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ROYAL OBSERVATORY, HONG KONG

Climatological Note No. 4

WIND, VISIBILITY, SEA AND SWELL OVER COASTAL WATERS OF EASTERN GUANGDONG (KWANGTUNG)

1961 - 1970

by

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SUMMARY

Based on weather observations made by voluntary observers aboard ships during 1961-1970, climatological information on wind, sea and swell and visibility conditions over the coastal waters of eastern Guangdong (Kwangtung) is presented. The sea area covered is bounded by longitudes 114°E and 117°E and north of 22°N.

The influence of the monsoons on the conditions in this area is reflected in the statistical results. There is a major peak in the wind speed and in the heights of sea and swell in November and a secondary peak in February. From June to August, southwesterly winds of the summer monsoon are dominant but they are not as strong as the winter monsoon.

Reduced visibility occurs more frequently in March and April due to mist and fog which form as a result of warm humid Pacific air interacting with cool surface water near the coast.

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1. INTRODUCTION

Historically, marine meteorology was mainly concerned with the needs of international shipping over the high seas. This has indeed been the major concern of meteorologists since the early days of modern meteorology (WMO, 1973). In recent years, as nations have become aware of the vast resources that are available in the continental shelves, more attention is being given to the climatology of coastal waters.

There are several categories of activities in coastal waters which require marine meteorological information (WMO, 1977 a, b). These include fishing, fixed or floating installations at sea, special transport in coastal areas, recreational boating, marine pollution monitoring and clean-up operations, search and rescue and coastal protection. Climatological information is required for planning many projects but the information is not readily available in common climatic atlases as they usually do not have sufficient resolution. The difficulty arises because of the significant contrast between land and sea resulting in sharp gradients in the climatological values of different parameters near the coast. Climatology of coastal waters should therefore not be inferred directly from information related to the high seas.

The main purpose of this note is to provide climatological information on wind, sea and swell and visibility off the coast of eastern Guangdong (Kwangtung). It is also intended to illustrate the kind of coastal climatology that can be derived from weather observations made by voluntary marine observers aboard ships. Climatological information for the South China Sea is given in such publications as Lam (1976), Marine Climatological Summaries published by the Royal Observatory (Royal Observatory, 1971-79) and a climatic atlas published by the U.S. Navy (Director, Naval Oceanography and Meteorology, 1977). However, these do not provide detailed information close to the coasts.

2. PROCEDURE

(a) Source of data

Weather observations made by volunteer observers aboard ships are recorded on logbooks. These are later punched onto cards by various national meteorological services and despatched to the "responsible members" of the Marine Climatological Summaries Scheme (WMO, 1977). Hong Kong is the responsible member for the South China Sea area bounded by longitudes 100°E and 120°E and by latitudes 0° and 25°N. All cards received are transferred onto magnetic tapes. These form the basic data set for the preparation of marine climatological summaries.

Information on wind, visibility, sea and swell was extracted from the basic data set for this study. Since there were less data prior to 1961, the ten-year period 1961-70 was chosen, and observations made within the area bounded by longitudes 114°E and 117°E and between 22°N and the coast of eastern Guangdong were analysed. Figure 1 shows the area under study.

(b) Analysis of data

Monthly and annual tables of wind observations classified according to wind direction and wind force in the beaufort scale were computed and are given in tables 1-13.

Observers aboard ships report sea and swell separately whenever it is possible to make a distinction between the two. "Sea" refers to waves raised by the wind blowing at the point of observation. Its direction is usually the same as that of the wind so that this is not given in the International Maritime Meteorological Punch Card (IMMPC) code. Only heights are observed and recorded. "Swell" refers to a wave system observed at a point remote from the wind field which produced the waves or observed when the wind field which generated the waves no longer exists. Both heights and periods of swell are observed and recorded.

There are several ways of presenting statistical information on the state of the sea. One way is to analyse the "sea" and "swell" separately Another procedure is to select the group of "sea" or "swell" with the greater height (or greater period when the heights are equal). The latter procedure was, for example, adopted by Hogben and Lumb (1967). However, this involves discarding part of the available information so the first procedure was adopted for the present study.

An analysis of the "sea", that is, locally wind-driven waves, was carried out, giving the frequency distribution of different height intervals (table 14). For swells, frequency tables were prepared for different swell directions (tables 15-28). Monthly frequency distribution in different height intervals was given in each of these tables.

Visibility reports made by marine observers follow a WMO code which is given in table 29. A table giving monthly frequency distribution in different visibility ranges was prepared (table 30).

3. DISCUSSIONS

(a) Wind

The sea area examined in this report is situated on the southeastern edge of the Asian continent. It is therefore under the influence of the monsoon winds. Table 1 shows that there is a modal peak in the 050°-070° direction sector, which is related to the winter monsoon. Another modal peak, which is less well-defined, occurs in the 200°-220° direction sector. This is related to the southwest monsoon. In going through tables 2-13, it will be noticed that 050°-070° is the preferred wind direction during most of the year apart from June, July and August when southwesterly winds (200°-220° or 230°-250°) are dominant. The modal wind speed ranges from a minimum of force 2-3 during the summer months of July and August to a maximum of force 5 in November. A secondary maximum occurs in February with a modal wind speed of force 4-5.

