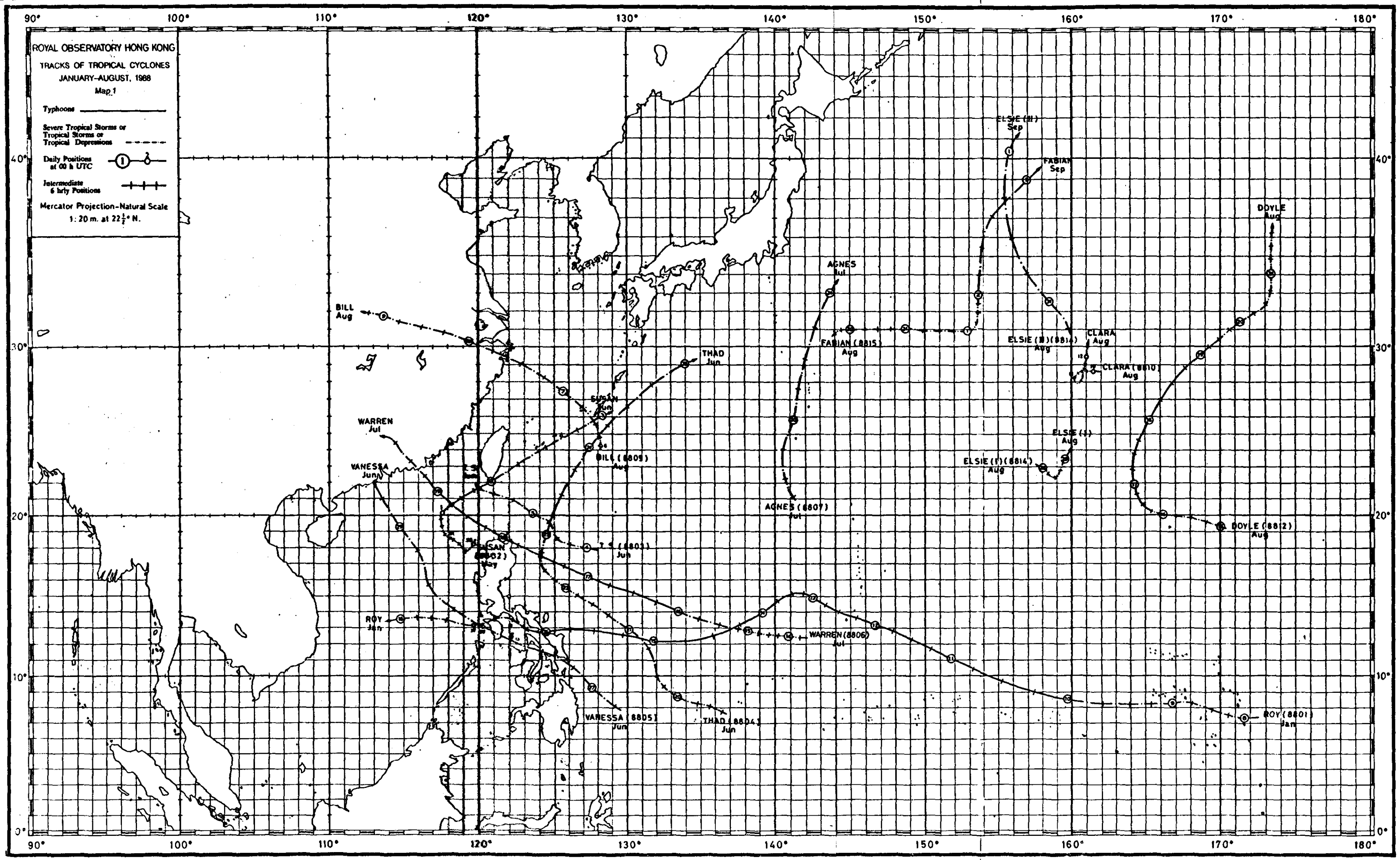
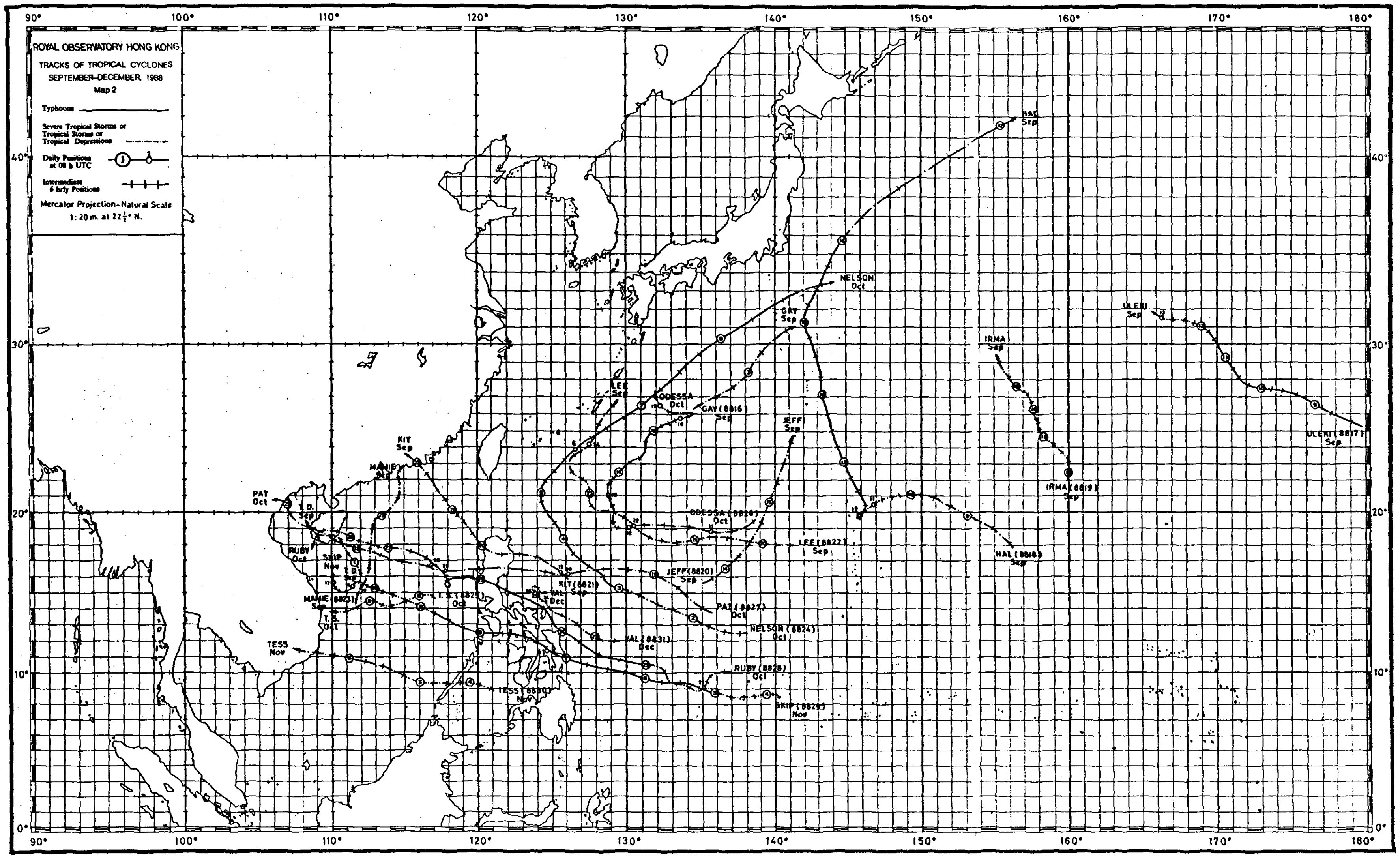


ROYAL OBSERVATORY HONG KONG
TRACKS OF TROPICAL CYCLONES
JANUARY-AUGUST, 1988
Map 1
Typhoons
Severe Tropical Storms or Tropical Storms or Tropical Depressions
Daily Positions at 00 h UTC
Intermediate 6 hrly Positions
Mercator Projection-Natural Scale
1: 20 m. at 22½° N.
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
0°
10°
20°
30°
40°
BILL Aug
BILL (8809) Aug
THAD Jun
THAD (8804) Jun
WARREN Jul
WARREN (8806) Jul
VANESSA Jun
VANESSA (8805) Jun
ROY Jan
ROY (8801) Jan
AGNES Jul
AGNES (8807) Jul
FABIAN (8815) Aug
FABIAN Sep
ELSIE (II) Sep
ELSIE (II) (8814) Aug
ELSIE (I) Aug
ELSIE (I) (8814) Aug
CLARA Aug
CLARA (8810) Aug
DOYLE Aug
DOYLE (8812) Aug



ROYAL OBSERVATORY HONG KONG
TRACKS OF TROPICAL CYCLONES
SEPTEMBER–DECEMBER, 1988
Map 2
Typhoons
Severe Tropical Storms or Tropical Storms or Tropical Depressions
Daily Positions at 00 h UTC
Intermediate 6 hrly Positions
Mercator Projection–Natural Scale
1: 20 m. at 22½° N.
90° 100° 110° 120° 130° 140° 150° 160° 170° 180°
0° 10° 20° 30° 40°
HAL Sep
NELSON Oct
GAY Sep
ULEKI Sep
IRMA Sep
LEE Sep
ODESSA Oct
GAY (8816) Sep
JEFF Sep
KIT Sep
MAMIE Sep
PAT Oct
T.D. Sep
IRMA (8819) Sep
ULEKI (8817) Sep
ODESSA (8826) Oct
LEE (8822) Sep
HAL (8818) Sep
RUBY Oct
SKIP Nov
JEFF (8820) Sep
KIT (8821) Sep
VAL Dec
T.S. (8825) Oct
MAMIE (8823) Sep
T.S. Oct
PAT (8827) Oct
NELSON (8824) Oct
VAL (8831) Dec
TESS Nov
RUBY (8828) Oct
TESS (8830) Nov
SKIP (8829) Nov

ROYAL OBSERVATORY HONG KONG

TROPICAL CYCLONES IN 1988

Published September 1989

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1. INTRODUCTION

Apart from a short break during 1940-1946, surface observations of meteorological elements since 1884 have been summarized and published in the Royal Observatory's Meteorological Results. Upper-air observations began in 1947 and from then onwards the annual publication was divided into two parts, namely Part I-Surface Observations and Part II-Upper-air Observations. The publication of Meteorological Results Part II was terminated in 1981. Upper-air data are now archived on magnetic tape. Starting from the 1987 issue, Part I was re-titled as Surface Observations in Hong Kong with the format and contents remaining unchanged.

During the period 1884-1939, reports on some destructive typhoons were printed as Appendices to the Meteorological Results. This practice was extended and accounts of all tropical cyclones which caused gales in Hong Kong were included in the Director's Annual Departmental Reports from 1947 until 1967 inclusive. The series 'Meteorological Results, Part III-Tropical Cyclone Summaries' was subsequently introduced. It contains information on tropical cyclones over the western North Pacific and the South China Sea. The first issue containing reports on tropical cyclones occurring during 1968, was published in 1971. In the 1984 issue, all tropical cyclones within the area bounded by the equator, 45°N, 100°E and 160°E, were described in the publication. Reconnaissance aircraft reports which had been available until August 1987 and terminated thereafter and satellite pictures have facilitated the tracking of tropical cyclones over the otherwise data-sparse ocean. Beginning from 1985, the area of coverage is extended from east of 160°E to 180°. Starting from the 1987 issue, the series was re-titled to the present format with its contents largely remaining the same.

Tracks of tropical cyclones in the western North Pacific and the South China Sea were published in Meteorological Results up to 1939 and in Meteorological Results, Part I from 1947 to 1967. For the period 1884-1960, only daily positions were plotted on the tracks. The time of the daily positions varied to some extent but remained fixed at 0000 UTC after 1944. Details of the variation are given in the Royal Observatory Technical Memoir No. 11, Volume 1. From 1961 onwards, six-hourly positions were shown on the tracks of all tropical cyclones.

Provisional reports on individual tropical cyclones affecting Hong Kong have been prepared since 1960 to meet the immediate needs of the press, shipping companies and others. These reports are printed and supplied on request. Initially, reports were only written on those tropical cyclones for which gale or storm signals had been hoisted in Hong Kong, but by 1968 it had become necessary to produce a report on every tropical cyclone which necessitated the hoisting of a tropical cyclone warning signal.

In this publication, tropical cyclones are classified into the following four categories according to the maximum sustained winds near their centres:

A TROPICAL DEPRESSION (T.D.) has maximum sustained winds of less than 63 km/h and at this stage the centre is often not very clearly defined and cannot always be located precisely.

A TROPICAL STORM (T.S.) has maximum sustained winds in the range 63-87 km/h.

A SEVERE TROPICAL STORM (S.T.S.) has maximum sustained winds in the range 88-117 km/h.

A TYPHOON (T.) has maximum sustained winds of 118 km/h or more.

At the 13th session of the ESCAP/WMO Typhoon Committee held in December 1980, a common system for identification of tropical cyclones in the western North Pacific and the South China Sea was adopted. Since 1 January 1981, the Japan Meteorological Agency has undertaken the responsibility of assigning to each tropical cyclone of tropical storm intensity or above a common code which is composed of four digits. For example, the sixth tropical cyclone of tropical storm intensity or above which occurred within the area in 1988 was assigned the code (8806). The appropriate code immediately follows the name of the tropical cyclone in this publication, for example, Typhoon Warren (8806).

Surface wind data presented in this report were obtained from a network of anemometers operated by the Royal Observatory. Instruments used in 1988 included M.O. Mark IV/V cup anemometers manufactured by R.W. Munro Ltd., WS 201 cup anemometers manufactured by Teledyne Geotech and Gill propeller anemometer manufactured by R.M. Young Company. Details of the stations are listed below:

Station	Position		Head of anemometer above M.S.L.	Type of anemometer
	Latitude N	Longitude E		
			(m)	
Royal Observatory	22°18′	114°10′	72	Cup
Hong Kong Airport	22°20′	114°11′	14(NW)	Cup
			16(SE)†	Cup
Waglan Island	22°11′	114°18′	75	Cup
Tate's Cairn	22°22′	114°13′	588	Cup
Cheung Chau	22°12′	114°01′	92	Cup
King's Park	22°19′	114°10′	78	Cup
Star Ferry	22°18′	114°10′	17	Cup
Green Island	22°17′	114°07′	90	Cup
Tai O	22°15′	113°51′	90	Cup
Sha Tin△	22°24′	114°12′	16	Cup
Chek Lap Kok△	22°19′	113°56′	65	Cup
Lau Fau Shan△	22°28′	113°59′	50	Cup
Ta Kwu Ling△	22°32′	114°09′	28	Cup
Tuen Mun△	22°24′	113°58′	68	Cup
Cheung Sha Wan	22°20′	114°09′	30	Propeller
Tai Mo Shan	22°25′	114°07′	969	Cup
Tsing Yi (Mobil Oil Co.)	22°21′	114°06′	18	Cup
Tamar	22°17′	114°10′	15	Cup

† Anemometer located near 22°19′ 114°12′.
△ Automatic weather station

Wind reports were also provided by Hong Kong International Terminal Ltd. at Kwai Chung. Maximum storm surges caused by tropical cyclones are measured by tide gauges installed at several locations in Hong Kong. The locations of these anemometers and tide gauges are shown in Figure 1.

The reports in Section 3 present a general description of the life history of each tropical cyclone which affected Hong Kong in 1988 and include the following information:-

(a) the effect of the tropical cyclone on Hong Kong;
(b) the sequence of display of tropical cyclone warning signals;
(c) the maximum gust peak speeds and maximum mean hourly winds recorded at selected stations in Hong Kong;
(d) the lowest barometric pressure recorded at the Royal Observatory;
(e) the daily amounts of rainfall recorded at the Royal Observatory and selected locations;
(f) the times and heights of the highest tides and maximum storm surges recorded in Hong Kong.

Whenever practical, radar displays and pictures received from weather satellites are included. With a view of providing further information on the characteristics of tropical cyclones, six-hourly positions together with the corresponding estimated minimum central pressures and maximum sustained surface winds for individual tropical cyclones are tabulated and presented in Section 5.

