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ROYAL OBSERVATORY, HONG KONG

CLIMATOLOGICAL NOTE NO. 7

WIND, VISIBILITY, SEA AND SWELL IN THE GULF OF TONKIN WEST OF HAINAN ISLAND 1961 - 1970

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SUMMARY

Based on weather observations made by voluntary observers aboard ships during 1961-70, climatological information on wind, visibility, sea and swell conditions over the Gulf of Tonkin west of Hainan Island is presented. The sea area covered is bounded by latitudes 18.5°N and 20.0°N and the coasts of Vietnam and Hainan Island.

The area is very much influenced by the monsoons. Strong winds ($\geqslant$ force 6) and higher waves ($\geqslant$ 2 metres) are most frequent in the winter months.

The frequency of reduced visibility is highest in March.

CONTENTS

TABLES

FIGURE

1. INTRODUCTION

There has been a significant increase in the activity taking place in coastal waters in the past few years. This is the consequence of a greater awareness of the vast resources that are available in the continental shelves. In the South China Sea, oil has been discovered at several sites while prospecting is taking place in other coastal areas (Lauriat, 1979).

Field surveys during the exploratory stage and the operation of oil-drilling platforms during the production stage are both weather-dependent. For example, delays of up to three months in the completion of seismic surveys off the coast of southern China due to strong monsoon winds were reported during the winter of 1979-80 (Liu, 1980). It is anticipated that in the next few years, there will be an increased demand for the provision of meteorological services to support these activities.

This note is intended to provide climatological information on wind, visibility, sea and swell in the Gulf of Tonkin west of Hainan Island.

2. PROCEDURE

(a) Source of data

Weather observations made by voluntary observers aboard ships are recorded in logbooks. They 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 latitudes 18.5°N and 20.0°N and between the coasts of Vietnam and Hainan Island 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 the same as that of the wind so that it 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 winds which produced the waves or observed when the winds which generated the waves have died down. 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, gives the frequency distribution of waves in different height intervals (Table 14). For swells, frequency tables were prepared for different swell directions (Tables 15 - 28). The monthly frequency distribution of swells in different height intervals is 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 of 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 affected by the monsoons. Table 1 shows that there is a modal peak in the 020° - 040° direction sector which is related to the winter monsoon. Another modal peak occurs in the 140° - 160° sector. This peak is related to the summer monsoon. Frequency of winds in this sector is comparable to but slightly lower than that in the 020° - 040° sector.

Data for individual months are presented in Tables 2 - 13. The modal wind direction in the months of September to February is from the 020° - 040° sector. March and April are transition months when winds from the modal directions: 020° - 040° and 140° - 160° are more or less equally frequent. The modal wind direction during the summer months of May to August gradually veers from the 140° - 160° sector to the 200° - 220° sector.

The modal wind speed for most months is force 4. Winds tend to be weaker during the transition months when the modal wind direction changes. The modal wind speed for the months March to April and August to September is between force 3 and 4. Because of the arrival of surges of the winter monsoon, the percentages of wind reports of force 6 or above are several times higher in winter than in summer. The following figures bear this out.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of reports ⩾ force 6	20	12	12	5	5	6	5	4	8	12	15	16

(b) Sea and swell

Table 14 shows that higher waves occur during the winter months. The percentages of wave reports of 2 metres or more in each month are as follows:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of reports ⩾2 metres	11	12	8	3	2	1	1	2	6	7	9	15

The peak frequency of 15% occurs in December. There is no secondary peak in summer associated with the summer monsoon.

Tables 15 - 28 show that the monsoons have significant influence on the directions of swells observed at different times of the year. The modal swell directions for each month are as follows:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
direction sector	020 -040	020 -040	110 -130 (050 -070)	050 -070 (110 -130)	140 -160	110 -130	140 -160	170 -190	140 -160 (020 -040)	020 -040	050 -070	050 -070

The sectors enclosed in brackets are secondary peaks in the distribution. The preferred swell direction in the winter months of October to February is from the northeast while that in the summer months of May to August is from south or southeast. March, April and September are transition months.

