HONG KONG OBSERVATORY

Technical Note No. 97

CLIMATOLOGY OF TUEN MUN 1988-1998

by

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摘要

本報告是屯門自動氣象站在1988 - 1998期間的氣候摘要。 除列出標準氣候圖表外，亦將屯門的紀錄與橫瀾島的風紀錄及天文台的氣溫紀錄作出比較。

Abstract

This note gives a climatological summary for Tuen Mun Automatic Weather Station during 1988-1998. In addition to standard climatological tables and diagrams, comparisons of wind with Waglan Island and temperature with Hong Kong Observatory are also made.

CONTENTS

FIGURES

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1. INTRODUCTION

Automatic weather stations were set up in Hong Kong to meet increasing demands for regional meteorological data for engineering projects in areas under development and to improve weather services. There are 27 such stations in operation at present. Tuen Mun Automatic Weather Station is one of these stations with a history of more than 11 years. This note is to give a climatological summary for this station.

2. HISTORY OF THE STATION

Tuen Mun Automatic Weather Station (22°23'32"N , 113°58'27"E) has been in operation since 23 October 1987. It is situated on the roof top of Tuen Mun Government Offices Building. It is sheltered to the east and west by hills and most exposed to the north-northeast and the south. Its location is shown in Figures 1 and 2.

The high hills around the station are :

Hill to the east of Tuen Mun	(507 m)	2 km to E
Castle Peak	(583 m)	2 km to W
Hill near Yuen Long	(297 m)	5 km to NE

3. DATA

The data used in this note are hourly records measured at Tuen Mun Automatic Weather Station between January 1988 and December 1998. A total of 96 432 observations was loaded into the Oracle database of the Hong Kong Observatory and analyzed using SQL (Structured Query Language). It should be noted that there are periods of incomplete data due to equipment or transmission failure.

4. INSTRUMENTS AND METHODS OF OBSERVATION

At automatic weather stations, measurements of dry-bulb and wet-bulb temperatures, dew point, relative humidity and wind are recorded by automatic instruments and data are transmitted to the Hong Kong Observatory at one-minute intervals via telephone circuits. Figures 3(a) and (b) show the instruments at Tuen Mun. The following paragraphs describe the instruments and methods of observation used during the years 1988-1998.

(a) Air temperature, dew point and relative humidity

Two Stevenson screen boxes were installed on the roof of the Tuen Mun Government Offices Building which is 62.6 m above mean sea-level, one on the east side and the other on the west side. The screen boxes were mounted as far away from the parapet wall as possible to avoid the influence of the concrete wall which would be heated to a rather high temperature by the sun.

Dry-bulb and wet-bulb temperatures were measured by platinum resistance thermometers with its sensing elements placed in these screen boxes. The lower reading from the two thermometers was taken as the official record so that the effect of heat given off by the building, if any, could be eliminated.

Values of dew-point temperature and relative humidity were calculated from the dry-bulb and wet-bulb temperatures. However, the measurement of wet-bulb temperature has ceased since 14 June 1995.

Daily maximum and minimum temperatures were extracted from 1-minute data in each day.

(b) Wind

Winds were measured with a Teledyne Geotech WS201 cup anemometer on the same roof. Its head was 68.1 m above mean sea-level before the replacement of the mast on 31 January 1996. It is now 69.4 m above mean sea-level. Hourly mean wind was computed from the 1-minute data in the hour (Yeung et al 1987).

5. ANALYSIS

(a) Climatological Summary

Monthly values of meteorological elements are summarized in Table 1. Readers are reminded that data are subject to loss because of equipment or transmission failure.

(b) Monthly and annual wind roses

The total number of occurrences of concurrent wind speed and direction is computed for each month. Wind directions are grouped into ranges of 30° and wind speeds in m/s into categories as follows : 0.1-3.2, 3.3-8.2, 8.3-14.2 and >14.2. The percentage frequencies are shown in Table 2 and are plotted in the form of wind roses in Figures 4-6.

It can be seen that the most frequent and prevailing wind direction is south or south-southeast from March to August and north-northeast from September to February. (see Table 1).

(c) Diurnal variation of wind

Hourly vector mean winds are computed for each month. These are shown in Table 3 and plotted in Figures 7-8. Winds begin to veer in the morning and back in the late afternoon from August to March. No regular change in direction is observed from April to July. Maximum wind speeds occur around 8-10 a.m. from September to February, but shift to the afternoon from March to August.

(d) Hourly means of meteorological elements

Hourly means in each month for the following elements are shown in Tables 4-7 and are plotted in Figures 9-12.

(i) air temperature
(ii) wet-bulb temperature
(iii) dew point
(iv) relative humidity

(e) Gust factor

Gust factor is defined as the ratio of hourly instantaneous maximum gust to hourly mean wind. Using the regression equation of gust(G) on hourly mean wind(M), gust factor(GF) can be obtained.

If the regression equation is written as

$$G = a M + b$$

then $GF = a + b/M$

Regression equations for winds in different quadrants and their corresponding gust factors are shown below :

G = 2.08 M + 1.82 ,	r=0.89	(direction between 050° and 130° , east)
G = 1.89 M + 1.85 ,	r=0.85	(direction between 140° and 220° , south)
G = 2.36 M + 1.43 ,	r=0.91	(direction between 230° and 310° , west)
G = 1.87 M + 1.69 ,	r=0.92	(direction between 320° and 040° , north)

where r is the correlation coefficient.

Hourly mean wind (m/s)	Gust factor			
	East	South	West	North
5	2.44	2.26	2.65	2.21
10	2.26	2.08	2.50	2.04
15	2.20	2.01	2.46	1.98
20	2.17	1.98	2.43	1.95

(f) Extreme values of temperature and gust

The top 20 extreme values of maximum and minimum temperatures and maximum gust are listed in Table 8. The extreme values recorded at the Hong Kong Observatory during the same period are also given on the last line for comparison.

Extreme maximum temperatures were due to subsidence ahead of tropical cyclones or prolonged fine weather brought about by ridges. Extreme minimum temperatures were due to cold surges in winter times.

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The occurrences of maximum gusts were recorded during the passage of tropical cyclones. They were Gordon, Faye, Koryn, Tasha, Becky, Helen and Sally in July 1989, July 1992, June 1993, August 1993, September 1993, August 1995 and September 1996 respectively.

(g) Comparison of wind with Waglan Island

Differences in wind direction between Tuen Mun and Waglan Island, grouped by four quadrants (as in (e) above), are measured with the angle veering or backing from the prevailing wind direction recorded at Waglan Island. These differences are shown in Figure 13. For the south and north quadrants, the distributions are single-peak and bell-shaped. Winds at Tuen Mun

most often veer 20 degrees from the northerlies at Waglan but back 20 degrees from the southerlies. Two peaks are observed for the east and west quadrants. For east quadrant, when winds at Waglan are easterlies, winds at Tuen Mun would most often back 40 degrees and the second likely direction would veer 80 degrees from the easterlies. For west quadrant, winds would most often back 70 degrees and the second likely direction would back 30 degree from westerlies.

Regression equations of hourly wind speeds at Tuen Mun (TUN) against those at Waglan Island (WGL) in different quadrants with the speed at Waglan Island exceeding 5 m/s are shown below:

East	:	$V_{TUN} = 0.65\ V_{WGL} + 1.62$	(r = 0.14)
South	:	$V_{TUN} = 0.18\ V_{WGL} + 1.72$	(r = 0.34)
West	:	$V_{TUN} = 0.19\ V_{WGL} + 0.69$	(r = 0.43)
North	:	$V_{TUN} = 0.36\ V_{WGL} + 0.38$	(r = 0.54)

The linear relationships can only be regarded as fair, as reflected by the small values of correlation coefficients. The wind speed of Tuen Mun is about 80% of that at Waglan Island with easterlies but only 40% from other directions.

(h) Comparison of temperature with Hong Kong Observatory

Regression equations of daily maximum, minimum and mean temperatures at Tuen Mun against those at the Observatory (HKO) are shown below:

daily maximum temperature	:	$T_{TUN} = 1.00\ T_{HKO} + 0.21$	(r = 0.98)
daily minimum temperature	:	$T_{TUN} = 1.10\ T_{HKO} - 2.86$	(r = 0.98)
daily mean temperature	:	$T_{TUN} = 1.06\ T_{HKO} - 1.75$	(r = 0.99)

Excellent linear relationships can be seen in the scatter diagrams with associated regression lines shown in Figures 14.

Generally, the daily maximum temperature and daily mean temperature are almost the same as those of the Observatory in summer. On the other hand, the daily minimum temperature is about 1.5^{o}C lower and the daily mean temperature is 1^{o}C lower in winter at Tuen Mun.

ACKNOWLEDGEMENT

The authors would like to thank Mr. W.K. Kwan for his valuable comments on reviewing this note.