In this publication different times are used in different contexts. The reference times of tropical cyclone warnings for shipping are given in UTC. Unlabelled times given in hours and minutes (e.g. 1454) on a 24-hour clock or times expressed as a.m. or p.m. are in Hong Kong Time. Hong Kong Time is eight hours ahead of UTC. Times labelled UTC are in Co-ordinated Universal Time.

Throughout this publication, maximum sustained surface winds when used without qualification refer to wind speeds averaged over a period of 10 minutes. Mean hourly winds were obtained by averaging the winds over a 60-minute interval ending on the hour. Daily rainfall amounts are rainfall recorded in a 24-hour period ending at midnight Hong Kong Time.

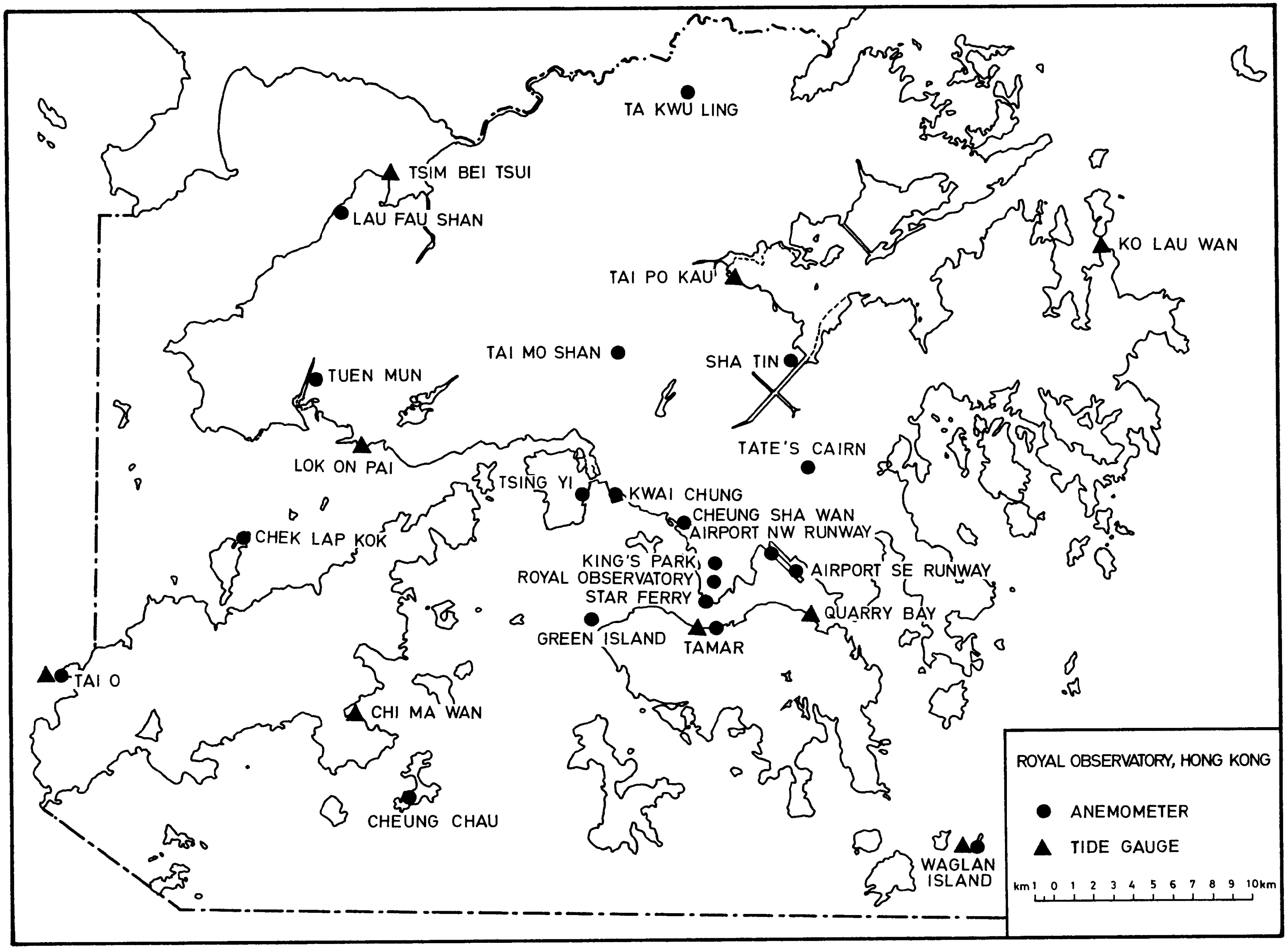


Figure 1. Locations of anemometer and tide gauge stations in Hong Kong.

2. TROPICAL CYCLONE SUMMARIES FOR 1988

In 1988, twenty-nine* tropical cyclones affected the western North Pacific and the South China Sea bounded by the equator, 45°N, 100°E and 180°. This number falls below the annual average (1951-1980) of 32 tropical cyclones in the region. Fifteen of the tropical cyclones in 1988 attained typhoon intensity, slightly lower than the annual average of sixteen. Twelve tropical cyclones affected the South China Sea, four of which formed within this region. A total of eight tropical cyclones traversed the Philippines, one crossed Taiwan and three crossed Hainan. Five made landfall over the mainland of China, two over Vietnam, but none over Japan or Korea.

The monthly distribution of the frequency of first occurrence of tropical cyclones and that of typhoons for 1988 are shown in Figure 2 and a brief summary is contained in Table 1. The monthly mean frequencies of these two parameters during the years 1951-1980 are shown in Figure 3. Six-hourly positions of these tropical cyclones together with their estimated minimum central pressures and maximum sustained surface winds are tabulated in Section 5.

The most intense tropical cyclone of the year was Typhoon Nelson (8824) in early October. Prior to its recurvature over the eastern part of the Bashi Channel, its lowest central pressure was estimated to be about 910 hPa with maximum sustained winds of over 60 m/s. Fortunately, Nelson spent its entire lifetime over water and did not cause damage on land. The most ferocious storm to hit land was Typhoon Ruby (8828) which swept across Luzon on 24 October at peak intensity (estimated maximum sustained winds were around 57 m/s). The sinking of the passenger liner "Dona Marilyn" in the central Philippines with over 500 passengers aboard during the passage of Ruby was the major tragic incident related to tropical cyclones in 1988.

During the year, 17 tropical cyclones occurred within the area of responsibility of Hong Kong for tropical cyclone warnings for shipping, (i.e. the area bounded by 10°N, 30°N, 105°E and 125°E). This number equalled the 30-year annual average. Thirteen of these tropical cyclones developed outside this area. Altogether 335 warnings for shipping were issued by the Royal Observatory in connection with these 17 tropical cyclones.

Tropical cyclone warning signals were displayed in Hong Kong for six tropical cyclones. Four of them necessitated the hoisting of the Strong Wind Signal No. 3. However, no gale signals were hoisted during the year.

The total tropical cyclone rainfall (defined as the total rainfall recorded at the Royal Observatory, Hong Kong from the first day when a tropical cyclone was centred within 600 km of Hong Kong to the end of the third day after the tropical cyclone has dissipated or moved outside 600 km of Hong Kong) during 1988 amounted to 351.6 mm, which is 62 per cent of the annual average value of 566.9 mm (1884-1939 and 1947-1970). It accounted for only 21 per cent of the year's total rainfall of 1 685.0 mm. Eight tropical cyclones came within 600 km of Hong Kong. Typhoon Warren (8806) brought 250.6 mm of rainfall. Typhoon Kit (8821) together with Tropical Storm Mamie (8823) brought 13.7 mm and the tropical depression in early October brought only 9.2 mm. Rainfall figures associated with the other tropical cyclones are given in Table 8.

Roy (8801) was the first tropical cyclone to develop over the western North Pacific. It formed as a tropical depression in the vicinity of the Marshall Islands on 8 January and soon intensified into a tropical storm. It moved west-northwestwards at about 22 km/h and swept across the Marshall Islands leaving one person dead and about 3 500 people homeless. On 10 January, it became a typhoon about 1 710 km east-southeast of Guam and passed about 40 km north-northeast of Guam on 12 January. The island was flooded and electricity supply had to be suspended, many trees were uprooted and roofs blown off. Roy turned to the southwest during the night of 14 January but moved westwards the next evening. It then made landfall over the southeastern tip of Luzon on the morning of 16 January. Heavy flooding occurred in the central Philippines where communications were severely disrupted. Roy then weakened and became a tropical storm as it entered the South China Sea on the morning of 17 January. Further weakening followed and Roy finally dissipated about 770 km east-southeast of Danang early on 18 January. Its life-span of 10 days was the longest among the tropical cyclones in 1988.

For more than four months since the dissipation of Roy, the western North Pacific and the South China Sea was devoid of tropical cyclone activity. Then Tropical Depression Susan (8802) developed from an area of low pressure over the northeastern part of the South China Sea about 410 km southeast of Dongsha on 30 May. After an initial clockwise loop, it took on a northward and then northeastward track while intensifying to severe tropical storm strength. By 1 June, Susan had reached typhoon intensity. It accelerated and crossed the southern tip of Taiwan on 2 June and left a damage of around US$4.5 million. Floods and landslides also occurred in the Philippines where 36 people were reported dead or missing. Financial losses were estimated to be about US$l million. Susan then moved into the Pacific and weakened rapidly. It finally degenerated into an area of low pressure about 100 km east of Okinawa on 3 June.

A tropical depression (8803) formed over the western North Pacific about 770 km east-northeast of Manila on 4 June. It moved west-northwestwards at about 19 km/h initially, then turned north-northwestwards during the night while intensifying into a tropical storm. It resumed a west-northwestward track the following day and moved across the Bashi Channel, weakening into a tropical depression at the same time. It passed about 60 km south-southwest of Hengchun in southern Taiwan during the night of 5 June and soon dissipated over water about 100 km south of Gaoxiong.

*The number 29 includes Typhoon Uleki (8817) which formed over the central North Pacific and moved across the International Date Line.

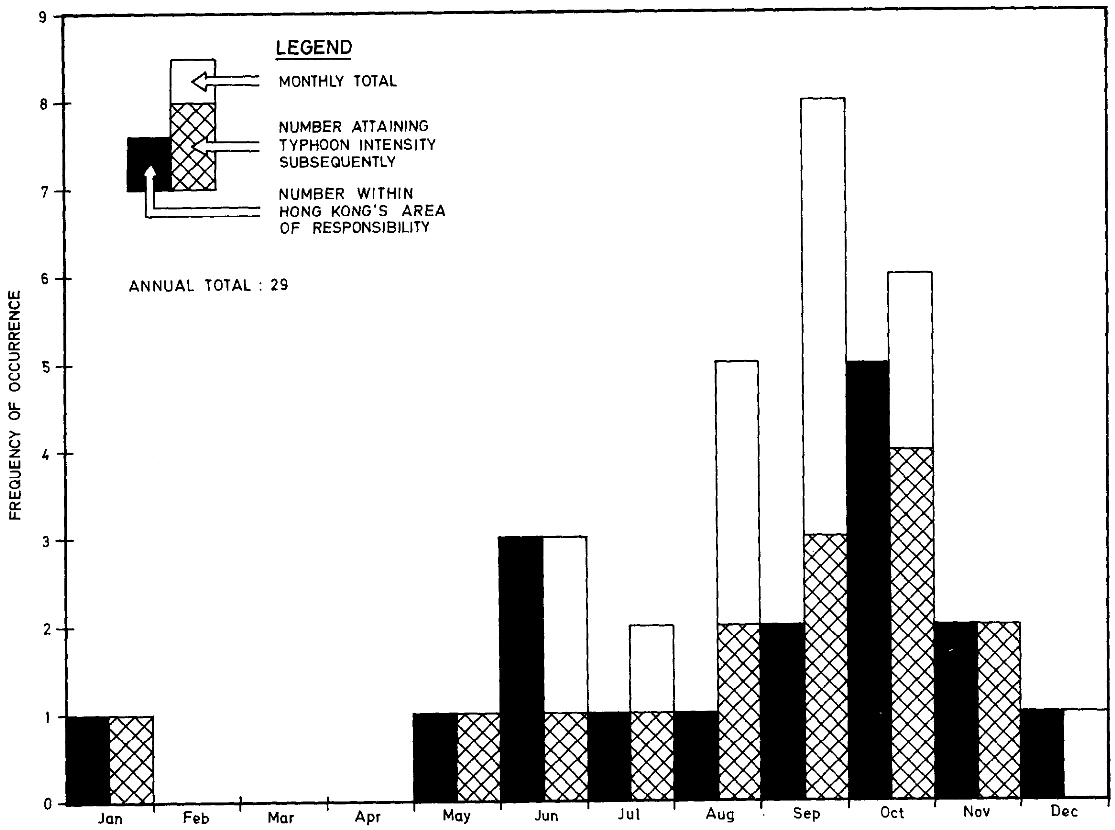


Figure 2. Monthly distribution of the frequency of first occurrence of tropical cyclones in the western North Pacific and the South China Sea in 1988.

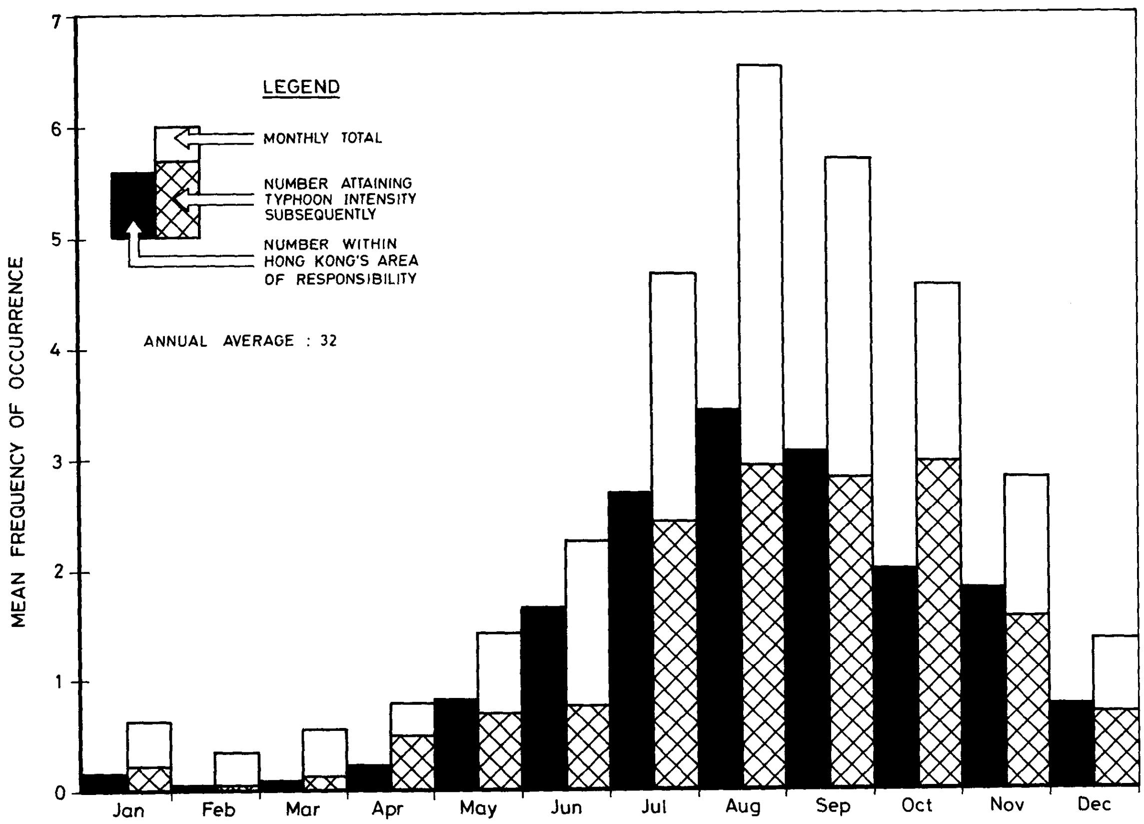


Figure 3. Monthly distribution of the mean frequency of first occurrence of tropical cyclones in the western North Pacific and the South China Sea, 1951–1980.

