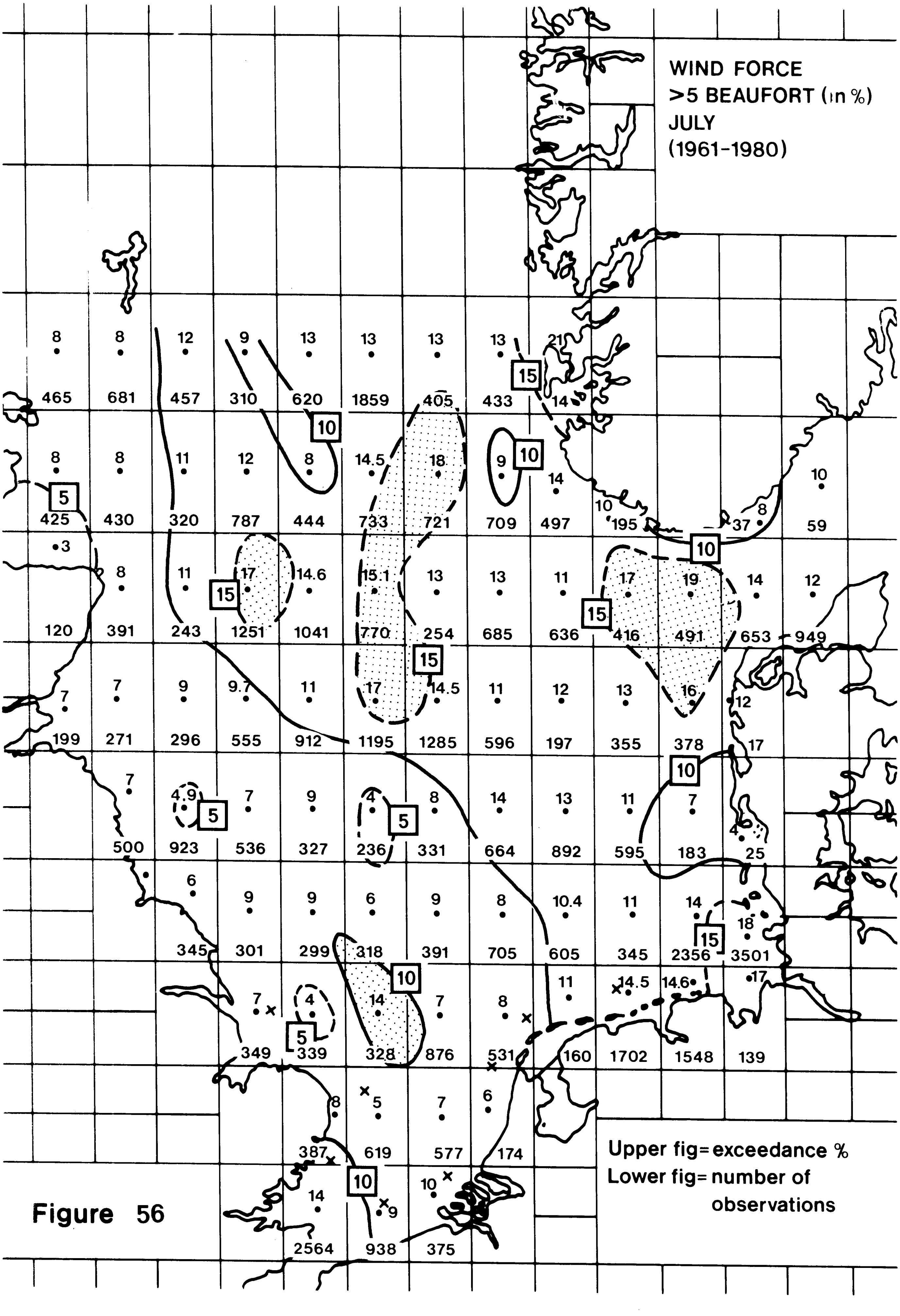

WIND FORCE
>5 BEAUFORT (in %)
JULY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 56

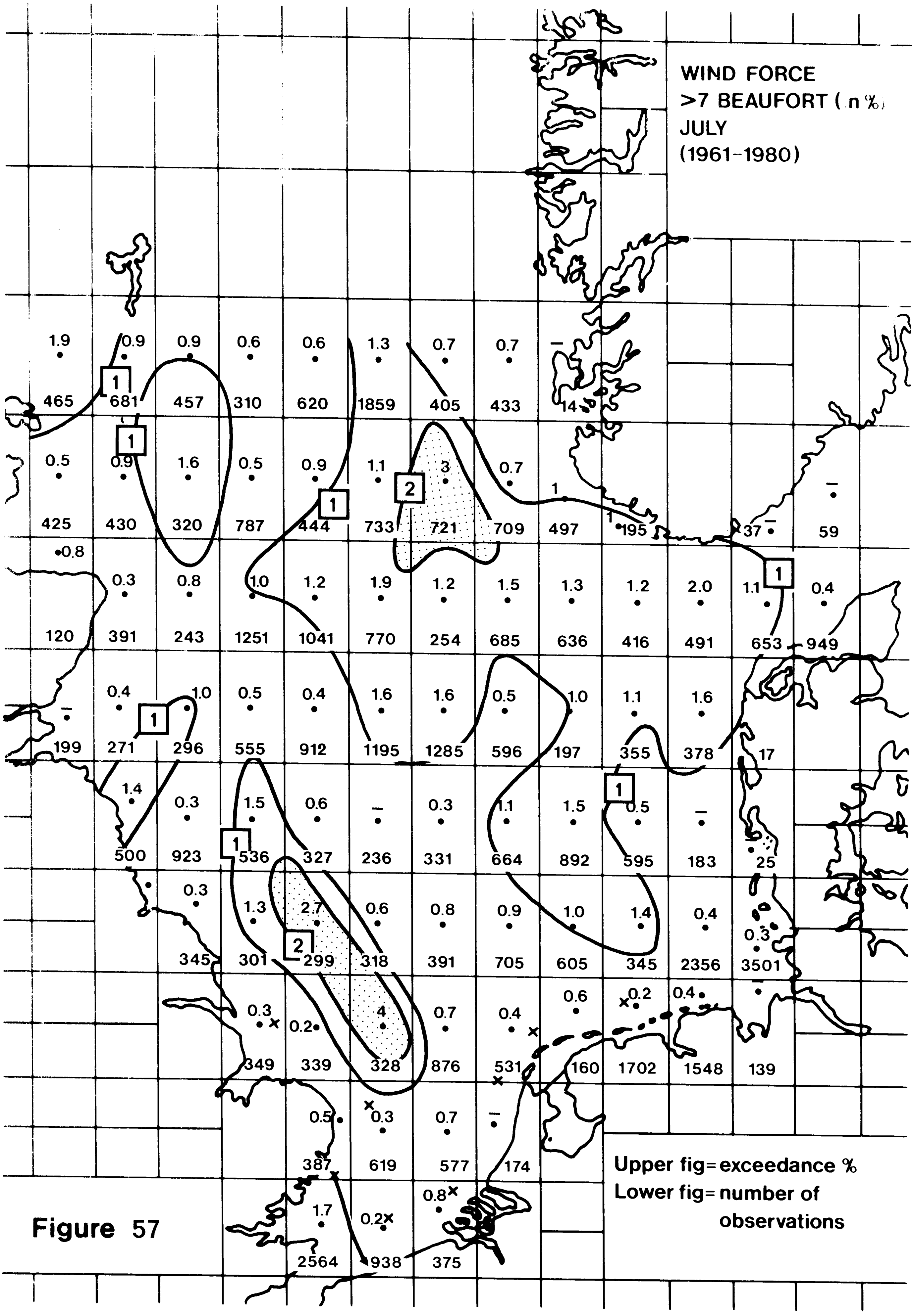

WIND FORCE
>7 BEAUFORT (in %)
JULY
(1961-1980)
Upper fig = exceedance %
Lower fig = number of
observations

Figure 57

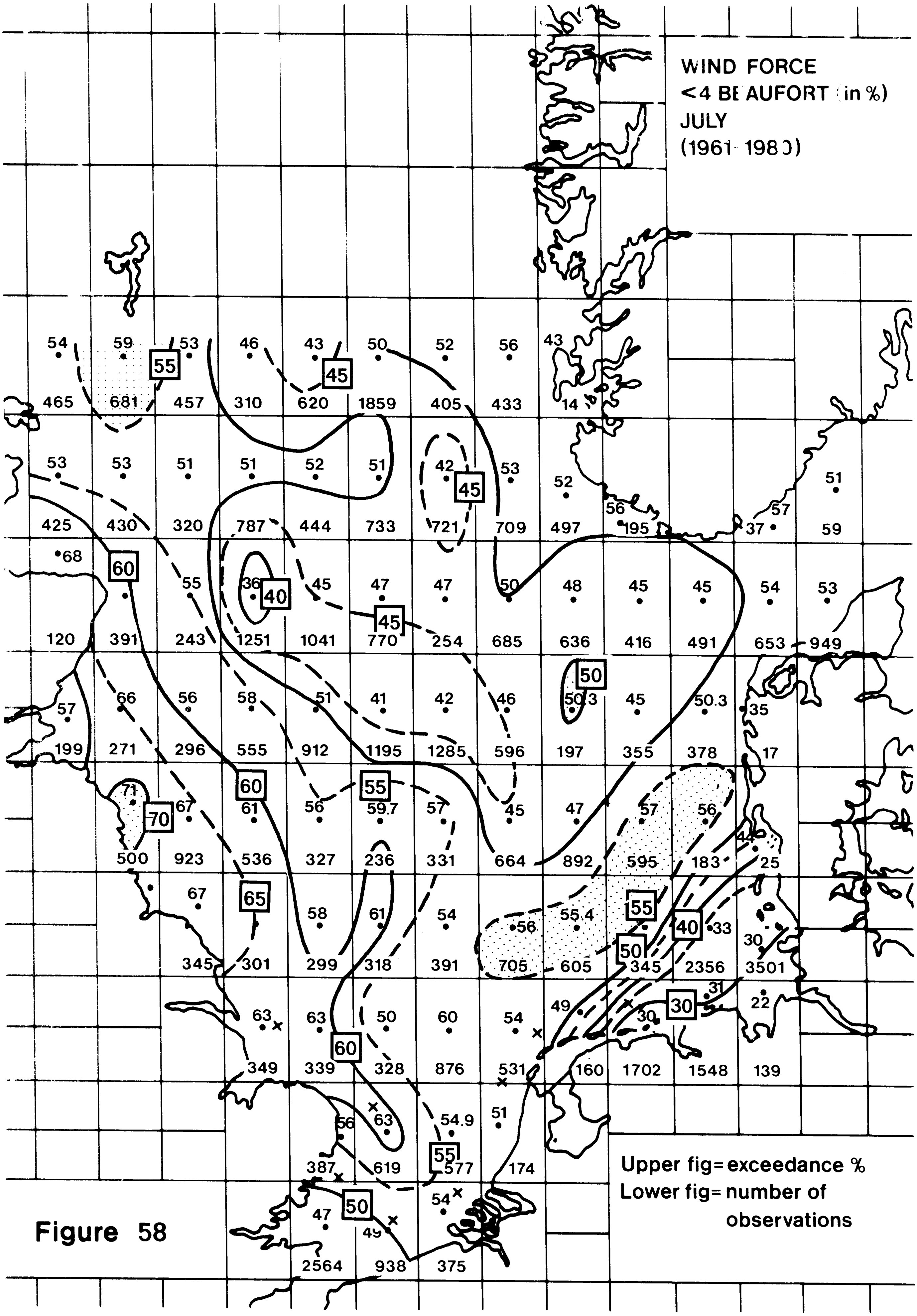

WIND FORCE
<4 BEAUFORT (in %)
JULY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of
observations

Figure 58

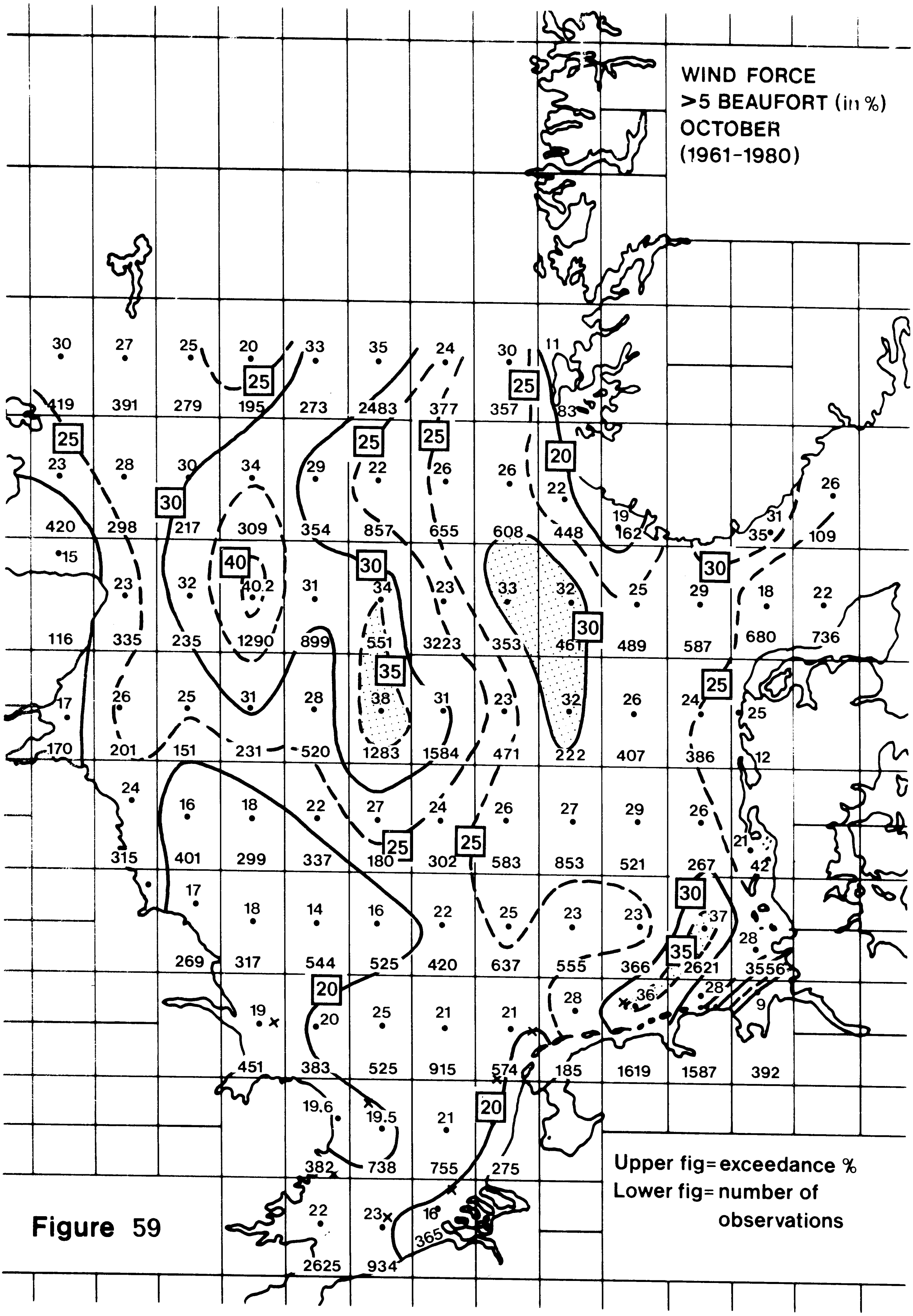

WIND FORCE
>5 BEAUFORT (in %)
OCTOBER
(1961-1980)
30 27 25 20 33 35 24 30 11
419 391 279 195 273 2483 377 357 83
23 28 30 34 29 22 26 26 22 19 31 26
420 298 217 309 354 857 655 608 448 162 35 109
15 23 32 40.2 31 34 23 33 32 25 29 18 22
116 335 235 1290 899 551 3223 353 461 489 587 680 736
17 26 25 31 28 38 31 23 32 26 24 25
170 201 151 231 520 1283 1584 471 222 407 386 12
24 16 18 22 27 24 26 27 29 26 21
315 401 299 337 180 302 583 853 521 267 42
17 18 14 16 22 25 23 23 37 28
269 317 544 525 420 637 555 366 2621 3556
19 20 25 21 21 28 36 28 9
451 383 525 915 574 185 1619 1587 392
19.6 19.5 21
382 738 755 275
22 23 16
2625 934 365
25 25 30 40 25 25 30 25 20 30 30 35 25 25 25 30 35 20 20
Upper fig= exceedance %
Lower fig= number of observations

Figure 59

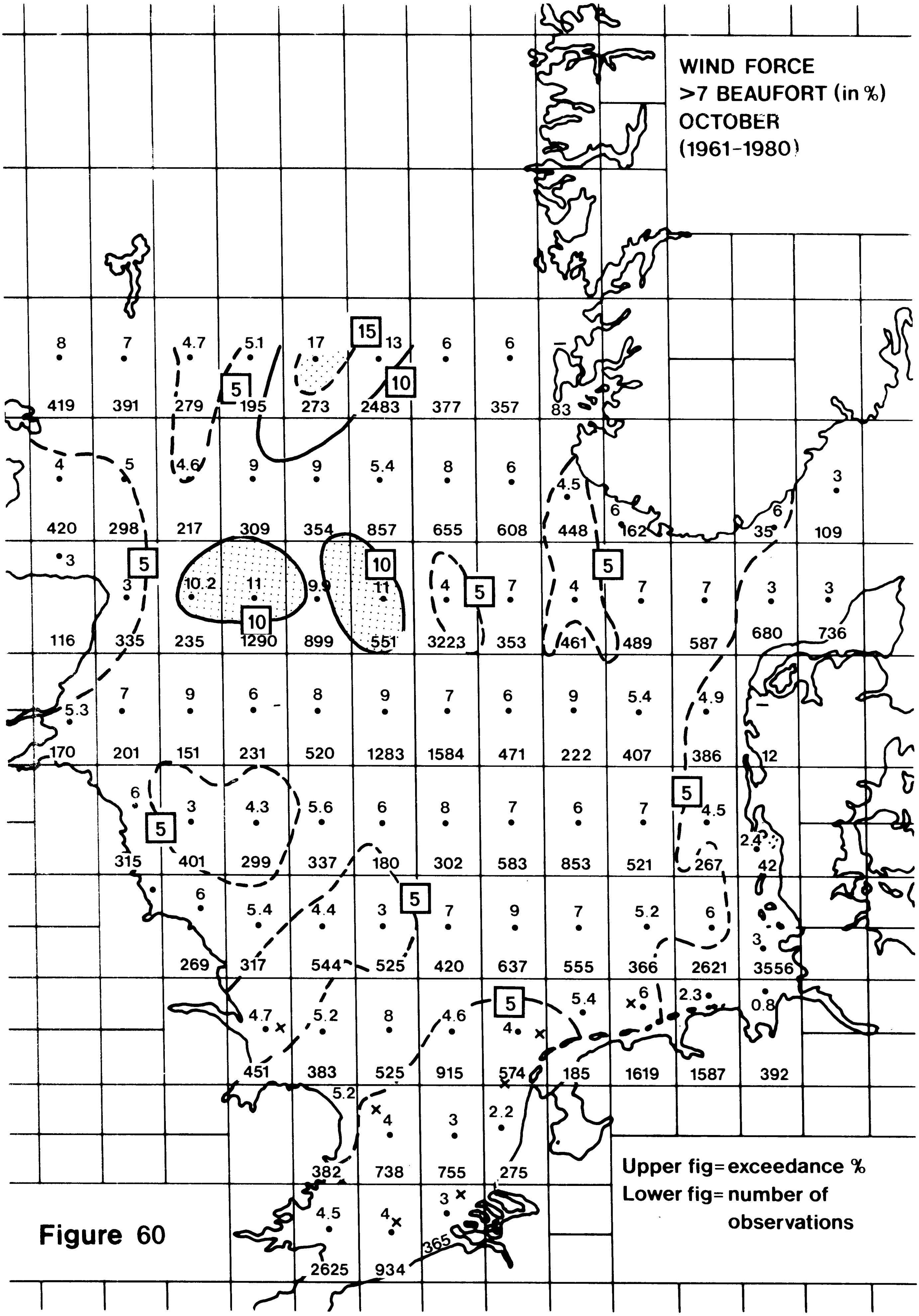

WIND FORCE
>7 BEAUFORT (in %)
OCTOBER
(1961-1980)
8 7 4.7 5.1 17 15 13 6 6
5 10
419 391 279 195 273 2483 377 357 83
4 5 4.6 9 9 5.4 8 6 4.5 6 6 3
420 298 217 309 354 857 655 608 448 162 35 109
3 5 3 10.2 11 9.9 10 11 4 5 7 4 5 7 7 3 3
116 335 235 10 1290 899 551 3223 353 461 489 587 680 736
5.3 7 9 6 8 9 7 6 9 5.4 4.9
170 201 151 231 520 1283 1584 471 222 407 386 12
6 3 4.3 5.6 6 8 7 6 7 5 4.5
5 2.4
315 401 299 337 180 302 583 853 521 267 42
6 5.4 4.4 3 5 7 9 7 5.2 6 3
269 317 544 525 420 637 555 366 2621 3556
4.7 5.2 8 4.6 5 4 5.4 6 2.3 0.8
451 383 525 915 574 185 1619 1587 392
5.2 4 3 2.2
382 738 755 275
4.5 4 3
2625 934 365
Upper fig=exceedance %
Lower fig=number of observations

Figure 60

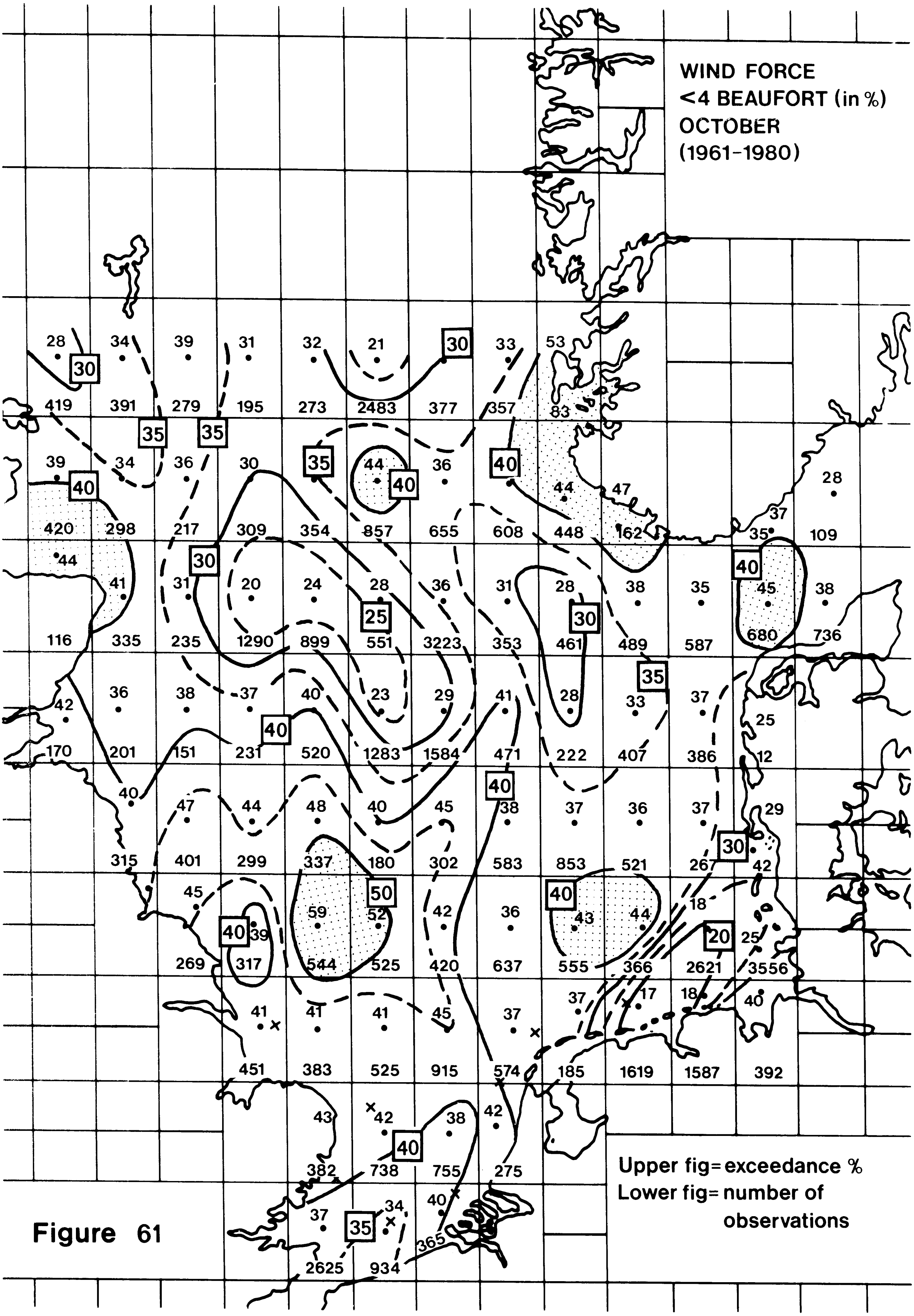

WIND FORCE
<4 BEAUFORT (in %)
OCTOBER
(1961-1980)
Upper fig= exceedance %
Lower fig= number of
observations

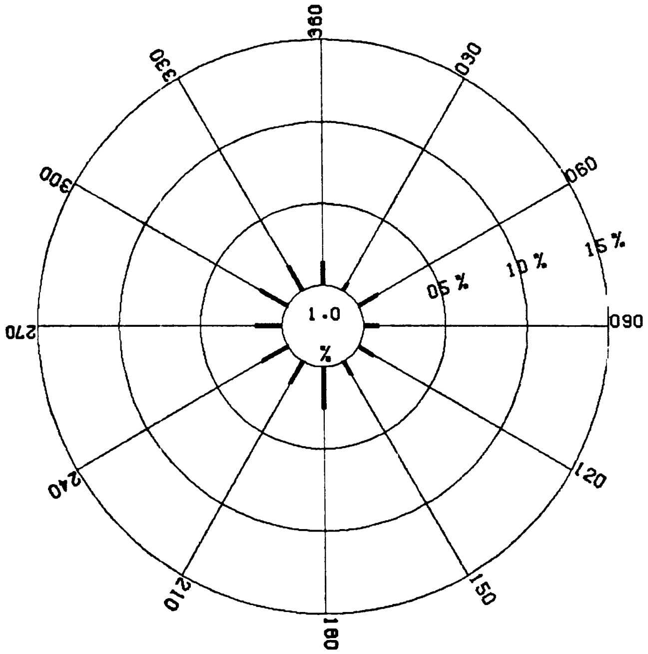
Figure 61

W I N D   R O S E

JANUARY   610101 - 801231 (YYMMDD)

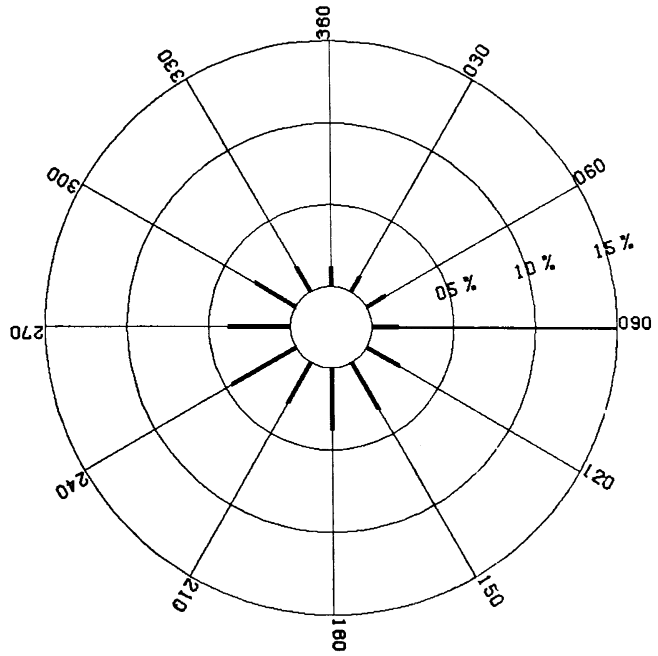
AREA: 58.0N - 59.9N , 0.0E - 1.9E   N= 1839

BEAUFORT 1 - 3   N= 337



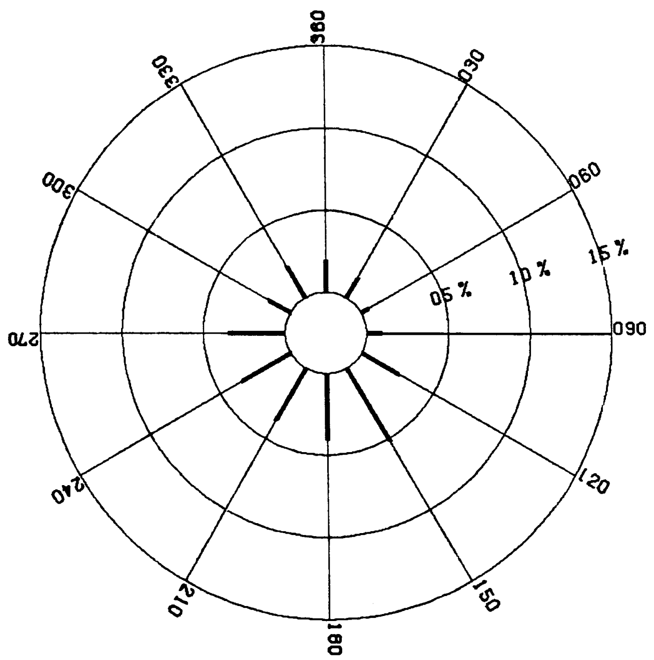
360=	1.4%	090=	0.9%	180=	2.6%	270=	1.6%
030=	0.5%	120=	1.0%	210=	1.6%	300=	1.8%
060=	1.4%	150=	1.0%	240=	1.8%	330=	1.7%

BEAUFORT 4 - 5   N= 557



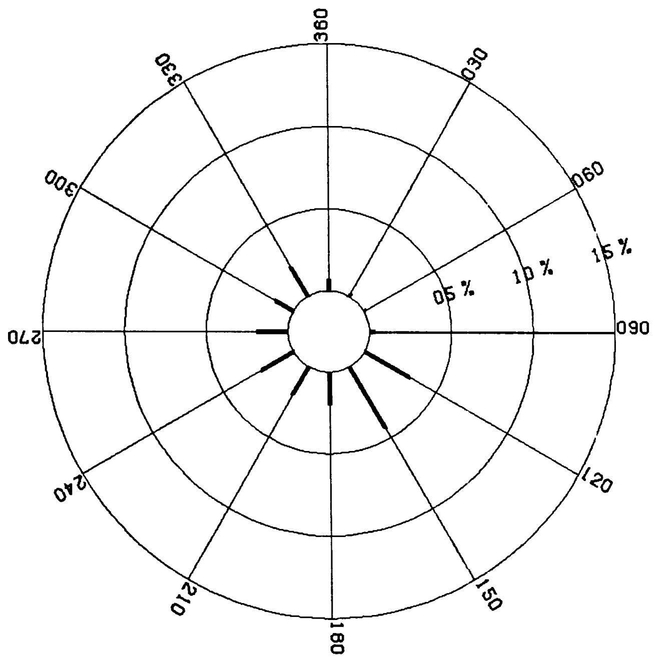
360=	1.1%	090=	1.6%	180=	3.8%	270=	3.8%
030=	1.0%	120=	2.3%	210=	2.9%	300=	2.9%
060=	1.3%	150=	3.3%	240=	4.6%	330=	1.7%

BEAUFORT 6 - 7   N= 572



360=	2.0%	090=	0.9%	180=	4.1%	270=	3.5%
030=	1.4%	120=	2.6%	210=	3.7%	300=	1.5%
060=	0.5%	150=	5.2%	240=	3.5%	330=	2.2%

BEAUFORT 8 - 12   N= 373



360=	0.7%	090=	0.3%	180=	2.0%	270=	1.9%
030=	0.2%	120=	3.2%	210=	2.0%	300=	1.3%
060=	0.1%	150=	4.4%	240=	2.3%	330=	2.1%

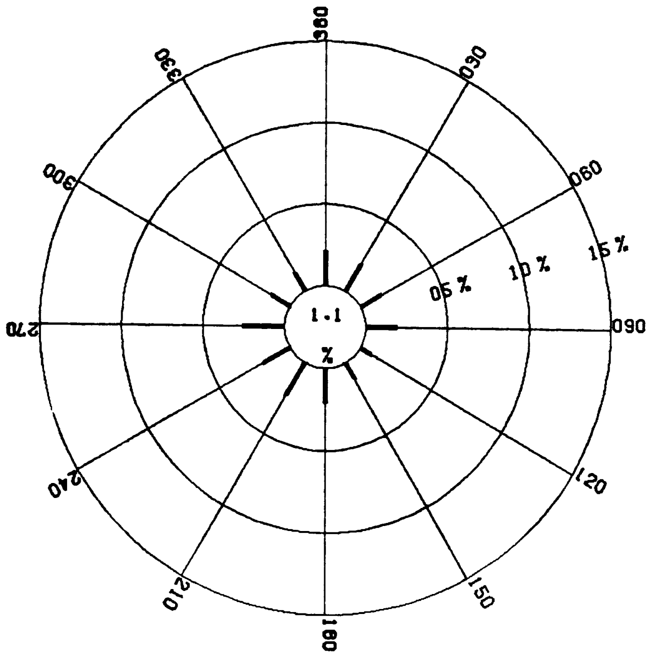
Figure 62

W I N D   R O S E

JANUARY   610101 - 801231 (YYMMDD)

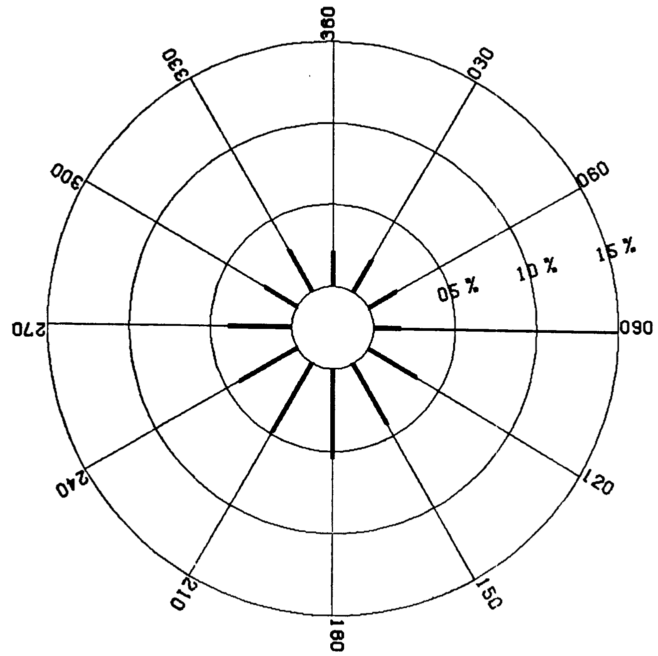
AREA: 56.0N - 57.9N ,   0.0W -   1.9W   N= 903

BEAUFORT 1 - 3   N= 196



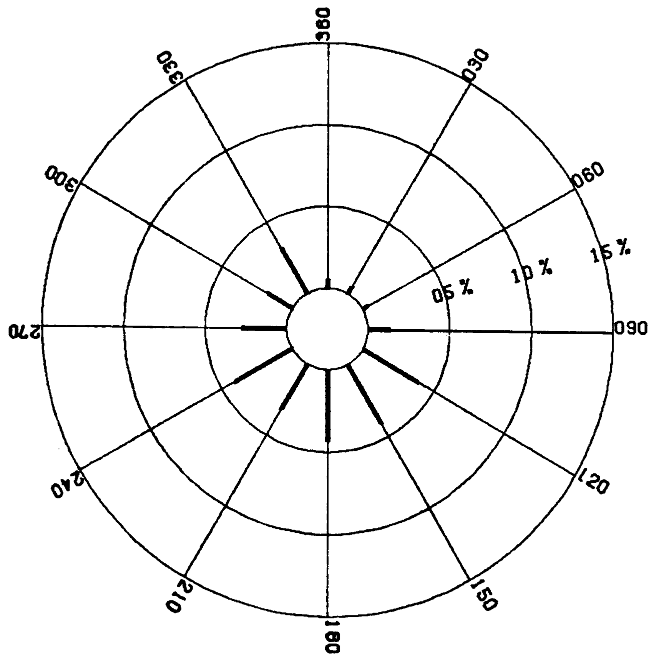
360=	2.1%	090=	1.9%	180=	2.1%	270=	2.5%
030=	1.9%	120=	0.8%	210=	2.3%	300=	1.3%
060=	1.4%	150=	1.1%	240=	1.9%	330=	1.2%

BEAUFORT 4 - 5   N= 353



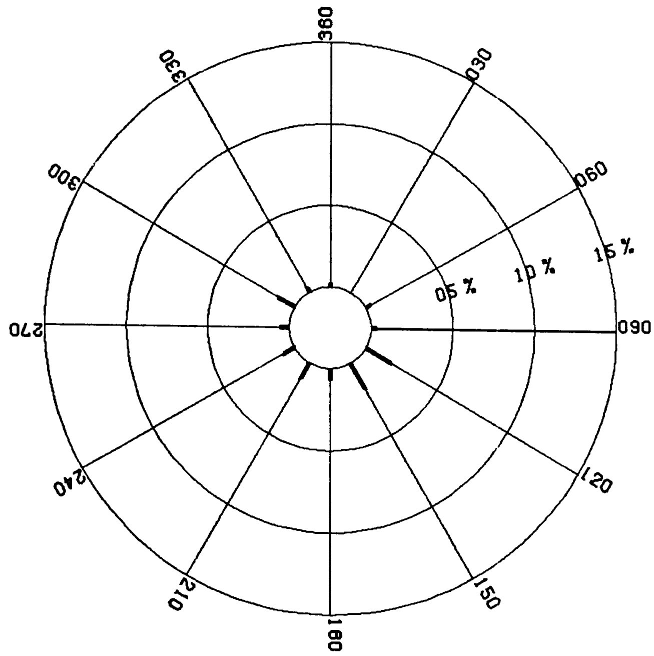
360=	2.1%	090=	1.7%	180=	5.4%	270=	3.9%
030=	2.2%	120=	3.4%	210=	4.9%	300=	2.3%
060=	2.0%	150=	4.2%	240=	4.1%	330=	2.9%

BEAUFORT 6 - 7   N= 272



360=	0.6%	090=	1.3%	180=	4.3%	270=	2.8%
030=	0.6%	120=	3.9%	210=	3.2%	300=	1.8%
060=	0.3%	150=	4.1%	240=	4.1%	330=	3.2%

BEAUFORT 8 - 12   N= 82



360=	0.2%	090=	0.3%	180=	0.7%	270=	0.6%
030=	0.0%	120=	1.8%	210=	1.1%	300=	1.2%
060=	0.3%	150=	1.6%	240=	0.8%	330=	0.3%

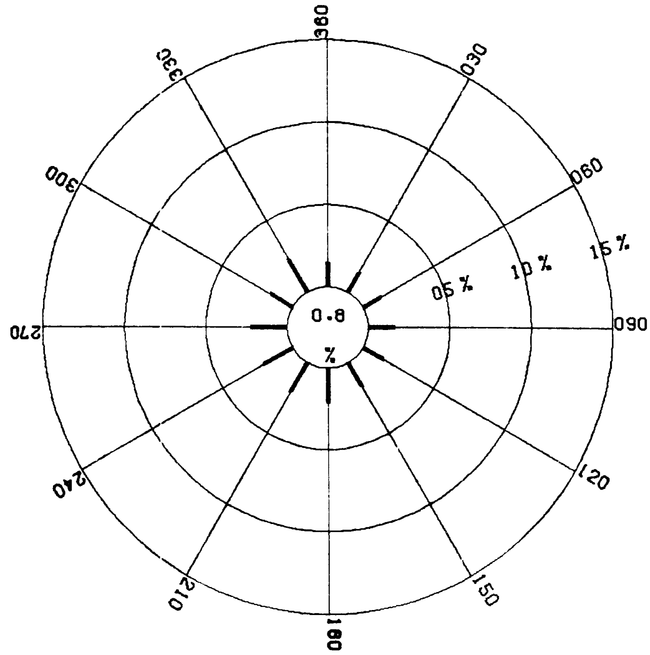
Figure 63

W I N D   R O S E

JANUARY   610101 - 801231 (YYMMDD)

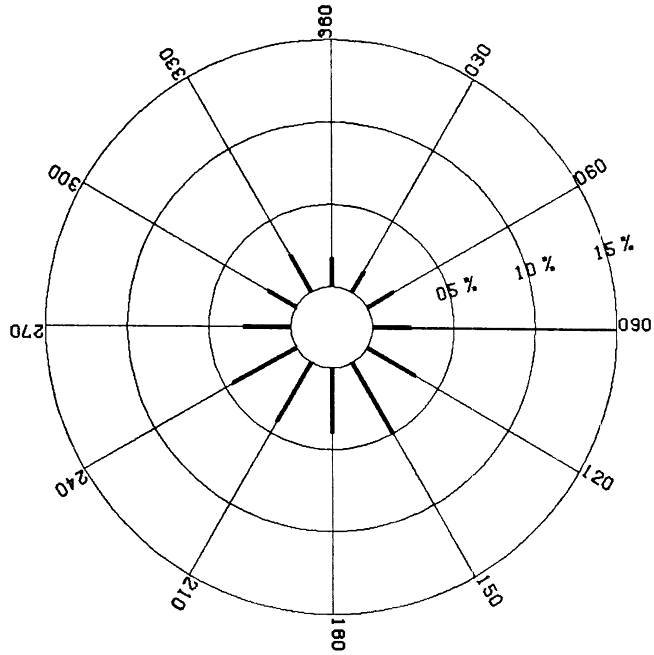
AREA: 56.0N - 57.9N , 2.0E - 3.9E   N= 6446

BEAUFORT 1 - 3   N= 1416



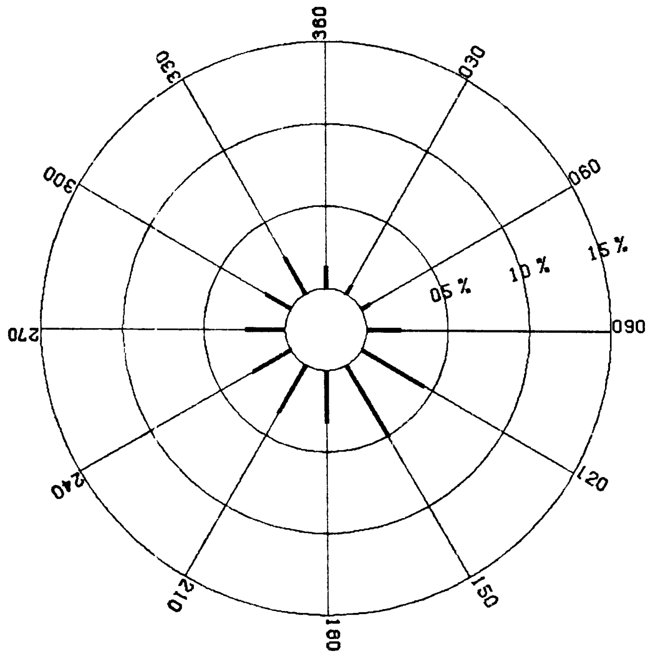
360=	1.5%	090=	1.6%	180=	2.2%	270=	2.2%
030=	1.3%	120=	1.4%	210=	2.1%	300=	1.6%
060=	1.2%	150=	1.7%	240=	2.1%	330=	2.3%

BEAUFORT 4 - 5   N= 2311



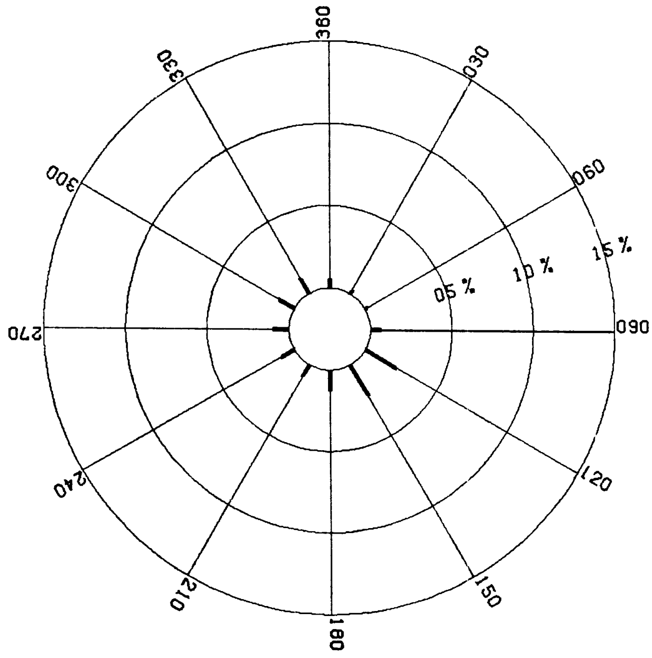
360=	1.7%	090=	2.4%	180=	4.0%	270=	2.9%
030=	1.4%	120=	3.4%	210=	4.2%	300=	2.0%
060=	1.9%	150=	5.0%	240=	4.5%	330=	2.6%

BEAUFORT 6 - 7   N= 1942



360=	1.4%	090=	2.1%	180=	3.2%	270=	2.5%
030=	0.6%	120=	4.4%	210=	3.4%	300=	1.8%
060=	0.6%	150=	5.0%	240=	2.7%	330=	2.6%

BEAUFORT 8 - 12   N= 777



360=	0.6%	090=	0.7%	180=	1.3%	270=	1.0%
030=	0.3%	120=	2.2%	210=	0.8%	300=	1.1%
060=	0.1%	150=	2.2%	240=	0.9%	330=	1.0%

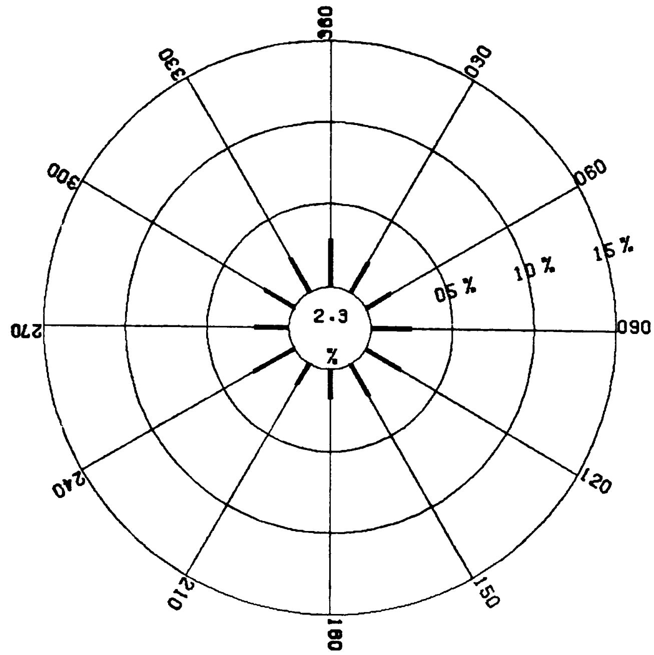
Figure 64

WIND ROSE

JANUARY 610101 - 801231 (YYMMDD)

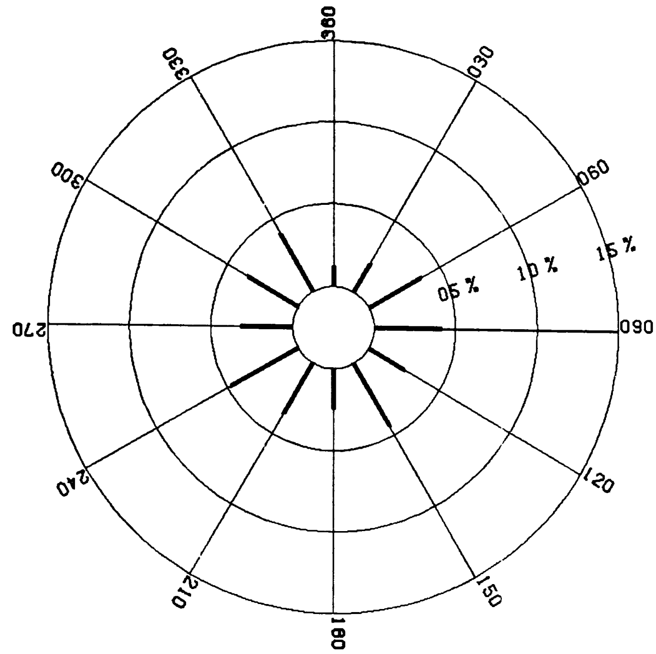
AREA: 56.0N - 57.9N , 6.0E - 7.9E N= 1429

BEAUFORT 1 - 3 N= 410



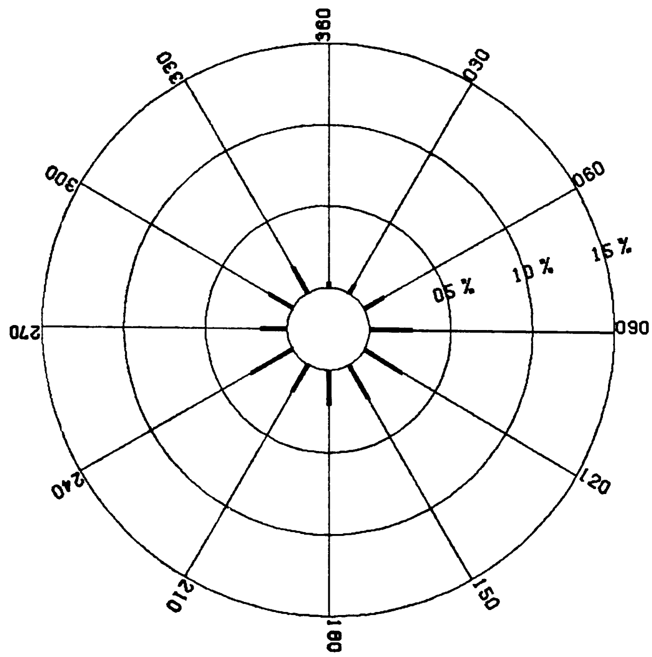
360=	2.9%	090=	2.4%	180=	1.7%	270=	2.1%
030=	2.1%	120=	2.4%	210=	1.5%	300=	2.1%
060=	1.7%	150=	2.2%	240=	2.9%	330=	2.3%

BEAUFORT 4 - 5 N= 564



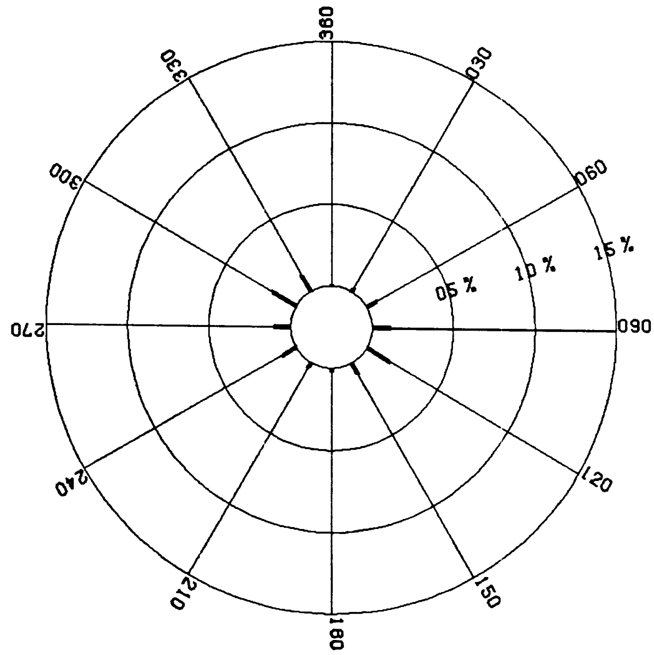
360=	1.2%	090=	4.1%	180=	2.4%	270=	3.2%
030=	2.0%	120=	2.5%	210=	3.6%	300=	3.6%
060=	3.7%	150=	4.4%	240=	4.8%	330=	4.0%

BEAUFORT 6 - 7 N= 314



360=	0.3%	090=	2.6%	180=	2.1%	270=	1.6%
030=	0.6%	120=	2.7%	210=	1.9%	300=	1.7%
060=	1.4%	150=	2.3%	240=	2.9%	330=	1.8%

BEAUFORT 8 - 12 N= 141



360=	0.1%	090=	1.1%	180=	0.2%	270=	1.0%
030=	0.2%	120=	1.6%	210=	0.3%	300=	1.7%
060=	0.7%	150=	0.8%	240=	1.0%	330=	1.1%

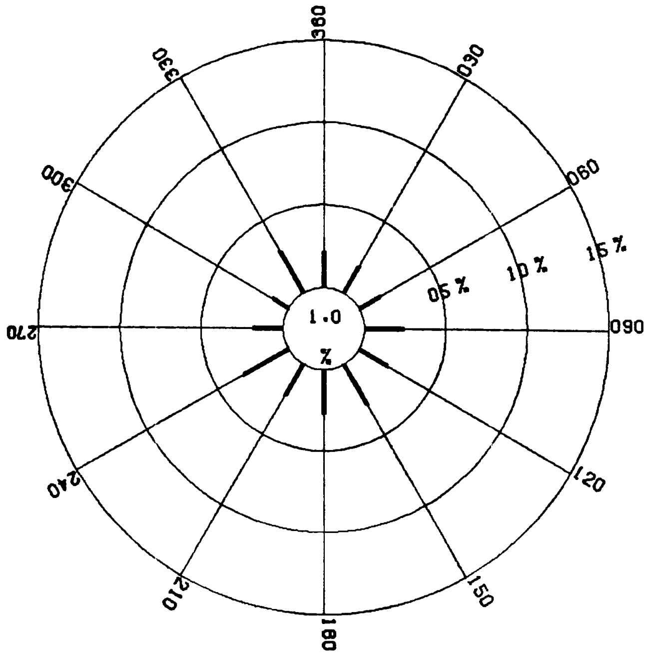
Figure 65

W I N D   R O S E

JANUARY 610101 - 801231 (YYMMDD)

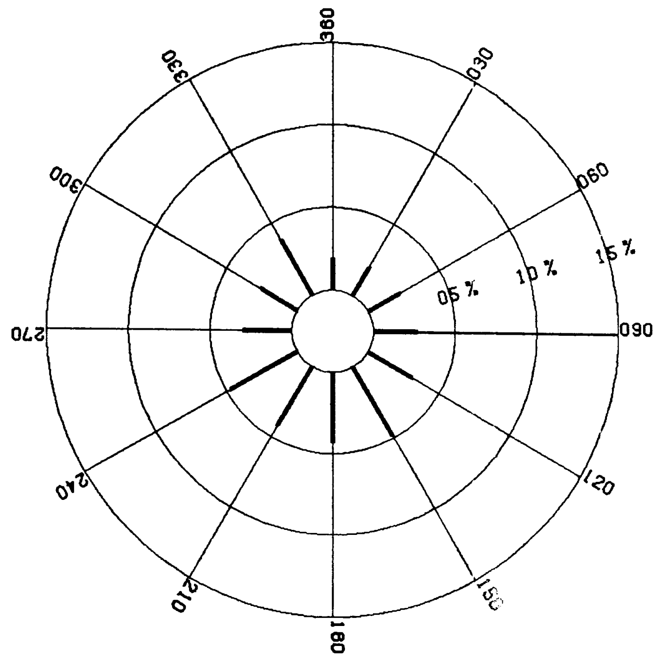
AREA: 54.0N - 55.9N , 2.0E - 3.9E N= 1480

BEAUFORT 1 - 3 N= 410



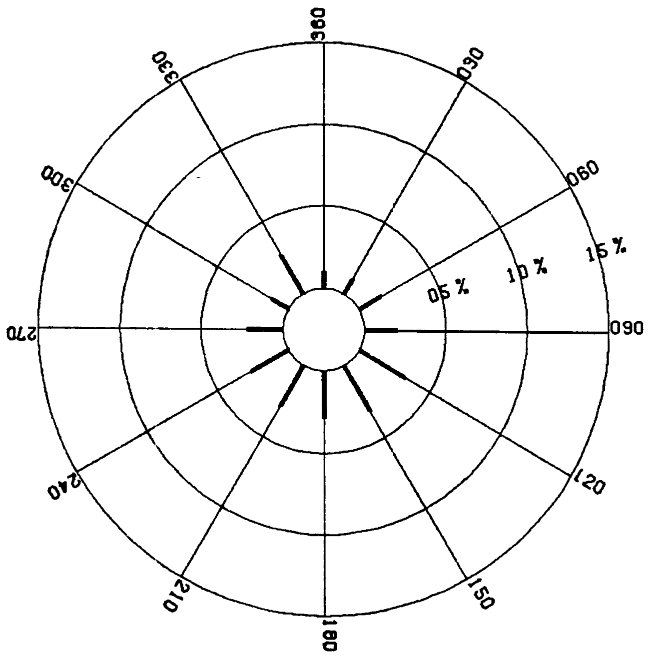
360=	2.2%	090=	2.4%	180=	2.7%	270=	1.8%
030=	1.8%	120=	2.0%	210=	2.2%	300=	1.1%
060=	1.5%	150=	2.8%	240=	3.2%	330=	2.9%

BEAUFORT 4 - 5 N= 582



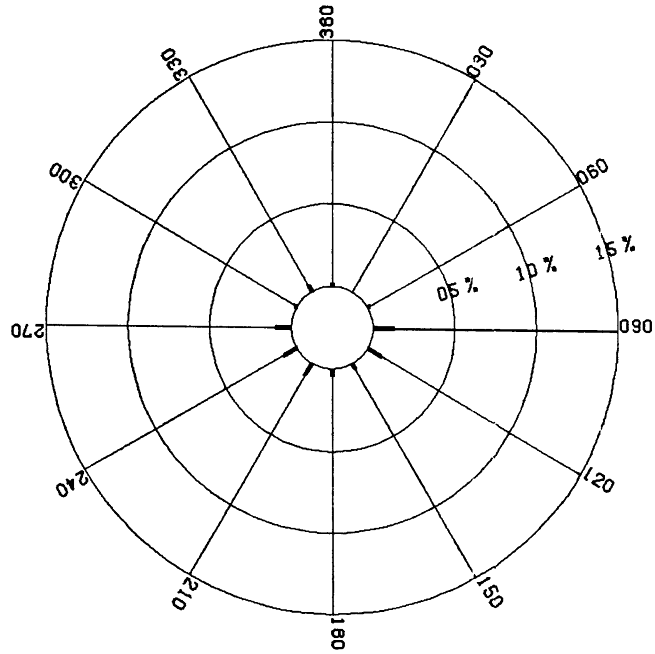
360=	1.9%	090=	2.6%	180=	4.3%	270=	3.0%
030=	2.0%	120=	3.1%	210=	4.2%	300=	2.6%
060=	2.2%	150=	4.9%	240=	4.7%	330=	3.9%

BEAUFORT 6 - 7 N= 391



360=	1.0%	090=	2.0%	180=	2.8%	270=	2.2%
030=	1.0%	120=	3.2%	210=	2.9%	300=	1.2%
060=	1.6%	150=	3.1%	240=	2.6%	330=	2.7%

BEAUFORT 8 - 12 N= 97



360=	0.2%	090=	1.3%	180=	0.4%	270=	0.9%
030=	0.0%	120=	0.9%	210=	0.8%	300=	0.1%
060=	0.1%	150=	0.3%	240=	0.9%	330=	0.5%

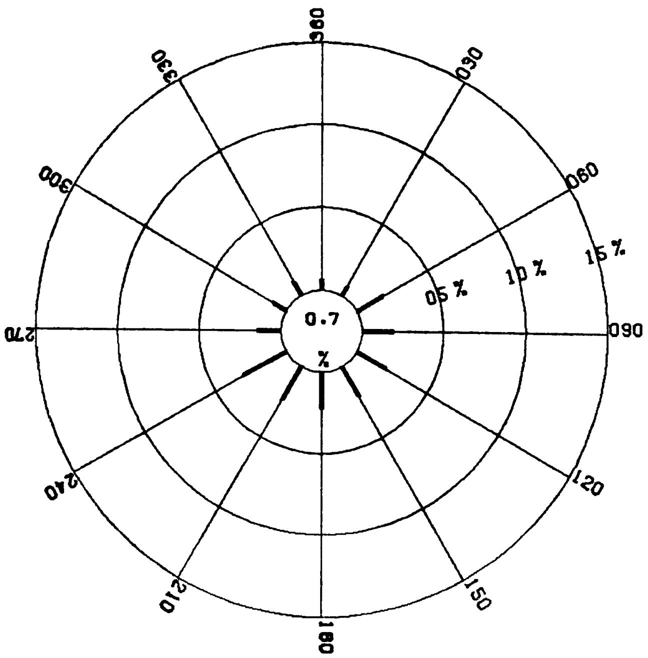
Figure 66

W I N D   R O S E

JANUARY   610101 - 801231 (YYMMDD)

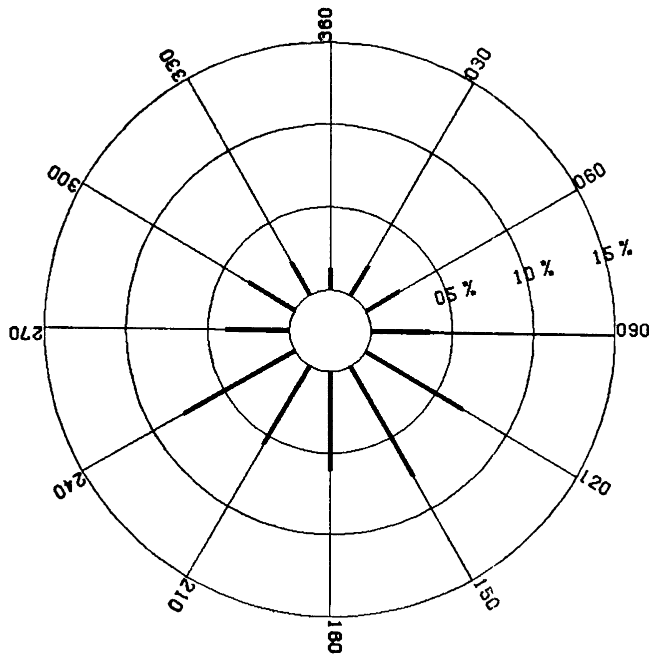
AREA: 54.0N - 54.9N , 6.0E - 8.9E   N= 7734