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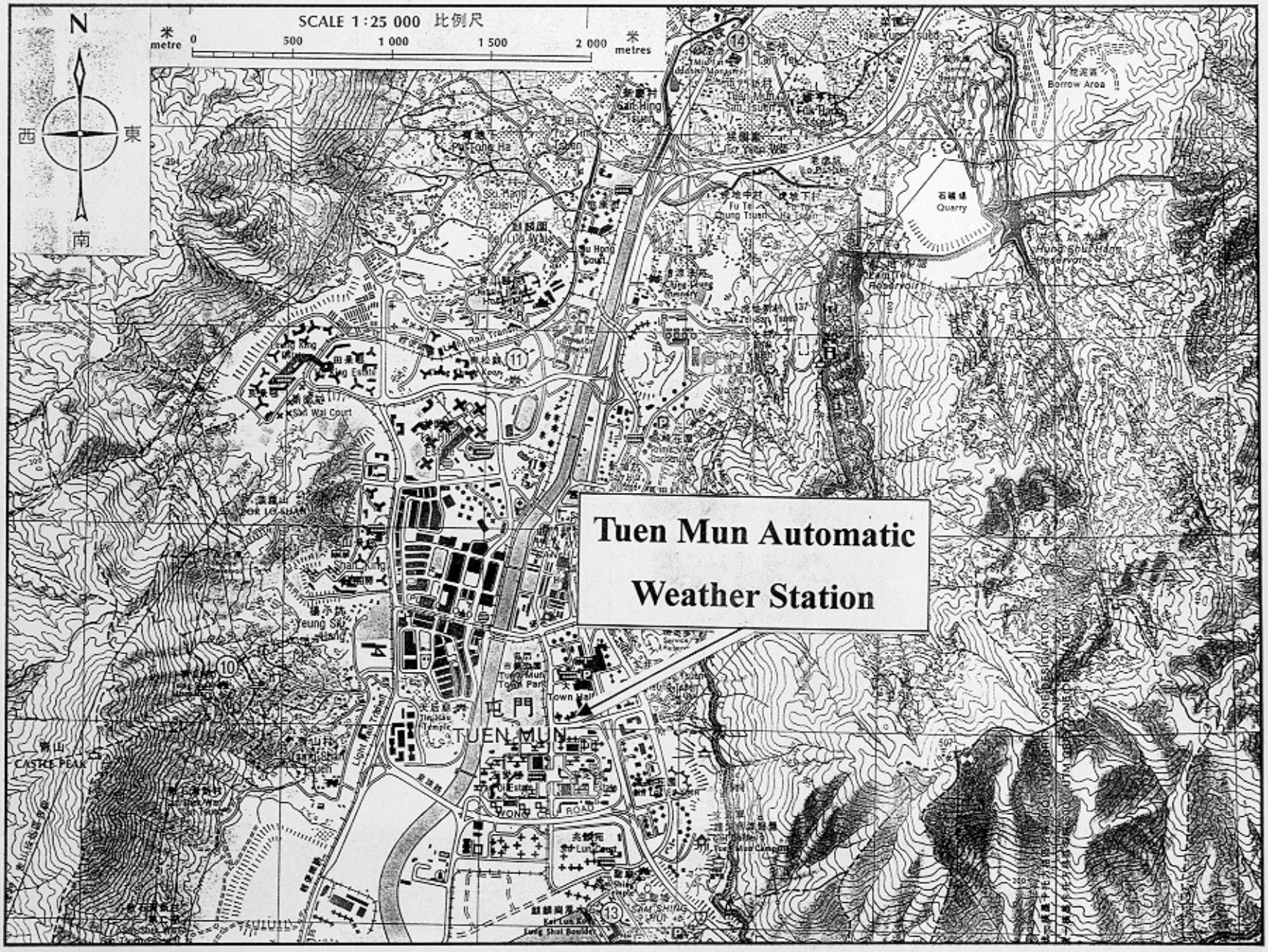
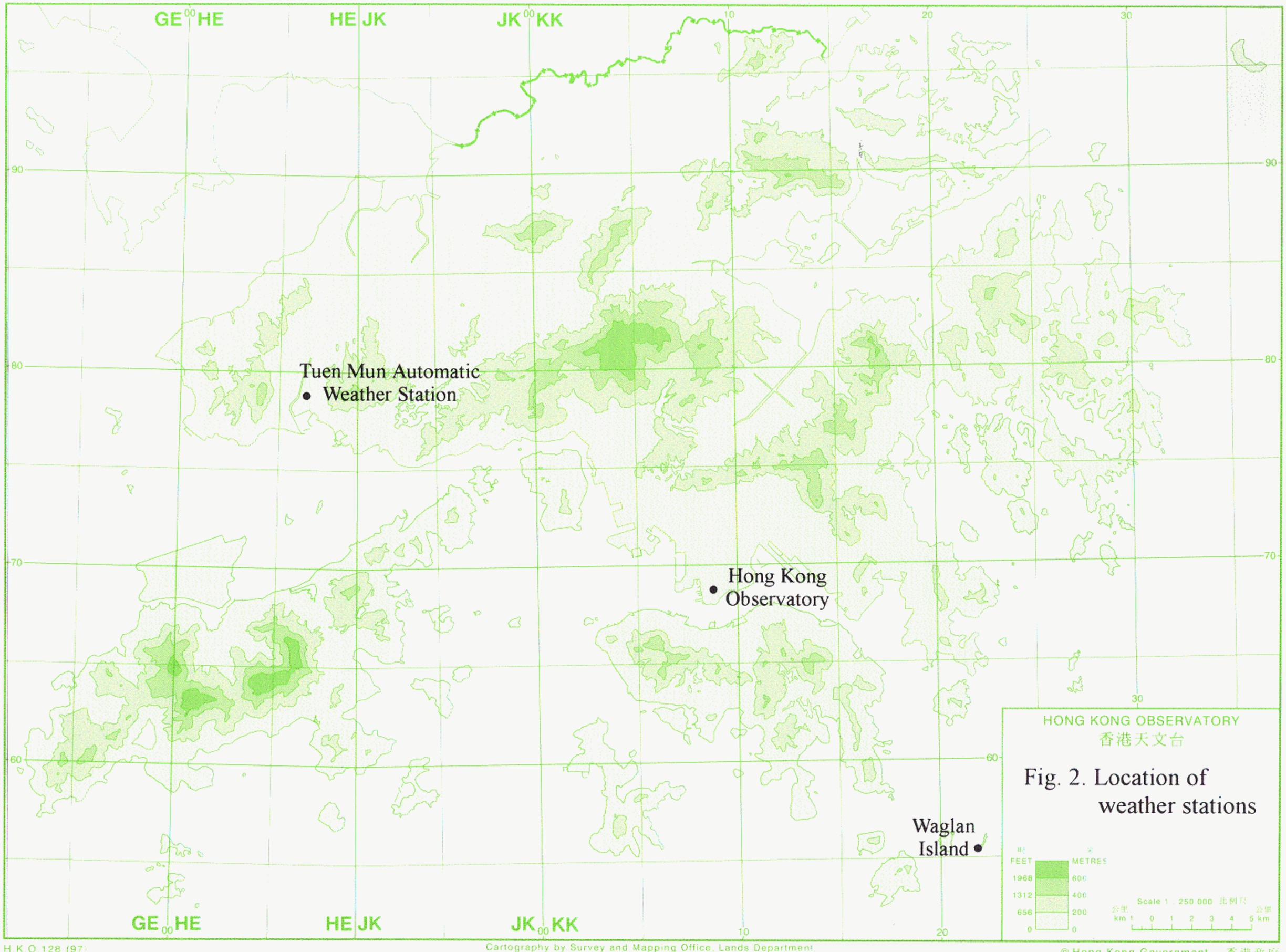


Fig. 1. Location of Tuen Mun Automatic Weather Station.



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Cartography by Survey and Mapping Office, Lands Department
地政總署測繪處繪製

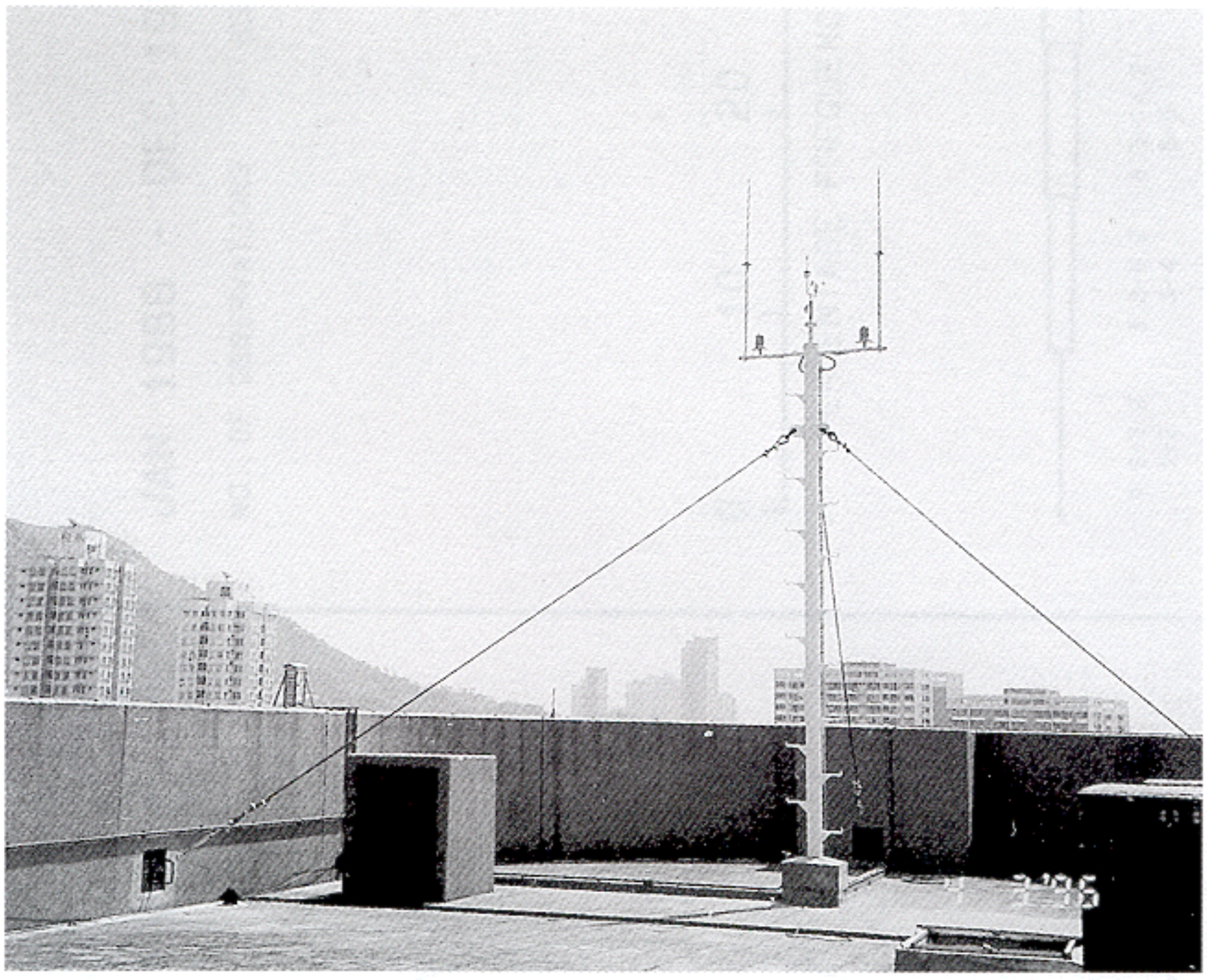

Fig. 3(a). Instruments at Tuen Mun looking towards the southeast. The screen box(east) is mounted on the outer wall to the left.

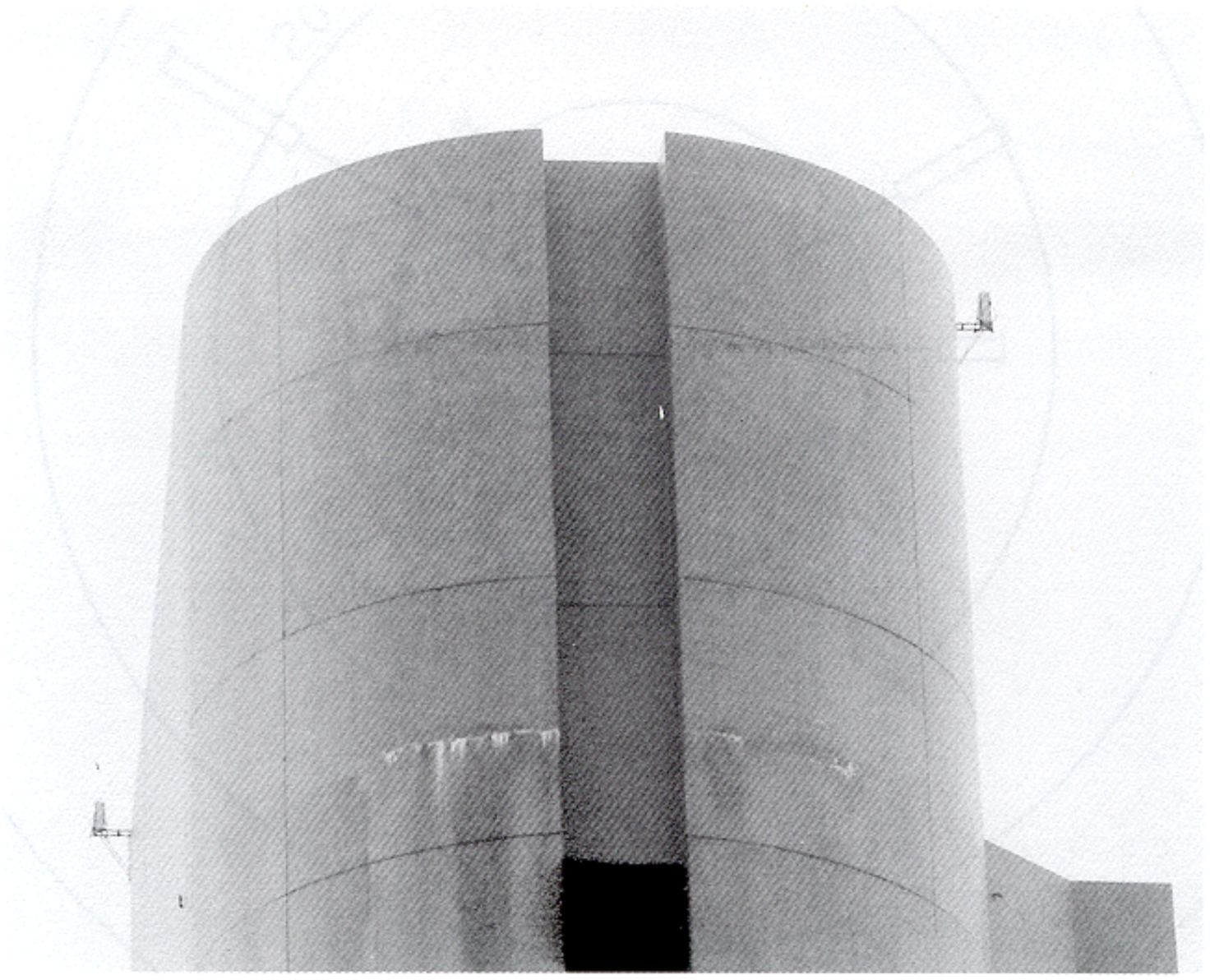

Fig. 3(b). The two screen boxes at Tuen Mun looking from below.