Thad (8804) formed over the Pacific about 1 850 km east-southeast of Manila on 19 June. It moved northwestwards and intensified into a tropical storm later on 20 June. Moving at about 23 km/h, Thad further intensified into a severe tropical storm during the night of 21 June. It started to recurve on 22 June and attained typhoon strength early next morning when it was about 610 km northeast of Manila. Thad then gradually weakened as it moved along a northeastward track. By 24 June, it had degenerated into a tropical storm and passed about 130 km southeast of Okinawa that afternoon. Thad weakened further into a tropical depression the next day and dissipated over water about 910 km southwest of Tokyo.

Vanessa (8805) developed as a tropical depression 1 140 km southeast of Manila early on 27 June. It moved northwestwards and crossed the central Philippines at about 38 km/h. Upon entering the South China Sea on 28 June, Vanessa intensified into a tropical storm and continued to traverse at a high speed of about 40 km/h. With this translation speed, Vanessa became the fastest moving tropical cyclone in the South China Sea on record. As it approached the coast of southern China, it began to weaken and finally dissipated over western Guangdong Province on 29 June.

Only two tropical cyclones formed in July, which was less than half of the normal number for the month. The first one formed from an area of low pressure which was southeast of Guam on 11 July. It then developed into a tropical depression named Warren (8806) about 370 km west-southwest of Guam early on 14 July. It soon intensified into a tropical storm while moving westwards at about 13 km/h. On 15 July, Warren took on a west-northwestward track and became a typhoon about 1 350 km east of Manila the next day. It passed the northern tip of Luzon early on 18 July and one person was killed. Warren then entered the South China Sea during the afternoon. It passed about 110 km northeast of Dongsha on 19 July. On the same day, the M.V. "Thita Horizon" was sunk off the coast of western Luzon by high seas associated with Warren. That afternoon, Warren made landfall over eastern Guangdong Province about 80 km southwest of Shantou. It maintained a northwestward course and finally dissipated inland the next morning. During the passage of Warren, six people were killed in Shantou and one person was reported missing in Hong Kong.

Agnes (8807) was the other tropical cyclone in July. It formed as a tropical depression about 1 610 km south of Tokyo on 29 July and moved north-northwestwards at about 22 km/h initially. It intensified into a tropical storm and accelerated north-northeastwards to a speed of about 34 km/h that evening. Early on 31 July, Agnes passed about 460 km east-southeast of Tokyo and became extratropical soon afterwards.

August saw the area of active tropical cyclone genesis shifting to its northernmost position near 30^{o}N. A total of five tropical cyclones developed during the month, four of which spent their entire lifetime over water.

The only tropical cyclone in August that made landfall was Bill (8809) which developed as a tropical depression about 220 km south-southeast of Okinawa on 6 August. It moved slowly northwards initially and accelerated northwestwards that evening, passing about 20 km southwest of Okinawa. Rapid intensification took place on the morning of 7 August and Bill became a severe tropical storm that afternoon. Continuing on a northwestward track across the East China Sea, it turned west-northwestwards later and made landfall over Zhejiang Province about 190 km south-southeast of Shanghai around midnight of 7 August. Shortly after landfall, Bill reached maximum intensity. Its centre passed very near to Hangzhou early on 8 August. Bill moved into Anhui Province and weakened into a tropical storm about 240 km west-northwest of Hangzhou that afternoon. It finally dissipated in Hubei Province about 200 km northwest of Wuhan on 9 August.

In Zhejiang Province the damage inflicted by Bill was extremely serious. A total of 10.5 million people were affected. The death toll was 160 and 1 232 people were injured. About 111 000 hectares of farmland were inundated. Over 190 000 houses were collapsed or were damaged. In the coastal regions over 1 000 boats sank. The total loss in Zhejiang Province was estimated at 1 000 million RMB. According to press reports, this was the most severe natural disaster in 40 years in Zhejiang. The scenic capital of the province, Hangzhou suffered a direct hit. About 20 000 trees were brought down by storm force winds and violent rain. In Anhui Province, the passage of Bill also resulted in collapse of houses and interruption of electricity supply and telecommunication. The loss was also heavy.

Clara (8810) formed as a tropical depression on 10 August about 1 170 km north-northwest of Wake Island. It drifted slowly westwards at first and intensified into a tropical storm early next day. After undergoing an anti-clockwise loop, Clara started to move north-northeastwards at about 13 km/h. It weakened into a tropical depression later on 11 August and became extratropical the next day about 1 330 km north-northwest of Wake Island.

A tropical disturbance developed into Tropical Storm Doyle (8812) about 350 km east of Wake Island on 15 August and moved westwards initially. Rapid intensification then ensued and Doyle became a typhoon the next day about 180 km northwest of the island. Afterwards, it began to recurve towards the northeast. Although Doyle started to weaken, typhoon intensity was maintained until early 20 August when it was about 1 200 km west-northwest of Midway Island. It turned northwards on 20 August and degenerated into a tropical storm by the following day. Doyle eventually became extratropical about 1 250 km northwest of Midway Island early on 22 August.

Elsie (8814) developed as a tropical depression about 990 km west-northwest of Wake Island on 28 August and moved southeastwards initially. It soon turned northeastwards and subsequently weakened to an area of low pressure the next day when it was about 870 km northwest of the island. Regeneration took place early on 31 August when Elsie was about 1 920 km east of Tokyo. It then moved northwestwards and intensified into a tropical storm. Later in the day, Elsie turned to the north. It then weakened again into a tropical depression on 1 September and became extratropical about 1 500 km east-northeast of Tokyo.

The last tropical cyclone in August was Fabian (8815) which formed as a tropical depression about 660 km southeast of Tokyo on 29 August. It moved slowly eastwards and soon became a tropical storm the following day. Fabian intensified further into a severe tropical storm on 31 August. It turned abruptly northwards on 1 September and attained typhoon strength about 1 300 km east of Tokyo the following day. Later on 2 September, Fabian accelerated northeastwards and weakened into a severe tropical storm. It completed its extratropical transition the following day about 1 570 km east-northeast of Tokyo while still maintaining severe tropical storm intensity.

Tropical cyclone activity became more intense in September with eight tropical cyclones forming in the month. This compares with the normal of five to six for the month. Gay (8816) was the first September cyclone in 1988. It formed as a tropical depression about 1 110 km south-southwest of Tokyo on 2 September and intensified into a tropical storm during the night. It moved steadily northeastwards and evolved into an extratropical cyclone about 550 km south of Tokyo later on 3 September.

Hurricane Uleki (8817) formed in the central North Pacific Ocean and crossed the International Date Line about 410 km southwest of Midway Island on 8 September. It moved west-northwestwards at first but changed to a northwestward track two days later. Uleki weakened into a severe tropical storm on 12 September and resumed a west-northwestward track. It became extratropical on 13 September about 2 500 km east of Tokyo.

While Uleki was crossing the International Date Line on 8 September, Hal (8818) developed as a tropical depression about 1 300 km east-northeast of Guam. It moved west-northwestwards and intensified into a tropical storm the next day. Hal turned southwestwards on 10 September and reached typhoon intensity with the formation of an eye on 11 September. It then made a sharp turn early on 12 September and later moved north-northwestwards. The eye of Hal became very large on 14 September. Hal recurved to the northeast when it was about 530 km south-southeast of Tokyo on 15 September while moving at about 16 km/h. It accelerated rapidly to 56 km/h when it became extratropical about 1 510 km east-northeast of Tokyo on 17 September. The proximity of Hal brought high seas to the southeastern shore of Honshu where two people were reported missing.

Irma (8819) formed in a trough associated with Typhoon Hal on 12 September. It soon intensified into a tropical storm about 780 km west-northwest of Wake Island and took on a northwestward track. Irma was a very compact system. Severe tropical storm strength was reached two days later when it was about 1 200 km northwest of Wake Island. Irma weakened into a tropical depression during the evening of 15 September and soon degenerated into an area of low pressure about 1 640 km east-southeast of Tokyo.

One day prior to the genesis of Irma, an area of low pressure formed to the east of Luzon. It developed into Tropical Depression Jeff (8820) about 1 580 km east of Manila during the night on 13 September. Jeff moved steadily northeastwards at about 20 km/h and soon intensified into a tropical storm on 14 September. It weakened during the night of 15 September and degenerated into an area of low pressure about 1 270 km south of Tokyo.

Kit (8821) formed about 540 km east-northeast of Manila on 19 September and moved initially northwestwards but then turned westwards towards Luzon at about 22 km/h. Kit made landfall around midnight and crossed northern Luzon. It entered the South China Sea on the morning of 20 September and moved northwestwards at about 20 km/h. Kit intensified into a tropical storm that evening and slowed down to 9 km/h. Intensification continued as Kit approached the coast of southern China. On the morning of 21 September, Kit became a severe tropical storm when it was about 180 km east-southeast of Dongsha and speeded up again. It passed about 100 km northeast of the island and reached typhoon strength that evening. However, Kit soon weakened to a severe tropical storm early on 22 September. It made landfall about 80 km southwest of Shantou later that morning and dissipated over land shortly afterwards. Eight people were killed in the Shantou area with financial damage adding up to about 131 million RMB.

While Kit was crossing northern Luzon on 19 September, Tropical Depression Lee (8822) formed over the western North Pacific about 1 650 km east-southeast of Okinawa. It moved westwards and intensified into a tropical storm during the night of 20 September. Later on 21 September, Lee started to move northwestwards and turned progressively towards the north for the next 48 hours. Intensity of Lee fluctuated diurnally during this period and severe tropical storm intensity was briefly attained during the night hours. It recurved to the northeast about 390 km south-southwest of Okinawa during the night of 23 September. Lee accelerated northeastwards and weakened into a tropical depression later on 24 September. It became extratropical soon afterwards before reaching Japan.

Tropical Depression Mamie (8823) formed over the South China Sea about 250 km south-southwest of Xisha on the evening of 21 September. It moved slowly in a generally northward direction initially but speeded up and intensified into a tropical storm the next day. Mamie turned to the northeast early on 23 September, but moved northwards again when it was about 170 km south-southeast of Hong Kong. Under the influence of a cool northeast monsoon, it finally weakened into an area of low pressure about 60 km east-northeast of Hong Kong during the night of 23 September. Nine people were killed in Fujian Province during rainstorms and floods associated with the remnants of Kit and Mamie.

An above-normal number of tropical cyclones occurred in October. While the average number is four, six tropical cyclones formed during October 1988. The first one was a tropical depression which developed about 70 km south-southwest of Xisha early on 1 October. It moved northwestwards at a speed of around 15 km/h and landed over Hainan during the night. The tropical depression then traversed the southern portion of the island on 2 October and finally weakened into an area of low pressure that evening over Beibu Wan.

October also saw the development of the most intense typhoon of the year, namely Typhoon Nelson (8824). It formed as a tropical depression about 1 800 km east of Manila on 1 October. Initially, it moved west-northwestwards at around 22 km/h towards the Bashi Channel. Nelson intensified into a tropical storm on the evening of 1 October and finally to a typhoon on 3 October when a distinct eye can be readily identified from satellite imageries. On 4 October, Nelson turned progressively towards the north and decelerated. At about the same time, Nelson reached its peak intensity with maximum winds estimated to be about 220 km/h. The next day, it recurved towards the northeast. Continuing on a northeastward course, Nelson gradually weakened and passed about 150 km to the south-southeast of Okinawa on 6 October. It then accelerated to over 40 km/h on 8 October and finally became extratropical during the night over the Pacific to the southeast of Japan.

Meanwhile, another tropical depression (8825) formed over the South China Sea early on 8 October about 430 km west of Manila. It moved westwards at about 16 km/h and intensified into a tropical storm that afternoon. It maintained its westward movement and moved across the South China Sea. As it approached the Vietnam coast, it weakened rapidly into an area of low pressure about 330 km southeast of Danang.

Odessa (8826) formed as a tropical depression on 10 October about 1 340 km east-southeast of Okinawa and moved westwards at about 19 km/h. It intensified into a tropical storm on 11 October and turned to the north the next day. On 13 October, it recurved slowly towards the northeast and reached typhoon strength during the evening with a distinct eye. Odessa passed about 410 km east-southeast of Okinawa on 14 October and maintained its northeastward movement at around 11 km/h for the next 48 hours. It then weakened rapidly into a tropical depression on 16 October and turned sharply towards the west-northwest. It became extratropical on 17 October about 440 km east-northeast of Okinawa.

Pat (8827) formed as a tropical depression about 1 510 km east of Manila on the evening of 18 October and moved northwestwards at about 36 km/h initially. It then turned westwards towards Luzon and slowed down to around 15 km/h on the morning of 19 October. Meanwhile, it continued to strengthen gradually and attained severe tropical storm intensity early on 20 October. Accelerating again to about 30 km/h, Pat landed over Luzon about 260 km north-northeast of Manila that evening. It moved rapidly westwards across Luzon while maintaining severe tropical storm strength. After entering the South China Sea the next day, Pat continued its rapid westward movement at first but then turned west-northwestwards towards Hainan. Early on 22 October, Pat intensified into a typhoon with a compact structure. It made landfall over the southeastern part of Hainan that afternoon. Pat weakened rapidly into a severe tropical storm shortly after landfall and degenerated further into a tropical depression the next morning. It finally dissipated over the coast of northern Vietnam near Hanoi later that morning. Financial damage inflicted on Hainan totalled about 60 million RMB.

The last October tropical cyclone, Ruby (8828) was also the most devastating in terms of the damage it inflicted. It formed as a tropical depression about 1 760 km east-southeast of Manila on 21 October and moved southwestwards at first. Early on 22 October, Ruby intensified into a tropical storm and took on a westward course towards the southern Philippines. During that afternoon, Ruby further strengthened into a severe tropical storm and turned west-northwestwards. Typhoon strength was attained on 23 October and Ruby accelerated to a speed of about 27 km/h in its movement towards Luzon. It made landfall over central Luzon early on 25 October and entered the South China Sea later that morning, passing about 70 km to the south-southwest of Baguio. In the Philippines, the passenger liner "Dona Marilyn" was sunk with over 200 people dead or missing. The death toll on land was over 130 and financial losses totalled over US$50 million. During the evening of 25 October when it was about 350 km west-northwest of Manila, Ruby weakened slightly and slowed down significantly, moving on an erratic track. It then took on a west-northwestward track at about 20 km/h later on 26 October. Ruby weakened into a severe tropical storm on 27 October and degenerated further into a tropical storm early on 28 October under the influence of strengthening northeast monsoon. That afternoon, it swept across Hainan. Two people were killed and about 133 million RMB of damage was incurred. Ruby finally weakened into an area of low pressure over the sea areas to the southwest of the island on 29 October. During the passage of Ruby over the South China Sea, high seas associated with the outer circulation of Ruby affected the coast of Fujian Province and caused financial damage of about 37 million RMB.

Skip (8829) formed as a tropical depression about 250 km east-southeast of Yap on 3 November. It moved westwards and passed about 100 km south of the island the next day. Skip attained typhoon intensity on 5 November and moved generally west-northwestwards. It made landfall over Samar in the eastern Philippines on the morning of 7 November and entered the South China Sea the following day. Over 350 people were killed or reported missing in the Philippines due to floods and landslides. Skip slowed down and weakened into a severe tropical storm on 9 November. It turned southwestwards on the evening of 10 November and then westwards the next day. It finally moved to the northwest and dissipated while the centre was still over water about 220 km east-southeast of Danang on 12 November.

The other tropical cyclone in November was Tess (8830) which formed as a tropical depression over the Sulu Sea in the Philippines about 620 km south of Manila on 3 November. It moved westwards and intensified into a tropical storm the next day before crossing the island of Palawan. Over 80 people were killed on the islands of Cebu and Palawan. Tess continued to intensify over the southern part of the South China Sea. After briefly attaining typhoon intensity early on 6 November, it began to weaken rapidly as it approached the coast of southern Vietnam. Tess made landfall about 240 km east-northeast of Ho Chi Minh City that evening and dissipated further inland. In Vietnam, 37 people were killed or reported missing and financial losses totalled about US$11 million.