The percentage of swell reports exceeding or equal to 2 metres each month is as follows:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of reports $\geqslant$ 2 metres	40	28	8	10	4	3	1	2	10	16	18	23

The highest swells occur in winter with a peak in January. There is no peak associated with the summer monsoon.

(c) Visibility

Table 29 gives the WMO code used when visibility is reported at sea. Table 30 shows the monthly distribution of visibilities in different ranges. The months of February to April have the highest frequencies of reduced visibility. The percentage of visibility reports less than 2 km or 10 km each month is as follows:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of reports $<$ 2 km	0.6	2.3	5.3	3.4	<0.1	<0.1	<0.1	0.2	0.5	<0.1	0.2	0.4
% of reports $<$ 10 km	8.0	16.7	24.0	13.7	0.6	0.6	0.2	0.8	2.2	0.7	3.1	6.2

This pattern is similar to those of the coastal waters of Guangdong (Hung 1951 and Lam 1979, 1980) but with one difference. The peak frequency of poor visibility ($<$ 2 km) occurs in March rather than in April which is the peak month for coastal waters of Guangdong. The phenomenon of earlier occurrence of fog and mist in the western part of the South China coast compared with coastal waters to the east has been described by several authors (e.g. Dalian Marine Transport Institute 1975). It arises as a result of the gradual northward advance of warm moist airstreams towards the south China coast as the winter monsoon subsides.

4. CONCLUSIONS

Data on the climatological conditions in the Gulf of Tonkin have been presented and discussed. It is shown that this area is very much influenced by the monsoons.

The winter monsoon is dominant from September to February while the summer monsoon prevails from May to August. March and April are the spring transition months when winds are relatively weaker. Winds are also weaker in August and September during the autumn transition.

The seasonal variation of sea waves follows closely that of winds. The highest frequency of waves $\geq$ 2 metres occurs in December. Swell conditions are also closely related to the prevailing winds.

Visibility conditions are worst in March, one month earlier than in the coastal waters of Guangdong. This is consistent with the observations of other authors.

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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	586														586
1		0	133	109	125	144	113	133	110	103	69	68	66	93	1266
2		0	418	559	607	456	465	470	461	331	230	245	241	312	4795
3		0	893	1354	1226	714	794	1357	1009	741	438	272	332	462	9592
4		0	1161	2309	1541	654	929	2266	1753	1044	541	209	226	391	13024
5		0	568	1525	953	197	246	1290	799	513	211	59	55	141	6557
6		0	318	1095	577	49	58	455	199	119	43	9	10	58	2990
7		0	83	350	159	10	4	49	8	9	2	4	0	16	694
8		0	9	63	34	2	0	2	4	0	2	0	0	2	118
9		0	0	2	0	1	0	0	0	2	0	0	0	0	5
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	586	0	3583	7366	5222	2227	2609	6022	4343	2862	1536	866	930	1475	39627

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	18														18
1		0	8	6	5	8	2	6	6	9	9	3	2	6	70
2		0	31	27	26	14	6	16	19	17	3	6	11	9	185
3		0	92	131	85	23	27	46	27	13	2	3	7	37	493
4		0	201	307	142	30	20	70	27	3	0	3	6	52	861
5		0	109	231	111	7	11	28	3	0	0	0	0	9	509
6		0	52	240	71	2	6	19	0	0	0	0	2	3	395
7		0	16	79	15	1	1	1	0	0	0	0	0	0	113
8		0	2	17	7	1	0	0	0	0	0	0	0	0	27
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	18	0	511	1038	462	86	73	186	82	42	14	15	28	116	2671

