1. Introduction

According to the World Meteorological Organization (WMO), the climatological normal of a meteorological element is defined as the average computed for a uniform and relatively long period comprising at least three consecutive ten-year periods (WMO, 1983 & 1989). Following the recommendation by WMO, the Hong Kong Observatory compiled the 1961-1990 climatological standard normals in the early 1990s. These "standard normals" have since been used as the reference in all publications and summaries issued by the HKO.

A recent study of climate change in Hong Kong revealed that there were significant trends in some meteorological observations, which may be attributed to global warming and urban development in and around Hong Kong (Leung et al, 2004a). Such changes in local climate, particularly in the last few decades, suggested that a new set of climatological normals based on observations taken from the period of 1971-2000 would serve as a more useful reference for certain applications.

Observations taken from 4 stations, namely, the Hong Kong Observatory Headquarters (HKO), King's Park Meteorological Station (KP), North Point Fire Station (NP) and Waglan Island (WGL) were used to compile the 1971-2000 climatological normals. The instruments and methods of observation used in these stations are briefly described in Section 2. The methods used to compute the 1971-2000 climatological normals are discussed in Section 3. In Section 4, the results of the new 30-year climatological normals are presented and compared with the normals for 1961-1990. A summary of the findings of this study is given in Section 5.

2. Instruments and methods of observation

Hourly meteorological observations used in the compilation of the 1971-2000 climatological normals were all made at HKO except for the followings :

(i) global solar radiation;
(ii) total bright sunshine;
(iii) total evaporation and potential evapo-transpiration;
(iv) wind speed and direction; and
(v) sea surface temperature.

Items (i) to (iii) were recorded at KP. Item (iv) was recorded at WGL because of its relatively good exposure and being not affected by urban development. The wind recorded there is therefore more representative of the ambient wind flow over Hong Kong. Sea surface temperature measurements were manually made at the fire boat pier of NP and at WGL twice daily. Since August 1989, sea surface temperature at WGL was recorded automatically. Figure 1 shows the locations of HKO, KP, NP and WGL.

Information on the instruments used at the four locations and the elevation of the instruments above mean sea level as at 31 December 2000 are given in Table 1. Details of measurement practices and instrumental changes from 1971 to 2000 are documented in the following HKO annual publications :

(i) Meteorological Results Part I – Surface Observations (1971-1986);
(ii) Surface Observations in Hong Kong (1987-1992); and
(iii) Summary of Meteorological Observations in Hong Kong (1993-2000).

For easy reference, major instrument/site changes for some of the meteorological measurements at HKO, KP and WGL from 1947 to 2005 are summarized in Appendix I.

3. Methods of analysis

3.1 Daily, monthly, annual mean and climatological normal

The daily mean value for any particular meteorological element is computed by averaging all hourly readings of that element available in the day. Monthly means are computed from the average of all the hourly data in the month. Annual means are the averages of the 12 monthly means for that year. The 30-year climatological normals are the average of the corresponding monthly and annual mean values within the period between 1971 and 2000. Where an element is only measured at a specific hour of a day, the monthly mean of this element is calculated from the average of all the data recorded at the corresponding time of observation in the month.

3.2 Prevailing wind direction

The principles for the computation of 30-year climatological normals mentioned in Section 3.1 apply to all elements except for prevailing wind directions. Since computing a 30-year normal prevailing wind direction using 30 monthly values can produce erratic results, the monthly normal and annual normal of the prevailing wind directions are produced by weighting all hourly wind directions available according to the '1-4-6-4-1' scheme (Yeung et al, 1986).

3.3 Other statistics

The definitions of the other statistics included in this publication are as follows :

(a) Fog Days

A fog day is a day with fog (visibility below 1000 metres due to suspension of water droplets in the air) reported anytime during the day.

(b) Thunderstorm Days and Lightning Days

A thunderstorm (lightning) day is a day with thunderstorm (lightning) reported anytime during the day.

(c) Very Hot Days, Cold Days and Hot Nights

A very hot day is a day with a maximum temperature ≥ 33.0°C. A cold day is a day with a minimum temperature ≤ 12.0°C. A hot night refers to a day with a minimum temperature ≥ 28.0°C.

4. Results

4.1 1971-2000 climatological normals

4.1.1 Tables 2 and 3 summarize respectively the monthly normals of the main meteorological elements and monthly means of selected meteorological parameters in Hong Kong for 1971 – 2000.

4.1.2 Table 4 lists the annual and monthly means of number of very hot days, cold days and hot nights for 1971-2000.

4.1.3 Monthly means of number of days with daily total rainfall ≥ 0.1 mm, 10mm, 30mm, 50mm, 70mm and 100 mm for 1971-2000 are tabulated in Table 5.

4.1.4 The annual and monthly wind rose diagrams of Waglan Island from 1971 to 2000 are shown in Figures 2, 3(a) and 3(b).

4.1.5 The annual mean/total values of selected meteorological elements from 1961 to 2000 as well as the 30-year means and standard deviations are tabulated in Appendix II.

4.2 Comparison between climatological normals for 1961-1990 and 1971-2000

4.2.1 Table 6 summarizes the difference between the normals for 1961-1990 and 1971-2000 for selected meteorological elements.

4.2.2 A two tailed t-test was applied to test the statistical significance of the difference between the two normals at 5% significance level (Hann, 1977). Here, the test statistics T for the null hypothesis H_0 : *difference* = 0 against the alternative hypothesis H_1 : *difference* ≠ 0, is given by :

$$T = (\overline{X_1} - \overline{X_2}) \Big/ \sqrt{\sigma_1^{\,2}/n_1 + \sigma_2^{\,2}/n_2}$$
$$= (\overline{X_1} - \overline{X_2}) \Big/ \sqrt{\sigma_1^{\,2}/30 + \sigma_2^{\,2}/30}$$

where $\overline{X_1}$ is the average of 30 annual data for 1971-2000
$\overline{X_2}$ is the average of 30 annual data for 1961-1990
σ_1 is the standard deviation of 30 annual data for 1971-2000
σ_2 is the standard deviation of 30 annual data for 1961-1990
n_1 and n_2 are the respective number of sample (equal to 30)

The degree of freedom is 58 ($n_1 + n_2 - 2$) and critical values for two-tailed t-test at 5% significance level are ±2.002. The population means are significantly different if $|T| > 2.002$.

4.2.3 Amongst the 18 meteorological elements listed in Table 6, the differences between the two normals for six of the elements are statistically significant at 5% level. They are :

(i) daily minimum temperature;
(ii) annual total bright sunshine duration;
(iii) daily global solar radiation;
(iv) annual total evaporation;
(v) annual number of cold days; and
(vi) annual number of hot nights.

4.2.4 The mean daily minimum temperature in 1971-2000 was 0.2 degrees higher than that in 1961-1990. An analysis of the variation of the difference in the monthly normals of mean daily minimum temperature between the two 30-year periods (Figure 4) revealed that the difference in mean daily minimum temperature was more prominent from October to April. The mean annual number of cold days in 1971-2000 was lower than that in 1961-1990 (18.6 days compared to 23.3 days). The mean annual number of hot nights in 1971-2000 was higher than that in 1961-1990 (13.1 days compared to 8.7 days). Figures 5, 6 and 7 illustrate respectively the increasing trend of the annual mean of daily minimum temperature (about 0.3 degrees per decade), the decreasing trend of the annual number of cold days (about 3.7 days per decade) and the increasing trend of the annual number of hot nights (about 4.7 days per decade) from 1961 to 2005. Recent studies on climate change in Hong Kong suggest that, besides global warming, rapid urban development around HKO in the last few decades also contributed significantly to these changes (Leung et al, 2004a).

4.2.5 The mean annual total bright sunshine duration in 1971-2000 was 5.4% lower than that in 1961-1990 (1842.9 hours compared to 1948.1 hours).

Moreover, the mean daily global solar radiation in 1971-2000 was 8.5% lower than that in 1961-1990 (13.2 MJ/m^2 compared to 14.5 MJ/m^2). The differences in the normals of the annual total bright sunshine duration and daily global solar radiation between these two periods are likely to be attributable to the increase in the concentration of the suspended particulates associated with urban development. Such increase in suspended particulates favours the formation of clouds (by increasing the concentration of condensation nuclei) and increases scattering and absorption of incoming solar radiation (Leung et al, 2004a; Leung et al, 2004b). In parallel with the decrease in the mean daily global solar radiation, the mean annual total evaporation in 1971-2000 was also 12.1% lower than that in 1961-1990 (1343.4 mm compared to 1528.8 mm). The decreasing trend of the annual total bright sunshine duration (about 68.7 hours per decade), annual mean of daily global solar radiation (about 1.0 MJ/m^2 per decade) and annual total evaporation (about 159.7 mm per decade) from 1961 to 2005 are illustrated in Figures 8, 9 and 10 respectively.

5 Conclusions

The 1971-2000 climatological normals of meteorological elements were computed and presented in this report. When compared with the 1961-1990 climatological normals, there were less sunshine (a decrease of 5.4% in sunshine duration and 8.5% in solar radiation) and significantly more hot nights (by more than 50%) during 1971-2000. All these changes are inline with global warming and the increasing extent of urban development in Hong Kong.