It is of interest to compare these statistics with those for Waglan Island which is a well-exposed island station to the southeast of Hong Kong (see figure 1). According to published data for 1975 and 1976 (Royal Observatory, 1978), a major peak occurred in the sector 070°-090° and a less distinct peak occurred around 220°-250°. The direction of the first peak when compared with that of the sea area indicates that winds tend to be more easterly near the coast around Hong Kong during the northeast monsoon. Based on unpublished records (1953-1978), the mean wind speed at Waglan Island is lowest in August (9.8 knots) and highest in November (14.3 knots). The timing of the annual variations in wind strength is similar to that of the sea area but the secondary maximum observed in the sea area is absent from the Waglan Island data.

(b) Sea and swell

Figure 14 shows some interesting features. As one would have expected, the higher wind speeds associated with the northeast monsoon give rise to higher waves during winter. This may be illustrated by the following figures which give the percentage of reports each month with heights greater than or equal to 2 metres :-

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
14	25	16	13	9	4	10	10	13	20	29	16

The peak frequency of 29% in November and the secondary peak frequency of 25% in February are related to the generally higher wind speeds in these months (see section (a)). However, when the frequency of occurrence of very high waves such as 5 metres or above are considered, a different pattern emerges. Out of the 49 reports available, the distribution among the months are as follows :-

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	1	2	0	0	1	4	7	14	12	5	3

This is because more tropical cyclones affect the coastal waters southern China during the autumn months.

Tables 15-28 show that the monsoons have significant influence on the directions of the swells observed at different times of the year. The stronger northeast monsoon also results in higher swells during winter. The percentage by months of reports of swell with heights exceeding or equal to 2 metres illustrates this point :-

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
46	53	46	34	25	20	25	33	37	42	59	49

A secondary peak again appears in February in addition to the major peak in November.

The presence of two periods (November and February) of relatively higher waves and swells near the China coast are also evident in the marine climatological tables published by the Japan Meteorological Agency (1977). However, these tables were based on less data and cover slightly different areas so that direct comparison with the results of the present study is not possible.

(c) Visibility

Table 30 shows that March and April are the months with the highest frequency of reduced visibility. This is readily borne out by the following figures :-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% <2 km	1	2	3	5	1	*	*	1	1	0	0	*
% <10 km	7	7	13	11	6	3	3	4	7	3	2	3

(* indicates less than 0.5%)

This pattern is similar to the annual distribution of fog days at Waglan Island (Hung 1951). The sea surface off the coast of southern China is quite cool in March and April. At the same time, warm moist air with a long sea track over the Pacific gradually replaces the cool and relatively drier northeast monsoon winds in this area. This constitutes a favourable combination of conditions for the formation of mist and fog over the coastal waters of southern China.

4. CONCLUDING REMARKS

Analysed data on the climatological conditions off the coast of eastern Guangdong in terms of wind, visibility, sea and swell have been presented and discussed. The results show that this area is influenced by both the winter and summer monsoons, the effect of the former being much more significant than the latter.

An interesting feature in the analysis is the occurrence of two separate months(November and February) with stronger winds and higher waves during the winter period. According to Tsuchiya et al (1964), a few stations along the coast of southeastern China also show similar characteristics in their wind data; including Shantou (Swatow) and Xiamen (Amoy). However, there is only one peak during winter in the wind data of Fuzhou (Foochow) which is situated to the northeast of Xiamen. (Refer to figure 1 for the locations of the stations). As mentioned earlier in paragraph 3(a), there is also only one peak during winter in the wind data of Waglan Island. It can therefore be seen that the occurrence of two separate months with stronger winds and higher waves during winter is probably confined to the coastal waters between Fuzhou and Hong Kong.

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REFERENCES

1. Director, Naval Oceanography and Meteorology — 1977 — U.S. Navy Marine Climatic Atlas, Vol. II, North Pacific Ocean, U.S. Government Printing Office.

2. Hogben, N., and F.E. Lumb — 1967 — "Ocean Wave Statistics", H.M.S.O., London.

3. Hung, K.R. — 1951 — Fogs at Waglan Island and their relationship to fogs in Hong Kong harbour, Royal Observatory, Tech. Note No. 3.

4. Japan Meteorological Agency — 1977 — Marine climatological tables of the North Pacific Ocean for 1961-1970.

5. Lam, C.Y. — 1976 — Estimation of wind conditions in selected marine areas from land station data, Royal Observatory, Tech. Note (Local) No. 23.

6. Royal Observatory — 1971-79 — Marine climatological summaries for areas 20057 and 21156 in the South China Sea, 1961-1966 (in annual volumes).