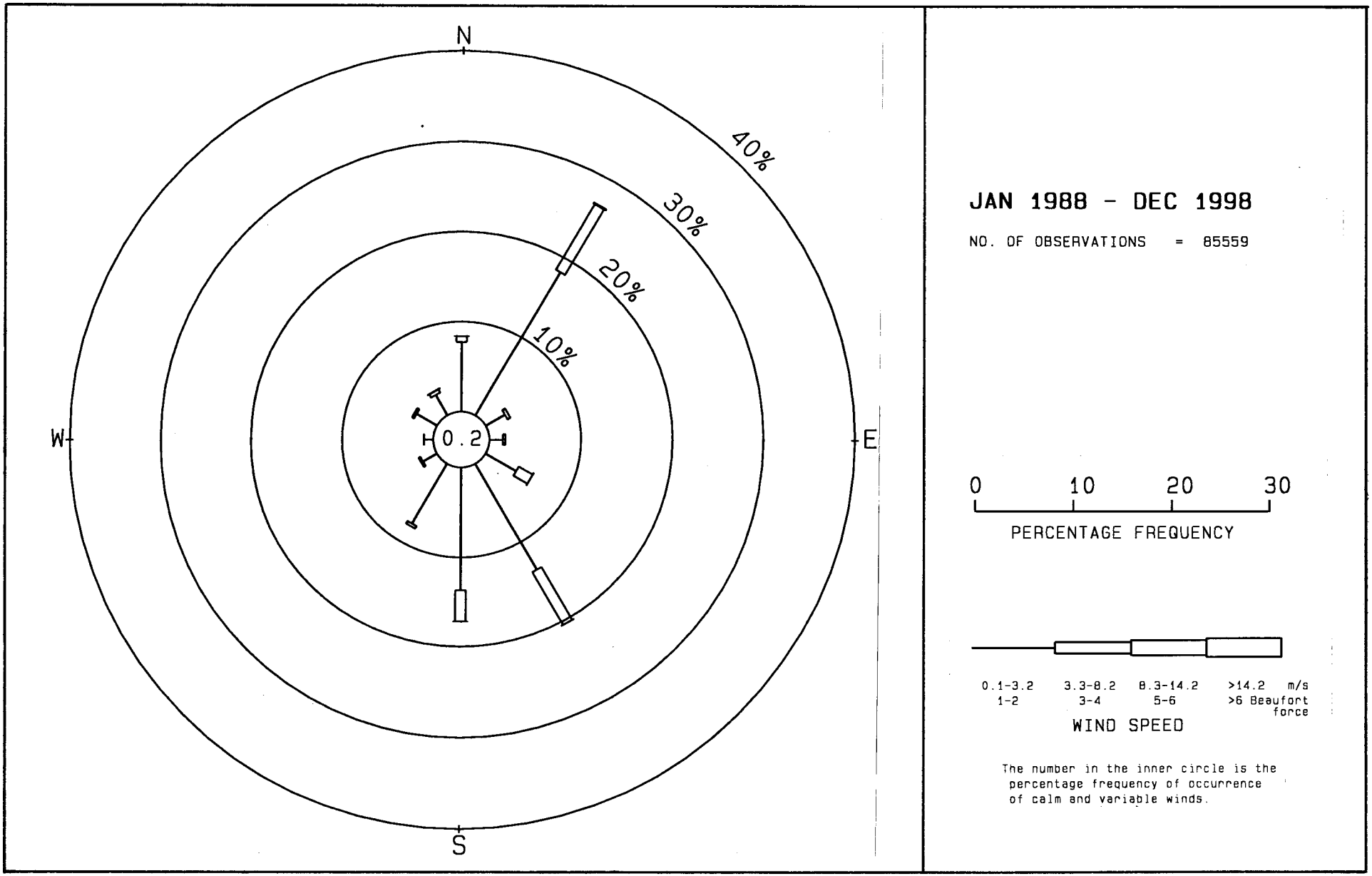

Fig. 4. Annual wind rose for Tuen Mun, 1988-1998.

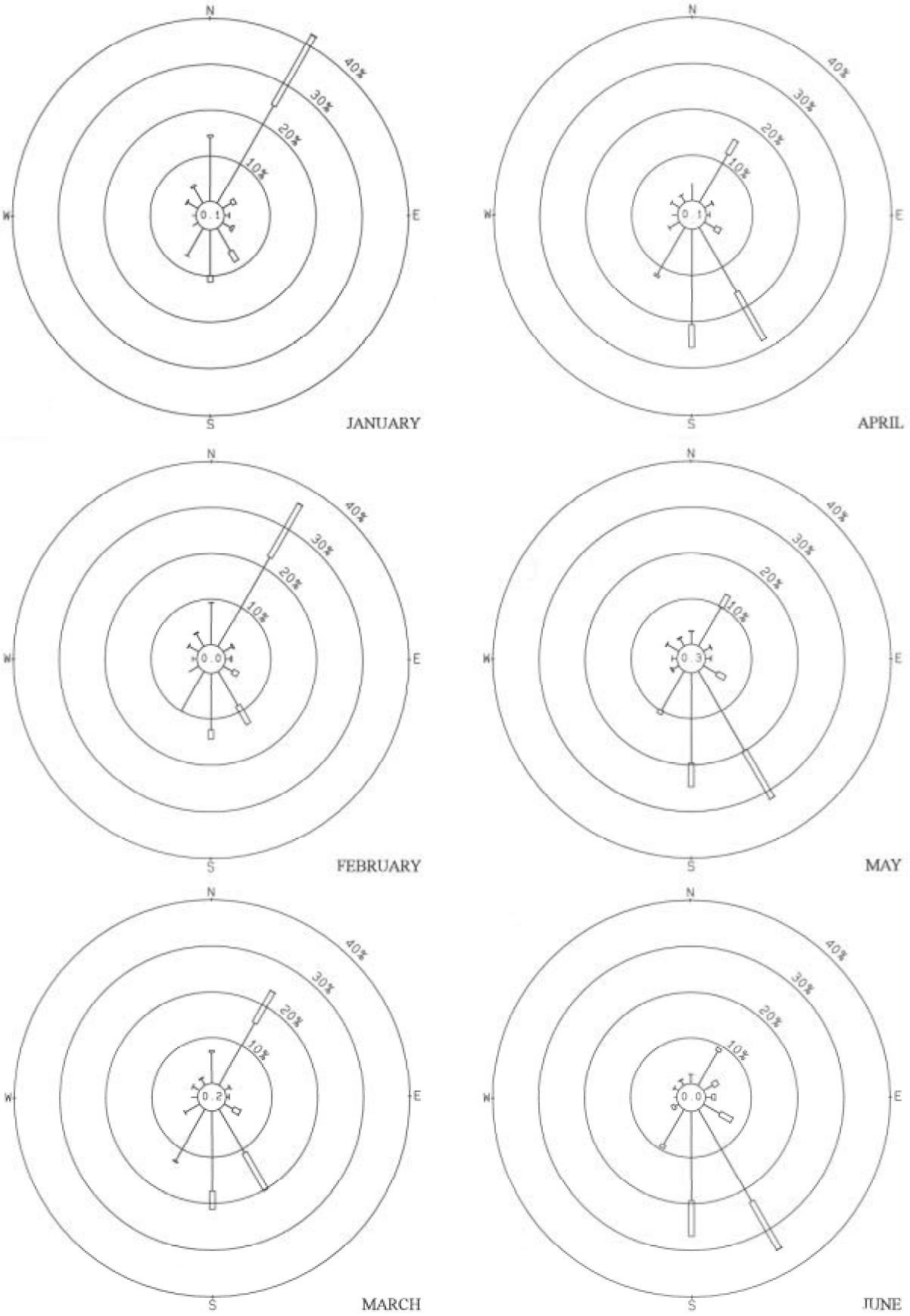

Fig. 5. Monthly wind roses from January to June for Tuen Mun, 1988-1998.

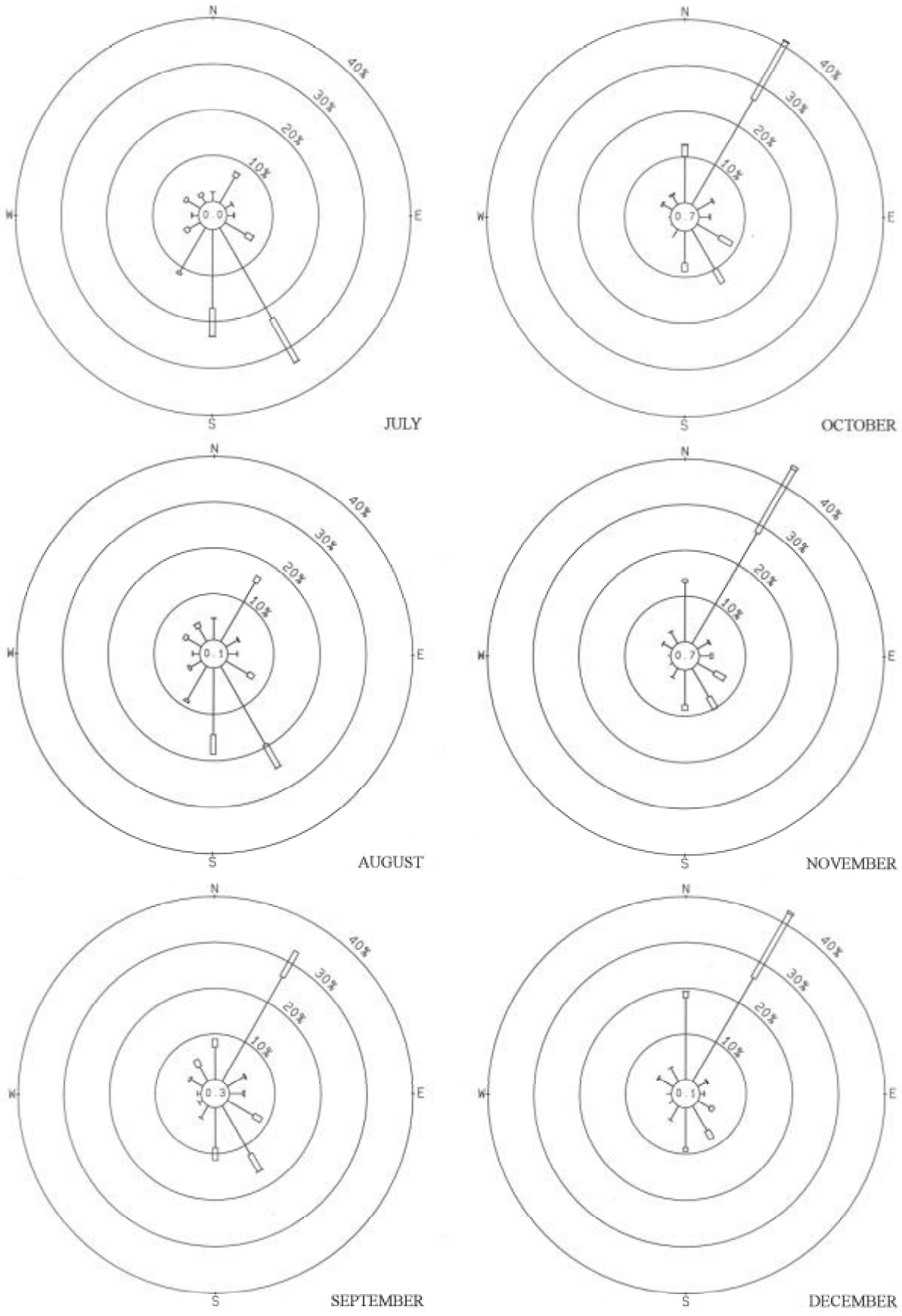

Fig. 6. Monthly wind roses from July to December for Tuen Mun, 1988-1998.