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Table 1 Instrument and elevation at the Hong Kong Observatory Headquarters (HKOHq), King's Park Meteorological Station (KP), North Point Fire Station (NP) and Waglan Island (WGL) as at 31 December 2000

Location	Meteorological Element	Instrument	Elevation above mean sea level (metres)
HKO	Pressure	Kew-pattern barometer (F. Darton Co. Ltd)	62
	Dry and Wet bulb Temperatures	Platinum resistance thermometer (inside an open shed, back up by conventional mercury-in-glass maximum/minimum thermometers	33
	Rainfall	Ordinary 203-mm raingauge	32
	Grass and Soil Temperatures (soil temperature 50, 100 and 150 cm below soil depth)	Platinum resistance thermometer (back up by conventional mercury-in-glass thermometers)	32
KP	Sunshine Duration	Campbell-Stokes recorder	71
	Global Solar Radiation (Lau, 1989)	Thermo-electric pyranometer (Kipp & Zonen Holland)	71
	Evaporation (Chen, 1976)	Evaporation Pans (US Weather Bureau Class "A")	65
	Potential Evapotranspiration (Chen, 1976)	Lysimeters	65
WGL	Winds	R.W. Munro Mk. 4 cup-generator anemometer	82
	Sea Surface Temperature (Li, 1964)	Rosemont T-200 platinum thermometer	-1
NP	Sea Surface Temperature	Conventional mercury-in-glass thermometer	---

Table 2 Monthly normals of meteorological elements for Hong Kong, 1971-2000

Month	ATMOSPHERIC PRESSURE		AIR TEMPERATURE			WET-BULB TEMPERATURE	DEW POINT	VAPOUR PRESSURE	RELATIVE HUMIDITY			AMOUNT OF CLOUD	RAINFALL					BRIGHT SUNSHINE		WIND	
															Numbers of Days with						
	Mean	Mean Diurnal Range	Mean Daily Maximum	Mean	Mean Daily Minimum				Mean	Mean at 0200 hours	Mean at 1400 hours		Total	Duration	0.1 mm or more	25.0 mm or more	50.0 mm or more	Duration	Percentage of Possible	Prevailing Direction	Mean Speed
	hPa	hPa	°C	°C	°C	°C	°C	hPa	%	%	%	%	mm	hours				hours	%	degree	km/h
JAN	1020.1	4.1	18.6	16.1	14.1	13.5	11.0	13.7	73	78	65	60	24.9	43	5.60	0.20	0.00	141.7	42	070	25.4
FEB	1018.6	4.2	18.6	16.3	14.4	14.1	12.2	14.8	78	82	71	73	52.3	76	9.47	0.53	0.07	93.8	29	070	25.1
MAR	1016.1	4.2	21.5	18.9	16.9	17.0	15.5	18.2	82	86	75	79	71.4	91	10.47	0.67	0.30	89.6	24	070	23.5
APR	1012.8	3.9	25.1	22.5	20.6	20.5	19.4	22.9	83	88	76	80	188.5	87	11.67	2.57	1.23	101.8	27	070	21.2
MAY	1009.4	3.4	28.4	25.8	23.9	23.7	22.7	27.8	84	88	77	77	329.5	101	15.47	3.77	2.00	138.6	34	080	20.2
JUN	1006.2	3.2	30.4	27.9	26.1	25.6	24.6	30.9	82	86	76	76	388.1	95	18.77	4.17	2.13	158.3	39	230	23.3
JUL	1005.5	3.4	31.3	28.7	26.7	26.1	25.0	31.7	81	85	74	68	374.4	80	17.77	4.67	2.40	214.9	52	230	21.9
AUG	1005.1	3.5	31.1	28.4	26.4	25.9	24.9	31.5	82	86	75	69	444.6	87	17.43	5.40	2.40	189.7	48	240	20.0
SEP	1009.2	3.5	30.2	27.6	25.6	24.7	23.4	28.9	79	83	72	65	287.5	68	14.80	3.47	1.60	171.8	47	090	22.8
OCT	1014.0	3.6	27.7	25.3	23.4	21.9	19.9	23.8	74	78	66	57	151.9	50	8.10	1.57	1.00	191.1	53	080	28.7
NOV	1018.0	3.8	24.0	21.4	19.4	17.9	15.3	18.1	70	75	61	53	35.1	36	5.67	0.37	0.10	178.2	54	080	27.9
DEC	1020.5	4.0	20.3	17.8	15.7	14.5	11.6	14.4	69	74	60	51	34.5	36	4.27	0.30	0.13	173.3	52	070	26.5
YEAR	1013.0	3.7	25.6	23.1	21.1	20.5	18.8	23.1	78	82	71	67	2382.7	850	139.49	27.69	13.36	1842.9	41	070	23.9
Observed at	Hong Kong Observatory																	King's Park		Waglan Island	

Table 3 Monthly means of selected meteorological parameters for Hong Kong, 1971-2000

Month	THUNDERSTORM ACTIVITY		NUMBER OF DAYS WITH FOG (Visibility < 1000 m)	SOIL TEMPERATURE						MEAN DAILY GLOBAL SOLAR RADIATION	TOTAL EVAPORATION	TOTAL POTENTIAL EVAPOTRANSPIRATION	SEA SURFACE TEMPERATURE				NUMBER OF DAYS WITH TROPICAL CYCLONE WARNING SIGNAL				NUMBER OF DAYS WITH STRONG MONSOON SIGNAL
				0.5 M		1.0 M		1.5 M					TIME OF OBSERVATION (HKT)								
				TIME OF OBSERVATION (HKT)									0700	1400	0700 or 1100	1400 or 1700	No. 1 and Higher	No. 3 and Higher	No. 8 and Higher	No. 9 and No. 10	
	Number of Days with Lightning	Number of Days with Thunderstorm		0700	1900	0700	1900	0700	1900												
				°C	°C	°C	°C	°C	°C	MJ/m^2	mm	mm	°C	°C	°C	°C					
JAN	0.13	0.10	0.23	18.8	18.8	20.3	20.4	21.6	21.6	10.55	80.7	57.9	17.5	17.7	17.5	17.7	-	-	-	-	4.33
FEB	1.00	0.97	1.23	18.9	18.9	19.8	19.9	20.8	20.8	9.61	67.6	53.0	16.7	17.0	16.6	16.7	-	-	-	-	4.33
MAR	1.77	1.63	2.30	20.6	20.7	20.8	20.8	21.1	21.1	10.18	78.1	63.5	17.9	18.2	17.6	17.8	-	-	-	-	3.83
APR	4.77	4.20	1.13	23.4	23.5	22.8	22.8	22.5	22.5	11.83	93.2	80.0	20.9	21.3	20.7	20.9	0.17	0.03	-	-	3.00
MAY	6.67	5.27	0.17	26.5	26.6	25.5	25.6	24.8	24.8	14.35	118.4	98.3	24.5	25.0	24.5	24.7	0.43	0.27	0.07	-	1.60
JUN	7.70	5.60	-	28.5	28.5	27.5	27.5	26.7	26.8	15.31	129.0	112.7	26.5	26.9	26.6	26.9	2.23	1.23	0.20	0.03	1.17
JUL	8.47	5.90	-	29.8	29.9	29.0	29.0	28.2	28.2	17.52	155.5	131.6	26.6	27.1	27.2	27.5	4.43	2.57	0.57	0.07	0.50
AUG	11.00	8.10	-	30.0	30.0	29.4	29.4	29.0	29.0	16.07	143.2	120.9	26.5	27.0	27.1	27.4	3.93	1.67	0.60	0.13	0.17
SEP	6.93	4.30	-	29.6	29.6	29.3	29.4	29.1	29.1	15.14	134.2	99.0	27.1	27.5	27.5	27.7	4.53	2.23	0.40	0.07	1.77
OCT	1.13	0.80	-	27.7	27.7	28.1	28.1	28.2	28.2	14.46	136.4	92.8	26.3	26.6	26.4	26.6	3.17	2.03	0.20	0.07	5.30
NOV	0.23	0.23	-	24.4	24.3	25.6	25.5	26.3	26.3	12.64	112.5	74.0	23.4	23.6	23.3	23.5	0.50	0.17	0.07	-	4.83
DEC	-	-	0.03	20.5	20.5	22.4	22.4	23.6	23.6	11.13	94.5	60.8	19.8	20.0	19.7	19.9	0.07	0.07	-	-	5.23
YEAR	49.80	37.10	5.09	24.9	25.0	24.9	25.0	25.0	25.1	13.23	1343.4	1044.5	22.8	23.2	22.9	23.1	19.46	10.27	2.11	0.37	36.06
Period of record	1971 - 2000			1971 - 2000						1971 - 2000			1975 – 2004*		1971 - 2000						
Observed at	Hong Kong Observatory									King's Park			North Point		Waglan Island						

* The 30-year mean between 1975 and 2004 is used as sea surface temperature measurement at North Point commenced since 18 June 1974.

Table 4 Mean number of very hot days, cold days and hot nights, 1971-2000 (based on Hong Kong Observatory Headquarters data)

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Total**
Very Hot Days	**-**	**-**	**-**	**-**	**0.37**	**1.40**	**4.00**	**2.83**	**1.23**	**-**	**-**	**-**	**9.83**
Cold Days	**6.97**	**5.53**	**1.77**	**0.13**	**-**	**-**	**-**	**-**	**-**	**-**	**0.40**	**3.83**	**18.63**
Hot Nights	**-**	**-**	**-**	**-**	**0.37**	**3.50**	**5.43**	**3.23**	**0.57**	**-**	**-**	**-**	**13.10**

Table 5 Mean number of days with daily total rainfall ≥ 0.1 mm, 10 mm, 30 mm, 50 mm, 70 mm and 100 mm, 1971-2000 (based on Hong Kong Observatory Headquarters data)

Number of days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Daily rainfall ≥ 0.1 mm	**5.60**	**9.47**	**10.47**	**11.67**	**15.47**	**18.77**	**17.77**	**17.43**	**14.80**	**8.10**	**5.67**	**4.27**	**139.49**
Daily rainfall ≥ 10 mm	**0.70**	**1.57**	**1.80**	**4.17**	**6.60**	**7.63**	**8.40**	**9.03**	**6.20**	**2.60**	**0.93**	**0.73**	**50.37**
Daily rainfall ≥ 30 mm	**0.20**	**0.30**	**0.57**	**2.17**	**3.30**	**3.53**	**3.93**	**4.47**	**2.80**	**1.37**	**0.27**	**0.20**	**23.10**
Daily rainfall ≥ 50 mm	**-**	**0.07**	**0.30**	**1.23**	**2.00**	**2.13**	**2.40**	**2.40**	**1.60**	**1.00**	**0.10**	**0.13**	**13.36**
Daily rainfall ≥ 70 mm	-	-	**0.17**	**0.47**	**1.20**	**1.43**	**1.30**	**1.40**	**1.03**	**0.73**	**0.03**	**0.07**	**7.83**
Daily rainfall ≥ 100 mm	-	-	**0.07**	**0.20**	**0.50**	**0.77**	**0.60**	**0.73**	**0.37**	**0.43**	**-**	**0.03**	**3.70**