The last tropical cyclone of the year was Tropical Storm Val (8831) which developed as a tropical depression about 940 km east-southeast of Manila early on 23 December. It moved west-northwestwards at about 27 km/h initially and intensified into a tropical storm that evening. Val became very slow-moving when it was about 400 km east of Manila on 24 December and began to weaken at the same time. It finally dissipated over water about 360 km east of Manila on 26 December.

Note: Casualties and damage figures were consolidated from press reports.

3. REPORTS ON TROPICAL CYCLONES AFFECTING HONG KONG IN 1988

(a) Typhoon Susan (8802)

30 May-3 June 1988

The track of Typhoon Susan is shown in Figure 4

Susan was the first tropical cyclone to develop in the South China Sea in 1988. On 27 May, an area of low pressure formed over the South China Sea between Dongsha and Luzon. It developed into a tropical depression about 410 km southeast of Dongsha Dao on the morning of 30 May. Tracking slowly southwestwards and then northwestwards, Susan deepened into a severe tropical storm on 31 May and moved slowly towards the north-northwest.

Susan reached typhoon intensity on the early morning of I June when it was about 130 km southeast of Dongsha. It turned northeastwards and accelerated. Moving at about 23 km/h, Susan crossed the southern tip of Taiwan near Hengchun on the morning of 2 June. It then weakened into a severe tropical storm in the afternoon while moving northeastwards at around 38 km/h towards the Ryukyu Islands. Susan further weakened to a tropical storm early on 3 June and passed about 80 km south of Okinawa. Later in the day, it degenerated into an area of low pressure while moving east-northeastwards.

According to press reports, high winds and torrential rain associated with Susan resulted in landslides and disruption in highway and rail traffic in southern Taiwan. About 1 000 hectares of fruit plantation and paddy fields were flooded. The estimated loss was about US$4.5 million. In Taidong, power supply to 16 000 families was interrupted. However, no casualties were reported.

After crossing Taiwan, Susan enhanced the southwest monsoon over the South China Sea, bringing torrential rain to Luzon. Thirty-six people were reported missing or dead due to floods and landslides. About 56 000 people fled their homes. Crop and property damage was estimated at US$l million.

In Hong Kong, the Stand By Signal No. 1 was hoisted at 4.30 p.m. on 31 May when Severe Tropical Storm Susan was about 520 km southeast of Hong Kong. Winds were light at first, but gradually became moderate to fresh from the north the next day as Susan moved closer. It came closest to Hong Kong on the morning of 1 June when it was about 430 km to the east-southeast. The lowest sea-level pressure of 998.5 hPa recorded at the Royal Observatory occurred at 5 p.m. on 1 June when Susan was about 480 km to the east-southeast. As Susan recurved towards the northeast, the Stand By Signal No. 1 was lowered at 9 p.m. when it was about 520 km east-southeast of Hong Kong. The maximum hourly mean and maximum gust peak speeds together with associated wind directions at selected locations during the display of the Stand By Signal were as follows:

Location	*Maximum mean hourly wind speed in km/h with direction in points*		*Maximum gust peak speed in km/h with direction in points*	
Royal Observatory	N	14	N	36
H.K. Airport (SE)	NW	22	NW	40
H.K. Airport (NW)	NNW	22	NNW	51
Waglan Island	N	38	N	58
Tate's Cairn	N	40	NNW	58
Cheung Chau	N	31	N	58
King's Park	N	16	NNW	38
Start Ferry	W	16	NNW	27
Green Island	NW	23	NW	58
Kwai Chung	NW & NNW	22	NW	34
Chek Lap Kok	NW	36	NW	45
Lau Fau Shan	N	25	N	41
Ta Kwu Ling	N	16	NNE	36
Tai Mo Shan	N	49	N	59
Tsing Yi	N	19	NNE	47
Tuen Mun	NNE	16	NNE	45
Tai O	N	22	N	43

In Hong Kong the weather was cloudy with some heavy and thundery showers on the evening of 31 May. The weather improved gradually on the afternoon of 1 June and it was fine and sunny on 2 June. The daily amounts of rainfall recorded were as follows:

Date	*Royal Observatory*	*Sha Tau Kok*	*Tai Po*	*Happy Valley*
	mm	mm	mm	mm
30 May	Nil	Nil	Nil	Nil
31 May	6.3	29.5	15.0	13.5
1 June	Nil	Nil	Nil	Nil
2 June	Nil	Nil	Nil	Nil
3 June	Nil	Nil	Nil	Nil
Total	6.3	29.5	15.0	13.5

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passage of Susan are tabulated below:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Quarry Bay	2.61	1 June	8.07 a.m.	0.37	31 May	10.45 a.m.
Lok On Pai	2.64	31 May	8.39 a.m.	0.57	31 May	1.00 p.m.
Tai O	2.71	1 June	9.21 a.m.	0.40	31 May	10.30 a.m.
Tamar	2.56	31 May	8.26 a.m.	0.40	31 May	10.45 a.m.
Tsim Bei Tsui	2.95	1 June	10.05 a.m.	0.92	31 May	3.00 p.m.
Waglan Island	2.61	1 June	8.56 a.m.	0.45	1 Jun	12.30 p.m.

There were no reports of damage and casualties in Hong Kong.

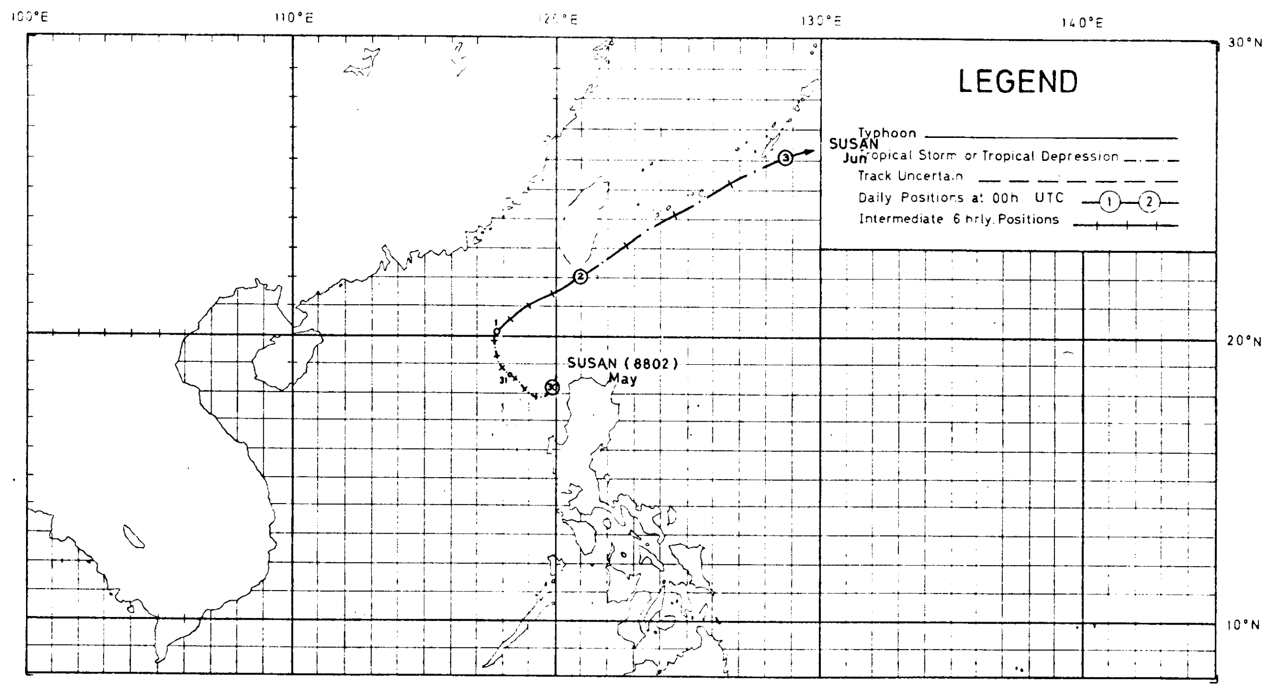


Figure 4. Track of Typhoon Susan (8802): 30 May–3 June 1988.

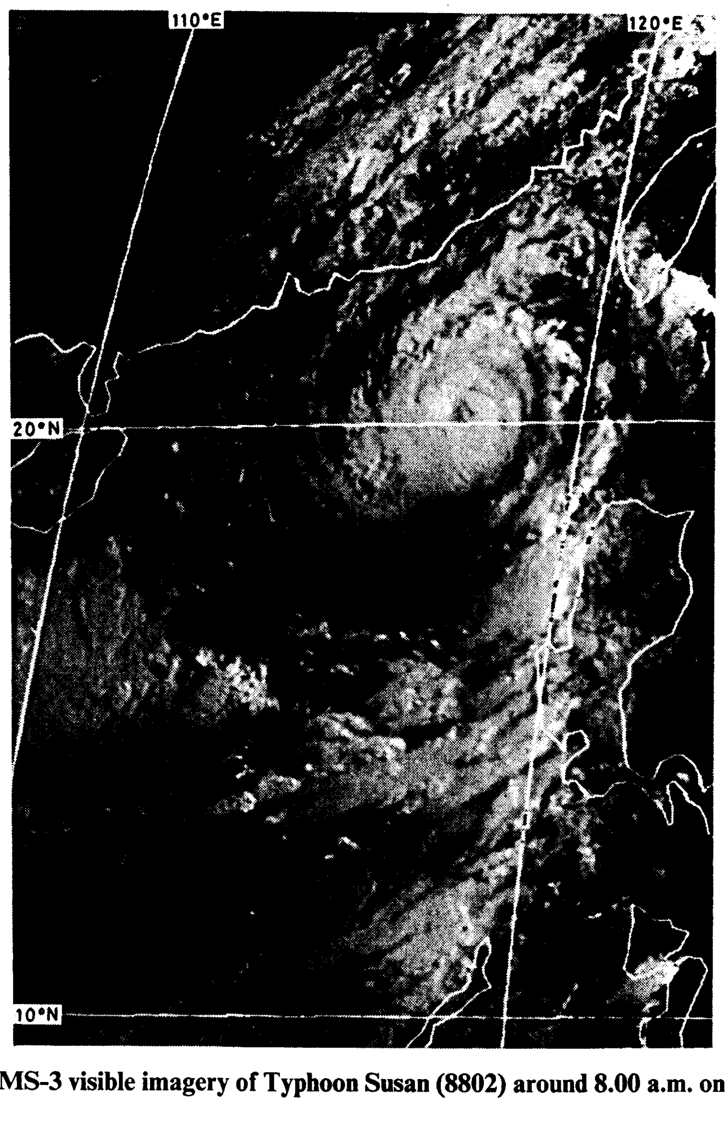


Figure 5. GMS-3 visible imagery of Typhoon Susan (8802) around 8.00 a.m. on 1 June 1988.

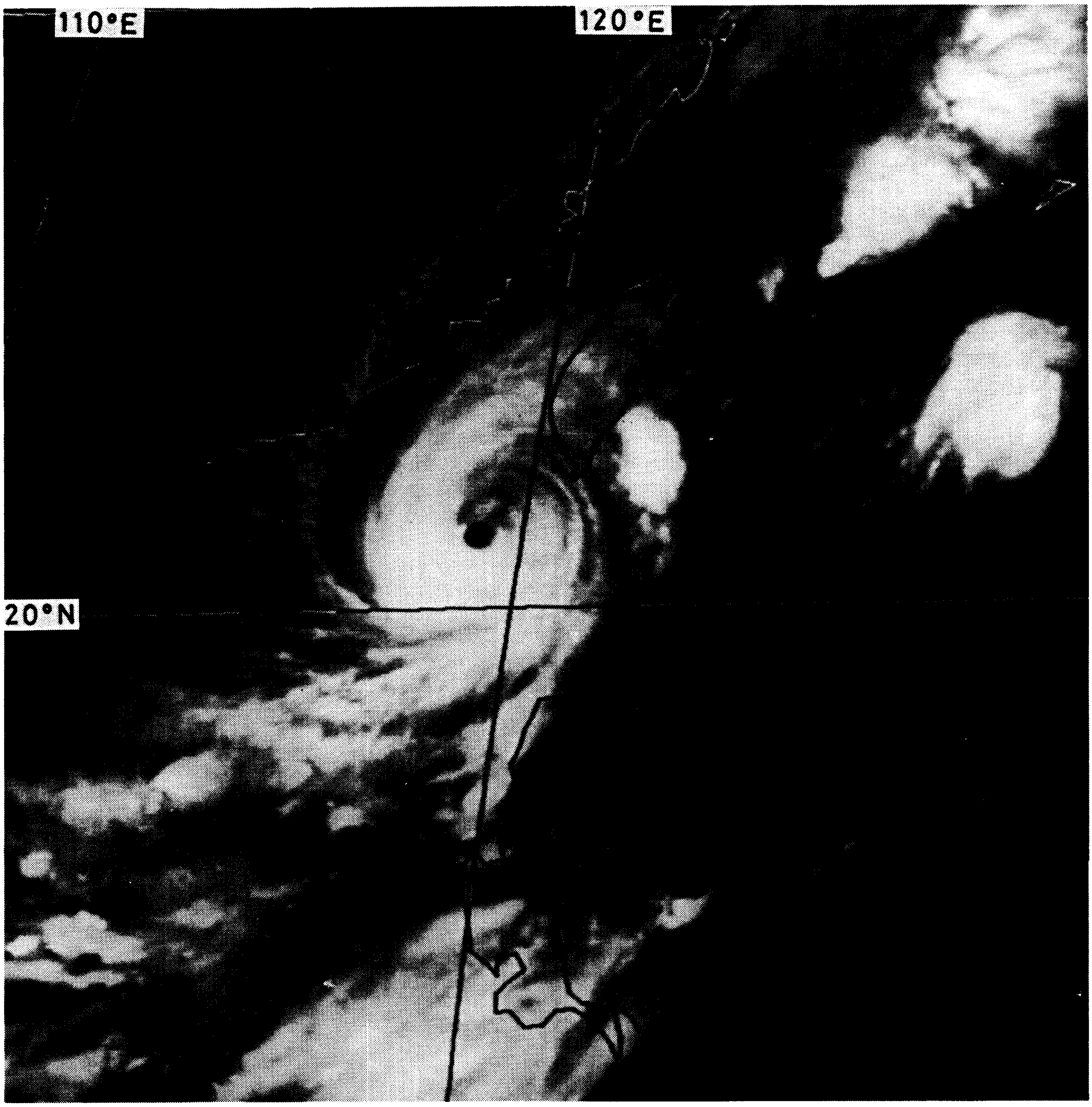


Figure 6. GMS-3 infra-red imagery of Typhoon Susan (8802) around 11.00 p.m. on 1 June 1988.

(b) Tropical Storm Vanessa (8805)

27-29 June 1988

The track of Tropical Storm Vanessa is shown in Figure 7

Vanessa was the fastest moving tropical cyclone in the South China Sea on record. For over 30 hours, its average speed was 40 km/h. It developed as a tropical depression about 1 140 km southeast of Manila early on 27 June and took on a northwestward track. Vanessa then crossed the central Philippines on the night of 27 June at about 38 km/h. Upon entering the South China Sea the next day, it continued to move rapidly northwestwards. Vanessa intensified to a tropical storm on the evening of 28 June. On the afternoon of 29 June, it made landfall near Shangchuan Dao and dissipated overland.

In Hong Kong, the Stand By Signal No. 1 was hoisted at 11.20 p.m. on 28 June when Vanessa was about 640 km to the south-southeast. Winds were light to moderate easterly at first, but became fresh and gusty the next morning. Occasional strong winds were reported offshore.

As Vanessa came nearer to the south China coast, winds in Hong Kong also increased but did not reach strong force. The Stand By Signal No. 1 was lowered at 4.50 p.m. on 29 June when Vanessa was about 120 km west-southwest of Hong Kong just before its landfall over western Guangdong.