7. Royal Observatory — 1978 — Meteorological Results 1977 Part I : surface observations.

8. Tsuchiya, I., and collaborators — 1964 — World Climatological Record Vol. I, Kokusai Shobo Ltd. (in Japanese).

9. World Meteorological Organisation — 1973 — "One Hundred Years of International Co-operation in Meteorology", W.M.O. - No. 345.

10. World Meteorological Organisation — 1977 — Guide to marine meteorological services, W.M.O. - No. 471.

11. World Meteorological Organisation — 1977 — Abridged final report of the seventh session of the Commission on Marine Meteorology, W.M.O. - No. 462.

TABLE 1. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - ALL MONTHS

			DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO. OF OBS
0	446														446
1		149	44	71	99	96	65	67	82	87	50	27	16	14	867
2		28	76	155	326	281	174	148	154	193	139	49	43	43	1809
3		2	107	312	713	483	184	160	222	238	160	45	43	54	2723
4		0	105	454	1173	556	90	110	141	151	126	31	20	52	3009
5		0	68	364	960	309	39	33	35	31	41	11	10	23	1924
6		0	31	229	605	150	17	18	12	6	8	1	8	8	1073
7		0	20	107	208	54	12	8	11	2	1	1	0	1	425
8		0	8	23	64	10	10	7	4	2	0	0	0	0	128
9		0	0	3	7	1	4	1	0	0	0	0	0	1	17
10		0	0	2	0	1	1	3	0	0	1	0	0	0	8
11		0	0	0	2	0	0	0	1	0	0	0	0	0	3
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	446	179	459	1720	4157	1921	596	555	662	710	526	165	140	196	12432

TABLE 2. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - JANUARY

		DIRECTION IN TENS OF DEGREES													
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO. OF OBS
0	43														43
1		7	4	9	24	18	8	2	6	2	2	2	0	2	86
2		1	13	19	50	41	3	4	0	0	0	4	3	7	145
3		0	15	68	94	69	13	1	2	0	1	0	8	26	297
4		0	28	79	156	78	1	7	1	3	0	0	5	9	367
5		0	13	52	123	37	5	0	0	0	0	0	0	2	232
6		0	7	37	87	8	2	0	0	0	0	0	0	0	141
7		0	6	18	35	1	0	0	0	1	0	0	0	0	61
8		0	0	2	7	1	0	0	1	0	0	0	0	0	11
9		0	0	1	1	0	0	0	0	0	0	0	0	0	2
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	43	8	86	285	577	253	32	14	10	6	3	6	16	46	1385

TABLE 3. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - FEBRUARY

		DIRECTION IN TENS OF DEGREES													
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO. OF OBS
0	39														39
1		10	7	4	7	8	0	2	1	3	3	1	1	1	48
2		0	3	8	34	17	4	1	1	1	3	1	3	0	76
3		0	10	27	50	38	2	2	0	1	0	0	0	0	130
4		0	8	42	110	58	1	0	0	0	0	0	1	0	220
5		0	14	49	119	36	0	1	0	0	0	0	1	1	221
6		0	0	37	79	15	0	1	0	0	0	0	1	0	133
7		0	0	15	29	3	0	0	0	0	0	0	0	1	48
8		0	0	2	6	0	0	0	0	0	0	0	0	0	8
9		0	0	0	0	0	0	0	0	0	0	0	0	0	0
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	39	10	42	184	434	175	7	7	2	5	6	2	7	3	923

TABLE 4. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - MARCH

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO. OF OBS
0	43														43
1		14	4	3	10	10	7	7	0	6	2	1	0	3	67
2		2	12	12	17	24	10	17	9	6	4	2	2	0	117
3		0	11	27	61	38	6	7	6	10	2	0	2	1	171
4		0	6	53	123	7	3	1	2	0	0	0	2	4	231
5		0	3	39	120	40	0	0	0	1	0	0	0	1	204
6		0	1	17	73	17	0	0	0	0	0	0	0	0	108
7		0	3	10	20	2	0	0	0	0	0	0	0	0	35
8		0	0	0	8	0	0	0	0	0	0	0	0	0	8
9		0	0	0	0	0	0	0	0	0	0	0	0	0	0
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	43	16	40	161	432	168	26	32	17	23	8	3	6	9	984

TABLE 5. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - APRIL

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO. OF OBS
0	50														50
1		20	4	7	13	16	7	4	7	4	2	1	1	2	88
2		1	4	14	42	25	19	10	7	3	5	2	2	2	136
3		0	0	25	114	48	30	10	4	7	2	0	1	4	245
4		0	5	38	144	53	8	4	0	7	1	0	0	4	264
5		0	4	21	75	24	1	3	0	0	0	0	0	0	128
6		0	4	13	61	17	0	0	0	0	1	0	0	0	96
7		0	0	4	15	0	0	0	0	0	0	0	0	0	19
8		0	0	0	5	0	0	0	0	0	0	0	0	0	5
9		0	0	0	0	0	0	0	0	0	0	0	0	0	0
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	50	21	21	122	469	183	65	31	18	21	11	3	4	12	1031