Table 6 Comparison between the normals of selected meteorological elements for 1961-1990 and 1971-2000

	1961-1990 Normal	**1971-2000 Normal**	**Difference Normal(71-00)- Normal(61-90)**		**Statistical Significance at 5 % level**
			Difference	Percentage	
Pressure (hPa)	1012.9	1013.0	0.1	+0.01 %	No
Air temperature (Deg C)	23.0	23.1	0.1	+0.4%	No
Daily maximum temperature (Deg C)	25.7	25.6	-0.1	-0.4%	No
Daily minimum temperature (Deg C)	20.9	21.1	0.2	+1.0%	Yes
Daily relative humidity (%)	77	78	1	+1.3%	No
Daily cloud amount (%)	65	67	2	+3.1%	No
Annual total rainfall (mm)	2214.3	2382.7	168.4	+7.6%	No
Annual total bright sunshine duration (hour)	1948.1	1842.9	-105.2	-5.4%	Yes
Daily global solar radiation (MJ/m^2)	14.46	13.23	-1.23	-8.5%	Yes
Annual total evaporation (mm)	1528.8	1343.4	-185.4	-12.1%	Yes
Annual number of thunderstorm days	33.47	37.10	3.63	+10.9%	No
Annual number of lightning days	46.03	49.80	3.77	+8.2%	No
Annual number of fog days	5.90	5.09	-0.81	-13.7%	No
Annual number of very hot days	13.37	9.83	-3.54	-26.5%	No
Annual number of cold days	23.33	18.63	-4.7	-20.2%	Yes
Annual number of hot nights	8.73	13.10	4.37	+50.1%	Yes
Annual number of days with daily rainfall ≥ 0.1 mm	137.40	139.49	2.09	+1.5%	No
Annual number of days with daily rainfall ≥ 30 mm	21.23	23.10	1.87	+8.8%	No

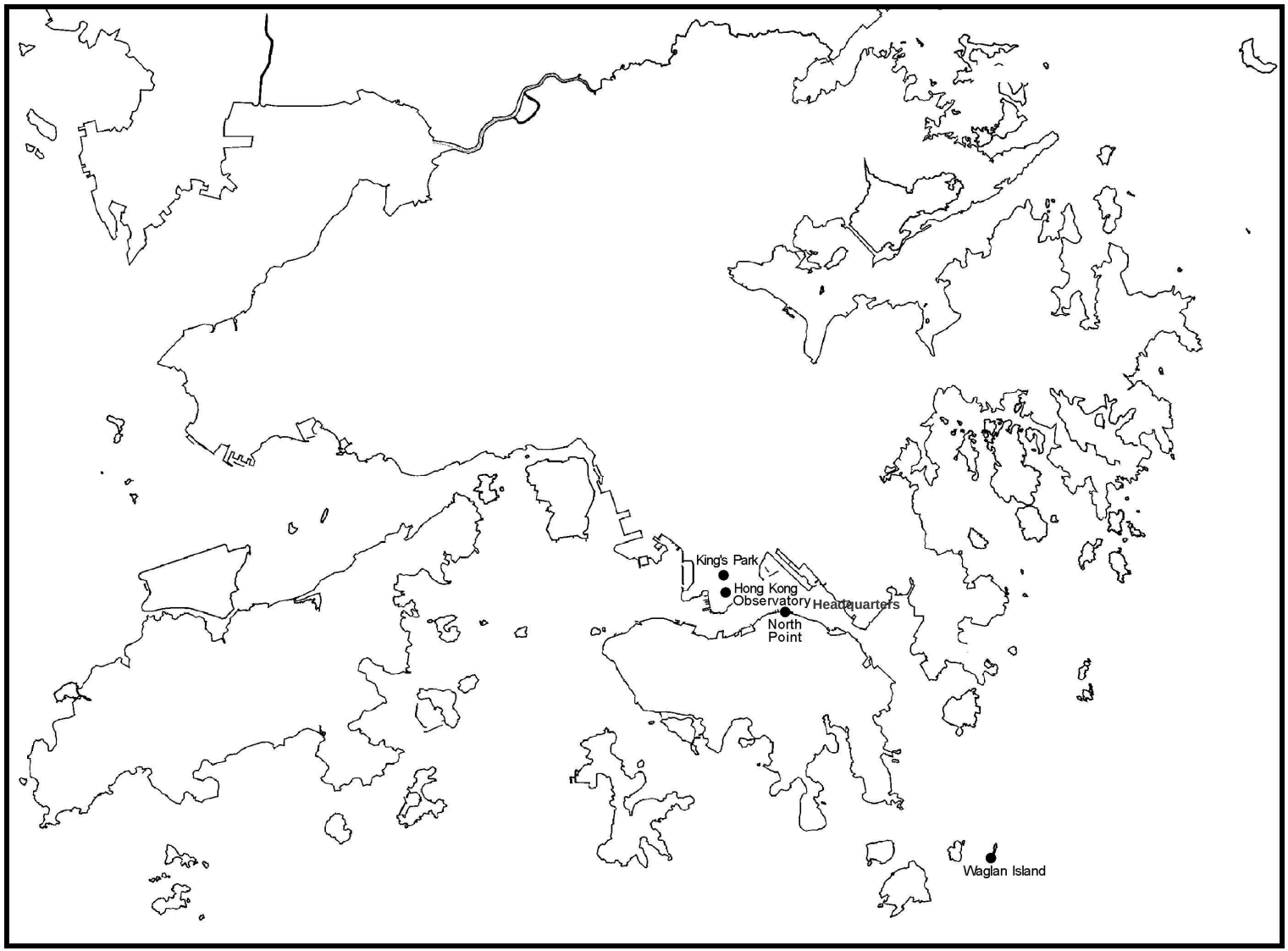
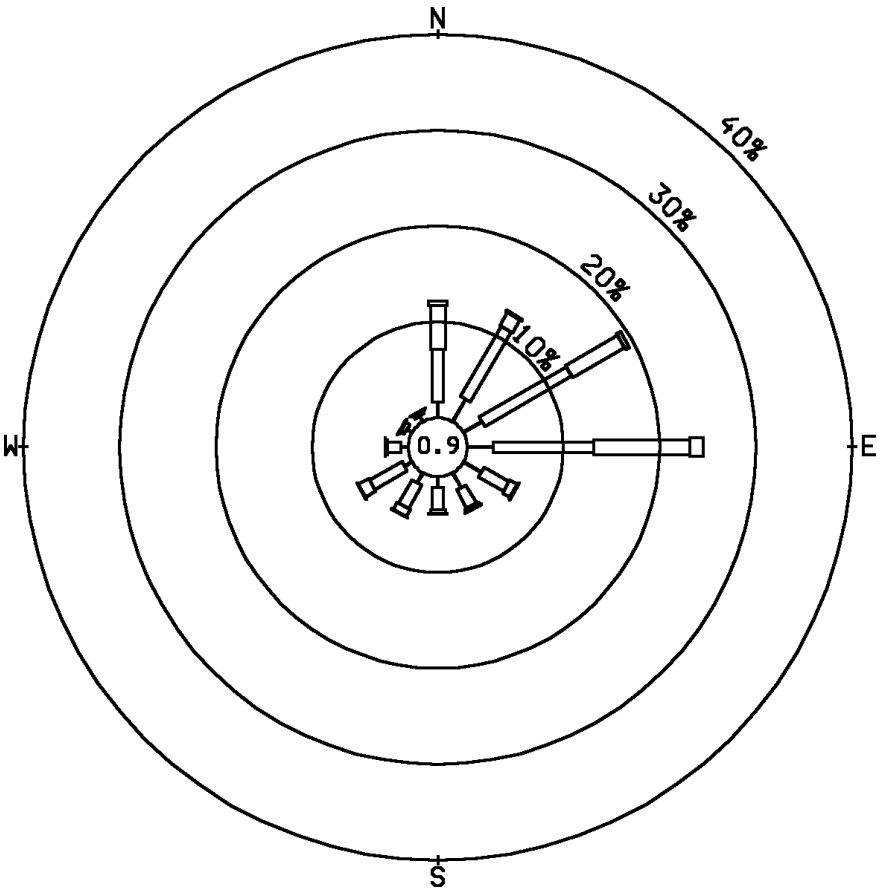


Figure 1 Locations of the Hong Kong Observatory Headquarters, King's Park, North Point and Waglan Island



Legend :

0.1 - 3.2	3.3 - 8.2	8.3 - 14.2	> 14.2	m/s
1 - 2	3 - 4	5 - 6	> 6	Beaufort force

Wind Speed

0 10 20 30 40 50

The number in the inner circle is the percentage frequency of occurrence of calm and variable winds.