BEAUFORT 1 - 3   N= 1613



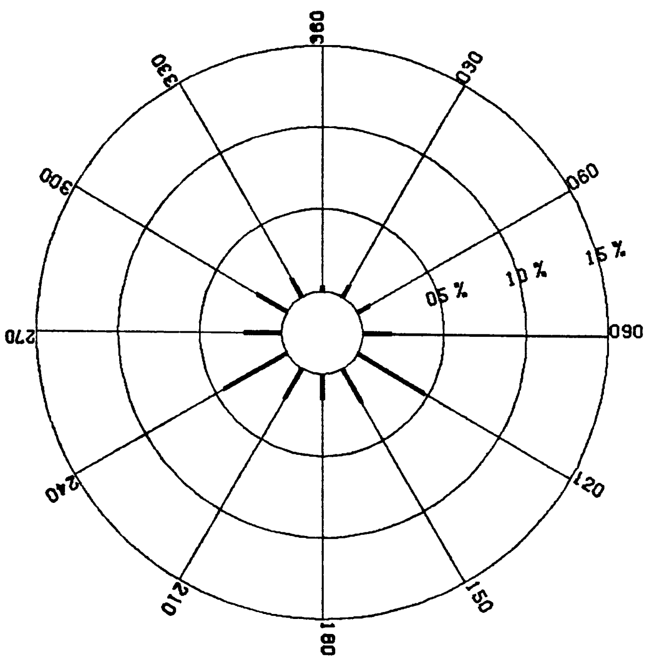
360=	0.6%	090=	1.9%	180=	2.3%	270=	1.4%
030=	0.6%	120=	2.1%	210=	2.4%	300=	0.9%
060=	1.9%	150=	2.1%	240=	3.0%	330=	0.9%

BEAUFORT 4 - 5   N= 4067



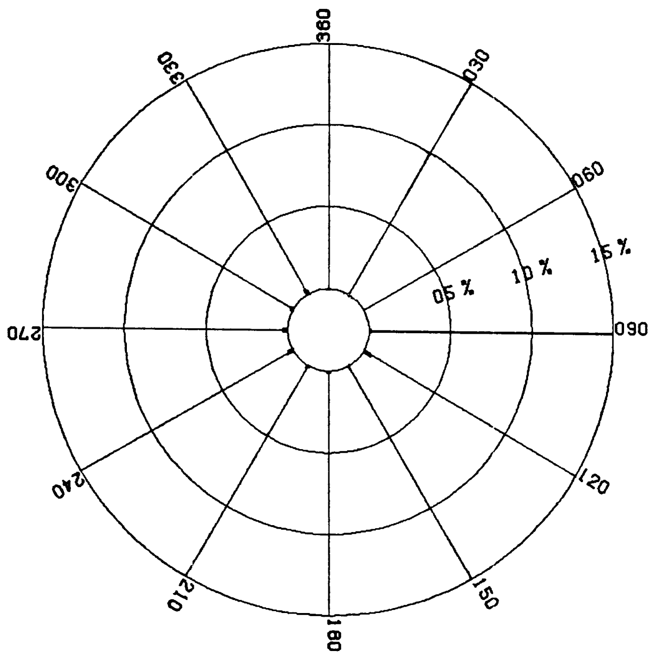
360=	1.3%	090=	3.6%	180=	6.1%	270=	3.9%
030=	2.0%	120=	6.9%	210=	5.6%	300=	3.2%
060=	2.3%	150=	7.7%	240=	7.8%	330=	2.2%

BEAUFORT 6 - 7   N= 1904



360=	0.4%	090=	1.7%	180=	1.6%	270=	2.2%
030=	0.8%	120=	4.7%	210=	2.1%	300=	2.1%
060=	0.9%	150=	2.3%	240=	4.4%	330=	1.3%

BEAUFORT 8 - 12   N= 150



360=	0.0%	090=	0.1%	180=	0.1%	270=	0.3%
030=	0.0%	120=	0.4%	210=	0.1%	300=	0.2%
060=	0.0%	150=	0.1%	240=	0.3%	330=	0.3%

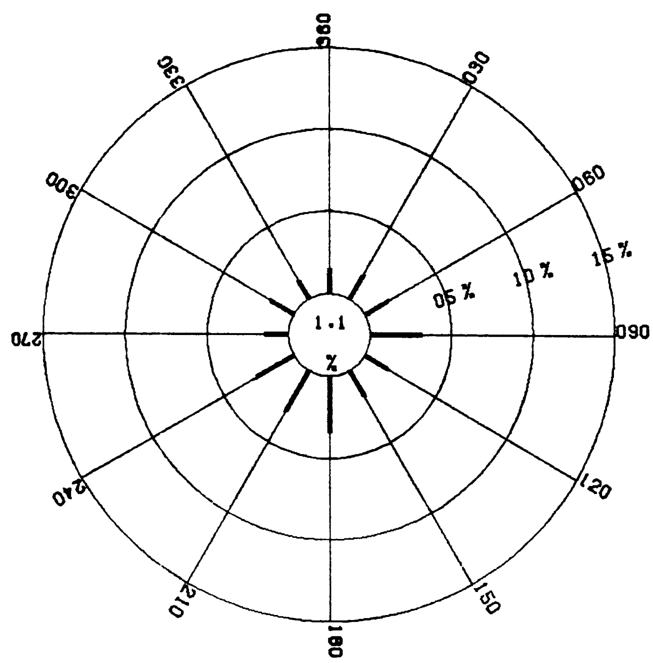
Figure 67

W I N D   R O S E

JANUARY 610101 - 801231 (YYMMDD)

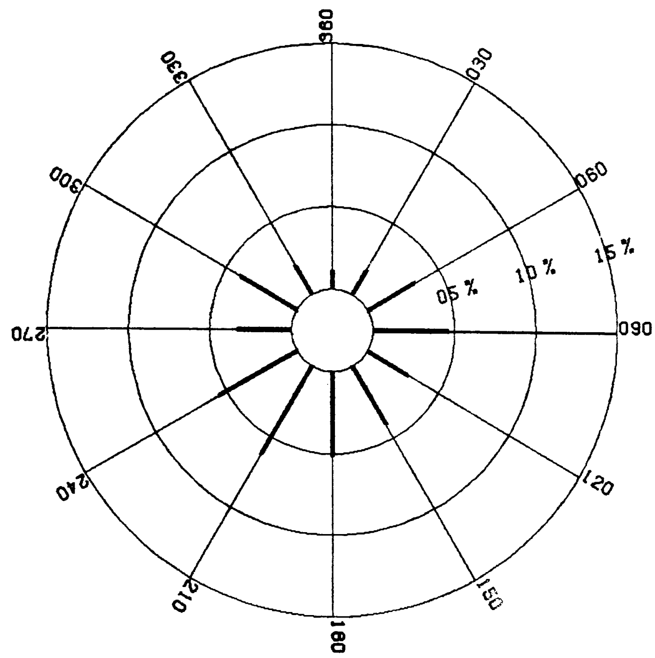
AREA: 52.0N - 52.9N , 3.0E - 4.9E N= 1430

BEAUFORT 1 - 3 N= 369



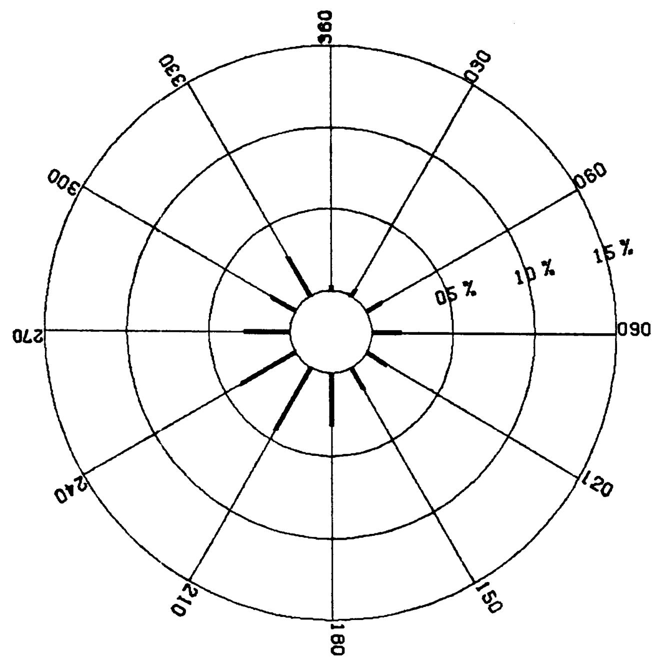
360=	1.5%	090=	3.1%	180=	3.4%	270=	1.5%
030=	1.7%	120=	1.6%	210=	2.9%	300=	1.7%
060=	1.7%	150=	1.7%	240=	2.7%	330=	1.3%

BEAUFORT 4 - 5 N= 627



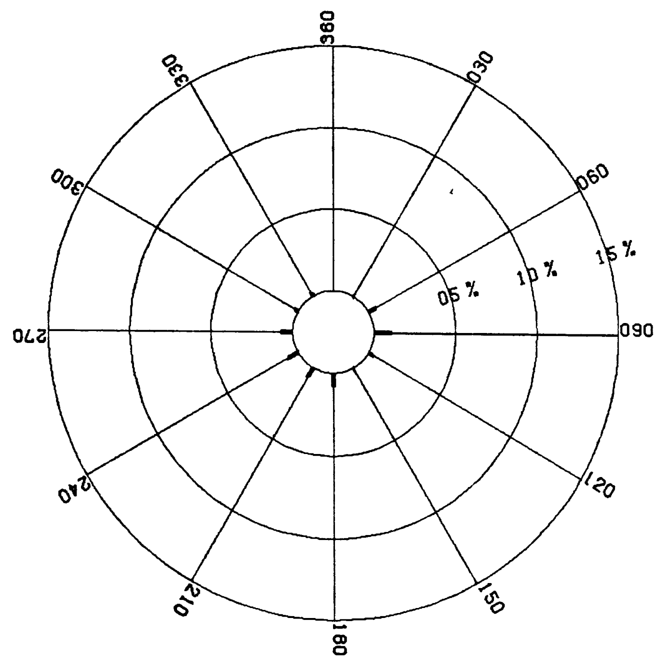
360=	1.1%	090=	4.6%	180=	5.2%	270=	3.3%
030=	1.7%	120=	2.9%	210=	6.2%	300=	4.0%
060=	3.4%	150=	4.1%	240=	5.5%	330=	2.0%

BEAUFORT 6 - 7 N= 360



360=	0.3%	090=	1.8%	180=	3.1%	270=	2.8%
030=	0.5%	120=	1.4%	210=	4.3%	300=	1.7%
060=	1.0%	150=	1.5%	240=	3.9%	330=	2.7%

BEAUFORT 8 - 12 N= 74



360=	0.0%	090=	1.0%	180=	0.8%	270=	0.7%
030=	0.1%	120=	0.3%	210=	0.6%	300=	0.2%
060=	0.5%	150=	0.1%	240=	0.7%	330=	0.2%

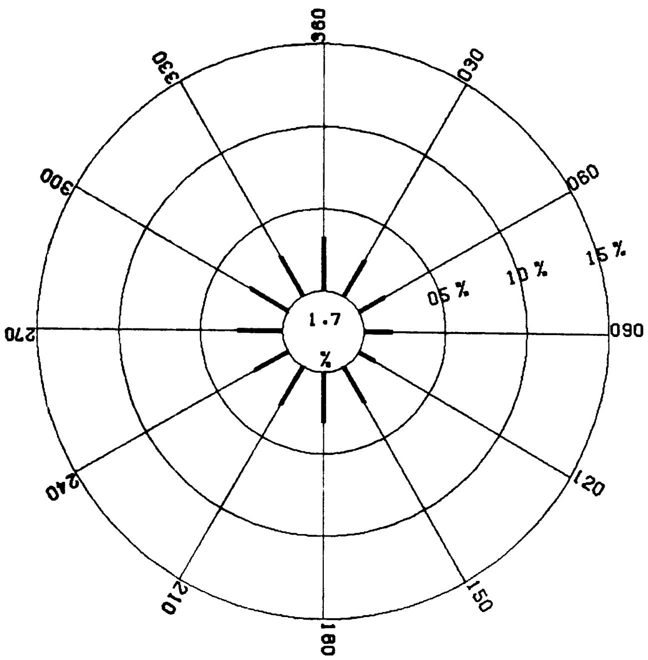
Figure 68

W I N D   R O S E

APRIL   610101 - 801231 (YYMMDD)

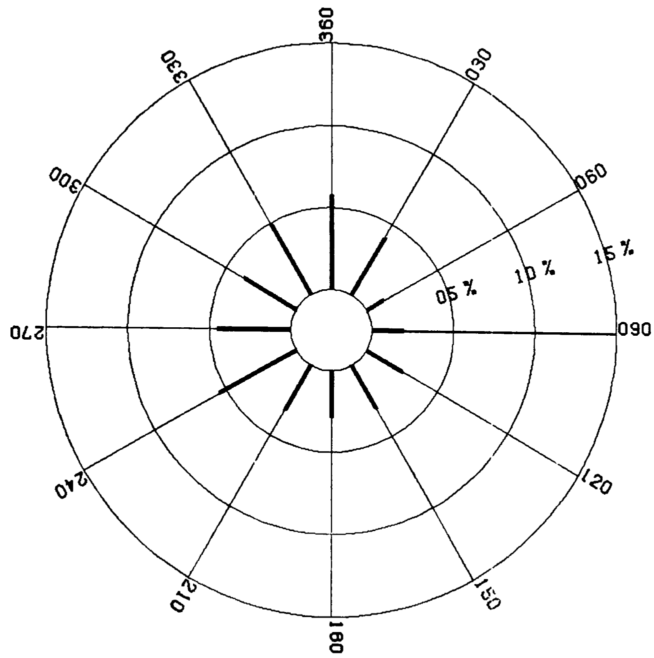
AREA: 58.0N - 59.9N , 0.0E - 1.9E   N= 2715

BEAUFORT 1 - 3   N= 841



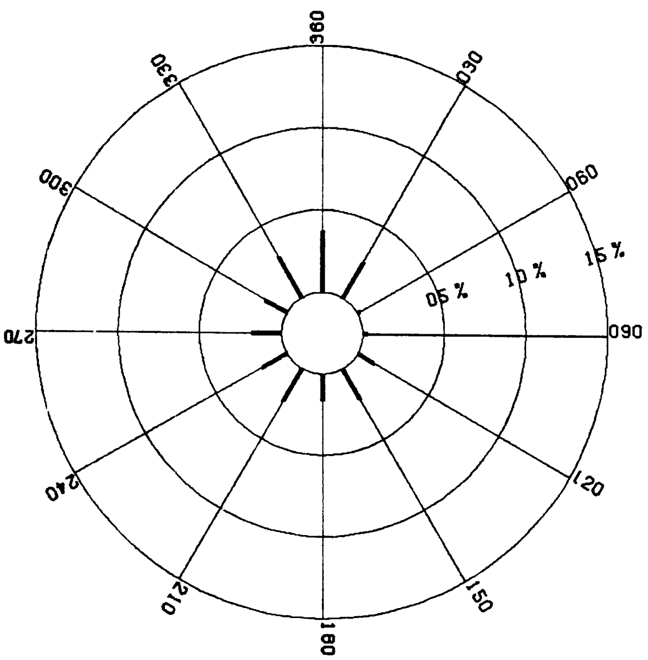
360=	3.3%	090=	1.7%	180=	3.1%	270=	2.7%
030=	2.5%	120=	1.1%	210=	2.7%	300=	2.7%
060=	1.8%	150=	2.5%	240=	2.4%	330=	2.8%

BEAUFORT 4 - 5   N= 1173



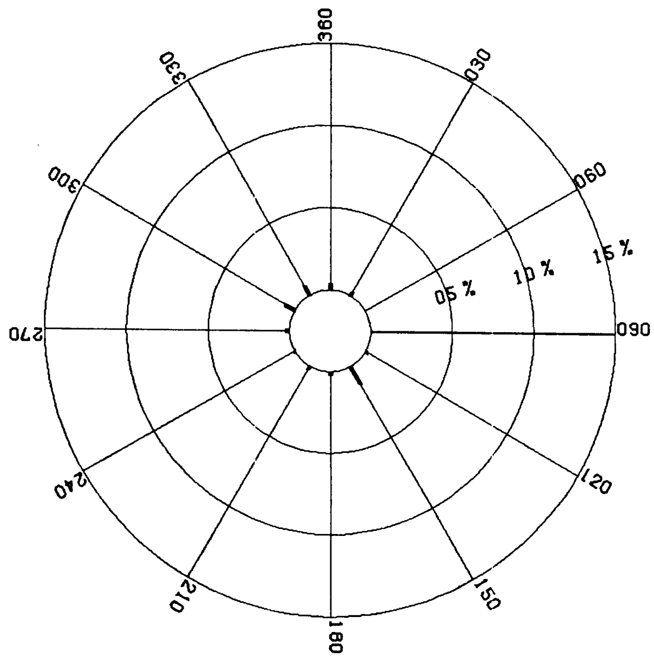
360=	5.8%	090=	1.9%	180=	2.9%	270=	4.5%
030=	4.1%	120=	2.5%	210=	3.2%	300=	3.7%
060=	1.2%	150=	3.0%	240=	5.5%	330=	4.9%

BEAUFORT 6 - 7   N= 592



360=	3.7%	090=	0.3%	180=	1.6%	270=	1.8%
030=	2.5%	120=	1.1%	210=	2.4%	300=	1.5%
060=	0.1%	150=	2.1%	240=	1.7%	330=	2.9%

BEAUFORT 8 - 12   N= 109



360=	0.4%	090=	0.0%	180=	0.2%	270=	0.2%
030=	0.2%	120=	0.1%	210=	0.2%	300=	0.7%
060=	0.0%	150=	1.2%	240=	0.0%	330=	0.7%

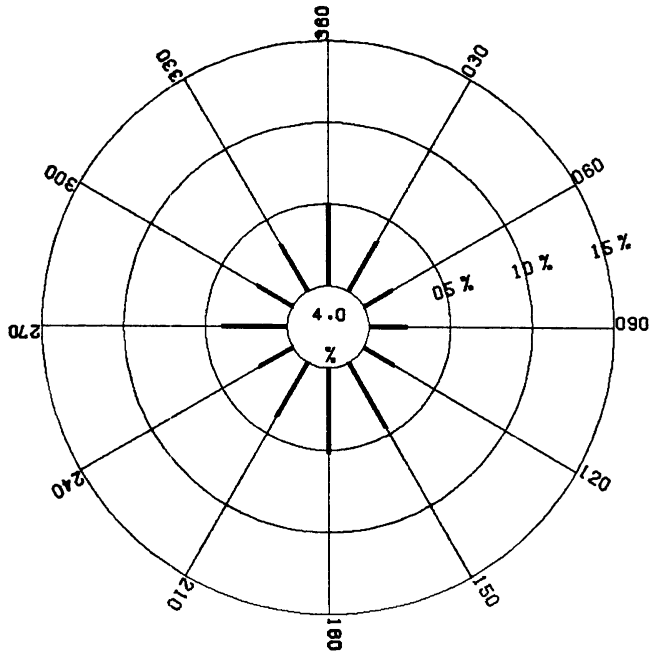
Figure 69

W I N D   R O S E

APRIL   610101 - 801231 (YYMMDD)

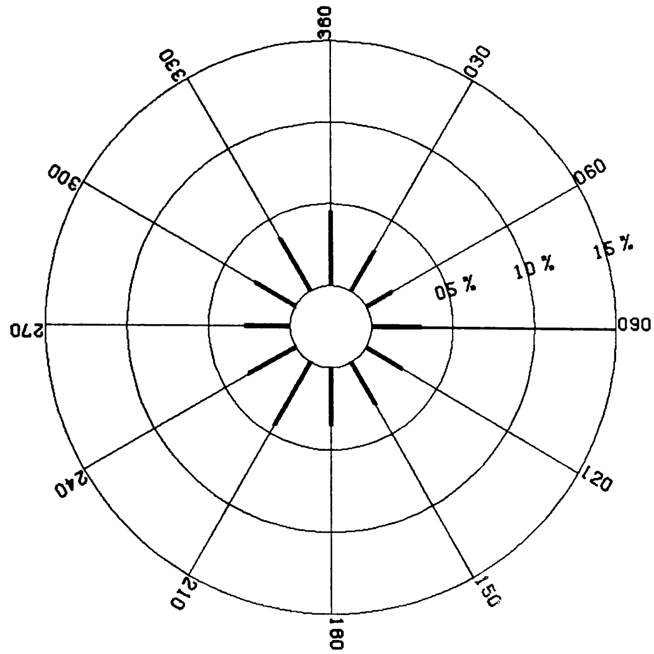
AREA: 56.0N - 57.9N , 0.0W - 1.9W   N= 1054

BEAUFORT 1 - 3   N= 469



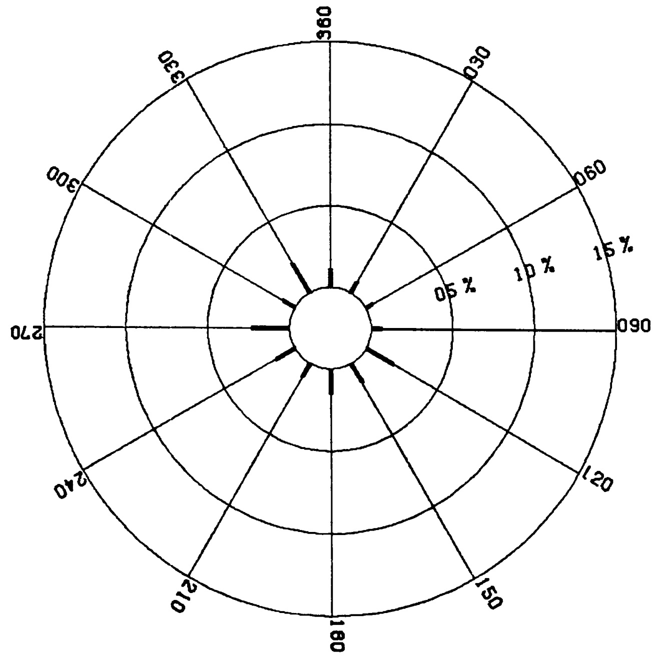
360=	5.0%	090=	2.3%	180=	5.2%	270=	4.0%
030=	3.5%	120=	2.1%	210=	3.8%	300=	2.5%
060=	2.0%	150=	4.6%	240=	2.4%	330=	3.2%

BEAUFORT 4 - 5   N= 404



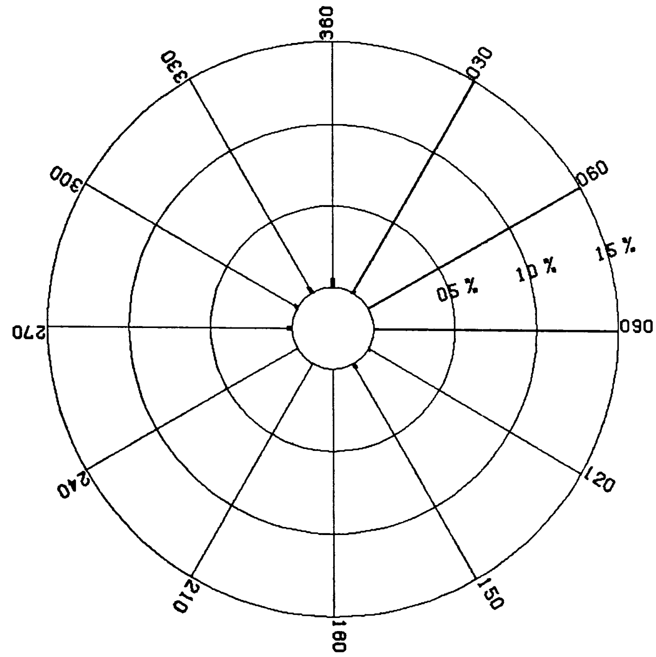
360=	4.6%	090=	3.0%	180=	3.5%	270=	2.8%
030=	2.8%	120=	2.6%	210=	4.5%	300=	2.8%
060=	1.8%	150=	2.9%	240=	3.3%	330=	3.7%

BEAUFORT 6 - 7   N= 161



360=	1.1%	090=	0.7%	180=	1.5%	270=	2.3%
030=	0.8%	120=	1.9%	210=	0.9%	300=	0.9%
060=	0.5%	150=	1.3%	240=	1.3%	330=	2.1%

BEAUFORT 8 - 12   N= 20



360=	0.6%	090=	0.0%	180=	0.0%	270=	0.3%
030=	0.1%	120=	0.1%	210=	0.0%	300=	0.2%
060=	0.0%	150=	0.3%	240=	0.0%	330=	0.4%

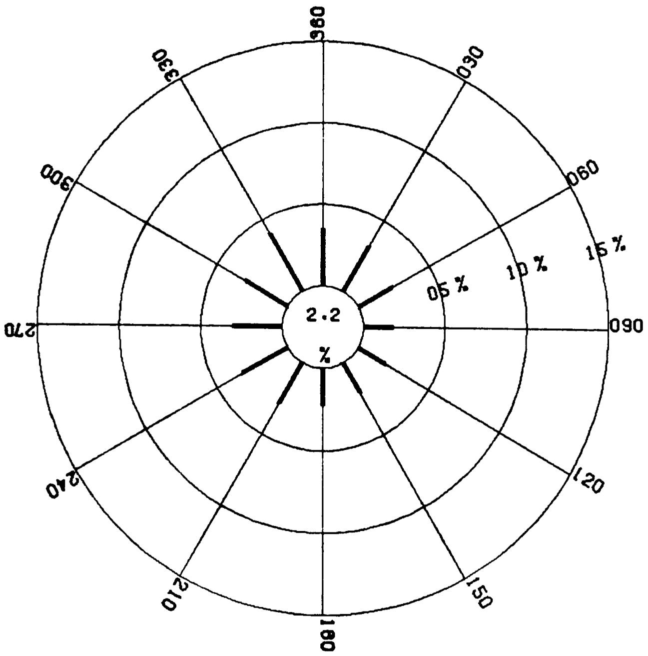
Figure 70

W I N D   R O S E

APRIL 610101 - 801231 (YYMMDD)

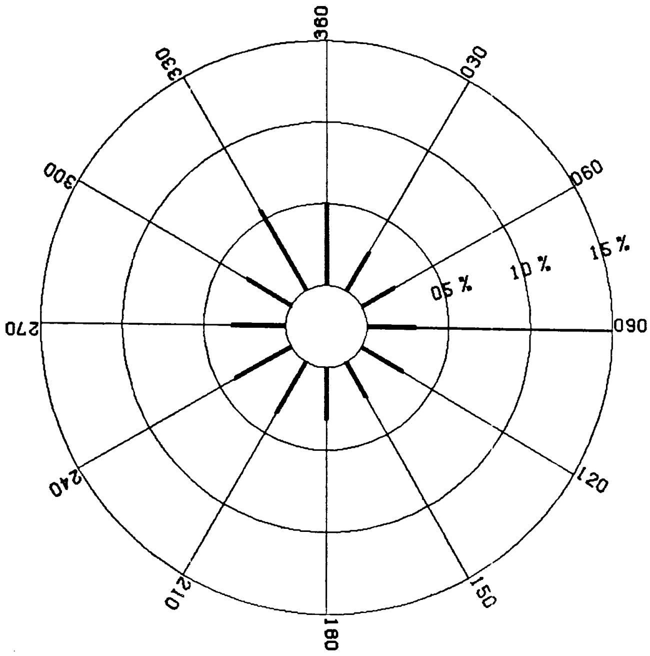
AREA: 56.0N - 57.9N , 2.0E - 3.9E N= 4975

BEAUFORT 1 - 3 N= 1765



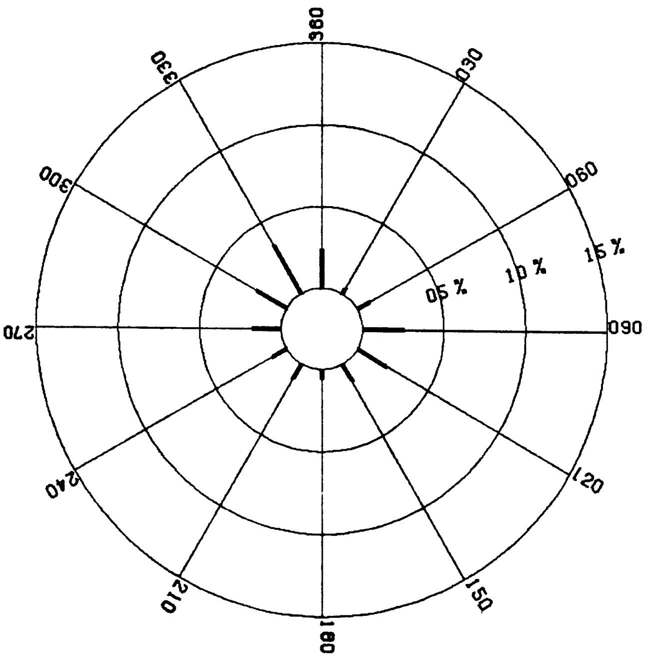
360=	3.5%	090=	1.8%	180=	2.3%	270=	3.0%
030=	3.2%	120=	1.9%	210=	2.9%	300=	3.0%
060=	2.4%	150=	2.1%	240=	3.2%	330=	4.0%

BEAUFORT 4 - 5 N= 2042



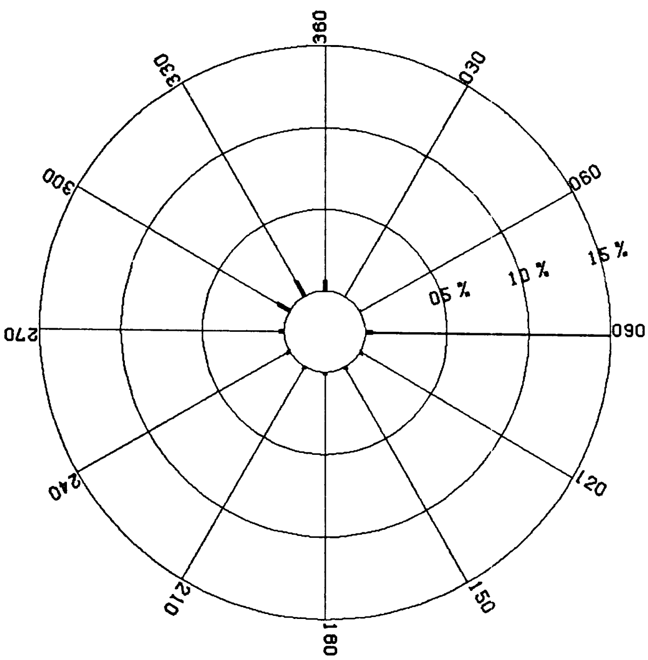
360=	5.0%	090=	3.0%	180=	3.1%	270=	3.3%
030=	2.7%	120=	2.9%	210=	3.6%	300=	3.1%
060=	2.3%	150=	2.5%	240=	3.9%	330=	5.6%

BEAUFORT 6 - 7 N= 970



360=	2.4%	090=	2.6%	180=	0.6%	270=	1.7%
030=	0.4%	120=	2.0%	210=	1.1%	300=	2.1%
060=	0.9%	150=	1.2%	240=	1.0%	330=	3.4%

BEAUFORT 8 - 12 N= 198



360=	0.6%	090=	0.4%	180=	0.1%	270=	0.3%
030=	0.0%	120=	0.1%	210=	0.1%	300=	0.8%
060=	0.0%	150=	0.1%	240=	0.2%	330=	1.1%

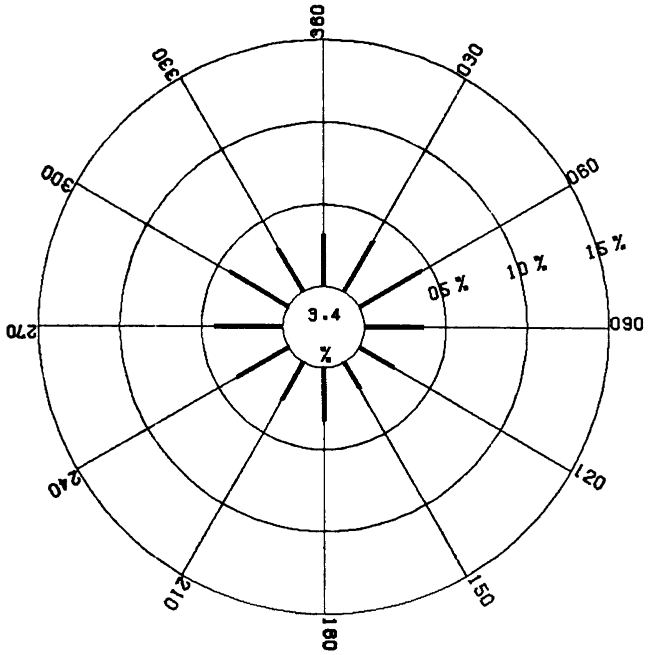
Figure 71

W I N D   R O S E

APRIL 610101 - 801231 (YYMMDD)

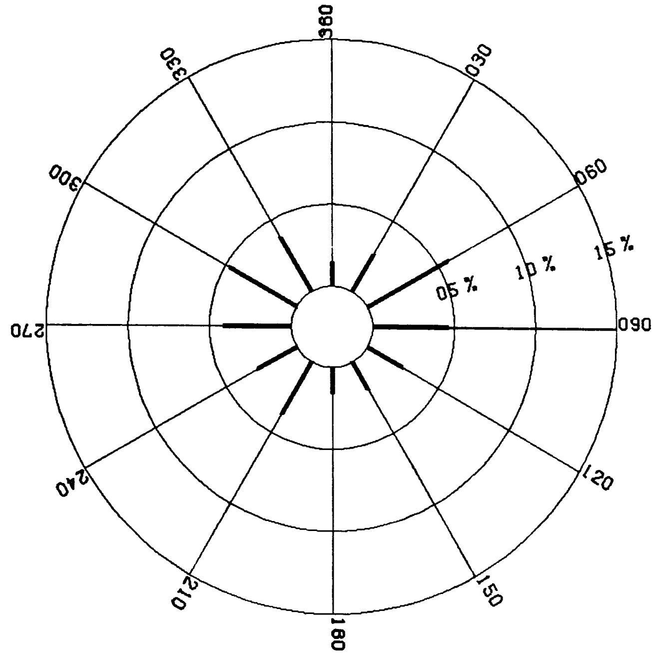
AREA: 56.0N - 57.9N , 6.0E - 7.9E N= 1349

BEAUFORT 1 - 3 N= 588



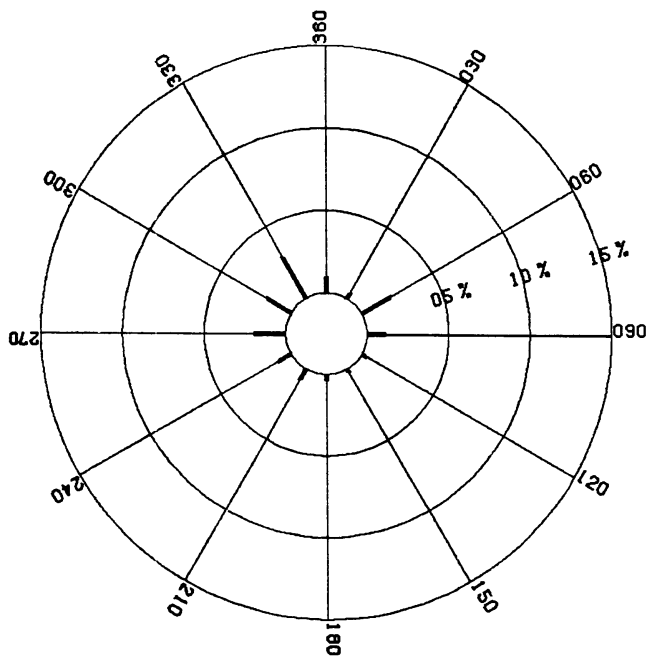
360=	3.2%	090=	3.6%	180=	3.3%	270=	4.2%
030=	3.6%	120=	2.4%	210=	2.7%	300=	4.2%
060=	4.4%	150=	1.9%	240=	3.7%	330=	3.0%

BEAUFORT 4 - 5 N= 535



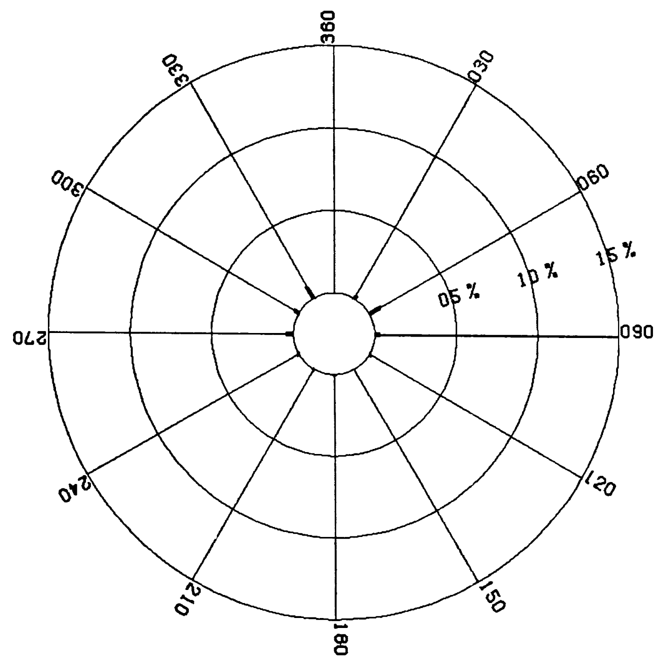
360=	1.5%	090=	4.6%	180=	1.6%	270=	4.2%
030=	2.7%	120=	2.4%	210=	3.7%	300=	4.7%
060=	5.7%	150=	1.9%	240=	2.8%	330=	3.8%

BEAUFORT 6 - 7 N= 185



360=	1.0%	090=	1.1%	180=	0.4%	270=	2.0%
030=	0.4%	120=	0.3%	210=	0.7%	300=	1.8%
060=	2.1%	150=	0.2%	240=	0.9%	330=	2.9%

BEAUFORT 8 - 12 N= 41



360=	0.0%	090=	0.3%	180=	0.1%	270=	0.4%
030=	0.1%	120=	0.1%	210=	0.1%	300=	0.3%
060=	0.7%	150=	0.0%	240=	0.1%	330=	0.8%

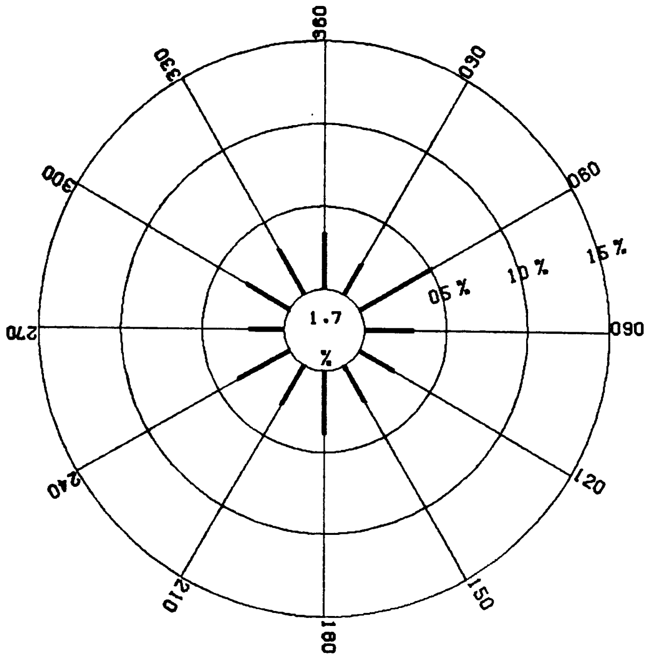
Figure 72

W I N D   R O S E

APRIL   610101 - 801231 (YYMMDD)

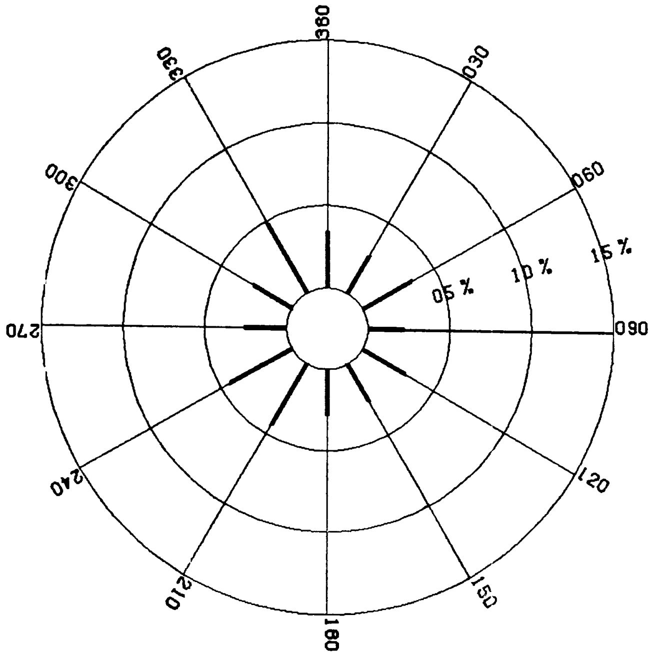
AREA: 54.0N - 55.9N , 2.0E - 3.9E   N= 1458

BEAUFORT 1 - 3   N= 567



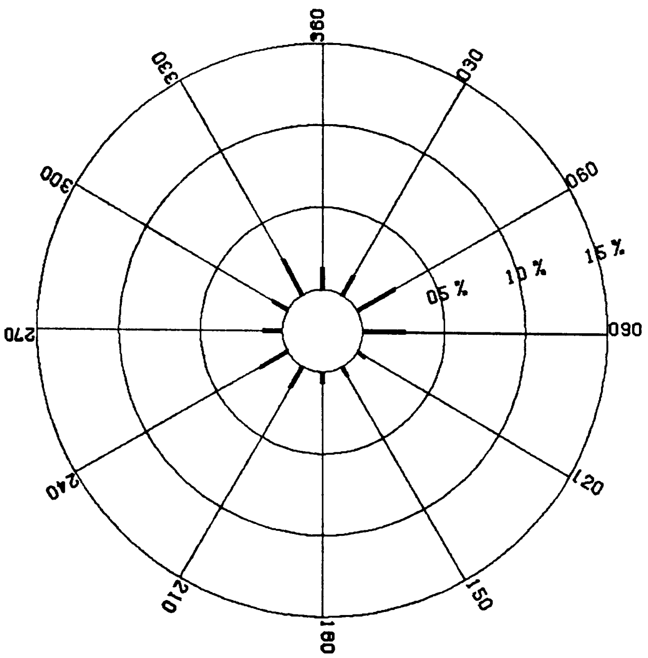
360=	3.4%	090=	2.9%	180=	3.9%	270=	2.1%
030=	2.1%	120=	2.5%	210=	2.8%	300=	3.0%
060=	5.1%	150=	2.5%	240=	3.6%	330=	3.2%

BEAUFORT 4 - 5   N= 570



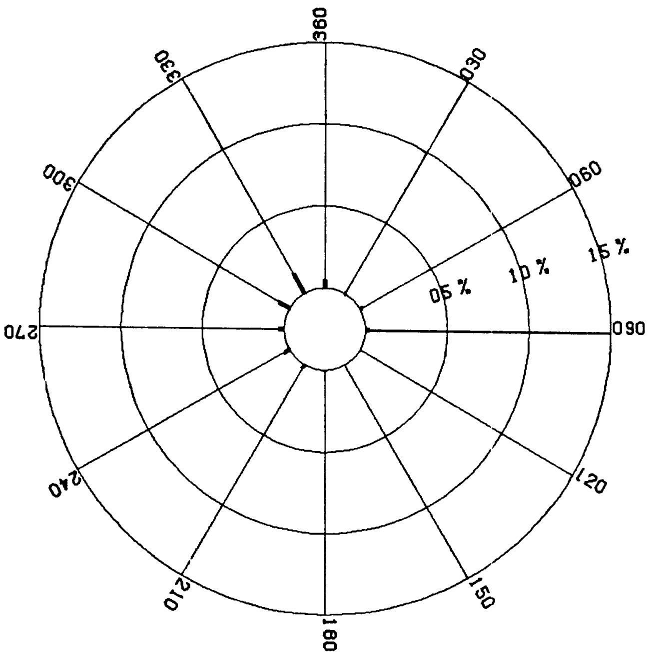
360=	3.4%	090=	2.2%	180=	2.8%	270=	2.5%
030=	2.7%	120=	3.0%	210=	4.4%	300=	2.7%
060=	3.4%	150=	2.6%	240=	4.4%	330=	4.9%

BEAUFORT 6 - 7   N= 263



360=	1.4%	090=	2.6%	180=	0.7%	270=	1.2%
030=	1.4%	120=	0.5%	210=	1.5%	300=	1.1%
060=	2.7%	150=	0.6%	240=	1.9%	330=	2.5%

BEAUFORT 8 - 12   N= 58



360=	0.5%	090=	0.2%	180=	0.1%	270=	0.3%
030=	0.1%	120=	0.0%	210=	0.2%	300=	0.8%
060=	0.1%	150=	0.0%	240=	0.3%	330=	1.4%

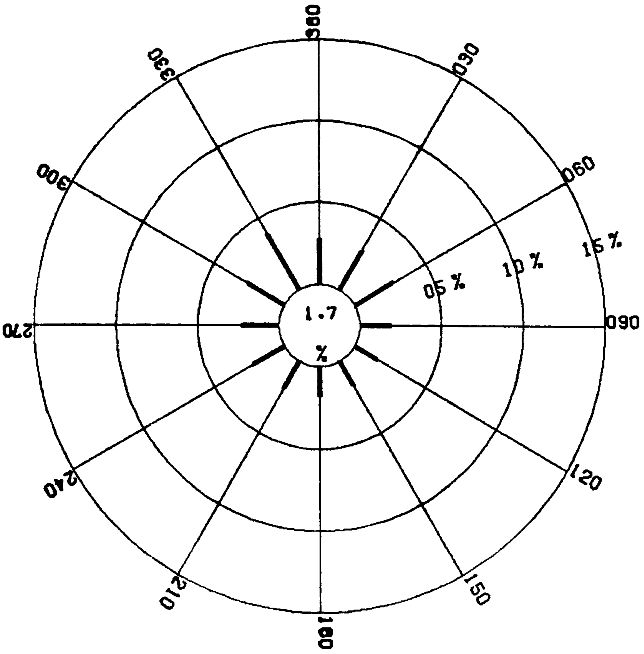
Figure 73

W I N D   R O S E

APRIL   610101 - 801231 (YYMMDD)

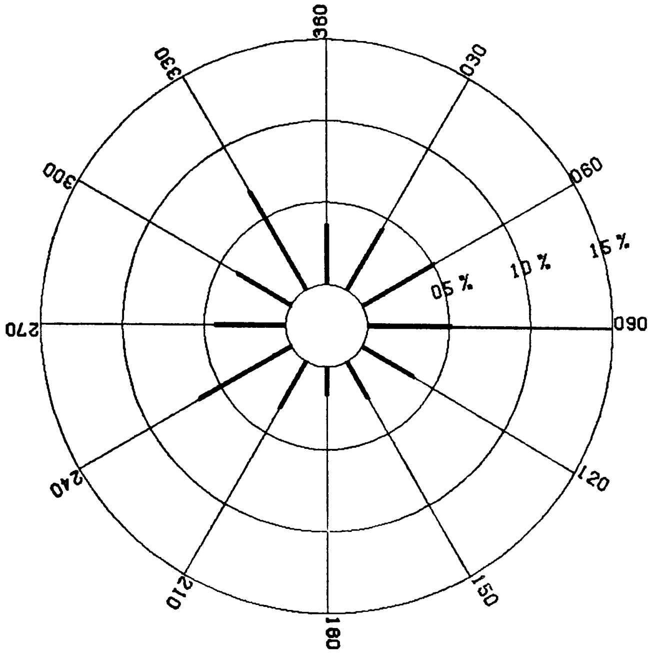
AREA: 54.0N - 54.9N , 6.0E - 8.9E   N= 6918

BEAUFORT 1 - 3   N= 2050



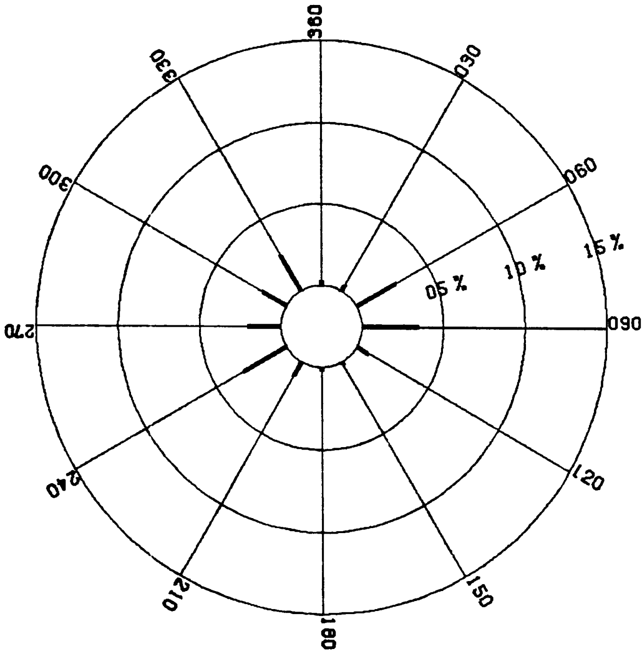
360=	2.8%	090=	1.9%	180=	1.8%	270=	2.3%
030=	2.7%	120=	1.6%	210=	1.9%	300=	2.6%
060=	2.7%	150=	1.7%	240=	2.3%	330=	3.9%

BEAUFORT 4 - 5   N= 3519



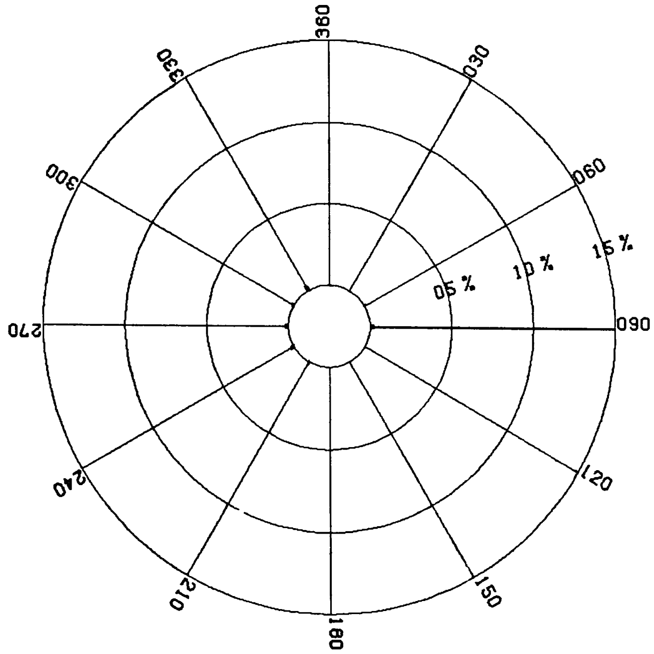
360=	3.6%	090=	5.2%	180=	1.7%	270=	4.3%
030=	4.3%	120=	3.7%	210=	3.3%	300=	3.8%
060=	5.1%	150=	2.5%	240=	6.5%	330=	6.9%

BEAUFORT 6 - 7   N= 1268



360=	0.3%	090=	3.4%	180=	0.2%	270=	2.0%
030=	0.4%	120=	0.8%	210=	1.0%	300=	1.7%
060=	2.8%	150=	0.1%	240=	3.0%	330=	2.5%

BEAUFORT 8 - 12   N= 81



360=	0.0%	090=	0.2%	180=	0.0%	270=	0.2%
030=	0.0%	120=	0.0%	210=	0.1%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.1%	330=	0.3%

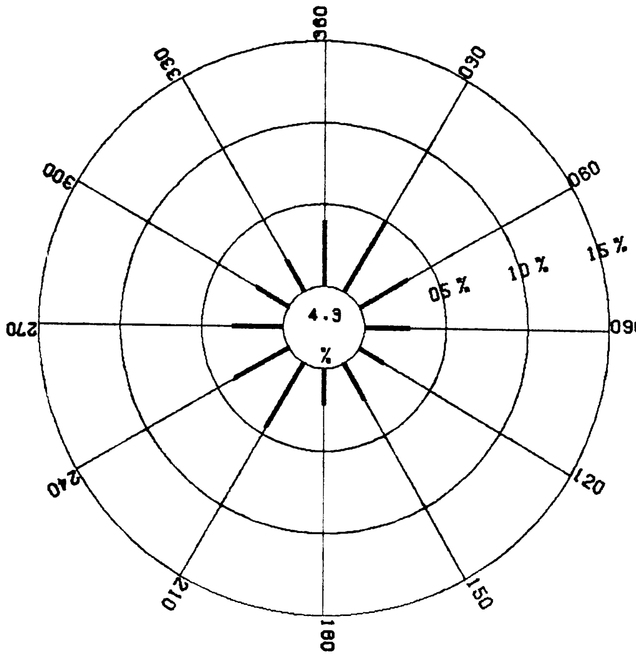
Figure 74

W I N D   R O S E

APRIL   610101 - 801231 (YYMMDD)

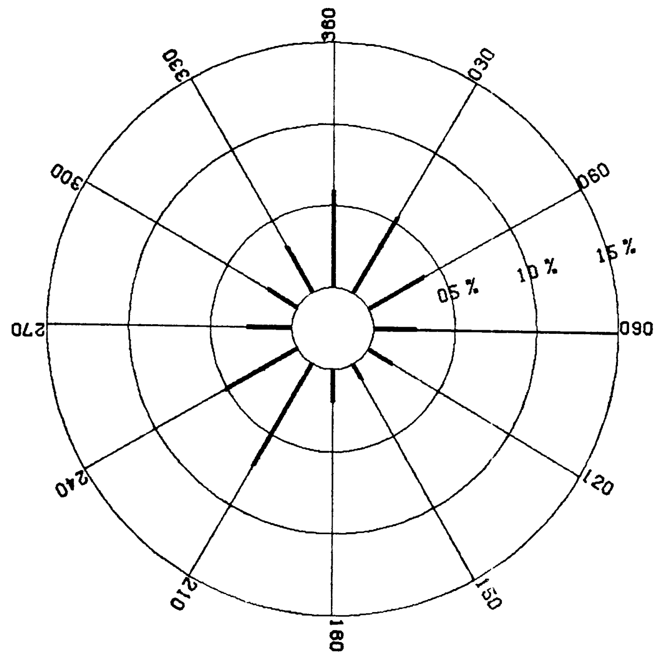
AREA: 52.0N - 52.9N , 3.0E - 4.9E   N= 1262

BEAUFORT 1 - 3   N= 524



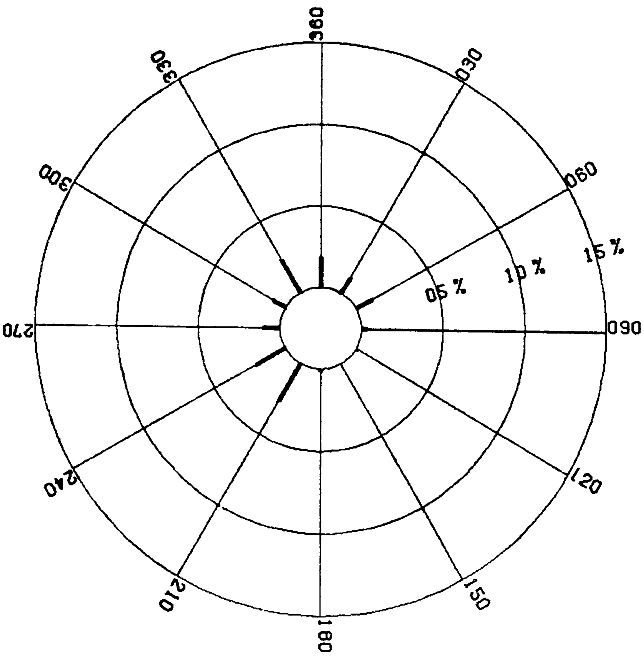
360=	4.0%	090=	2.7%	180=	2.2%	270=	3.1%
030=	5.0%	120=	1.7%	210=	4.5%	300=	2.3%
060=	3.3%	150=	2.5%	240=	3.8%	330=	2.1%

BEAUFORT 4 - 5   N= 541



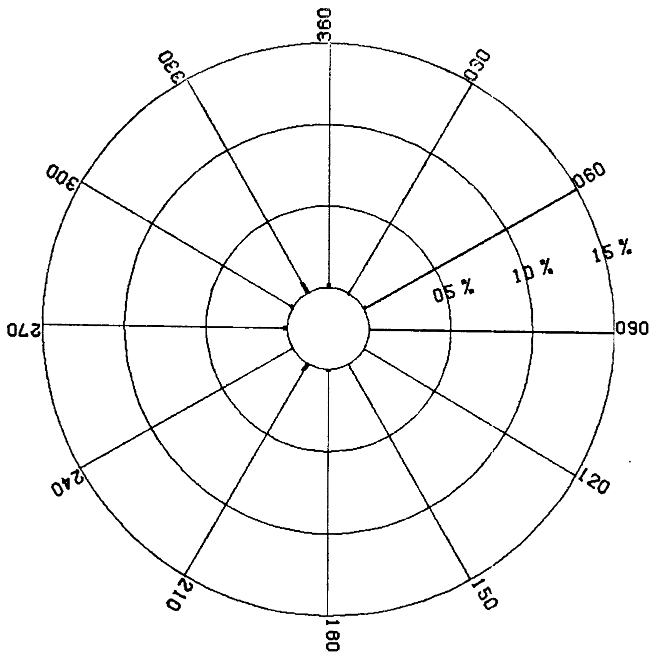
360=	5.9%	090=	2.6%	180=	2.0%	270=	2.8%
030=	5.4%	120=	1.7%	210=	7.2%	300=	2.1%
060=	3.9%	150=	1.0%	240=	5.1%	330=	3.2%

BEAUFORT 6 - 7   N= 172



360=	1.9%	090=	0.3%	180=	0.2%	270=	1.0%
030=	1.1%	120=	0.1%	210=	2.7%	300=	0.9%
060=	1.1%	150=	0.0%	240=	2.1%	330=	2.3%

BEAUFORT 8 - 12   N= 25



360=	0.2%	090=	0.0%	180=	0.1%	270=	0.2%
030=	0.1%	120=	0.0%	210=	0.5%	300=	0.1%
060=	0.1%	150=	0.0%	240=	0.0%	330=	0.1%

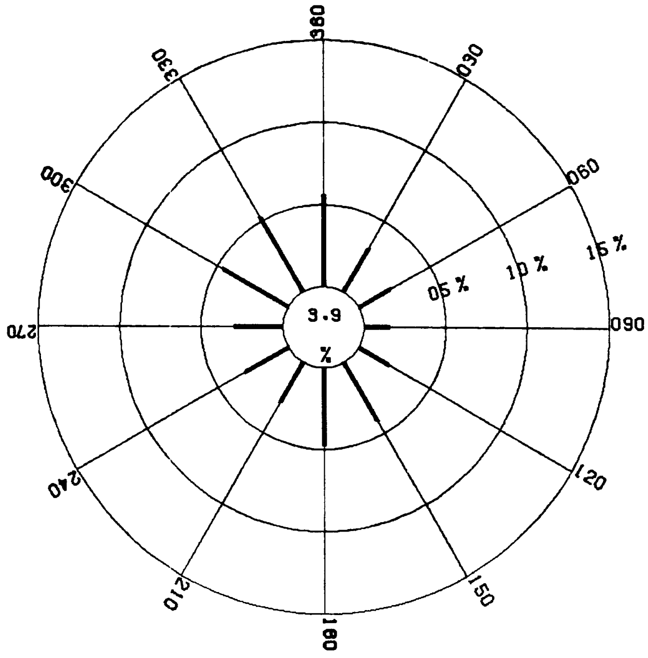
Figure 75

W I N D   R O S E

JULY 610101 - 801231 (YYMMDD)

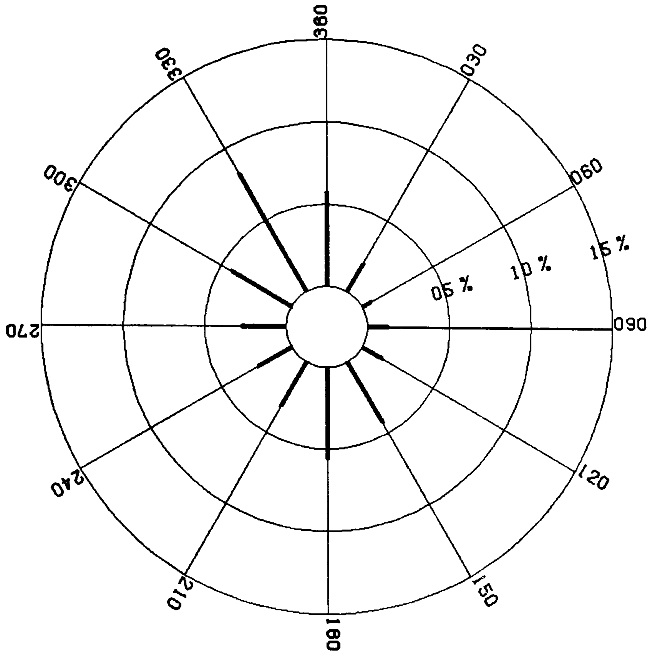
AREA: 58.0N - 59.9N , 0.0E - 1.9E N= 2434