The lowest sea-level pressure of 1 003.3 hPa recorded at the Royal Observatory occurred at 4 p.m. on 29 June when Vanessa was about 130 km to the southwest. It came closest to Hong Kong just before its landfall at around 5 p.m. on 29 June. The maximum hourly mean and maximum gust peak speeds together with associated wind directions at selected locations during the display of the Stand By Signal No. 1 were as follows:

Location	*Maximum mean hourly wind speed in km/h with direction in points*		*Maximum gust peak speed in km/h with direction in points*	
Royal Observatory	E	25	E	58
H.K. Airport (SE)	ENE, E&ESE	31	ENE	58
H.K. Airport (NW)	SE	30	E	72
Waglan Island	E	41	ESE	68
Tate's Cairn	ESE	49	ESE	83
Cheung Chau	E	41	E	72
King's Park	ESE	23	ESE	51
Start Ferry	ESE	31	ESE	58
Green Island	E	45	E	72
Sha Tin	SSE	19	ESE	47
Kwai Chung	E	27	E&ESE	49
Chek Lap Kok	ESE	41	ESE	65
Lau Fau Shan	E	25	E	41
Ta Kwu Ling	ESE	22	ESE	45
Tai Mo Shan	ESE	59	ESE	81
Tsing Yi	SE	30	ESE	49
Tuen Mun	SSE	19	SSE	49
Tamar	ENE	23	ENE&E	49
Tai O	SE	31	SE	76

In Hong Kong the weather was fine and sunny on 28 June, although one or two showers occurred in the late afternoon. Cloud amounts increased the next day with some scattered showers. There were some heavy showers on the morning of 30 June. A minor landslip occurred in Kwai Chung and 27 residents had to be evacuated. Showers gradually decreased on 1 July and the weather became sunny in the afternoon. The daily amounts of rainfall recorded were as follows:

Date	Royal *Observatory*	*Stanley*	*Sai Kung*	*Tuen Mun*
	mm	mm	mm	mm
29 June	7.0	3.0	1.0	3.0
30 June	15.7	25.0	16.0	4.5
1 July	4.2	44.5	40.0	10.0
2 July	Trace	Nil	Nil	1.0
Total	26.9	72.5	57.0	18.5

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passage of Vanessa are tabulated below:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Lok On Pai	2.49	29 Jun	8.11 a.m.	0.34	29 Jun	1.00 p.m.
Quarry Bay	2.39	29 Jun	6.45 a.m.	0.15	29 Jun	12.45 p.m.
Tai O	2.51	29 Jun	8.21 a.m.	0.19	29 Jun	10.00 a.m.
Tai Po Kau	2.17	29 Jun	6.47 a.m.	0.31	29 Jun	4.30 a.m.
Tamar	2.79	29 Jun	7.08 a.m.	0.55	29 Jun	1.00 p.m.
Tsim Bei Tsui	2.85	29 Jun	9.00 a.m.	0.58	29 Jun	4.00 p.m.

There were no reports of damage and casualties in Hong Kong.

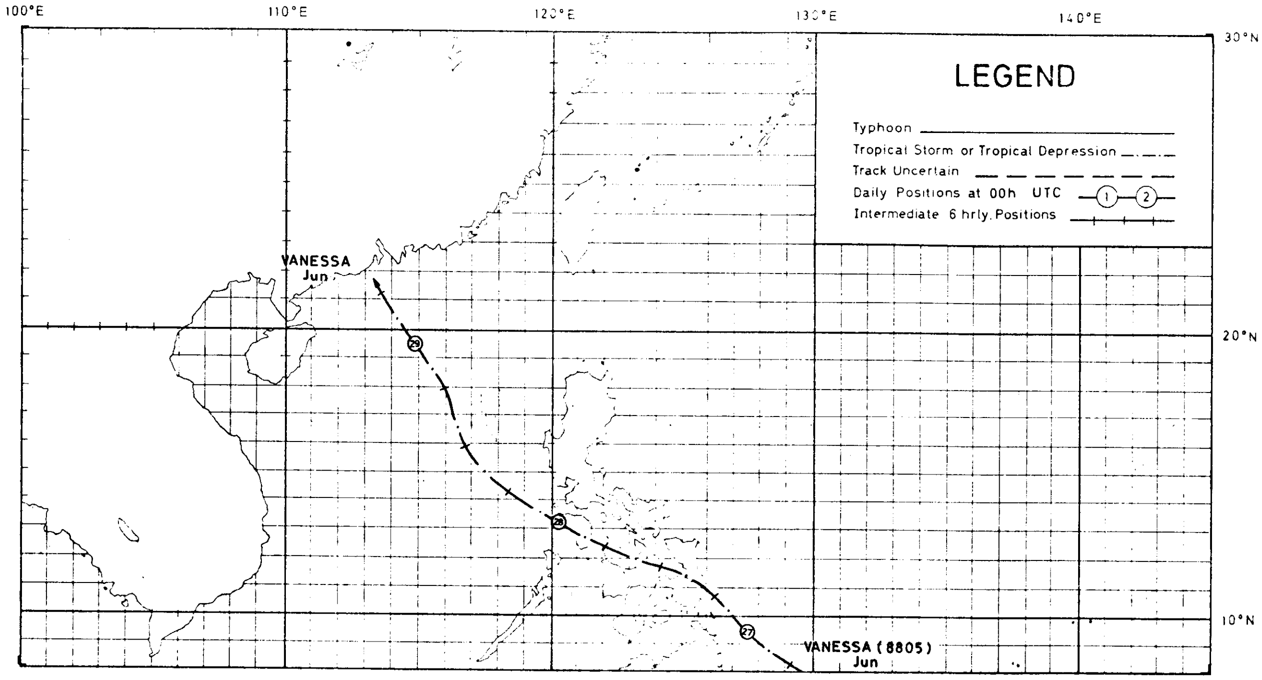


Figure 7. Track of Tropical Storm Vanessa (8805): 27-29 June 1988.

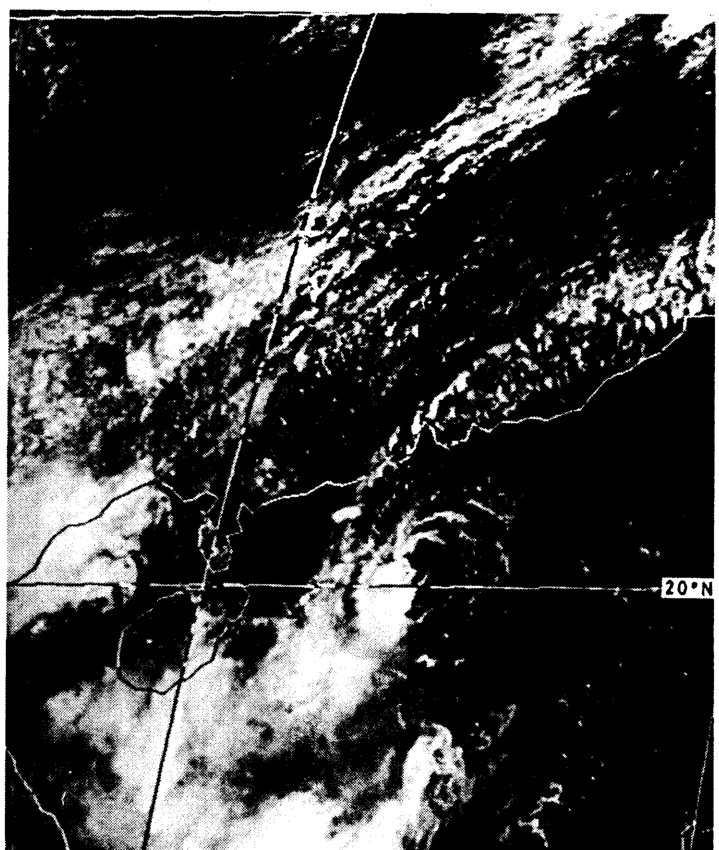


Figure 8. GMS-3 visible imagery of Tropical Storm Vanessa (8805) around 11.00 a.m. on 29 June 1988.

(c) Typhoon Warren (8806)

14-20 July 1988

The track of Typhoon Warren is shown in Figure 9

An area of low pressure formed to the southeast of Guam on 11 July. It developed into Tropical Depression Warren about 370 km west-southwest of Guam early on 14 July and moved westwards at about 13 km/h initially. It soon intensified to a tropical storm. On 15 July, Warren began to move west-northwestwards at about 25 km/h and became a typhoon when it was about 1 360 km east of Manila the next day. It passed the northern tip of Luzon early on 18 June. Heavy rain resulted in severe flooding in the northern Philippines where, according to press reports, at least one person was killed and 4 000 had to flee their homes. Thousands of hectares of rice and corn fields were ruined.

Warren then entered the South China Sea on the afternoon of 18 July. It passed about 110 km northeast of Dongsha on 19 July. The M.V. 'Thita Horizon' capsized and sank off the coast of western Luzon by high seas associated with Warren. At 2 p.m. the M.V. 'German Senator' reported a pressure of 977.5 hPa about 45 km southeast of the centre. Warren made landfall over eastern Guangdong about 210 km east-northeast of Hong Kong around 4.30 p.m. Warren continued its northwestward movement and finally dissipated inland in northern Guangdong early on 20 July.

In Hong Kong heavy rain associated with Warren caused severe flooding in several parts of the New Territories. According to press reports, flooding also occurred in Shenzhen. Damage in Shantou was more severe. Six people were killed and 106 people injured. Over 50 000 tonnes of food were lost. About 4 500 houses and 143 000 huts collapsed, and 38 000 houses damaged. A total of 147 incidents of irrigation works damage was reported and four bridges were also damaged. About 178 000 hectares of agricultural area were destroyed, of which 68 000 hectares were paddy fields. Seven ships were sunk and another 187 damaged. Twenty-seven electricity sub-stations were destroyed and five hydroelectric power stations were damaged. Electricity supply and telephone lines in the area were interrupted.

In Hong Kong, the Stand By Signal, No. 1 was hoisted at 11.00 a.m. on 18 July when Typhoon Warren was about 800 km to the southeast. Winds were light to moderate westerly at first. As Warren approached the southeast coast of China, squalls associated with a rainband of Warren affected Hong Kong on the early hours of 19 July. The Strong Wind Signal No. 3 was hoisted at 4.10 a.m. when Warren was about 410 km to the southeast. Winds remained moderate westerly in the morning. However as Warren made landfall in the afternoon and winds in Hong Kong became southwesterly, wind force increased and nearly reached gale force with gusts up to 115 km/h at Waglan Island. The maximum hourly mean wind recorded at Tai Mo Shan was 87 km/h with gusts up to 124 km/h. Warren came closest to Hong Kong at around 9 p.m. on 19 July when it was over eastern Guangdong about 180 km to the northeast. The lowest sea-level pressure of 995.3 hPa at the Royal Observatory was recorded two hours earlier. Warren dissipated over northern Guangdong about 300 km north-northwest of Hong Kong and all signals were lowered at 5.00 a.m. on 20 July. The maximum hourly mean and maximum gust peak speeds together. with associated wind directions at selected locations during the passage of Warren were as follows:

Location	*Maximum mean hourly wind speed in km/h with direction in points*		*Maximum gust peak speed in km/h with direction in points*	
Royal Observatory	SW	41	SW	99
H.K. Airport (SE)	WSW	51	WSW	99
H.K. Airport (NW)	SSW	36	SW	81
Waglan Island	WSW	65	ESE	115
Tate's Cairn	SSW	63	SSW	133
Cheung Chau	W	62	W	96
King's Park	SW	45	SSW	110
Star Ferry	SW	43	WSW	99
Tai O	ESE	59	SE	94
Sha Tin	SW	38	SW	68
Kwai Chung	SW	52	SW	76
Chek Lap Kok	ESE	62	SSW	99
Lau Fau Shan	SSW	62	SSW	99
Ta Kwu Ling	SW	25	N	85
Tai Mo Shan	SW	87	SSW	124
Tsing Yi	S	36	SSE	122
Tuen Mun	SE	30	WSW	79
Tamar	WNW	23	WNW	92

When the Stand By Signal No. 1 was hoisted on 18 July, the weather was sunny and very hot in the afternoon. Early next morning, a rainband associated with Warren brought periods of heavy rain and squally thunderstorms. During the one-hour period between 3 a.m. and 4 a.m., 65.5 millimetres of rainfall were recorded at the Royal Observatory. Thunderstorms and rain continued during the morning. There were breaks in the early afternoon. As Warren landed to the east of Hong Kong and continued to move northwestwards, strong southwesterly winds brought more heavy rain during the evening of 19 July. Severe flooding occurred in several parts of the New Territories. It remained showery on 20 July. Weather improved on 21 July and for the next four days, there were sunny periods although isolated showers also occurred. The daily amounts of rainfall recorded at selected locations were as follows:

Date	*Royal Observatory* mm	*Cheung Chau* mm	*North Point* mm	*High Island*	*Tai Mei Tuk* mm
18 July	Nil	Nil	Nil	Nil	Nil
19 July	203.5	129.3	249.0	117.5	83.0
20 July	44.2	24.5	47.0	38.5	106.0
21 July	0.8	0.2	2.5	15.5	6.5
22 July	2.1	3.5	2.5	0.5	2.0
23 July	Trace	Nil	1.0	Nil	Nil
Total	250.6	157.5	302.0	172.0	197.5

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passage of Warren are tabulated below:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Ko Lau Wan	2.26	19 Jul	1.13 p.m.	0.63	19 Jul	8.30 a.m.
Lok On Pai	2.21	19 Jul	11.57 a.m.	0.42	19 Jul	11.45 p.m.
Quarry Bay	2.18	19 Jul	11.25 a.m.	0.31	19 Jul	9.30 a.m.
Tai O	2.31	19 Jul	12.21 p.m.	0.34	19 Jul	11.45 p.m.
Tai Po Kau	2.13	19 Jul	1.07 a.m.	0.67	19 Jul	9.30 p.m.
Tamar	2.10	18 Jul	10.09 a.m.	0.17	19 Jul	9.30 p.m.
Tsim Bei Tsui	2.56	18 Jul	12.24 p.m.	1.09	20 Jul	0.45 a.m.

In Hong Kong, damage due to flooding was severe. A total of 118 cases of flooding and five minor landslips were reported. Flooding was most severe in Tuen Mun and in the north and northwestern parts of the New Territories. The low-lying areas were inundated. Many village houses were submerged. In Sheung Shui, more than 20 people were stranded by severe floodings in Tin Ping Shan and had to be rescued from rooftops of squatter huts by helicopters and rubber dinghies. About 100 hectares of fish ponds in San Tin, Kam Tin, Sheung Shui and Lam Tsuen were flooded and 220 tonnes of fish lost. Fish farmers estimated a total loss of $760 000. In addition, 270 hectares of agricultural land were also flooded, 60 hectares of which were in Yuen Long, Tuen Mun, San Tin and Pat Heung. The remaining 210 hectares were in Sheung Shui, Fanling, Ta Kwu Ling and Tai PO. Livestock farmers reported that 1 370 pigs, 133 000 poultry had been drowned. A scaffolding in Tsim Sha Tsui also collapsed in strong winds. There were also several reports of fallen trees. Along the Tuen Mun Highway, a 15-metre tree collapsed, damaging a van and injuring two men. Warren also disrupted air and sea traffic. At the airport, nine departures and eight arrivals were cancelled. Ferry services to Tap Mun, Macau and China were suspended. During the passage of Warren, 12 people were injured and a 5-year old boy was reported missing after falling into the sea at Tsim Bei Tsui.