Percentage Frequency

Figure 2 Annual wind rose for Waglan Island from 1971 to 2000

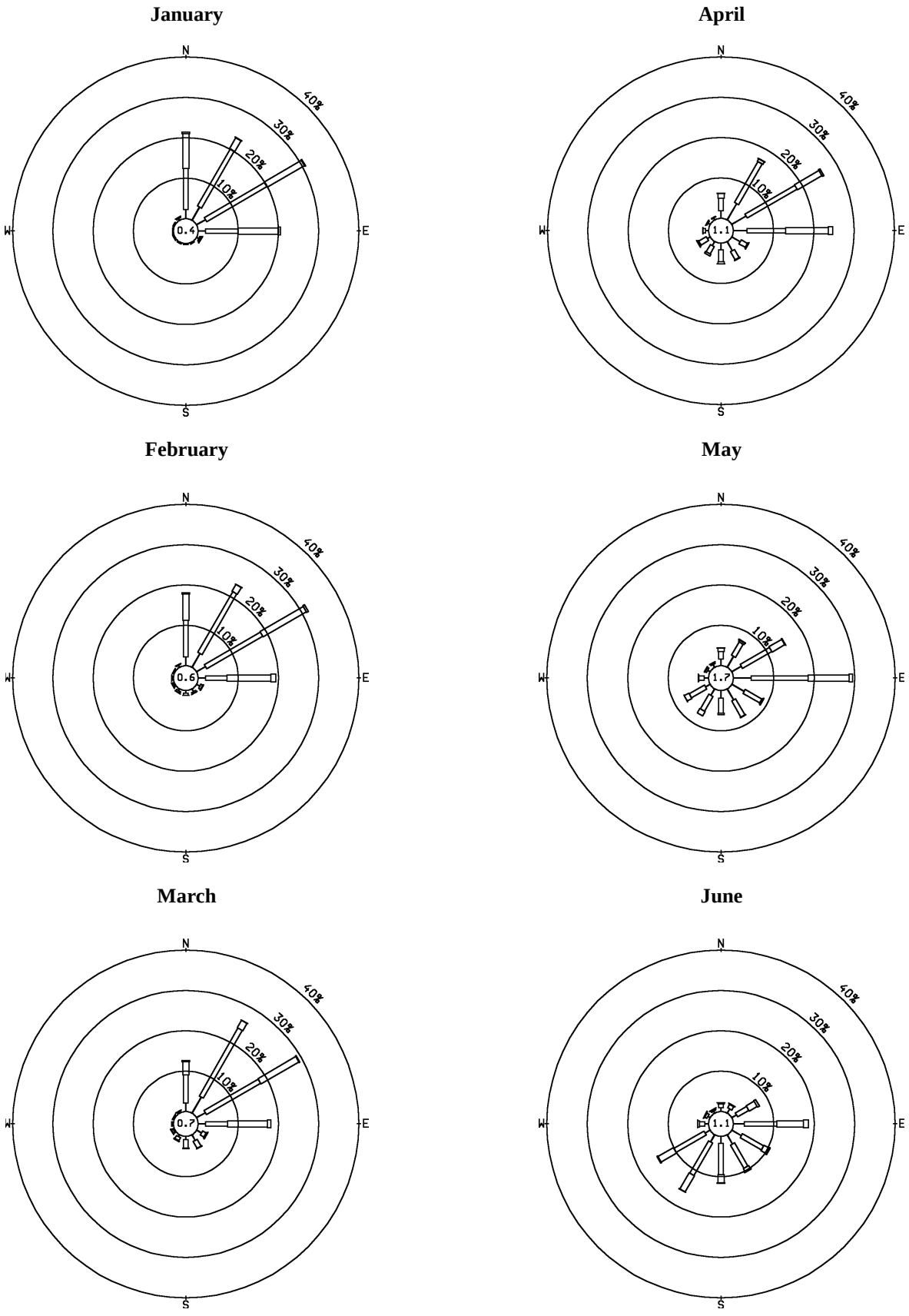


Figure 3(a) Monthly wind roses for Waglan Island from 1971 to 2000 (January to June)

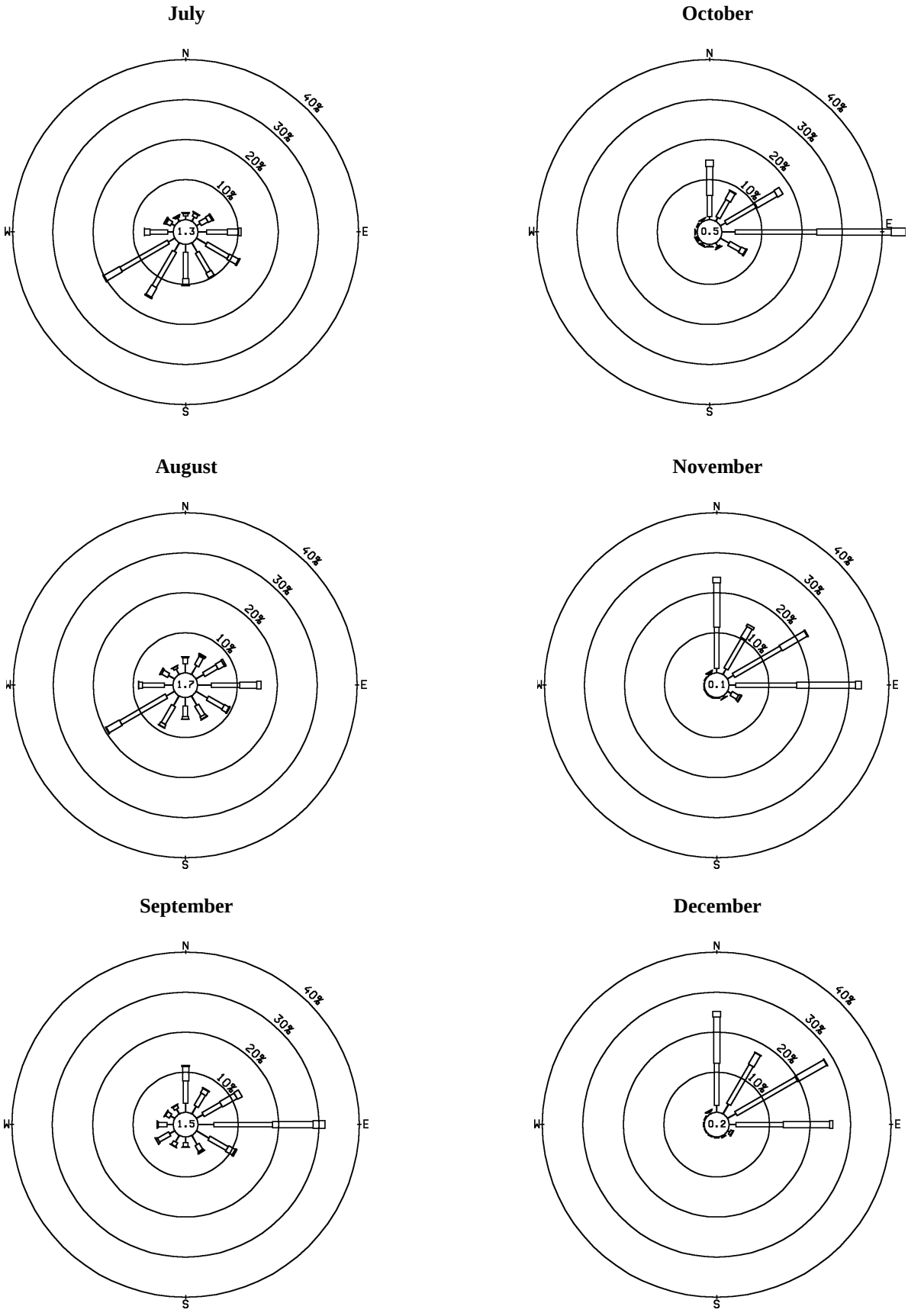


Figure 3(b) Monthly wind roses for Waglan Island from 1971 to 2000 (July to December)

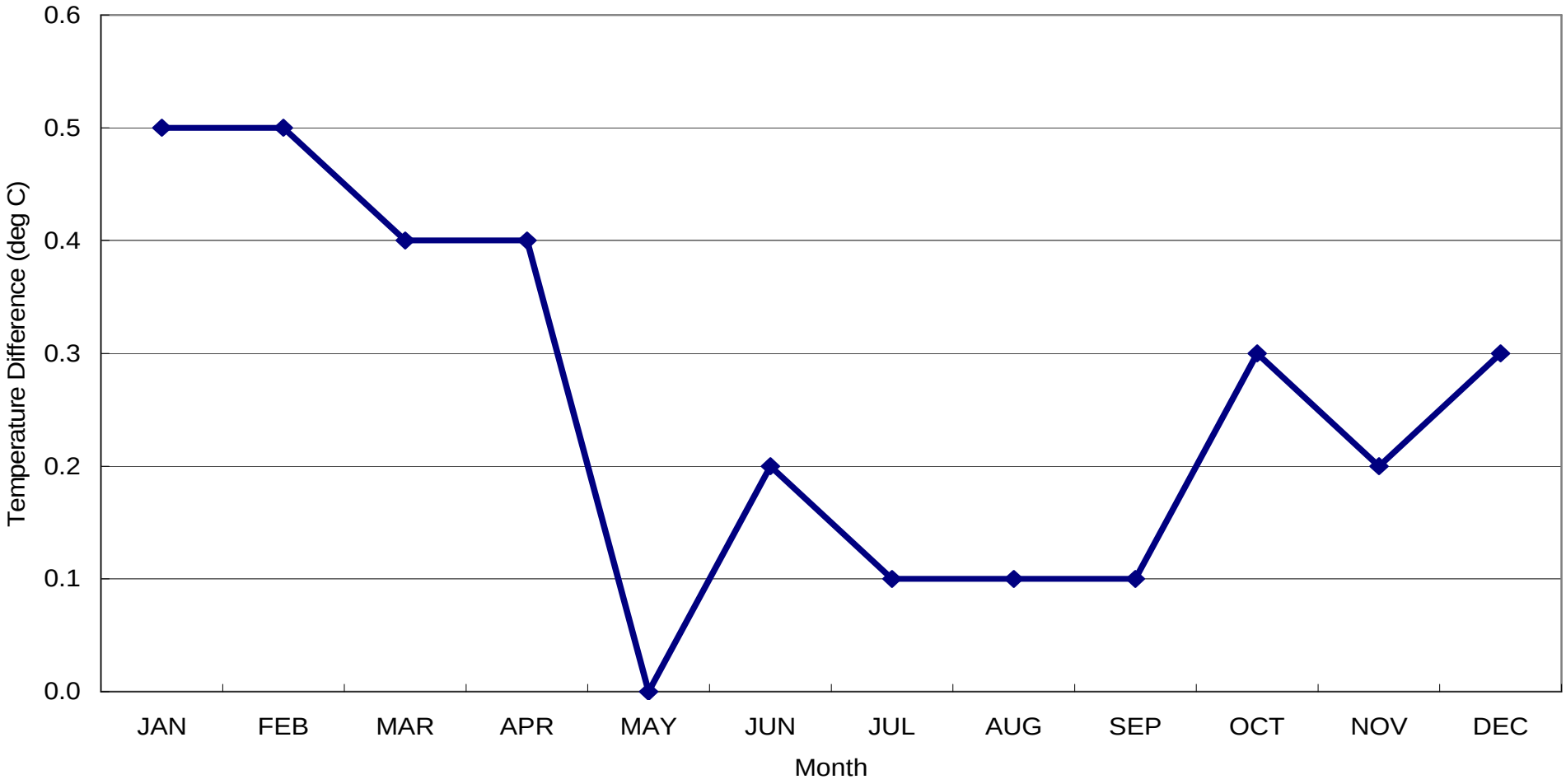


Figure 4 Deviation of the 1971-2000 monthly normals of mean daily minimum temperature from those of 1961-1990