TABLE 6. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - MAY

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO. OF OBS
0	53														53
1		12	3	3	3	5	4	12	13	11	9	2	1	0	78
2		5	3	16	16	19	25	16	36	34	16	3	2	5	196
3		0	4	15	39	32	15	27	62	32	13	3	3	1	246
4		0	9	15	87	33	5	30	50	21	16	1	0	3	270
5		0	1	9	59	21	0	0	6	0	3	1	0	1	101
6		0	0	6	31	8	0	0	0	0	0	0	0	0	45
7		0	0	0	4	6	0	2	1	0	0	0	0	0	13
8		0	0	0	3	2	0	0	1	0	0	0	0	0	6
9		0	0	0	4	0	0	0	0	0	0	0	0	0	4
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	53	17	20	64	246	126	49	87	169	98	57	10	6	10	1012

TABLE 7 . FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - JUNE

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO. OF OBS
0	51														51
1		18	2	5	4	5	10	9	9	16	8	7	6	2	101
2		3	2	10	23	22	30	30	38	45	30	2	2	5	242
3		0	3	12	37	33	25	23	66	69	30	4	6	4	312
4		0	4	15	48	40	10	16	37	58	29	1	3	3	264
5		0	0	6	26	13	4	8	7	13	11	2	3	0	93
6		0	0	0	8	6	0	0	2	2	2	0	4	0	24
7		0	0	0	0	1	0	0	1	0	0	0	0	0	2
8		0	0	0	1	1	0	0	0	0	0	0	0	0	2
9		0	0	0	0	0	0	0	0	0	0	0	0	0	0
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	51	21	11	48	147	121	79	86	160	203	110	16	24	14	1091

TABLE 8. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - JULY

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO.OF OBS
0	38														38
1		25	3	2	3	2	8	16	14	21	5	2	1	0	102
2		6	1	3	9	18	21	27	32	45	26	9	7	2	206
3		1	4	3	13	16	34	36	41	61	46	3	3	0	261
4		0	0	4	8	13	16	21	24	37	31	7	2	2	165
5		0	0	2	7	11	11	11	11	13	11	0	1	0	78
6		0	0	1	6	7	5	8	3	2	1	0	1	1	35
7		0	2	2	5	9	4	2	1	0	1	0	0	0	26
8		0	0	0	0	0	2	2	0	0	0	0	0	0	4
9		0	0	0	0	1	0	0	0	0	0	0	0	1	2
10		0	0	0	0	1	0	0	0	0	1	0	0	0	2
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	38	32	10	17	51	78	101	123	126	179	122	21	15	6	919

TABLE 9. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - AUGUST

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO.OF OBS
0	63														63
1		25	4	6	9	7	5	4	16	9	9	3	3	1	101
2		7	7	20	24	29	23	31	23	39	42	15	6	5	271
3		0	7	9	40	32	26	26	27	41	47	18	6	5	284
4		0	5	6	15	29	18	20	16	20	31	12	2	5	179
5		0	2	3	16	13	9	8	5	3	14	5	4	2	84
6		0	0	1	7	6	8	6	4	2	1	0	1	0	36
7		0	0	2	5	14	6	4	1	1	0	0	0	0	33
8		0	0	1	2	3	4	3	0	1	0	0	0	0	14
9		0	0	0	1	0	2	0	0	0	0	0	0	0	3
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	63	32	25	48	119	133	101	102	92	116	144	53	22	18	1068

TABLE 10. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - SEPTEMBER

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO.OF OBS
0	36														36
1		7	9	13	15	14	11	9	16	13	10	5	2	2	126
2		2	9	16	34	31	16	8	6	16	7	8	10	5	168
3		0	16	36	73	62	23	16	11	13	13	11	10	6	290
4		0	11	27	76	70	18	7	10	4	14	7	5	6	255
5		0	7	10	53	32	5	2	6	0	2	3	0	7	127
6		0	2	10	29	8	1	2	1	0	1	1	0	3	58
7		0	1	6	16	4	2	0	5	0	0	1	0	0	35
8		0	2	3	3	1	4	2	2	1	0	0	0	0	18
9		0	0	1	0	0	2	1	0	0	0	0	0	0	4
10		0	0	2	0	0	1	3	0	0	0	0	0	0	6
11		0	0	0	1	0	0	0	1	0	0	0	0	0	2
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	36	9	57	124	300	222	83	50	58	47	47	36	27	29	1125