BEAUFORT 1 - 3 N= 1123



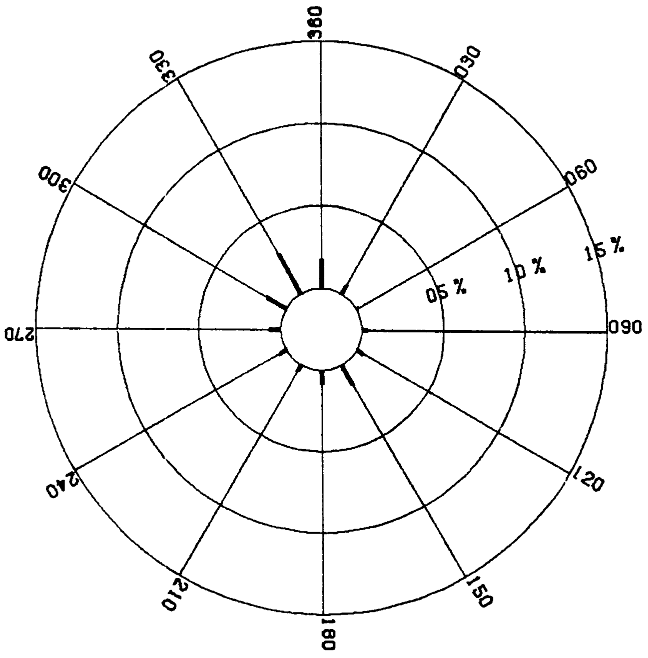
360=	5.6%	090=	1.5%	180=	4.8%	270=	3.0%
030=	3.1%	120=	2.1%	210=	2.9%	300=	4.6%
060=	2.2%	150=	4.1%	240=	3.0%	330=	5.3%

BEAUFORT 4 - 5 N= 1018



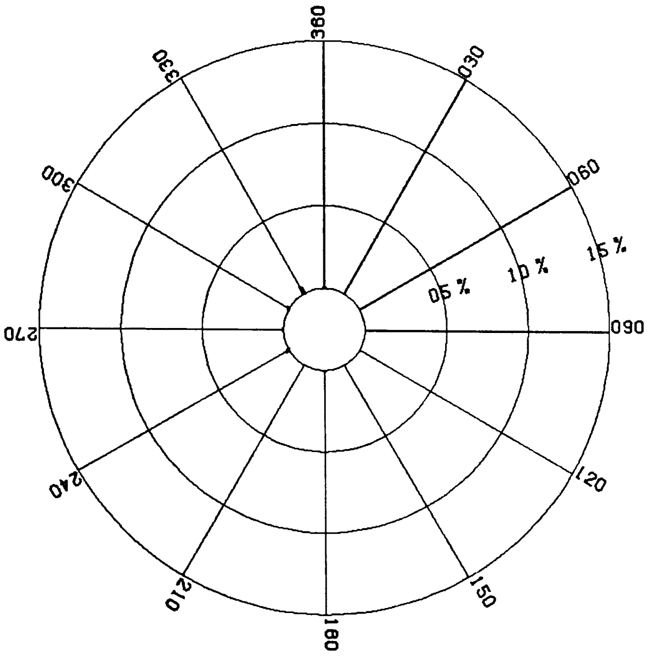
360=	5.8%	090=	1.3%	180=	5.6%	270=	2.8%
030=	2.0%	120=	1.4%	210=	3.2%	300=	4.3%
060=	0.6%	150=	4.3%	240=	2.4%	330=	8.3%

BEAUFORT 6 - 7 N= 270



360=	1.8%	090=	0.3%	180=	0.8%	270=	0.7%
030=	0.6%	120=	0.4%	210=	0.5%	300=	1.4%
060=	0.1%	150=	1.4%	240=	0.5%	330=	2.8%

BEAUFORT 8 - 12 N= 23



360=	0.1%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.2%	330=	0.5%

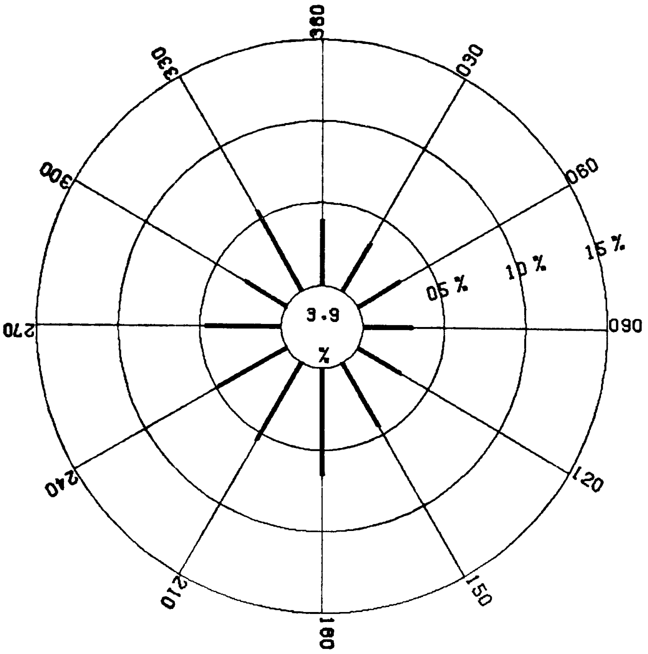
Figure 76

W I N D   R O S E

JULY   610101 - 801231 (YYMMDD)

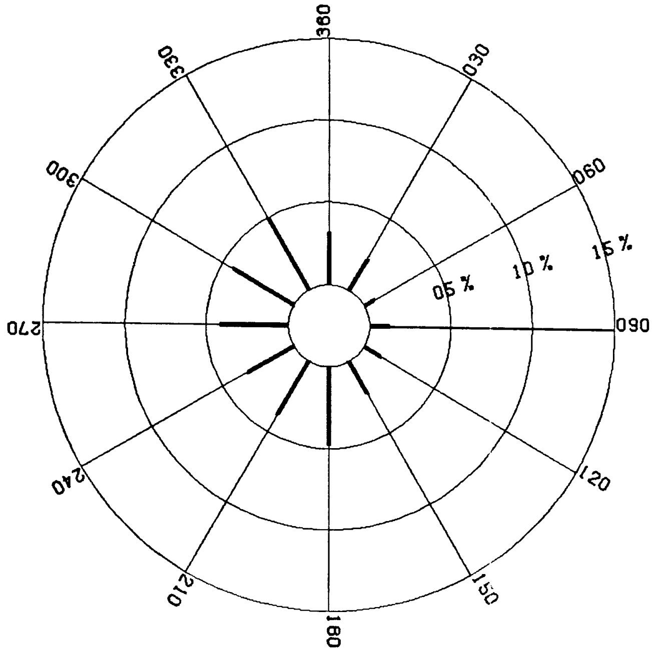
AREA: 56.0N - 57.9N , 0.0W - 1.9W   N= 1478

BEAUFORT 1 - 3   N= 810



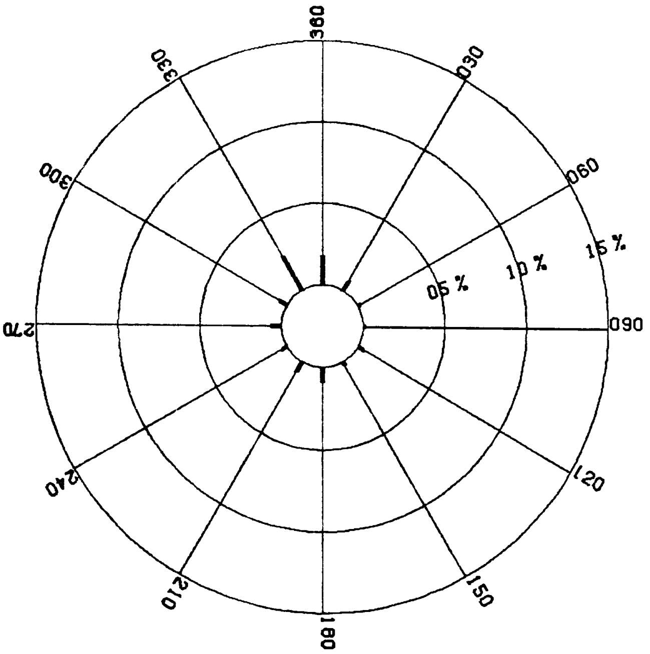
360=	4.0%	090=	3.0%	180=	6.6%	270=	4.7%
030=	3.3%	120=	3.1%	210=	5.5%	300=	2.9%
060=	3.0%	150=	4.5%	240=	4.9%	330=	5.5%

BEAUFORT 4 - 5   N= 530



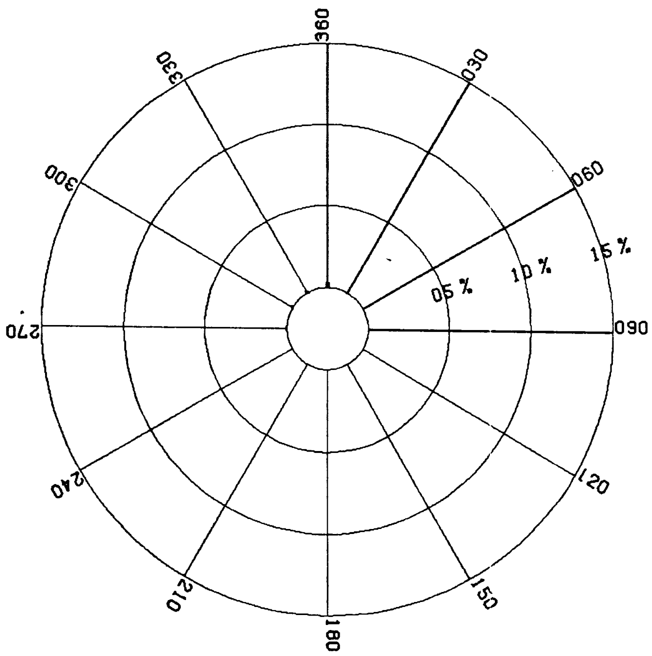
360=	3.2%	090=	1.2%	180=	4.8%	270=	4.1%
030=	2.2%	120=	1.2%	210=	3.8%	300=	4.3%
060=	0.7%	150=	2.2%	240=	3.2%	330=	4.9%

BEAUFORT 6 - 7   N= 130



360=	1.8%	090=	0.1%	180=	0.9%	270=	0.7%
030=	0.7%	120=	0.4%	210=	0.7%	300=	0.5%
060=	0.1%	150=	0.2%	240=	0.3%	330=	2.4%

BEAUFORT 8 - 12   N= 8



360=	0.3%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.1%

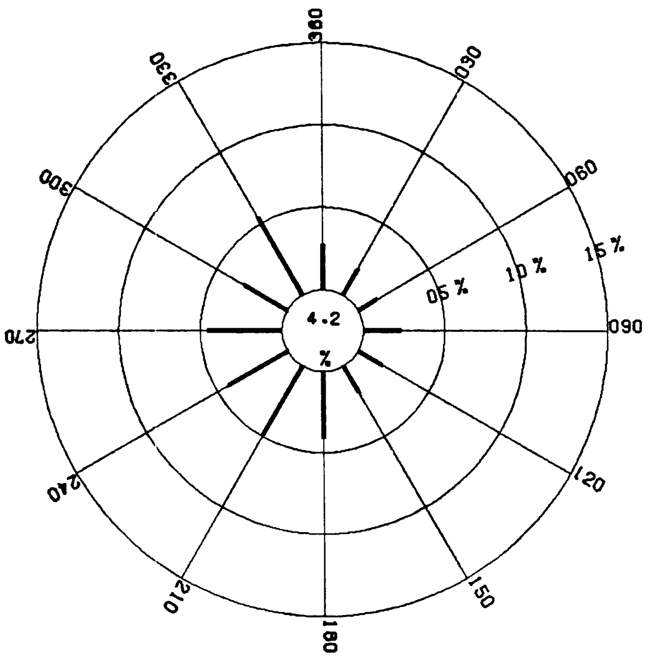
Figure 77

W I N D   R O S E

JULY   610101 - 801231 (YYMMDD)

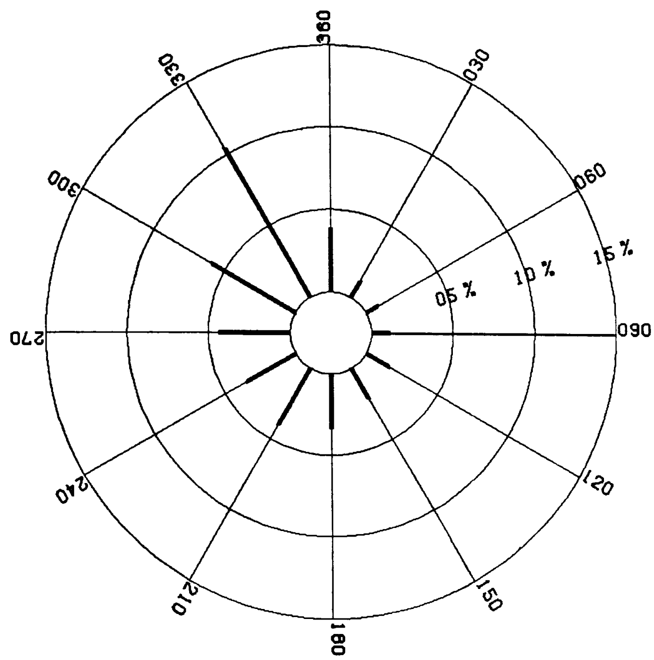
AREA: 56.0N - 57.9N , 2.0E - 3.9E   N= 3758

BEAUFORT 1 - 3   N= 1586



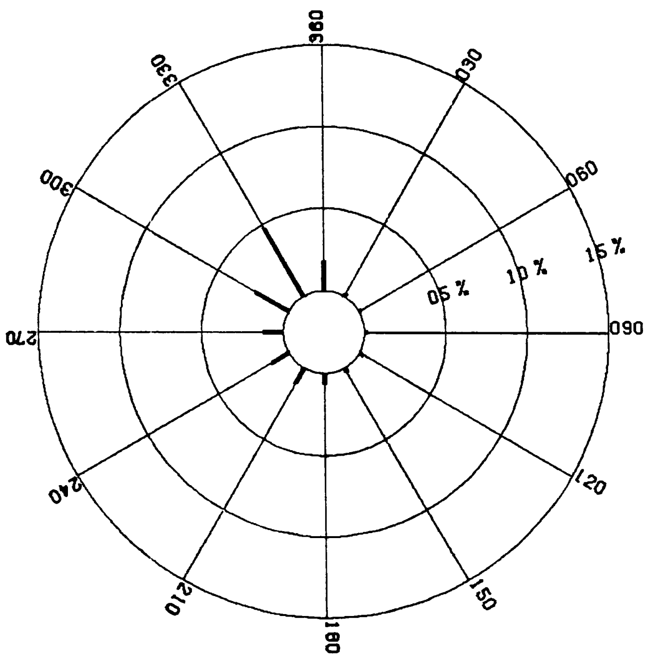
360=	2.7%	090=	2.3%	180=	4.1%	270=	4.6%
030=	1.6%	120=	1.7%	210=	4.9%	300=	3.1%
060=	1.3%	150=	1.9%	240=	4.2%	330=	5.4%

BEAUFORT 4 - 5   N= 1589



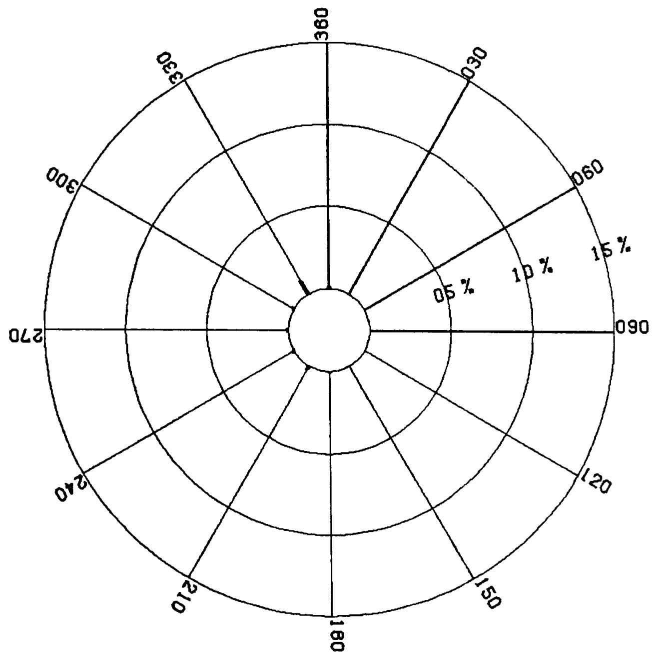
360=	3.9%	090=	1.1%	180=	3.4%	270=	4.4%
030=	1.1%	120=	1.6%	210=	4.0%	300=	5.9%
060=	0.9%	150=	2.1%	240=	3.5%	330=	10.4%

BEAUFORT 6 - 7   N= 522



360=	1.8%	090=	0.2%	180=	0.6%	270=	1.2%
030=	0.2%	120=	0.2%	210=	1.0%	300=	2.3%
060=	0.1%	150=	0.2%	240=	1.2%	330=	4.8%

BEAUFORT 8 - 12   N= 61



360=	0.1%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.2%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.1%	330=	0.9%

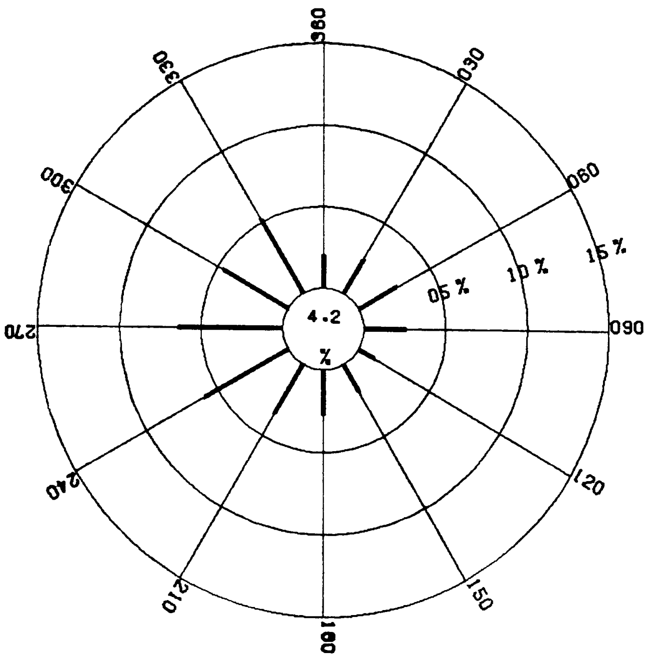
Figure 78

W I N D   R O S E

JULY   610101 - 801231 (YYMMDD)

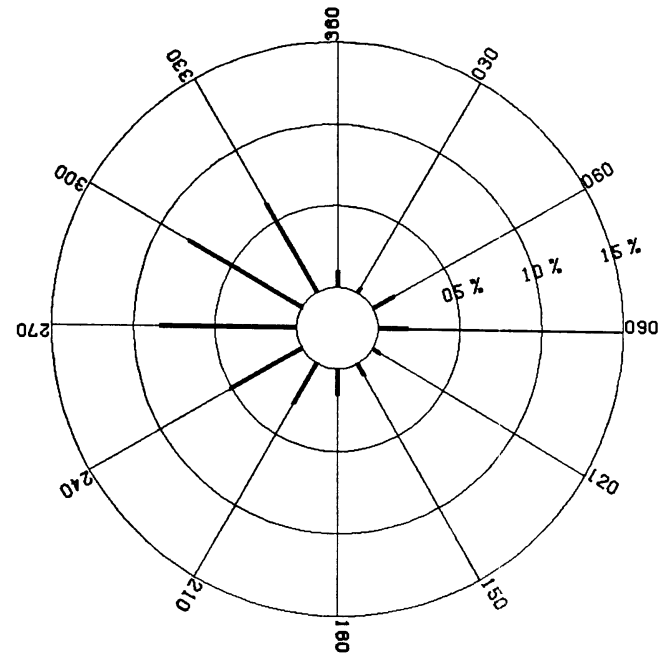
AREA: 56.0N - 57.9N , 6.0E - 7.9E   N= 1684

BEAUFORT 1 - 3   N= 763



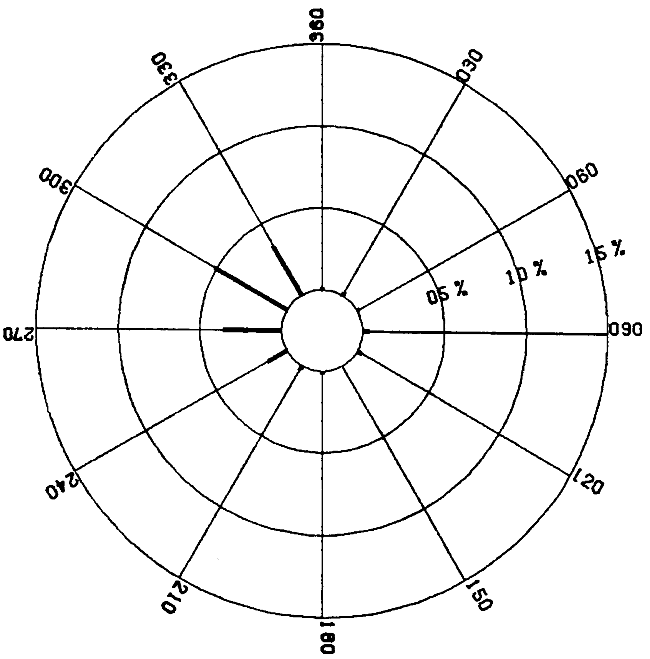
360=	2.0%	090=	2.6%	180=	2.7%	270=	6.4%
030=	2.4%	120=	1.1%	210=	3.5%	300=	4.6%
060=	2.7%	150=	1.9%	240=	5.9%	330=	5.2%

BEAUFORT 4 - 5   N= 642



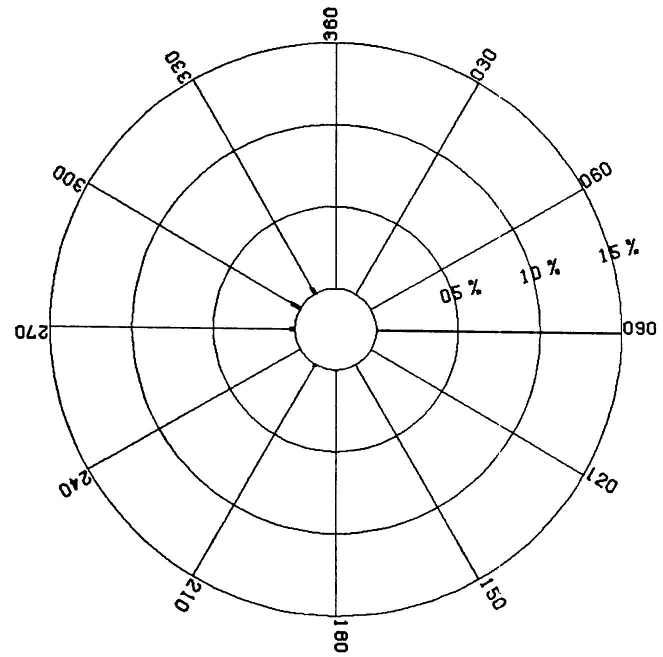
360=	1.0%	090=	1.8%	180=	1.6%	270=	8.4%
030=	0.3%	120=	0.5%	210=	2.9%	300=	8.0%
060=	1.5%	150=	0.8%	240=	5.1%	330=	6.2%

BEAUFORT 6 - 7   N= 252



360=	0.1%	090=	0.4%	180=	0.2%	270=	3.6%
030=	0.2%	120=	0.3%	210=	0.2%	300=	5.1%
060=	0.1%	150=	0.0%	240=	1.3%	330=	3.4%

BEAUFORT 8 - 12   N= 27



360=	0.0%	090=	0.1%	180=	0.1%	270=	0.3%
030=	0.0%	120=	0.0%	210=	0.1%	300=	0.7%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.4%

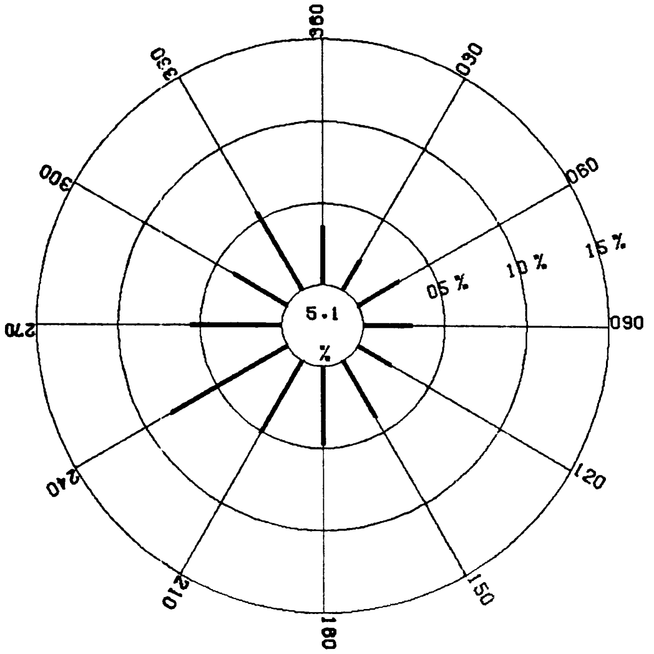
Figure 79

W I N D   R O S E

JULY 610101 - 801231 (YYMMDD)

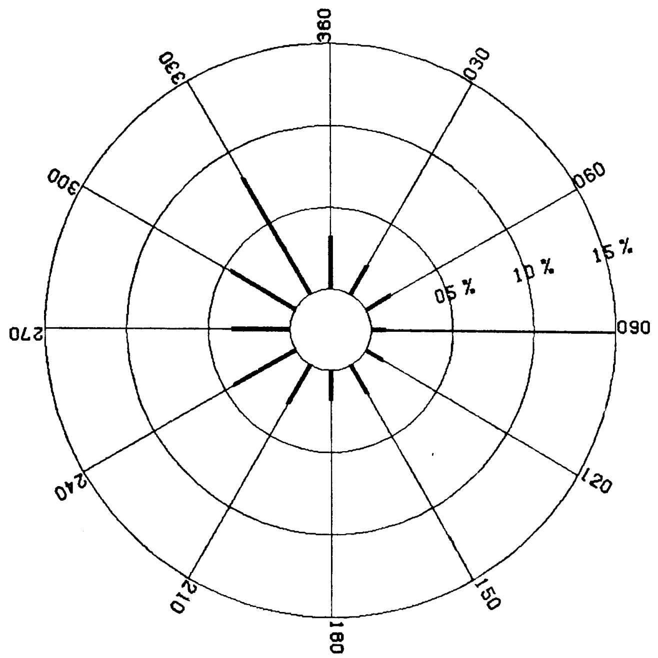
AREA: 54.0N - 55.9N , 2.0E - 3.9E N= 1484

BEAUFORT 1 - 3 N= 830



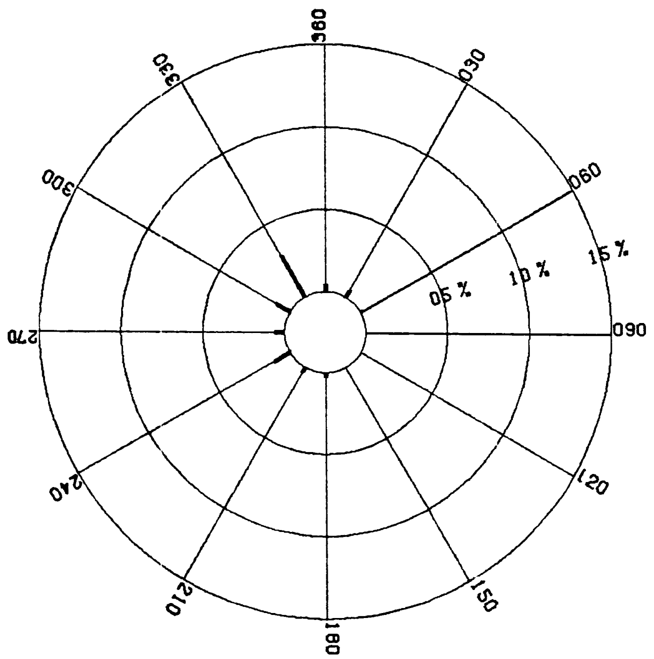
360=	3.6%	090=	3.0%	180=	4.8%	270=	5.6%
030=	2.1%	120=	2.4%	210=	5.1%	300=	3.8%
060=	2.9%	150=	4.0%	240=	8.2%	330=	5.5%

BEAUFORT 4 - 5 N= 541



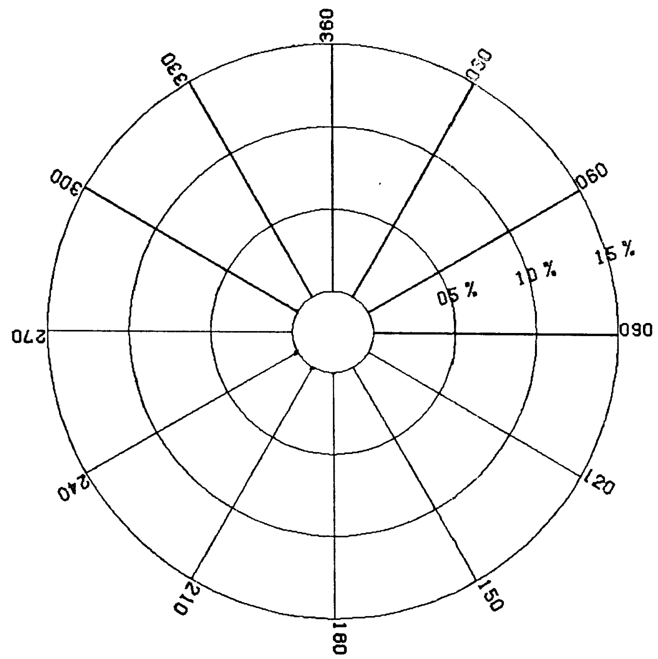
360=	3.2%	090=	0.9%	180=	1.8%	270=	3.6%
030=	2.0%	120=	1.2%	210=	2.8%	300=	4.6%
060=	1.8%	150=	2.0%	240=	4.4%	330=	8.2%

BEAUFORT 6 - 7 N= 106



360=	0.5%	090=	0.0%	180=	0.3%	270=	0.6%
030=	0.5%	120=	0.0%	210=	0.3%	300=	0.9%
060=	0.1%	150=	0.0%	240=	1.1%	330=	2.9%

BEAUFORT 8 - 12 N= 7



360=	0.0%	090=	0.0%	180=	0.1%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.1%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.2%	330=	0.0%

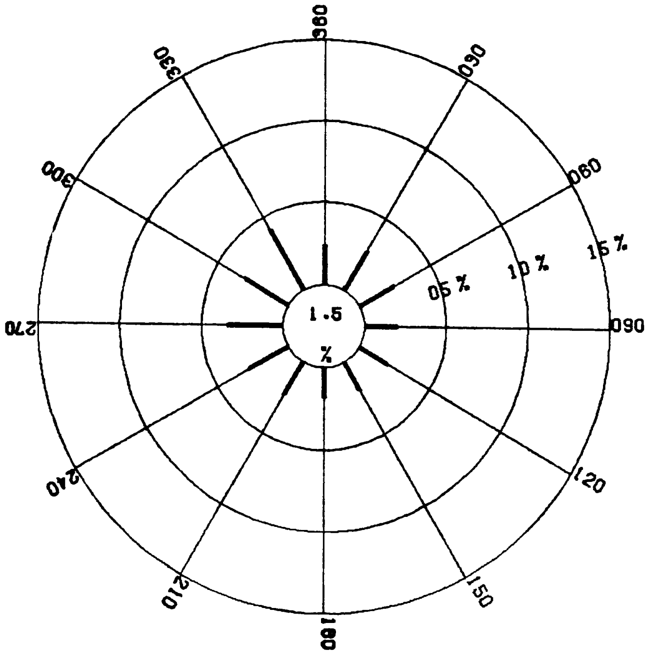
Figure 80

W I N D   R O S E

JULY   610101 - 801231 (YYMMDD)

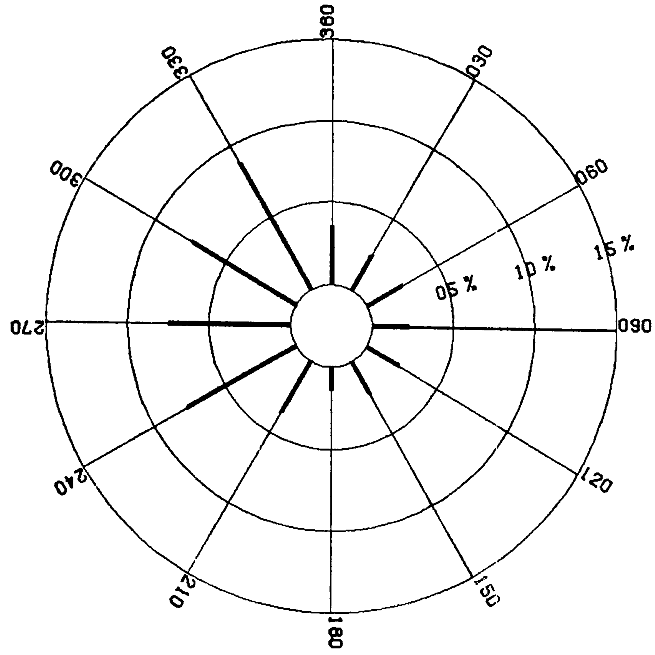
AREA: 54.0N - 54.9N , 6.0E - 8.9E   N= 6203

BEAUFORT 1 - 3   N= 2012



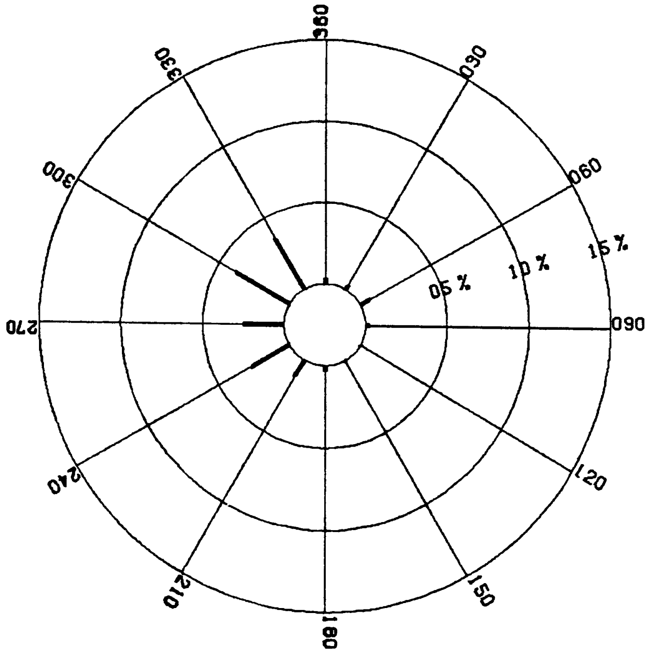
360=	2.4%	090=	2.0%	180=	1.8%	270=	3.4%
030=	2.7%	120=	2.0%	210=	2.3%	300=	3.1%
060=	2.4%	150=	1.9%	240=	2.8%	330=	4.2%

BEAUFORT 4 - 5   N= 3196



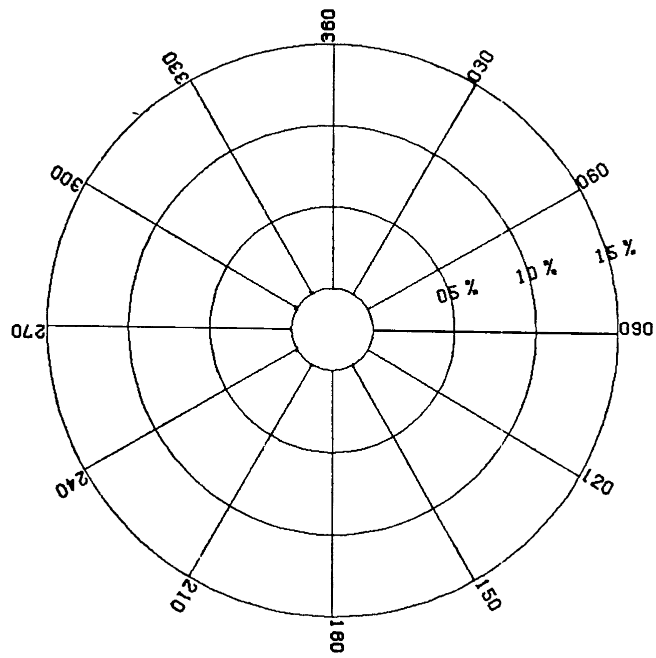
360=	3.6%	090=	2.2%	180=	1.4%	270=	7.5%
030=	2.5%	120=	2.3%	210=	3.6%	300=	7.4%
060=	2.5%	150=	2.2%	240=	7.7%	330=	8.8%

BEAUFORT 6 - 7   N= 964



360=	0.4%	090=	0.2%	180=	0.3%	270=	2.5%
030=	0.3%	120=	0.0%	210=	1.1%	300=	3.8%
060=	0.6%	150=	0.0%	240=	2.7%	330=	3.5%

BEAUFORT 8 - 12   N= 31



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.2%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.1%

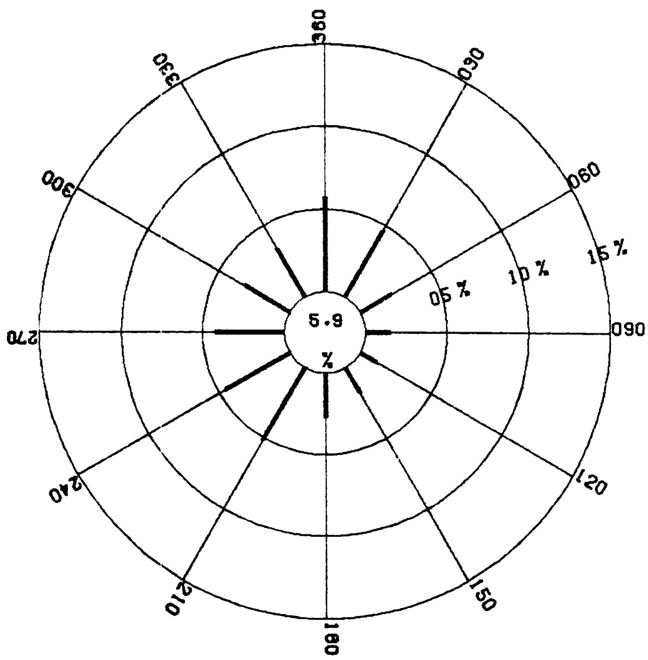
Figure 81

W I N D   R O S E

JULY 610101 - 801231 (YYMMDD)

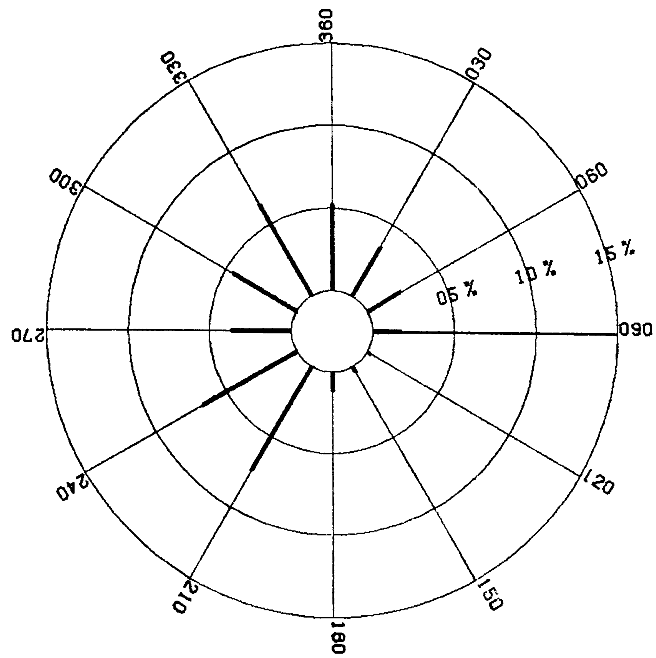
AREA: 52.0N - 52.9N , 3.0E - 4.9E N= 1068

BEAUFORT 1 - 3 N= 493



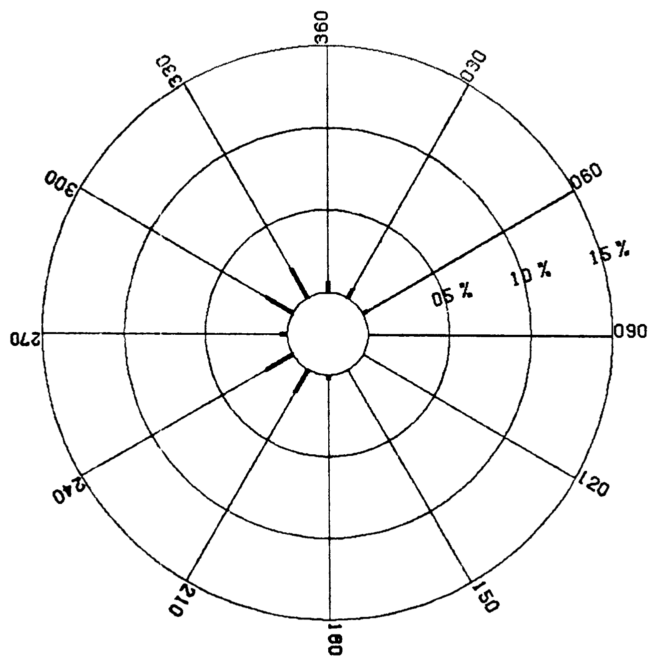
360=	5.7%	090=	1.5%	180=	2.7%	270=	4.2%
030=	4.7%	120=	1.2%	210=	5.1%	300=	3.2%
060=	2.2%	150=	1.8%	240=	4.6%	330=	3.4%

BEAUFORT 4 - 5 N= 461



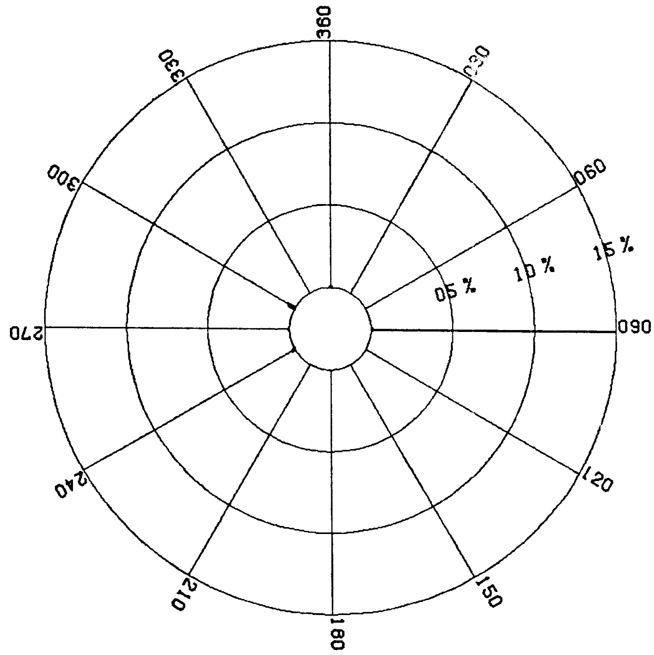
360=	5.2%	090=	1.8%	180=	1.2%	270=	3.7%
030=	3.5%	120=	0.2%	210=	7.4%	300=	4.5%
060=	2.3%	150=	0.4%	240=	6.6%	330=	6.4%

BEAUFORT 6 - 7 N= 104



360=	0.7%	090=	0.0%	180=	0.3%	270=	0.5%
030=	0.7%	120=	0.0%	210=	1.6%	300=	1.9%
060=	0.3%	150=	0.0%	240=	1.9%	330=	2.1%

BEAUFORT 8 - 12 N= 10



360=	0.1%	090=	0.1%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.5%
060=	0.0%	150=	0.0%	240=	0.2%	330=	0.0%

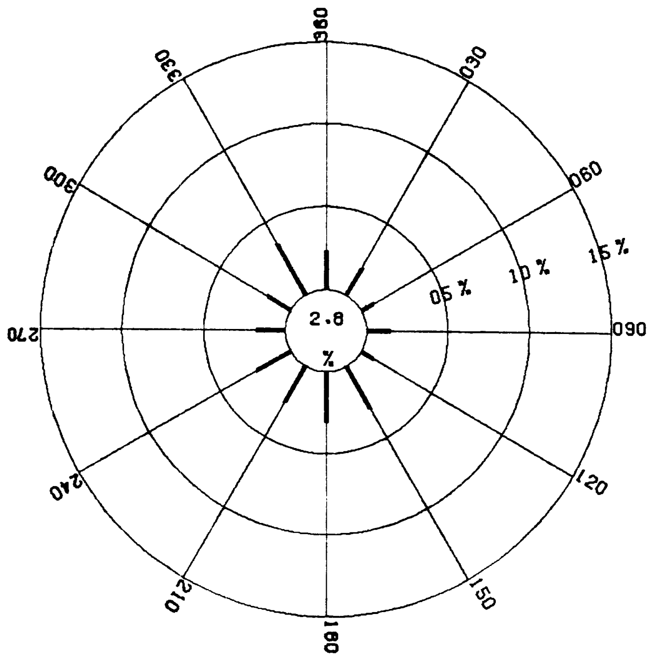
Figure 82

WIND ROSE

OCTOBER 610101 - 801231 (YYMMDD)

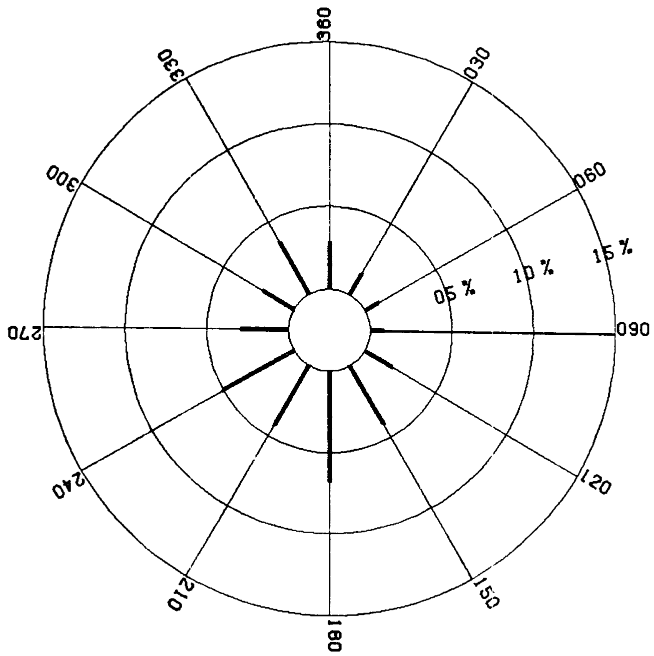
AREA: 58.0N - 59.9N , 0.0E - 1.9E N= 1409

BEAUFORT 1 - 3 N= 395



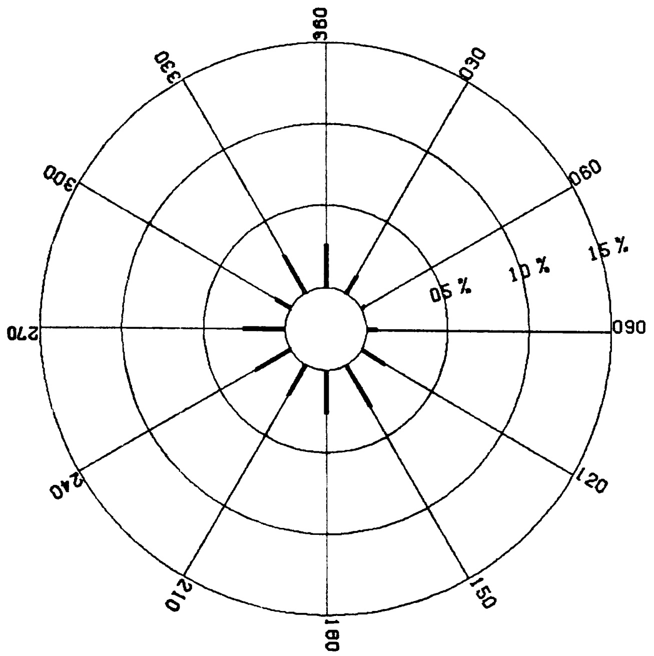
360=	2.3%	090=	1.4%	180=	3.1%	270=	1.8%
030=	1.8%	120=	0.9%	210=	2.6%	300=	1.6%
060=	0.9%	150=	3.0%	240=	2.4%	330=	3.5%

BEAUFORT 4 - 5 N= 520



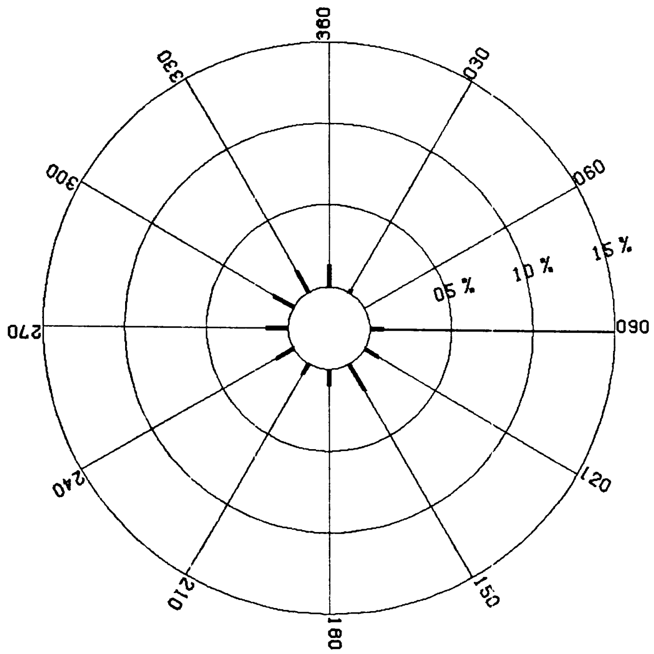
360=	2.8%	090=	0.8%	180=	6.8%	270=	2.9%
030=	1.5%	120=	1.9%	210=	4.3%	300=	2.2%
060=	0.9%	150=	4.1%	240=	5.0%	330=	3.6%

BEAUFORT 6 - 7 N= 320



360=	2.6%	090=	0.6%	180=	2.6%	270=	2.6%
030=	1.2%	120=	1.6%	210=	2.1%	300=	1.1%
060=	0.2%	150=	2.9%	240=	2.5%	330=	2.6%

BEAUFORT 8 - 12 N= 174



360=	1.3%	090=	0.8%	180=	1.0%	270=	1.3%
030=	0.2%	120=	0.9%	210=	0.8%	300=	1.4%
060=	0.0%	150=	1.8%	240=	1.2%	330=	1.5%

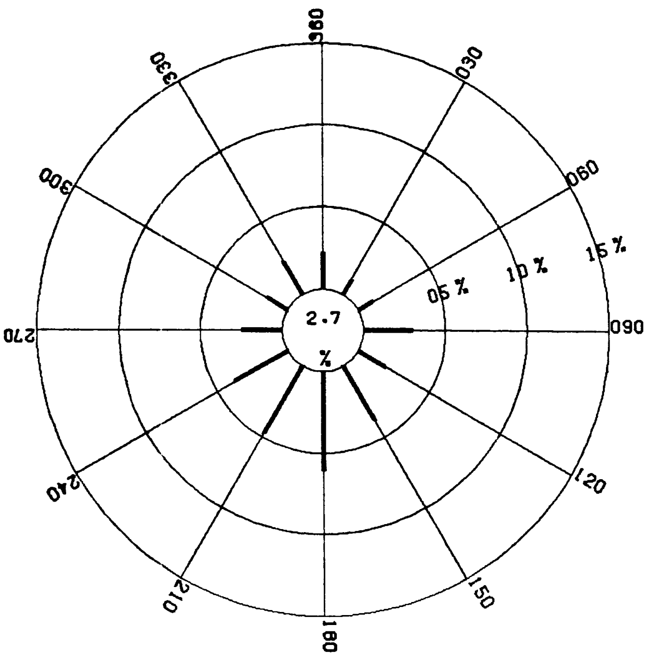
Figure 83

W I N D   R O S E

OCTOBER   610101 - 801231 (YYMMDD)

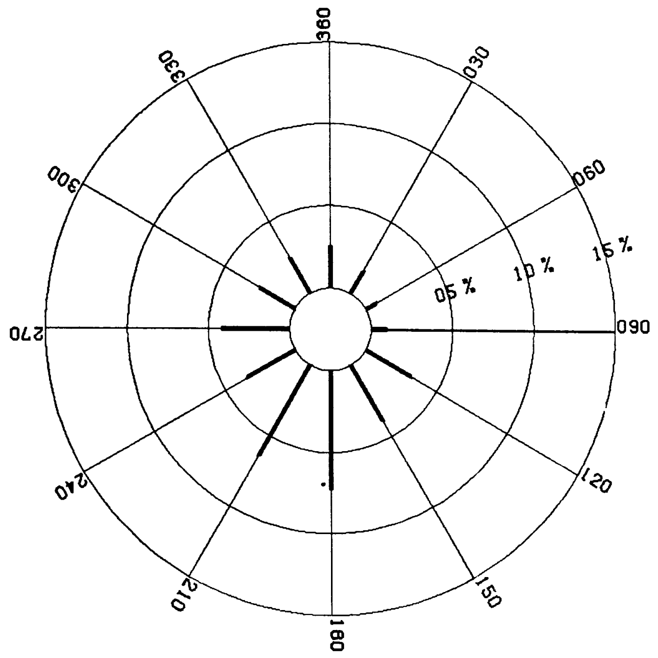
AREA: 56.0N - 57.9N , 0.0W - 1.9W   N= 1222

BEAUFORT 1 - 3   N= 442



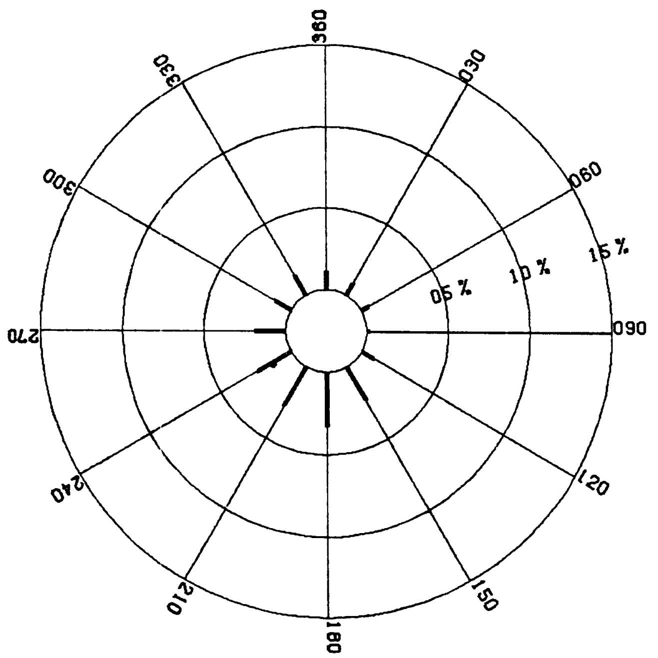
360=	2.2%	090=	2.9%	180=	6.1%	270=	2.5%
030=	1.0%	120=	1.9%	210=	4.7%	300=	1.4%
060=	1.0%	150=	3.8%	240=	3.8%	330=	2.3%

BEAUFORT 4 - 5   N= 479



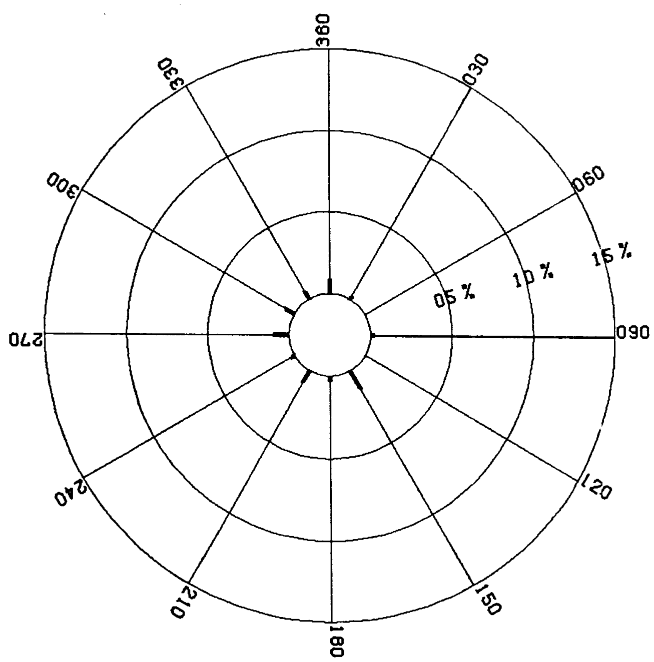
360=	2.5%	090=	1.0%	180=	7.3%	270=	4.2%
030=	1.6%	120=	3.2%	210=	6.4%	300=	2.5%
060=	0.7%	150=	3.9%	240=	3.4%	330=	2.5%

BEAUFORT 6 - 7   N= 226



360=	1.1%	090=	0.2%	180=	3.3%	270=	1.9%
030=	0.8%	120=	0.8%	210=	2.7%	300=	1.1%
060=	0.5%	150=	2.3%	240=	2.4%	330=	1.4%

BEAUFORT 8 - 12   N= 75



360=	0.9%	090=	0.2%	180=	0.3%	270=	1.0%
030=	0.2%	120=	0.0%	210=	0.8%	300=	0.7%
060=	0.0%	150=	1.2%	240=	0.2%	330=	0.6%

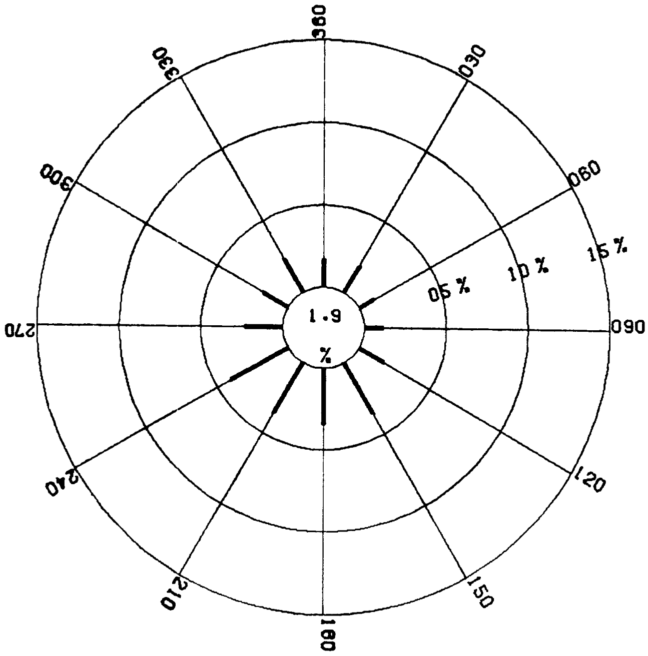
Figure 84

W I N D   R O S E

OCTOBER   610101 - 801231 (YYMMDD)

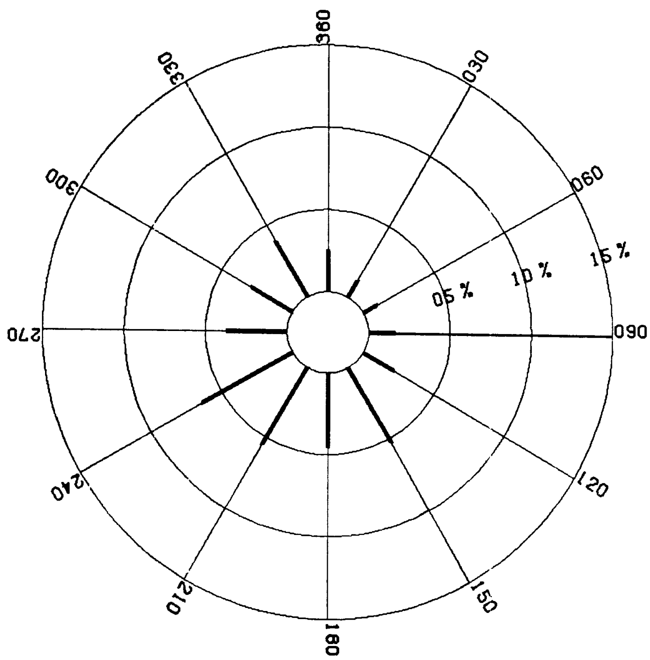
AREA: 56.0N - 57.9N , 2.0E - 3.9E   N= 7058

BEAUFORT 1 - 3   N= 2152



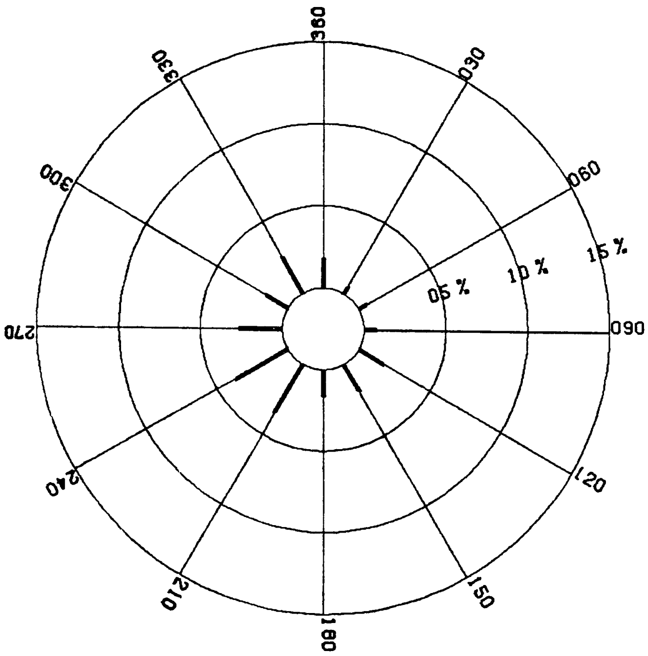
360=	1.7%	090=	1.1%	180=	3.5%	270=	2.4%
030=	1.9%	120=	1.7%	210=	3.6%	300=	1.8%
060=	1.0%	150=	3.6%	240=	4.1%	330=	2.4%