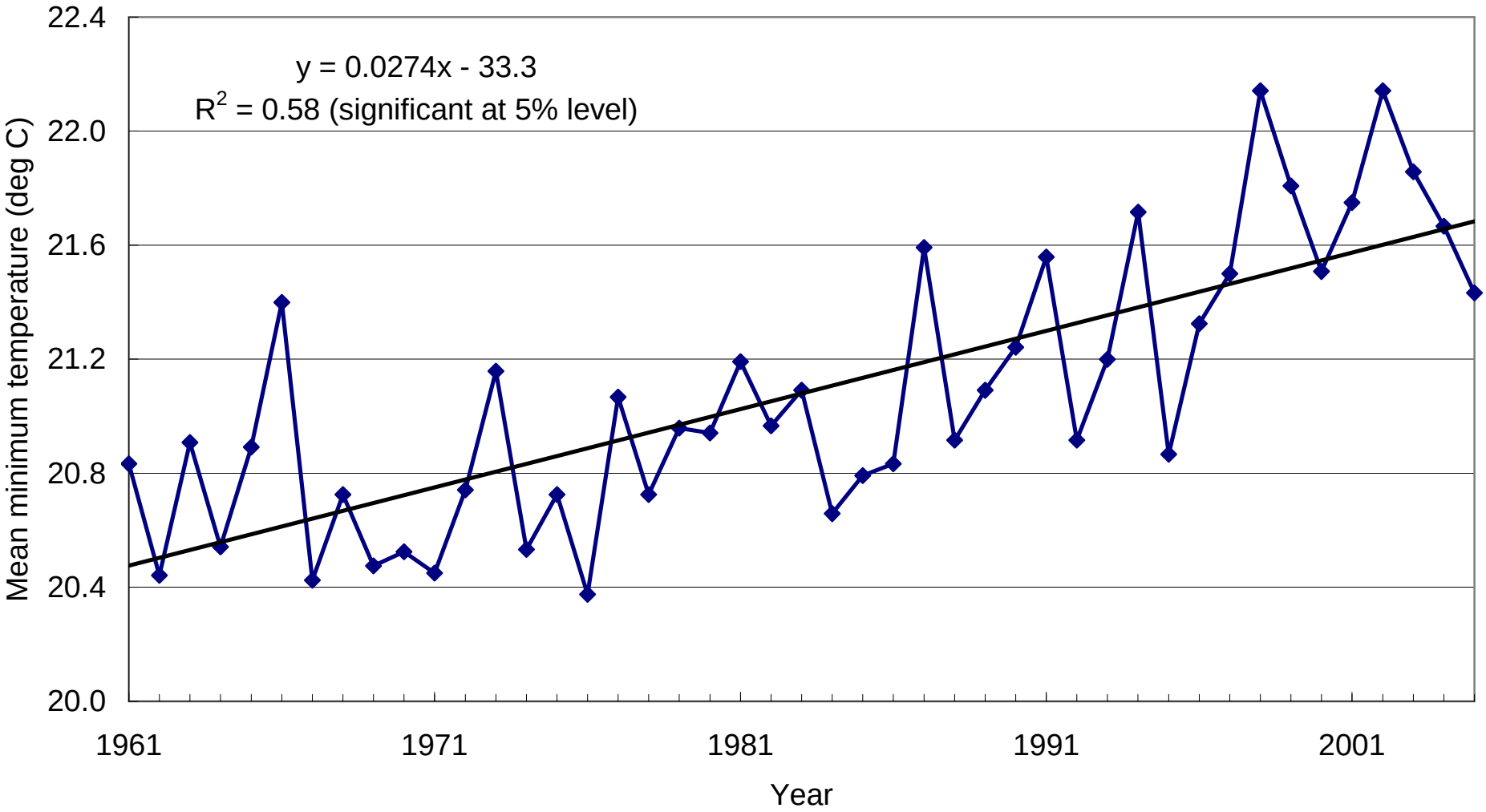


Figure 5 Long-term trend in the annual mean of the daily minimum temperature, 1961-2005