TABLE 11. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - **OCTOBER**

			DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO.OF OBS
0	9														9
1		8	0	1	6	2	2	1	0	2	0	2	0	0	24
2		1	6	11	20	19	9	4	1	3	4	1	1	1	81
3		0	6	30	573	41	7	8	3	2	3	2	0	3	178
4		0	4	3	136	52	6	4	1	1	3	2	0	2	264
5		0	5	48	113	33	1	0	0	1	0	0	0	1	202
6		0	5	27	73	13	1	1	1	0	0	0	1	1	123
7		0	2	13	22	6	0	0	2	0	0	0	0	0	45
8		0	2	7	9	0	0	0	0	0	0	0	0	0	18
9		0	0	0	1	0	0	0	0	0	0	0	0	0	1
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	1	0	0	0	0	0	0	0	0	0	1
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	9	9	30	190	454	166	26	18	8	9	10	7	2	8	946

TABLE 12. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - NOVEMBER

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO.OF OBS
0	13														13
1		2	1	9	1	5	1	0	0	0	0	0	0	1	20
2		0	9	9	25	17	3	0	0	0	0	1	2	2	68
3		1	16	26	66	31	2	0	0	1	0	2	2	2	149
4		0	11	51	120	39	1	0	0	0	1	1	0	3	227
5		0	7	55	144	29	2	0	0	0	0	0	1	4	242
6		0	4	42	82	17	0	0	1	0	0	0	0	2	148
7		0	2	23	39	8	0	0	0	0	0	0	0	0	72
8		0	2	6	15	2	0	0	0	0	0	0	0	0	25
9		0	0	1	0	0	0	0	0	0	0	0	0	0	1
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	13	3	52	222	492	148	9	0	1	1	1	4	5	14	965

TABLE 13. FREQUENCY OF WIND OBSERVATIONS IN DIFFERENT SPEED AND DIRECTION CLASSES - **DECEMBER**

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARIABLE	35-01	02-04	05-07	08-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	NO.OF OBS
0	8														8
1		1	3	9	4	4	2	1	0	0	0	1	1	0	26
2		0	7	17	32	19	11	0	1	1	2	1	3	9	103
3		0	15	34	53	43	1	4	0	1	3	2	2	2	160
4		0	14	71	150	54	3	0	0	0	0	0	0	11	303
5		0	12	70	105	20	1	0	0	0	0	0	0	4	212
6		0	8	38	69	8	0	0	0	0	2	0	0	1	126
7		0	4	14	18	0	0	0	0	0	0	0	0	0	36
8		0	2	2	5	0	0	0	0	0	0	0	0	0	9
9		0	0	0	0	0	0	0	0	0	0	0	0	0	0
10		0	0	0	0	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO OF OBS	8	1	65	255	436	148	18	5	1	2	7	4	6	27	983

TABLE 14. FREQUENCY OF WAVE REPORTS IN DIFFERENT HEIGHT INTERVALS

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	376	202	310	392	456	576	451	538	343	247	167	243	4301
1 - 1.5	435	308	345	307	246	290	214	218	348	382	350	400	3843
2 - 2.5	103	131	89	74	56	29	42	48	72	118	165	105	1032
3 - 3.5	19	32	27	20	9	5	21	17	15	27	37	14	243
4 - 4.5	6	6	4	9	4	1	10	12	4	9	7	3	75
5 - 5.5	0	0	1	0	0	0	3	4	5	6	4	3	26
6 - 6.5	0	1	0	0	0	1	0	0	3	1	1	0	7
7 - 7.5	0	0	1	0	0	0	0	0	6	0	0	0	7
8 - 8.5	0	0	0	0	0	0	1	1	0	0	0	0	2
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	2	0	1	0	0	3
TOTAL	939	680	777	802	771	902	742	840	796	791	731	768	4539

TABLE 15. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - ALL DIRECTION

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	32	25	21	59	75	72	82	83	42	32	13	18	554
1 - 1.5	201	149	172	196	180	244	273	206	231	221	149	182	2404
2 - 2.5	138	136	106	108	64	63	68	79	97	113	146	136	1254
3 - 3.5	34	40	45	20	15	11	29	32	37	45	57	42	407
4 - 4.5	20	19	9	3	3	0	13	17	13	14	22	10	143
5 - 5.5	4	3	3	0	1	1	6	4	4	8	3	2	39
6 - 6.5	0	0	1	0	0	0	0	3	3	5	1	0	13
7 - 7.5	0	0	0	0	0	0	1	3	4	1	1	0	10
8 - 8.5	0	0	0	0	0	0	1	1	4	0	2	0	8
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	1	0	1	0	2	0	2	0	0	1	1	8
TOTAL	429	373	357	387	338	393	473	430	435	439	395	391	4840
SWELL CALM	27	22	38	49	51	35	32	94	37	25	14	12	436

TABLE 16. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 350° - 010°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	2	2	0	1	0	0	0	0	0	0	0	1	6
1 - 1.5	3	3	2	2	1	2	1	0	1	4	2	3	24
2 - 2.5	4	1	2	2	0	0	0	2	0	2	0	5	18
3 - 3.5	0	0	0	0	0	0	0	0	0	1	0	0	1
4 - 4.5	0	0	0	0	0	0	0	0	1	0	0	0	1
5 - 5.5	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 6.5	0	0	0	0	0	0	0	0	1	0	0	0	1
7 - 7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
8 - 8.5	0	0	0	0	0	0	0	0	0	0	1	0	1
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	9	6	4	5	1	2	1	2	3	7	3	9	52