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	15														15
1		0	7	9	5	8	4	4	4	4	4	8	1	5	63
2		0	27	61	35	32	19	13	11	11	3	12	16	23	263
3		0	103	148	118	43	42	46	15	8	1	2	17	41	584
4		0	170	328	157	26	62	56	11	0	0	2	2	27	841
5		0	84	190	107	5	7	28	2	1	0	0	0	7	431
6		0	55	132	50	0	4	10	0	0	0	0	0	5	256
7		0	9	19	3	0	0	0	0	0	0	0	0	0	31
8		0	1	2	0	0	0	0	0	0	0	0	0	0	3
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	15	0	456	889	475	114	138	157	43	24	8	24	36	108	2487

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	23														23
1		0	25	9	14	20	8	8	4	2	3	5	9	11	118
2		0	32	61	98	54	48	23	29	9	12	16	19	31	432
3		0	60	126	134	100	111	115	53	18	5	14	13	24	773
4		0	76	161	135	85	141	183	43	10	4	0	1	14	853
5		0	34	81	61	15	32	109	22	7	0	2	2	7	372
6		0	14	57	35	4	18	99	23	4	0	0	1	0	255
7		0	8	14	11	1	2	32	4	0	0	0	0	0	72
8		0	0	4	1	0	0	2	2	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	23	0	249	513	489	279	360	571	180	50	24	37	45	87	2907

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	84														84
1		0	12	27	17	22	15	16	11	16	3	1	4	13	157
2		0	58	64	69	70	72	50	31	13	9	25	13	38	512
3		0	114	124	161	110	90	133	35	33	14	13	16	29	872
4		0	108	205	167	65	94	169	73	8	4	3	9	15	920
5		0	35	109	57	7	29	109	40	0	1	2	3	3	395
6		0	13	42	22	3	13	31	4	0	1	0	0	0	129
7		0	3	4	12	0	0	3	0	0	0	0	0	0	22
8		0	0	1	1	0	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	84	0	343	576	506	277	313	511	194	70	32	44	45	98	3093

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	23														23
1		0	5	5	1	12	9	8	10	5	4	7	7	3	76
2		0	22	21	40	36	39	63	59	27	37	22	8	7	381
3		0	26	35	60	59	86	222	159	86	61	18	22	22	856
4		0	24	53	45	57	127	694	445	181	72	21	5	14	1738
5		0	8	20	10	12	45	434	181	75	18	3	4	6	816
6		0	7	8	5	8	1	98	42	9	6	0	0	4	188
7		0	5	4	0	0	0	3	0	0	0	0	0	2	14
8		0	0	2	0	0	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	23	0	97	148	161	184	307	1522	896	383	198	71	46	58	4094

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

		DIRECTION IN TENS OF DEGREES												
FORCE	CALM	VARTABLE	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	65														65
1		0	7	8	10	7	11	27	9	8	10	8	3	5	113
2		0	24	12	6	18	19	61	71	83	53	44	39	23	453
3		0	38	23	12	24	83	191	263	175	98	69	76	52	1104
4		0	35	14	15	11	103	345	419	223	115	61	52	62	1455
5		0	20	3	2	9	41	304	219	108	47	22	11	27	813
6		0	7	4	0	0	6	143	59	18	4	2	0	10	253
7		0	0	3	0	0	0	6	0	2	0	3	0	6	20
8		0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	65	0	131	67	45	69	263	1077	1040	617	327	209	181	185	4276

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	78														78
1		0	8	5	7	10	10	9	2	16	13	6	7	6	99
2		0	15	18	10	34	42	53	72	31	23	15	14	22	349
3		0	22	18	12	28	41	177	161	113	77	19	27	31	726
4		0	10	16	7	27	65	339	452	304	112	19	9	17	1377
5		0	1	0	0	0	18	154	229	145	31	6	13	9	606
6		0	0	3	0	0	1	34	59	43	10	1	2	6	159
7		0	0	0	0	0	0	4	4	2	0	0	0	0	10
8		0	0	0	0	0	0	0	0	0	0	0	0	0	0
9		0	0	0	0	0	0	0	0	2	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	78	0	56	60	36	99	177	770	979	656	266	66	72	91	3406