BEAUFORT 4 - 5   N= 2867



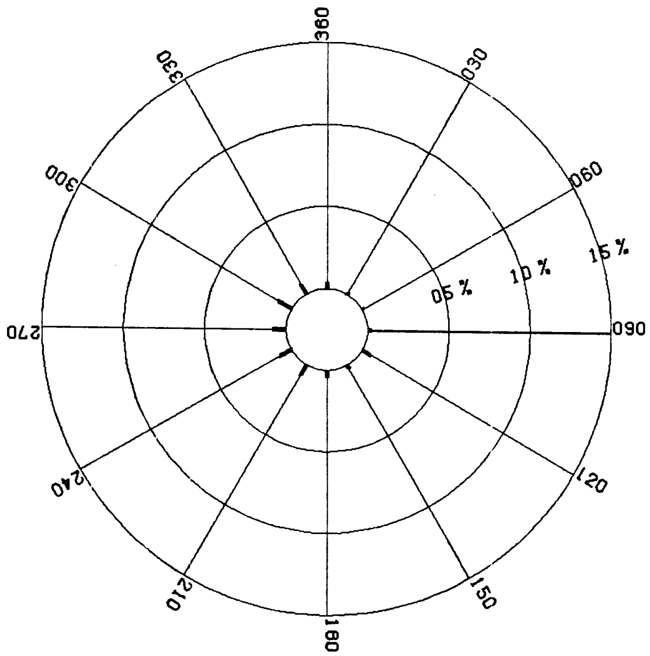
360=	2.5%	090=	1.6%	180=	4.6%	270=	3.7%
030=	1.2%	120=	2.2%	210=	5.5%	300=	2.9%
060=	0.9%	150=	5.2%	240=	6.4%	330=	3.9%

BEAUFORT 6 - 7   N= 1610



360=	1.8%	090=	0.8%	180=	1.6%	270=	2.7%
030=	0.5%	120=	1.8%	210=	3.4%	300=	1.6%
060=	0.5%	150=	1.9%	240=	3.7%	330=	2.6%

BEAUFORT 8 - 12   N= 429



360=	0.4%	090=	0.2%	180=	0.4%	270=	0.8%
030=	0.1%	120=	0.6%	210=	0.8%	300=	0.9%
060=	0.1%	150=	0.2%	240=	0.8%	330=	0.7%

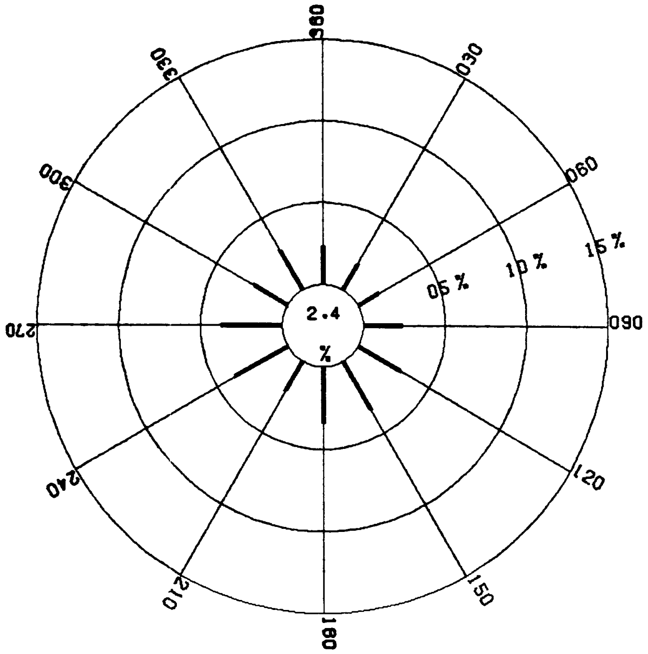
Figure 85

W I N D   R O S E

OCTOBER   610101 - 801231 (YYMMDD)

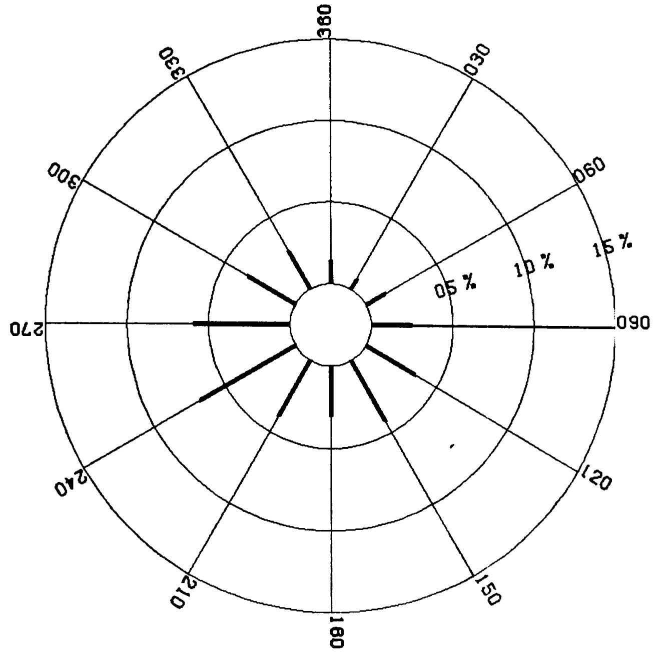
AREA: 56.0N - 57.9N , 6.0E - 7.9E   N= 1924

BEAUFORT 1 - 3   N= 669



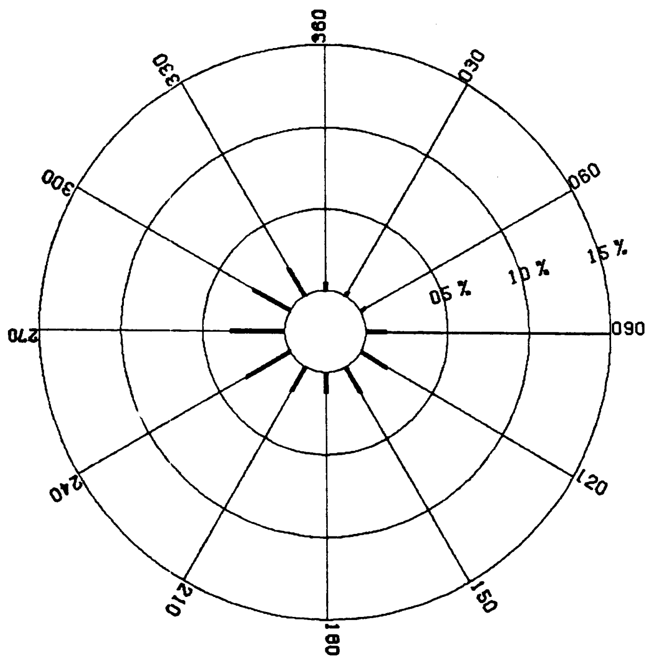
360=	2.3%	090=	2.3%	180=	3.4%	270=	3.7%
030=	1.8%	120=	3.0%	210=	2.1%	300=	2.3%
060=	1.5%	150=	3.3%	240=	3.7%	330=	2.8%

BEAUFORT 4 - 5   N= 755



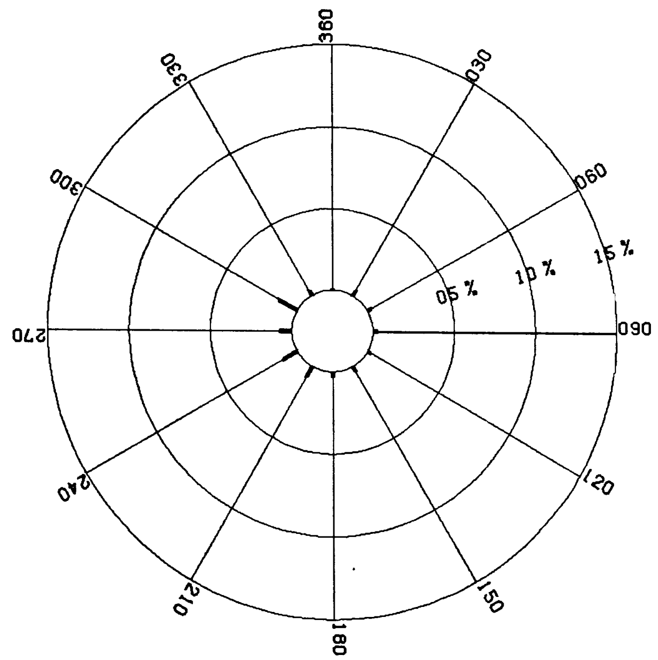
360=	1.4%	090=	2.5%	180=	3.1%	270=	5.9%
030=	0.7%	120=	3.5%	210=	3.9%	300=	3.4%
060=	1.4%	150=	4.2%	240=	6.8%	330=	2.7%

BEAUFORT 6 - 7   N= 383



360=	0.5%	090=	1.2%	180=	1.2%	270=	3.3%
030=	0.3%	120=	1.8%	210=	1.7%	300=	2.6%
060=	0.3%	150=	1.8%	240=	3.1%	330=	2.0%

BEAUFORT 8 - 12   N= 117



360=	0.1%	090=	0.3%	180=	0.3%	270=	0.8%
030=	0.4%	120=	0.2%	210=	0.8%	300=	1.3%
060=	0.3%	150=	0.3%	240=	1.0%	330=	0.4%

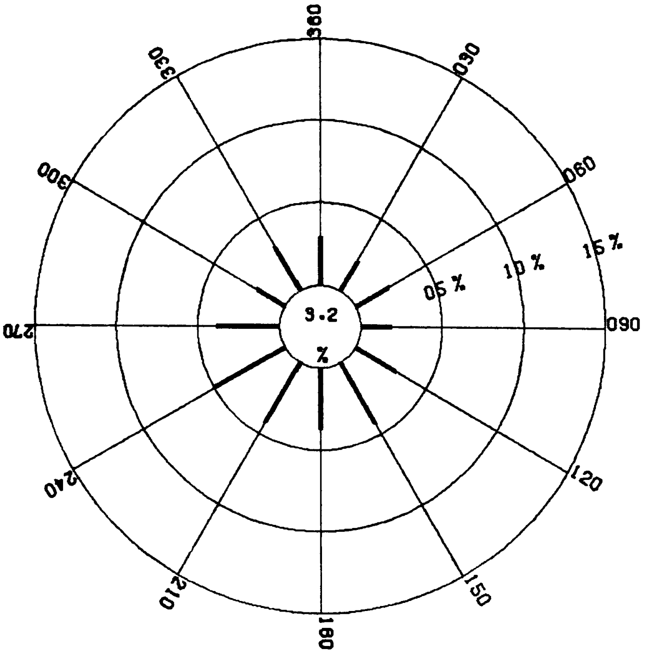
Figure 86

W I N D   R O S E

OCTOBER   610101 - 801231 (YYMMDD)

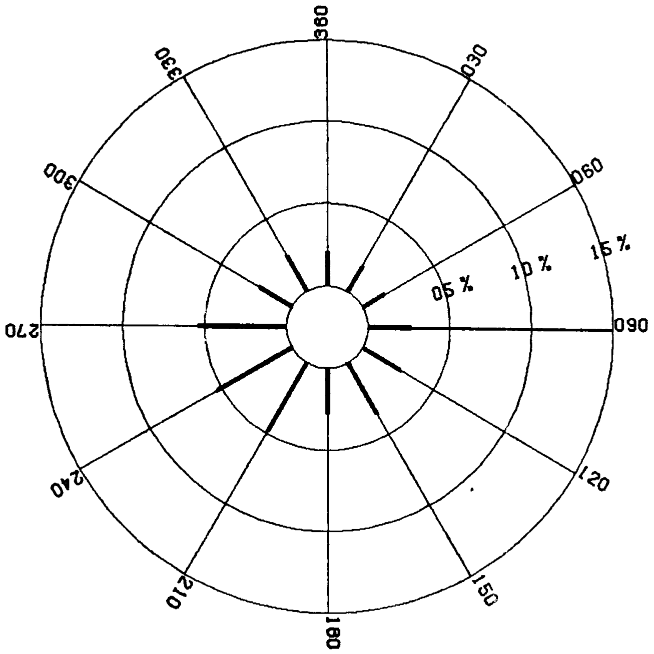
AREA: 54.0N - 55.9N ,   2.0E -   3.9E   N= 1713

BEAUFORT 1 - 3   N= 704



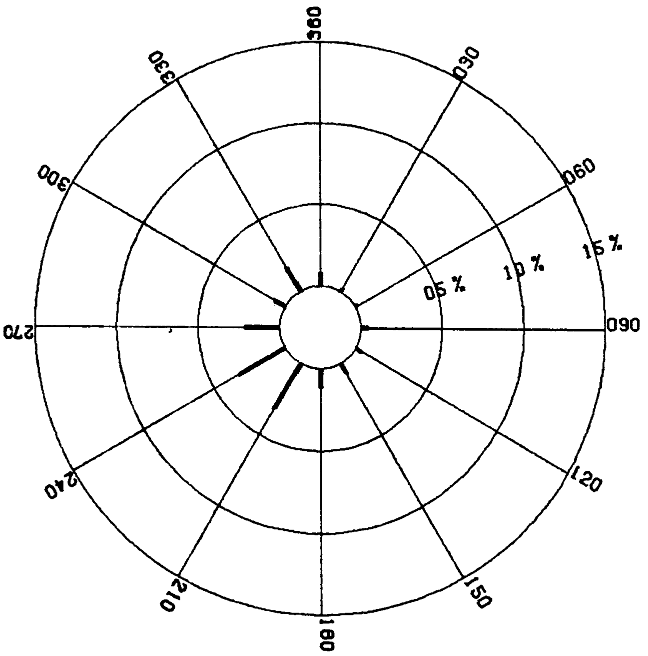
360=	2.9%	090=	1.9%	180=	3.7%	270=	3.9%
030=	2.0%	120=	2.9%	210=	4.2%	300=	1.9%
060=	2.3%	150=	4.3%	240=	4.9%	330=	3.0%

BEAUFORT 4 - 5   N= 641



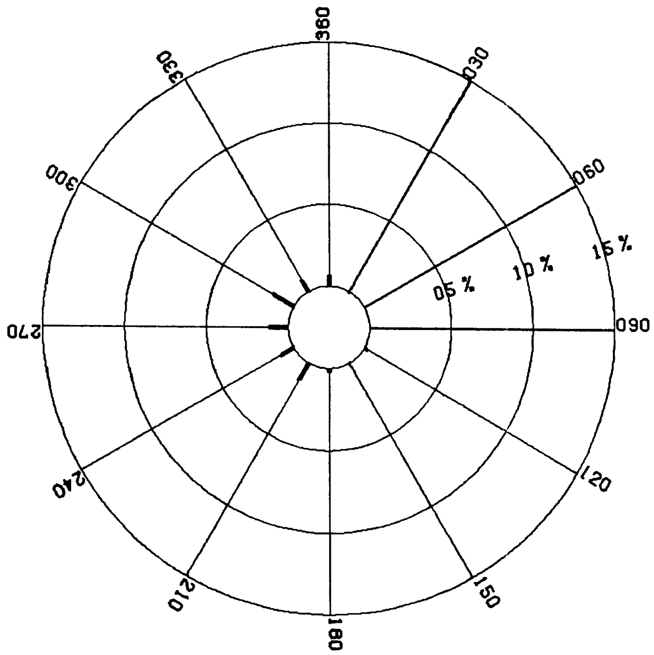
360=	2.0%	090=	2.6%	180=	2.8%	270=	5.4%
030=	1.8%	120=	2.7%	210=	4.9%	300=	2.3%
060=	1.5%	150=	3.6%	240=	5.3%	330=	2.5%

BEAUFORT 6 - 7   N= 254



360=	0.8%	090=	0.4%	180=	1.2%	270=	2.2%
030=	0.2%	120=	0.4%	210=	3.2%	300=	0.8%
060=	0.1%	150=	0.7%	240=	3.2%	330=	1.7%

BEAUFORT 8 - 12   N= 114



360=	0.6%	090=	0.0%	180=	0.2%	270=	1.2%
030=	0.1%	120=	0.2%	210=	1.2%	300=	1.5%
060=	0.0%	150=	0.1%	240=	0.9%	330=	0.8%

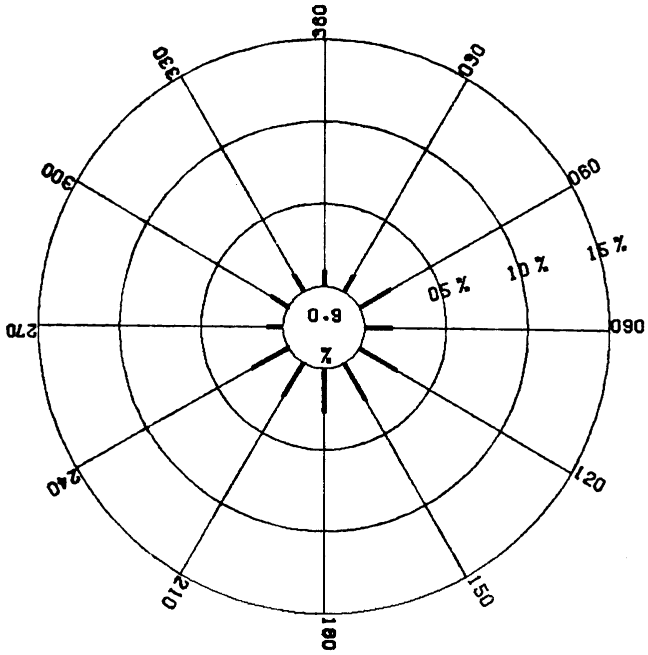
Figure 87

W I N D   R O S E

OCTOBER   610101 - 801231 (YYMMDD)

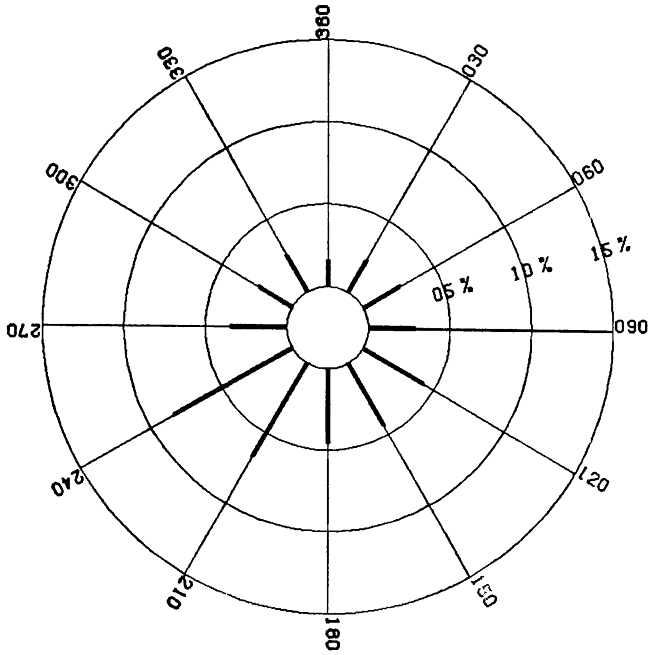
AREA: 54.0N - 54.9N , 6.0E - 8.9E   N= 6556

BEAUFORT 1 - 3   N= 1517



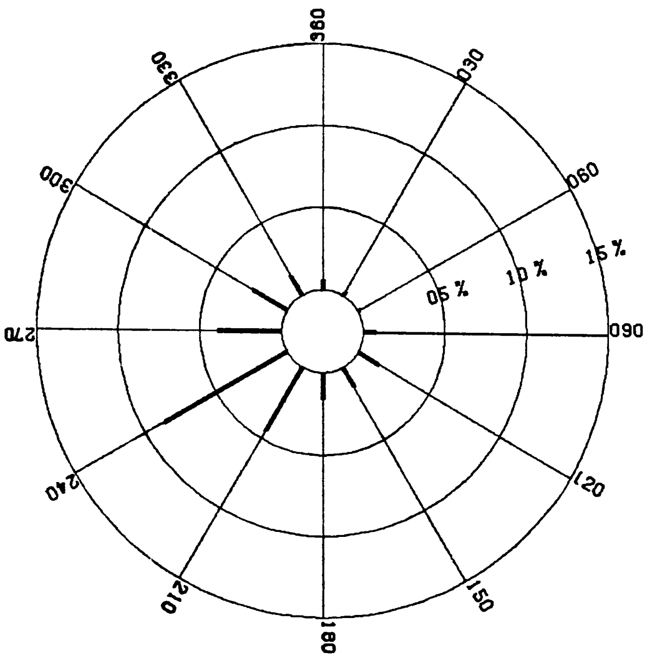
360=	0.9%	090=	1.7%	180=	2.7%	270=	1.0%
030=	1.2%	120=	2.7%	210=	2.4%	300=	1.2%
060=	2.2%	150=	2.6%	240=	2.5%	330=	1.2%

BEAUFORT 4 - 5   N= 3010



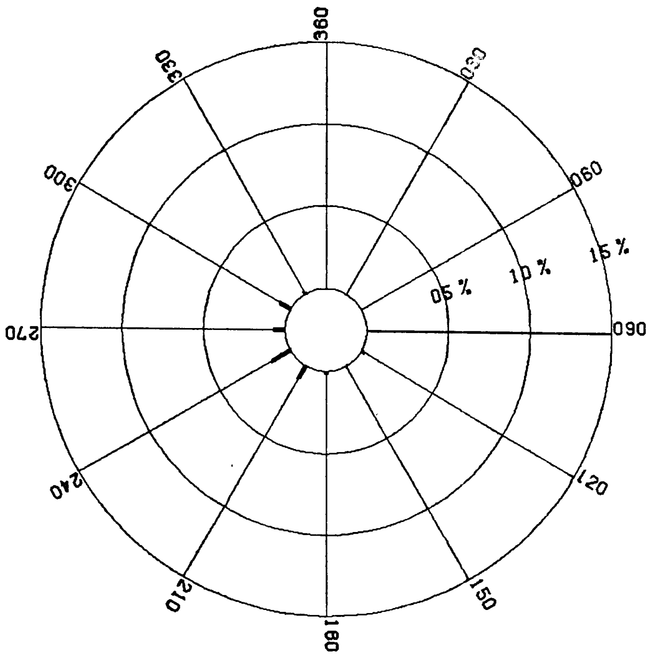
360=	1.6%	090=	2.9%	180=	4.6%	270=	3.5%
030=	2.2%	120=	4.3%	210=	6.6%	300=	2.4%
060=	2.6%	150=	4.4%	240=	8.4%	330=	2.5%

BEAUFORT 6 - 7   N= 1755



360=	0.6%	090=	0.7%	180=	1.6%	270=	3.9%
030=	0.2%	120=	1.4%	210=	4.5%	300=	2.4%
060=	0.1%	150=	1.3%	240=	8.6%	330=	1.4%

BEAUFORT 8 - 12   N= 274



360=	0.0%	090=	0.0%	180=	0.2%	270=	0.7%
030=	0.0%	120=	0.2%	210=	0.9%	300=	0.8%
060=	0.0%	150=	0.0%	240=	1.3%	330=	0.1%

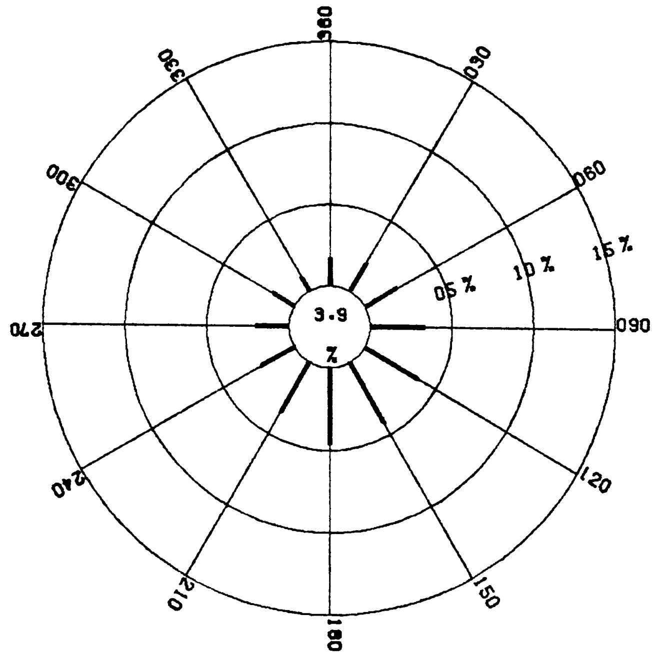
Figure 88

WIND ROSE

OCTOBER 610101 - 801231 (YYMMDD)

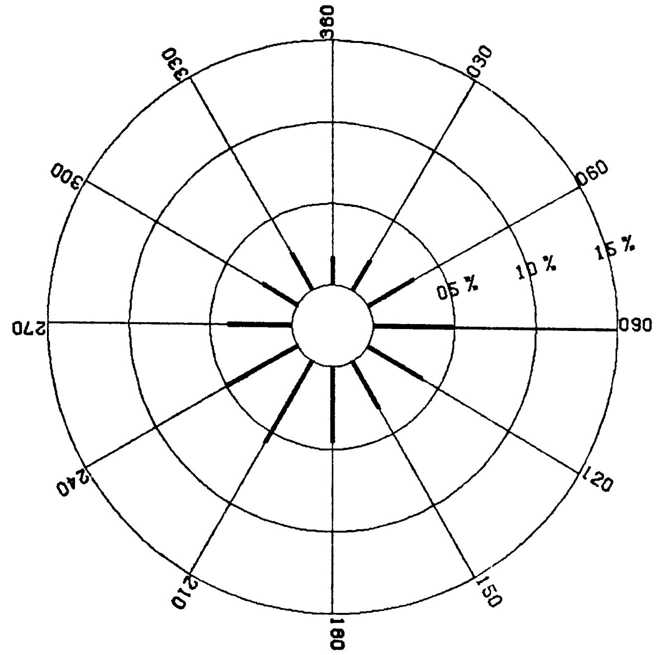
AREA: 52.0N - 52.9N , 3.0E - 4.9E N= 1471

BEAUFORT 1 - 3 N= 530



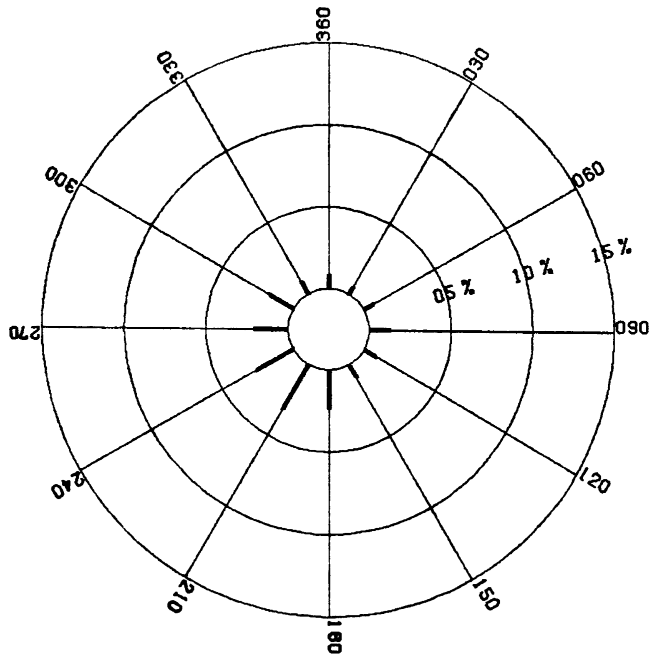
360=	1.7%	090=	3.3%	180=	4.6%	270=	2.0%
030=	2.0%	120=	3.7%	210=	3.5%	300=	1.5%
060=	2.2%	150=	4.2%	240=	2.4%	330=	1.0%

BEAUFORT 4 - 5 N= 635



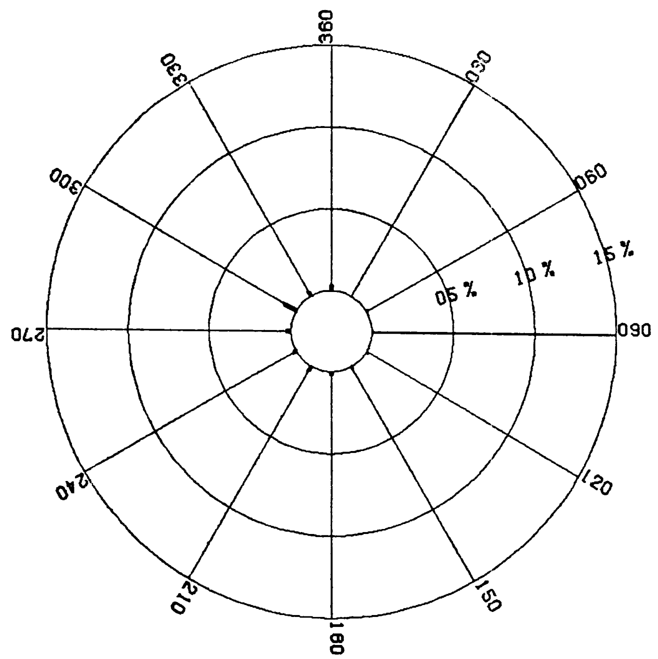
360=	1.7%	090=	4.9%	180=	4.6%	270=	3.9%
030=	2.1%	120=	3.9%	210=	5.7%	300=	2.4%
060=	3.2%	150=	3.3%	240=	5.0%	330=	2.6%

BEAUFORT 6 - 7 N= 264



360=	0.9%	090=	1.3%	180=	2.4%	270=	2.1%
030=	0.5%	120=	0.8%	210=	3.2%	300=	1.7%
060=	0.7%	150=	0.9%	240=	2.6%	330=	0.9%

BEAUFORT 8 - 12 N= 42



360=	0.3%	090=	0.1%	180=	0.2%	270=	0.3%
030=	0.0%	120=	0.1%	210=	0.3%	300=	0.9%
060=	0.1%	150=	0.1%	240=	0.2%	330=	0.3%

Figure 89

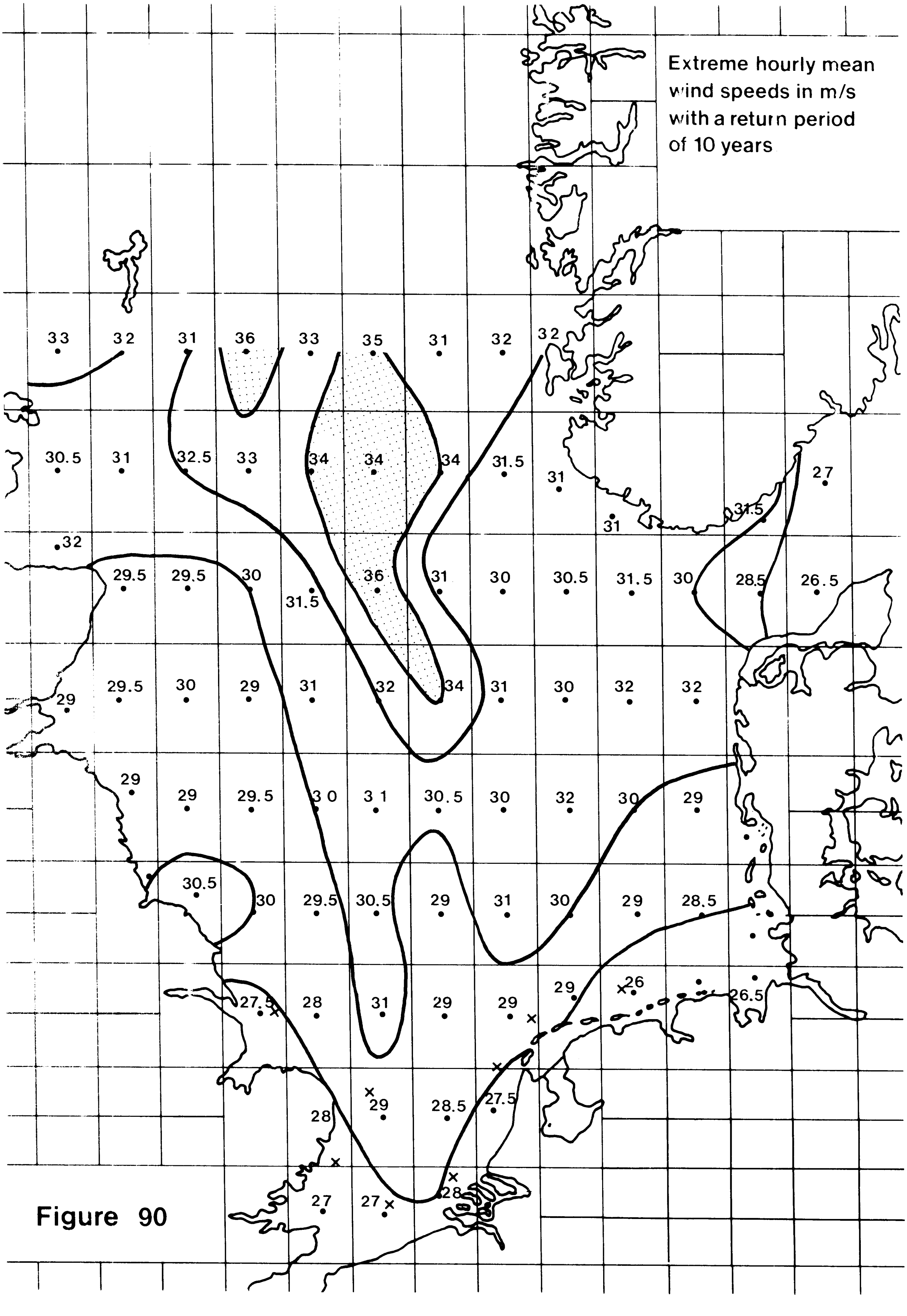

Extreme hourly mean wind speeds in m/s with a return period of 10 years
33 32 31 36 33 35 31 32 32
30.5 31 32.5 33 34 34 34 31.5 31 31 31.5 27
32 29.5 29.5 30 31.5 36 31 30 30.5 31.5 30 28.5 26.5
29 29.5 30 29 31 32 34 31 30 32 32
29 29 29.5 30 31 30.5 30 32 30 29
30.5 30 29.5 30.5 29 31 30 29 28.5
27.5 28 31 29 29 29 26 26.5
28 29 28.5 27.5
27 27 28

Figure 90

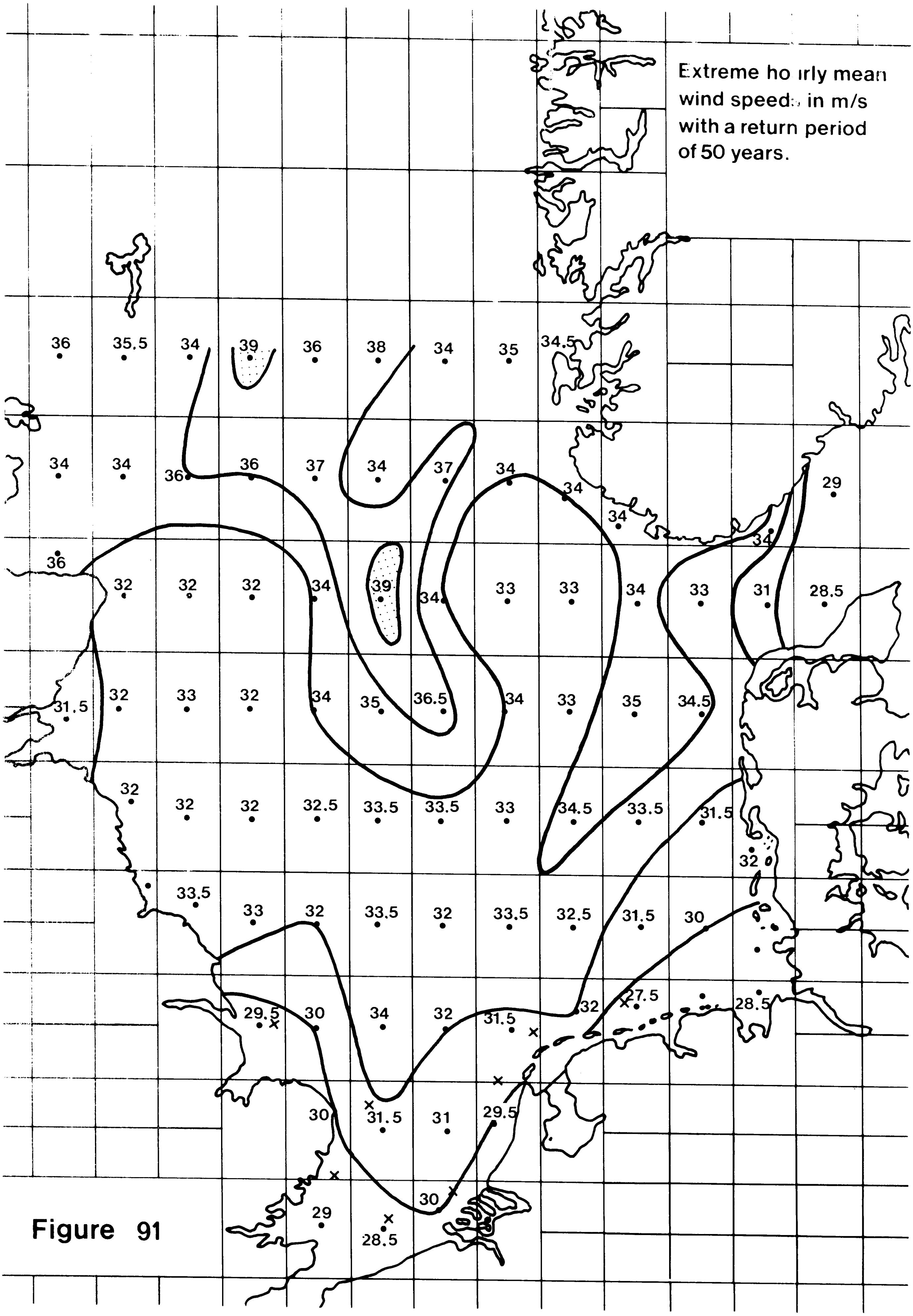
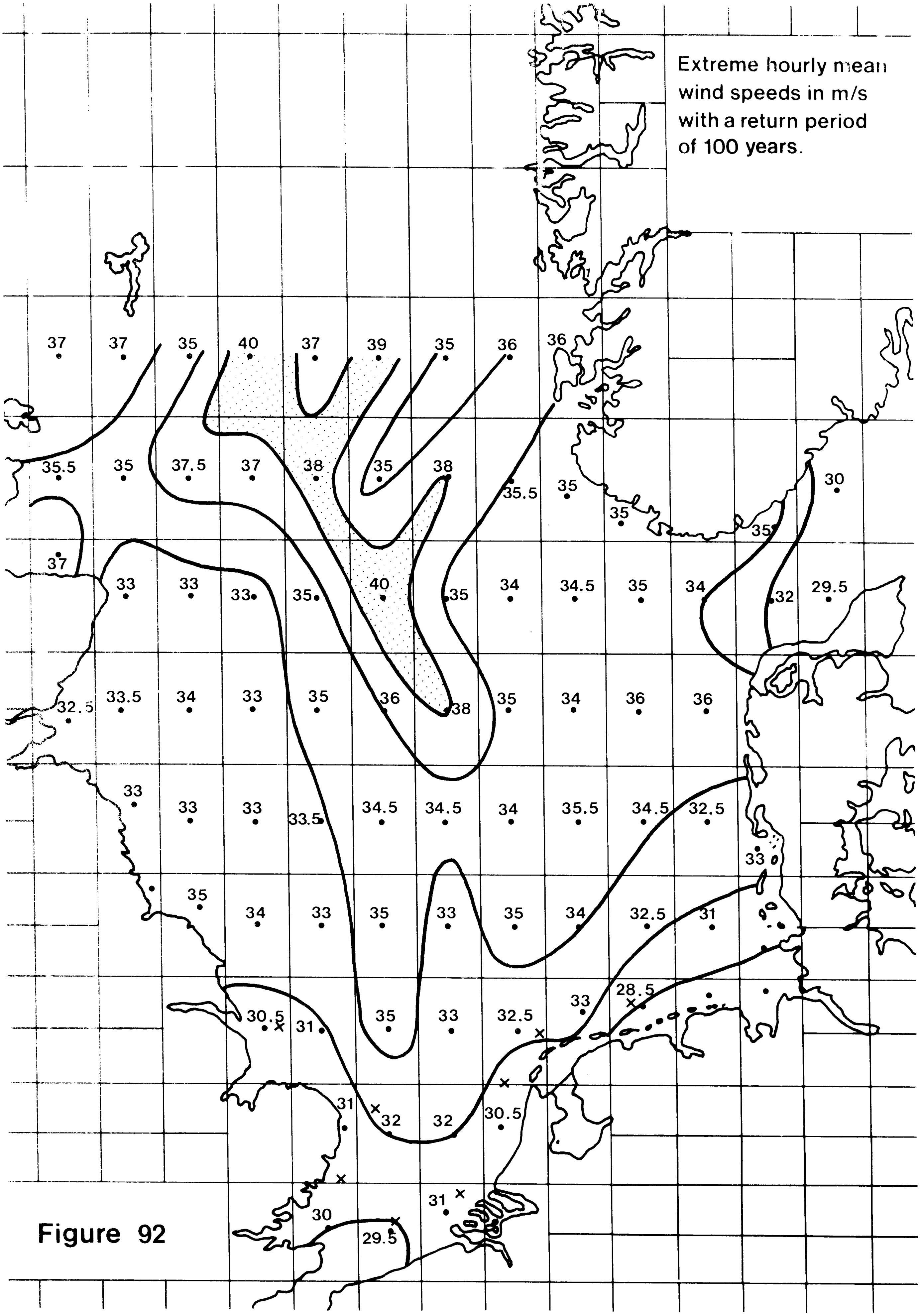

Extreme hourly mean wind speeds in m/s with a return period of 50 years.
36 35.5 34 39 36 38 34 35 34.5
34 34 36 36 37 34 37 34 34 34 29
36 34
32 32 32 34 39 34 33 33 34 33 31 28.5
31.5 32 33 32 34 35 36.5 34 33 35 34.5
32 32 32 32.5 33.5 33.5 33 34.5 33.5 31.5
32
33.5 33 32 33.5 32 33.5 32.5 31.5 30
29.5 30 34 32 31.5 32 27.5 28.5
30 31.5 31 29.5
30 29 28.5

Figure 91



Extreme hourly mean wind speeds in m/s with a return period of 100 years.
37 37 35 40 37 39 35 36 36
35.5 35 37.5 37 38 35 38 35.5 35 35 35 30
37 33 33 33 35 40 35 34 34.5 35 34 32 29.5
32.5 33.5 34 33 35 36 38 35 34 36 36
33 33 33 33.5 34.5 34.5 34 35.5 34.5 32.5 33
35 34 33 35 33 35 34 32.5 31
30.5 31 35 33 32.5 33 28.5
31 32 32 30.5
31 30 29.5

Figure 92

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	3.0	2.0	2.5	2.0	1.5	1.5	1.5	1.5	1.5	2.5	2.5	3.0	2.9
	2.0	1.7	1.8	1.2	1.3	1.0	0.9	1.0	1.3	1.8	1.7	1.8	1.6
07	2.5	1.5	1.5	1.0	1.0	0.5	1.0	1.0	1.5	1.5	2.0	2.0	1.5
	1.9	1.2	1.5	1.1	0.9	0.8	0.9	1.0	1.0	1.0	1.2	1.9	1.3
09	2.5	2.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	2.0	2.5	3.0	2.0
	2.0	1.5	1.5	1.6	1.2	1.1	1.2	1.2	1.4	1.6	1.9	1.8	1.7
11	1.5	2.0	1.5	1.5	1.0	1.5	1.0	1.0	1.5	1.5	2.0	2.5	1.5
	1.7	1.3	1.4	1.3	0.9	1.0	1.0	1.2	1.3	1.3	1.2	1.9	1.4
15	1.5	1.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.5	2.0	2.0	1.0
	1.2	1.0	1.2	1.1	0.9	0.9	0.9	1.0	1.0	1.5	1.8	1.6	1.2
18	1.0	1.0	1.0	0.5	0.5	1.0	0.5	1.0	1.0	1.0	1.5	1.5	1.0
	0.8	0.8	0.8	0.9	0.6	0.6	0.9	0.7	0.9	1.0	1.3	0.9	0.9
20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5	2.0	1.0
	1.3	1.0	1.1	1.0	0.9	0.7	0.9	0.8	1.2	1.2	1.2	1.4	1.1
24	1.0	0.5	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0	1.5	1.5	1.0
	1.0	0.8	1.0	0.9	0.7	0.7	0.7	0.8	0.9	1.0	1.3	1.2	1.0

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	1.5	1.5	2.0	1.0	1.0	0.5	0.5	1.0	1.0	1.5	1.5	1.5	1.0
	1.5	1.6	2.1	1.7	1.2	1.1	1.1	1.4	1.3	1.6	1.5	1.7	1.5
07	2.0	1.5	2.0	1.5	1.0	0.5	0.5	1.0	1.0	1.5	2.0	1.5	1.0
	1.3	1.4	1.7	1.4	0.9	1.0	1.1	1.0	1.2	1.3	1.3	1.4	1.3
09	2.0	1.5	2.0	1.0	1.0	1.0	1.5	1.0	1.5	1.5	2.0	2.0	1.5
	1.8	1.7	2.0	1.5	1.4	1.0	1.2	1.4	1.5	1.6	1.8	1.9	1.7
11	1.5	1.0	1.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.5	1.0	1.0
	1.4	1.3	1.5	1.3	0.9	1.0	1.1	1.1	1.2	1.4	1.6	1.4	1.3
15	1.5	1.0	1.5	1.0	1.0	0.5	0.5	1.0	1.0	1.0	1.5	1.0	1.0
	1.3	1.3	1.4	1.1	0.9	1.0	1.0	1.2	1.3	1.3	1.4	1.1	1.2
18	1.0	0.5	1.0	0.5	0.5	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0
	1.0	0.8	1.0	1.0	0.6	0.6	0.8	0.6	1.2	1.2	1.1	0.8	0.9
20	1.5	1.0	1.0	1.0	0.5	0.5	1.0	1.0	0.5	1.0	1.0	1.0	1.0
	1.2	1.2	1.2	0.9	0.7	0.8	0.9	0.9	1.1	1.1	1.4	1.1	1.1
24	1.0	1.0	0.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.0	1.0	0.5
	1.0	1.0	1.1	0.8	0.7	0.7	1.1	0.9	0.9	0.9	1.2	1.1	1.0

Figure 93. Median wave heights (upper figures) with standard deviations (lower figures) for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	34.5	19.8	26.3	11.1	6.0	3.8	3.3	5.1	11.5	29.4	23.2	34.0	15.6
03	13.2	5.6	7.1	1.4	1.5	0.0	0.1	0.5	1.5	7.0	7.3	10.3	4.1
	32.8	8.3	16.2	3.1	2.1	0.8	2.3	4.3	3.0	7.8	10.1	17.6	7.1
07	6.7	1.9	1.8	0.5	0.0	0.2	0.0	0.0	0.5	0.8	0.8	6.8	1.2
	28.3	15.4	14.5	12.5	5.7	4.9	5.5	5.4	10.2	17.7	25.5	28.0	15.4
09	9.1	3.8	4.0	4.0	1.3	0.4	0.5	0.9	3.0	4.8	7.9	9.2	4.4
	14.8	9.2	8.2	7.4	1.6	3.2	3.6	6.3	11.3	7.2	10.5	26.9	9.0
11	5.8	0.7	1.2	1.9	0.3	0.0	0.5	0.5	2.7	1.7	2.1	7.4	2.0
	4.0	3.8	5.1	5.0	3.6	1.1	1.7	3.0	3.1	13.2	18.2	13.8	5.7
15	1.3	0.8	2.0	0.7	0.0	0.0	0.0	0.5	0.2	3.7	4.4	4.9	1.3
	0.7	0.5	0.9	1.4	0.2	0.0	0.6	0.6	1.0	4.0	8.8	2.5	1.7
18	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.2	0.0	1.9	0.1	0.2
	8.1	2.2	5.4	3.3	2.2	0.2	1.3	1.2	3.6	5.5	8.5	14.4	3.9
20	1.9	0.4	1.1	0.0	0.2	0.0	0.0	0.0	0.9	0.8	1.3	4.4	0.7
	3.0	1.5	3.5	1.1	0.4	0.4	0.2	1.1	1.8	3.7	7.8	8.5	2.5
24	0.3	0.2	0.3	0.2	0.0	0.0	0.0	0.0	0.1	0.2	1.7	1.3	0.3

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	8.4	13.8	22.1	10.2	2.1	1.7	2.7	5.2	4.4	11.3	9.3	11.0	7.9
03	1.3	3.4	10.9	4.6	1.3	0.5	0.8	2.4	1.7	3.9	3.0	4.3	2.9
	12.5	4.1	15.9	5.2	1.2	2.4	2.6	2.3	3.4	8.4	7.5	10.8	5.4
07	2.3	1.8	4.2	2.6	0.0	0.2	1.4	0.5	1.0	0.6	1.7	1.5	1.3
	18.0	14.0	18.3	8.6	6.3	1.7	4.5	4.7	7.8	10.0	17.4	19.0	12.4
09	6.5	4.9	7.7	2.4	2.2	0.4	0.9	1.2	3.0	4.2	7.6	8.1	4.8
	6.7	3.3	10.2	3.7	1.3	1.7	2.4	2.0	4.7	6.7	9.5	4.4	4.6
11	1.1	0.9	1.6	1.2	0.6	0.4	1.5	0.9	0.8	1.8	2.6	1.9	1.2
	8.5	7.4	8.0	2.3	1.9	1.9	2.5	4.1	6.0	5.4	7.7	4.3	4.9
15	0.6	0.6	1.9	0.8	0.0	1.0	0.9	0.8	0.8	1.7	2.9	0.0	1.0
	2.3	0.6	2.5	1.6	0.3	0.1	0.2	0.1	2.0	4.3	4.6	0.4	1.5
18	0.2	0.1	0.3	0.5	0.0	0.0	0.1	0.0	0.2	0.3	0.8	0.0	0.2
	4.6	3.6	4.0	1.4	0.4	0.8	1.7	1.8	3.6	2.6	7.1	2.7	2.7
20	0.5	0.8	0.8	0.5	0.0	0.0	0.0	0.2	0.7	0.6	1.7	0.5	0.5
	1.7	2.3	1.9	0.6	0.5	0.1	1.1	1.0	1.1	1.2	4.2	4.2	1.6
24	0.3	0.4	0.6	0.1	0.0	0.0	0.2	0.2	0.3	0.3	0.8	0.4	0.3

Figure 94. Percentages of observations with wave heights of 4 m or more (upper figures) and of 6 m or more (lower figures) for areas indicated in figure 1.

1971-1980

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	24	41	31	40	62	63	69	65	52	27	32	21	46
07	33	55	53	68	77	91	83	76	67	55	41	34	66
09	31	43	43	50	66	63	64	62	52	41	27	24	46
11	51	45	54	65	76	67	71	72	52	56	42	29	57
15	65	70	69	65	80	80	82	82	72	52	41	42	68
18	80	81	80	83	93	92	81	86	79	74	53	69	80
20	74	79	71	77	77	87	79	86	72	64	58	46	74
24	71	87	75	79	84	89	85	79	76	71	57	57	77

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	51	55	45	73	77	82	82	80	72	61	57	57	69
07	38	61	48	68	88	90	85	82	70	67	50	54	70
09	44	56	45	69	67	76	70	68	59	60	41	45	55
11	60	70	61	77	85	86	78	80	71	71	60	72	73
15	54	68	68	74	83	88	86	76	76	75	58	68	74
18	81	88	79	85	93	94	87	91	79	74	80	84	85
20	64	75	74	82	94	90	87	83	82	82	63	79	80
24	75	81	83	91	95	92	86	84	83	87	79	77	85

Figure 95. Percentages of observations with wave heights of 1.5 m or less for areas indicated in figure 1.

1971-1980

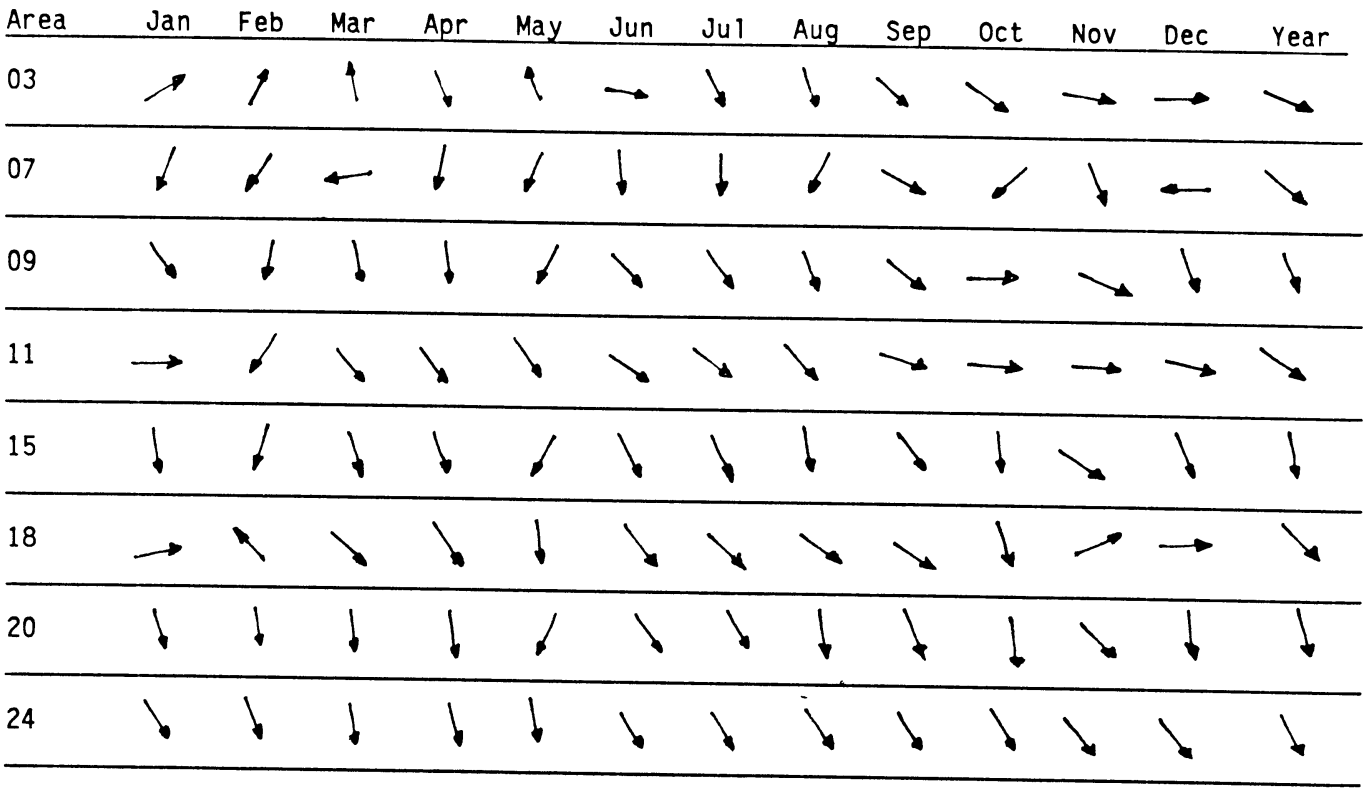
Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	65	61	59	51	29	43	36	46	60	69	63	73	51
07	50	42	42	32	24	15	24	25	32	36	45	53	32
09	57	42	46	44	33	30	26	33	42	50	59	65	45
11	52	45	44	30	24	35	31	28	42	33	48	52	38
15	21	22	27	26	19	23	19	22	39	42	46	47	28
18	24	19	17	22	15	16	16	9	24	21	48	22	21
20	20	16	23	13	19	15	18	17	21	24	25	35	20
24	24	14	27	19	26	19	17	27	27	29	30	26	24

1961-1970

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
03	44	57	66	43	29	20	26	29	27	55	50	47	42
07	62	53	46	52	33	18	13	24	42	35	57	51	38
09	67	63	62	35	29	26	33	26	37	58	73	65	52
11	42	35	54	29	24	32	36	26	38	34	49	29	35
15	47	37	37	23	26	23	28	27	32	30	54	41	33
18	11	13	18	12	8	5	10	10	13	23	13	11	12
20	35	29	22	21	17	20	23	23	20	12	35	31	23
24	32	33	23	19	16	16	21	21	19	17	19	34	22

Figure 96. Percentages of observations with wave periods of 6s or more for areas indicated in figure 1.

1971-1980



1961-1970

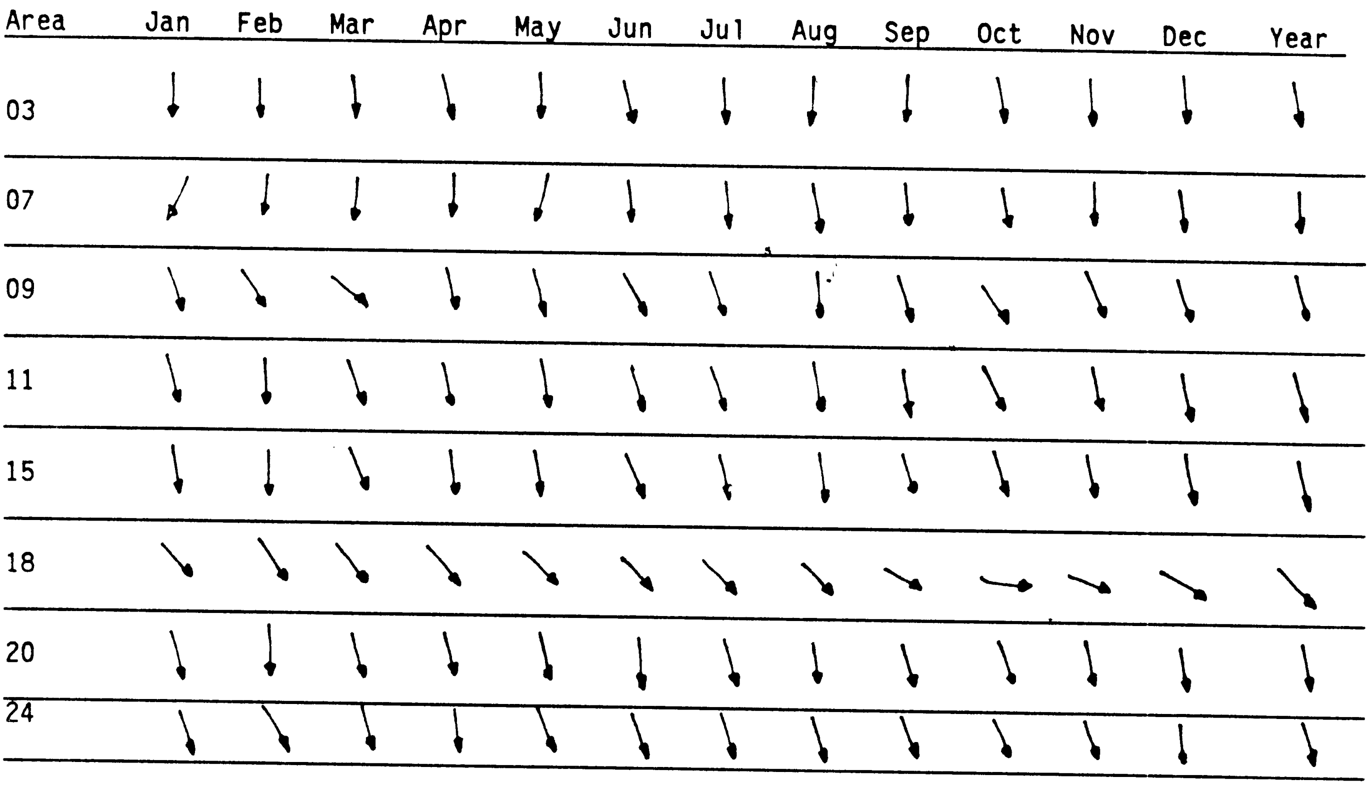


Figure 97. Prevailing swell directions for areas indicated in figure 1.