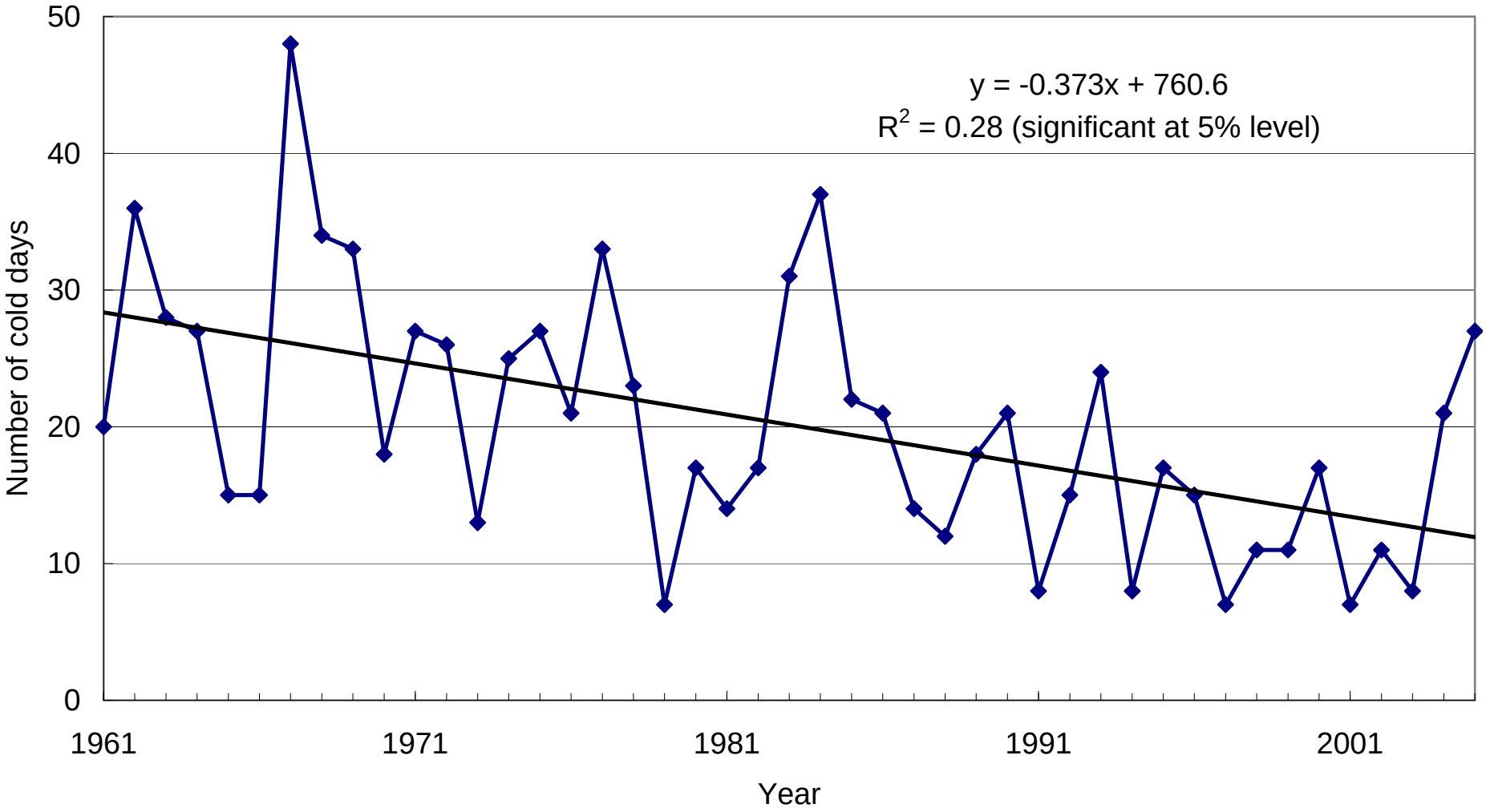


Figure 6 Long-term trend in the annual number of cold days, 1961-2005

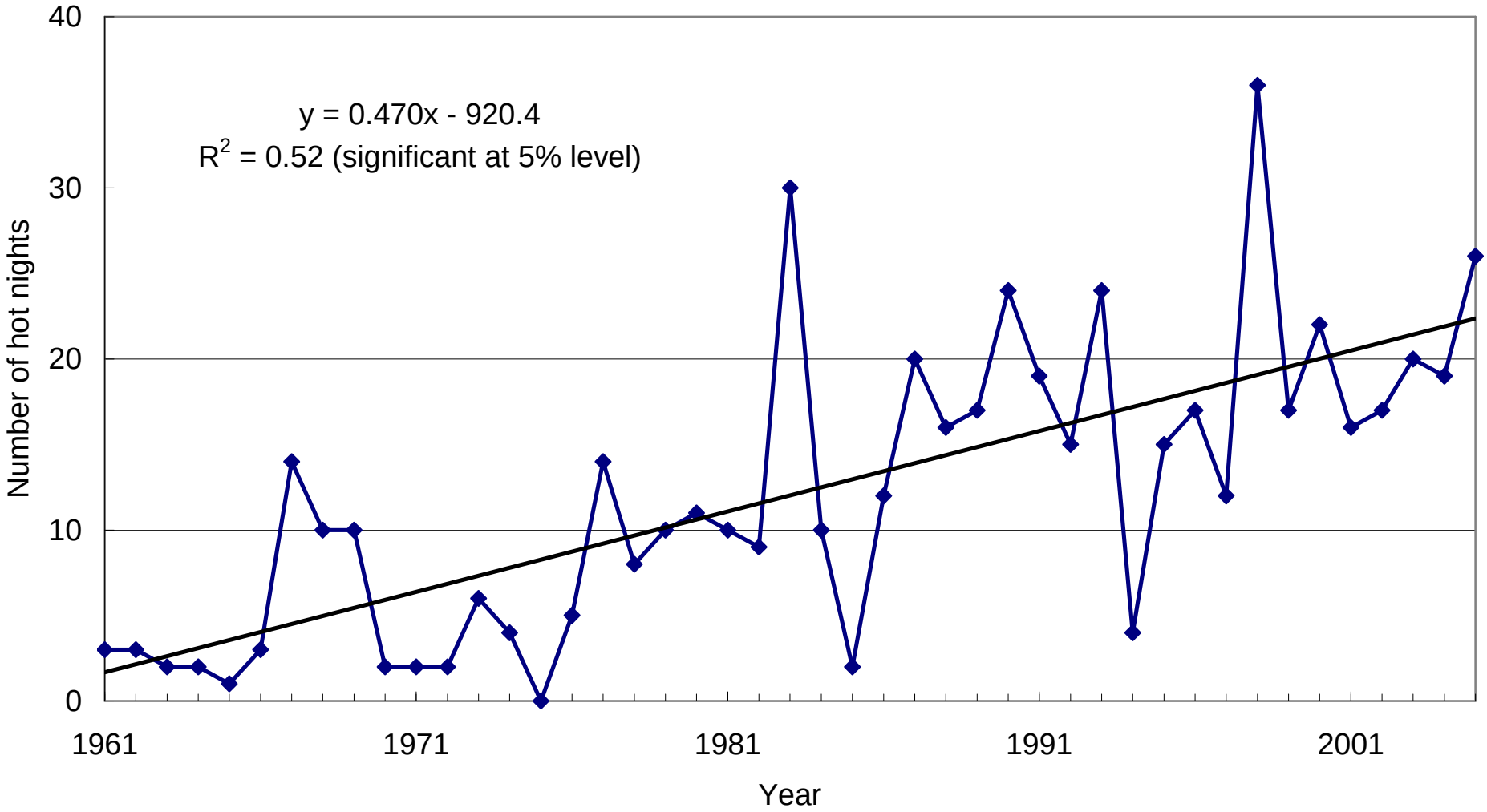


Figure 7 Long-term trend in the annual number of hot nights, 1961-2005

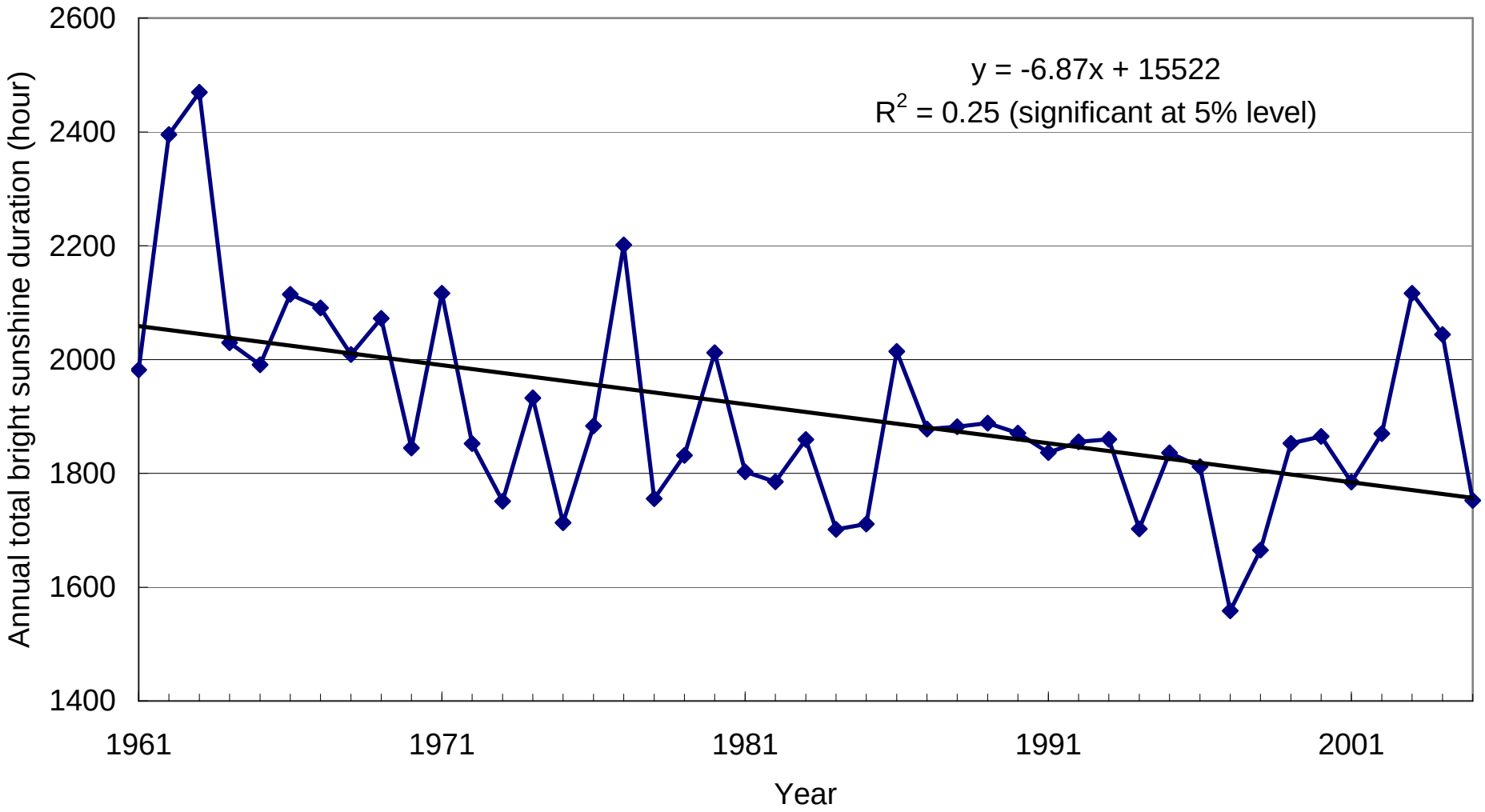


Figure 8 Long-term trend in the annual total bright sunshine duration, 1961-2005

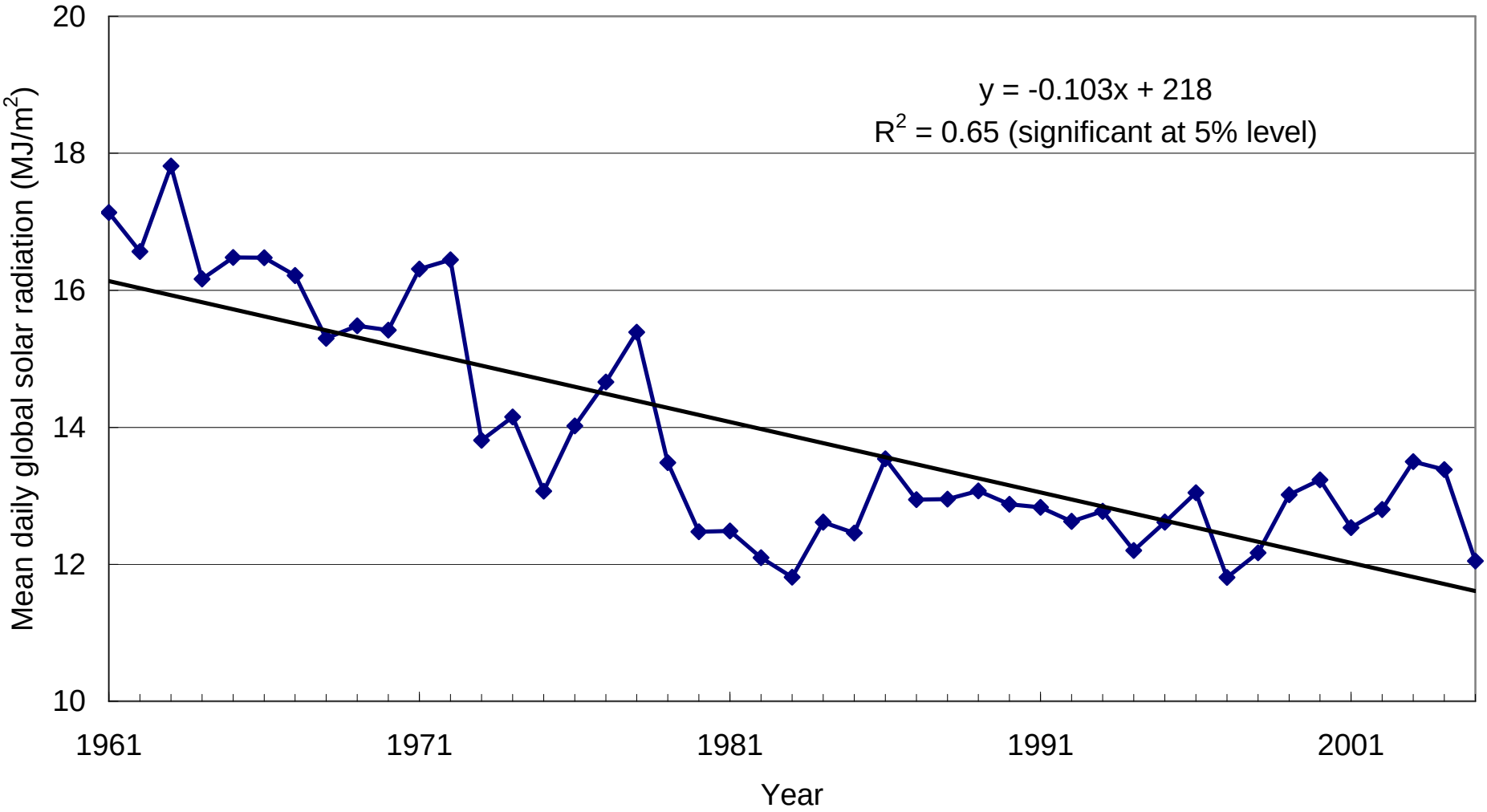


Figure 9 Long-term trend in the annual mean of the daily global solar radiation, 1961-2005