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	60														60
1		0	8	5	13	6	10	12	7	13	6	5	11	8	104
2		0	35	23	32	28	43	62	61	43	35	50	30	39	481
3		0	49	31	40	47	91	141	131	168	117	70	59	42	986
4		0	32	41	47	36	90	159	163	264	199	65	64	28	1188
5		0	6	12	14	3	16	41	71	172	108	22	11	14	490
6		0	2	7	14	2	1	11	7	44	22	5	3	0	118
7		0	0	0	2	2	1	0	0	4	2	1	0	1	13
8		0	0	0	4	0	0	0	2	0	0	0	0	0	6
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	60	0	132	119	166	124	252	426	442	708	489	218	178	132	3446

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	108														108
1		0	28	13	30	19	21	16	22	16	8	11	13	20	217
2		0	49	63	96	75	85	59	48	60	32	31	52	55	705
3		0	104	151	129	95	55	86	75	69	38	33	51	73	959
4		0	69	161	148	83	56	57	42	34	28	20	34	56	788
5		0	43	96	100	19	2	19	4	0	5	2	5	10	305
6		0	37	65	62	2	0	0	5	0	0	1	1	10	183
7		0	19	40	16	0	0	0	0	1	0	0	0	4	80
8		0	2	4	2	0	0	0	0	0	2	0	0	0	10
9		0	0	0	0	1	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	108	0	351	593	583	294	219	237	196	180	113	98	156	228	3356

TABLE 11. FREQUENCY OF WIND OBSERVATIONS IN DIFERENT 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	52														52
1		0	7	9	14	11	11	8	22	9	6	6	3	2	108
2		0	57	66	62	26	34	28	26	17	12	12	13	24	377
3		0	108	226	145	61	92	75	35	29	11	6	8	18	814
4		0	178	356	254	102	92	95	32	7	2	4	18	25	1165
5		0	72	280	198	59	22	49	20	3	0	0	4	17	724
6		0	39	172	137	7	4	10	0	0	0	0	1	3	373
7		0	4	45	23	0	0	0	0	0	0	0	0	2	74
8		0	0	2	1	0	0	0	0	0	0	0	0	0	3
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	52	0	465	1156	834	266	255	265	135	65	31	28	47	91	3690

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	34														34
1		0	9	8	5	12	2	7	2	3	2	6	0	11	67
2		0	37	75	65	36	29	13	12	8	6	5	13	26	325
3		0	77	172	133	62	27	41	14	13	7	14	23	51	634
4		0	118	336	197	76	54	21	9	2	2	10	15	48	888
5		0	70	222	135	31	19	4	0	0	0	0	2	14	497
6		0	27	155	95	19	4	0	0	1	0	0	0	10	311
7		0	5	60	41	0	0	0	0	0	0	0	0	1	107
8		0	2	14	8	0	0	0	0	0	0	0	0	0	24
9		0	0	2	0	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	34	0	345	1044	679	236	135	86	37	27	17	35	53	161	2889

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	26														26
1		0	9	5	4	9	10	12	11	2	1	2	6	3	74
2		0	31	68	68	33	29	29	22	12	5	7	13	15	332
3		0	100	169	197	62	49	84	41	16	7	11	13	42	791
4		0	140	331	227	56	25	78	37	8	3	1	11	33	950
5		0	86	281	158	30	4	11	8	2	1	0	0	18	599
6		0	65	210	86	2	0	0	0	0	0	0	0	7	370
7		0	14	82	36	6	0	0	0	0	0	0	0	0	138
8		0	2	17	10	1	0	0	0	0	0	0	0	2	32
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	26	0	447	1163	786	199	117	214	119	40	17	21	43	120	3312