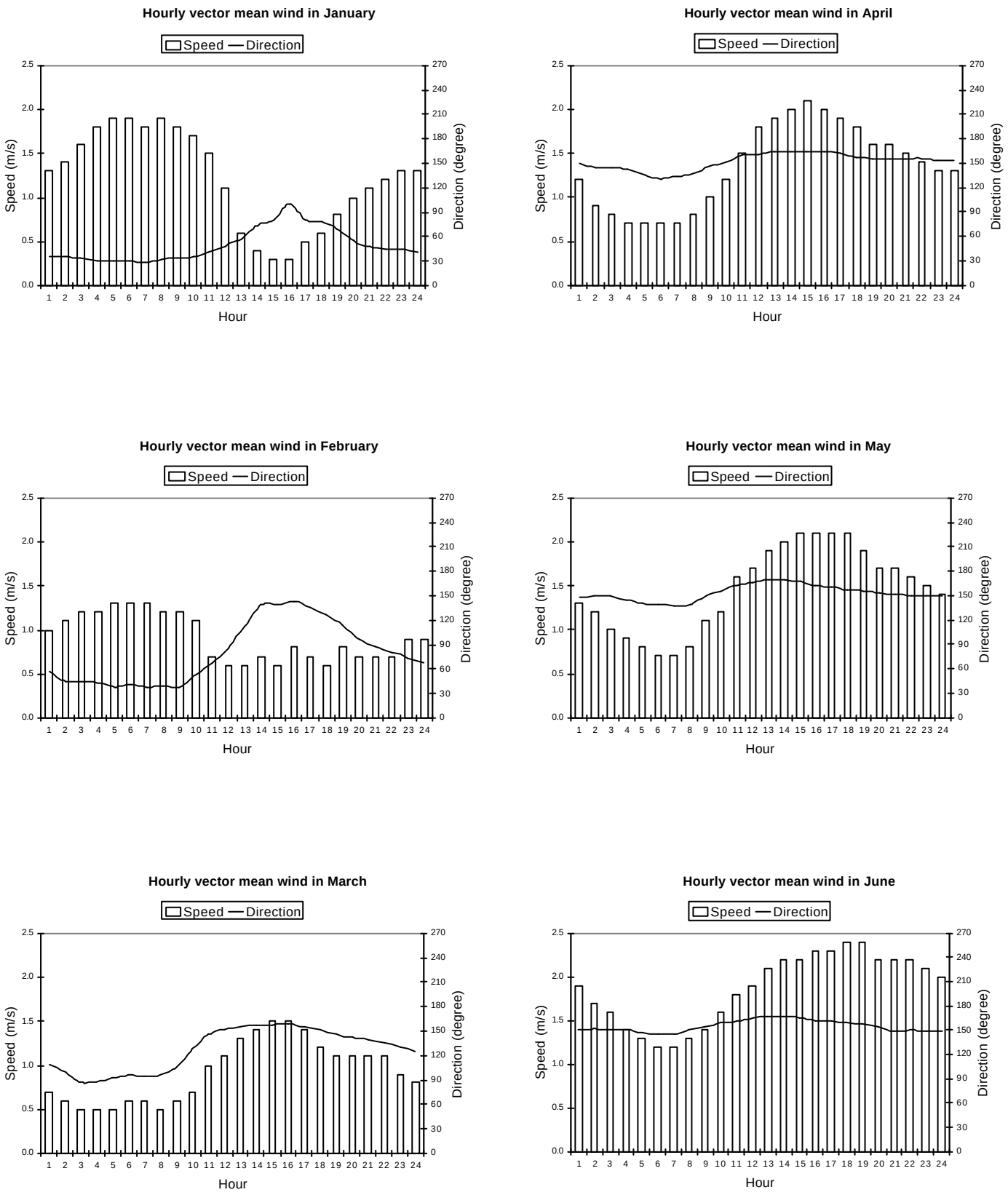

Fig. 7. Hourly vector mean wind from January to June at Tuen Mun, 1988-1998.

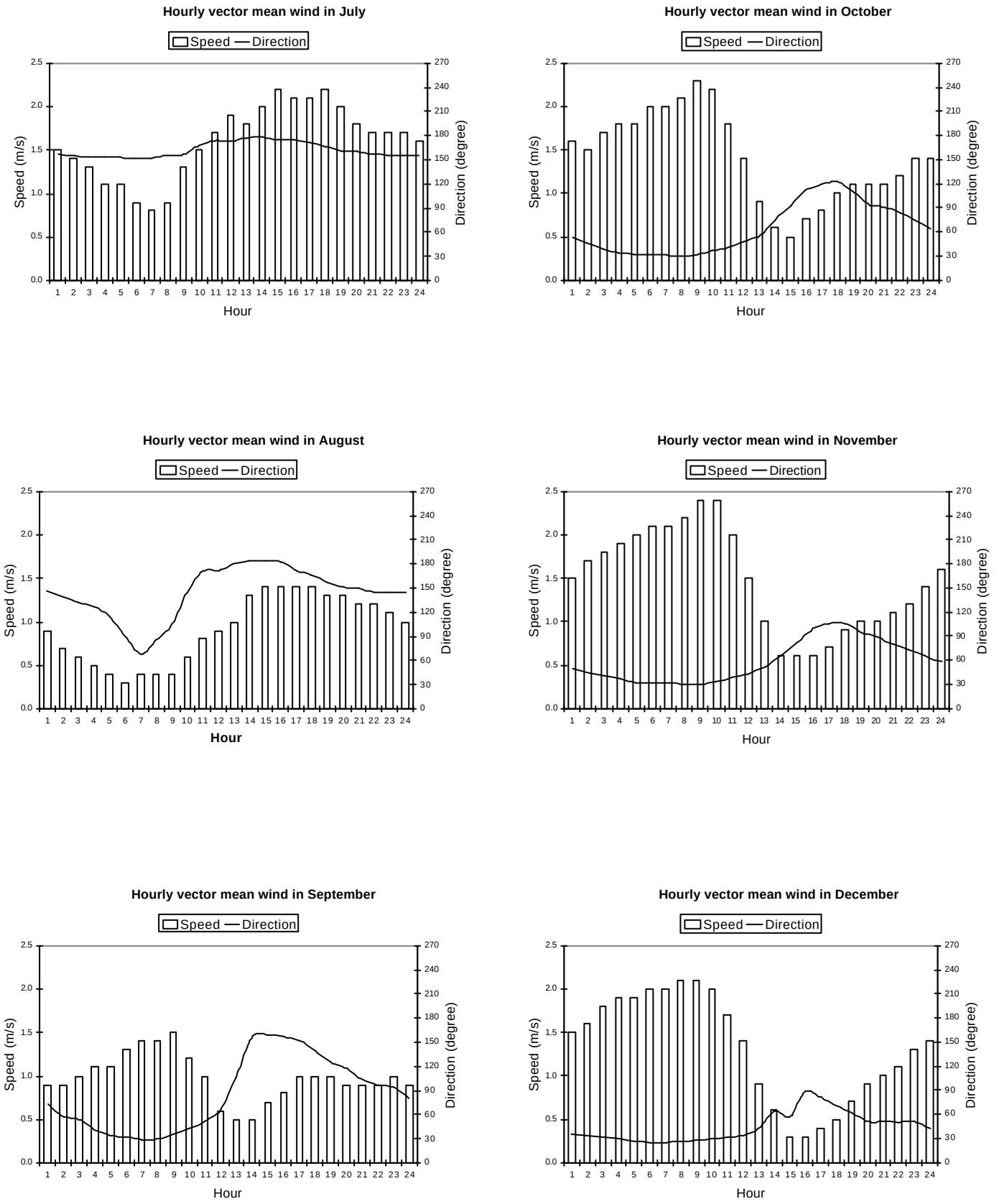

Fig. 8. Hourly vector mean wind from July to December at Tuen Mun, 1988-1998.

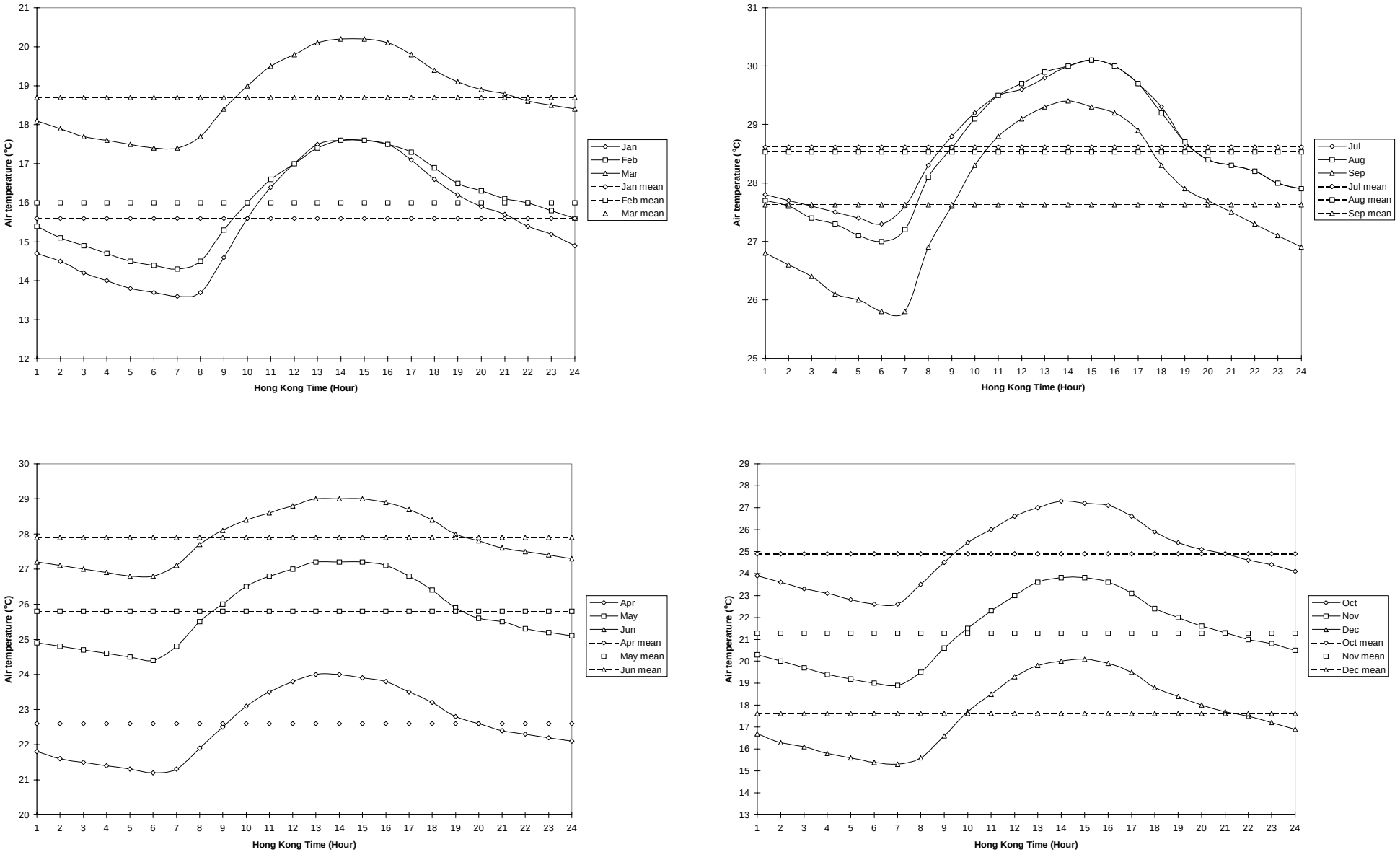

Fig. 9. Diurnal variation of air temperature at Tuen Mun, 1988-1998.