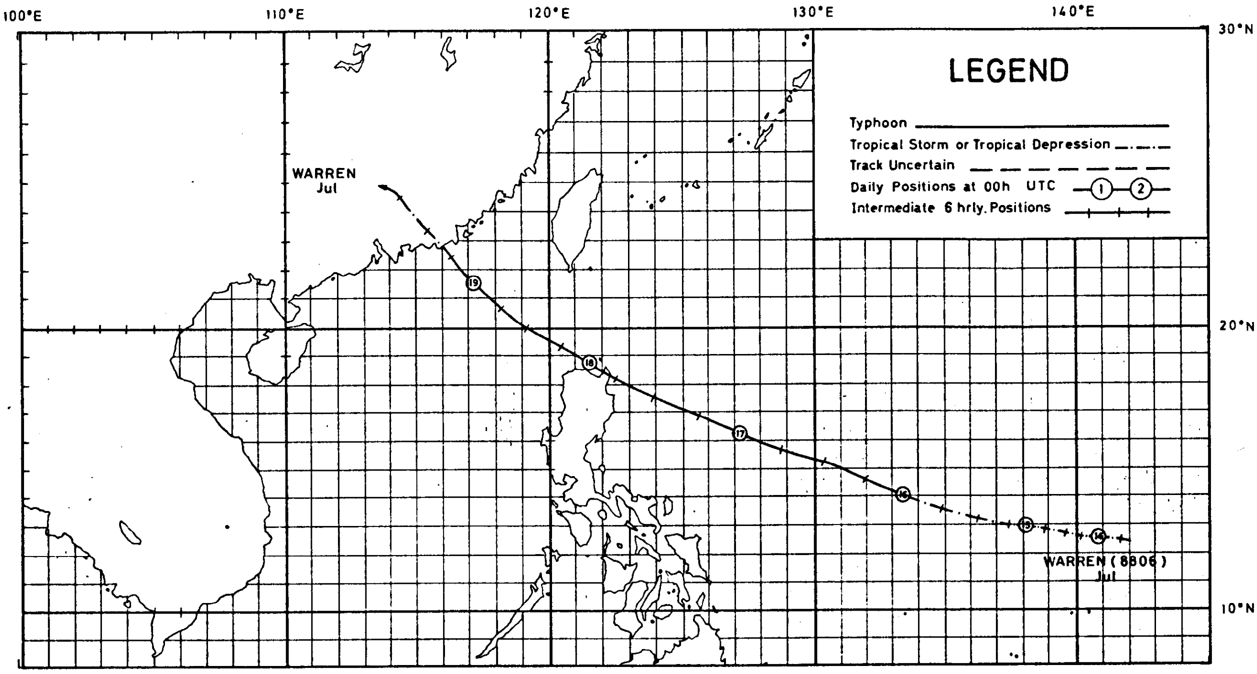


Figure 9. Track of Typhoon Warren (8806): 14–20 July 1988.

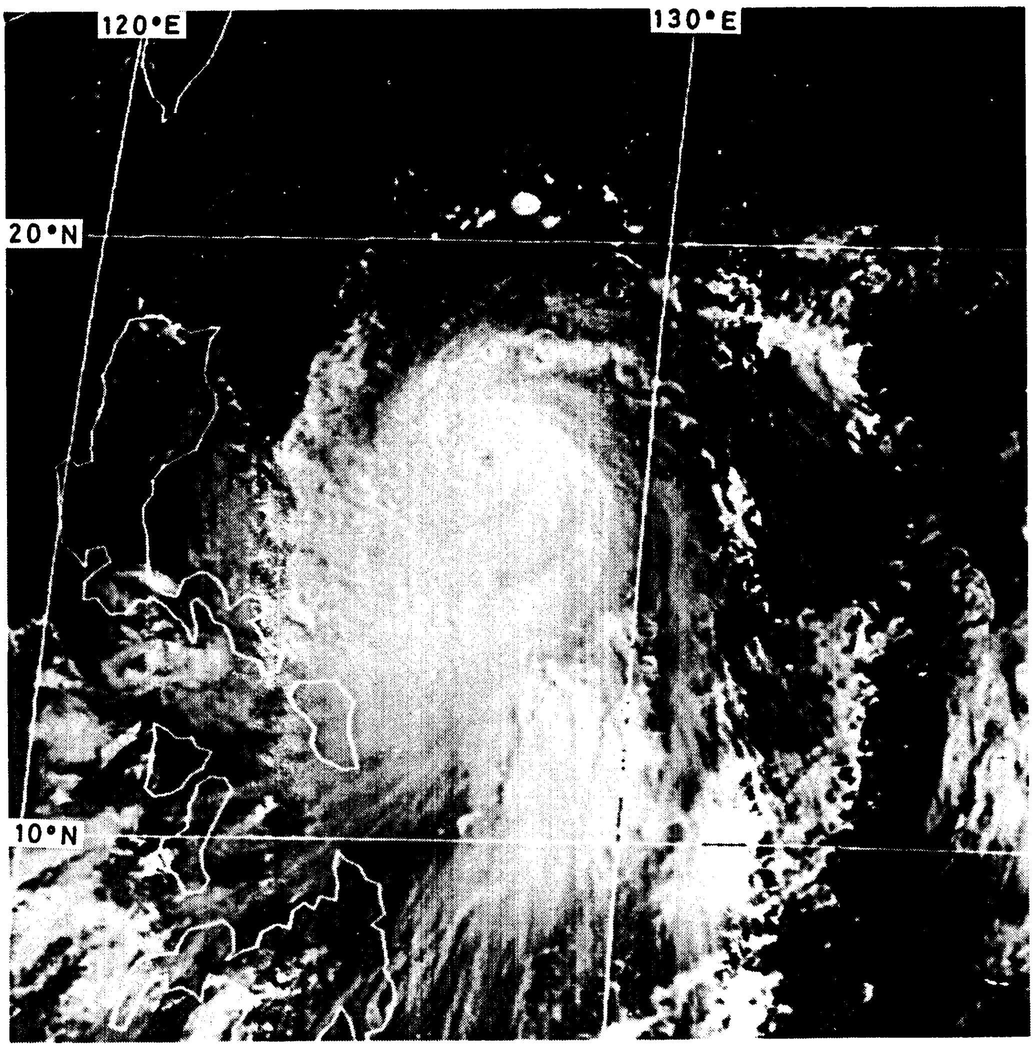


Figure 10. GMS-3 visible imagery of Typhoon Warren (8806) around 8.00 a.m. on 17 July 1988.

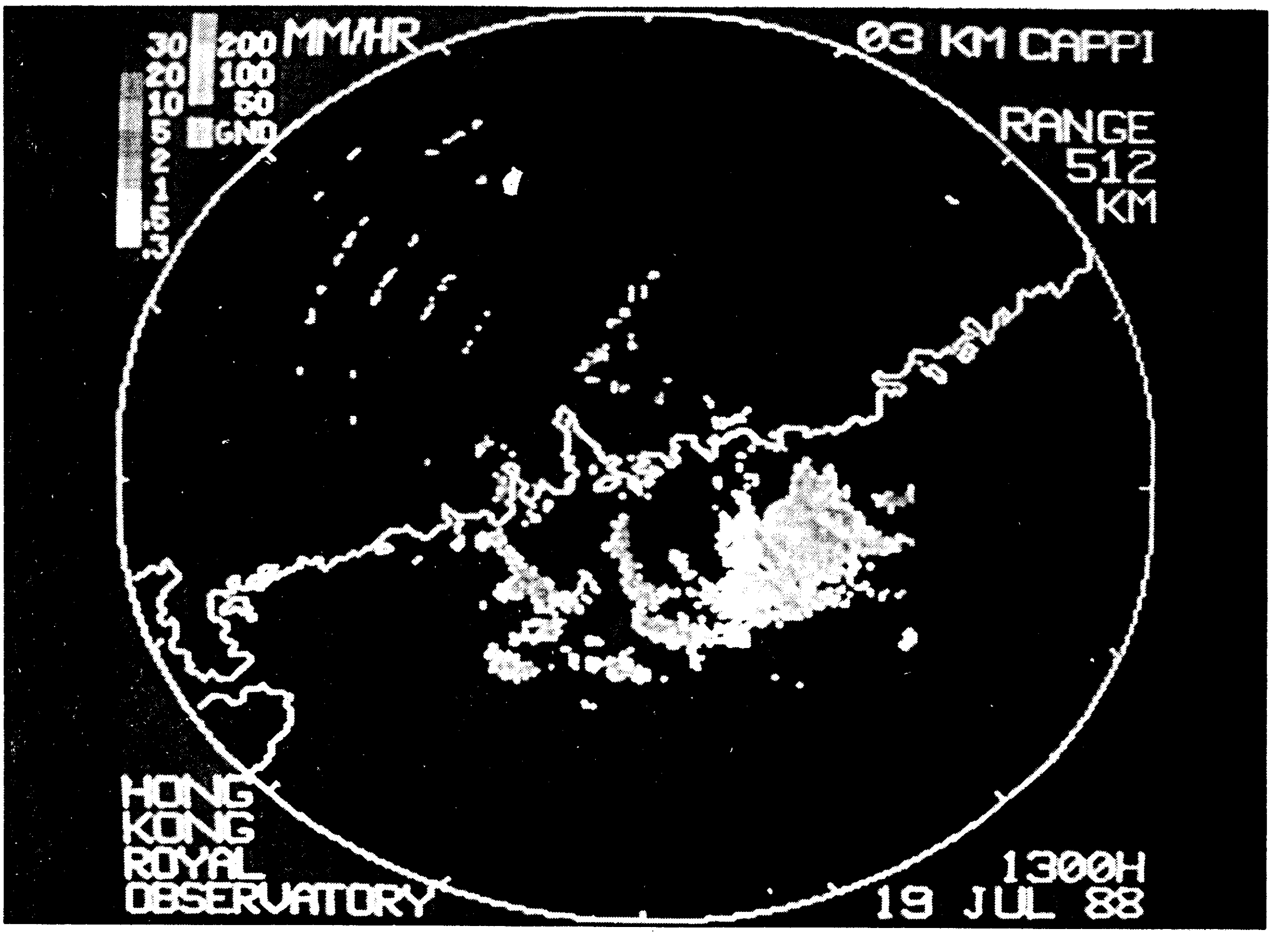
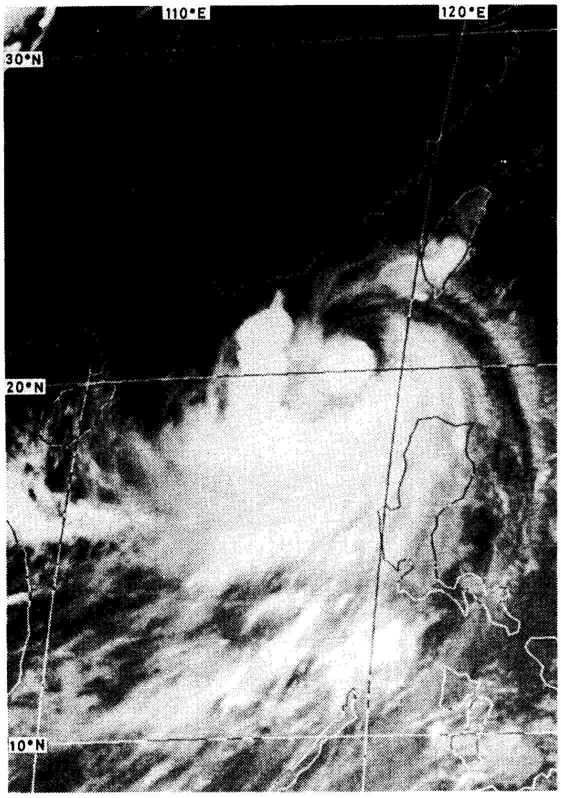
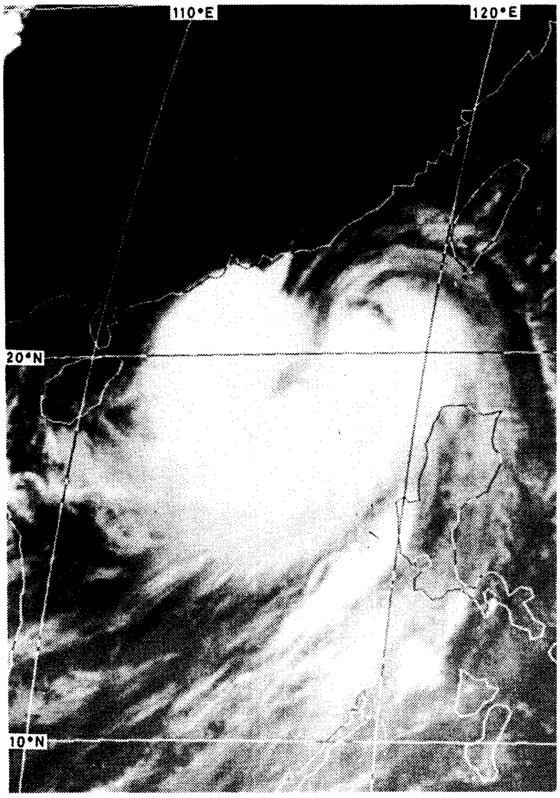


Figure 11. Radar display of the rain echoes of Typhoon Warren (8806) at 1.00 p.m. on 19 July 1988.



(a)



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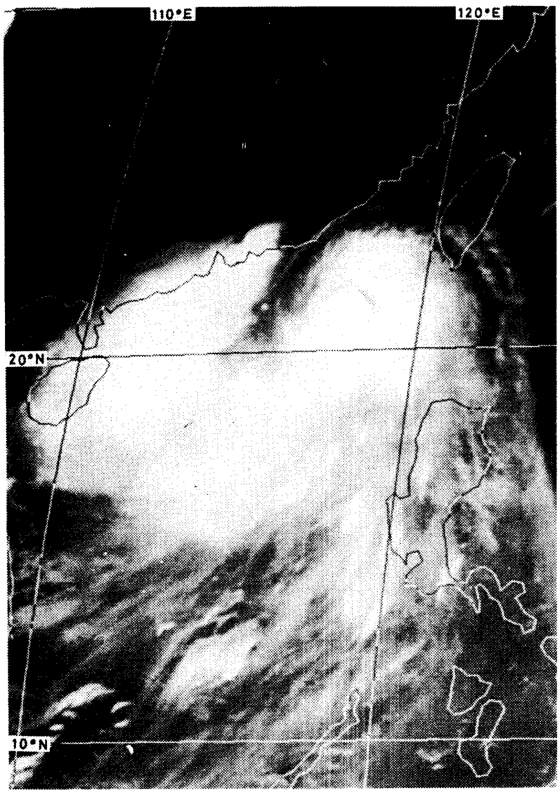

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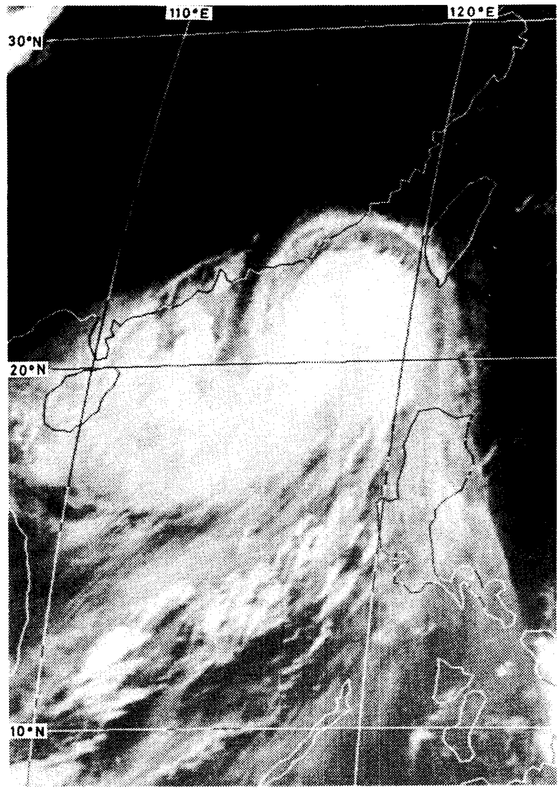

(d)

Figure 12. GMS-3 infra-red imageries of Typhoon Warren (8806) around
(*a*) 11.00 p.m. on 18 July 1988
(*b*) 2.00 a.m. on 19 July 1988
(*c*) 5.00 a.m. on 19 July 1988
(*d*) 8.00 a.m. on 19 July 1988