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	1045	911	1428	1547	2103	2211	1757	1856	1658	1574	1164	1280	18534
1 - 1.5	946	899	868	720	1334	1203	929	626	592	1057	860	1030	11064
2 - 2.5	172	198	175	69	65	45	17	49	138	184	167	279	1558
3 - 3.5	59	42	32	3	3	3	2	2	13	22	42	108	331
4 - 4.5	3	0	1	0	0	0	0	1	1	0	2	13	21
5 - 5.5	2	0	0	0	0	0	0	0	2	0	0	0	4
6 - 6.5	0	0	1	0	0	0	0	0	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	2227	2050	2505	2339	3505	3462	2705	2534	2404	2837	2235	2710	31513

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

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	213	233	356	543	392	408	374	608	411	392	280	249	4459
1 - 1.5	426	382	379	368	359	473	421	293	173	478	313	398	4466
2 - 2.5	230	189	54	88	27	23	4	14	51	141	94	102	1017
3 - 3.5	154	48	5	8	2	0	7	5	12	19	28	77	365
4 - 4.5	29	2	2	0	0	0	0	0	1	0	4	11	49
5 - 5.5	3	0	0	0	0	0	0	0	0	0	0	1	4
6 - 6.5	2	0	0	0	0	0	0	0	0	0	0	0	2
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	1057	854	796	1007	780	904	806	920	648	1030	719	838	10359
SWELL CALM	10	19	17	14	13	12	11	10	3	10	12	16	147

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

METRES	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0 - 0.5	9	8	5	18	9	8	2	19	30	9	43	16	176
1 - 1.5	32	14	6	23	11	3	0	8	7	28	54	35	223
2 - 2.5	19	24	2	24	6	0	0	0	15	16	7	1	114
3 - 3.5	6	4	0	0	2	0	0	0	6	10	6	5	39
4 - 4.5	4	0	0	0	0	0	0	0	0	0	0	2	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	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	70	50	13	65	28	11	2	27	58	63	110	59	556

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	24	36	35	65	7	37	0	9	35	35	32	22	337
1 - 1.5	154	154	75	98	9	14	0	4	23	170	78	99	879
2 - 2.5	90	74	24	17	0	1	0	0	12	60	49	56	383
3 - 3.5	89	40	4	3	0	0	0	0	3	7	15	40	201
4 - 4.5	22	2	2	0	0	0	0	0	1	0	2	2	31
5 - 5.5	3	0	0	0	0	0	0	0	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	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	382	306	140	183	16	52	0	13	74	272	176	219	1833

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	52	55	70	93	10	2	2	19	21	125	63	54	566
1 - 1.5	112	103	66	60	19	0	0	13	30	112	102	120	737
2 - 2.5	98	74	14	33	2	0	0	0	12	29	26	35	323
3 - 3.5	54	3	0	1	0	0	0	0	3	2	5	22	90
4 - 4.5	3	0	0	0	0	0	0	0	0	0	2	1	6
5 - 5.5	0	0	0	0	0	0	0	0	0	0	0	1	1
6 - 6.5	2	0	0	0	0	0	0	0	0	0	0	0	2
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	321	235	150	187	31	2	2	32	66	268	198	233	1725

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	26	27	82	103	23	9	9	52	50	108	66	58	613
1 - 1.5	37	35	30	46	16	7	2	24	14	78	17	58	364
2 - 2.5	5	8	0	4	0	0	0	0	2	23	6	6	54
3 - 3.5	3	0	1	0	0	0	0	0	0	0	2	6	12
4 - 4.5	0	0	0	0	0	0	0	0	0	0	0	4	4
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	71	70	113	153	39	16	11	76	66	209	91	132	1047

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	68	19	108	120	86	101	84	53	64	57	62	52	874
1 - 1.5	40	35	106	59	101	123	63	20	14	69	34	50	714
2 - 2.5	9	5	7	3	3	11	0	0	0	4	0	0	42
3 - 3.5	2	0	0	0	0	0	0	0	0	0	0	0	2
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	119	59	221	182	190	235	147	73	78	130	96	102	1632