TABLE 17. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 020° - 040°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	2	4	6	6	4	2	2	1	0	3	0	1	31
1 - 1.5	35	23	20	24	13	11	3	0	14	30	9	30	212
2 - 2.5	25	22	19	27	5	7	1	4	7	20	31	24	192
3 - 3.5	9	8	10	7	0	0	1	1	2	8	5	16	67
4 - 4.5	5	2	1	0	0	0	0	0	2	5	2	4	21
5 - 5.5	0	0	1	0	0	0	1	0	1	2	0	2	7
6 - 6.5	0	0	0	0	0	0	0	0	2	0	0	0	2
7 - 7.5	0	0	0	0	0	0	0	0	0	1	0	0	1
8 - 8.5	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	76	59	57	64	22	20	8	6	28	69	47	77	533

TABLE 18. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 050° - 070°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	11	2	2	7	10	4	0	5	9	8	6	3	67
1 - 1.5	74	55	61	61	46	33	7	10	57	79	66	68	617
2 - 2.5	76	72	57	51	32	12	3	8	24	57	80	66	538
3 - 3.5	21	24	24	11	8	4	1	5	21	25	41	20	205
4 - 4.5	9	16	6	3	0	0	1	0	1	7	16	4	63
5 - 5.5	4	1	2	0	1	0	0	0	0	3	3	0	14
6 - 6.5	0	0	1	0	0	0	0	0	0	2	1	0	4
7 - 7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
8 - 8.5	0	0	0	0	0	0	0	0	3	0	0	0	3
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	1	0	0	0	0	1
TOTAL	195	170	153	133	97	53	12	29	115	181	213	161	1512

TABLE 19. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 080° - 100°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	7	8	12	22	17	12	3	8	10	11	2	10	122
1 - 1.5	65	52	61	54	51	23	12	20	59	72	52	54	575
2 - 2.5	28	36	25	27	15	6	7	6	18	28	33	35	264
3 - 3.5	3	7	8	2	4	2	5	9	6	7	9	6	68
4 - 4.5	5	0	2	0	0	0	3	5	2	1	2	2	22
5 - 5.5	0	2	0	0	0	0	0	1	0	0	0	0	3
6 - 6.5	0	0	0	0	0	0	0	0	0	0	0	0	0
7 - 7.5	0	0	0	0	0	0	0	0	0	0	1	0	1
8 - 8.5	0	0	0	0	0	0	0	0	0	0	1	0	1
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	108	105	108	105	87	43	30	49	95	119	100	107	1056

TABLE 20. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 110° - 130°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	4	5	0	13	13	9	4	5	7	5	0	3	68
1 - 1.5	13	8	19	41	12	12	30	17	20	15	15	20	222
2 - 2.5	4	3	2	1	4	0	6	9	7	1	1	5	43
3 - 3.5	0	0	3	0	0	0	8	5	2	1	1	0	20
4 - 4.5	0	0	0	0	2	0	2	6	0	0	1	0	11
5 - 5.5	0	0	0	0	0	0	1	0	3	0	0	0	4
6 - 6.5	0	0	0	0	0	0	0	1	0	0	0	0	1
7 - 7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
8 - 8.5	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	21	16	24	55	31	21	51	43	39	22	18	28	369

TABLE 21. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 140° - 160°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	0	1	1	3	10	7	17	11	3	2	1	0	56
1 - 1.5	6	2	5	8	7	28	41	37	20	13	1	1	169
2 - 2.5	1	0	0	0	1	6	10	7	12	1	0	0	38
3 - 3.5	0	0	0	0	0	2	4	5	3	0	0	0	14
4 - 4.5	0	1	0	0	0	0	1	3	1	0	0	0	6
5 - 5.5	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 6.5	0	0	0	0	0	0	0	0	0	1	0	0	1
7 - 7.5	0	0	0	0	0	0	1	0	0	0	0	0	4
8 - 8.5	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	7	4	6	11	18	43	74	63	42	17	2	1	288

TABLE 22. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 170° - 190°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	0	2	0	4	9	15	24	15	2	0	0	0	71
1 - 1.5	1	1	1	2	17	47	68	43	20	3	0	0	203
2 - 2.5	0	0	0	0	2	14	14	21	13	2	0	0	66
3 - 3.5	0	0	0	0	1	3	6	3	2	0	0	0	15
4 - 4.5	0	0	0	0	1	0	4	1	2	0	0	0	8
5 - 5.5	0	0	0	0	0	1	2	0	0	1	0	0	4
6 - 6.5	0	0	0	0	0	0	0	0	0	0	0	0	0
7 - 7.5	0	0	0	0	0	0	0	2	1	0	0	0	3
8 - 8.5	0	0	0	0	0	0	0	1	1	0	0	0	2
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	3	1	6	30	80	118	86	41	6	0	0	372