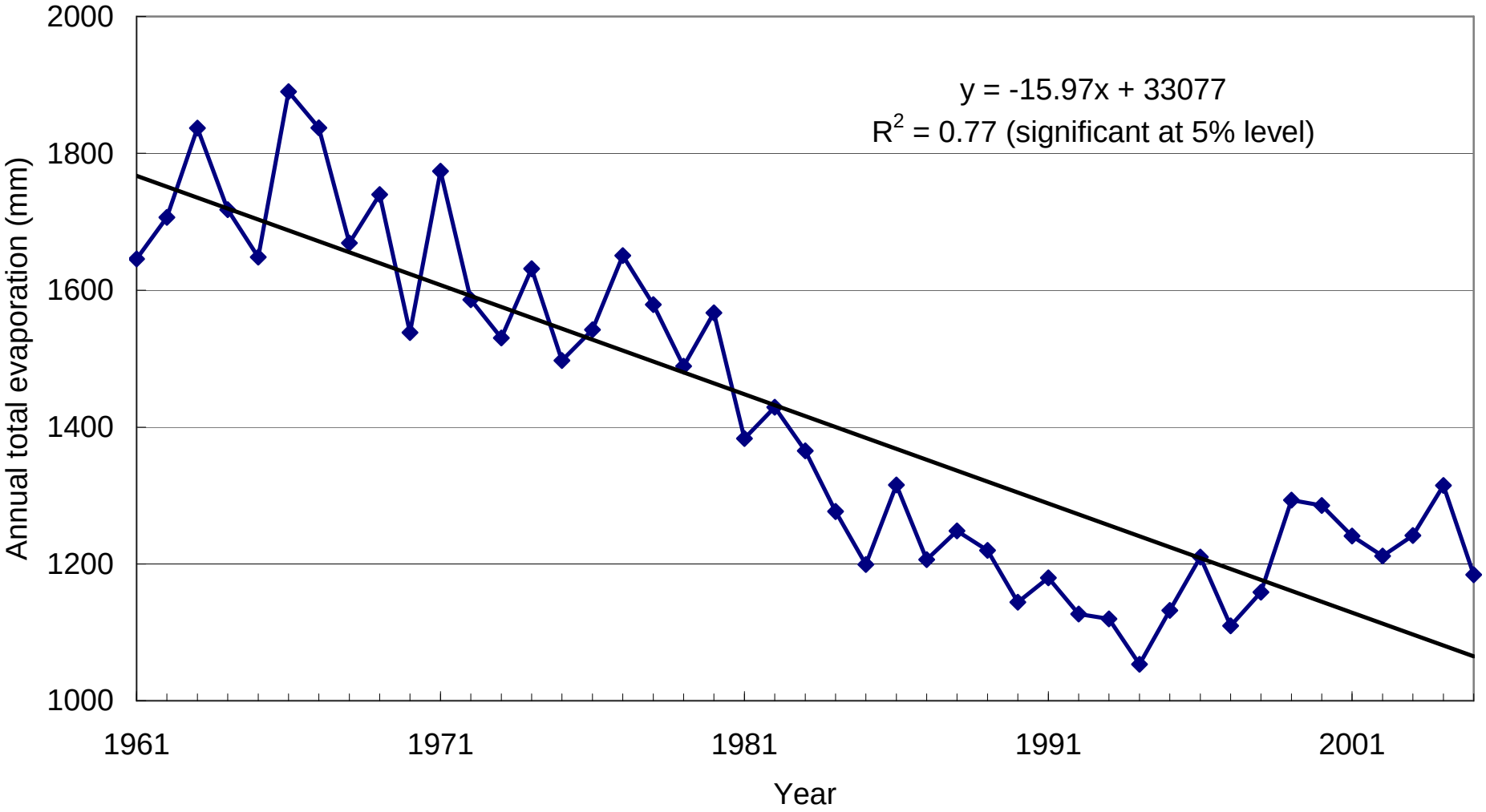


Figure 10 Long-term trend in the annual total evaporation, 1961-2005

Appendix I

Summary of major instrument/site changes for some of the meteorological measurements at the Hong Kong Observatory Headquarters (HKO), King's Park Meteorological Station (KP) and Waglan Island (WGL) (from 1947 to 2005)

Location	Meteorological Element	Instrument / Site Changes	
HKO	Pressure	1 Sept 1947	Casella No. 3623 (Fortin) used as standard barometer/ Negretti and Zambra (Kew Type) No. 3336 barometer was used for hourly readings
		1 Dec 1950	Casella No. 3623 (Fortin) used as standard barometer / Darton (Kew type) no.3478 barometer was used for hourly readings
		21 Jul 1962	Darton (Kew Type) No. S3423/47/56 barometer
		1 July 1979	Darton (kew Type) No. S3495/46/54/56 barometer
		7 May 1982	The station barometer, S3495/46/54/56, was removed to the Central Forecasting Office of the new building with the elevation of cistern 62.2 m above MSL
		1 Apr 2000	Setra Model 361 Digital Pressure Gauge/ Mercury in glass barometer (backup)
		1 Jan 2003	Setra Model 270 Digital Pressure Gauge/ Mercury in glass barometer (backup)
		16 Dec 2005	Elevation of the barometer changed to 40 m above MSL
	Temperature	1947	Ordinary fixed thermometer and max. & min. thermometers
		1981	Platinum resistance thermometer with digital display replaced the ordinary thermometer
		7 May 1982	Platinum resistance thermometer with digital display further replaced the max. and min. thermometers

	Rainfall	1947 Aug 1979 May 1982 1 Jan 1989	8-inch standard raingauge / Dines tilting siphon raingauge Satellite antenna erected close to raingauges to north-northwest (Figure A) Satellite antenna dismantled new 203-mm raingauge replaced the 8-inch standard raingauge and installed at 8.5 m south by west of entrance to main building (Figure B)
KP	Sunshine Duration	15 Jul 1957 1 Jan 1969 1 Jan 2005	Campbell-Stokes recorder on the roof of the Radiosonde Operations Room The recorder was moved to the roof of the Weather Satellite Workshop/Radiation Laboratory (elevation : 71 m above MSL) The Kipp & Zonen CSD-1 sunshine duration sensor replaced the Campbell Stokes recorder as the sunshine duration measuring instrument
	Global Solar Radiation (Lau, 1989)	28 Jan 1959 1 Jan 1969 17 Apr 2000	Bimetallic actinograph installed The bimetallic actinograph was moved to the roof of the Weather Satellite Workshop/Radiation Laboratory Thermo-electric pyranometer (Kipp & Zonen Holland) replaced the bimetallic actinograph
	Evaporation (Chen, 1976)	4 Jul 1957	Evaporation Pans (US Weather Bureau Class “A”)
	Potential Evapotranspiration (Chen, 1976)	1 Oct 1951	Lysimeters

WGL	Winds	1 Dec 1952	Dines Head pressure-tube anemometer (elevation 70 m above MSL)
		1 Jan 1964	Anemometer transferred to marine signal tower (elevation 67 m above MSL)
		1 Jan 1966	Anemometer extension (elevation 74 m above MSL)
		19 Dec 1971	Anemometer transferred to the new instrument room annexed to the signal tower (elevation 75 m above MSL)
		19 Mar 1975	MK4 Cup anemometer (elevation 74.8 m above MSL)
		14 Aug 1989	Teledyne Geotech WS-201 anemometer (elevation 74.8 m above MSL)
		Apr 1993	Teledyne Geotech WS-201 anemometer and R.W. Munro Mk 4 Cup-generator anemometer and vane (82.1 m above MSL)
		15 Nov 1999	R.W. Munro Mk 4 Cup-generator anemometer and vane (82.1 m above MSL)

Figure A A satellite antenna was erected close to raingauges from August 1979 to May 1982