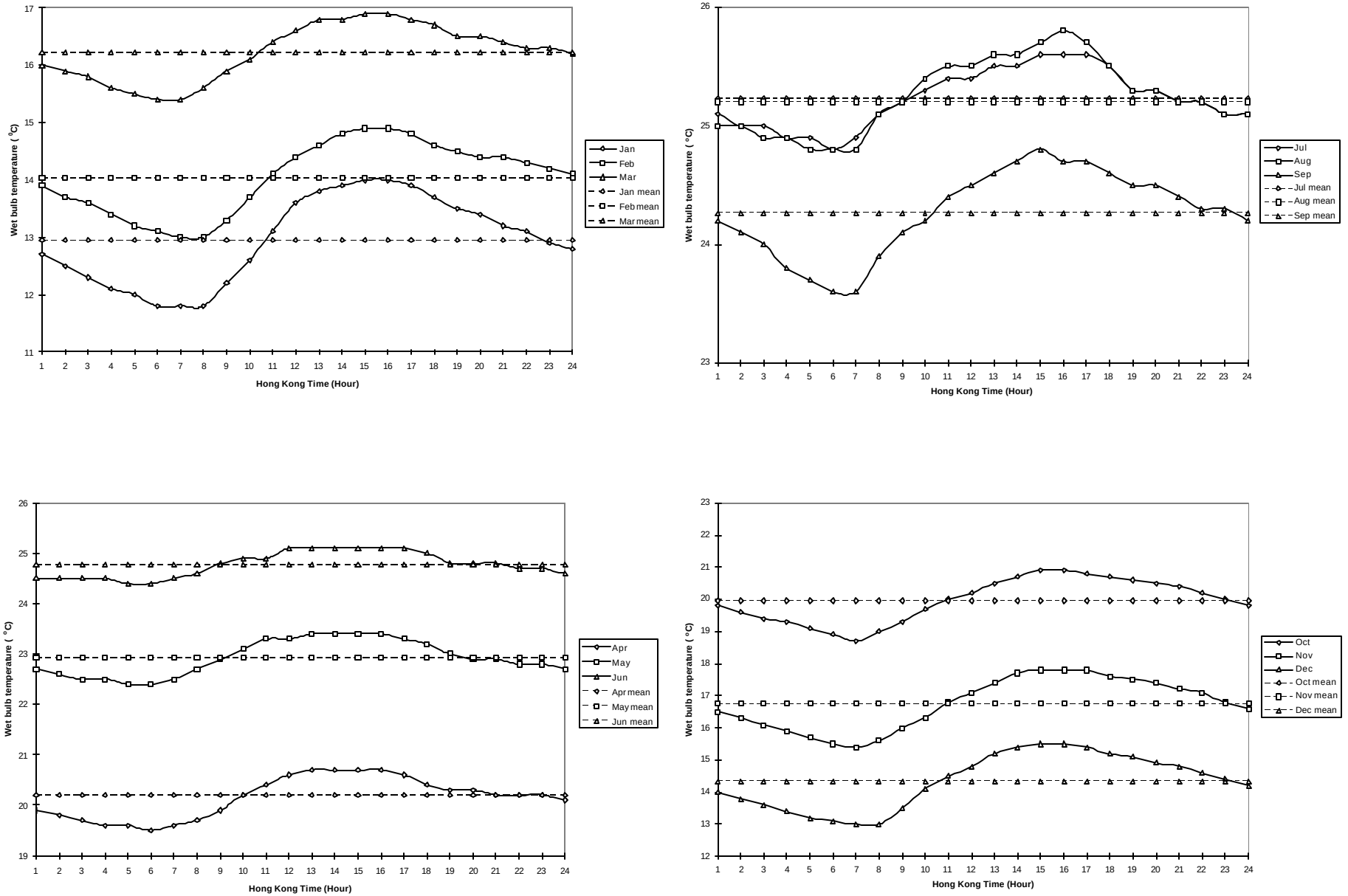

Fig. 10. Diurnal variation of wet-bulb temperature at Tuen Mun, 1988-1994.

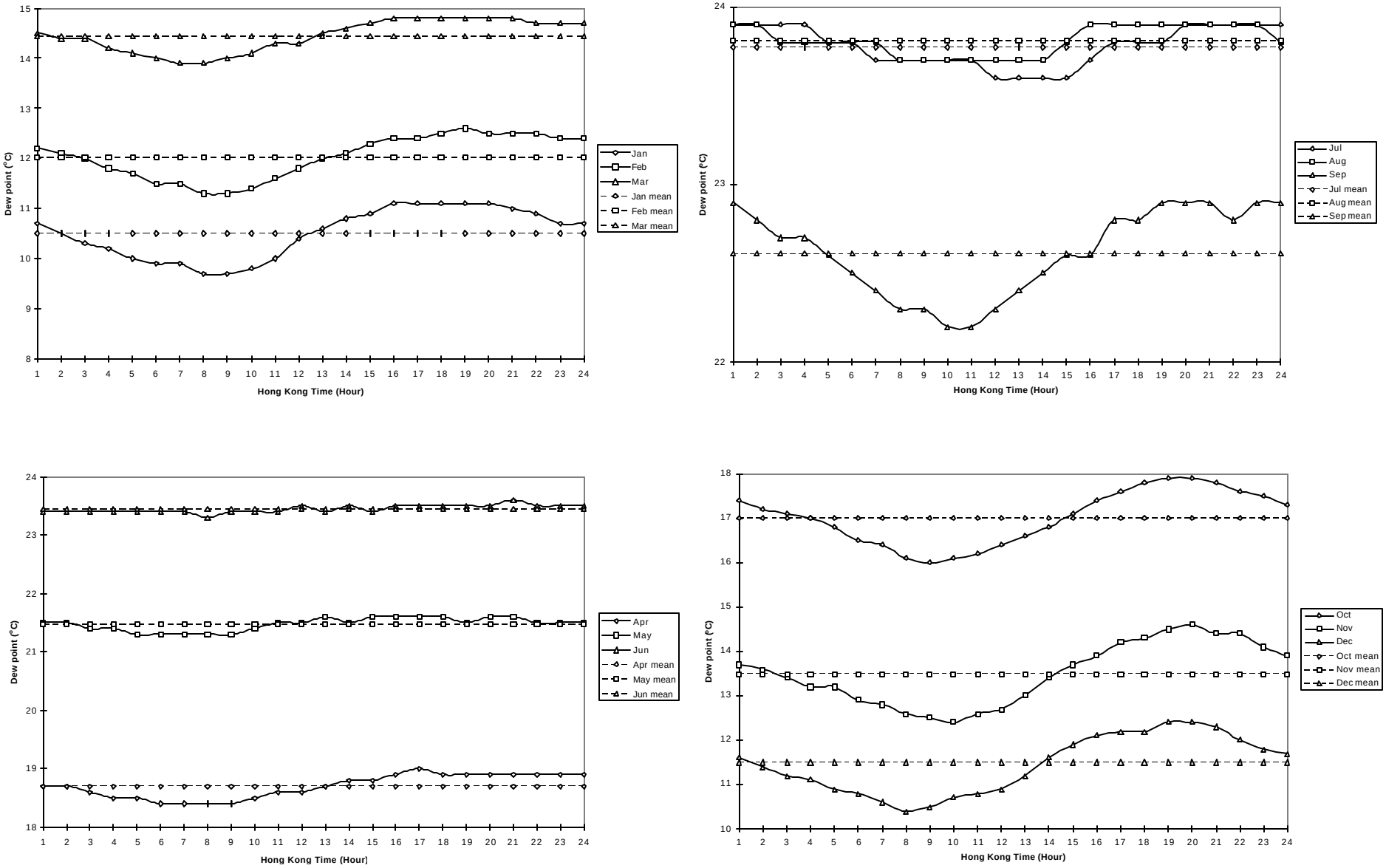

Fig. 11. Diurnal variation of dew point at Tuen Mun, 1988-1994.

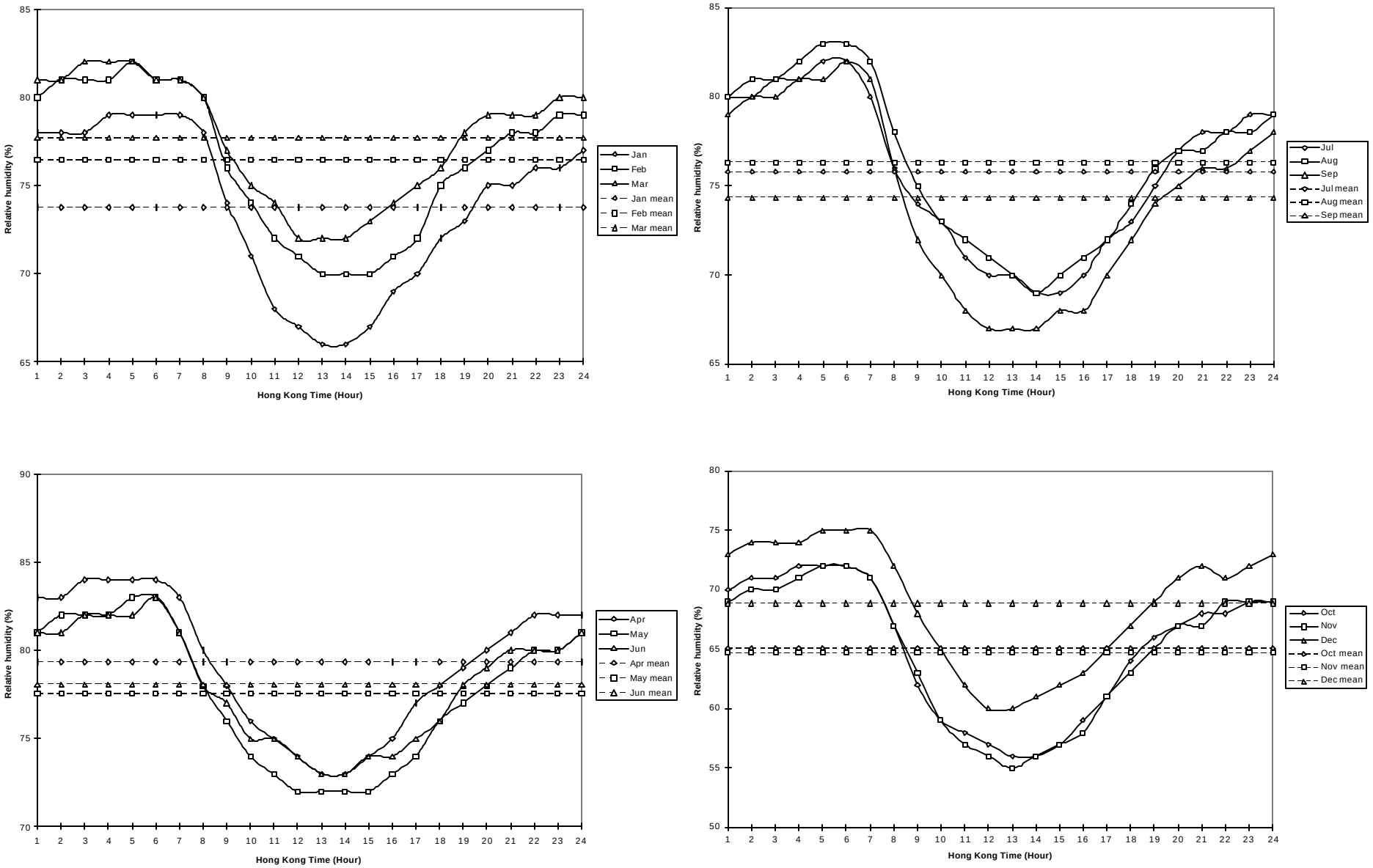

Fig. 12. Diurnal variation of relative humidity at Tuen Mun, 1988-1994.