TABLE 23. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 200° - 220°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	0	1	0	3	6	7	29	29	5	1	0	0	81
1 - 1.5	1	0	1	1	19	60	83	53	16	2	1	0	237
2 - 2.5	0	0	0	0	2	13	13	17	9	1	0	0	55
3 - 3.5	0	0	0	0	0	0	1	3	0	1	0	0	5
4 - 4.5	1	0	0	0	0	0	2	1	3	0	0	0	7
5 - 5.5	0	0	0	0	0	0	2	0	0	1	0	0	3
6 - 6.5	0	0	0	0	0	0	0	0	0	0	0	0	0
7 - 7.5	0	0	0	0	0	0	0	1	0	0	0	0	1
8 - 8.5	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	1	1	4	27	80	130	104	33	6	1	0	389

TABLE 24. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 230° - 250°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	0	0	0	0	3	11	2	5	3	2	0	0	26
1 - 1.5	0	1	0	0	10	16	19	14	8	1	0	0	69
2 - 2.5	0	0	0	0	3	2	10	4	1	0	0	0	20
3 - 3.5	0	0	0	0	1	0	3	1	0	0	0	0	5
4 - 4.5	0	0	0	0	0	0	0	1	0	0	0	0	1
5 - 5.5	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 6.5	0	0	0	0	0	0	0	0	0	0	0	0	0
7 - 7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
8 - 8.5	0	0	0	0	0	0	1	0	0	0	0	0	1
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	1	0	0	17	29	35	25	12	3	0	0	122

TABLE 25. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 260° - 280°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	0	0	0	0	2	0	1	1	1	0	0	0	5
1 - 1.5	0	0	0	0	1	3	3	1	2	1	2	0	13
2 - 2.5	0	0	0	0	0	0	0	0	2	0	0	0	2
3 - 3.5	1	0	0	0	1	0	0	0	0	0	0	0	2
4 - 4.5	0	0	0	0	0	0	0	0	1	0	0	0	1
5 - 5.5	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 6.5	0	0	0	0	0	0	0	0	0	0	0	0	0
7 - 7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
8 - 8.5	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	0	0	0	4	3	4	2	6	1	2	0	23

TABLE 26. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 290° - 310°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	0	0	0	0	0	0	0	1	1	0	1	0	3
1 - 1.5	0	1	1	1	0	3	0	1	5	0	0	0	12
2 - 2.5	0	0	0	0	0	0	1	0	2	0	0	0	3
3 - 3.5	0	0	0	0	0	0	0	0	0	0	0	0	0
4 - 4.5	0	0	0	0	0	0	0	0	0	0	0	0	0
5 - 5.5	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 6.5	0	0	0	0	0	0	0	0	0	0	0	0	0
7 - 7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
8 - 8.5	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	1	1	1	0	3	1	2	8	0	1	0	18

TABLE 27. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION 320° - 340°

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	0	0	0	0	0	0	0	0	0	0	2	0	2
1 - 1.5	3	1	0	0	0	3	0	0	3	0	1	3	14
2 - 2.5	0	0	0	0	0	0	0	0	0	0	0	0	0
3 - 3.5	0	0	0	0	0	0	0	0	0	0	0	0	0
4 - 4.5	0	0	0	0	0	0	0	0	0	0	0	0	0
5 - 5.5	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 6.5	0	0	0	0	0	0	0	0	0	0	0	0	0
7 - 7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
8 - 8.5	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	1	0	0	0	3	0	0	3	0	3	3	16

TABLE 28. FREQUENCY OF SWELL REPORTS IN DIFFERENT HEIGHT INTERVALS - DIRECTION INDETERMINATE

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	6	0	0	0	1	5	0	2	1	0	1	0	16
1 - 1.5	0	2	1	2	3	3	6	10	6	1	0	3	37
2 - 2.5	0	2	1	0	0	3	3	1	2	1	1	1	15
3 - 3.5	0	1	0	0	0	0	0	0	1	2	1	0	5
4 - 4.5	0	0	0	0	0	0	0	0	0	1	1	0	2
5 - 5.5	0	0	0	0	0	0	0	3	0	1	0	0	4
6 - 6.5	0	0	0	0	0	0	0	2	0	2	0	0	4
7 - 7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
8 - 8.5	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 9.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10 OR MORE	0	1	0	1	0	0	0	1	0	0	1	1	7
TOTAL	6	6	2	3	4	13	9	19	10	8	5	5	90

TABLE 29. W.M.O. VISIBILITY CODE

Code figure	km
90	< 0.05
91	0.05
92	0.2
93	0.5
94	1
95	2
96	4
97	10
98	20
99	$\geqslant 50$

Note : The following rule is followed in coding : If the observed visibility is between two of the reportable distances as given in the table, the code figure for the lower reportable distance is reported.