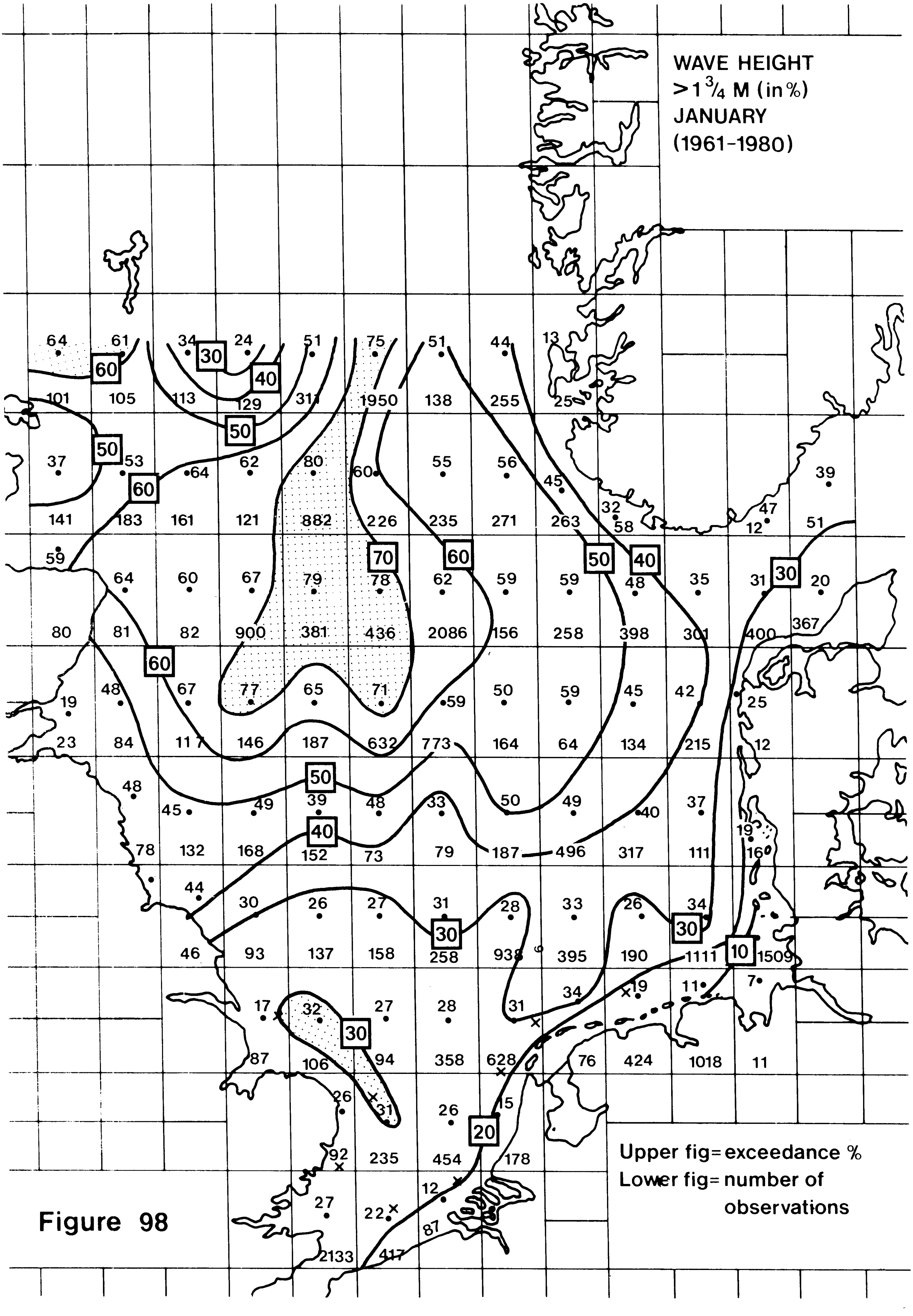
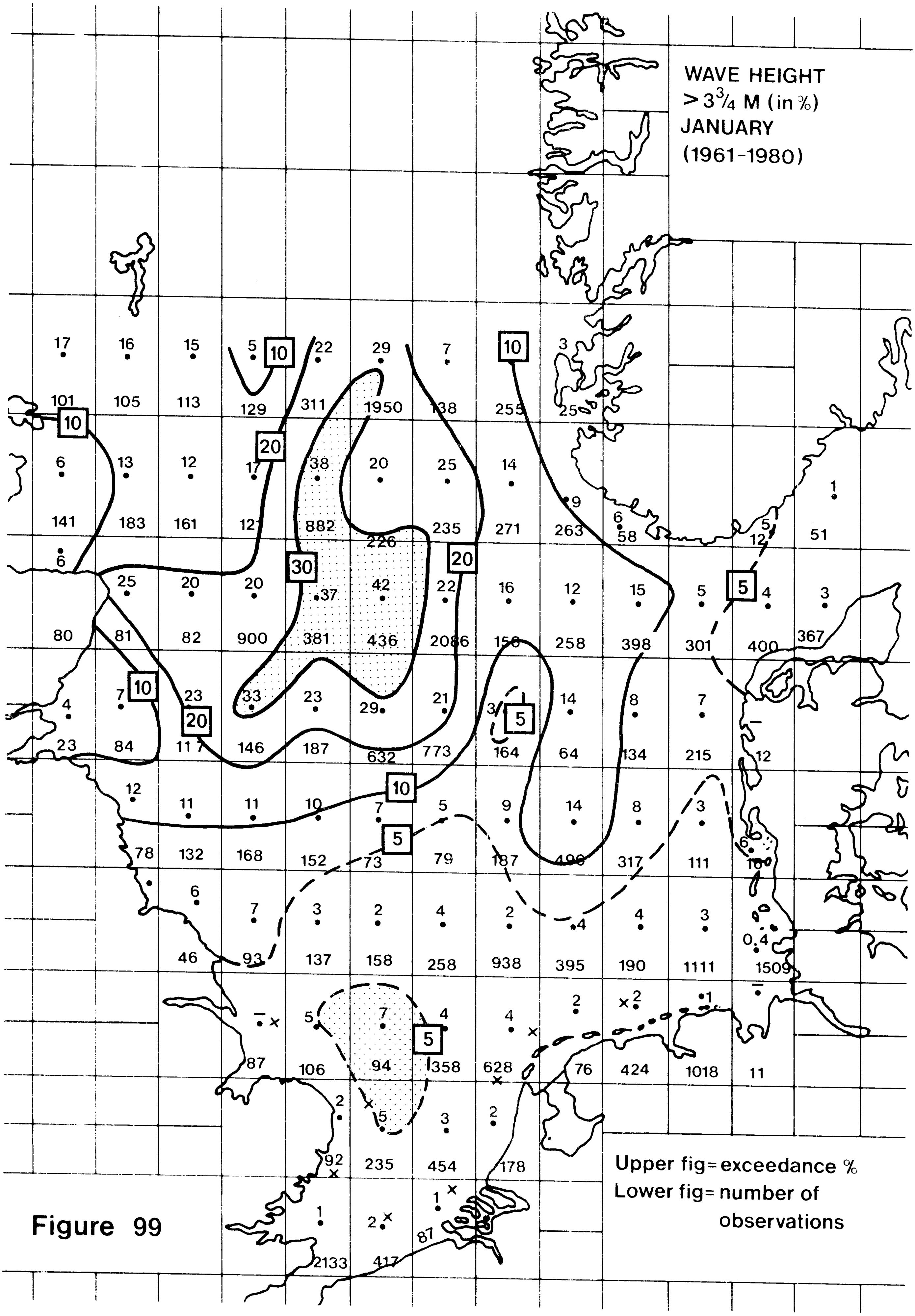

WAVE HEIGHT
>1 3/4 M (in%)
JANUARY
(1961-1980)
Upper fig=exceedance %
Lower fig= number of
observations

Figure 98



WAVE HEIGHT
> 3¾ M (in %)
JANUARY
(1961-1980)
Upper fig = exceedance %
Lower fig = number of observations

Figure 99

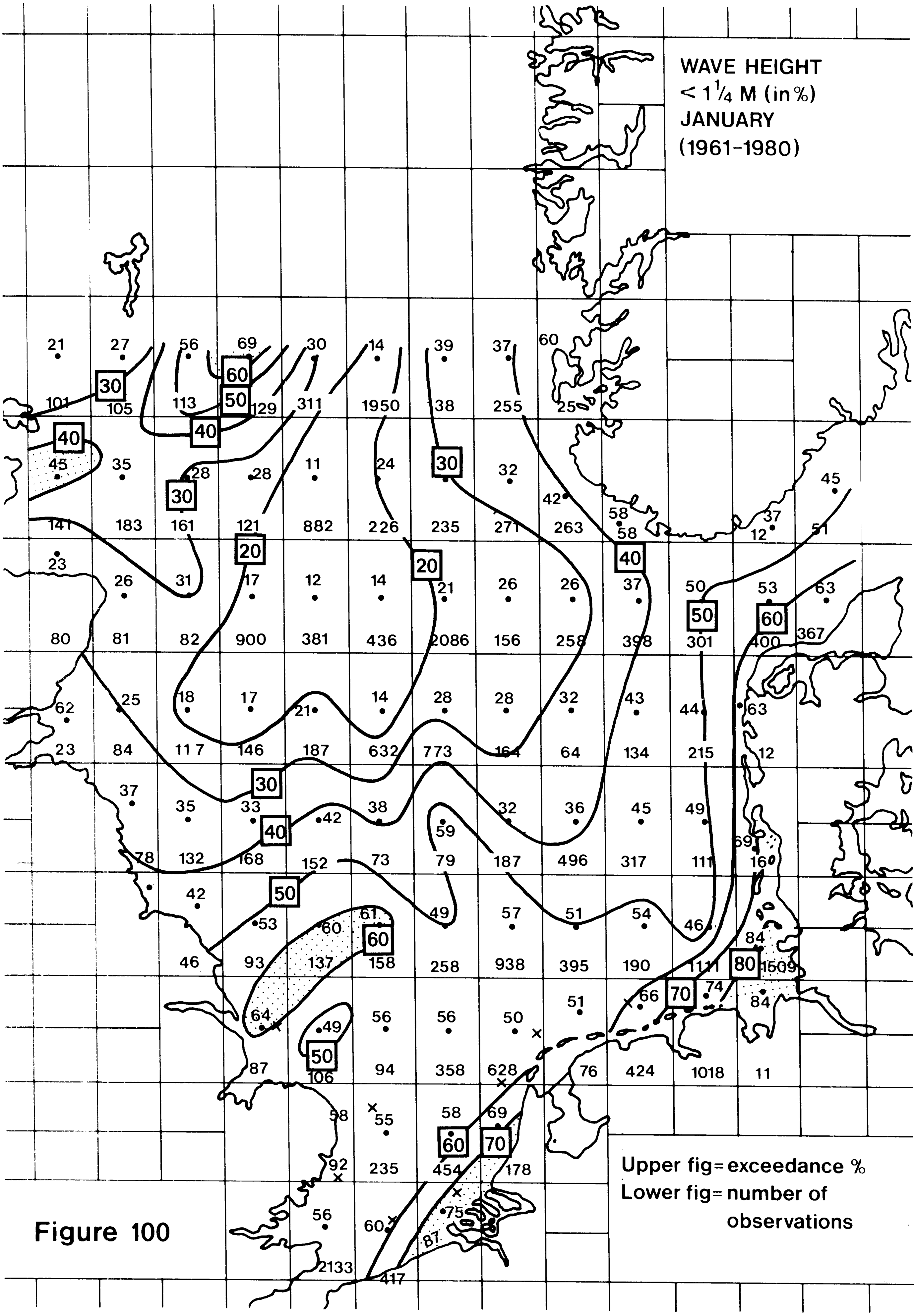

WAVE HEIGHT
< 1¼ M (in%)
JANUARY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 100

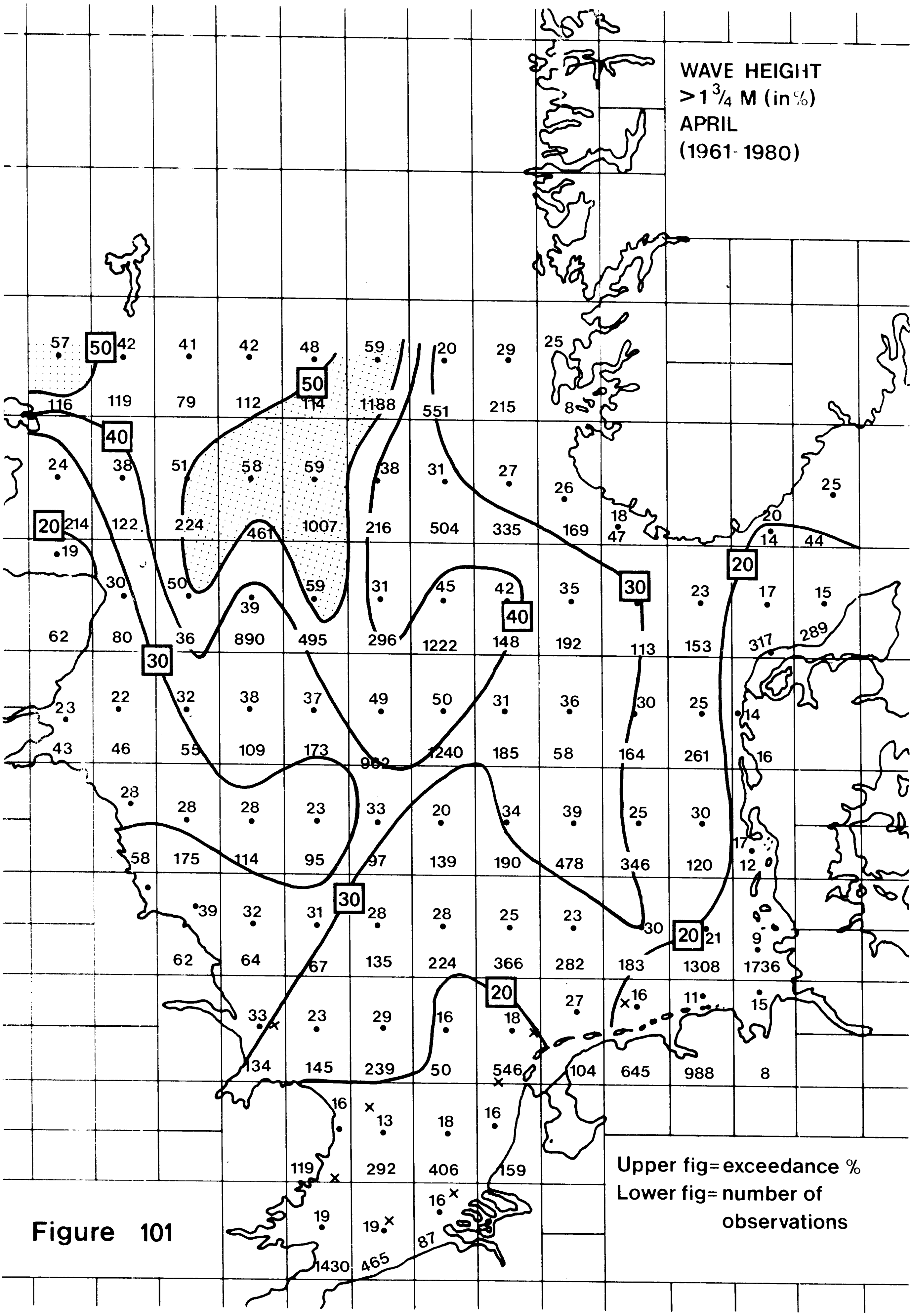

WAVE HEIGHT
>1 3/4 M (in %)
APRIL
(1961-1980)
Upper fig = exceedance %
Lower fig = number of observations

Figure 101

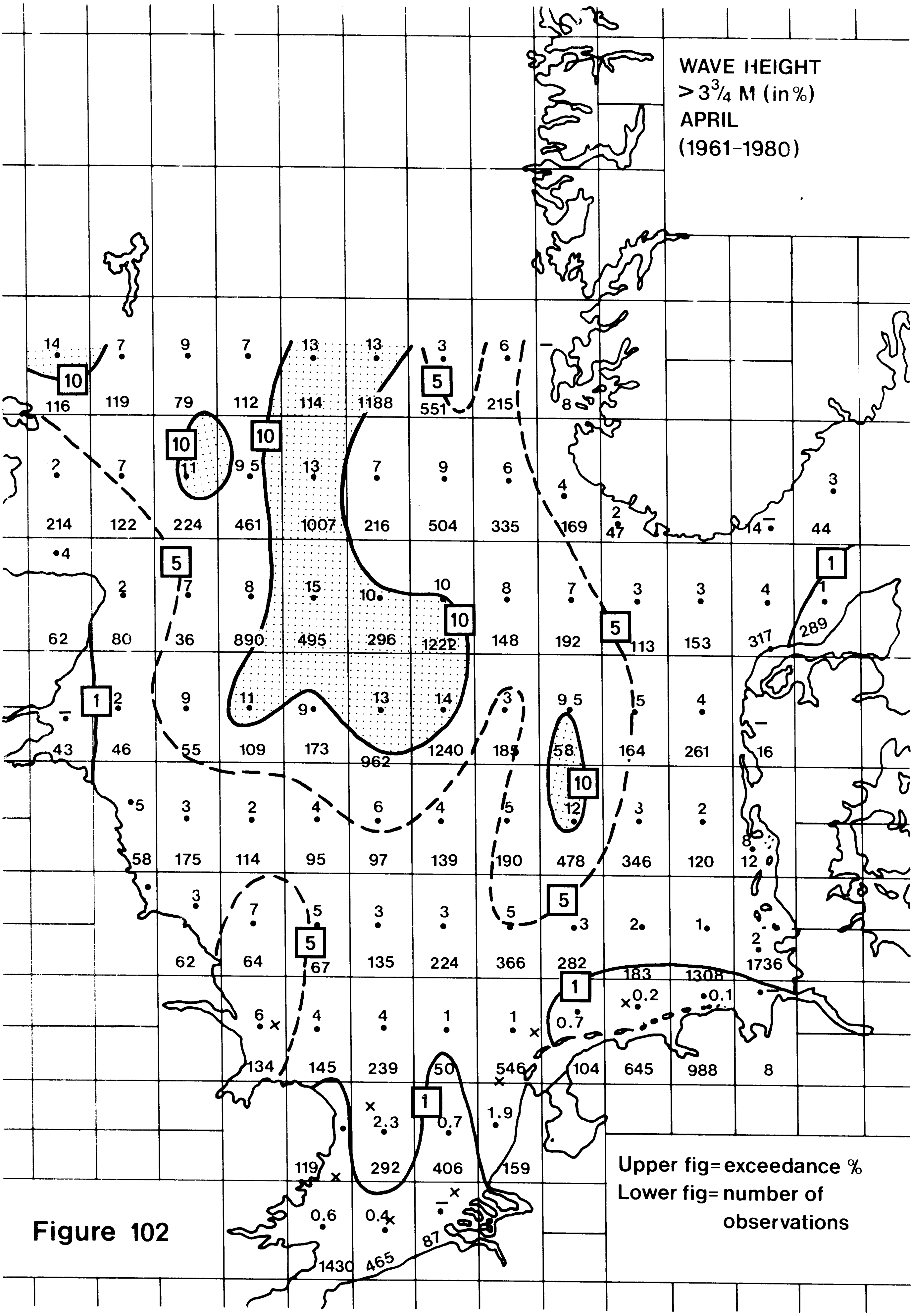

WAVE HEIGHT
> 3¾ M (in%)
APRIL
(1961-1980)
Upper fig=exceedance %
Lower fig= number of
observations

Figure 102

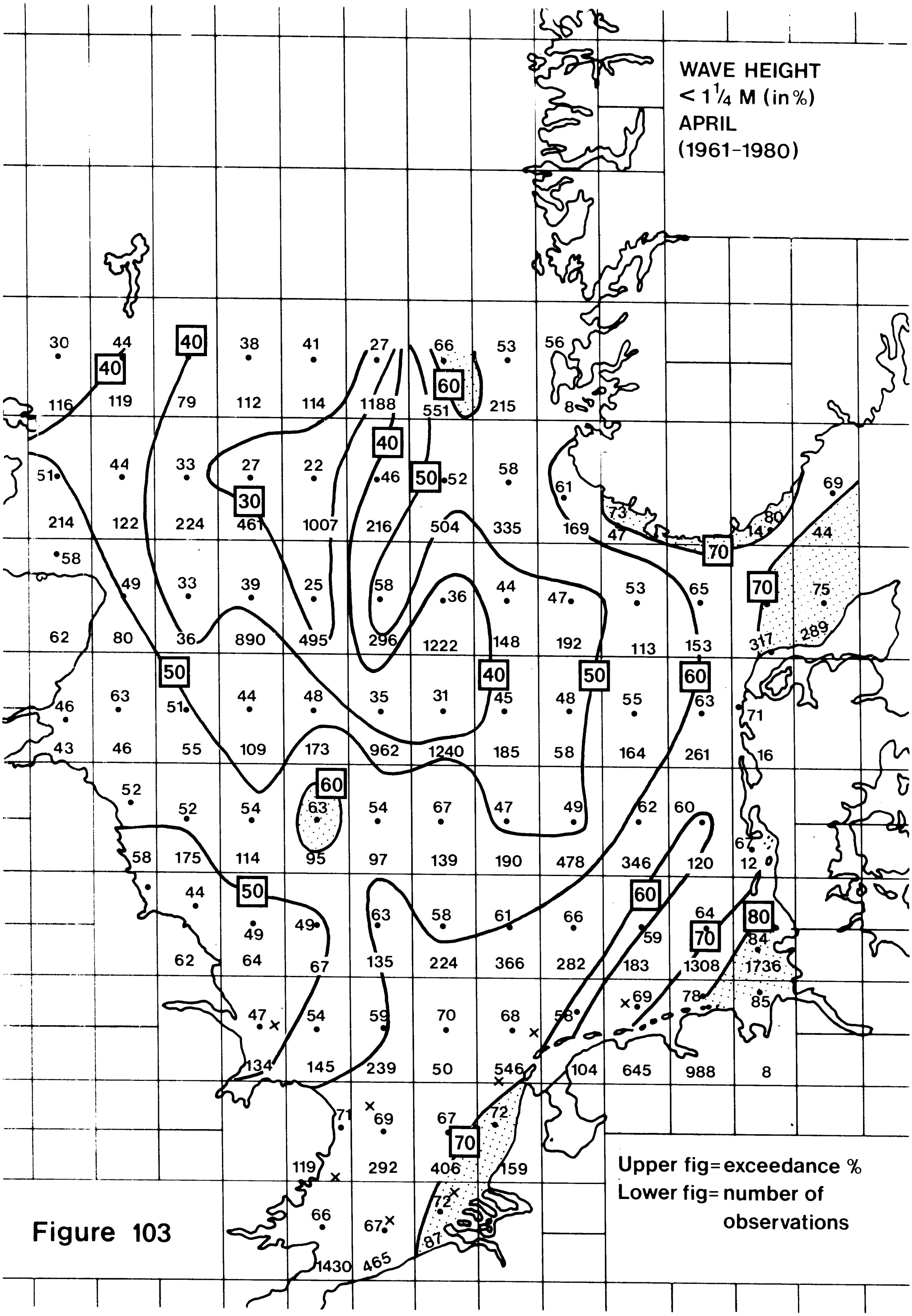

WAVE HEIGHT
< 1¼ M (in%)
APRIL
(1961-1980)
30 44 40 38 41 27 66 53 56
40 60
116 119 79 112 114 1188 551 215 8
51 44 33 27 22 46 50 52 58 61 69
30 40
214 122 224 461 1007 216 504 335 169 73 47 80 14 44 70
58 49 33 39 25 58 36 44 47 53 65 70 75
62 80 36 890 495 296 1222 148 192 113 153 317 289
50 40 50 60
46 63 51 44 48 35 31 45 48 55 63 71
43 46 55 109 173 962 1240 185 58 164 261 16
52 60 52 54 63 54 67 47 49 62 60
58 175 114 95 97 139 190 478 346 120 67 12
50 60 80
44 49 49 63 58 61 66 64 59 70 84
62 64 67 135 224 366 282 183 1308 1736
47 54 59 70 68 58 69 78 85
134 145 239 50 546 104 645 988 8
71 69 67 72 70
119 292 406 159
66 67 72 87
1430 465
Upper fig=exceedance %
Lower fig=number of
observations

Figure 103

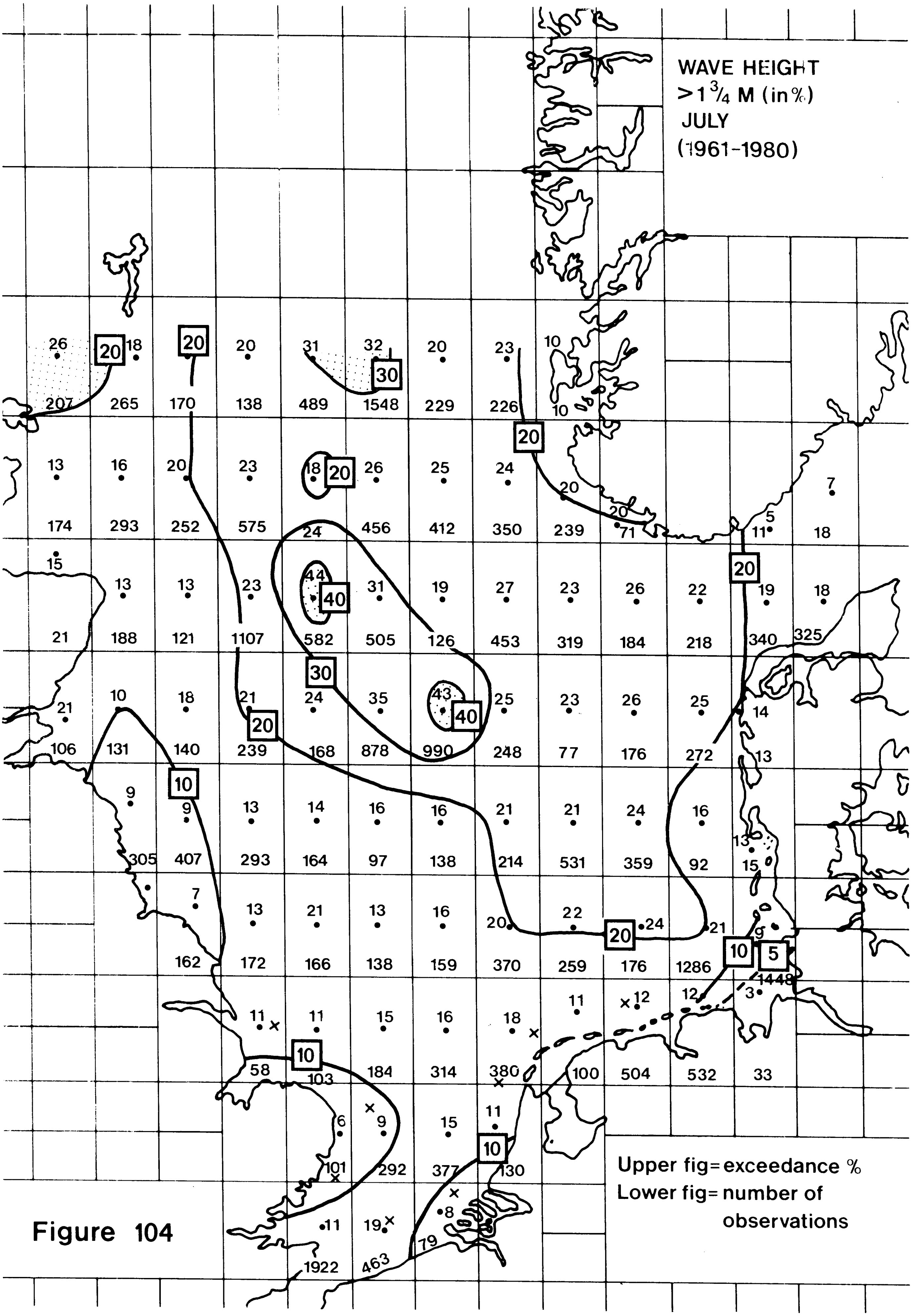

WAVE HEIGHT
>1 3/4 M (in %)
JULY
(1961-1980)
Upper fig = exceedance %
Lower fig = number of observations

Figure 104

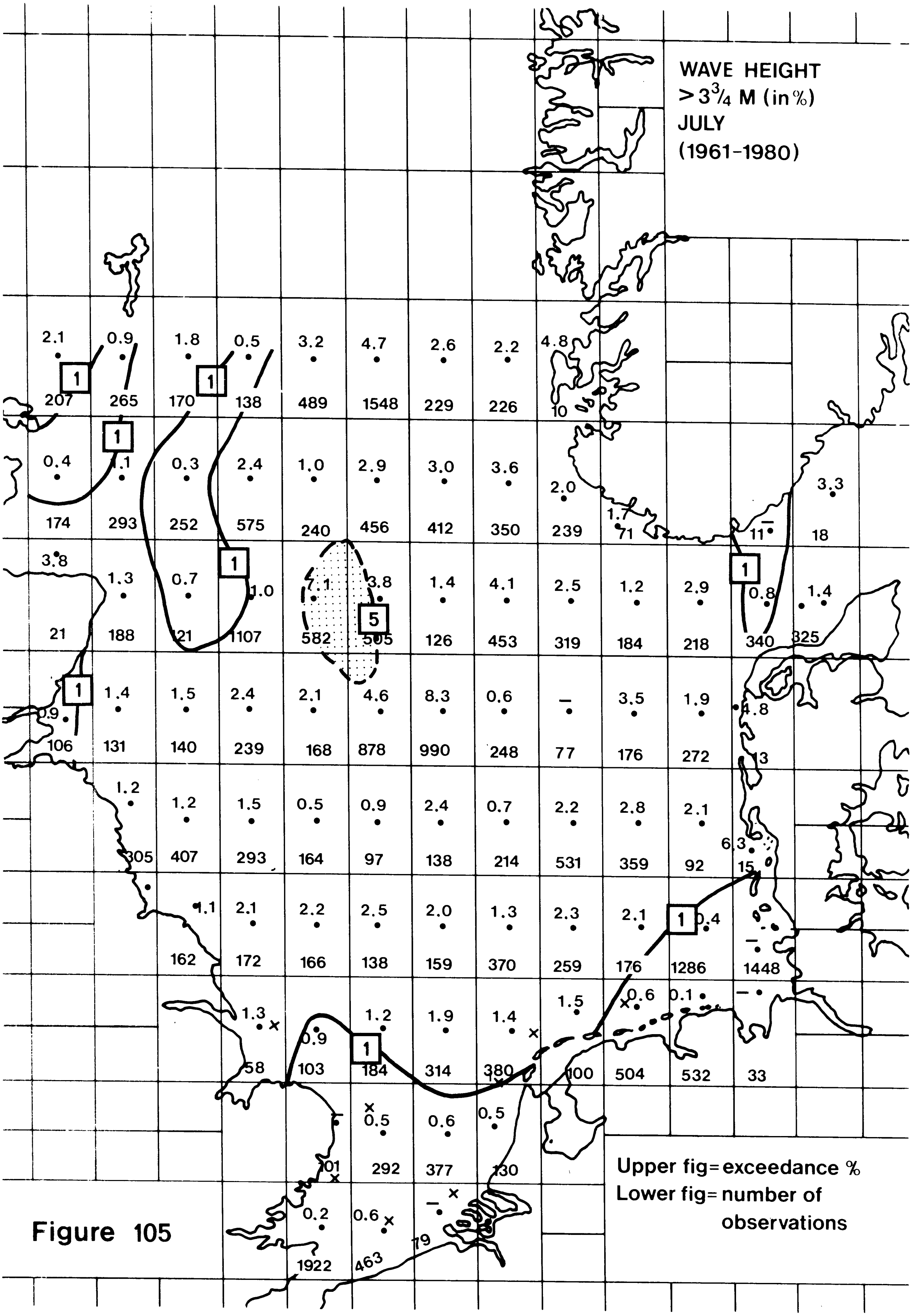

WAVE HEIGHT
>3¾ M (in%)
JULY
(1961-1980)
Upper fig=exceedance %
Lower fig=number of
observations

Figure 105

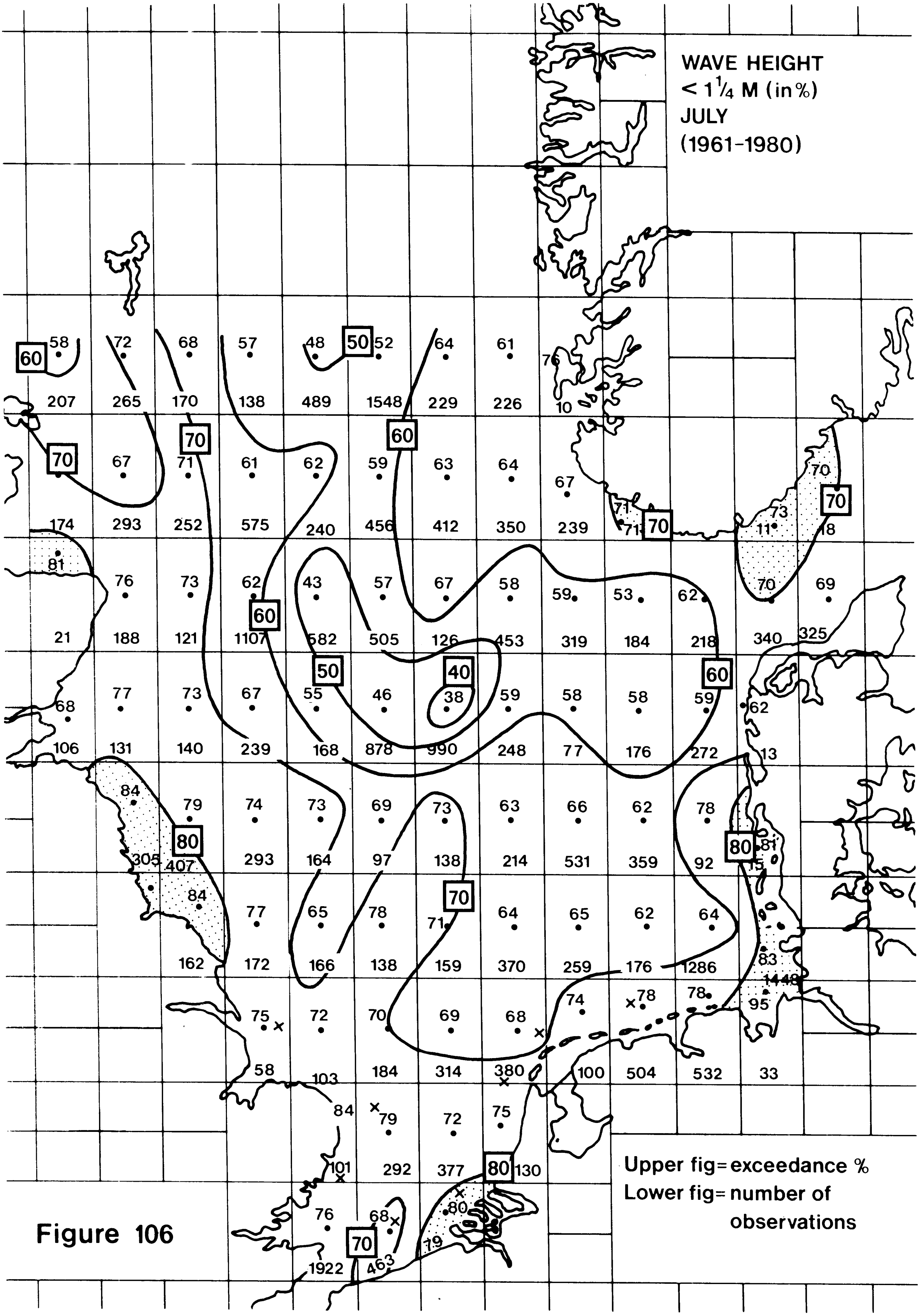

WAVE HEIGHT
< 1¼ M (in%)
JULY
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 106

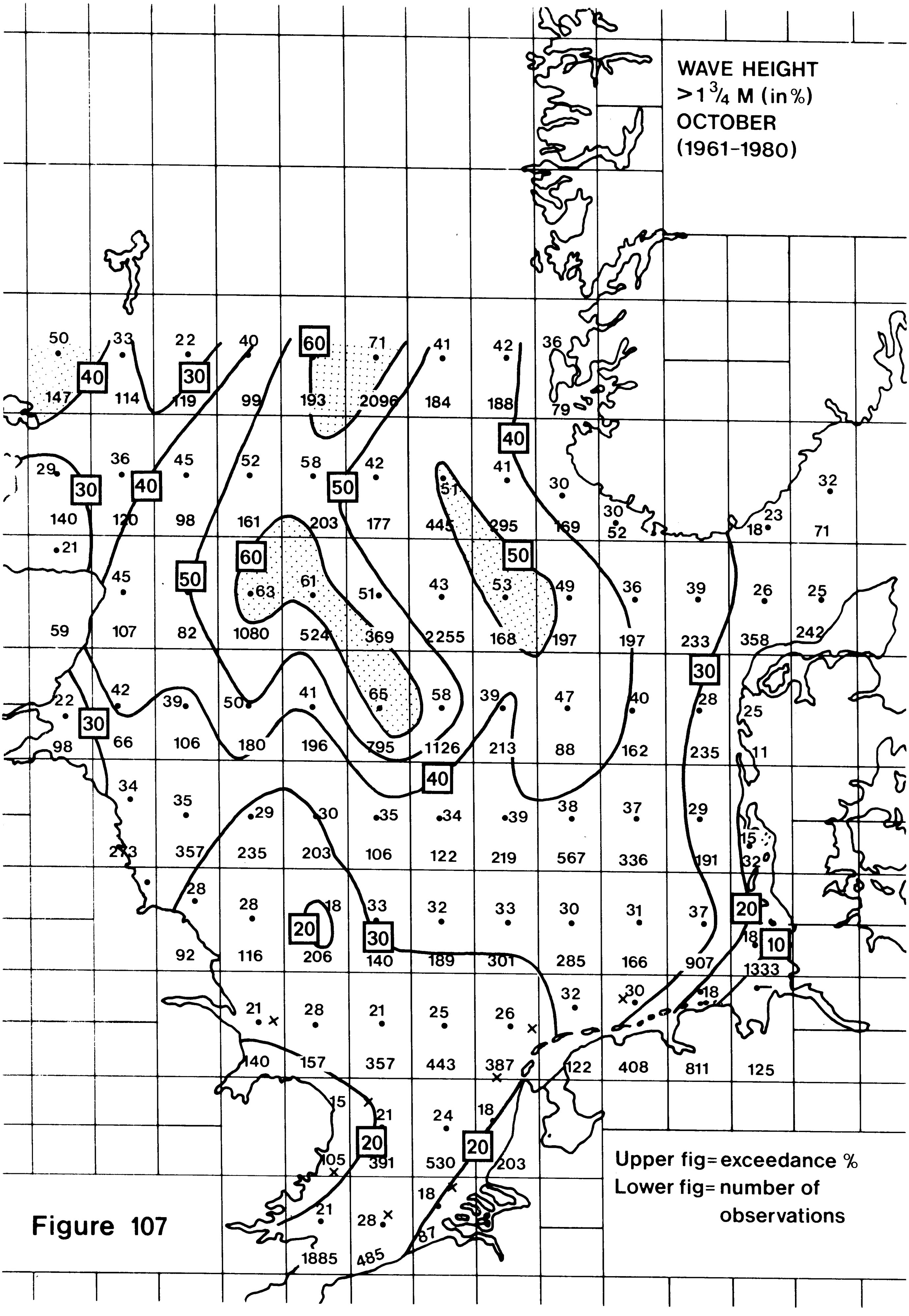

WAVE HEIGHT
>1 3/4 M (in%)
OCTOBER
(1961-1980)
Upper fig= exceedance %
Lower fig= number of observations

Figure 107

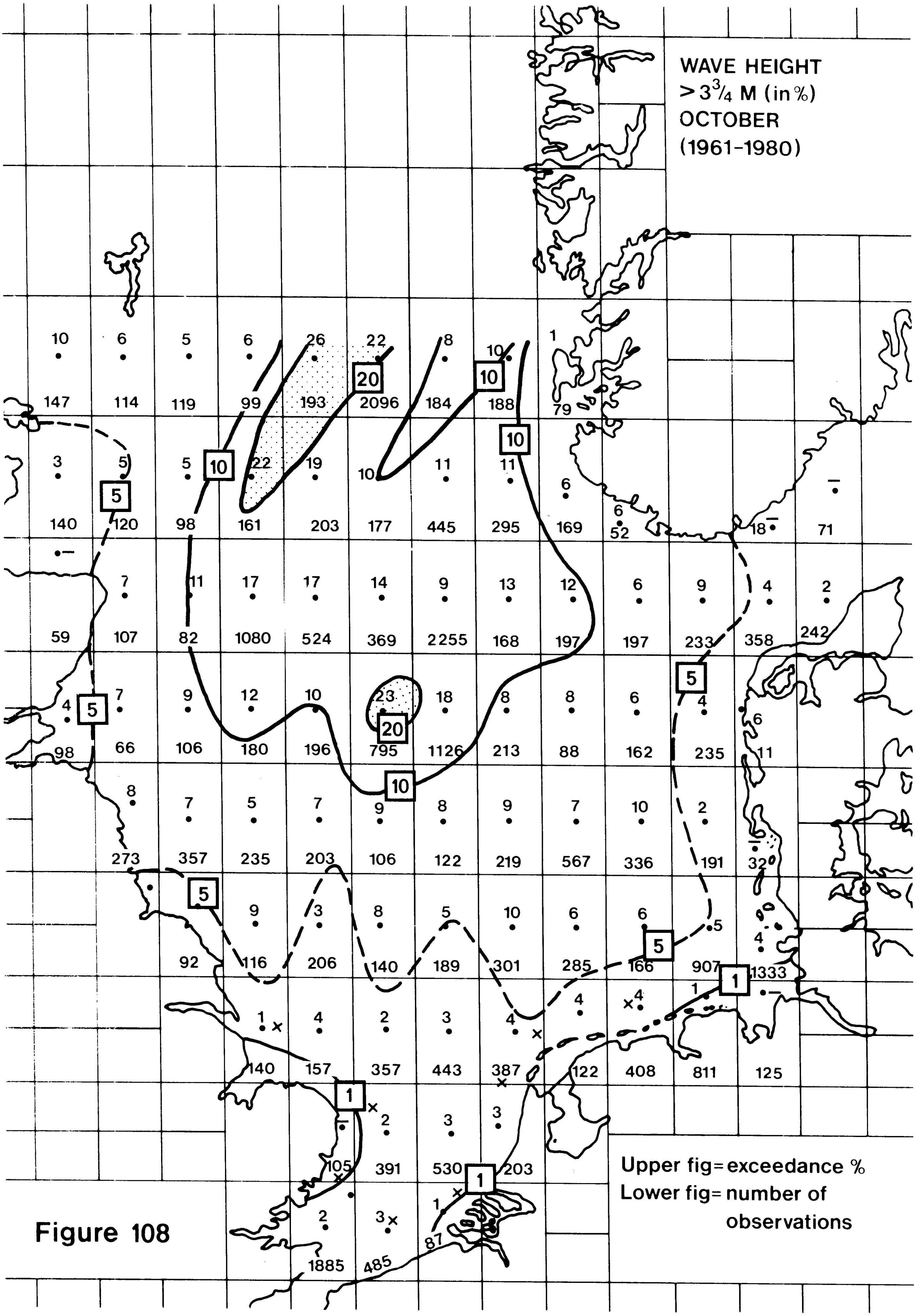

WAVE HEIGHT
> 3¾ M (in %)
OCTOBER
(1961-1980)
Upper fig = exceedance %
Lower fig = number of observations

Figure 108

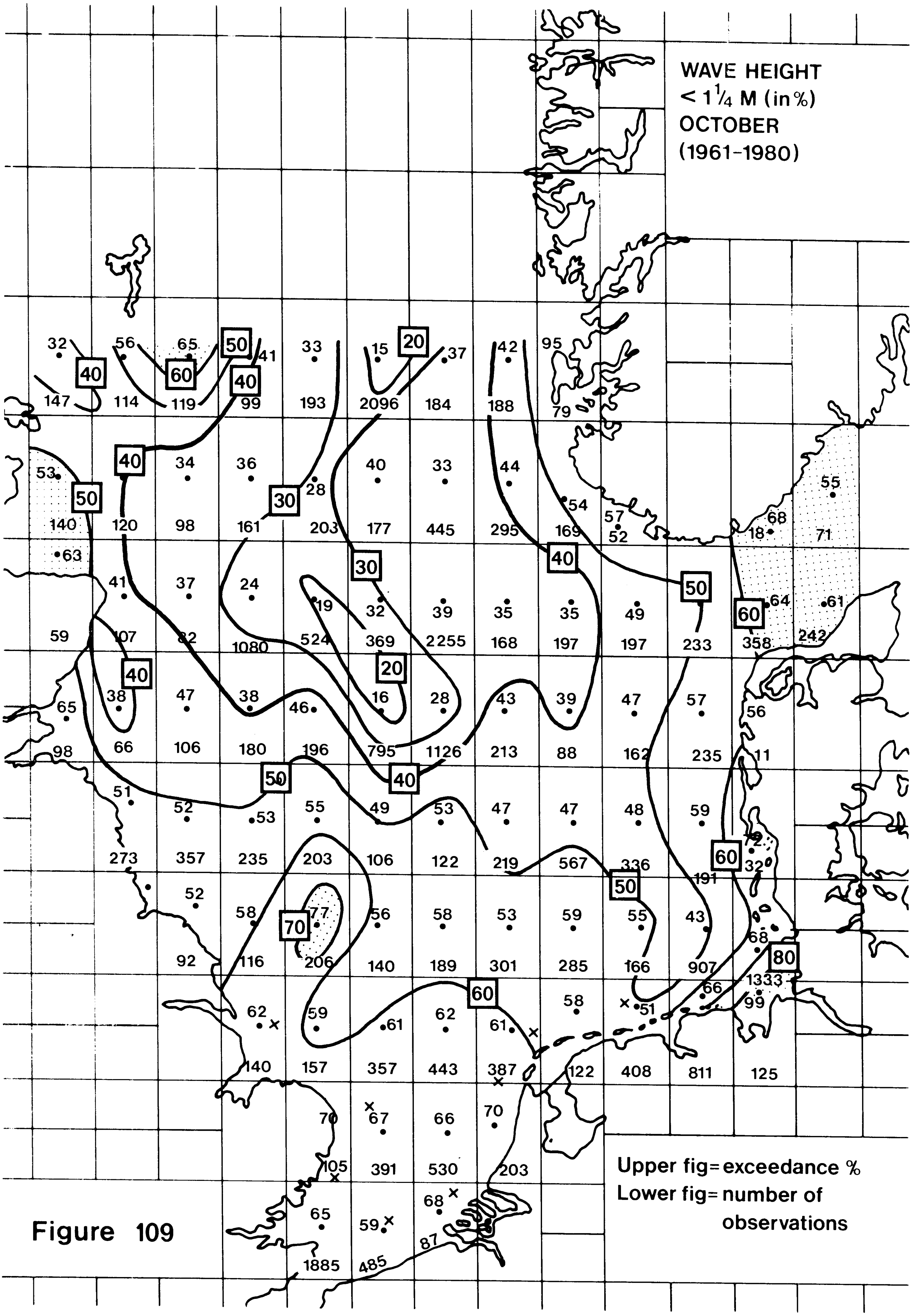

WAVE HEIGHT
< 1¼ M (in%)
OCTOBER
(1961-1980)
Upper fig= exceedance %
Lower fig= number of
observations

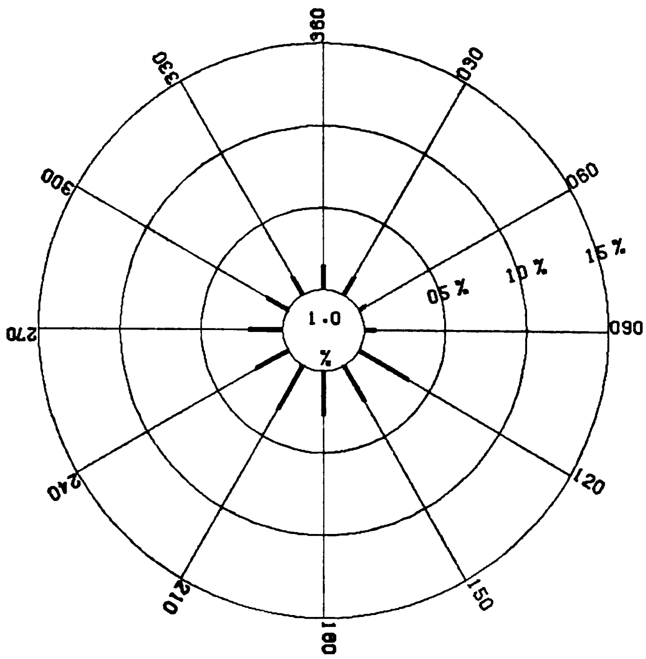
Figure 109

W A V E   R O S E

JANUARY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

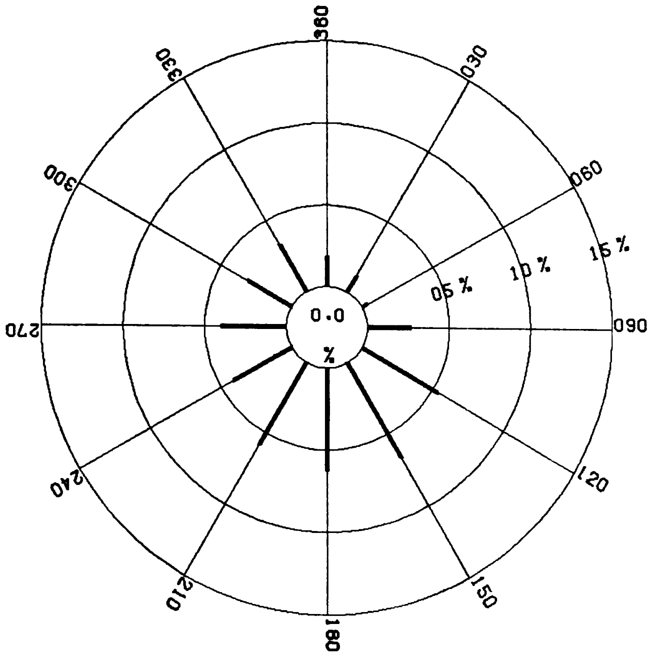
AREA: 58.0N - 59.9N , 0.0E - 1.9E N= 875

WAVE HEIGHT 0 - 3 N= 209



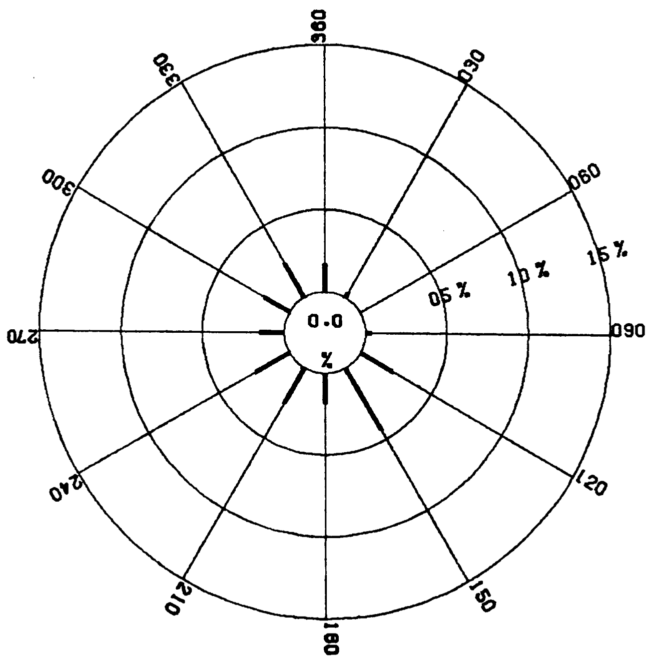
360=	1.5%	090=	0.7%	180=	2.7%	270=	2.1%
030=	1.3%	120=	3.5%	210=	3.1%	300=	1.5%
060=	0.5%	150=	2.5%	240=	2.3%	330=	1.3%

WAVE HEIGHT 4 - 7 N= 390



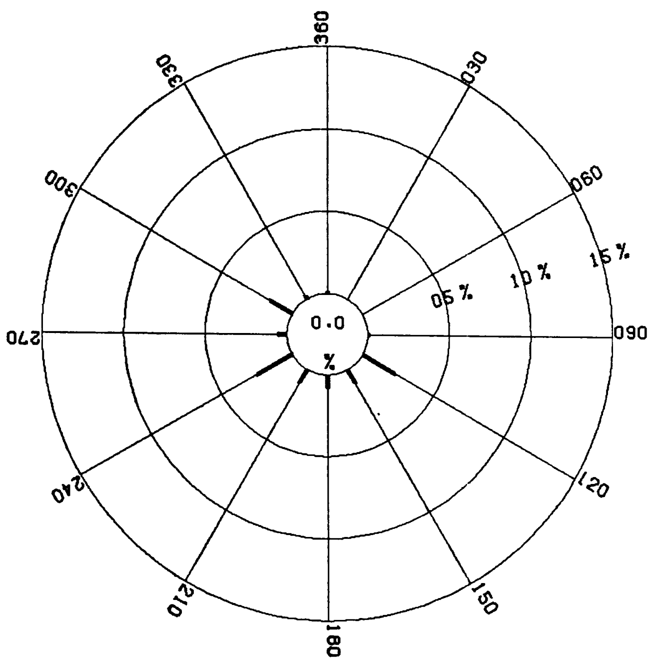
360=	1.8%	090=	2.6%	180=	6.3%	270=	4.0%
030=	1.1%	120=	5.4%	210=	5.8%	300=	3.1%
060=	0.3%	150=	6.6%	240=	4.1%	330=	3.3%

WAVE HEIGHT 8 - 11 N= 188



360=	1.7%	090=	0.3%	180=	1.8%	270=	1.5%
030=	0.3%	120=	2.3%	210=	2.5%	300=	1.8%
060=	0.0%	150=	4.3%	240=	2.4%	330=	2.4%

WAVE HEIGHT > 11 N= 88



360=	0.1%	090=	0.1%	180=	0.8%	270=	0.6%
030=	0.0%	120=	2.3%	210=	0.9%	300=	1.6%
060=	0.0%	150=	0.9%	240=	2.5%	330=	0.2%

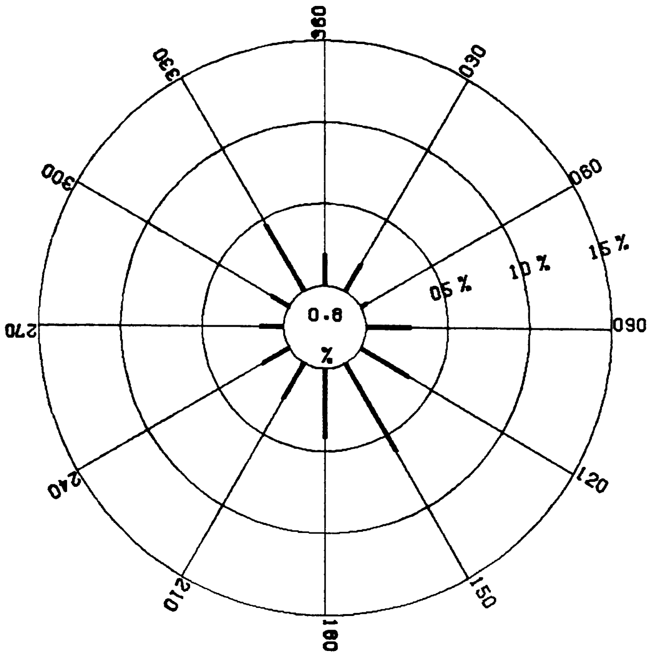
Figure 110

W A V E   R O S E

JANUARY   1961 - 1980   (WAVE HEIGHT IN 0.5M VALUES)

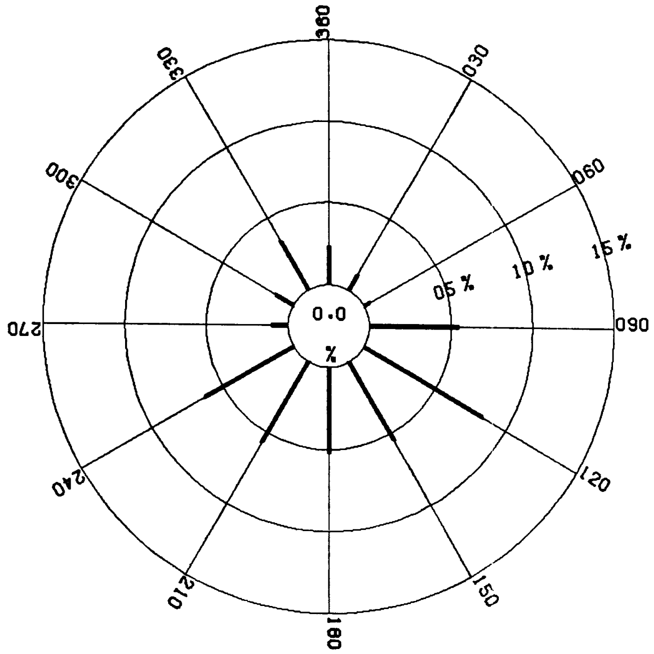
AREA: 56.0N - 57.9N ,   0.0W - 1.9W   N= 477

WAVE HEIGHT 0 - 3   N= 158



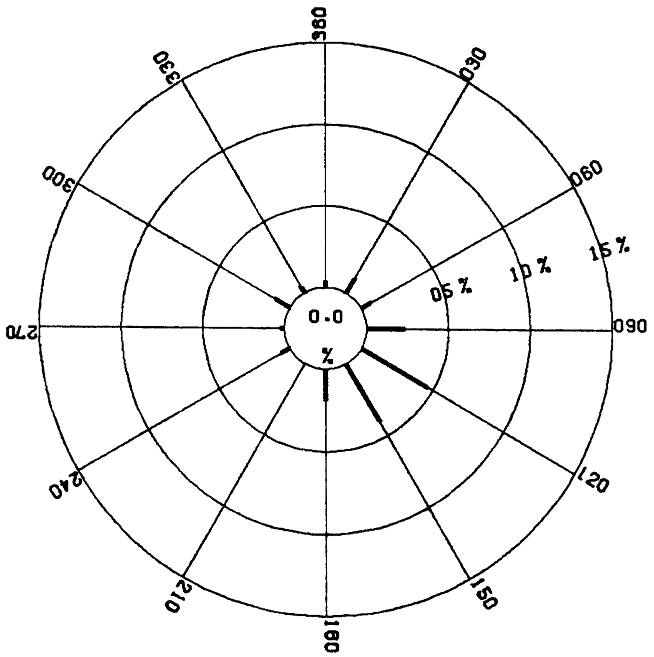
360=	1.9%	090=	2.7%	180=	4.2%	270=	1.5%
030=	1.9%	120=	3.4%	210=	2.5%	300=	1.3%
060=	0.4%	150=	6.1%	240=	1.9%	330=	4.6%

WAVE HEIGHT 4 - 7   N= 219



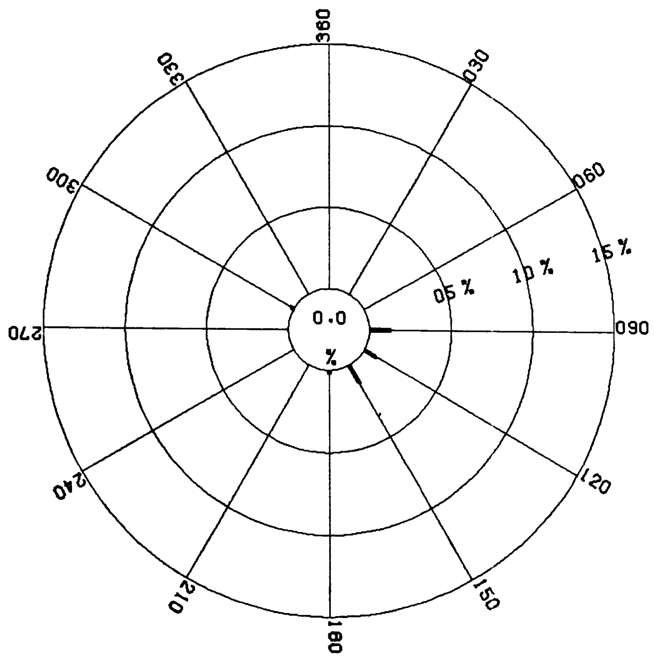
360=	2.3%	090=	5.5%	180=	5.2%	270=	1.0%
030=	1.0%	120=	8.4%	210=	5.7%	300=	1.3%
060=	0.4%	150=	5.5%	240=	6.3%	330=	3.4%

WAVE HEIGHT 8 - 11   N= 82



360=	0.4%	090=	2.3%	180=	1.9%	270=	0.2%
030=	1.0%	120=	4.6%	210=	0.0%	300=	1.0%
060=	0.6%	150=	4.0%	240=	0.6%	330=	0.4%

WAVE HEIGHT > 11   N= 18



360=	0.0%	090=	1.3%	180=	0.2%	270=	0.0%
030=	0.0%	120=	0.8%	210=	0.0%	300=	0.2%
060=	0.0%	150=	1.3%	240=	0.0%	330=	0.0%

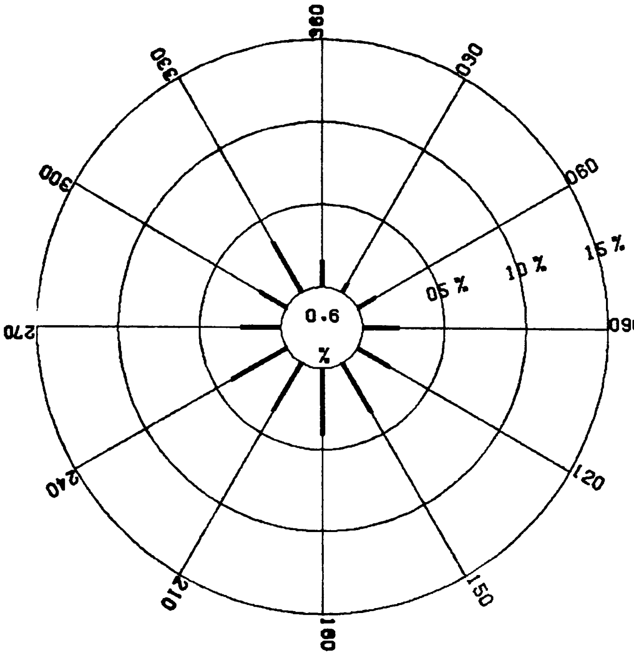
Figure 111

W A V E R O S E

JANUARY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

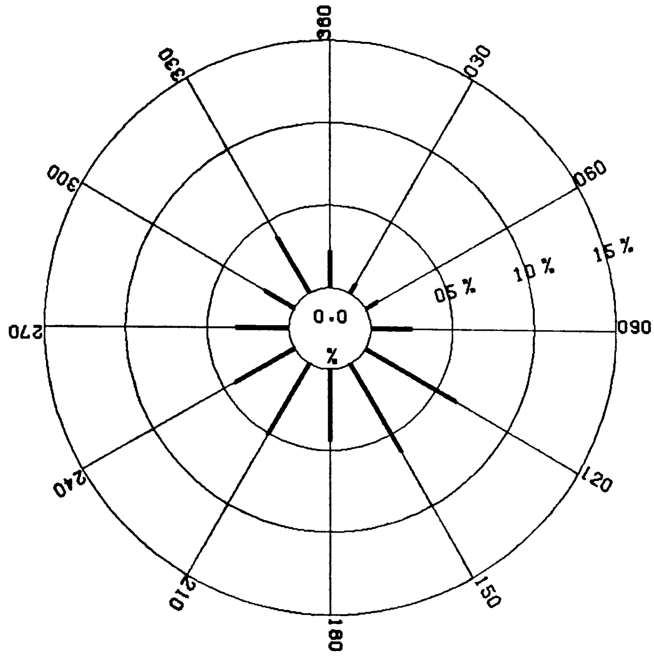
AREA: 56.0N - 57.9N , 2.0E - 3.9E N= 3955