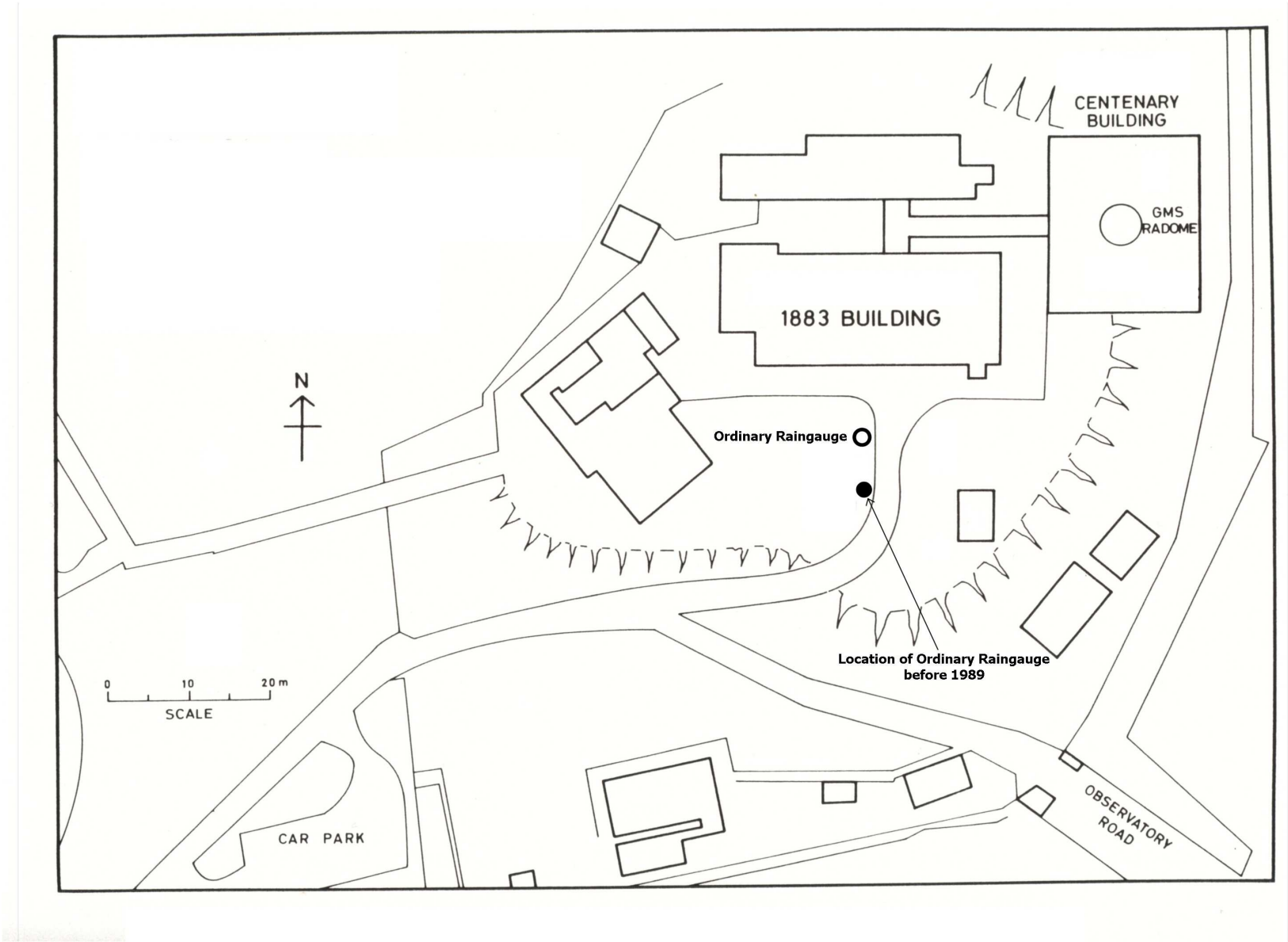


Figure B Layout plan showing the relocation of the ordinary raingauge of the Hong Kong Observatory in 1989.

Appendix II The annual mean/total values of selected meteorological elements from 1961 to 2000 as well as the 30-year means and standard deviations (S.D.) for 1961-1990 and 1971-2000

Year		Annual Mean Value						
		Pressure (hPa)	Air Temperature (deg C)	Daily Max. Temperature (deg C)	Daily Min. Temperature (deg C)	Relative Humidity (%)	Cloud Amount (%)	Daily Solar Radiation (MJ/m^2)
1961		1012.6	22.9	25.6	20.8	79	66	17.14
1962		1013.2	22.7	25.8	20.4	76	58	16.57
1963		1013.4	23.3	26.5	20.9	73	52	17.82
1964		1012.7	22.9	25.7	20.5	77	65	16.17
1965		1012.8	23.1	25.9	20.9	77	63	16.48
1966		1012.2	23.8	26.8	21.4	76	62	16.48
1967		1012.8	22.9	25.9	20.4	74	66	16.22
1968		1012.7	22.9	25.8	20.7	77	66	15.30
1969		1012.8	22.7	25.7	20.5	77	64	15.48
1970		1012.5	22.8	25.5	20.5	77	69	15.42
1971		1013.1	22.7	25.9	20.5	74	59	16.31
1972		1012.4	22.8	25.9	20.7	80	66	16.45
1973		1012.6	23.3	26.3	21.2	79	69	13.81
1974		1012.1	22.8	25.9	20.5	77	66	14.15
1975		1012.6	22.8	25.6	20.7	79	71	13.07
1976		1013.1	22.5	25.4	20.4	77	65	14.02
1977		1013.5	23.3	26.4	21.1	76	61	14.66
1978		1012.7	22.8	25.6	20.7	79	71	15.39
1979		1013.0	23.1	25.9	21.0	78	66	13.48
1980		1013.4	23.0	25.9	20.9	78	66	12.48
1981		1013.1	23.1	25.5	21.2	77	68	12.49
1982		1013.0	22.9	25.2	21.0	78	68	12.10
1983		1013.7	23.0	25.4	21.1	78	69	11.81
1984		1012.5	22.5	24.9	20.7	77	72	12.62
1985		1012.3	22.6	25.0	20.8	80	71	12.46
1986		1013.1	22.8	25.3	20.8	78	63	13.54
1987		1013.9	23.4	25.7	21.6	79	68	12.94
1988		1013.1	22.8	25.1	20.9	78	67	12.95
1989		1013.1	23.0	25.3	21.1	78	66	13.07
1990		1012.9	23.1	25.4	21.2	79	68	12.88
1991		1013.3	23.5	25.9	21.6	78	66	12.83
1992		1013.3	22.8	25.2	20.9	78	65	12.63
1993		1013.6	23.1	25.5	21.2	78	68	12.77
1994		1012.7	23.6	25.9	21.7	79	69	12.20
1995		1013.7	22.8	25.2	20.9	77	69	12.61
1996		1013.0	23.3	25.6	21.3	76	68	13.04
1997		1013.3	23.3	25.5	21.5	79	70	11.81
1998		1012.8	24.0	26.3	22.1	79	73	12.17
1999		1011.9	23.8	26.2	21.8	75	67	13.02
2000		1011.9	23.3	25.5	21.5	78	69	13.23
1961-1990	Mean	1012.9	23.0	25.7	20.9	77	65	14.46
	S.D.	0.44	0.28	0.43	0.30	1.70	4.13	1.75
1971-2000	Mean	1013.0	23.1	25.6	21.1	78	67	13.23
	SD.	0.51	0.36	0.39	0.42	1.37	2.94	1.17

Year		Annual Total Value					
		Rainfall (mm)	Sunshine (hour)	Total Evaporation (mm)	Number of Thunderstorm days	Number of Lightning days	Number of Fog days
1961		2232.4	1981.6	1645.6	38	55	8
1962		1741.0	2395.4	1706.4	20	34	7
1963		901.1	2469.7	1837.0	20	30	0
1964		2432.1	2029.6	1717.8	30	41	6
1965		2352.6	1990.7	1648.1	30	42	4
1966		2398.2	2114.8	1890.4	31	42	5
1967		1570.6	2090.9	1837.1	20	34	9
1968		2288.2	2008.7	1669.1	34	48	9
1969		1895.5	2072.6	1740.1	35	49	19
1970		2316.3	1844.7	1538.3	33	45	6
1971		1903.8	2116.6	1774.0	23	36	2
1972		2807.3	1852.3	1586.4	44	54	4
1973		3100.4	1750.9	1530.4	43	51	3
1974		2322.9	1932.6	1631.4	31	42	4
1975		3028.7	1713.4	1497.3	41	63	4
1976		2197.2	1883.5	1542.3	23	35	5
1977		1680.0	2201.3	1650.5	43	61	2
1978		2593.0	1755.2	1579.1	43	53	8
1979		2614.7	1831.5	1489.1	35	41	3
1980		1710.6	2012.0	1567.0	44	48	10
1981		1659.5	1802.9	1383.4	28	36	1
1982		3247.5	1785.0	1429.1	46	66	3
1983		2893.8	1859.4	1365.3	42	51	5
1984		2017.0	1701.9	1276.6	23	34	11
1985		2191.4	1711.2	1199.0	29	49	7
1986		2338.3	2014.0	1315.2	34	48	11
1987		2319.3	1878.0	1206.3	41	51	5
1988		1685.0	1881.9	1248.4	33	47	5
1989		1944.6	1888.5	1219.8	25	38	7
1990		2046.9	1871.0	1144.1	42	57	4
1991		1639.1	1836.6	1179.6	27	33	11
1992		2678.8	1855.5	1126.6	43	60	11
1993		2343.9	1859.9	1119.4	47	59	3
1994		2725.6	1702.5	1053.2	40	60	3
1995		2754.4	1836.1	1131.8	35	43	6
1996		2249.1	1811.7	1210.1	41	56	0
1997		3343.0	1558.2	1109.3	53	66	1
1998		2564.6	1665.3	1158.7	49	61	10
1999		2129.1	1852.6	1293.3	35	48	1
2000		2752.3	1864.9	1285.3	30	47	3
1961-1990	Mean	2214.3	1948.1	1528.8	33.47	46.03	5.90
	S.D.	512.48	186.64	209.91	8.24	9.30	3.75
1971-2000	Mean	2382.7	1842.9	1343.4	37.10	49.80	5.09
	SD.	491.14	129.53	197.45	8.36	9.91	3.38

Year		Annual Total Value				
		Number of Very Hot days	Number of Cold days	Number of Hot nights	Number of days with daily Rainfall ≥ 0.1mm	Number of days with daily Rainfall ≥ 30mm
1961		16	20	3	155	20
1962		30	36	3	120	17
1963		37	28	2	105	9
1964		13	27	2	164	20
1965		7	15	1	144	25
1966		16	15	3	116	26
1967		28	48	14	112	15
1968		18	34	10	149	21
1969		19	33	10	139	18
1970		8	18	2	144	20
1971		10	27	2	119	14
1972		16	26	2	130	26
1973		3	13	6	148	33
1974		11	25	4	125	21
1975		2	27	0	165	31
1976		9	21	5	125	18
1977		17	33	14	131	17
1978		28	23	8	152	22
1979		14	7	10	134	29
1980		16	17	11	121	19
1981		5	14	10	137	17
1982		8	17	9	146	28
1983		13	31	30	169	30
1984		7	37	10	132	21
1985		2	22	2	151	25
1986		7	21	12	129	20
1987		9	14	20	124	27
1988		4	12	16	138	15
1989		15	18	17	138	15
1990		13	21	24	160	18
1991		12	8	19	126	17
1992		16	15	15	148	19
1993		6	24	24	142	23
1994		5	8	4	143	26
1995		7	17	15	142	26
1996		9	15	17	136	27
1997		5	7	12	147	35
1998		10	11	36	152	28
1999		6	11	17	133	17
2000		10	17	22	141	29
1961-1990	Mean	13.37	23.33	8.73	137.40	21.23
	S.D.	8.55	9.04	7.34	16.46	5.69
1971-2000	Mean	9.83	18.63	13.10	139.49	23.10
	SD.	5.57	7.83	8.66	12.71	5.86