TABLE 30. FREQUENCY OF VISIBILITY OBSERVATIONS IN DIFFERENT RANGES

CODE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
90	0	6	5	5	1	2	0	0	0	0	0	0	19
91	2	4	3	8	0	0	0	0	0	0	0	1	18
92	6	3	8	9	3	1	0	1	6	0	0	2	39
93	6	0	2	13	0	0	1	1	1	0	0	0	24
94	5	2	8	13	3	2	3	7	5	0	0	0	48
95	15	6	14	16	8	9	9	7	17	5	1	4	111
96	61	48	87	51	41	24	14	24	46	26	23	22	467
97	457	253	330	262	320	225	121	199	165	115	195	195	2837
98	730	519	455	577	533	655	510	577	697	622	623	625	7123
99	111	82	73	76	103	175	269	259	187	174	124	141	1774
TOTAL	1393	923	985	1030	1012	1093	927	1075	1124	942	966	990	12460

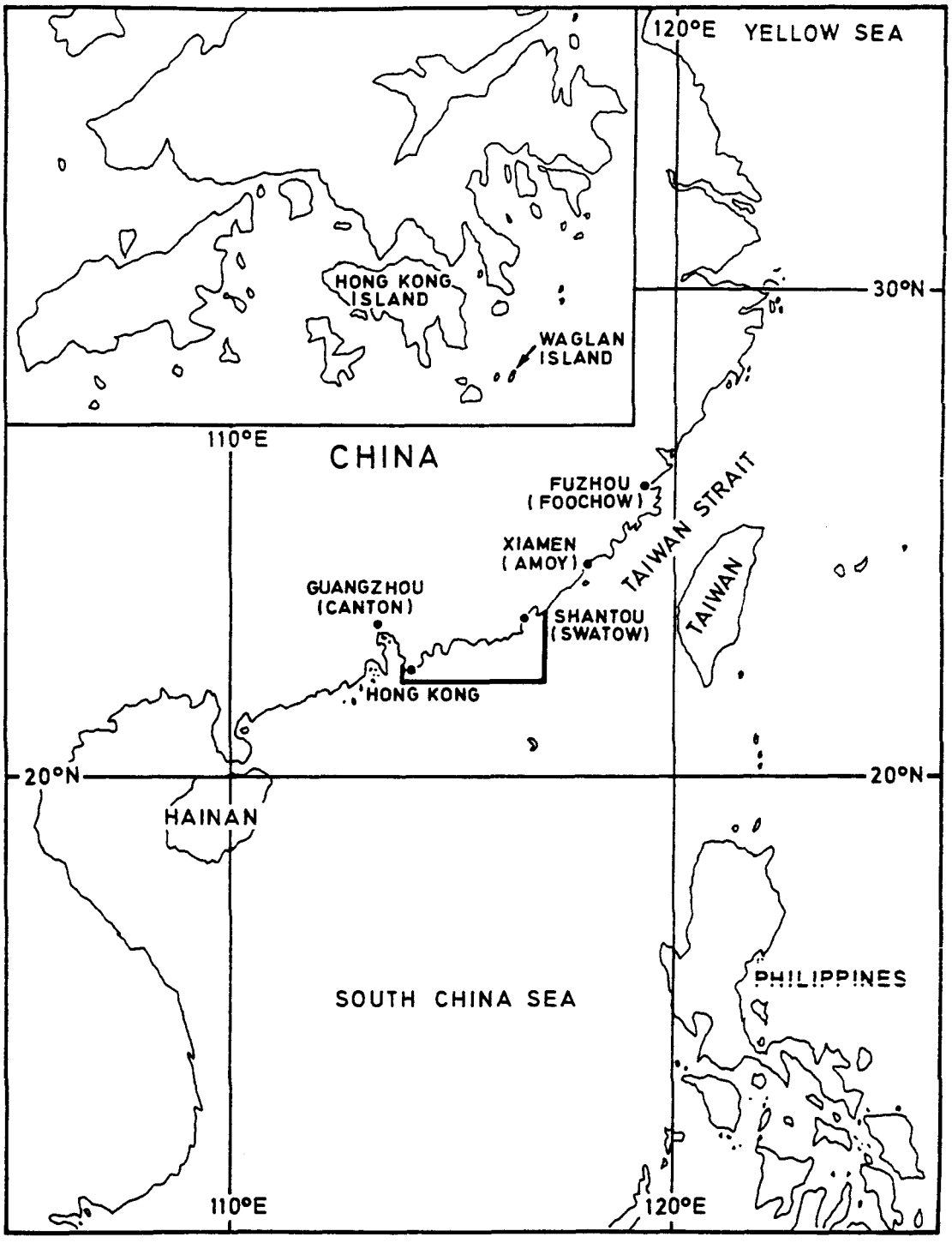

FIGURE 1 Map to show the sea area covered by this report. The inset shows the location of Waglan Island.