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	11	29	37	118	74	67	108	103	50	19	5	36	657
1 - 1.5	33	24	67	55	142	132	190	57	38	17	14	22	791
2 - 2.5	3	3	5	1	12	6	2	1	1	0	0	0	34
3 - 3.5	0	0	0	1	0	0	0	0	0	0	0	0	1
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	47	56	109	175	228	205	300	161	89	36	19	58	1483

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	6	9	5	6	105	34	45	144	25	15	2	4	400
1 - 1.5	7	2	12	9	34	58	66	82	16	2	4	8	300
2 - 2.5	0	0	2	0	1	1	2	2	0	1	0	0	9
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	2	2
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	13	11	19	15	140	93	113	228	41	18	6	14	711

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	0	0	1	5	29	44	51	16	4	0	0	150
1 - 1.5	0	0	4	0	7	57	73	44	5	0	0	1	191
2 - 2.5	2	0	0	0	0	0	0	2	0	0	0	0	4
3 - 3.5	0	0	0	0	0	0	0	2	0	0	0	0	2
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	2	0	4	1	12	86	117	99	21	4	0	1	347

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	1	10	2	0	22	15	31	73	16	2	0	0	172
1 - 1.5	1	2	2	3	0	48	8	19	3	0	2	0	88
2 - 2.5	0	0	0	0	0	0	0	7	0	0	0	1	8
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	2	12	4	3	22	63	39	99	19	2	2	1	268

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	31	0	0	1	32	14	23	12	0	0	2	115
1 - 1.5	0	2	2	6	2	3	10	8	7	0	0	0	40
2 - 2.5	0	0	0	0	0	0	0	2	0	0	0	0	2
3 - 3.5	0	0	0	0	0	0	7	0	0	0	0	0	7
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	33	2	6	3	35	31	33	19	0	0	2	164

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	6	5	4	0	3	17	11	23	24	12	0	0	105
1 - 1.5	5	4	2	6	4	7	7	6	5	0	2	5	53
2 - 2.5	0	0	0	0	2	0	0	0	2	0	0	1	5
3 - 3.5	0	0	0	0	0	0	0	2	0	0	0	4	6
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	11	9	6	6	9	24	18	31	31	12	2	10	169

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	6	4	2	1	13	17	18	13	20	6	7	5	112
1 - 1.5	5	7	5	3	14	17	2	2	6	2	6	0	69
2 - 2.5	4	1	0	6	0	4	0	0	7	8	6	2	38
3 - 3.5	0	1	0	3	0	0	0	1	0	0	0	0	5
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	15	13	7	13	27	38	20	16	33	16	19	7	224

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	4	0	6	18	34	40	6	26	48	0	0	0	182
1 - 1.5	0	0	2	0	0	4	0	6	5	0	0	0	17
2 - 2.5	0	0	0	0	1	0	0	0	0	0	0	0	1
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	4	0	8	18	35	44	6	32	53	0	0	0	200

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	≥ 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	2	0	23	9	0	0	0	0	0	0	0	4	38
91	5	9	29	31	0	0	0	0	1	0	0	0	75
92	2	14	29	23	0	1	0	1	2	0	2	2	76
93	2	8	23	12	0	0	0	2	5	0	0	0	52
94	5	25	53	29	2	2	0	3	9	0	4	7	139
95	15	43	78	56	2	3	0	2	18	6	20	37	280
96	183	316	464	263	19	19	6	21	40	21	63	157	1572
97	967	1288	1387	1156	643	353	130	369	447	449	637	1109	8935
98	1487	780	820	1505	3388	3786	3211	2991	2801	3161	2142	1992	28064
99	6	3	1	8	44	113	60	58	33	56	21	7	410
TOTAL	2674	2486	2907	3092	4098	4277	3407	3447	3356	3693	2889	3315	39641