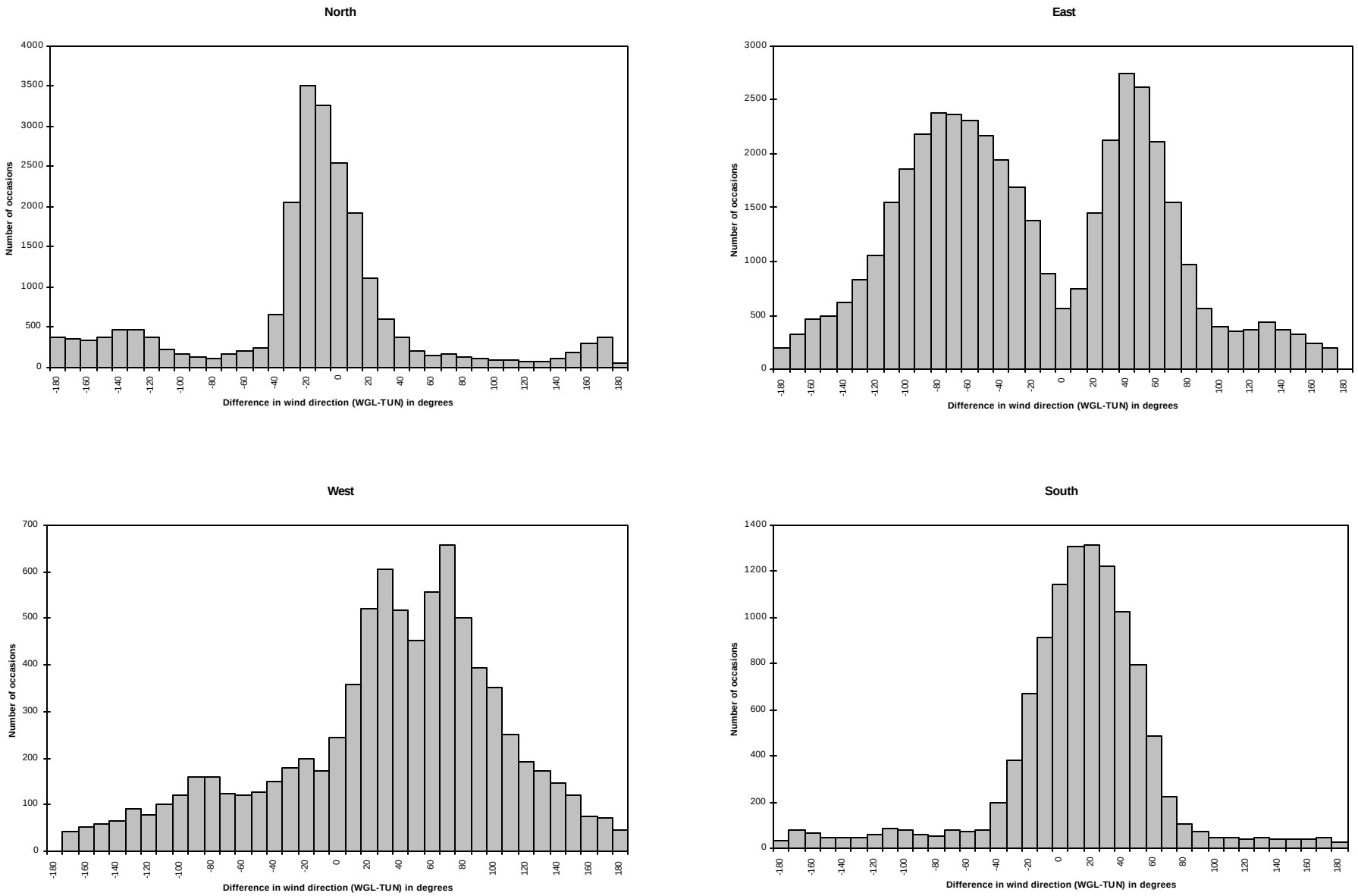

Fig 13. Frequency distribution of the difference in hourly mean wind directions between Tuen Mun (TUN) and Waglan Island (WGL), grouped according to the wind direction at Waglan Island.

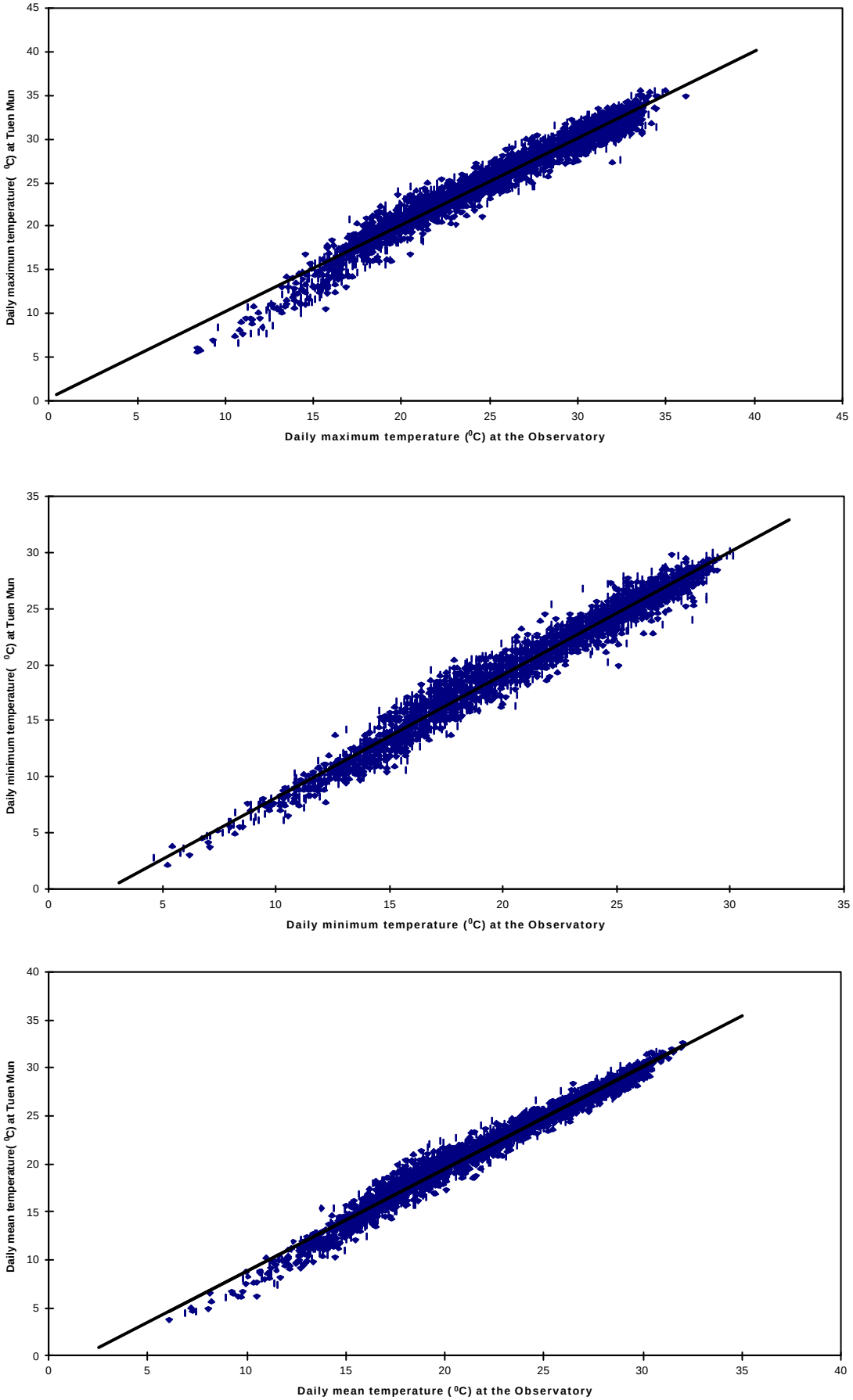

Fig. 14. Comparison of daily maximum, minimum and mean temperatures between Tuen Mun and the Observatory.

TABLE 1

CLIMATOLOGICAL SUMMARY FOR TUEN MUN, 1988-1998

Month	Air Temperature							Wet Bulb * Temperature	Dew * Point	Relative * Humidity	Prevailing Wind Direction	Wind Speed	Maximum Gust
	24-hour	Mean Daily		Absolute Extremes									
	Mean ^{o}C	Maximum ^{o}C	Minimum ^{o}C	Maximum ^{o}C	Date	Minimum ^{o}C	Date	^{o}C	^{o}C	%	degrees	m/s	m/s
January	15.6	18.7	12.9	26.8	1998/8/1	3.0	18/1/93	12.9	10.5	74	030	2.3	21.8
February	16.0	18.6	13.6	26.5	20/2/98	3.2	21/2/96	14.0	12.0	76	030	2.3	19.5
March	18.7	21.3	16.5	27.8	25/3/90 28/3/98	7.6	1988/4/3 6,7/3/92	16.2	14.4	78	170	2.3	22.9
April	22.6	25.0	20.5	31.0	26/4/94 27/4/94	8.8	1996/3/4	20.2	18.7	79	160	2.2	22.4
May	25.8	28.3	23.8	33.4	27/05/94	18.3	1990/5/5 1991/3/5	22.9	21.5	78	160	2.4	25.4
June	27.9	30.0	25.9	34.3	1996/7/6	20.4	1992/8/6	24.8	23.4	78	160	2.6	36.1
July	28.6	31.0	26.4	35.5	26/7/96	19.9	20/7/88	25.2	23.8	76	160	2.5	33.4
August	28.5	31.2	26.3	35.6	30/8/92 1996/1/8	20.2	1997/2/8	25.2	23.8	76	160	2.1	28.8
September	27.6	30.3	25.3	34.9	1990/1/9	17.2	29/9/97	24.3	22.6	74	030	2.2	40.9
October	24.9	28.0	22.3	33.2	14/10/98	13.4	31/10/88	20.0	17.0	65	030	2.5	22.5
November	21.3	24.7	18.5	30.8	1996/1/11 1996/7/11	8.2	22/11/93	16.7	13.5	65	030	2.4	25.4
December	17.6	21.0	14.8	27.5	1998/2/12	2.1	29/12/91	14.3	11.5	69	030	2.2	22.9
Year	22.9	25.7	20.6	35.6	30/8/92 1996/1/8	2.1	29/12/91	19.7	17.7	74	030	2.3	40.9

* computed from data between 1988 and 1994

TABLE 1 (con't)

Month	Number of Days with Maximum Temperature					Number of Days with Minimum Temperature				
	>=30°C	>=32°C	>=33°C	>=34°C	>=35°C	<=12°C	<=10°C	<=5°C	<=4°C	<=3°C
January	-	-	-	-	-	12.45	7.09	0.45	0.27	0.09
February	-	-	-	-	-	9.64	4.55	0.45	0.18	-
March	-	-	-	-	-	4.36	1.82	-	-	-
April	0.64	-	-	-	-	0.36	0.27	-	-	-
May	7.09	0.91	0.27	-	-	-	-	-	-	-
June	17.27	3.09	0.27	0.18	-	-	-	-	-	-
July	23.36	9.64	2.45	1.00	0.27	-	-	-	-	-
August	23.45	10.36	4.91	1.27	0.36	-	-	-	-	-
September	18.45	5.82	1.82	0.55	-	-	-	-	-	-
October	4.55	0.18	0.09	-	-	-	-	-	-	-
November	0.27	-	-	-	-	1.00	0.27	-	-	-
December	-	-	-	-	-	6.09	1.91	0.27	0.18	0.18
Year	95.08	30.00	9.81	3.00	0.63	33.90	15.91	1.17	0.63	0.27