WAVE HEIGHT 0 - 3 N= 1240



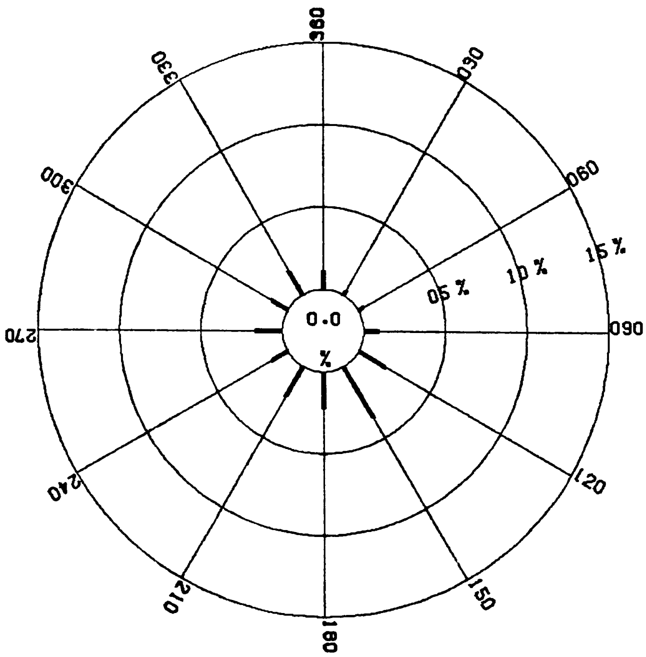
360=	1.6%	090=	2.2%	180=	4.1%	270=	2.4%
030=	0.7%	120=	2.3%	210=	3.4%	300=	1.9%
060=	1.3%	150=	3.5%	240=	3.9%	330=	3.5%

WAVE HEIGHT 4 - 7 N= 1652



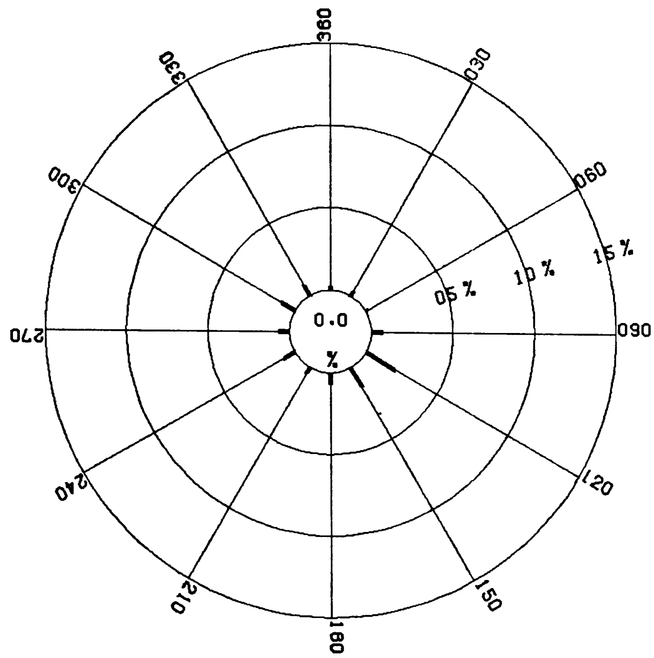
360=	2.2%	090=	2.5%	180=	4.4%	270=	3.3%
030=	0.6%	120=	6.4%	210=	5.1%	300=	2.1%
060=	0.8%	150=	6.2%	240=	4.2%	330=	3.9%

WAVE HEIGHT 8 - 11 N= 711



360=	1.2%	090=	0.9%	180=	2.2%	270=	1.6%
030=	0.3%	120=	1.9%	210=	2.1%	300=	1.2%
060=	0.4%	150=	3.6%	240=	1.1%	330=	1.6%

WAVE HEIGHT > 11 N= 352



360=	0.2%	090=	0.7%	180=	0.7%	270=	0.7%
030=	0.3%	120=	2.1%	210=	0.4%	300=	0.9%
060=	0.1%	150=	1.3%	240=	0.8%	330=	0.7%

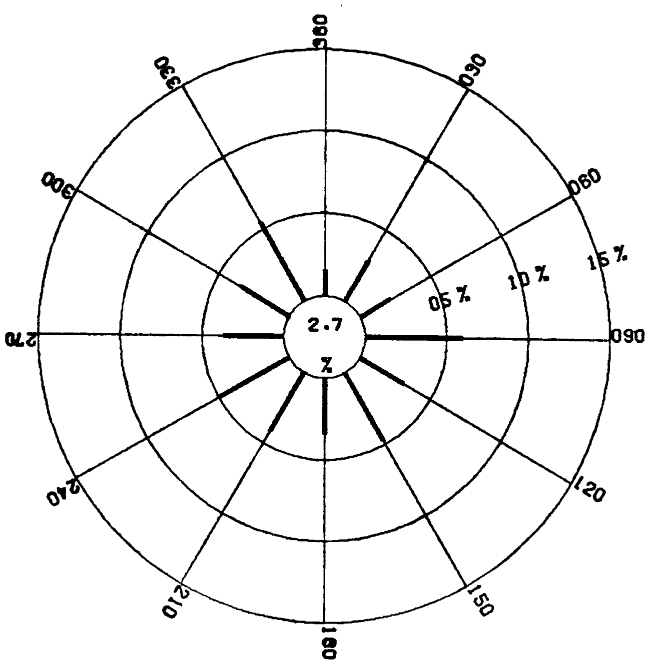
Figure 112

W A V E   R O S E

JANUARY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

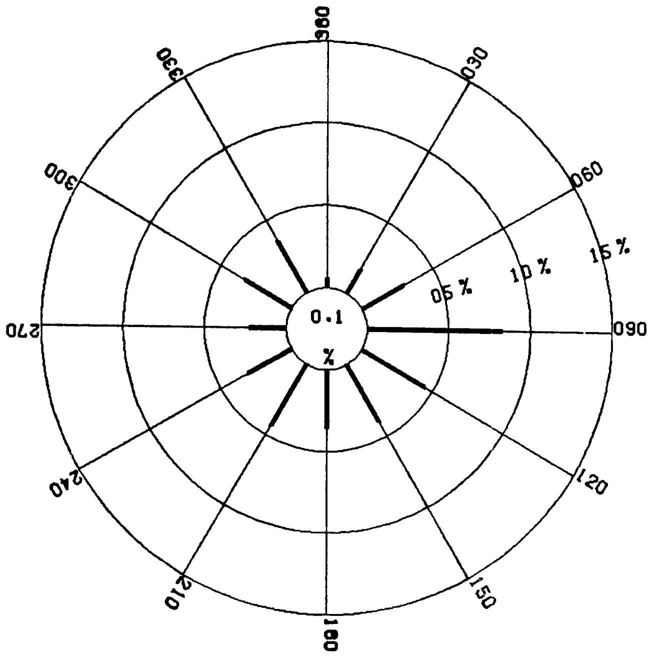
AREA: 56.0N - 57.9N , 6.0E - 7.9E N= 845

WAVE HEIGHT 0 - 3 N= 405



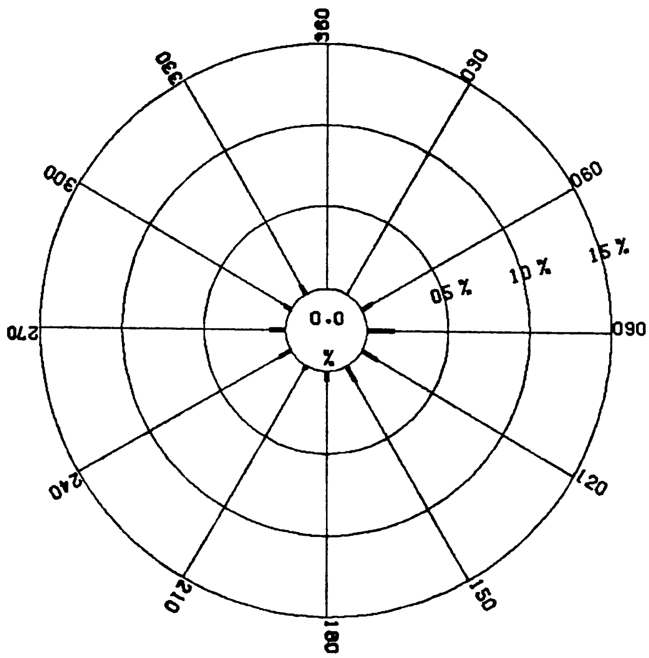
360=	1.5%	090=	5.9%	180=	3.4%	270=	3.7%
030=	2.8%	120=	3.1%	210=	4.1%	300=	3.4%
060=	2.1%	150=	4.7%	240=	4.9%	330=	5.4%

WAVE HEIGHT 4 - 7 N= 358



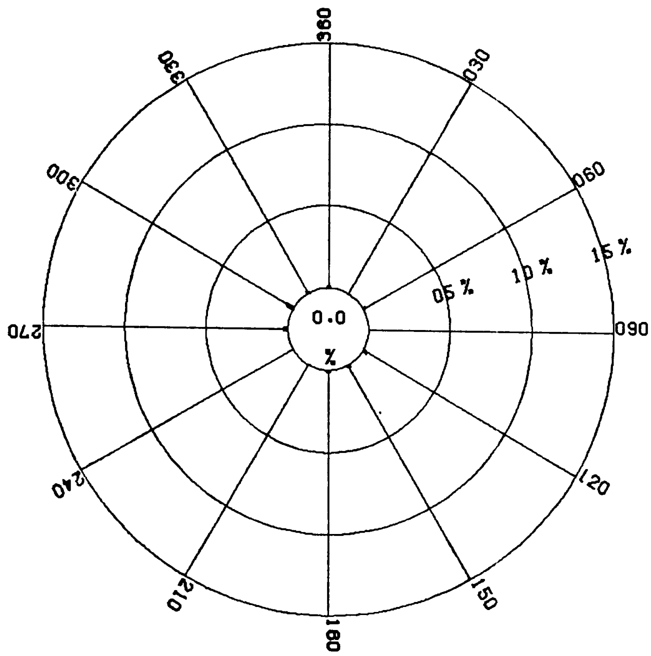
360=	0.6%	090=	8.3%	180=	3.6%	270=	2.2%
030=	1.7%	120=	4.5%	210=	4.4%	300=	3.3%
060=	3.0%	150=	4.0%	240=	3.1%	330=	3.6%

WAVE HEIGHT 8 - 11 N= 69



360=	0.0%	090=	1.7%	180=	0.6%	270=	0.9%
030=	0.0%	120=	1.1%	210=	0.2%	300=	0.5%
060=	0.7%	150=	1.1%	240=	0.8%	330=	0.6%

WAVE HEIGHT > 11 N= 13



360=	0.1%	090=	0.0%	180=	0.1%	270=	0.2%
030=	0.0%	120=	0.2%	210=	0.0%	300=	0.5%
060=	0.1%	150=	0.1%	240=	0.0%	330=	0.1%

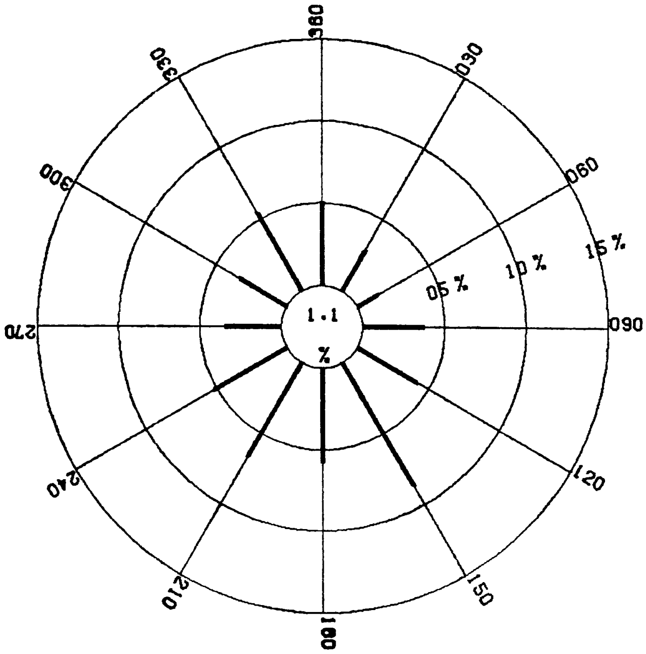
Figure 113

WAVE ROSE

JANUARY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

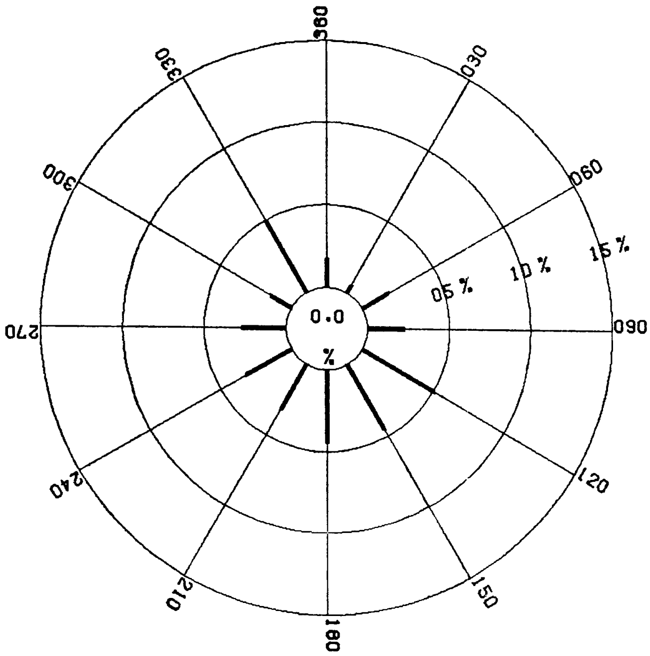
AREA: 54.0N - 55.9N , 2.0E - 3.9E N= 808

WAVE HEIGHT 0 - 3 N= 461



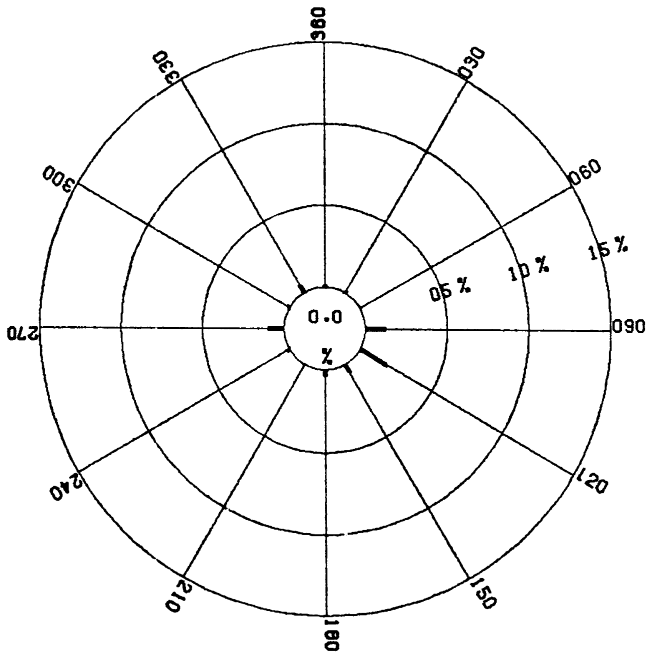
360=	5.1%	090=	3.7%	180=	5.8%	270=	3.5%
030=	2.8%	120=	4.2%	210=	6.7%	300=	3.3%
060=	1.5%	150=	8.7%	240=	5.2%	330=	5.4%

WAVE HEIGHT 4 - 7 N= 291



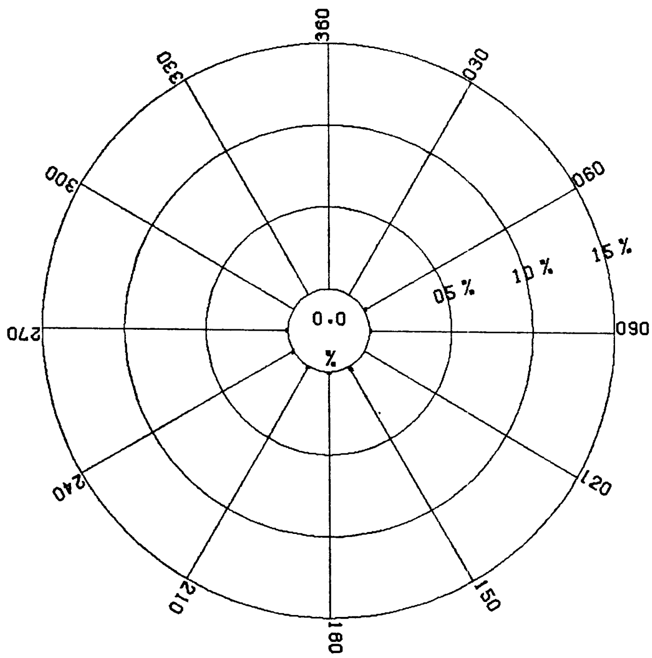
360=	1.7%	090=	2.2%	180=	4.5%	270=	2.7%
030=	0.5%	120=	5.1%	210=	3.2%	300=	1.5%
060=	1.9%	150=	4.6%	240=	3.2%	330=	5.0%

WAVE HEIGHT 8 - 11 N= 48



360=	0.1%	090=	1.2%	180=	0.4%	270=	1.0%
030=	0.1%	120=	1.9%	210=	0.0%	300=	0.1%
060=	0.0%	150=	0.5%	240=	0.1%	330=	0.5%

WAVE HEIGHT > 11 N= 8



360=	0.0%	090=	0.1%	180=	0.1%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.1%	300=	0.0%
060=	0.1%	150=	0.2%	240=	0.1%	330=	0.0%

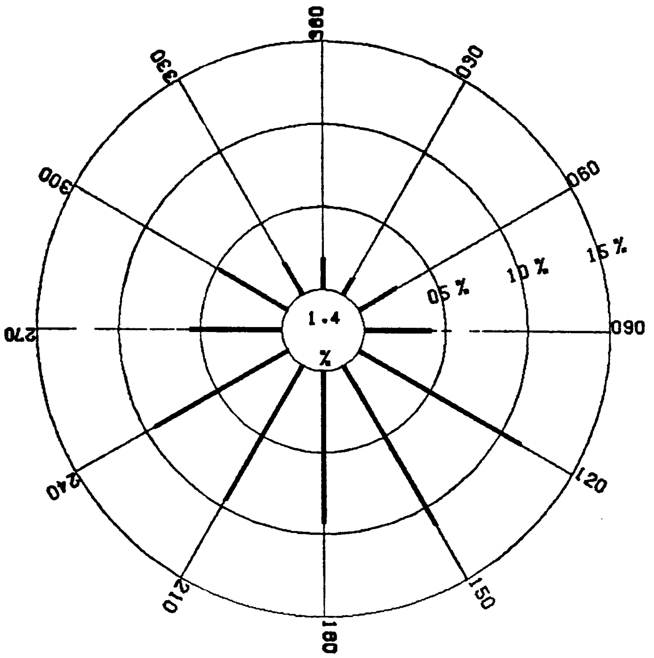
Figure 114

W A V E   R O S E

JANUARY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

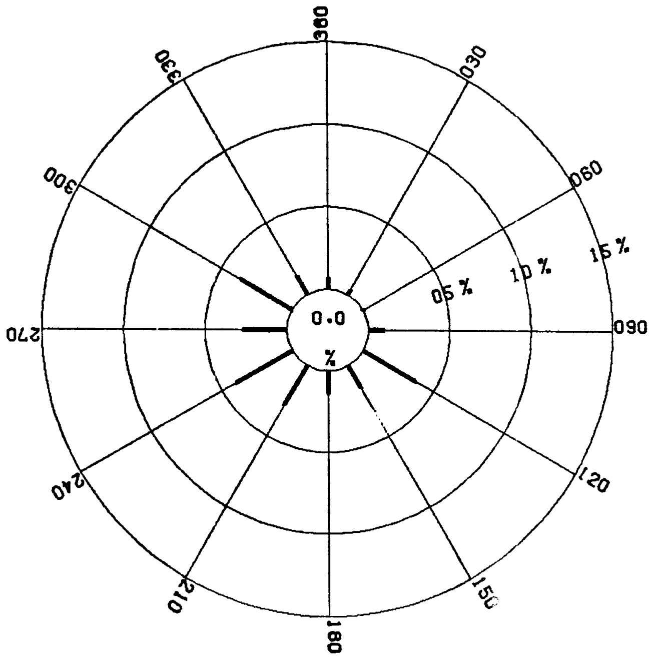
AREA: 54.0N - 54.9N , 6.0E - 8.9E N= 1766

WAVE HEIGHT 0 - 3 N= 1321



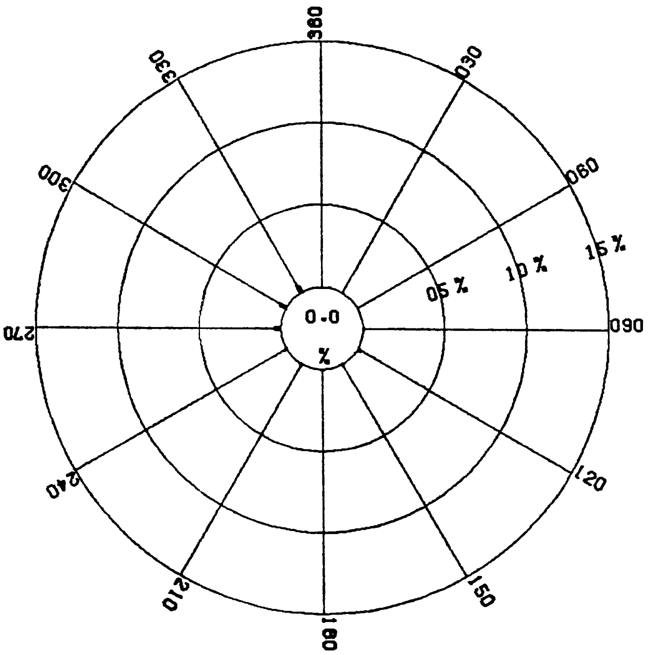
360=	1.9%	090=	4.1%	180=	9.3%	270=	5.6%
030=	1.2%	120=	11.4%	210=	9.6%	300=	4.8%
060=	2.7%	150=	11.2%	240=	9.4%	330=	2.2%

WAVE HEIGHT 4 - 7 N= 410



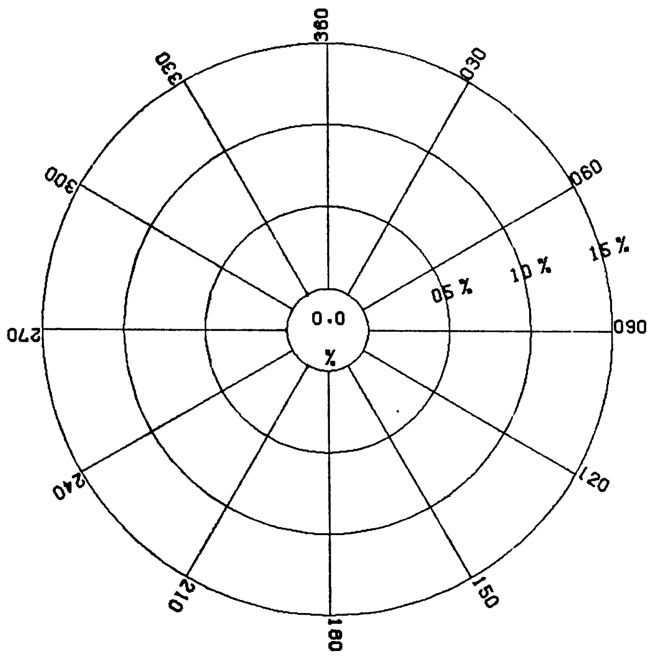
360=	0.7%	090=	1.0%	180=	1.4%	270=	2.7%
030=	0.3%	120=	3.7%	210=	2.8%	300=	3.6%
060=	0.1%	150=	1.6%	240=	4.0%	330=	1.3%

WAVE HEIGHT 8 - 11 N= 32



360=	0.0%	090=	0.1%	180=	0.1%	270=	0.4%
030=	0.0%	120=	0.2%	210=	0.1%	300=	0.5%
060=	0.0%	150=	0.1%	240=	0.1%	330=	0.5%

WAVE HEIGHT > 11 N= 3



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.1%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.1%

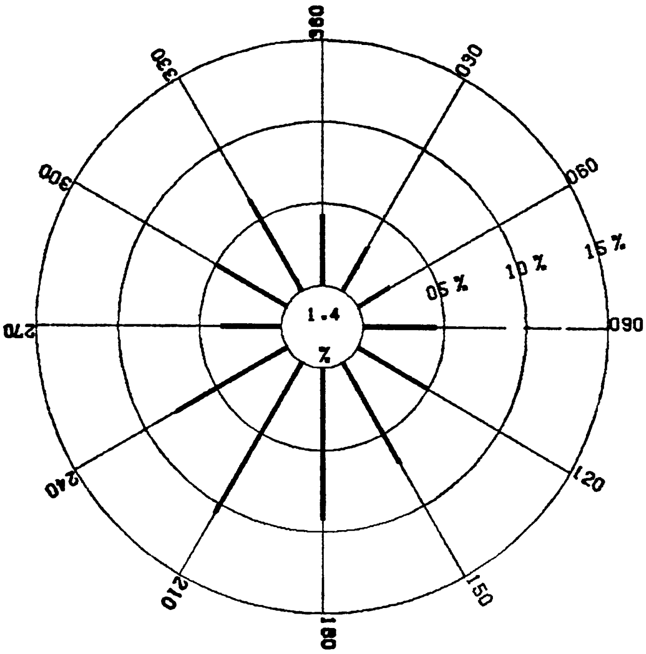
Figure 115

W A V E   R O S E

JANUARY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

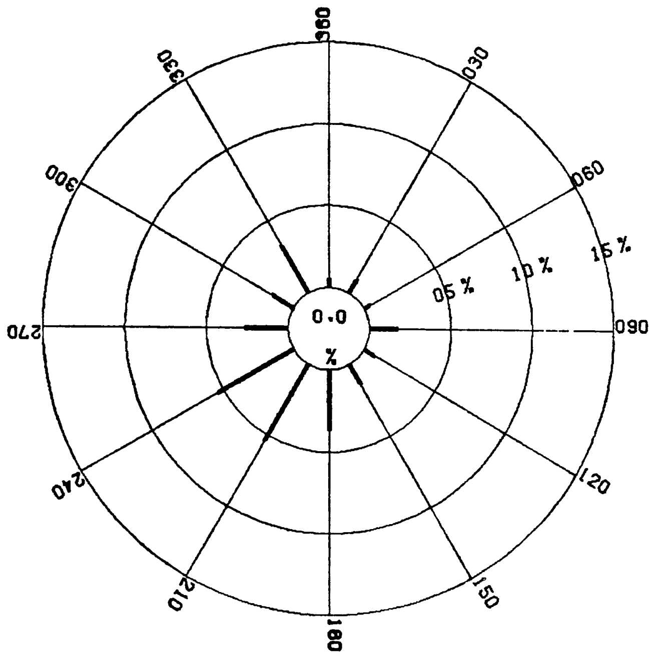
AREA: 52.0N - 52.9N , 3.0E - 4.9E N= 985

WAVE HEIGHT 0 - 3 N= 689



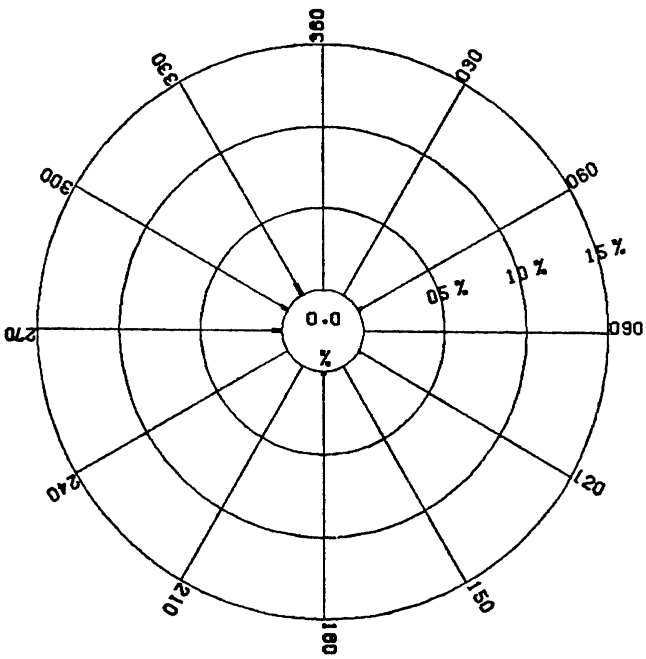
360=	4.3%	090=	4.5%	180=	9.2%	270=	3.7%
030=	3.0%	120=	5.0%	210=	10.6%	300=	4.9%
060=	2.2%	150=	7.0%	240=	7.8%	330=	6.4%

WAVE HEIGHT 4 - 7 N= 270



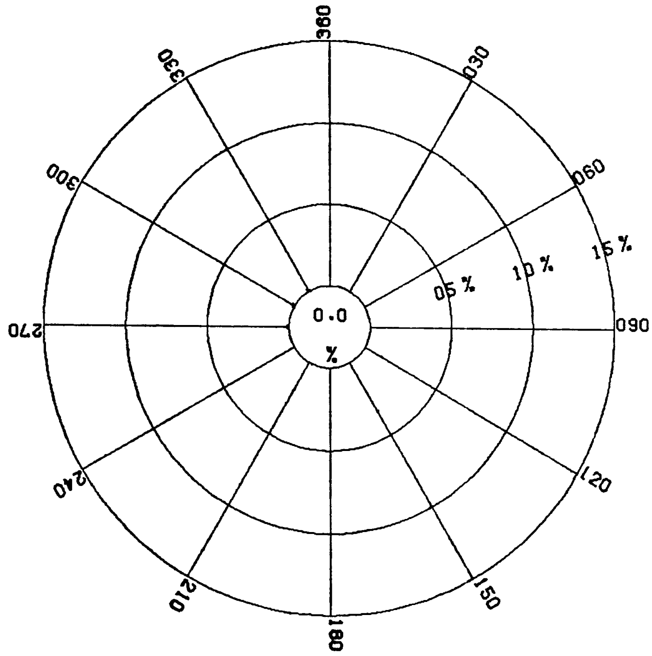
360=	0.5%	090=	1.7%	180=	3.7%	270=	2.6%
030=	0.9%	120=	0.7%	210=	5.4%	300=	1.5%
060=	0.4%	150=	1.3%	240=	5.4%	330=	3.2%

WAVE HEIGHT 8 - 11 N= 23



360=	0.0%	090=	0.0%	180=	0.2%	270=	0.6%
030=	0.0%	120=	0.1%	210=	0.0%	300=	0.4%
060=	0.2%	150=	0.0%	240=	0.0%	330=	0.8%

WAVE HEIGHT > 11 N= 3



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.1%

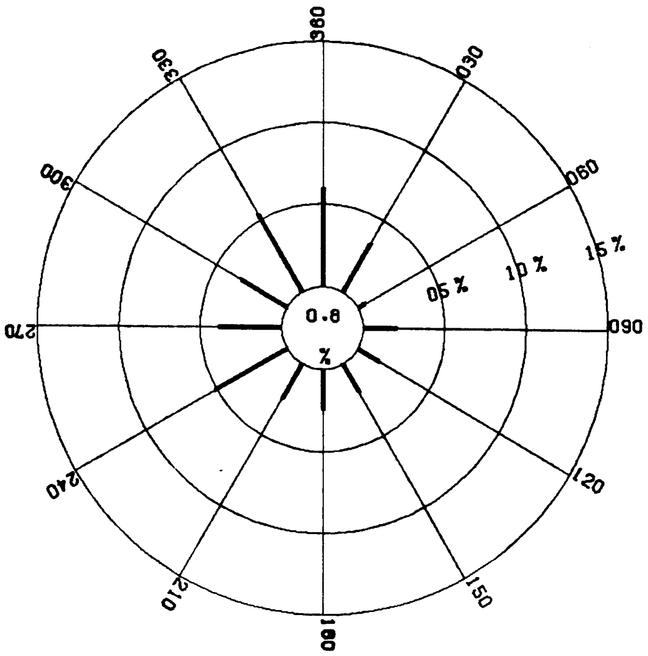
Figure 116

W A V E   R O S E

APRIL 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

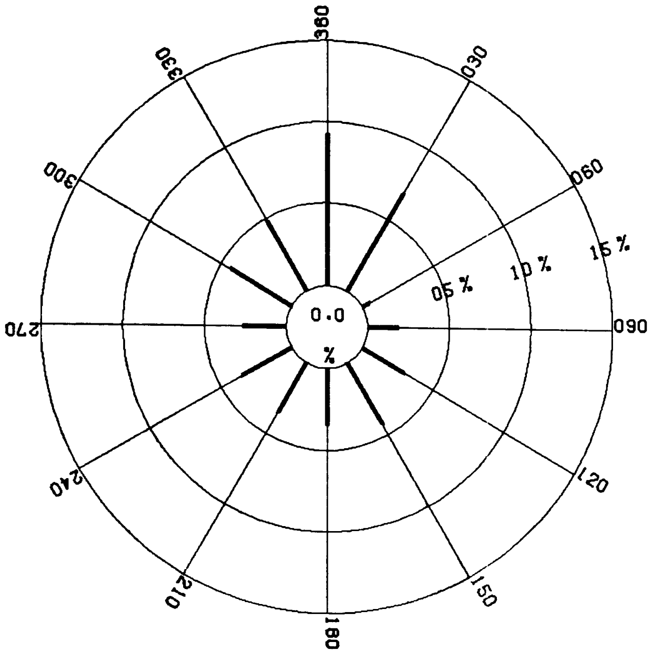
AREA: 58.0N - 59.9N , 0.0E - 1.9E N= 1932

WAVE HEIGHT 0 - 3 N= 749



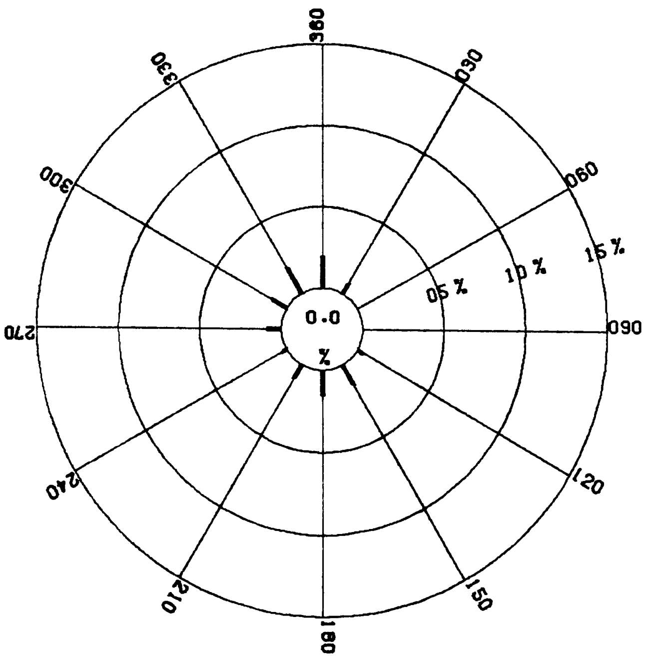
360=	6.0%	090=	2.0%	180=	2.5%	270=	3.9%
030=	3.4%	120=	1.5%	210=	2.5%	300=	3.3%
060=	0.5%	150=	2.0%	240=	5.1%	330=	5.4%

WAVE HEIGHT 4 - 7 N= 930



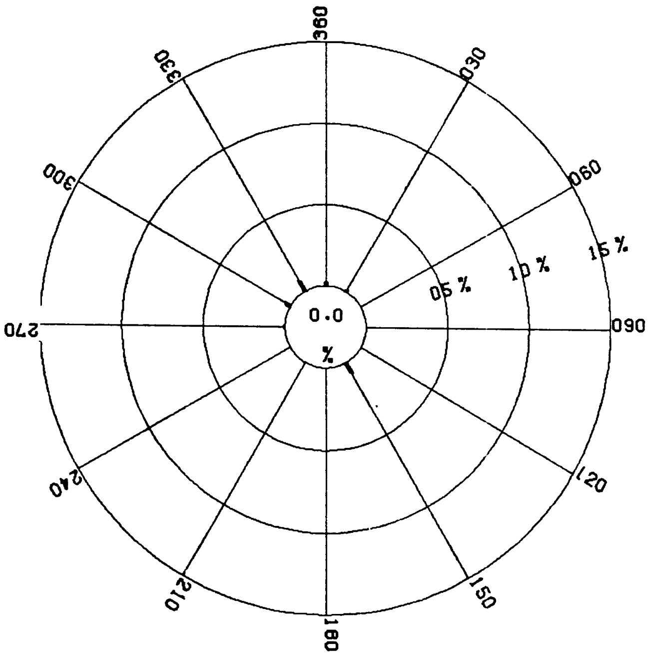
360=	9.3%	090=	1.9%	180=	3.5%	270=	2.6%
030=	6.9%	120=	3.0%	210=	3.5%	300=	4.3%
060=	0.5%	150=	4.3%	240=	3.5%	330=	4.9%

WAVE HEIGHT 8 - 11 N= 211



360=	2.0%	090=	0.0%	180=	1.6%	270=	0.9%
030=	0.7%	120=	0.4%	210=	0.9%	300=	1.0%
060=	0.0%	150=	1.3%	240=	0.3%	330=	1.6%

WAVE HEIGHT > 11 N= 42



360=	0.3%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.1%	120=	0.0%	210=	0.0%	300=	0.4%
060=	0.0%	150=	0.7%	240=	0.0%	330=	0.7%

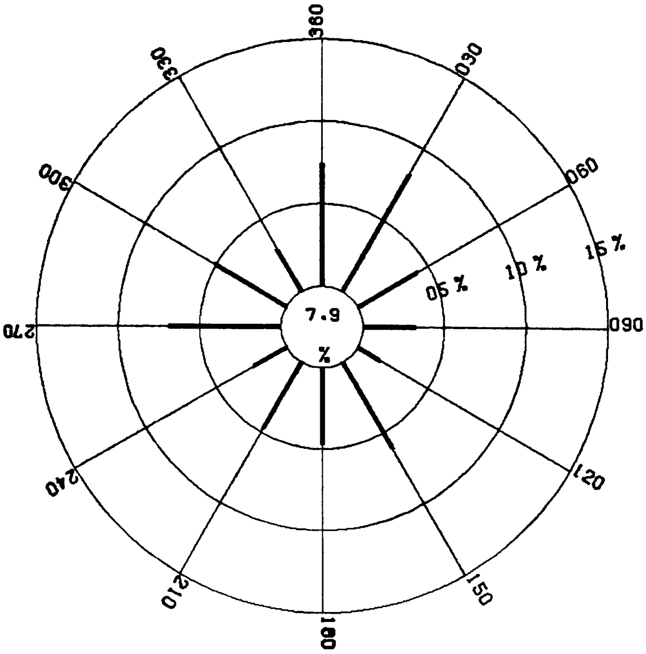
Figure 117

W A V E R O S E

APRIL 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

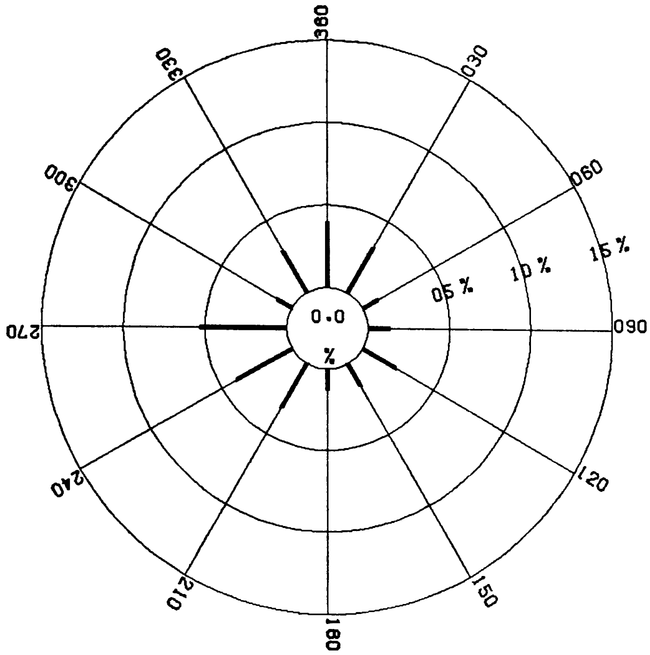
AREA: 56.0N - 57.9N , 0.0W - 1.9W N= 378

WAVE HEIGHT 0 - 3 N= 247



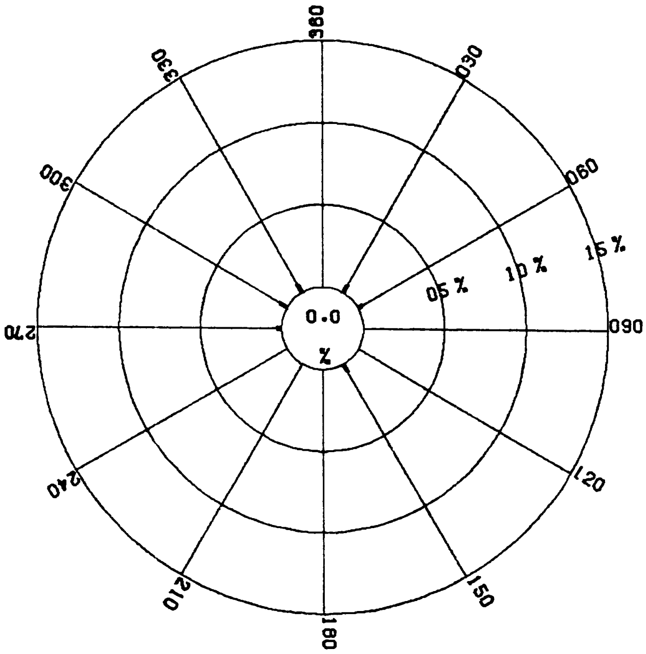
360=	7.4%	090=	3.2%	180=	4.8%	270=	6.9%
030=	8.2%	120=	1.6%	210=	4.8%	300=	5.0%
060=	4.2%	150=	6.1%	240=	2.4%	330=	2.9%

WAVE HEIGHT 4 - 7 N= 118



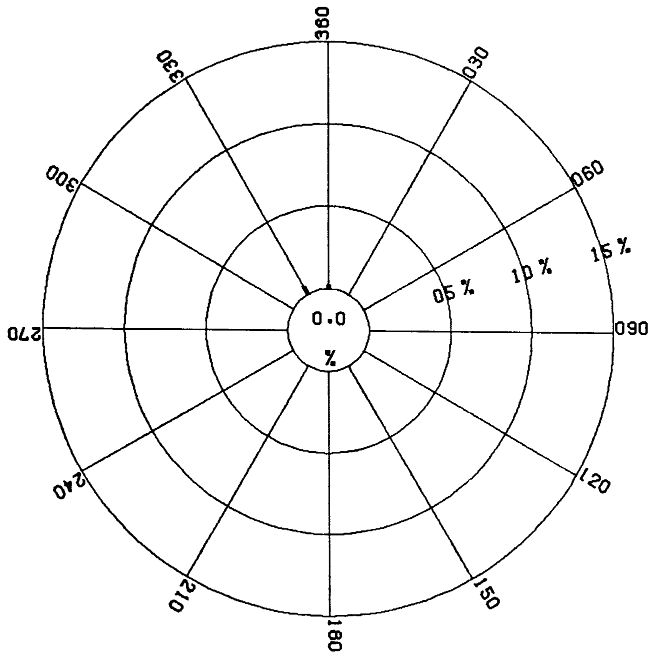
360=	4.0%	090=	1.3%	180=	1.3%	270=	5.3%
030=	3.2%	120=	2.4%	210=	3.2%	300=	1.1%
060=	1.1%	150=	1.6%	240=	4.0%	330=	2.9%

WAVE HEIGHT 8 - 11 N= 10



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.3%
030=	0.5%	120=	0.0%	210=	0.0%	300=	0.5%
060=	0.3%	150=	0.5%	240=	0.0%	330=	0.5%

WAVE HEIGHT > 11 N= 3



360=	0.3%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.5%

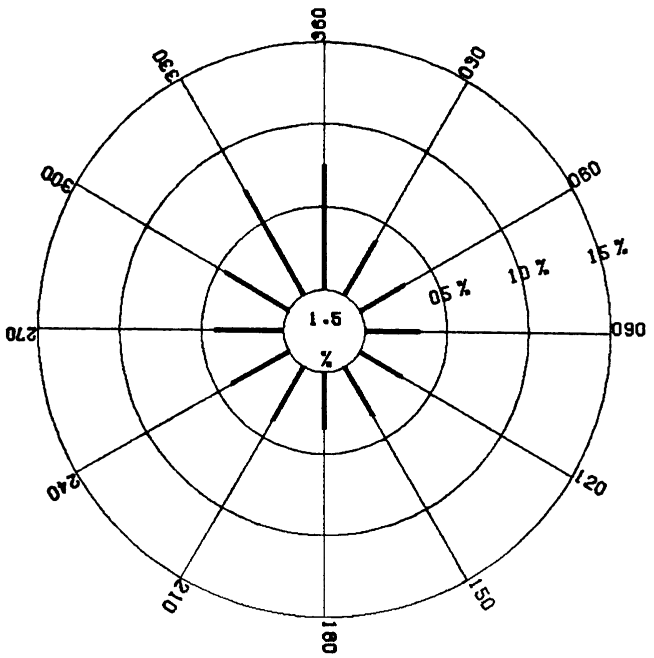
Figure 118

W A V E   R O S E

APRIL 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

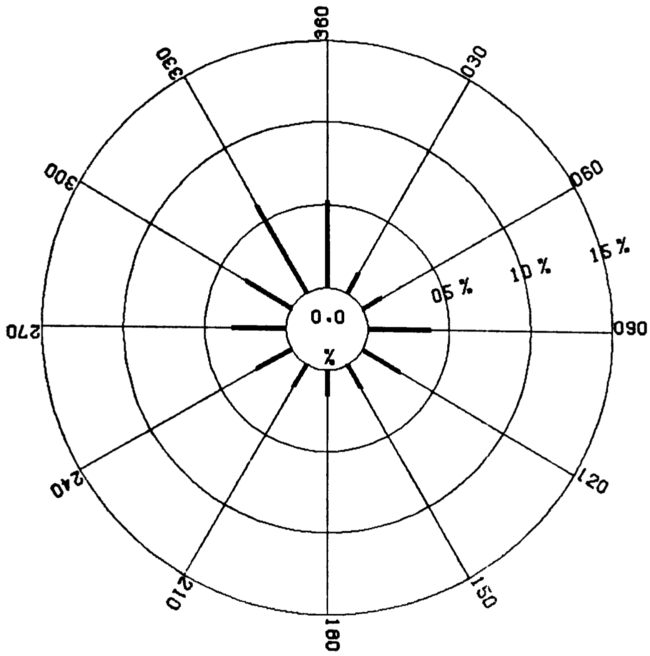
AREA: 56.0N - 57.9N , 2.0E - 3.9E N= 3730

WAVE HEIGHT 0 - 3 N= 1976



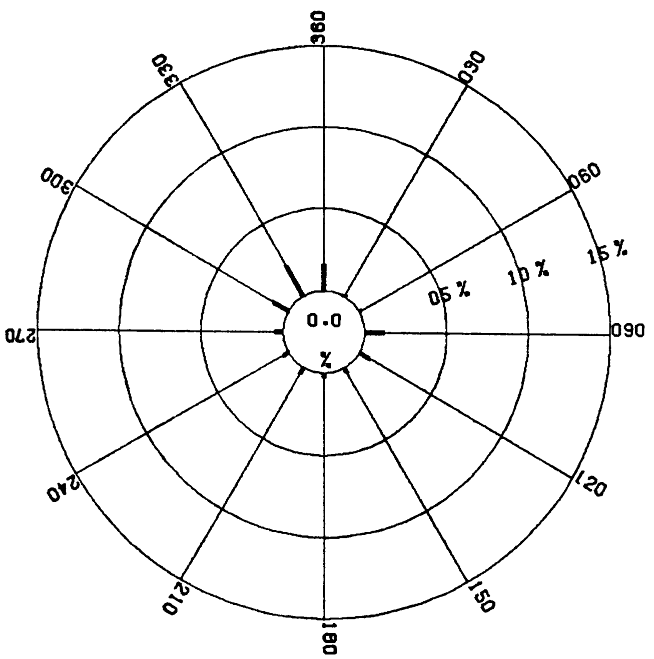
360=	7.5%	090=	3.3%	180=	3.5%	270=	4.2%
030=	3.8%	120=	2.9%	210=	3.8%	300=	4.5%
060=	3.1%	150=	3.4%	240=	4.0%	330=	7.2%

WAVE HEIGHT 4 - 7 N= 1278



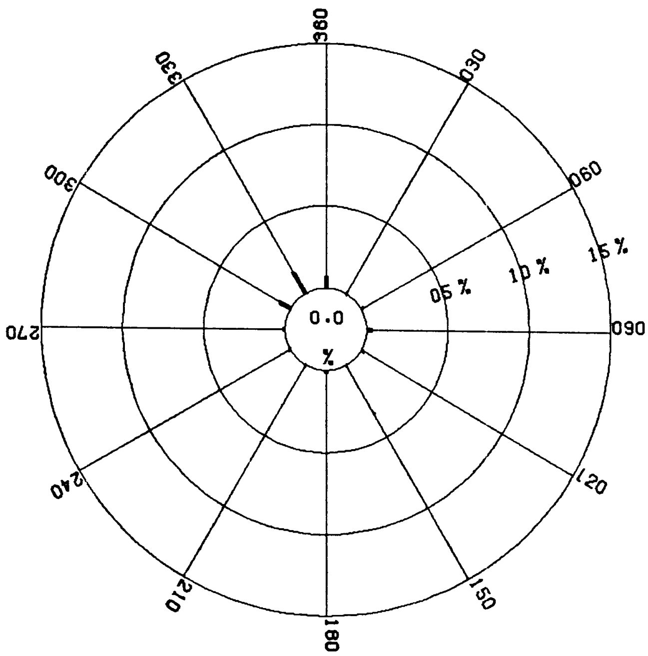
360=	5.2%	090=	3.8%	180=	1.6%	270=	3.3%
030=	1.4%	120=	2.7%	210=	1.6%	300=	3.2%
060=	1.3%	150=	1.6%	240=	2.5%	330=	6.0%

WAVE HEIGHT 8 - 11 N= 327



360=	1.6%	090=	1.2%	180=	0.2%	270=	0.5%
030=	0.1%	120=	0.7%	210=	0.4%	300=	1.1%
060=	0.1%	150=	0.3%	240=	0.4%	330=	2.1%

WAVE HEIGHT > 11 N= 149



360=	0.7%	090=	0.3%	180=	0.2%	270=	0.1%
030=	0.1%	120=	0.1%	210=	0.1%	300=	0.6%
060=	0.1%	150=	0.0%	240=	0.1%	330=	1.5%

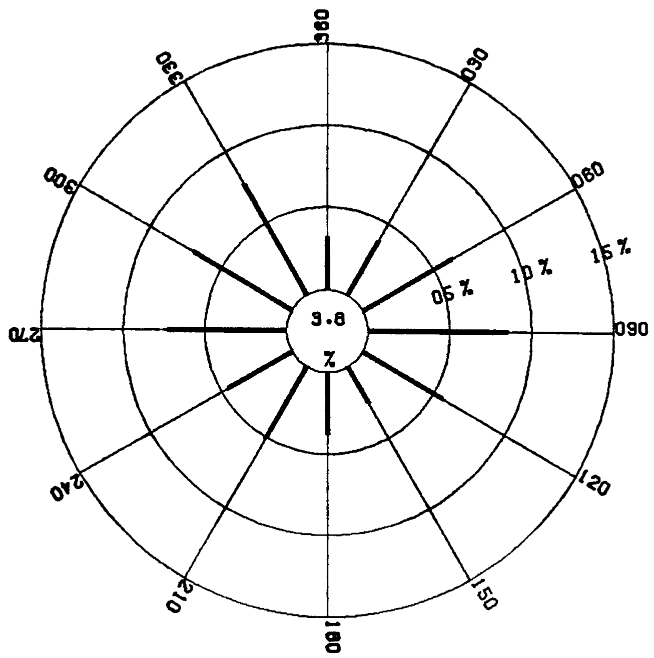
Figure 119

W A V E   R O S E

APRIL 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

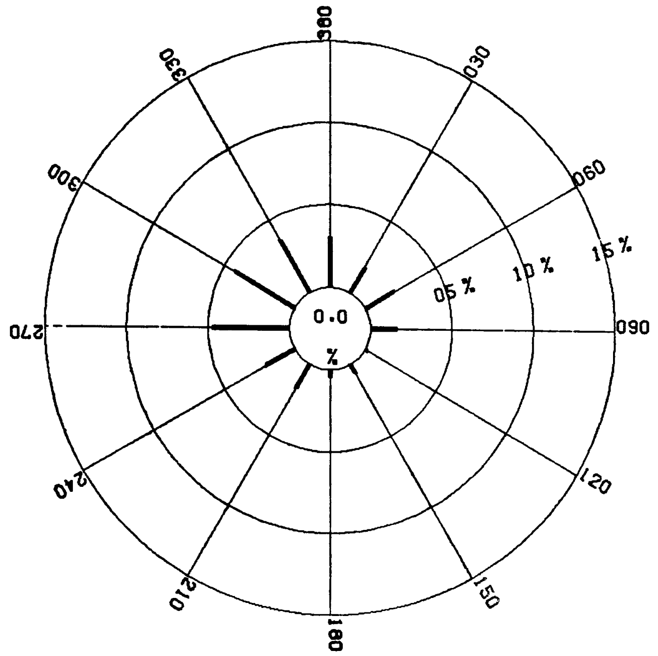
AREA: 56.0N - 57.9N , 6.0E - 7.9E N= 635

WAVE HEIGHT 0 - 3 N= 438



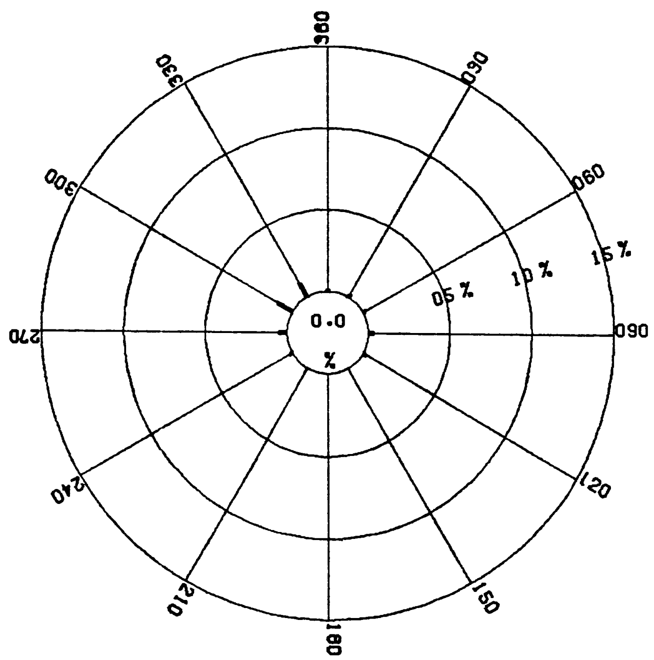
360=	3.1%	090=	8.5%	180=	3.8%	270=	7.2%
030=	3.8%	120=	5.7%	210=	5.0%	300=	6.9%
060=	6.3%	150=	2.5%	240=	4.6%	330=	7.7%

WAVE HEIGHT 4 - 7 N= 165



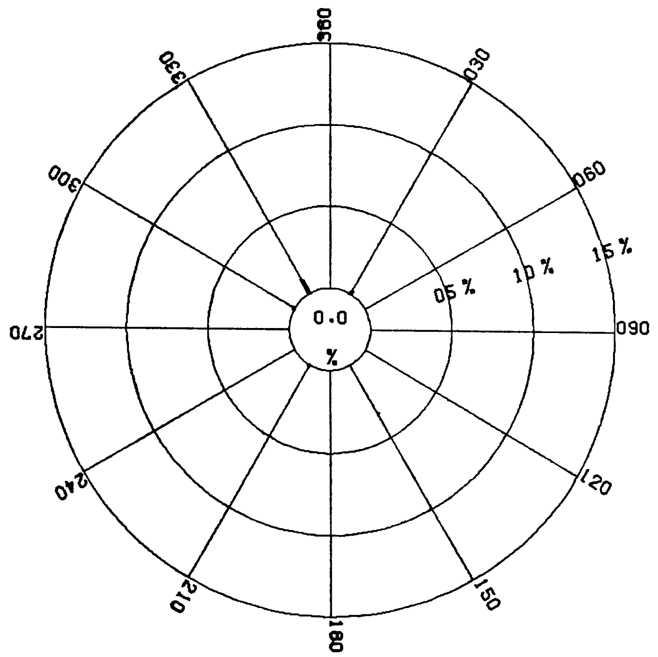
360=	3.0%	090=	1.6%	180=	0.5%	270=	4.7%
030=	1.7%	120=	0.2%	210=	1.7%	300=	4.3%
060=	2.0%	150=	0.6%	240=	2.0%	330=	3.6%

WAVE HEIGHT 8 - 11 N= 23



360=	0.2%	090=	0.3%	180=	0.0%	270=	0.5%
030=	0.2%	120=	0.2%	210=	0.0%	300=	1.1%
060=	[illegible].2%	150=	0.0%	240=	0.2%	330=	0.9%

WAVE HEIGHT > 11 N= 9



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.2%	120=	0.0%	210=	0.2%	300=	0.2%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.9%

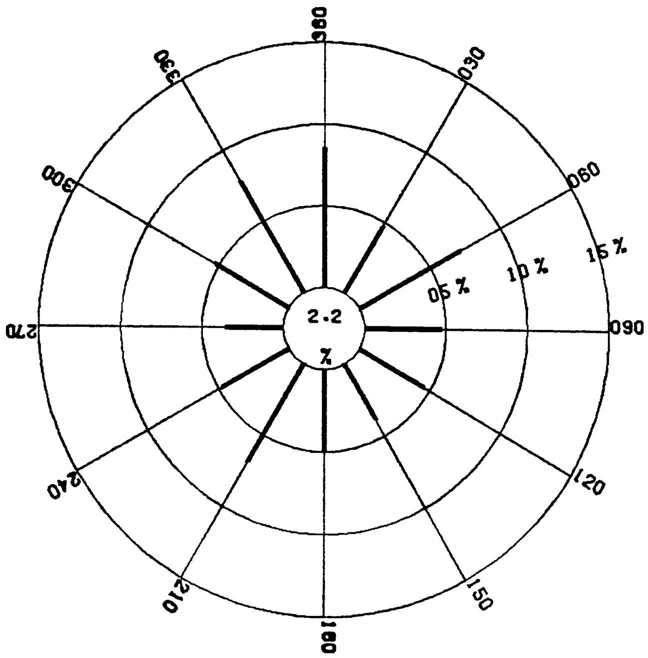
Figure 120

W A V E   R O S E

APRIL 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

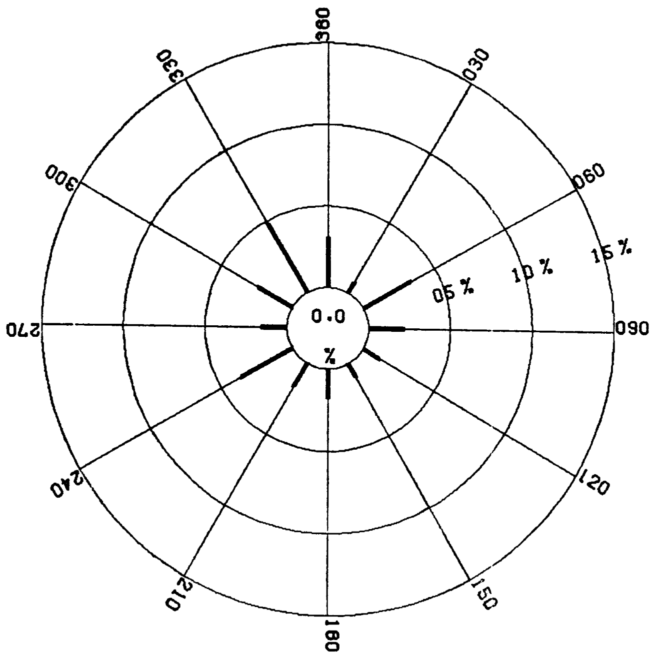
AREA: 54.0N - 55.9N , 2.0E - 3.9E N= 781

WAVE HEIGHT 0 - 3 N= 540



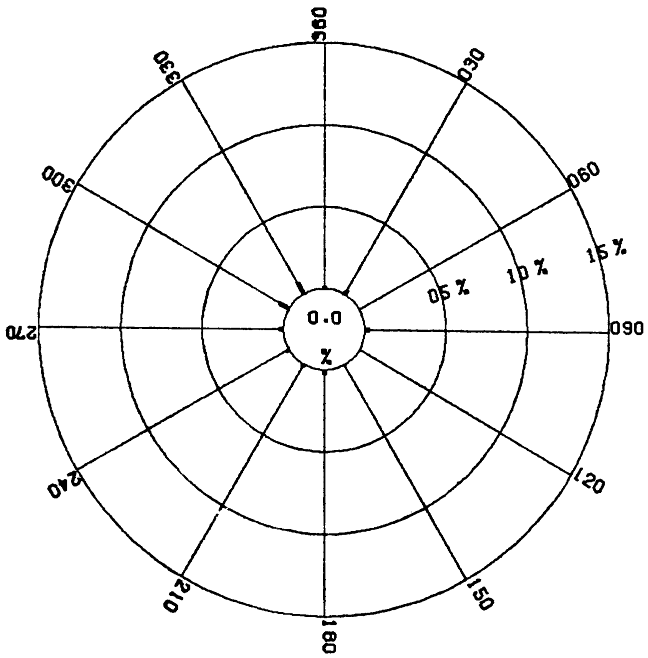
360=	8.6%	090=	4.7%	180=	5.0%	270=	3.6%
030=	4.7%	120=	4.6%	210=	6.9%	300=	5.2%
060=	7.2%	150=	3.8%	240=	4.7%	330=	7.8%