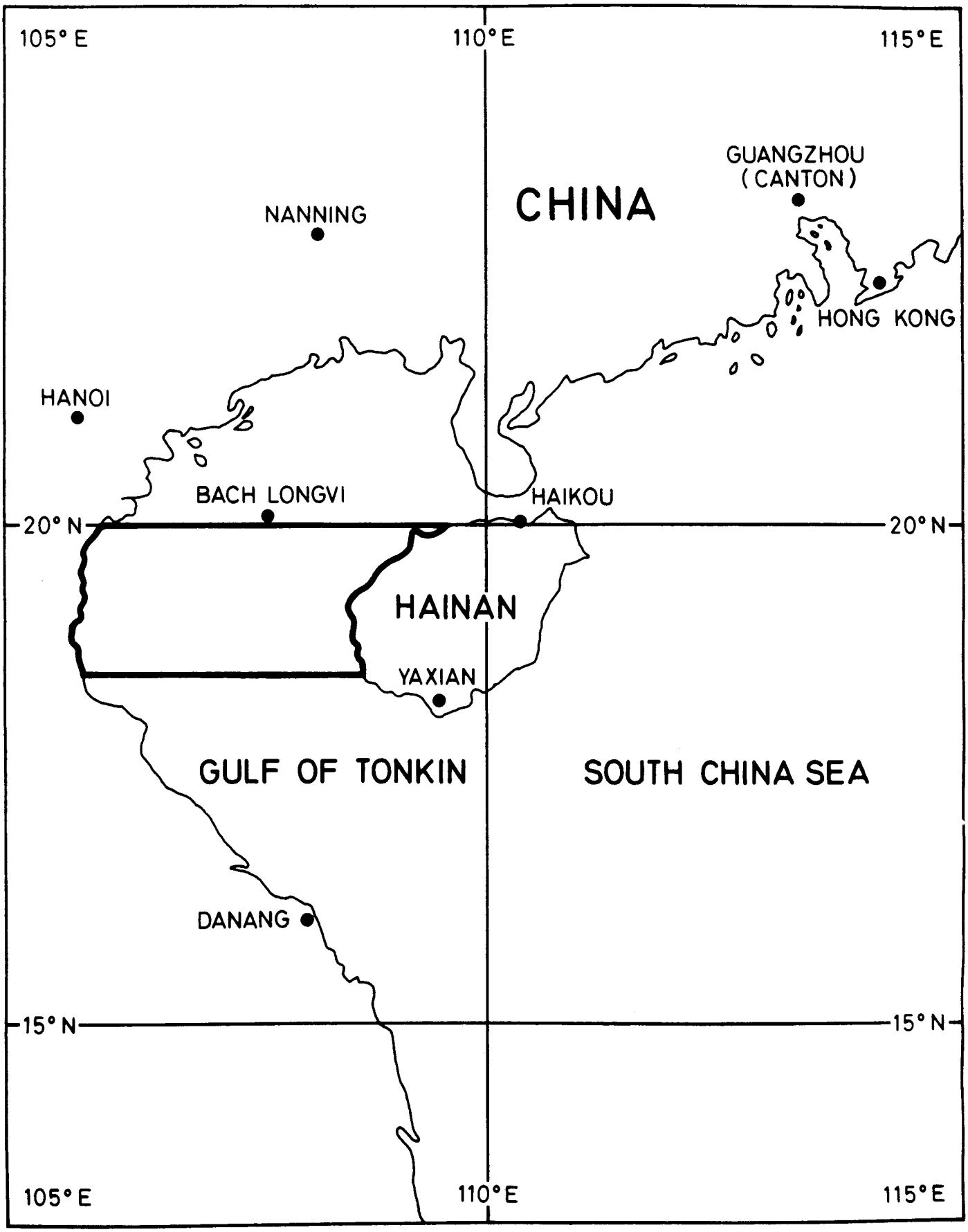

Figure 1. Map to show the sea area covered in this report.