TABLE 2

PERCENTAGE FREQUENCY OF OCCURRENCE OF HOURLY WIND DIRECTION AND SPEED WITHIN SPECIFIED RANGES AT TUEN MUN, 1988-1998

Month	Wind speed	Wind direction (tens of degrees)											
	(m/s)	2-4	5-7	8-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	35-1
January	0.1 - 3.2	24.68	2.30	1.04	2.12	5.79	10.04	7.00	1.24	0.80	2.57	4.05	14.11
	3.3 - 8.2	17.59	0.88	0.09	0.53	2.55	1.24	0.01	0.00	0.00	0.20	0.44	0.47
	8.3 - 14.2	0.14	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February	0.1 - 3.2	22.61	2.20	1.15	2.35	8.59	12.38	9.93	2.49	0.94	2.44	3.22	9.23
	3.3 - 8.2	13.28	0.33	0.34	1.24	4.61	1.93	0.10	0.00	0.01	0.10	0.25	0.07
	8.3 - 14.2	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	0.1 - 3.2	15.64	1.31	0.59	2.21	10.91	17.32	12.86	3.69	1.38	1.74	1.53	6.71
	3.3 - 8.2	7.96	0.09	0.09	1.61	9.31	3.92	0.22	0.01	0.00	0.04	0.17	0.40
	8.3 - 14.2	0.05	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
April	0.1 - 3.2	12.26	1.88	0.74	2.59	16.18	20.58	11.82	2.58	1.24	2.13	1.73	3.87
	3.3 - 8.2	3.51	0.11	0.04	1.28	11.74	5.01	0.49	0.01	0.00	0.01	0.04	0.00
	8.3 - 14.2	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	0.1 - 3.2	9.89	1.71	1.10	3.36	19.89	19.63	9.86	1.56	1.05	2.97	1.90	2.78
	3.3 - 8.2	2.99	0.13	0.16	2.00	11.85	5.05	0.95	0.28	0.03	0.15	0.24	0.19
	8.3 - 14.2	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
June	0.1 - 3.2	8.55	2.40	1.38	4.09	23.00	19.36	8.78	0.90	0.60	1.08	1.24	1.98
	3.3 - 8.2	0.75	1.21	0.78	2.94	11.70	7.49	0.72	0.70	0.00	0.06	0.10	0.03
	8.3 - 14.2	0.00	0.00	0.01	0.01	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
July	0.1 - 3.2	6.50	1.73	1.43	5.19	22.74	17.00	11.12	2.78	1.33	3.22	1.63	1.98
	3.3 - 8.2	1.07	0.14	0.24	1.65	10.64	6.12	0.54	1.00	0.17	0.73	0.74	0.04
	8.3 - 14.2	0.04	0.00	0.00	0.06	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
August	0.1 - 3.2	14.92	2.96	2.06	5.54	19.42	14.40	8.39	2.76	1.52	3.53	3.40	4.58
	3.3 - 8.2	1.49	0.24	0.12	1.40	5.64	4.20	0.51	0.48	0.08	0.91	1.04	0.17
	8.3 - 14.2	0.00	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.00	0.00	0.06	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 2 (cont'd)

Month	Wind speed	Wind direction (tens of degrees)											
	(m/s)	2-4	5-7	8-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	35-1
September	0.1 - 3.2	26.44	4.29	3.02	6.56	12.14	8.77	3.05	0.89	0.83	2.97	3.73	7.14
	3.3 - 8.2	6.35	0.30	0.35	1.97	4.17	2.65	0.03	0.08	0.02	0.41	1.68	1.77
	8.3 - 14.2	0.00	0.00	0.02	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
October	0.1 - 3.2	26.63	3.75	2.19	5.57	10.03	6.95	2.05	0.28	0.45	2.27	2.22	10.08
	3.3 - 8.2	14.34	0.31	0.36	3.11	3.32	1.84	0.00	0.00	0.00	0.35	0.33	2.47
	8.3 - 14.2	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.18
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November	0.1 - 3.2	28.16	2.77	2.34	4.21	7.18	7.51	2.29	0.63	0.63	2.29	3.00	13.04
	3.3 - 8.2	15.99	0.26	0.62	2.55	2.94	1.28	0.01	0.00	0.00	0.09	0.06	0.72
	8.3 - 14.2	0.70	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December	0.1 - 3.2	26.29	2.05	0.93	2.98	6.23	8.70	3.50	1.02	1.10	3.62	3.39	18.01
	3.3 - 8.2	16.02	0.27	0.10	0.88	1.99	0.71	0.03	0.00	0.00	0.20	0.10	1.29
	8.3 - 14.2	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overall	0.1 - 3.2	18.39	2.42	1.48	3.87	13.57	13.68	7.64	1.76	1.00	2.57	2.56	7.73
	3.3 - 8.2	8.37	0.35	0.27	1.76	6.80	3.47	0.31	0.21	0.03	0.27	0.42	0.63
	8.3 - 14.2	0.14	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.02
	> 14.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

STATISTICS OF THE OBSERVATIONS OF CALM AND VARIABLE WINDS AT TUEN MUN, 1988-1998

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
Number of observations	7015	6674	7662	7570	7884	6677	7013	7234	6599	7175	6978	7078	85559
Number of variable winds	0	0	2	1	4	1	0	1	0	1	0	2	12
Percetage of variable winds (%)	0.00	0.00	0.03	0.01	0.05	0.01	0.00	0.01	0.00	0.01	0.00	0.03	0.01
Number of calm winds	7	3	15	8	14	3	2	8	22	47	51	5	185
Percentage of calm winds (%)	0.10	0.04	0.20	0.11	0.18	0.04	0.03	0.11	0.33	0.66	0.73	0.07	0.22

TABLE 3

HOURLY VECTOR MEAN WIND AT TUEN MUN, 1988 -1998

HOUR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	dir	spd	dir	spd	dir	spd	dir	spd	dir	spd	dir	spd	dir	spd	dir	spd	dir	spd	dir	spd	dir	spd	dir	spd
0100	36	1.3	58	1.0	109	0.7	149	1.2	148	1.3	150	1.9	157	1.5	146	0.9	73	0.9	54	1.6	49	1.5	36	1.5
0200	36	1.4	45	1.1	100	0.6	145	0.9	149	1.2	152	1.7	155	1.4	139	0.7	58	0.9	46	1.5	45	1.7	34	1.6
0300	33	1.6	45	1.2	87	0.5	145	0.8	149	1.0	150	1.6	154	1.3	132	0.6	54	1.0	39	1.7	41	1.8	32	1.8
0400	31	1.8	43	1.2	88	0.5	142	0.7	145	0.9	151	1.4	153	1.1	127	0.5	41	1.1	34	1.8	37	1.9	30	1.9
0500	30	1.9	38	1.3	92	0.5	135	0.7	140	0.8	147	1.3	153	1.1	115	0.4	34	1.1	32	1.8	32	2.0	27	1.9
0600	30	1.9	41	1.3	96	0.6	131	0.7	139	0.7	145	1.2	151	0.9	90	0.3	32	1.3	31	2.0	32	2.1	25	2.0
0700	28	1.8	38	1.3	94	0.6	134	0.7	138	0.7	145	1.2	152	0.8	68	0.4	29	1.4	31	2.0	32	2.1	25	2.0
0800	32	1.9	39	1.2	97	0.5	137	0.8	139	0.8	150	1.3	156	0.9	86	0.4	30	1.4	30	2.1	30	2.2	26	2.1
0900	34	1.8	38	1.2	106	0.6	146	1.0	149	1.1	154	1.4	157	1.3	105	0.4	35	1.5	32	2.3	30	2.4	28	2.1
1000	35	1.7	54	1.1	128	0.7	151	1.2	156	1.2	159	1.6	168	1.5	145	0.6	42	1.2	37	2.2	34	2.4	29	2.0
1100	40	1.5	67	0.7	146	1.0	160	1.5	163	1.6	161	1.8	174	1.7	171	0.8	52	1.0	40	1.8	38	2.0	31	1.7
1200	49	1.1	86	0.6	152	1.1	161	1.8	166	1.7	165	1.9	173	1.9	172	0.9	66	0.6	48	1.4	43	1.5	34	1.4
1300	57	0.6	113	0.6	155	1.3	164	1.9	170	1.9	167	2.1	177	1.8	180	1.0	108	0.5	55	0.9	52	1.0	42	0.9
1400	74	0.4	139	0.7	158	1.4	165	2.0	169	2.0	167	2.2	178	2.0	184	1.3	156	0.5	75	0.6	66	0.6	64	0.6
1500	80	0.3	139	0.6	158	1.5	164	2.1	167	2.1	166	2.2	175	2.2	184	1.4	159	0.7	93	0.5	81	0.6	57	0.3
1600	100	0.3	143	0.8	159	1.5	164	2.0	162	2.1	162	2.3	175	2.1	183	1.4	157	0.8	112	0.7	99	0.6	88	0.3
1700	81	0.5	136	0.7	155	1.4	162	1.9	161	2.1	161	2.3	172	2.1	172	1.4	152	1.0	119	0.8	106	0.7	81	0.4
1800	78	0.6	126	0.6	151	1.2	157	1.8	157	2.1	159	2.4	167	2.2	166	1.4	139	1.0	123	1.0	106	0.9	71	0.5
1900	70	0.8	114	0.8	146	1.1	156	1.6	156	1.9	157	2.4	161	2.0	157	1.3	125	1.0	111	1.1	95	1.0	62	0.7
2000	55	1.0	97	0.7	142	1.1	156	1.6	153	1.7	154	2.2	160	1.8	151	1.3	117	0.9	94	1.1	89	1.0	51	0.9
2100	48	1.1	87	0.7	140	1.1	156	1.5	152	1.7	149	2.2	157	1.7	150	1.2	103	0.9	91	1.1	80	1.1	51	1.0
2200	45	1.2	81	0.7	136	1.1	156	1.4	150	1.6	150	2.2	156	1.7	145	1.2	97	0.9	84	1.2	73	1.2	50	1.1
2300	45	1.3	74	0.9	131	0.9	153	1.3	150	1.5	149	2.1	156	1.7	145	1.1	94	1.0	75	1.4	65	1.4	51	1.3
2400	41	1.3	67	0.9	125	0.8	154	1.3	149	1.4	149	2.0	155	1.6	144	1.0	81	0.9	64	1.4	58	1.6	42	1.4

dir : wind direction (degree)
spd : wind speed (m/s)

TABLE 4

HOURLY MEAN OF AIR TEMPERATURE (^{o}C) AT TUEN MUN, 1988-1998

HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0100	14.7	15.4	18.1	21.8	24.9	27.2	27.8	27.7	26.8	23.9	20.3	16.7
0200	14.5	15.1	17.9	21.6	24.8	27.1	27.7	27.6	26.6	23.6	20.0	16.3
0300	14.2	14.9	17.7	21.5	24.7	27.0	27.6	27.4	26.4	23.3	19.7	16.1
0400	14.0	14.7	17.6	21.4	24.6	26.9	27.5	27.3	26.1	23.1	19.4	15.8
0500	13.8	14.5	17.5	21.3	24.5	26.8	27.4	27.1	26.0	22.8	19.2	15.6
0600	13.7	14.4	17.4	21.2	24.4	26.8	27.3	27.0	25.8	22.6	19.0	15.4
0700	13.6	14.3	17.4	21.3	24.8	27.1	27.6	27.2	25.8	22.6	18.9	15.3
0800	13.7	14.5	17.7	21.9	25.5	27.7	28.3	28.1	26.9	23.5	19.5	15.6
0900	14.6	15.3	18.4	22.5	26.0	28.1	28.8	28.6	27.6	24.5	20.6	16.6
1000	15.6	16.0	19.0	23.1	26.5	28.4	29.2	29.1	28.3	25.4	21.5	17.7
1100	16.4	16.6	19.5	23.5	26.8	28.6	29.5	29.5	28.8	26.0	22.3	18.5
1200	17.0	17.0	19.8	23.8	27.0	28.8	29.6	29.7	29.1	26.6	23.0	19.3
1300	17.5	17.4	20.1	24.0	27.2	29.0	29.8	29.9	29.3	27.0	23.6	19.8
1400	17.6	17.6	20.2	24.0	27.2	29.0	30.0	30.0	29.4	27.3	23.8	20.0
1500	17.6	17.6	20.2	23.9	27.2	29.0	30.1	30.1	29.3	27.2	23.8	20.1
1600	17.5	17.5	20.1	23.8	27.1	28.9	30.0	30.0	29.2	27.1	23.6	19.9
1700	17.1	17.3	19.8	23.5	26.8	28.7	29.7	29.7	28.9	26.6	23.1	19.5
1800	16.6	16.9	19.4	23.2	26.4	28.4	29.3	29.2	28.3	25.9	22.4	18.8
1900	16.2	16.5	19.1	22.8	25.9	28.0	28.7	28.7	27.9	25.4	22.0	18.4
2000	15.9	16.3	18.9	22.6	25.6	27.8	28.4	28.4	27.7	25.1	21.6	18.0
2100	15.7	16.1	18.8	22.4	25.5	27.6	28.3	28.3	27.5	24.9	21.3	17.7
2200	15.4	16.0	18.6	22.3	25.3	27.5	28.2	28.2	27.3	24.6	21.0	17.5
2300	15.2	15.8	18.5	22.2	25.2	27.4	28.0	28.0	27.1	24.4	20.8	17.2
2400	14.9	15.6	18.4	22.1	25.1	27.3	27.9	27.9	26.9	24.1	20.5	16.9
MEAN	15.6	16.0	18.7	22.6	25.8	27.9	28.6	28.5	27.6	24.9	21.3	17.6