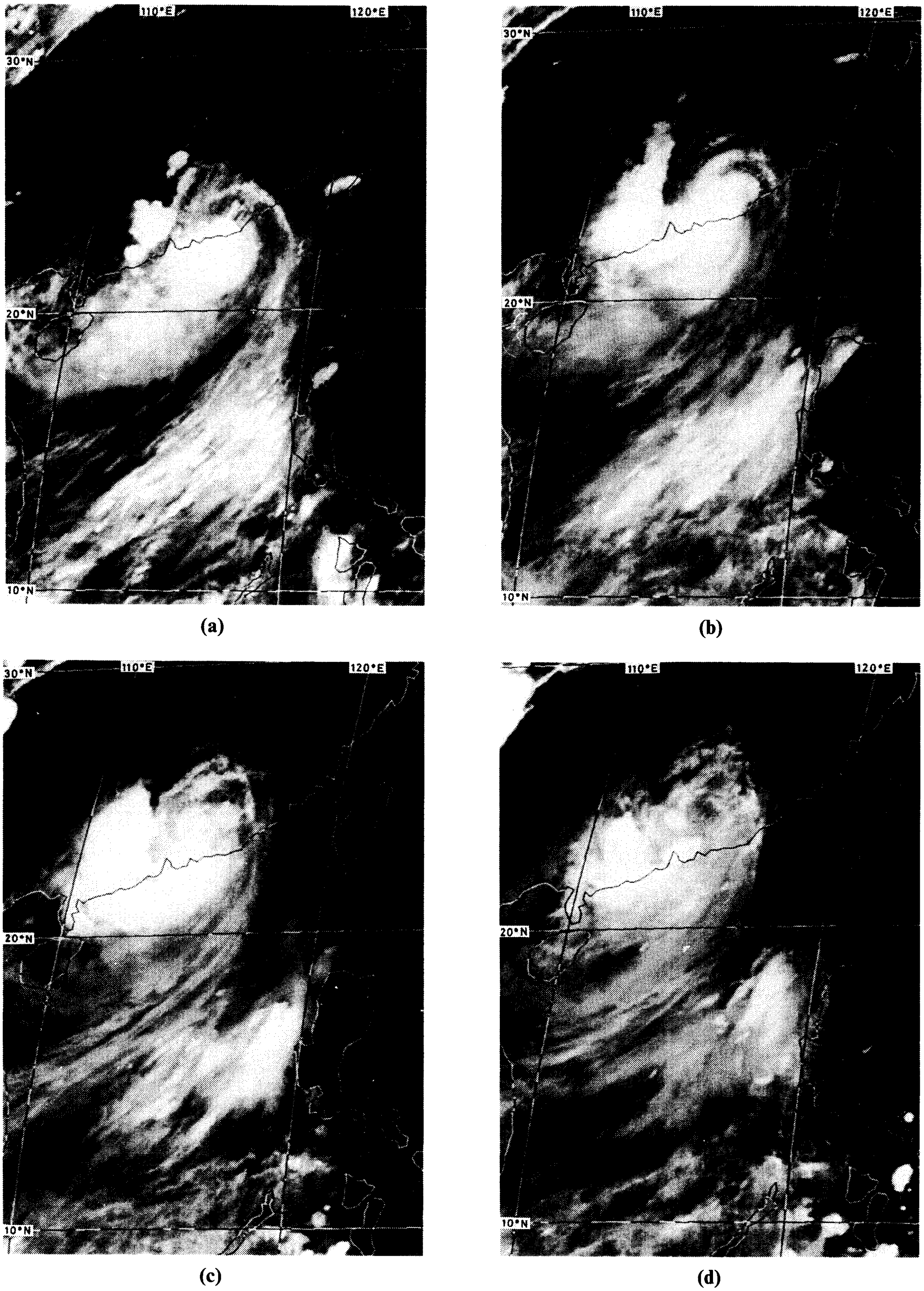

Figure 13. GMS-3 infra-red imageries of Typhoon Warren (8806) around
(a) 5.00 p.m. on 19 July 1988
(b) 8.00 p.m. on 19 July 1988
(c) 11.00 p.m. on 19 July 1988
(d) 2.00 a.m. on 20 July 1988

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Figure 14. A 7-metre tree was blown down by strong winds in Nathan Road on the evening of 19 July 1988 (By courtesy of Sing Tao Ltd.).

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Figure 15. A van was crushed by a 15-metre tree in Tuen Mun Highway on the evening of 19 July 1988 (By courtesy of Oriental Daily News).

Figure 16. Flooding of the road near Fairview Park, Yuen Long on 20 July 1988 (By courtesy of Oriental Daily News).

Figure 17a. **Flooding in various locations in the Sheung Shui area on 20 July 1988 (By courtesy of Buildings and Lands Department).**

Figure 17b. **Flooding in various locations in the Sheung Shui area on 20 July 1988 (By courtesy of Buildings and Lands Department).**

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Figure 17c. Flooding in various locations in the Sheung Shui area on 20 July 1988 (By courtesy of South China Morning Post).

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Figure 17d. Flooding in various locations in the Sheung Shui area on 20 July 1988 (By courtesy of South China Morning Post).

(d) Typhoon Kit (8821)

19-22 September 1988

The track of Typhoon Kit is shown in Figure 18

Tropical Depression Kit formed about 540 km east-northeast of Manila on 19 September. It moved northwestwards initially and then turned westwards towards Luzon at about 22 km/h. Kit made landfall near midnight and crossed the northern part of Luzon. It entered the South China Sea on the morning of 20 September and moved northwestwards at about 19 km/h. Kit intensified to a tropical storm in the evening and slowed down to 9 km/h. Intensification continued as Kit moved towards the south China coast. On the morning of 21 September, Kit became a severe tropical storm when it was about 180 km east-southeast of Dongsha and speeded up again. It passed about 100 km northeast of the island and reached typhoon strength that evening. However Kit soon weakened to a severe tropical storm early on 22 September. It made landfall about 220 km east-northeast of Hong Kong on the morning of 22 September and dissipated overland shortly afterwards.

Kit did not bring much rain to Hong Kong. However, according to press reports, torrential rain occurred near its landfall location in the Shantou area. Eight people were killed and over one hundred were injured. About 74 000 hectares of farmland were inundated. Over 24 000 houses were damaged and 759 houses collapsed. Forty boats, one bridge and several river embankments were also damaged. The total damage in the area was estimated at about 131 million RMB. In Fujian Province, heavy rain due to the remnants of Kit and another tropical cyclone Mamie resulted in nine people killed and 51 000 were made homeless. About 26 000 hectares of farmland were inundated and over 1 200 houses collapsed. The approach of Kit together with the northeast monsoon also affected the maiden voyage of the 'MV Macmosa'. It took 41 hours to make the trip from Macau to Gaoxiong instead of the scheduled 24 hours.

In Hong Kong, the Stand By Signal, No. 1 was hoisted at 8.45 a.m. on 21 September when Tropical Depression Kit was about 480 km to the east-southeast. Winds were moderate northerly and strengthened gradually. As Kit moved closer to Hong Kong, the Strong Wind Signal No. 3 was hoisted at 9.00 p.m. that evening when Typhoon Kit was about 320 km east-southeast of Hong Kong. With Kit finally making landfall over eastern Guangdong at around 6 a.m. on 22 September, all signals were lowered at 9.10 a.m. Kit was closest to Hong Kong at around 11 a.m. just before its dissipation about 170 km to the northeast on 22 September. The lowest sea-level pressure of 1 000.8 hPa at the Royal Observatory was recorded earlier at 3 a.m. on 22 September. The maximum hourly mean and maximum gust peak speeds together with associated wind directions at selected locations during the passage of Kit were as follows:

Location	*Maximum mean hourly wind speed in km/h with direction in points*		*Maximum gust peak speed in km/h with direction in points*	
Royal Observatory	WNW	22	NNE	41
H.K. Airport (SE)	N	31	N	62
H.K. Airport (NW)	N	31	N	67
Waglan Island	N	52	N	72
Tate's Cairn	NNW	63	N	88
Cheung Chau	N	41	N	75
Star Ferry	WNW	31	WNW	47
Sha Tin	N	27	N	43
Kwai Chung	NNW	30	NNW	49
Chek Lap Kok	NW	47	NNW & NW	58
Lau Fau Shan	N	34	N	51
Ta Kwu Ling	N	22	NNE	47
Tsing Yi	N	25	N	63
Tai Mo Shan	N	62	NNW	83
Tuen Mun	N	19	N	63
Tamar	WNW	31	NNW	47
Cheung Sha Wan	N	23	N	47
King's Park	N	22	N	51
Green Island	NW	54	NW	76
Tai O	N	40	N	63

When the Stand By Signal No. 1 was hoisted on 21 September, the weather was fine. It became cloudy the next day with some showers occurring in the evening. Weather remained cloudy with some showers on 22 September, but deteriorated the next day with the approach of another tropical cyclone, Mamie. The daily amounts of rainfall recorded at selected locations were as follows:

Date	*Royal Observatory*	*Hong Kong Airport*	*Cheung Chau*
	mm	mm	mm
20 September	Trace	Trace	Nil
21 September	Trace	Trace	Trace
22 September	0.8	0.5	Trace
23 September	4.9	7.5	14.0
Total	5.7	8.0	14.0

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passage of Kit were tabulated below:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Ko Lau Wan	2.50	22 Sep	5.01 a.m.	0.85	21 Sep	6.00 p.m.
Lok On Pai	2.50	22 Sep	5.45 a.m.	0.78	21 Sep	6.15 p.m.
Quarry Bay	2.46	22 Sep	5.50 a.m.	0.32	21 Sep	6.00 p.m.
Tai Po Kau	2.53	22 Sep	5.25 a.m.	0.82	21 Sep	6.15 p.m.
Tsim Bei Tsui	2.44	22 Sep	7.22 a.m.	0.71	21 Sep	6.45 p.m.
Tamar	2.34	22 Sep	5.48 a.m.	0.30	21 Sep	6.00 p.m.

No casualties were reported in Hong Kong. Due to the approach of Kit, several ferry services to China were suspended.

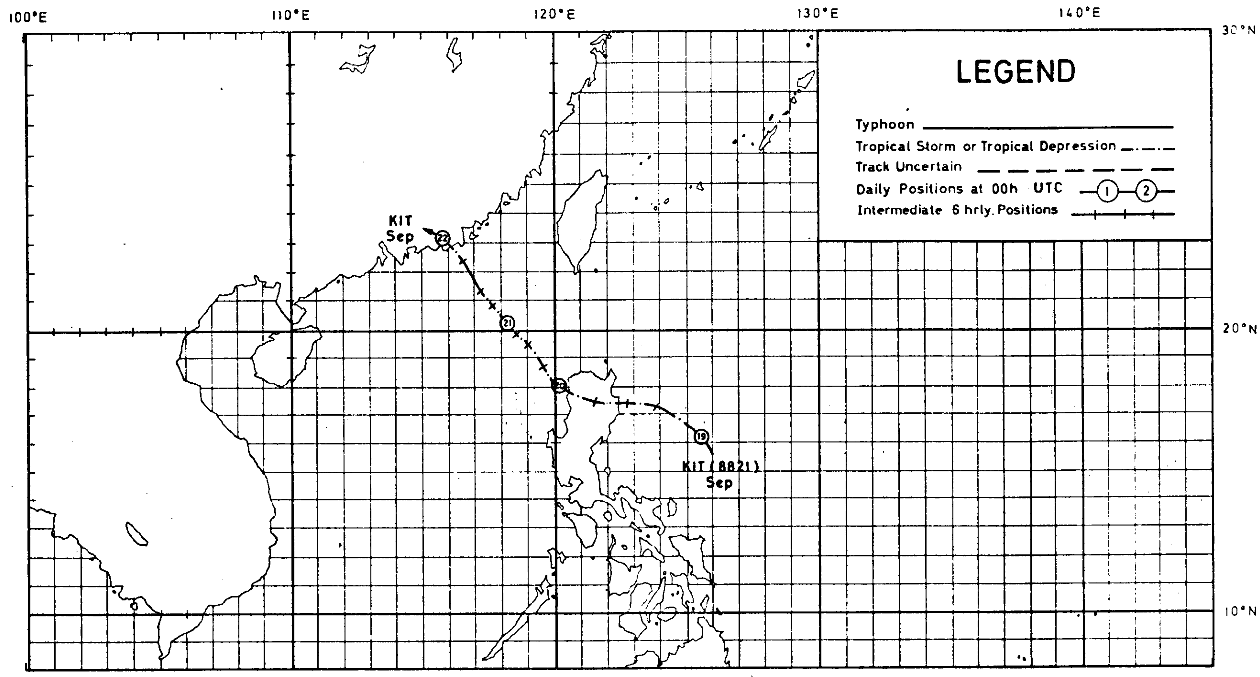

Figure 18. Track of Typhoon Kit (8821): 19–22 September 1988.

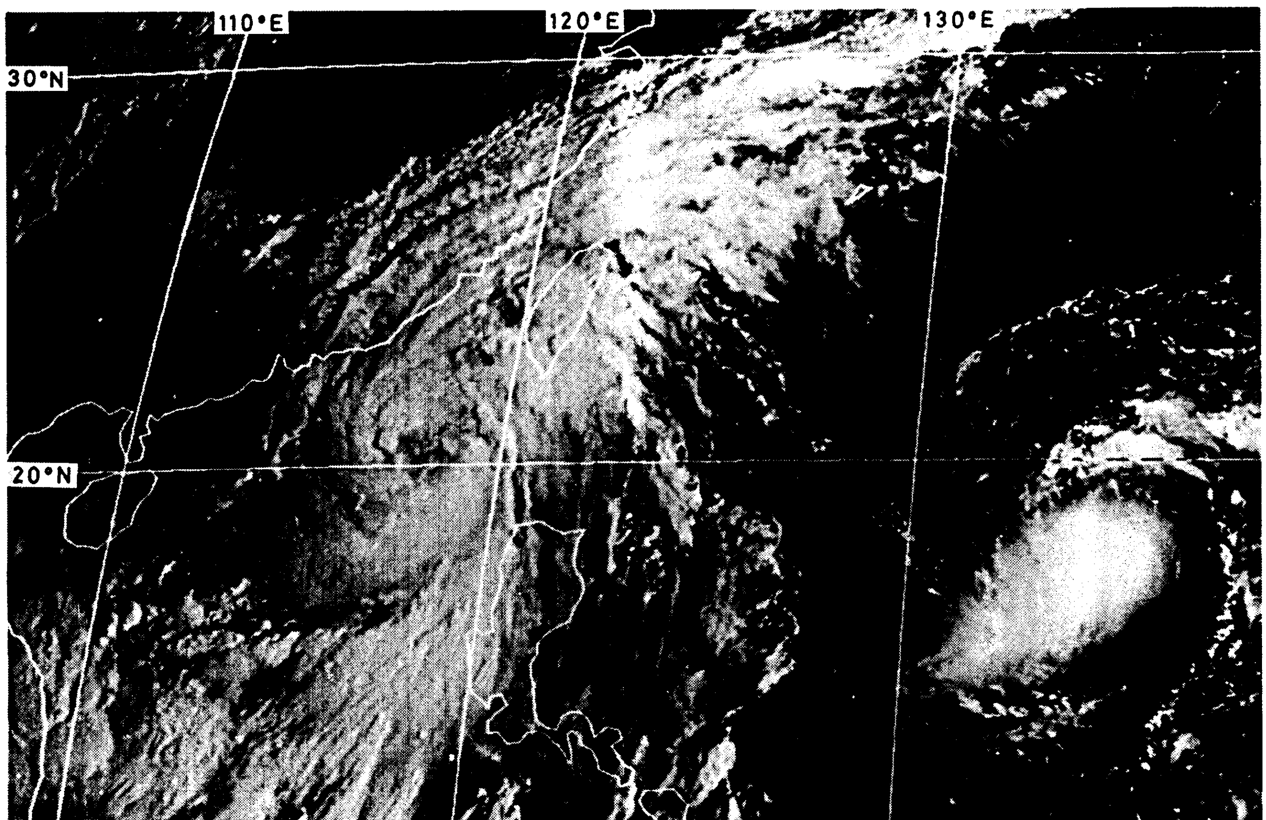

Figure 19. GMS-3 visible imagery of Severe Tropical Storm Kit (8821) around 8.00 a.m. on 21 September 1988.

Figure 20. GMS-3 infra-red imagery of Typhoon Kit (8821) around 8.00 p.m. on 21 September 1988.