WAVE HEIGHT 4 - 7 N= 213



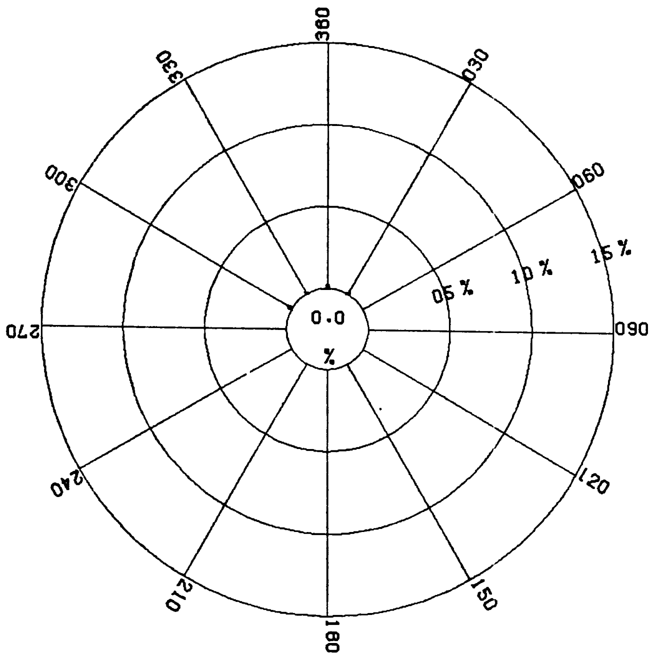
360=	3.1%	090=	2.2%	180=	1.8%	270=	1.5%
030=	0.8%	120=	1.2%	210=	1.7%	300=	2.4%
060=	3.3%	150=	0.9%	240=	3.6%	330=	4.9%

WAVE HEIGHT 8 - 11 N= 22



360=	0.1%	090=	0.3%	180=	0.3%	270=	0.3%
030=	0.3%	120=	0.0%	210=	0.1%	300=	0.6%
060=	0.0%	150=	0.0%	240=	0.1%	330=	0.8%

WAVE HEIGHT > 11 N= 6



360=	0.3%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.1%	120=	0.0%	210=	0.0%	300=	0.3%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.1%

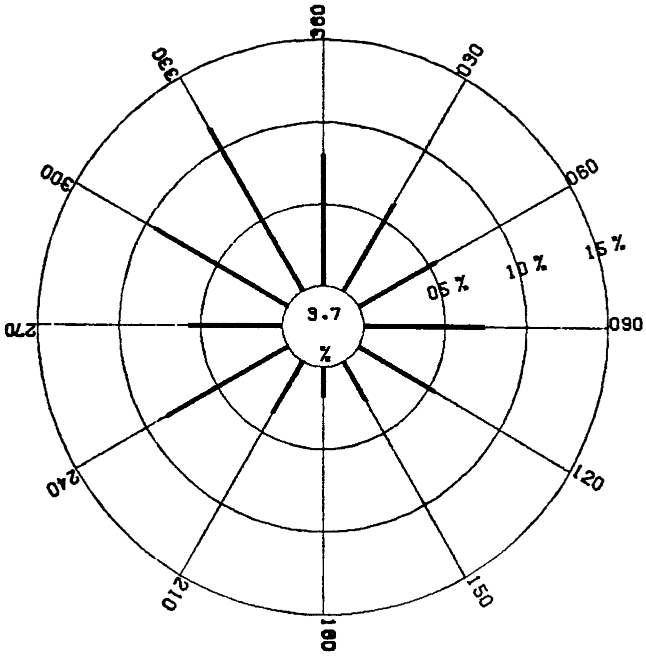
Figure 121

W A V E   R O S E

APRIL 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

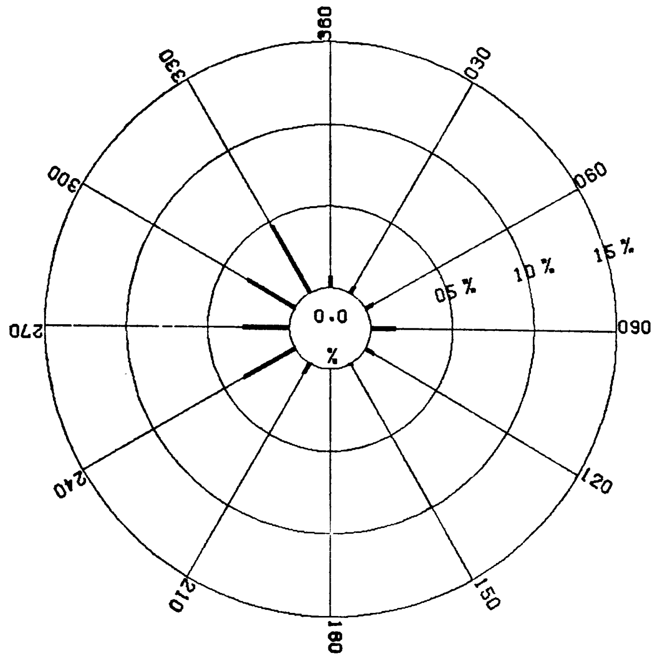
AREA: 54.0N - 54.9N , 6.0E - 8.9E N= 2254

WAVE HEIGHT 0 - 3 N= 1793



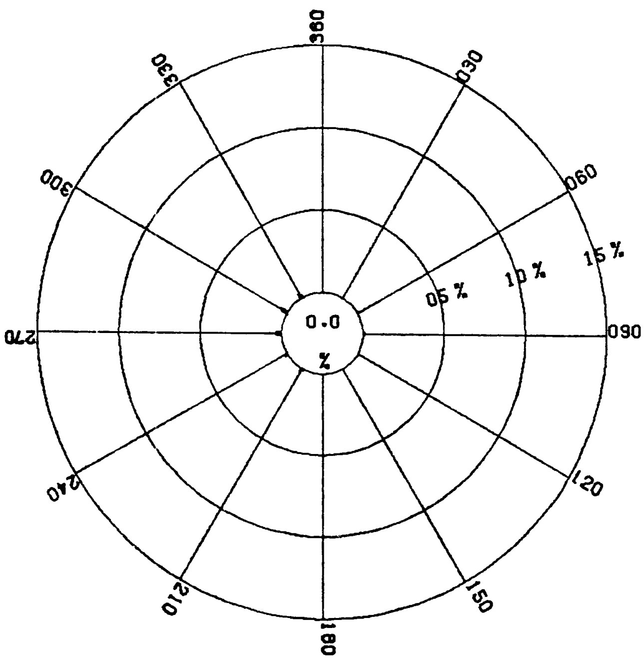
360=	8.0%	090=	7.4%	180=	1.8%	270=	5.7%
030=	6.2%	120=	5.4%	210=	3.7%	300=	9.4%
060=	5.5%	150=	2.8%	240=	8.6%	330=	11.4%

WAVE HEIGHT 4 - 7 N= 429



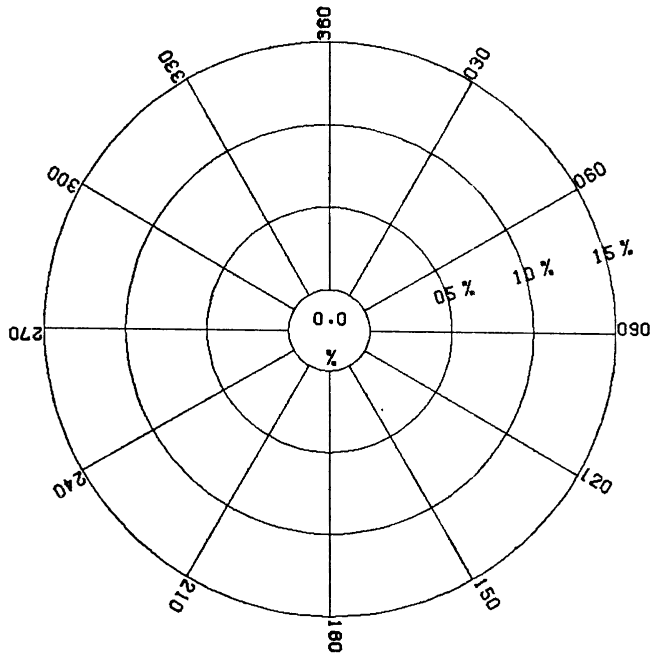
360=	0.7%	090=	1.5%	180=	0.0%	270=	2.8%
030=	0.4%	120=	0.6%	210=	0.8%	300=	3.4%
060=	0.5%	150=	0.1%	240=	3.6%	330=	4.7%

WAVE HEIGHT 8 - 11 N= 32



360=	0.0%	090=	0.1%	180=	0.0%	270=	0.3%
030=	0.0%	120=	0.0%	210=	0.1%	300=	0.4%
060=	0.0%	150=	0.0%	240=	0.1%	330=	0.3%

WAVE HEIGHT > 11 N= 0



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

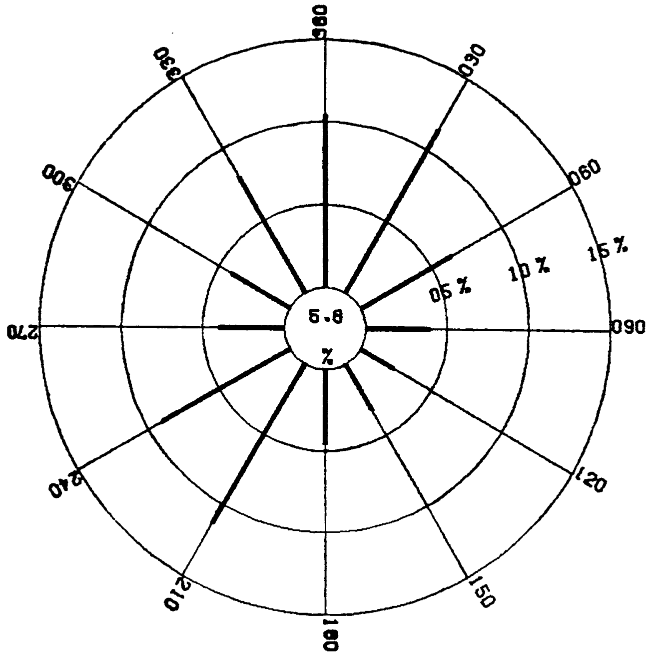
Figure 122

W A V E   R O S E

APRIL 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

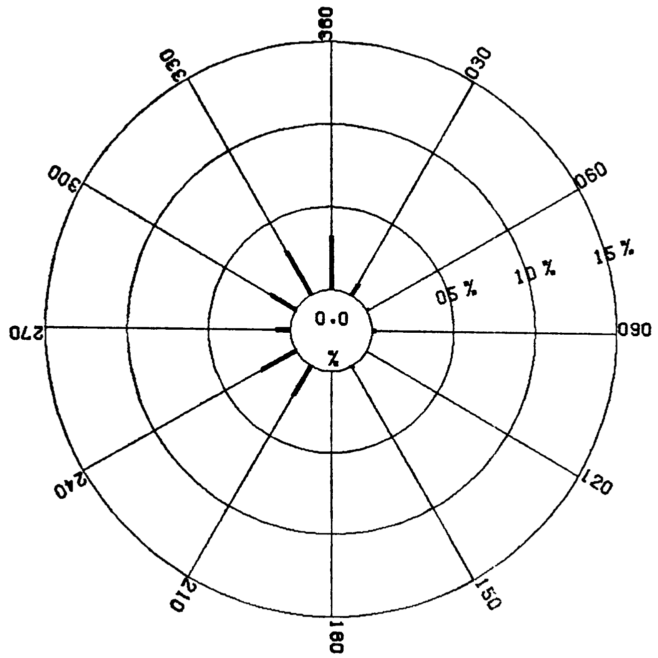
AREA: 52.0N - 52.9N , 3.0E - 4.9E N= 900

WAVE HEIGHT 0 - 3 N= 761



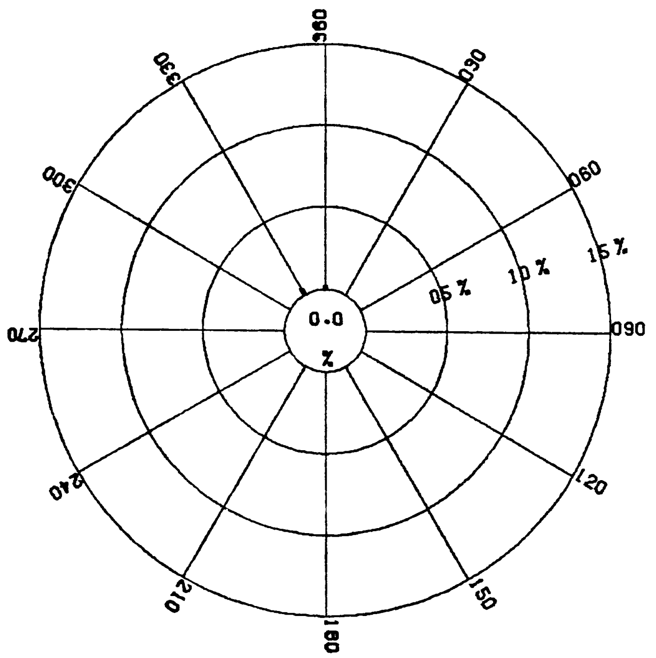
360=	10.4%	090=	3.9%	180=	4.6%	270=	4.0%
030=	11.4%	120=	2.3%	210=	11.3%	300=	4.1%
060=	6.4%	150=	3.2%	240=	9.0%	330=	8.0%

WAVE HEIGHT 4 - 7 N= 132



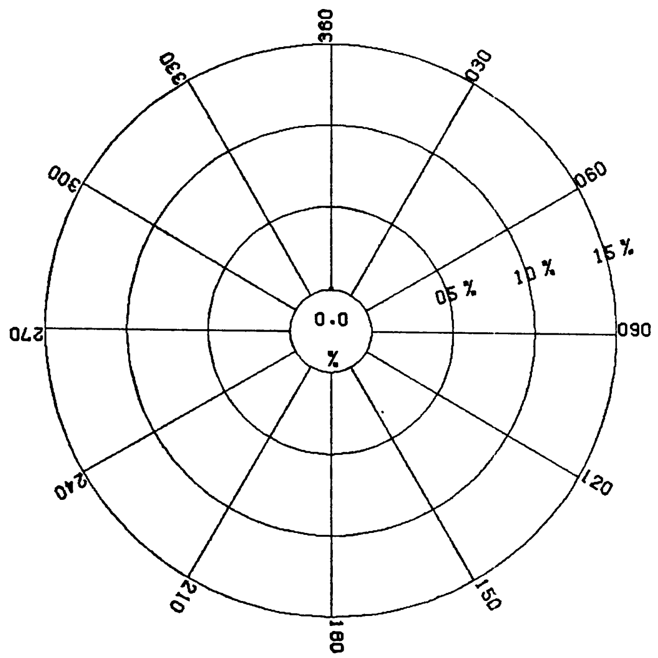
360=	3.2%	090=	0.2%	180=	0.0%	270=	0.9%
030=	0.8%	120=	0.0%	210=	2.1%	300=	1.8%
060=	0.1%	150=	0.1%	240=	2.4%	330=	3.0%

WAVE HEIGHT 8 - 11 N= 6



360=	0.2%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.4%

WAVE HEIGHT > 11 N= 1



360=	0.1%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

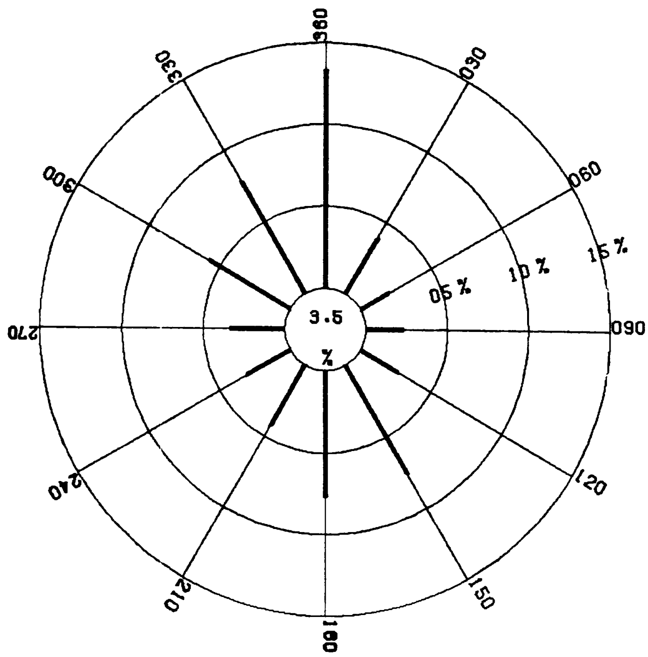
Figure 123

W A V E   R O S E

JULY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

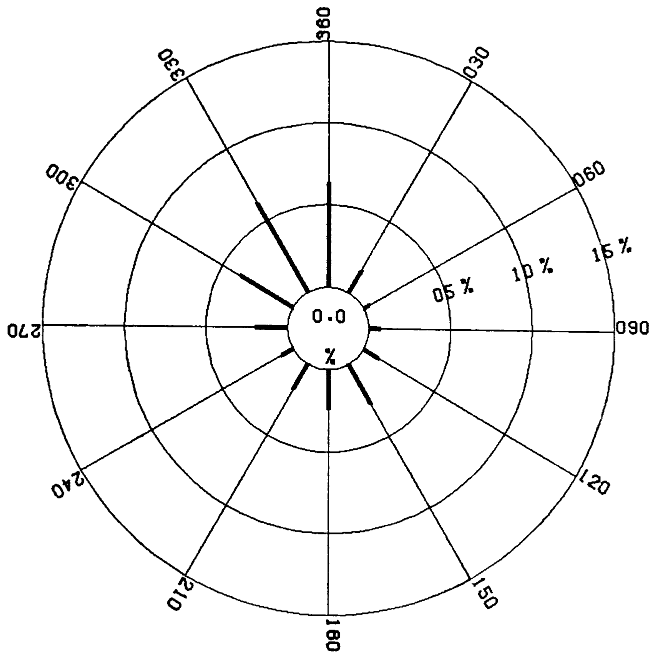
AREA: 58.0N - 59.9N , 0.0E - 1.9E N= 1532

WAVE HEIGHT 0 - 3 N= 1027



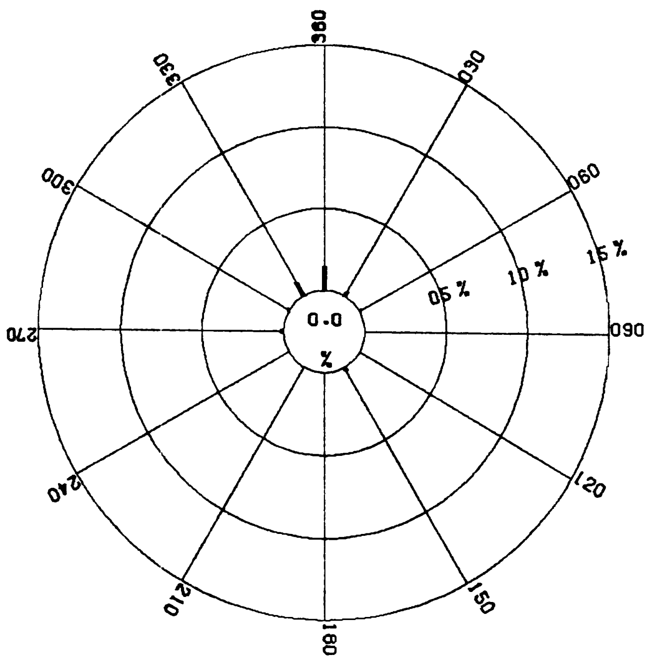
360=	13.3%	090=	2.3%	180=	7.7%	270=	3.3%
030=	3.9%	120=	2.7%	210=	4.2%	300=	5.7%
060=	2.0%	150=	7.6%	240=	3.1%	330=	7.8%

WAVE HEIGHT 4 - 7 N= 455



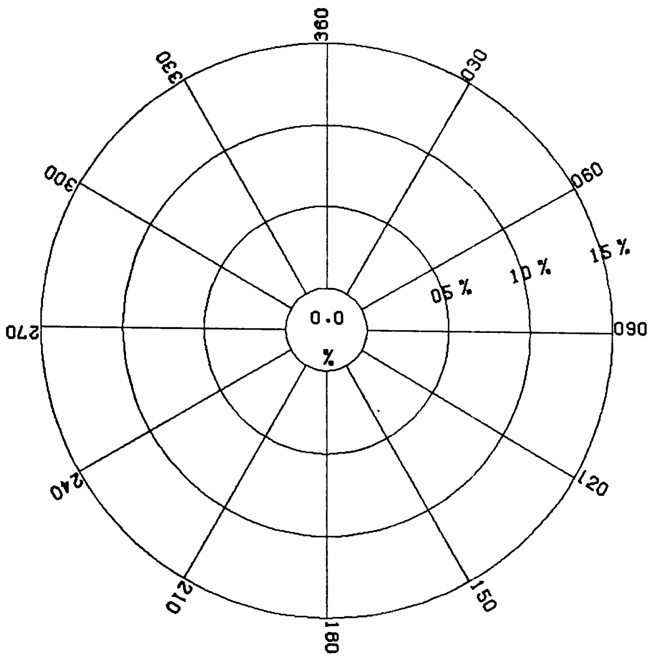
360=	6.3%	090=	0.7%	180=	2.4%	270=	2.0%
030=	1.6%	120=	1.0%	210=	1.8%	300=	3.7%
060=	0.4%	150=	2.7%	240=	0.8%	330=	6.2%

WAVE HEIGHT 8 - 11 N= 50



360=	1.4%	090=	0.0%	180=	0.0%	270=	0.2%
030=	0.3%	120=	0.0%	210=	0.0%	300=	0.1%
060=	0.1%	150=	0.2%	240=	0.0%	330=	0.9%

WAVE HEIGHT > 11 N= 0



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

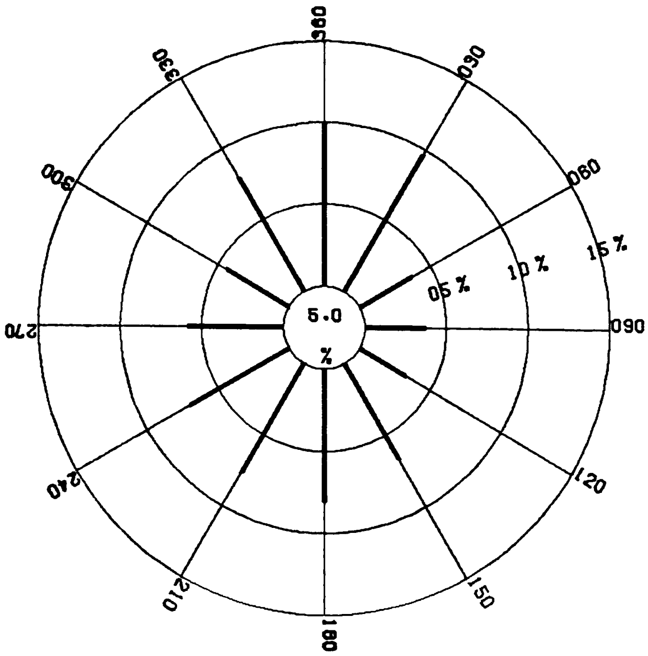
Figure 124

W A V E   R O S E

JULY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

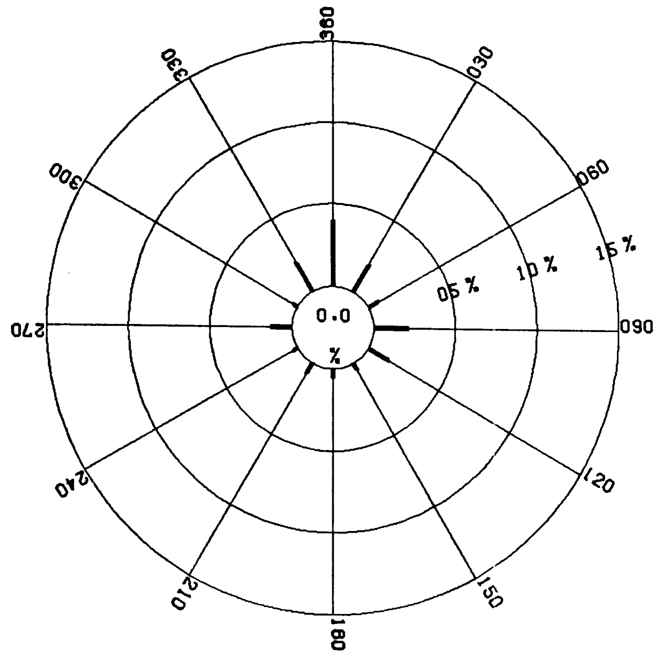
AREA: 56.0N - 57.9N . 0.0W - 1.9W N= 704

WAVE HEIGHT 0 - 3 N= 583



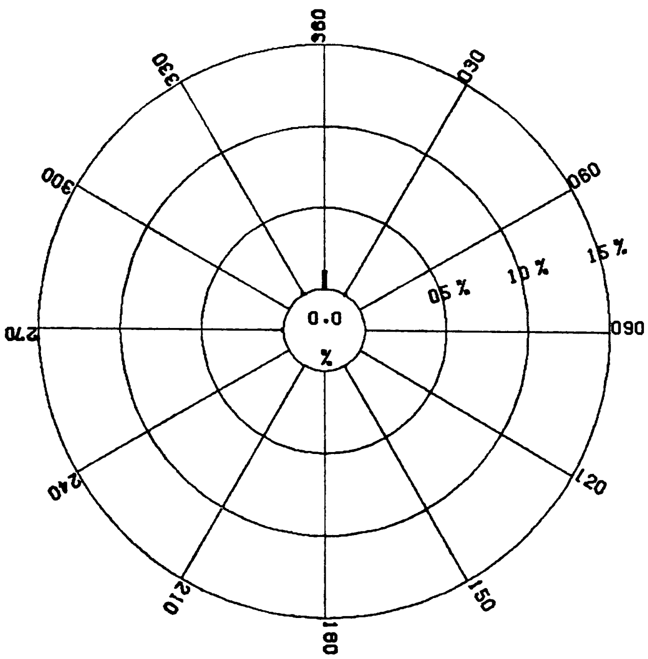
360=	9.9%	090=	3.7%	180=	8.1%	270=	5.8%
030=	9.7%	120=	3.3%	210=	7.7%	300=	4.4%
060=	3.7%	150=	6.7%	240=	7.0%	330=	8.0%

WAVE HEIGHT 4 - 7 N= 110



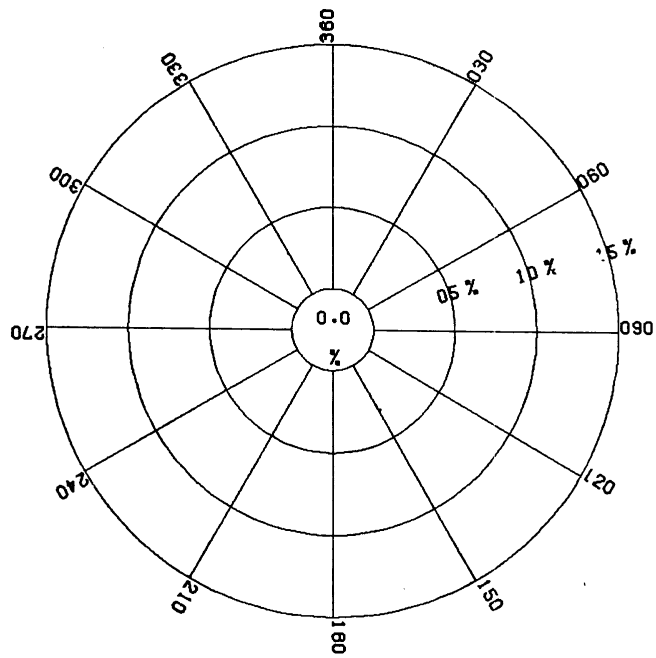
360=	4.0%	090=	2.1%	180=	0.6%	270=	1.3%
030=	1.8%	120=	1.4%	210=	0.7%	300=	0.3%
060=	0.7%	150=	0.4%	240=	0.3%	330=	2.0%

WAVE HEIGHT 8 - 11 N= 11



360=	1.1%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.1%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.1%

WAVE HEIGHT > 11 N= 0



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

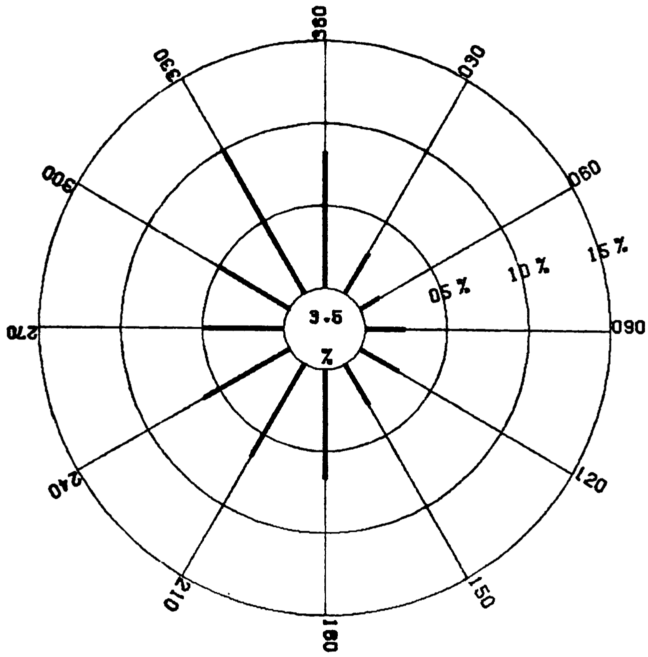
Figure 125

W A V E   R O S E

JULY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

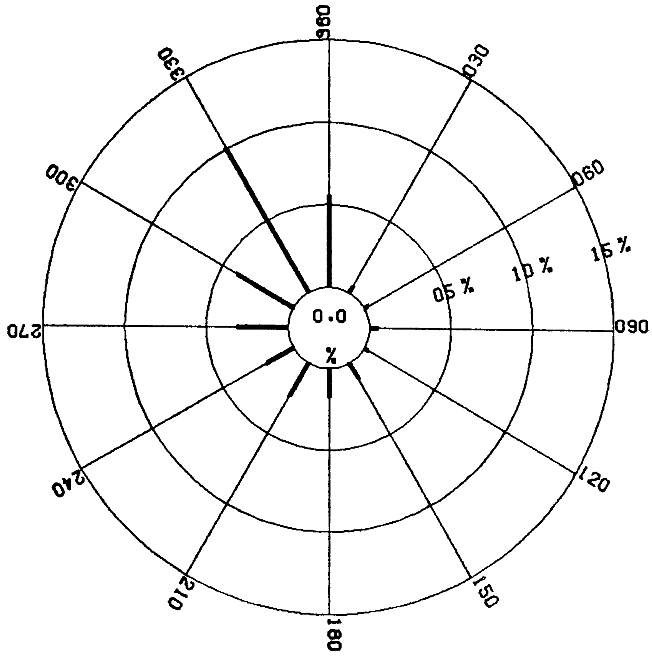
AREA: 56.0N - 57.9N , 2.0E - 3.9E N= 2658

WAVE HEIGHT 0 - 3 N= 1671



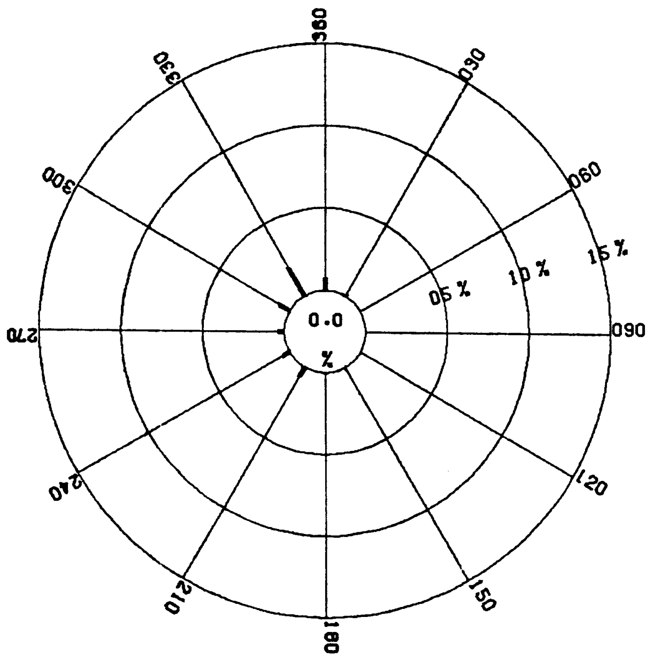
360=	8.2%	090=	2.4%	180=	6.7%	270=	5.0%
030=	2.8%	120=	2.7%	210=	6.5%	300=	4.9%
060=	1.3%	150=	2.8%	240=	6.0%	330=	10.0%

WAVE HEIGHT 4 - 7 N= 830



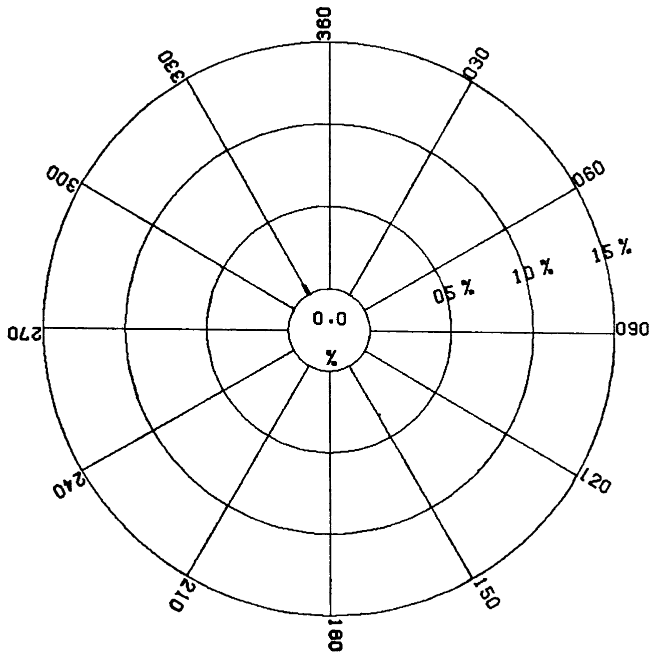
360=	5.5%	090=	0.5%	180=	1.8%	270=	3.1%
030=	0.5%	120=	0.3%	210=	2.4%	300=	4.0%
060=	0.3%	150=	1.1%	240=	1.9%	330=	10.0%

WAVE HEIGHT 8 - 11 N= 138



360=	0.8%	090=	0.0%	180=	0.0%	270=	0.4%
030=	0.1%	120=	0.0%	210=	0.6%	300=	0.8%
060=	0.0%	150=	0.1%	240=	0.5%	330=	2.0%

WAVE HEIGHT > 11 N= 19



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.6%

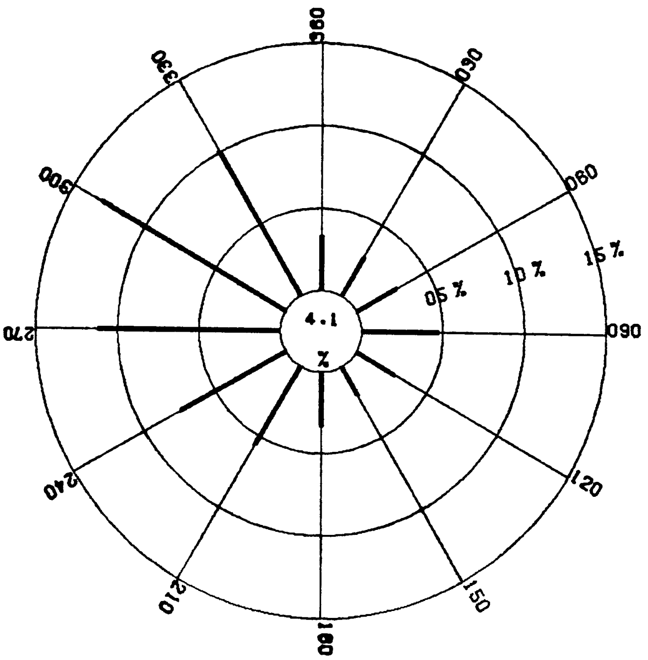
Figure 126

W A V E   R O S E

JULY   1961 - 1980   (WAVE HEIGHT IN 0.5M VALUES)

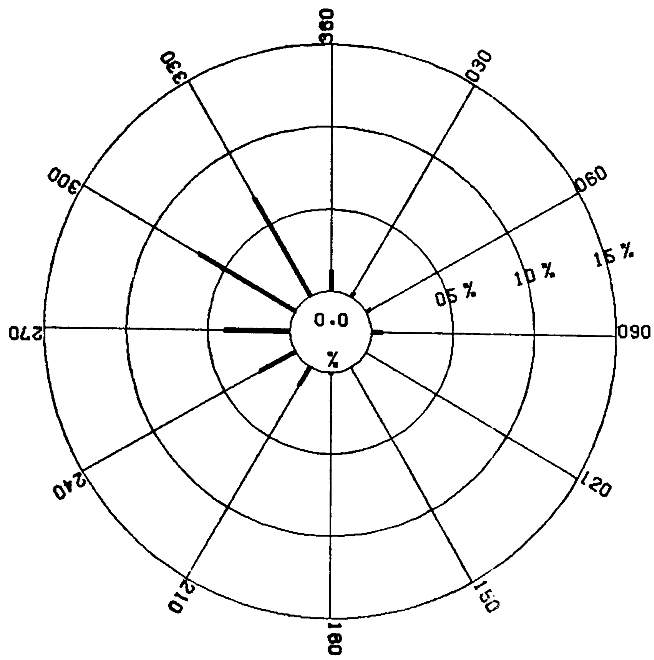
AREA: 56.0N - 57.9N , 6.0E - 7.9E   N= 805

WAVE HEIGHT 0 - 3   N= 589



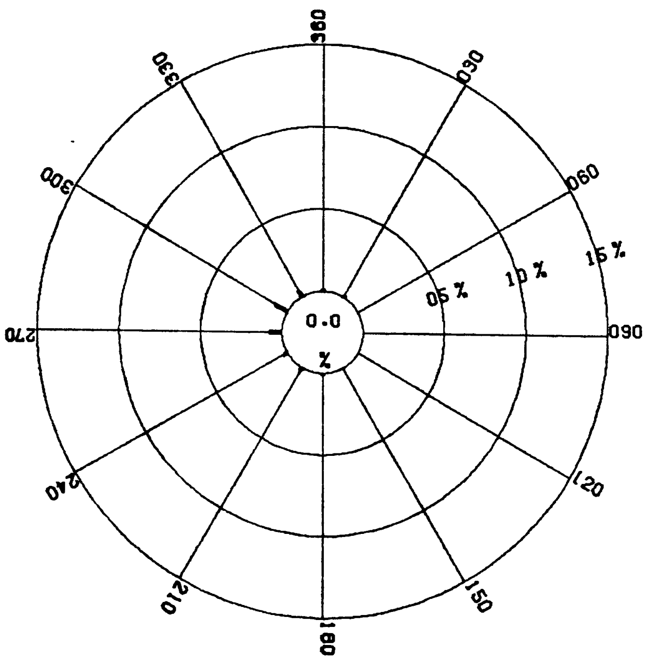
360=	3.4%	090=	4.7%	180=	3.4%	270=	11.2%
030=	2.7%	120=	2.7%	210=	5.6%	300=	13.0%
060=	2.9%	150=	2.0%	240=	7.5%	330=	10.1%

WAVE HEIGHT 4 - 7   N= 193



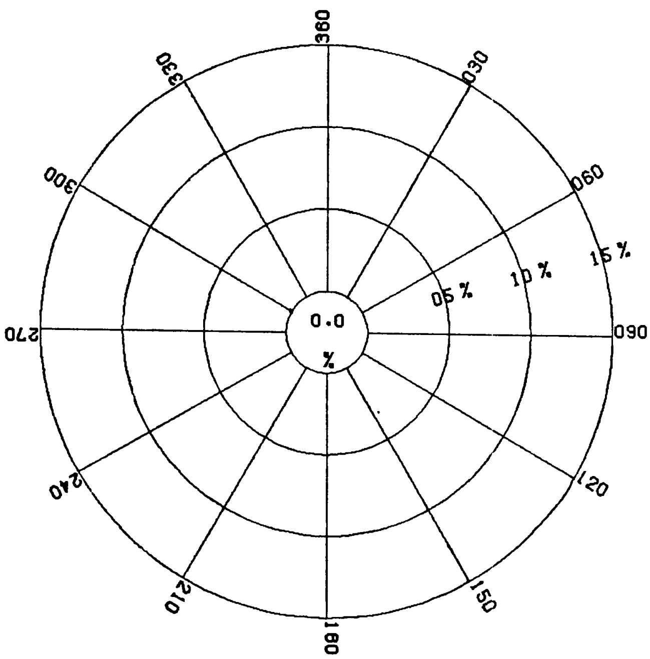
360=	1.2%	090=	0.6%	180=	0.1%	270=	4.0%
030=	0.2%	120=	0.0%	210=	1.4%	300=	6.8%
060=	0.2%	150=	0.0%	240=	2.5%	330=	6.8%

WAVE HEIGHT 8 - 11   N= 22



360=	0.1%	090=	0.0%	180=	0.1%	270=	0.7%
030=	0.1%	120=	0.0%	210=	0.1%	300=	0.9%
060=	0.0%	150=	0.0%	240=	0.2%	330=	0.4%

WAVE HEIGHT > 11   N= 1



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

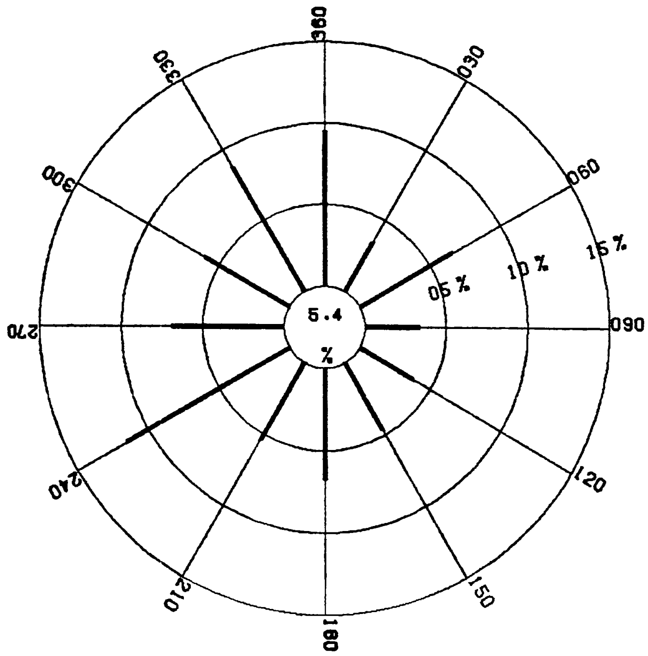
Figure 127

W A V E   R O S E

JULY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

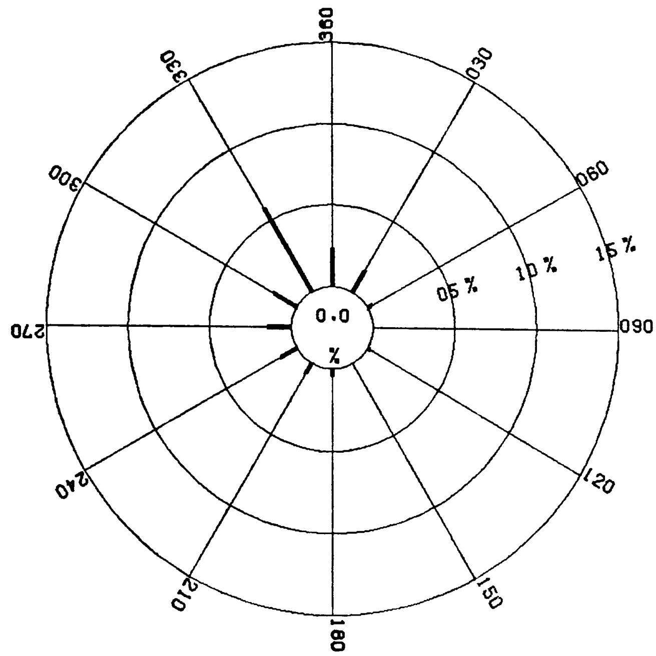
AREA: 54.0N - 55.9N , 2.0E - 3.9E N= 683

WAVE HEIGHT 0 - 3 N= 562



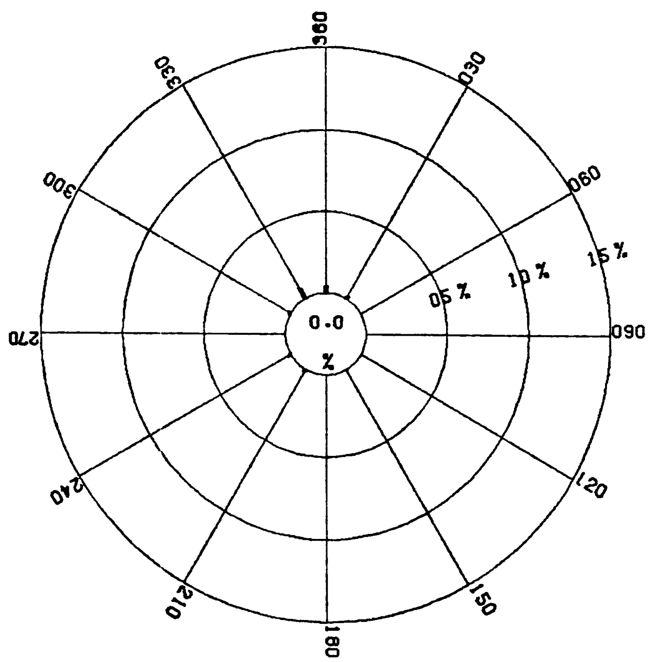
360=	9.5%	090=	3.4%	180=	6.7%	270=	6.9%
030=	3.5%	120=	3.8%	210=	5.4%	300=	6.0%
060=	6.6%	150=	4.7%	240=	11.6%	330=	8.8%

WAVE HEIGHT 4 - 7 N= 106



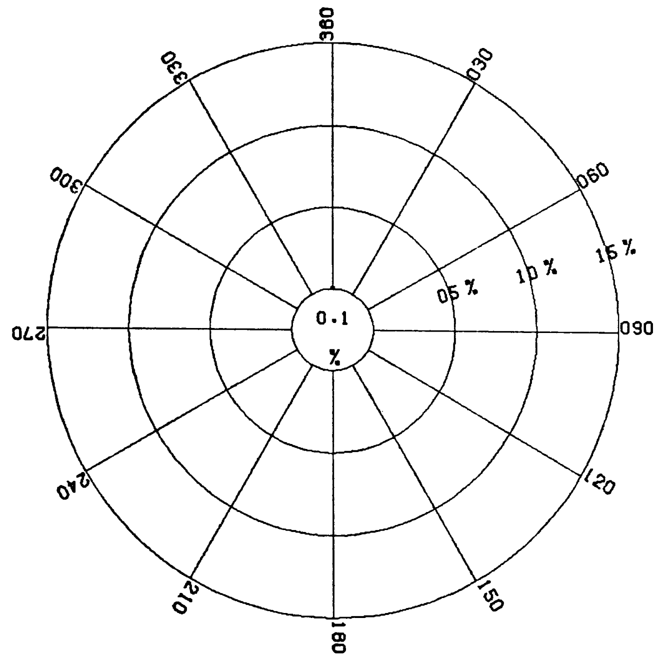
360=	2.3%	090=	0.0%	180=	0.4%	270=	1.5%
030=	1.5%	120=	0.1%	210=	0.7%	300=	1.6%
060=	0.3%	150=	0.0%	240=	1.2%	330=	5.9%

WAVE HEIGHT 8 - 11 N= 12



360=	0.4%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.1%	120=	0.0%	210=	0.1%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.1%	330=	0.7%

WAVE HEIGHT > 11 N= 3



360=	0.1%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

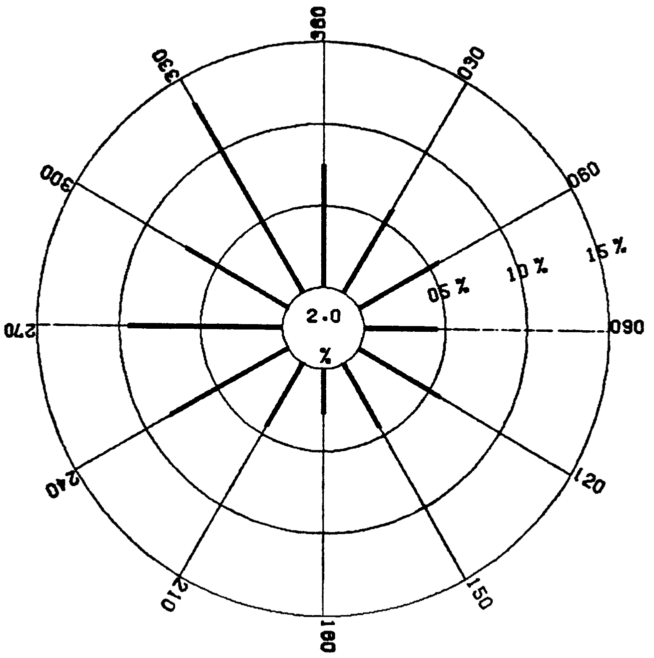
Figure 128

W A V E R O S E

JULY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

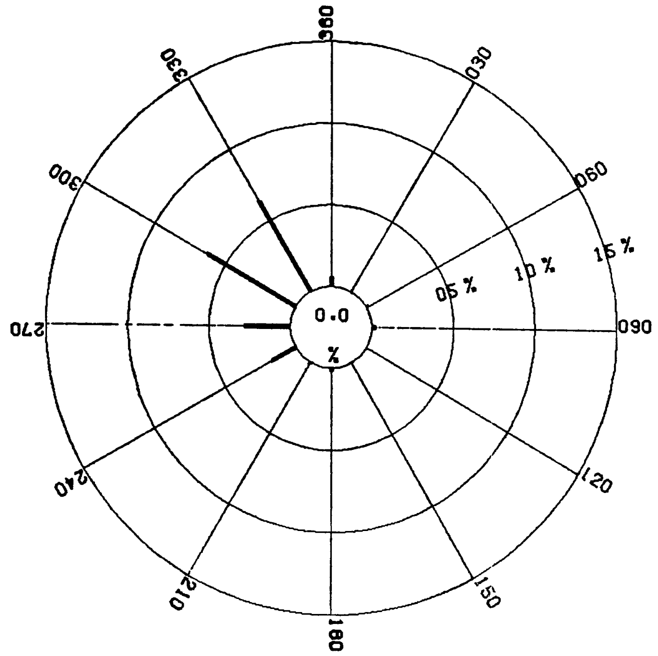
AREA: 54.0N - 54.9N , 6.0E - 8.9E N= 2166

WAVE HEIGHT 0 - 3 N= 1756



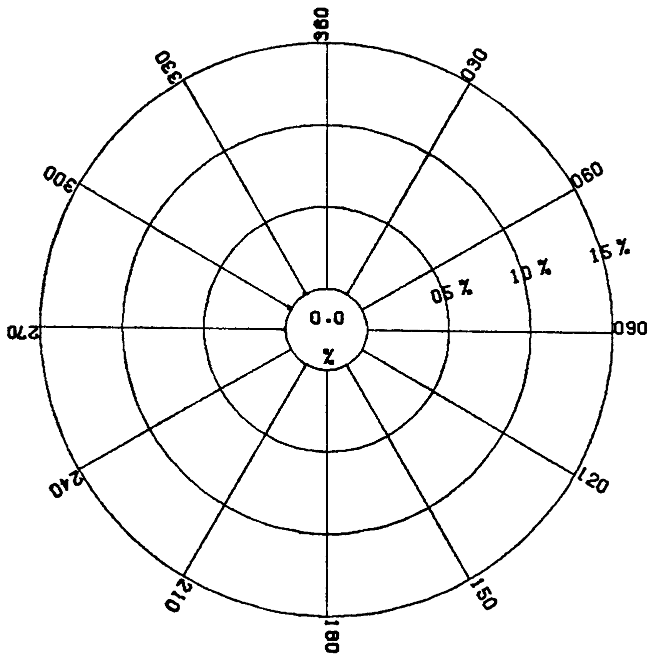
360=	7.5%	090=	4.5%	180=	2.7%	270=	9.4%
030=	5.9%	120=	5.7%	210=	4.5%	300=	7.2%
060=	5.7%	150=	4.4%	240=	8.3%	330=	13.3%

WAVE HEIGHT 4 - 7 N= 400



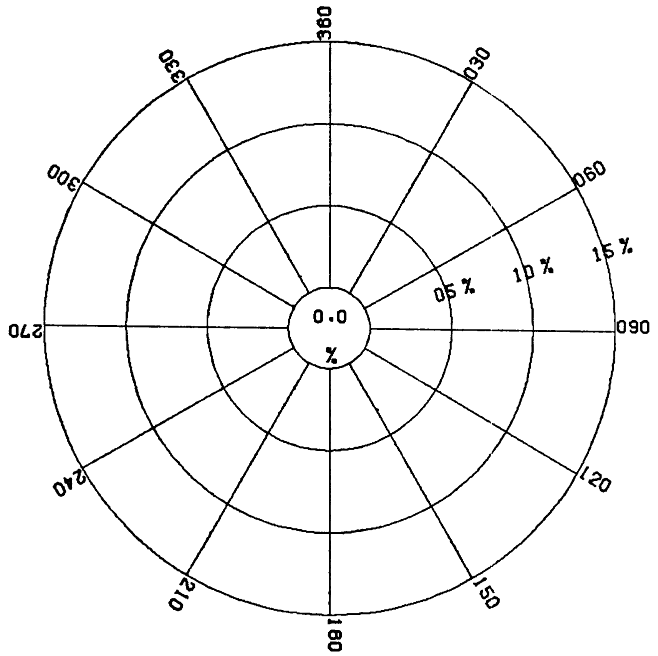
360=	0.6%	090=	0.2%	180=	0.2%	270=	2.8%
030=	0.0%	120=	0.0%	210=	0.1%	300=	6.3%
060=	0.1%	150=	0.0%	240=	1.7%	330=	6.4%

WAVE HEIGHT 8 - 11 N= 9



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.2%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.1%

WAVE HEIGHT > 11 N= 1



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

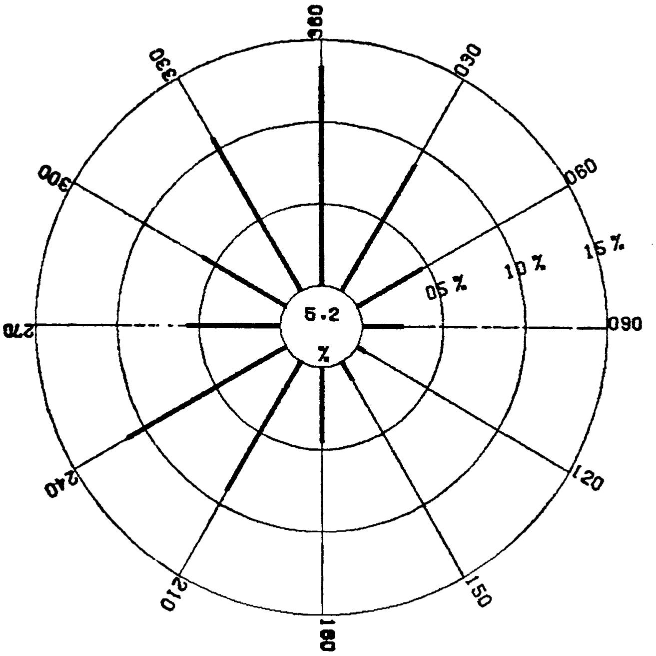
Figure 129

W A V E R O S E

JULY 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

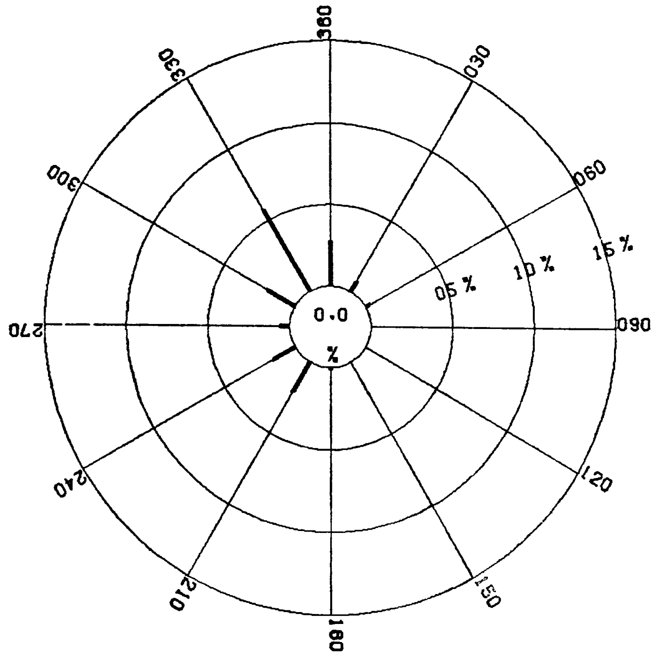
AREA: 52.0N - 52.9N , 3.0E - 4.9E N= 695

WAVE HEIGHT 0 - 3 N= 582



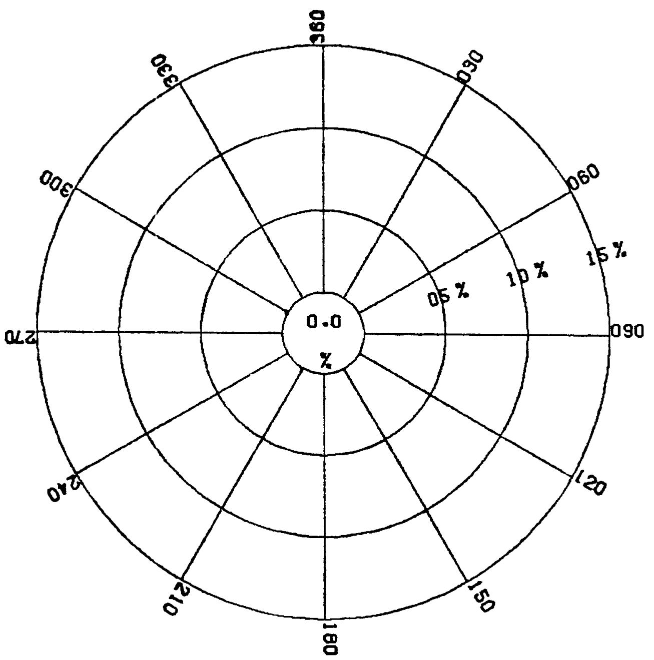
360=	13.4%	090=	2.4%	180=	4.6%	270=	5.8%
030=	8.9%	120=	0.8%	210=	9.1%	300=	5.9%
060=	4.6%	150=	1.3%	240=	11.2%	330=	10.8%

WAVE HEIGHT 4 - 7 N= 111



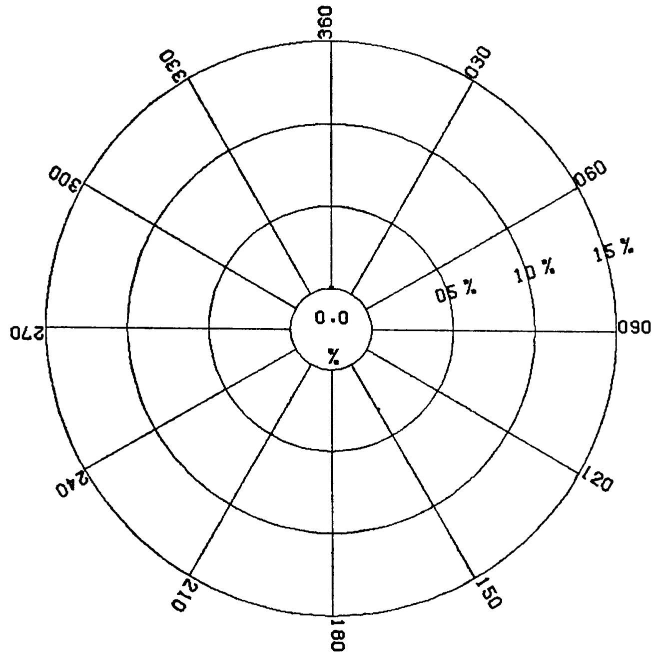
360=	2.7%	090=	0.0%	180=	0.1%	270=	0.6%
030=	0.7%	120=	0.0%	210=	2.2%	300=	2.0%
060=	0.3%	150=	0.0%	240=	1.6%	330=	5.8%

WAVE HEIGHT 8 - 11 N= 1



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.1%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