TABLE 5

HOURLY MEAN OF WET BULB TEMPERATURE (^{o}C) AT TUEN MUN, 1988-1994

HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0100	12.7	13.9	16.0	19.9	22.7	24.5	25.1	25.0	24.2	19.8	16.5	14.0
0200	12.5	13.7	15.9	19.8	22.6	24.5	25.0	25.0	24.1	19.6	16.3	13.8
0300	12.3	13.6	15.8	19.7	22.5	24.5	25.0	24.9	24.0	19.4	16.1	13.6
0400	12.1	13.4	15.6	19.6	22.5	24.5	24.9	24.9	23.8	19.3	15.9	13.4
0500	12.0	13.2	15.5	19.6	22.4	24.4	24.9	24.8	23.7	19.1	15.7	13.2
0600	11.8	13.1	15.4	19.5	22.4	24.4	24.8	24.8	23.6	18.9	15.5	13.1
0700	11.8	13.0	15.4	19.6	22.5	24.5	24.9	24.8	23.6	18.7	15.4	13.0
0800	11.8	13.0	15.6	19.7	22.7	24.6	25.1	25.1	23.9	19.0	15.6	13.0
0900	12.2	13.3	15.9	19.9	22.9	24.8	25.2	25.2	24.1	19.3	16.0	13.5
1000	12.6	13.7	16.1	20.2	23.1	24.9	25.3	25.4	24.2	19.7	16.3	14.1
1100	13.1	14.1	16.4	20.4	23.3	24.9	25.4	25.5	24.4	20.0	16.8	14.5
1200	13.6	14.4	16.6	20.6	23.3	25.1	25.4	25.5	24.5	20.2	17.1	14.8
1300	13.8	14.6	16.8	20.7	23.4	25.1	25.5	25.6	24.6	20.5	17.4	15.2
1400	13.9	14.8	16.8	20.7	23.4	25.1	25.5	25.6	24.7	20.7	17.7	15.4
1500	14.0	14.9	16.9	20.7	23.4	25.1	25.6	25.7	24.8	20.9	17.8	15.5
1600	14.0	14.9	16.9	20.7	23.4	25.1	25.6	25.8	24.7	20.9	17.8	15.5
1700	13.9	14.8	16.8	20.6	23.3	25.1	25.6	25.7	24.7	20.8	17.8	15.4
1800	13.7	14.6	16.7	20.4	23.2	25.0	25.5	25.5	24.6	20.7	17.6	15.2
1900	13.5	14.5	16.5	20.3	23.0	24.8	25.3	25.3	24.5	20.6	17.5	15.1
2000	13.4	14.4	16.5	20.3	22.9	24.8	25.3	25.3	24.5	20.5	17.4	14.9
2100	13.2	14.4	16.4	20.2	22.9	24.8	25.2	25.2	24.4	20.4	17.2	14.8
2200	13.1	14.3	16.3	20.2	22.8	24.7	25.2	25.2	24.3	20.2	17.1	14.6
2300	12.9	14.2	16.3	20.2	22.8	24.7	25.1	25.1	24.3	20.0	16.8	14.4
2400	12.8	14.1	16.2	20.1	22.7	24.6	25.1	25.1	24.2	19.8	16.6	14.2
MEAN	12.9	14.0	16.2	20.2	22.9	24.8	25.2	25.2	24.3	20.0	16.7	14.3

TABLE 6

HOURLY MEAN OF DEW POINT (^{o}C) AT TUEN MUN, 1988-1994

HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0100	10.7	12.2	14.5	18.7	21.5	23.4	23.9	23.9	22.9	17.4	13.7	11.6
0200	10.5	12.1	14.4	18.7	21.5	23.4	23.9	23.9	22.8	17.2	13.6	11.4
0300	10.3	12.0	14.4	18.6	21.4	23.4	23.9	23.8	22.7	17.1	13.4	11.2
0400	10.2	11.8	14.2	18.5	21.4	23.4	23.9	23.8	22.7	17.0	13.2	11.1
0500	10.0	11.7	14.1	18.5	21.3	23.4	23.8	23.8	22.6	16.8	13.2	10.9
0600	9.9	11.5	14.0	18.4	21.3	23.4	23.8	23.8	22.5	16.5	12.9	10.8
0700	9.9	11.5	13.9	18.4	21.3	23.4	23.7	23.8	22.4	16.4	12.8	10.6
0800	9.7	11.3	13.9	18.4	21.3	23.3	23.7	23.7	22.3	16.1	12.6	10.4
0900	9.7	11.3	14.0	18.4	21.3	23.4	23.7	23.7	22.3	16.0	12.5	10.5
1000	9.8	11.4	14.1	18.5	21.4	23.4	23.7	23.7	22.2	16.1	12.4	10.7
1100	10.0	11.6	14.3	18.6	21.5	23.4	23.7	23.7	22.2	16.2	12.6	10.8
1200	10.4	11.8	14.3	18.6	21.5	23.5	23.6	23.7	22.3	16.4	12.7	10.9
1300	10.6	12.0	14.5	18.7	21.6	23.4	23.6	23.7	22.4	16.6	13.0	11.2
1400	10.8	12.1	14.6	18.8	21.5	23.5	23.6	23.7	22.5	16.8	13.4	11.6
1500	10.9	12.3	14.7	18.8	21.6	23.4	23.6	23.8	22.6	17.1	13.7	11.9
1600	11.1	12.4	14.8	18.9	21.6	23.5	23.7	23.9	22.6	17.4	13.9	12.1
1700	11.1	12.4	14.8	19.0	21.6	23.5	23.8	23.9	22.8	17.6	14.2	12.2
1800	11.1	12.5	14.8	18.9	21.6	23.5	23.8	23.9	22.8	17.8	14.3	12.2
1900	11.1	12.6	14.8	18.9	21.5	23.5	23.8	23.9	22.9	17.9	14.5	12.4
2000	11.1	12.5	14.8	18.9	21.6	23.5	23.9	23.9	22.9	17.9	14.6	12.4
2100	11.0	12.5	14.8	18.9	21.6	23.6	23.9	23.9	22.9	17.8	14.4	12.3
2200	10.9	12.5	14.7	18.9	21.5	23.5	23.9	23.9	22.8	17.6	14.4	12.0
2300	10.7	12.4	14.7	18.9	21.5	23.5	23.9	23.9	22.9	17.5	14.1	11.8
2400	10.7	12.4	14.7	18.9	21.5	23.5	23.9	23.8	22.9	17.3	13.9	11.7
MEAN	10.5	12.0	14.4	18.7	21.5	23.4	23.8	23.8	22.6	17.0	13.5	11.5

TABLE 7

HOURLY MEAN OF RELATIVE HUMIDITY (%) AT TUEN MUN, 1988-1994

HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0100	78	80	81	83	81	81	80	80	79	70	69	73
0200	78	81	81	83	82	81	80	81	80	71	70	74
0300	78	81	82	84	82	82	81	81	80	71	70	74
0400	79	81	82	84	82	82	81	82	81	72	71	74
0500	79	82	82	84	83	82	82	83	81	72	72	75
0600	79	81	81	84	83	83	82	83	82	72	72	75
0700	79	81	81	83	81	81	80	82	81	71	71	75
0800	78	80	80	80	78	78	76	78	76	67	67	72
0900	74	76	77	78	76	77	74	75	72	62	63	68
1000	71	74	75	76	74	75	73	73	70	59	59	65
1100	68	72	74	75	73	75	71	72	68	58	57	62
1200	67	71	72	74	72	74	70	71	67	57	56	60
1300	66	70	72	73	72	73	70	70	67	56	55	60
1400	66	70	72	73	72	73	69	69	67	56	56	61
1500	67	70	73	74	72	74	69	70	68	57	57	62
1600	69	71	74	75	73	74	70	71	68	59	58	63
1700	70	72	75	77	74	75	72	72	70	61	61	65
1800	72	75	76	78	76	76	73	74	72	64	63	67
1900	73	76	78	79	77	78	75	76	74	66	65	69
2000	75	77	79	80	78	79	77	77	75	67	67	71
2100	75	78	79	81	79	80	78	77	76	68	67	72
2200	76	78	79	82	80	80	78	78	76	68	69	71
2300	76	79	80	82	80	80	79	78	77	69	69	72
2400	77	79	80	82	81	81	79	79	78	69	69	73
MEAN	74	76	78	79	78	78	76	76	74	65	65	69

TABLE 8

EXTREME VALUES OF TEMPERATURE AND GUST AT TUEN MUN, 1988-1998

Rank	Daily Temperature				Maximum Gust		
	Maximum ^{o}C	Date	Minimum ^{o}C	Date	Hourly m/s	Time	
1	35.6	30/8/92	2.1	29/12/91	40.9	09	17/9/93
2	35.6	1996/1/8	2.8	28/12/91	39.3	10	17/9/93
3	35.5	26/7/96	3.0	18/1/93	39.3	11	17/9/93
4	35.4	1994/11/7	3.2	21/2/96	36.1	20	27/6/93
5	35.3	29/8/92	3.6	20/2/96	35.7	19	27/6/93
6	35.1	17/8/90	3.7	17/1/93	33.8	21	27/6/93
7	35.0	18/7/88	3.8	16/01/93	33.4	10	18/7/92
8	34.9	18/8/90	4.1	1990/1/2	33.0	09	18/7/92
9	34.9	23/8/90	4.5	15/1/93	32.2	22	27/6/93
10	34.9	1990/1/9	4.7	19/2/96	32.1	08	17/9/93
11	34.9	19/7/91	4.7	22/2/96	29.6	17	27/6/93
12	34.9	1994/10/7	4.9	30/12/91	29.3	23	27/6/93
13	34.8	16/7/89	5.0	14/1/89	28.8	10	1995/12/8
14	34.8	1992/4/9	5.2	24/1/93	28.5	10	18/7/89
15	34.8	1994/2/7	5.3	19/1/93	28.3	09	1995/12/8
16	34.7	1988/9/7	5.5	31/1/90	28.0	03	1996/9/9
17	34.5	1992/2/9	5.5	23/2/96	27.9	12	17/9/93
18	34.5	1998/4/8	5.5	15/1/92	27.4	23	20/8/93
19	34.3	17/7/88	5.7	24/2/96	27.4	02	21/8/93
20	34.3	25/8/95	5.8	18/2/96	27.2	21	20/8/93
*	36.1	18/8/90	4.6	28/12/91	37.5	16	27/6/93

* : extreme values recorded at the Hong Kong Observatory during 1988-1998