WAVE HEIGHT > 11 N= 1



360=	0.1%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

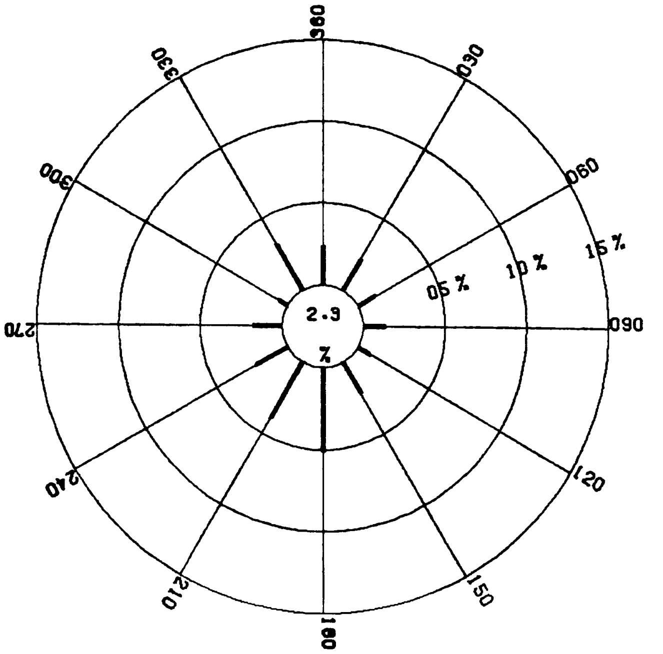
Figure 130

W A V E   R O S E

OCTOBER 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

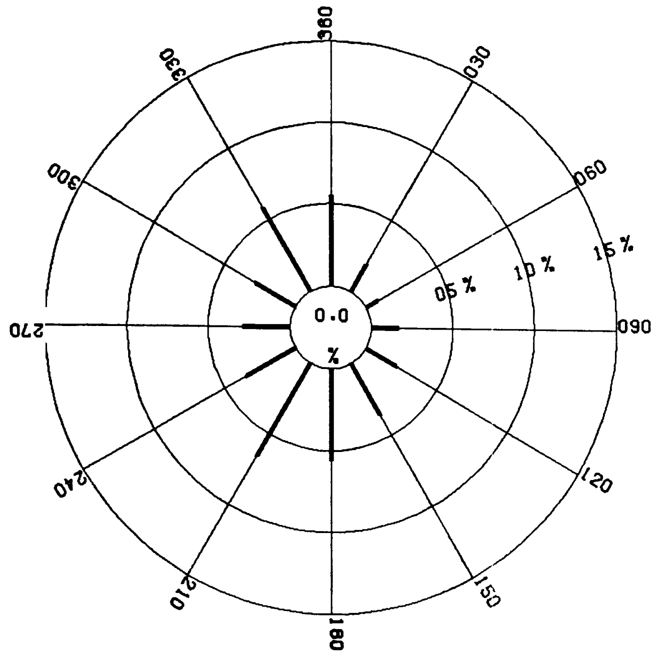
AREA: 58.0N - 59.9N , 0.0E - 1.9E N= 838

WAVE HEIGHT 0 - 3 N= 245



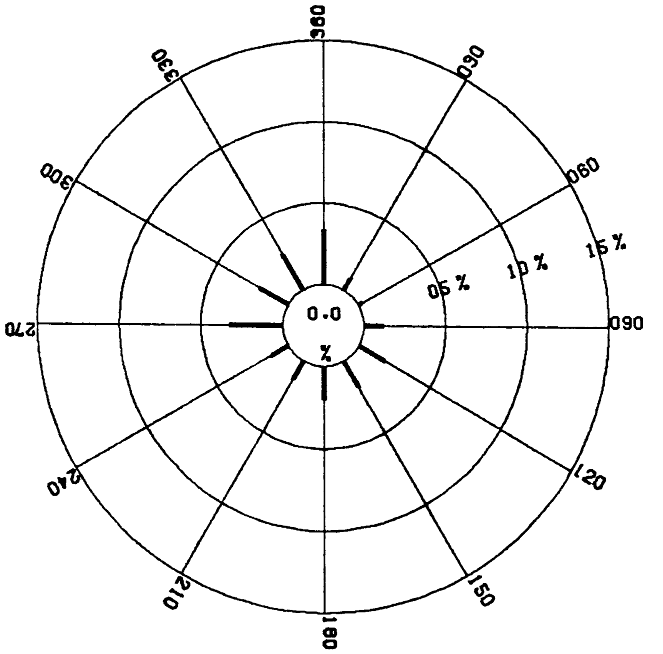
360=	2.4%	090=	1.3%	180=	5.1%	270=	1.6%
030=	2.1%	120=	0.8%	210=	3.9%	300=	0.6%
060=	1.2%	150=	2.1%	240=	2.3%	330=	3.2%

WAVE HEIGHT 4 - 7 N= 359



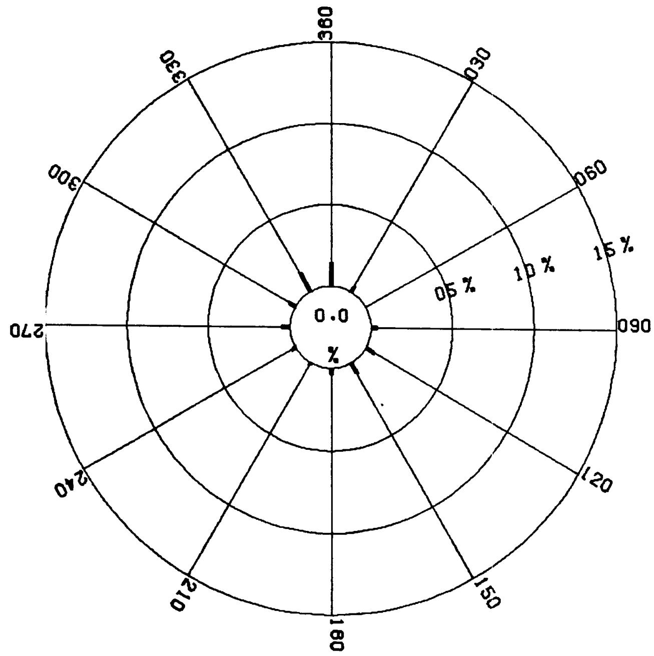
360=	5.5%	090=	1.7%	180=	5.6%	270=	2.9%
030=	1.9%	120=	2.1%	210=	6.6%	300=	2.9%
060=	0.8%	150=	3.6%	240=	3.5%	330=	5.8%

WAVE HEIGHT 8 - 11 N= 180



360=	3.3%	090=	1.2%	180=	2.0%	270=	3.2%
030=	0.8%	120=	1.8%	210=	1.3%	300=	2.0%
060=	0.2%	150=	1.8%	240=	1.2%	330=	2.5%

WAVE HEIGHT > 11 N= 54



360=	1.4%	090=	0.4%	180=	0.4%	270=	0.5%
030=	0.4%	120=	0.6%	210=	0.1%	300=	0.5%
060=	0.0%	150=	0.7%	240=	0.2%	330=	1.3%

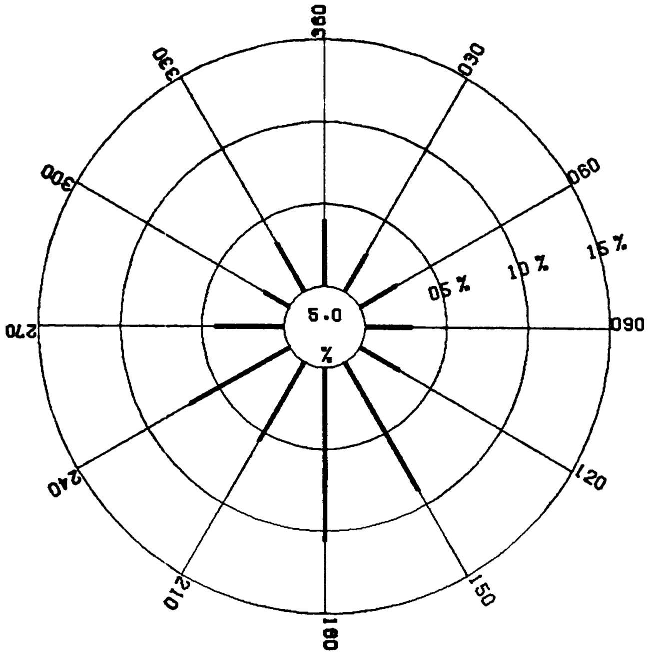
Figure 131

W A V E   R O S E

OCTOBER 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

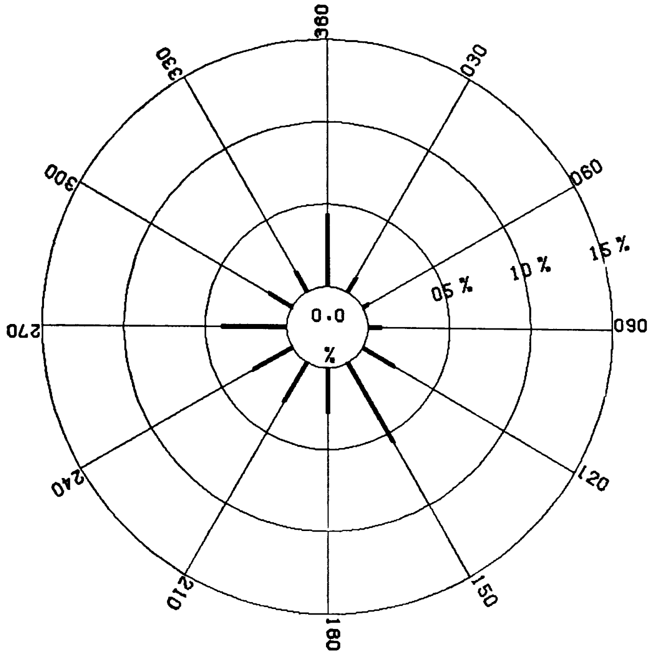
AREA: 56.0N - 57.9N , 0.0W - 1.9W N= 499

WAVE HEIGHT 0 - 3 N= 307



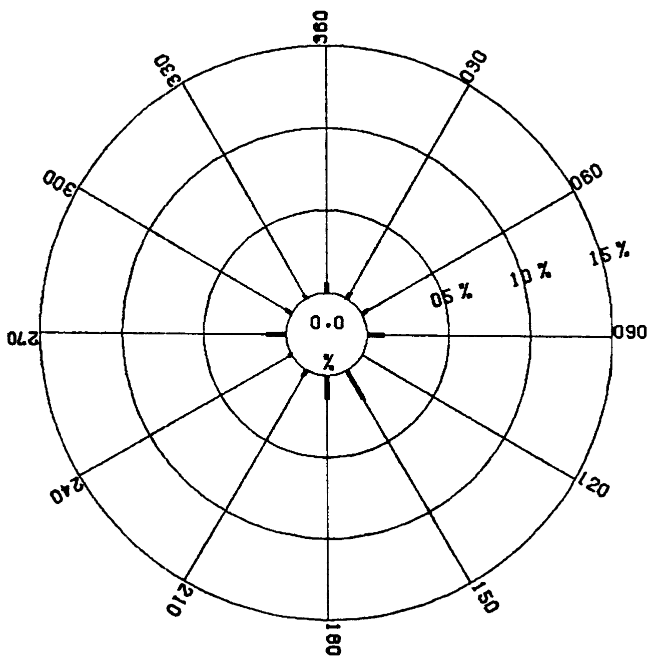
360=	4.0%	090=	2.8%	180=	10.6%	270=	4.2%
030=	2.6%	120=	2.8%	210=	5.6%	300=	1.8%
060=	2.6%	150=	9.0%	240=	7.0%	330=	3.4%

WAVE HEIGHT 4 - 7 N= 149



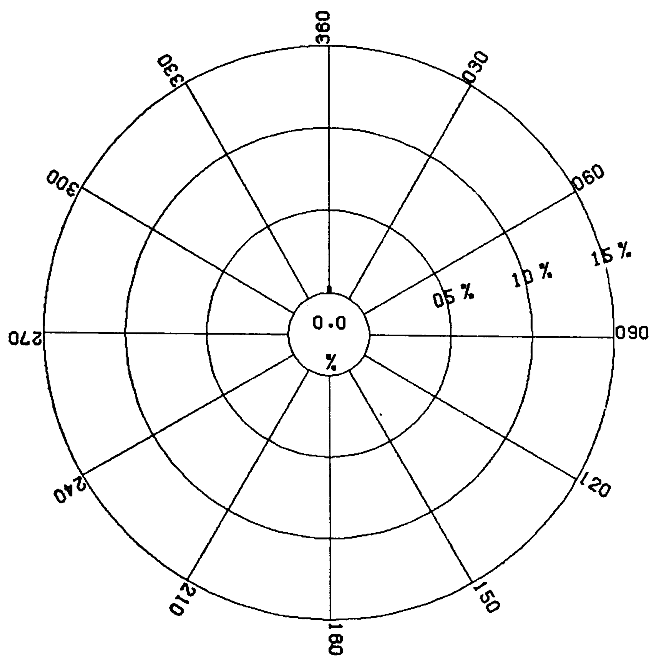
360=	4.4%	090=	0.8%	180=	2.8%	270=	4.0%
030=	1.0%	120=	2.2%	210=	2.8%	300=	1.6%
060=	0.4%	150=	5.6%	240=	2.8%	330=	1.4%

WAVE HEIGHT 8 - 11 N= 41



360=	0.6%	090=	1.0%	180=	1.4%	270=	1.2%
030=	0.4%	120=	0.0%	210=	0.4%	300=	0.4%
060=	0.4%	150=	2.0%	240=	0.2%	330=	0.2%

WAVE HEIGHT > 11 N= 2



360=	0.4%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

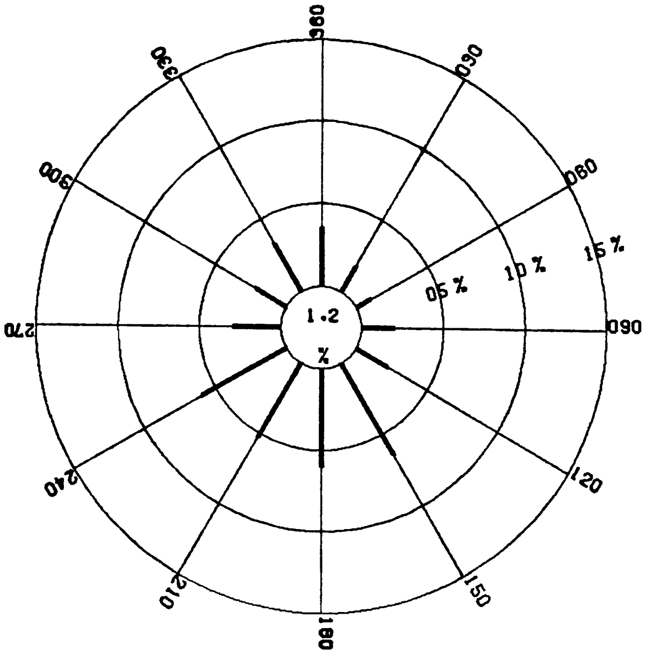
Figure 132

W A V E   R O S E

OCTOBER 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

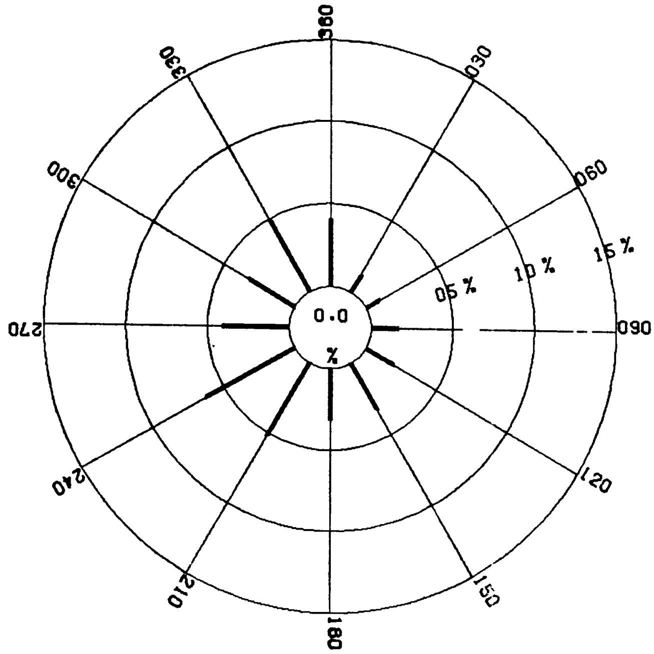
AREA: 56.0N - 57.9N , 2.0E - 3.9E N= 4741

WAVE HEIGHT 0 - 3 N= 2078



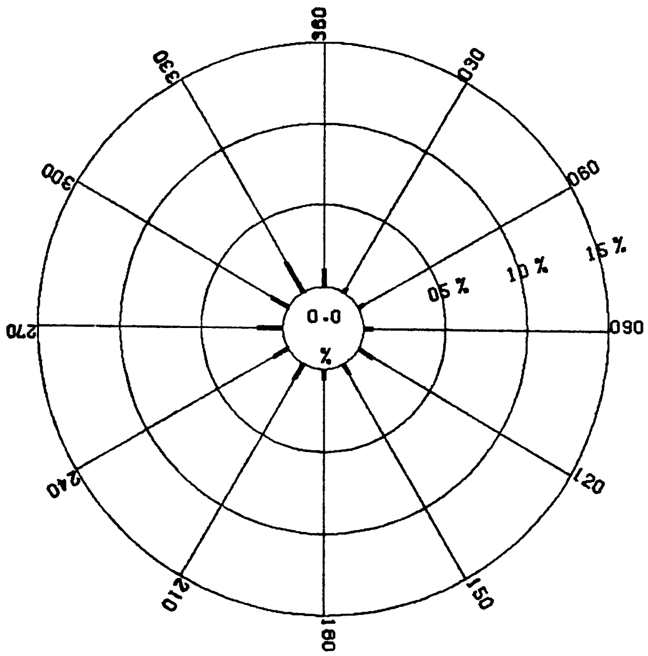
360=	3.5%	090=	1.9%	180=	6.0%	270=	3.0%
030=	1.8%	120=	2.2%	210=	5.3%	300=	2.2%
060=	1.0%	150=	6.4%	240=	6.0%	330=	3.3%

WAVE HEIGHT 4 - 7 N= 1892



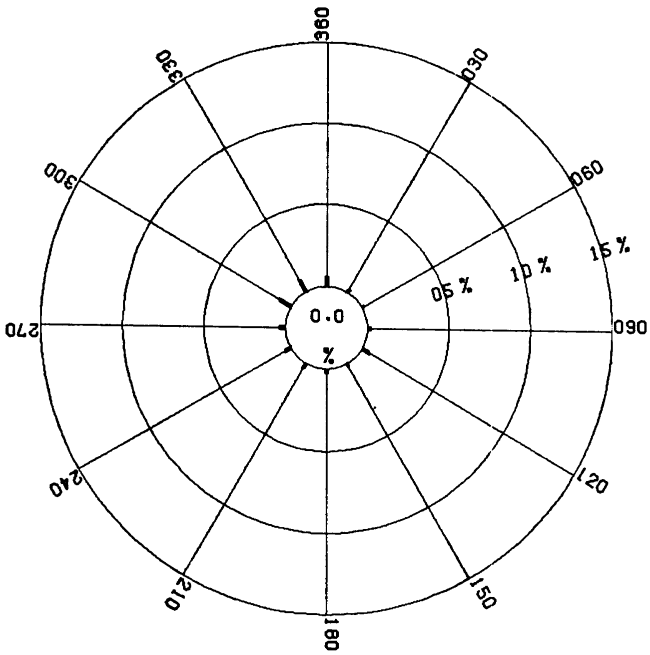
360=	4.1%	090=	1.7%	180=	3.1%	270=	4.1%
030=	1.2%	120=	2.0%	210=	5.2%	300=	3.2%
060=	0.9%	150=	3.2%	240=	6.3%	330=	4.9%

WAVE HEIGHT 8 - 11 N= 544



360=	1.1%	090=	0.5%	180=	0.7%	270=	1.5%
030=	0.3%	120=	1.0%	210=	1.1%	300=	1.2%
060=	0.3%	150=	0.7%	240=	1.0%	330=	2.1%

WAVE HEIGHT > 11 N= 227



360=	0.6%	090=	0.2%	180=	0.3%	270=	0.4%
030=	0.2%	120=	0.5%	210=	0.3%	300=	0.8%
060=	0.1%	150=	0.1%	240=	0.4%	330=	0.8%

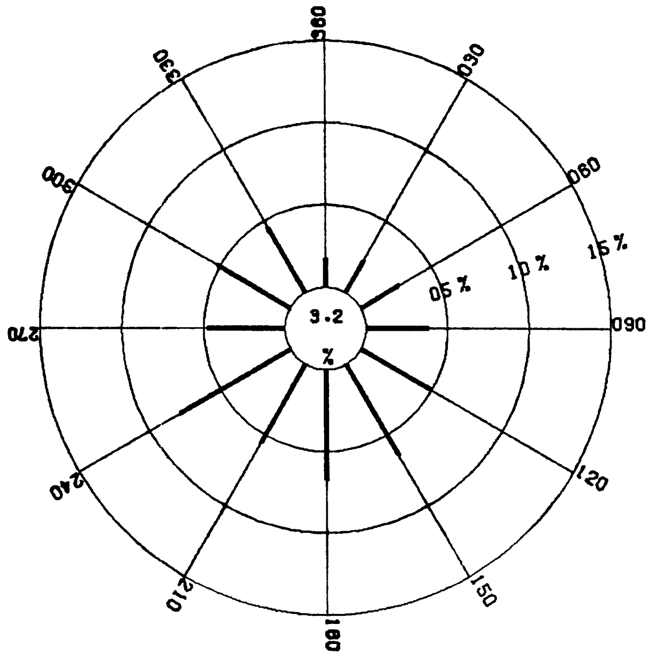
Figure 133

W A V E R O S E

OCTOBER 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

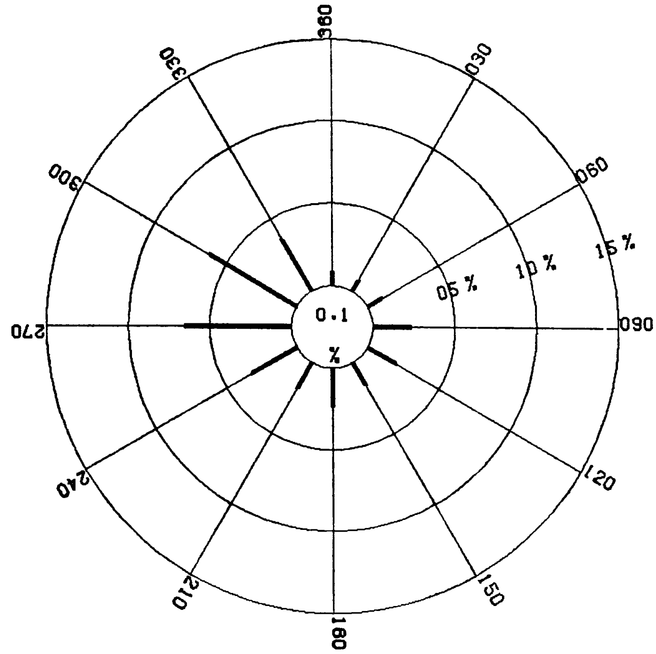
AREA: 56.0N - 57.9N , 6.0E - 7.9E N= 813

WAVE HEIGHT 0 - 3 N= 485



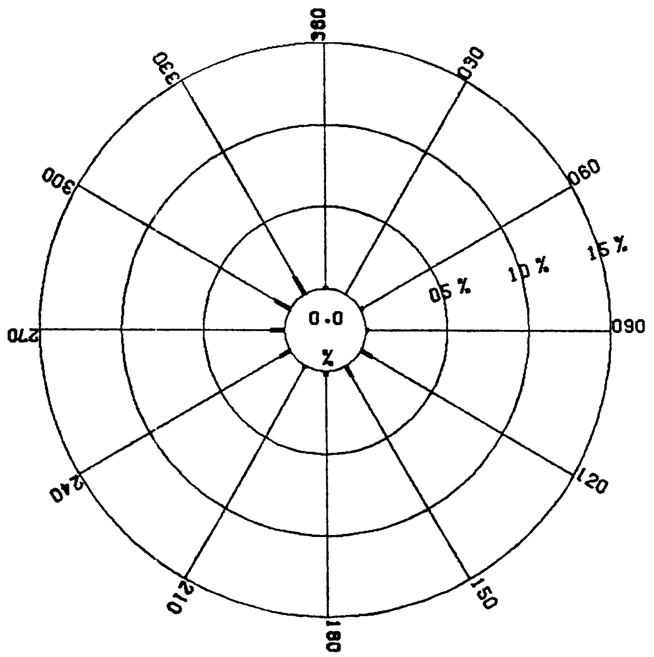
360=	1.7%	090=	3.8%	180=	6.8%	270=	4.8%
030=	2.2%	120=	4.9%	210=	5.5%	300=	5.2%
060=	2.7%	150=	6.4%	240=	7.9%	330=	4.6%

WAVE HEIGHT 4 - 7 N= 263



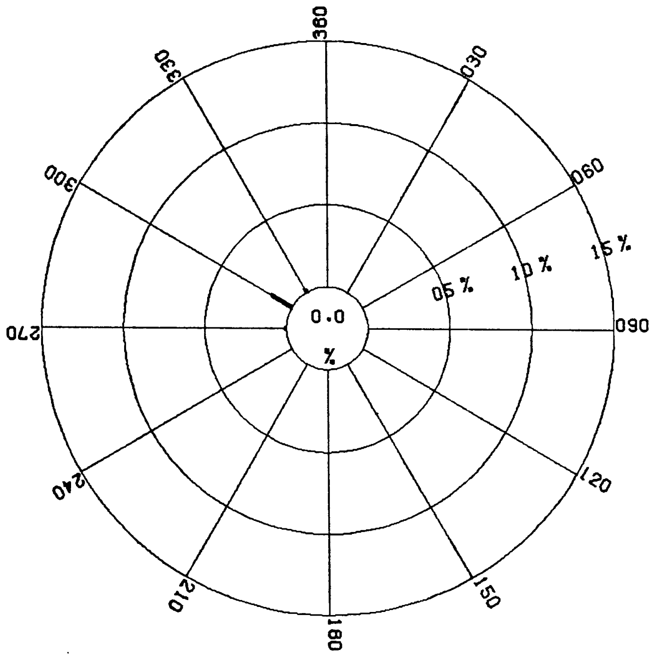
360=	0.9%	090=	2.3%	180=	2.3%	270=	6.5%
030=	0.7%	120=	2.0%	210=	1.8%	300=	6.2%
060=	1.0%	150=	1.6%	240=	3.2%	330=	3.6%

WAVE HEIGHT 8 - 11 N= 50



360=	0.1%	090=	0.1%	180=	0.2%	270=	0.9%
030=	0.0%	120=	0.7%	210=	0.1%	300=	1.1%
060=	0.1%	150=	0.7%	240=	0.7%	330=	1.2%

WAVE HEIGHT > 11 N= 15



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.0%	300=	1.5%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.2%

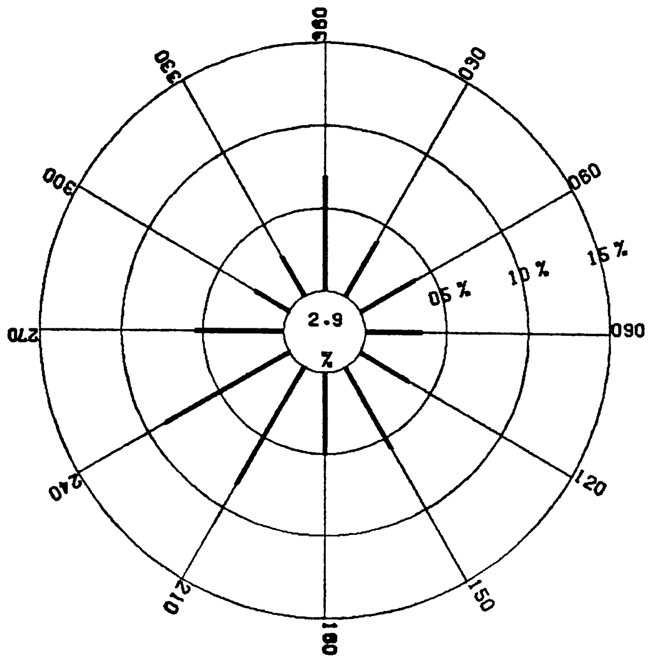
Figure 134

W A V E   R O S E

OCTOBER   1961 - 1980   (WAVE HEIGHT IN 0.5M VALUES)

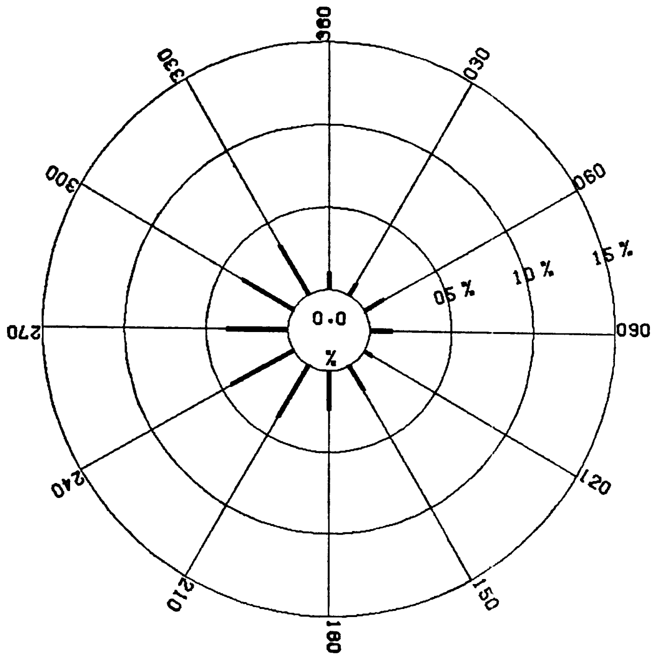
AREA: 54.0N - 55.9N , 2.0E - 3.9E   N= 751

WAVE HEIGHT 0 - 3   N= 474



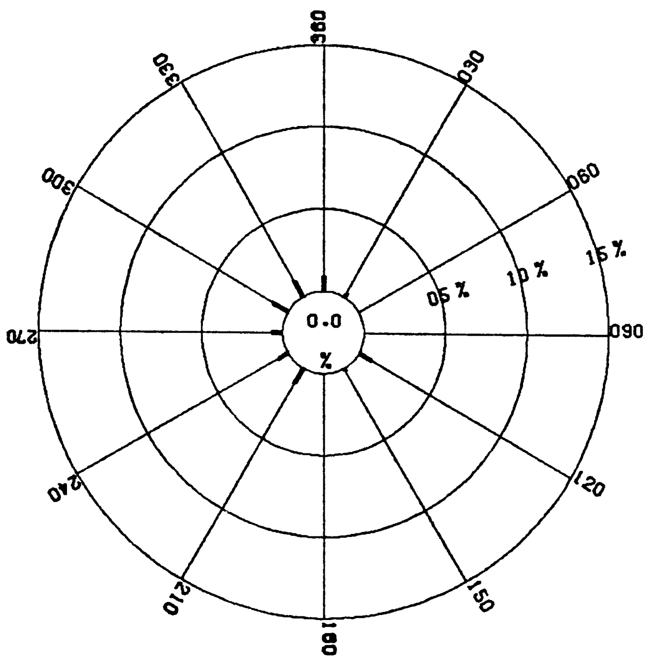
360=	6.9%	090=	3.5%	180=	5.1%	270=	5.5%
030=	3.9%	120=	3.5%	210=	8.4%	300=	2.4%
060=	3.9%	150=	5.7%	240=	8.8%	330=	2.8%

WAVE HEIGHT 4 - 7   N= 211



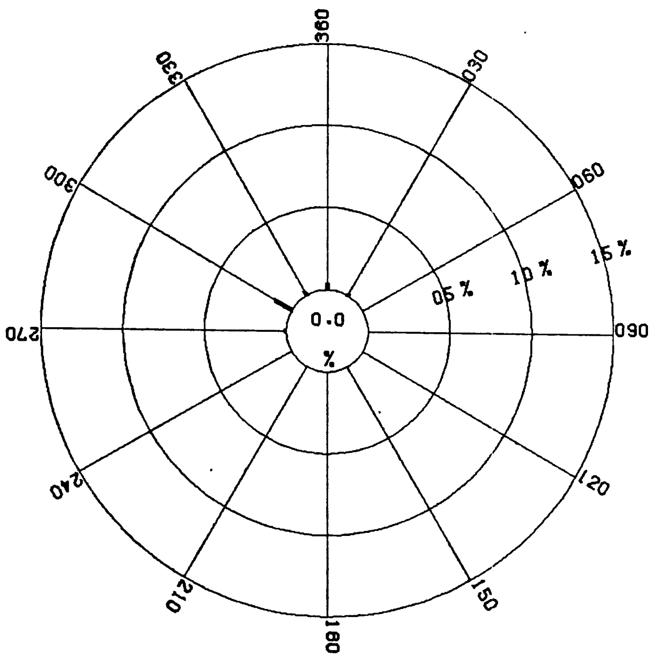
360=	1.1%	090=	1.3%	180=	2.4%	270=	3.7%
030=	0.8%	120=	0.5%	210=	3.7%	300=	3.6%
060=	1.3%	150=	1.7%	240=	4.4%	330=	3.5%

WAVE HEIGHT 8 - 11   N= 50



360=	0.9%	090=	0.0%	180=	0.0%	270=	0.7%
030=	0.3%	120=	0.8%	210=	1.1%	300=	1.1%
060=	0.0%	150=	0.1%	240=	0.7%	330=	1.1%

WAVE HEIGHT > 11   N= 16



360=	0.4%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.1%	120=	0.0%	210=	0.0%	300=	1.2%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.3%

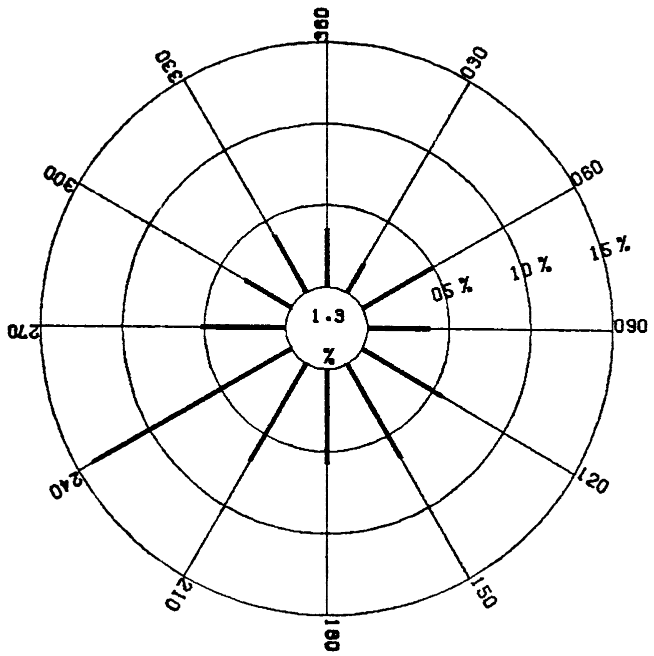
Figure 135

W A V E   R O S E

OCTOBER 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

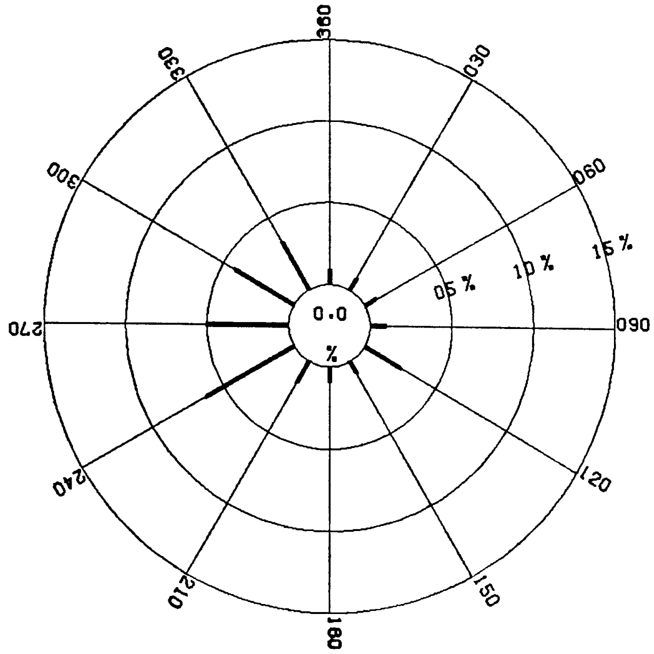
AREA: 54.0N - 54.9N , 6.0E - 8.9E N= 1591

WAVE HEIGHT 0 - 3 N= 1061



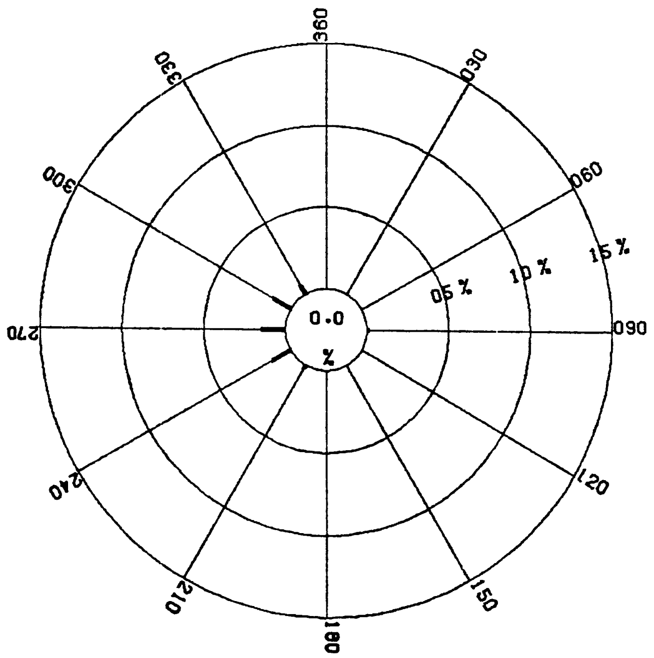
360=	3.5%	090=	3.8%	180=	5.7%	270=	5.2%
030=	1.9%	120=	5.6%	210=	6.9%	300=	3.3%
060=	5.0%	150=	6.5%	240=	14.0%	330=	4.0%

WAVE HEIGHT 4 - 7 N= 445



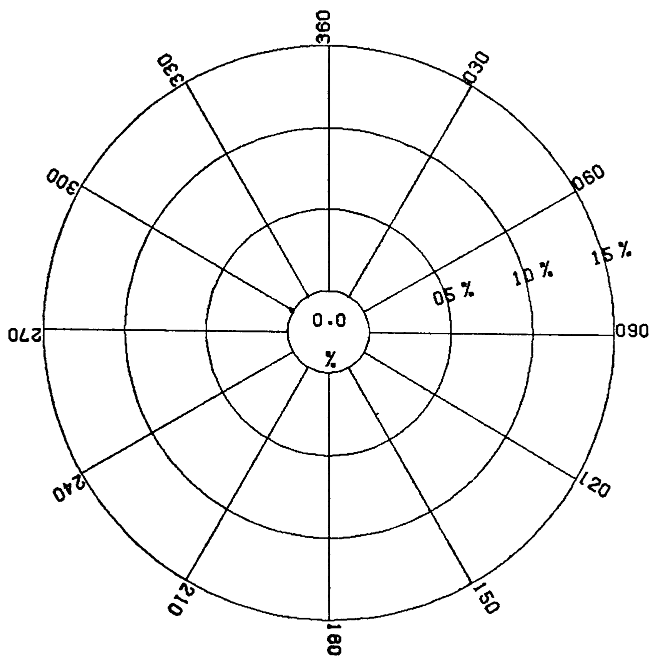
360=	0.9%	090=	0.9%	180=	0.9%	270=	5.0%
030=	0.8%	120=	2.5%	210=	1.5%	300=	4.2%
060=	0.8%	150=	0.8%	240=	6.2%	330=	3.3%

WAVE HEIGHT 8 - 11 N= 80



360=	0.0%	090=	0.1%	180=	0.1%	270=	1.4%
030=	0.0%	120=	0.0%	210=	0.2%	300=	1.3%
060=	0.0%	150=	0.0%	240=	1.3%	330=	0.6%

WAVE HEIGHT > 11 N= 5



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.0%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.3%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.1%

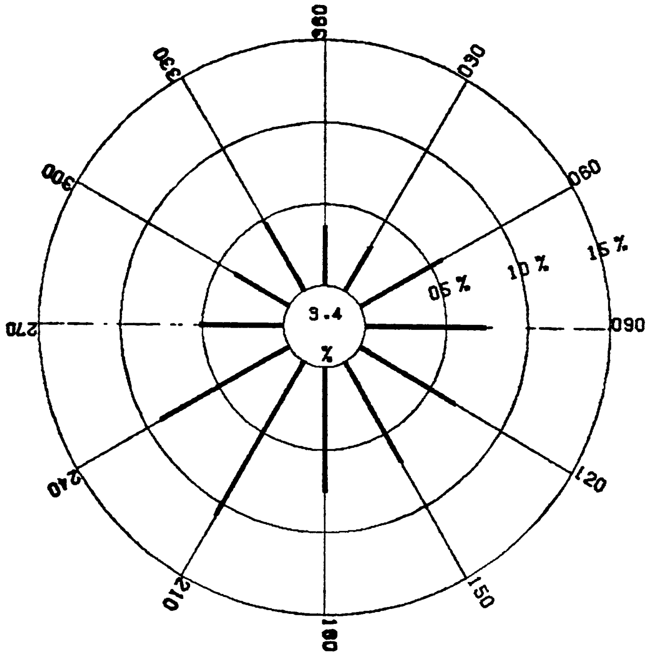
Figure 136

W A V E   R O S E

OCTOBER 1961 - 1980 (WAVE HEIGHT IN 0.5M VALUES)

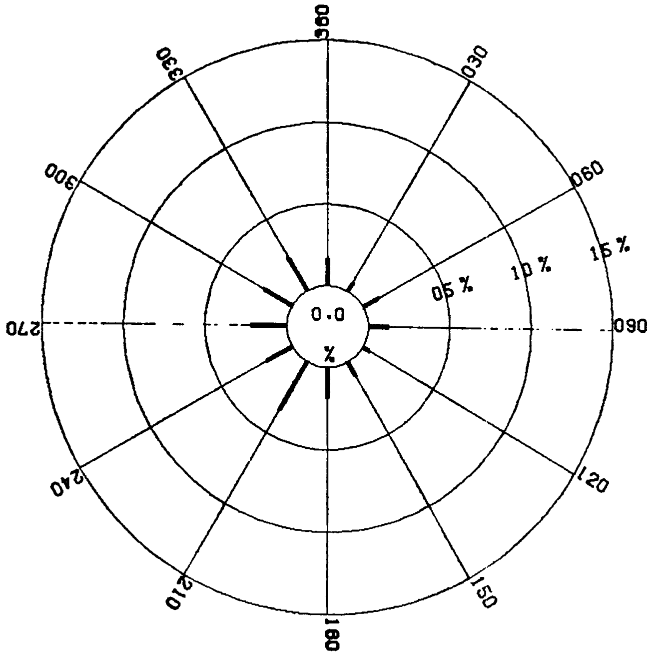
AREA: 52.0N - 52.9N , 3.0E - 4.9E N= 1049

WAVE HEIGHT 0 - 3 N= 820



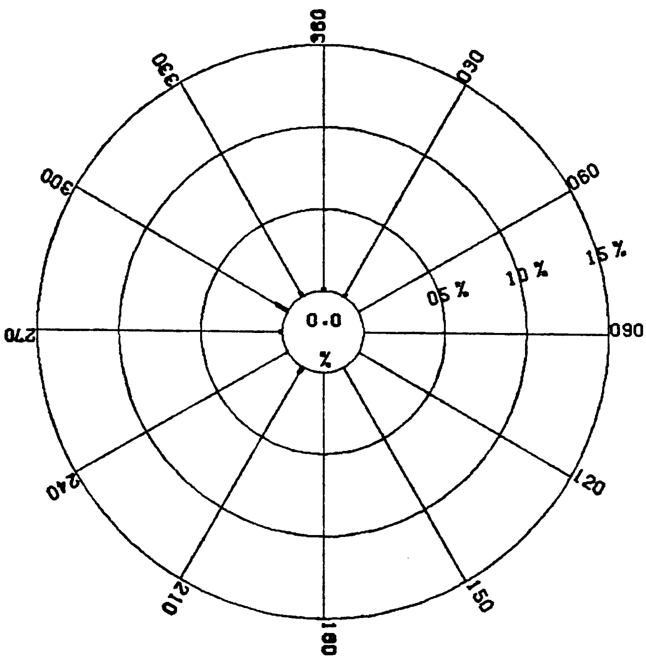
360=	3.6%	090=	7.3%	180=	7.5%	270=	5.1%
030=	3.1%	120=	6.8%	210=	10.8%	300=	3.8%
060=	5.8%	150=	7.0%	240=	9.1%	330=	4.8%

WAVE HEIGHT 4 - 7 N= 205



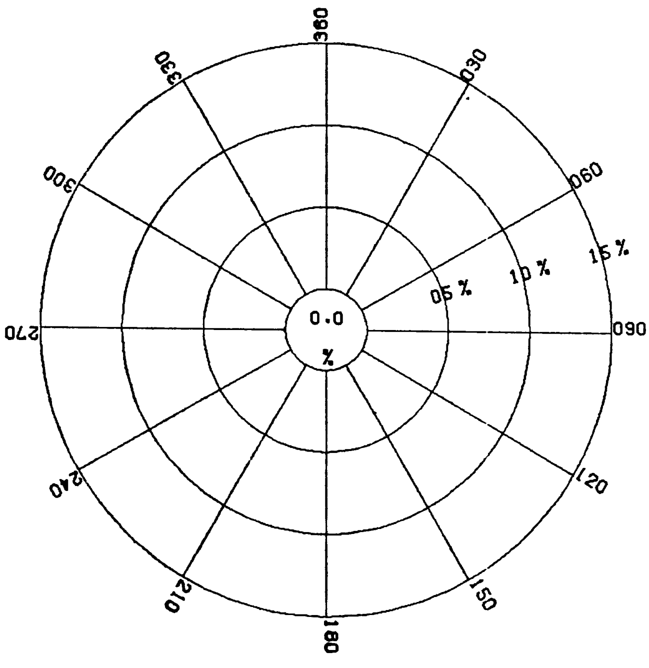
360=	1.6%	090=	1.2%	180=	1.9%	270=	2.2%
030=	0.6%	120=	0.5%	210=	3.4%	300=	2.0%
060=	1.0%	150=	1.0%	240=	1.8%	330=	2.3%

WAVE HEIGHT 8 - 11 N= 23



360=	0.2%	090=	0.0%	180=	0.0%	270=	0.2%
030=	0.2%	120=	0.0%	210=	0.4%	300=	0.9%
060=	0.0%	150=	0.0%	240=	0.1%	330=	0.3%

WAVE HEIGHT > 11 N= 1



360=	0.0%	090=	0.0%	180=	0.0%	270=	0.1%
030=	0.0%	120=	0.0%	210=	0.0%	300=	0.0%
060=	0.0%	150=	0.0%	240=	0.0%	330=	0.0%

Figure 137

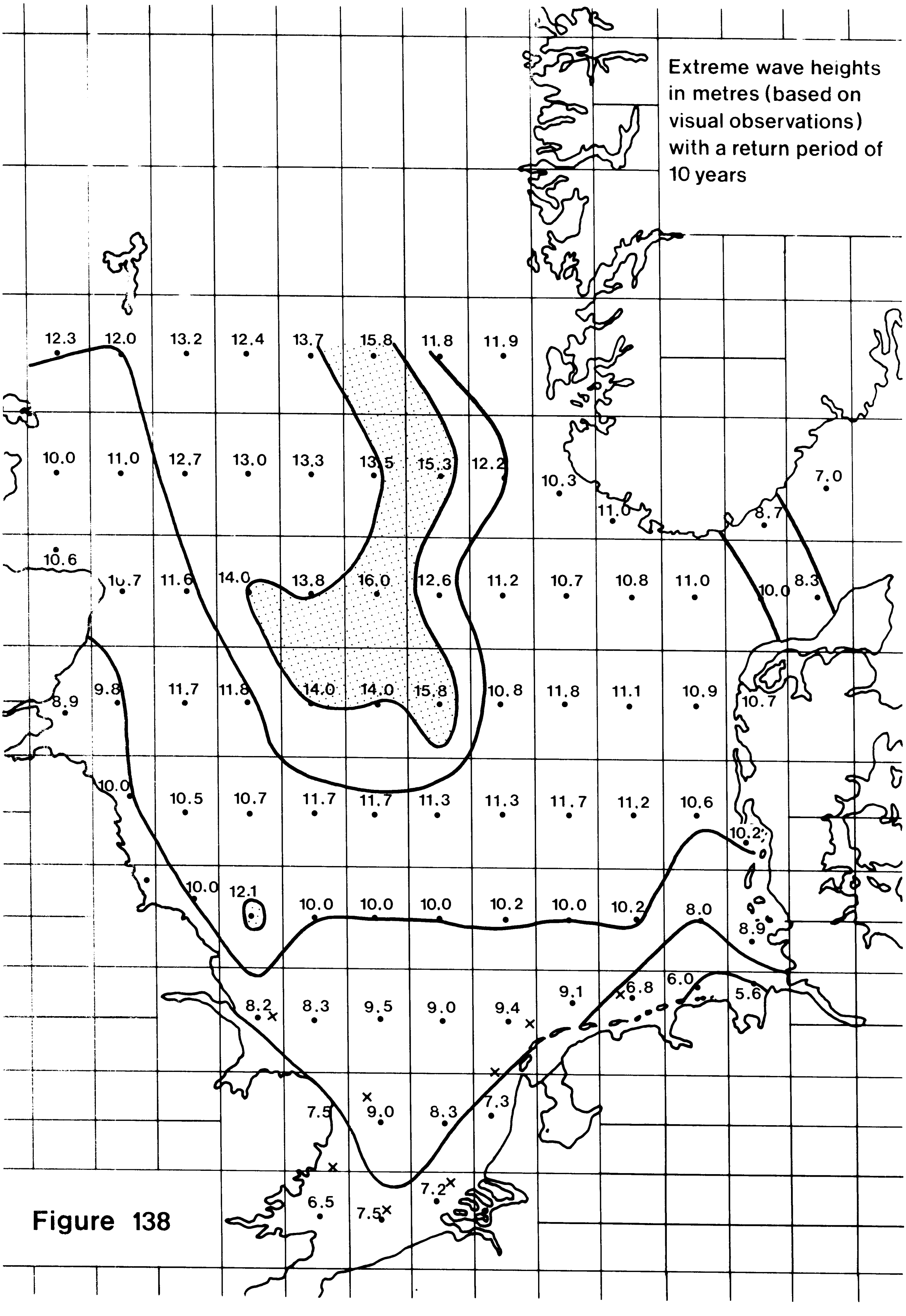
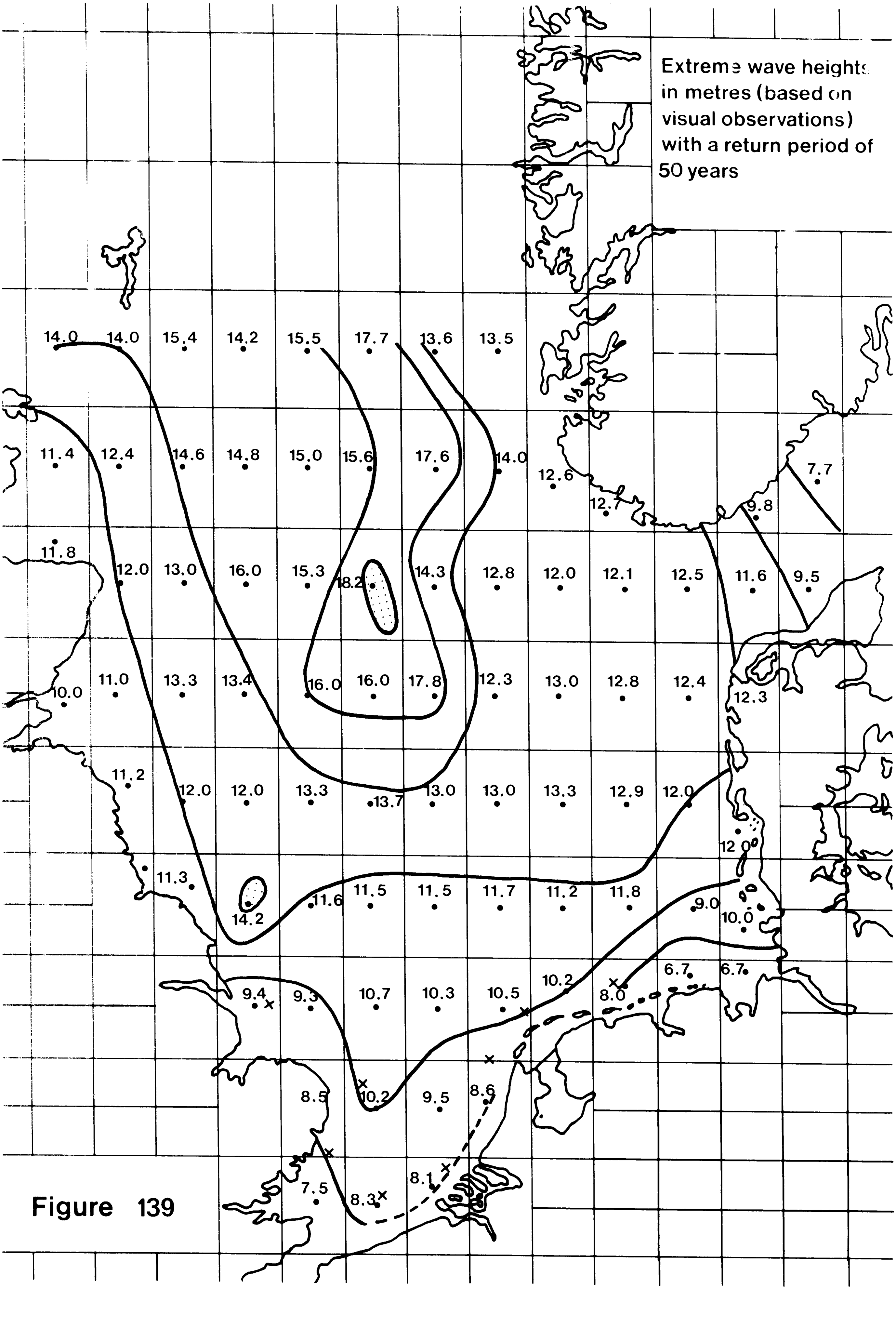
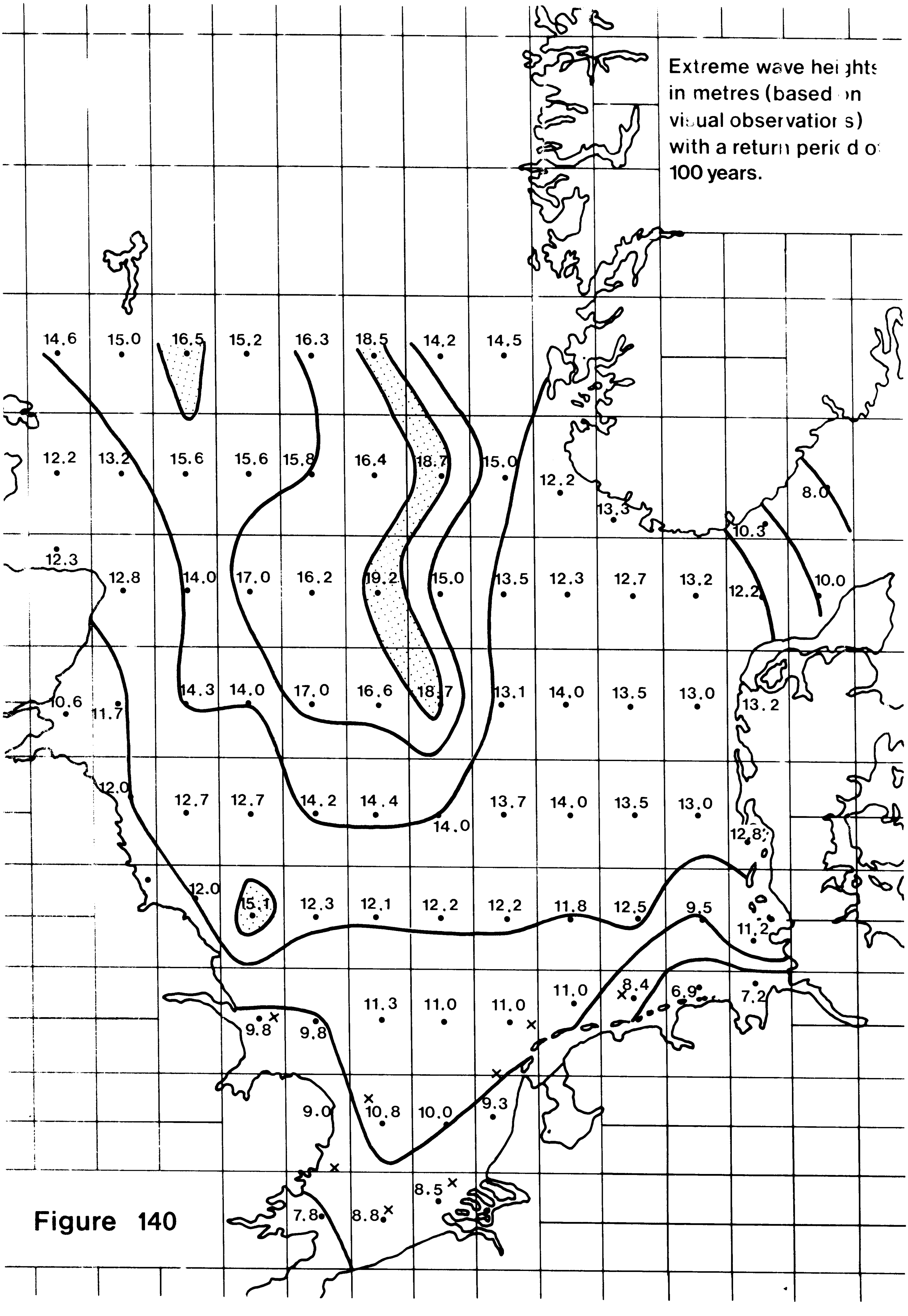

Extreme wave heights in metres (based on visual observations) with a return period of 10 years
12.3
12.0
13.2
12.4
13.7
15.8
11.8
11.9
10.0
11.0
12.7
13.0
13.3
13.5
15.3
12.2
10.3
7.0
11.0
8.7
10.6
11.6
14.0
13.8
16.0
12.6
11.2
10.7
10.8
11.0
10.0
8.3
8.9
9.8
11.7
11.8
14.0
14.0
15.8
10.8
11.8
11.1
10.9
10.7
10.0
10.5
10.7
11.7
11.7
11.3
11.3
11.7
11.2
10.6
10.2
10.0
12.1
10.0
10.0
10.0
10.2
10.0
10.2
8.0
8.9
8.2
8.3
9.5
9.0
9.4
9.1
6.8
6.0
5.6
7.5
9.0
8.3
7.3
7.2
6.5
7.5

Figure 138



Extreme wave heights in metres (based on visual observations) with a return period of 50 years

Figure 139



Extreme wave heights in metres (based on visual observations) with a return period of 100 years.

Figure 140

Appendix 1. Beaufort scale of wind force for reporting wind at sea.

Beaufort number	Descriptive term	Windspeed equivalents metres/sec	knots	Specifications
0	Calm	0 - 0.2	< 1	Sea like a mirror.
1	Light air	0.3 - 1.5	1 - 3	Ripples with the appearance of scales are formed, but without foam crests.
2	Light breeze	1.6 - 3.3	4 - 6	Small wavelets, still short but more pronounced; crests have a glassy appearance and do not break.
3	Gentle breeze	3.4 - 5.4	7 - 10	Large wavelets; crests begin to break; foam of glassy appearance; perhaps scattered white horses.
4	Moderate breeze	5.5 - 7.9	11 - 16	Small waves, becoming longer; fairly frequent white horses.
5	Fresh breeze	8.0 - 10.7	17 - 21	Moderate waves, taking a more pronounced long form; many white horses are formed (chance of some spray).
6	Strong breeze	10.8 - 13.8	22 - 27	Large waves begin to form; the white foam crests are more extensive everywhere (probably some spray).
7	Near gale	13.9 - 17.1	28 - 33	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.
8	Gale	17.2 - 20.7	34 - 40	Moderately high waves of greater length; edges of crests begin to break into the spindrift; the foam is blown in wellmarked streaks along the direction of the wind.
9	Strong gale	20.8 - 24.4	41 - 47	High waves; dense streaks of foam along the direction of the wind; crests of waves begin to topple, tumble and roll over, spray may effect visibility.

10	Storm	24.5 - 28.4	48 - 55	Very high waves with long overhanging crests; the resulting foam in great patches, is blown in dense white streaks along the direction of the wind; on the whole, the surfae of the sea takes a white appearance; the tumbling of the sea becomes heavy and shock-like; visibility affected.
11	Violent storm	28.5 - 32.6	56 - 63	Exceptionally high waves (small and medium -sized ships might be for a time lost to view behind the waves); the sea is completely covered with long white patches of foam lying along the direction of the wind; everywhere the edges of the wave crests are blown into froth; visibility affected.
12	Hurricane	32.7 and over	64 and over	The air is filled with foam and spray; sea completely white with driving spray; visibility very seriously affected.

Appendix 2. Beaufort scale of wind for use in scientific projects.

Beaufort number	wind speed metres/sec	equivalents knots
0	0 - 1.3	0 - 2
1	1.4 - 2.7	3 - 5
2	2.8 - 4.5	6 - 8
3	4.6 - 6.6	9 - 12
4	6.7 - 8.9	13 - 16
5	9.0 - 11.3	17 - 21
6	11.4 - 13.8	22 - 26
7	13.9 - 16.4	27 - 31
8	16.5 - 19.2	32 - 37
9	19.3 - 22.4	38 - 43
10	22.5 - 26.0	44 - 50
11	26.1 - 30.0	51 - 57
12	30.1 and above	58 and above