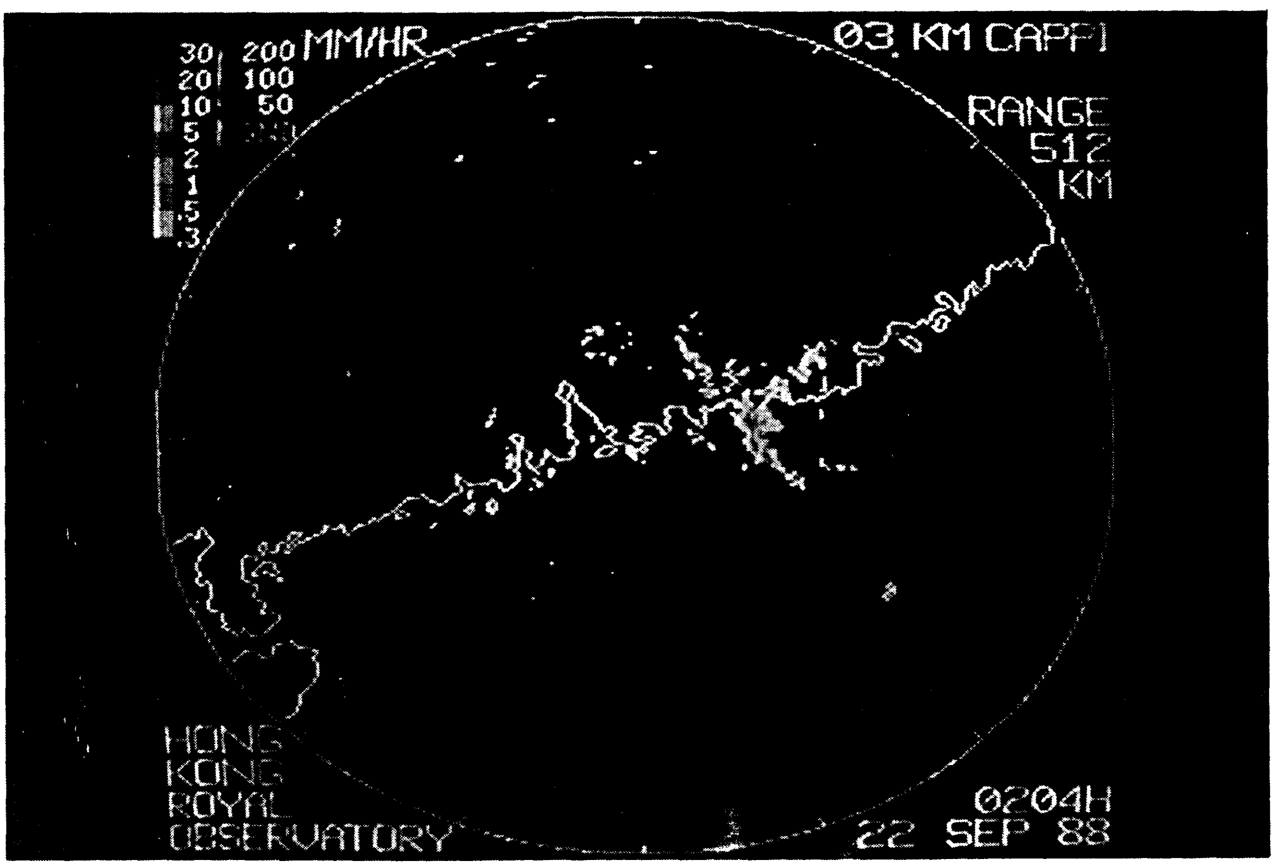

Figure 21. Radar display of the rainbands of Typhoon Kit (8821) at 2.04 a.m. on 22 September 1988.

(e) Typhoon Pat (8827)

18-23 October 1988

The track of Typhoon Pat is shown in Figure 22

Pat formed as a tropical depression about 1 510 km east of Manila on the evening of 18 October and moved northwestwards at about 36 km/h initially. It then turned westwards towards Luzon and slowed down to around 15 km/h on the morning of 19 October. At about the same time, it intensified into a tropical storm. That evening, Pat accelerated again to about 30 km/h. It further intensified into a severe tropical storm early next morning and landed over Luzon about 260 km north-northeast of Manila on the evening of 20 October. A minimum sea-level pressure of 991.9 hPa was recorded at Casiguran in eastern Luzon at around 9 p.m. on 20 October when Pat was passing to its north. Pat moved rapidly westwards across Luzon while maintaining severe tropical storm strength.

After entering the South China Sea early on 21 October, Pat continued its rapid westward movement at first but then turned west-northwestwards towards Hainan. Pat intensified further over the South China Sea. The ship "Sealand Mariner" reported an easterly wind of 92 km/h and a pressure of 997.7 hPa at 2 a.m. on 22 October when it was about 220 km northeast of the centre. Later that morning, Pat passed about 80 km north-northeast of Xisha and intensified into a typhoon with a compact structure and intense convective activity to the south of the centre. Pat made landfall over the southeastern part of Hainan around 3 p.m. on 22 October. A sea-level pressure of 986.2 hPa was recorded at Lingshui Xian on Hainan an hour earlier. Pat weakened rapidly to a severe tropical storm shortly after landfall as it interacted with the terrain. It weakened further to a tropical depression on 23 October and finally dissipated over the coast of northern Vietnam near Hanoi later that morning.

According to press reports, flooding occurred in eight villages and cities on Hainan with economic losses totalling 60 million RMB. Transport and telephone services were disrupted. About 33 000 hectares of paddy fields were flooded and 16 000 hectares of sugar cane were damaged or destroyed. Roof-tops of some farm houses were also blown off.

Press reports also indicated that Pat and rainstorms associated with a low pressure area in mid-October left at least 90 people killed and 500 000 homeless in Vietnam.

In Hong Kong, the Stand By Signal No. 1 was hoisted at 8.50 a.m. on 21 October when Severe Tropical Storm Pat was about 750 km to the south-southeast. Winds were moderate northerlies at first but became easterly to northeasterly later as Pat moved closer. Winds began to strengthen in the evening. The Strong Wind Signal No. 3 was hoisted at 10.45 p.m. when Pat was about 580 km to the south. Local winds continued to strengthen and became generally strong and gusty during the late morning and afternoon of 22 October. Winds were near gale force offshore and sea conditions were rough. Gusts of over 72 km/h were recorded at some offshore stations and on high ground. As Pat landed over Hainan in the afternoon of 22 October and continued to move away from Hong Kong, all signals were lowered at 3.45 p.m. Pat was closest to Hong Kong at around 4 a.m. on 22 October when its centre was about 540 km to the south. The lowest pressure of 1 008.0 hPa was recorded at the Royal Observatory at 4.00 p.m. on 21 October when Pat was about 650 km to the south-southeast. The maximum hourly mean and maximum gust peak speeds together with associated wind directions at selected locations during the passage of Pat were as follows:

Location	*Maximum mean hourly wind speed in km/h with direction in points*		*Maximum gust peak speed in km/h with direction in points*	
Royal Observatory	E	31	E	63
H.K. Airport (SE)	E	38	E	67
H.K. Airport (NW)	E	34	E	88
Waglan Island	E	65	E	85
Tate's Cairn	E	51	E	92
Cheung Chau	E	52	E	85
King's Park	ESE	27	E	72
Star Ferry	E	38	E	67
Tai O	NE	36	E	79
Sha Tin	E	23	E	56
Kwai Chung	ENE	27	ENE	59
Chek Lap Kok	E	47	E	75
Lau Fau Shan	ENE	30	E	47
Ta Kwu Ling	NNE	23	E	54
Tai Mo Shan	E	72	E	101
Tsing Yi	E	31	E	75
Tuen Mun	SE	20	NNE	59
Tamar	ESE	13	ESE	38
Cheung Sha Wan	NNE & E	20	ENE & E	58

The weather was fine on the morning of 21 October when the Stand By Signal No. 1 was hoisted. It turned cloudy in the late afternoon with showers setting in during the night. A rainband associated with Pat moved in from the south and brought some showers early on 22 October. Rain set in again during the afternoon and continued into the next day. Cloudy and rainy conditions prevailed on 23 October but the weather turned fine and sunny the following day. The daily amounts of rainfall recorded at selected locations were as follows:

Date	*Royal Observatory* mm	*Tai O* mm	*Tai Po* mm	*Sha Tau Kok* mm
21 October	Trace	Nil	Nil	Nil
22 October	19.1	14.5	7.5	16.5
23 October	8.1	0.5	7.0	13.0
24 October	Nil	Nil	Nil	Nil
25 October	Nil	Nil	Nil	Nil
Total	27.2	15.0	14.5	29.5

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passage of Pat are tabulated below:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Ko Lau Wan	2.62	22 Oct	7.04 a.m.	0.62	22 Oct	2.15 p.m.
Lok On Pai	2.61	22 Oct	7.06 a.m.	0.58	22 Oct	11.00 a.m.
Quarry Bay	2.62	22 Oct	6.36 a.m.	0.51	22 Oct	1.30 p.m.
Tai Po Kau	2.54	22 Oct	7.13 a.m.	0.82	22 Oct	2.30 p.m.
Tsim Bei Tsui	2.75	22 Oct	8.12 a.m.	0.55	22 Oct	4.45 p.m.
Tamar	2.51	22 Oct	6.30 a.m.	0.46	22 Oct	8.15 a.m.

In Hong Kong, over ten containers fell down at a container terminal in Tsing Yi during the morning of 22 October when strong gusty winds were blowing. A man was killed when one of the containers crushed onto a truck which he was driving. In another incident, a woman was killed after being hit by a falling flower pot in Causeway Bay. Near Choi Hung Estate, a man was injured by a falling tree. Scaffoldings at a construction site in Kowloon City also collapsed, causing damage to two vehicles nearby.

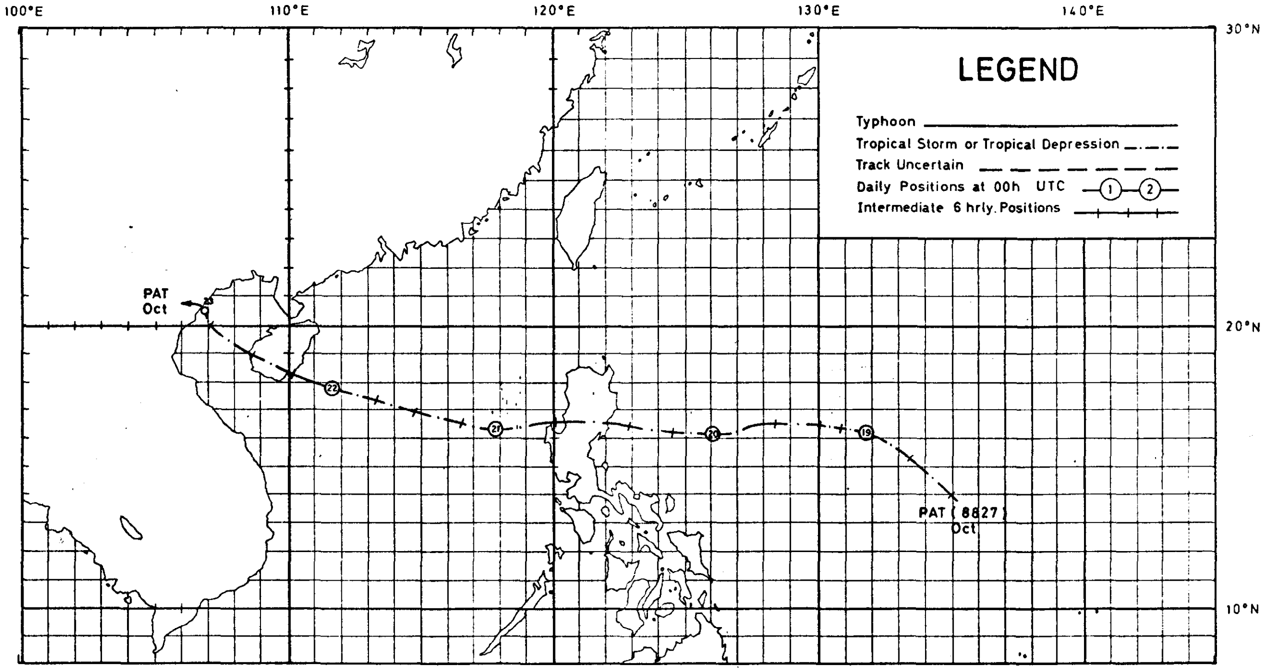

Figure 22. Track of Typhoon Pat (8827): 18–23 October 1988.

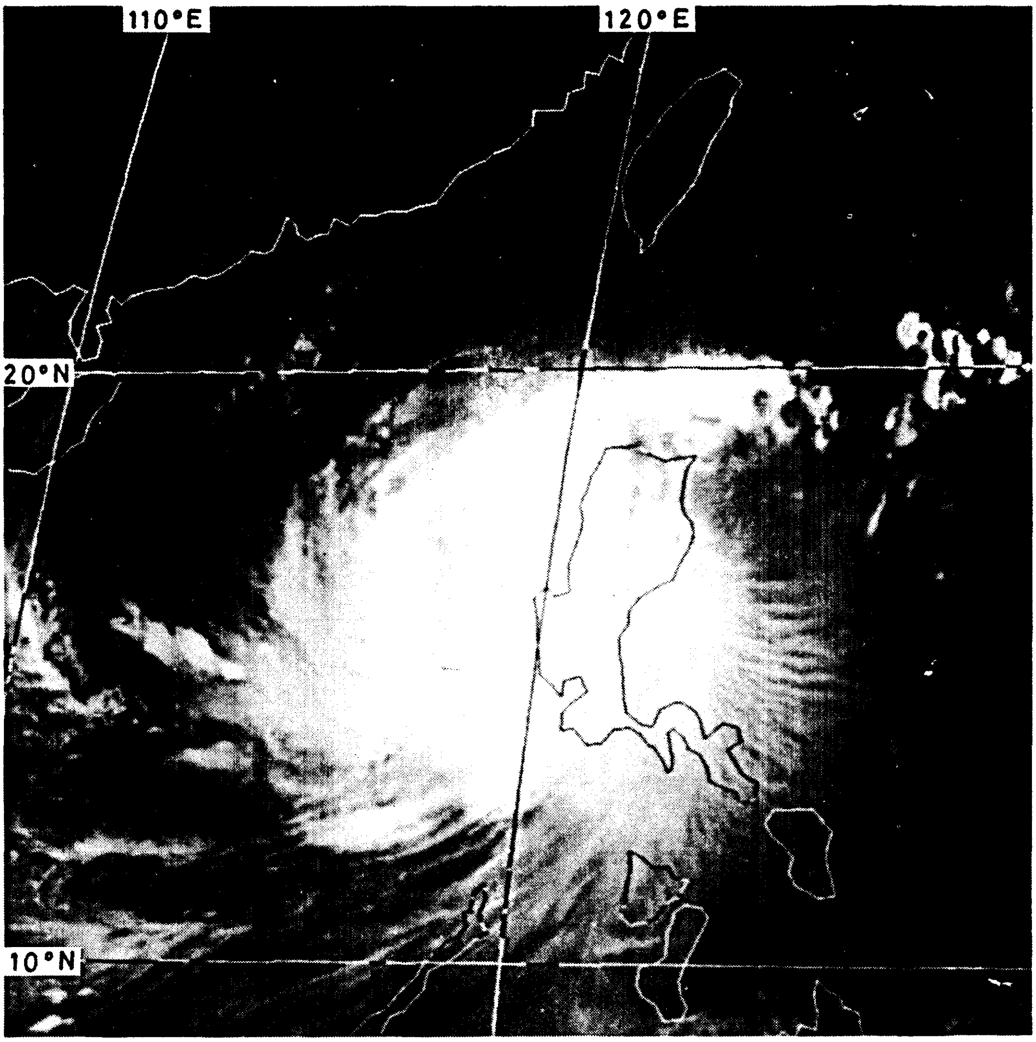

Figure 23. GMS-3 infra-red imagery of Severe Tropical Storm Pat (8827) around 2.00 a.m. on 21 October 1988.

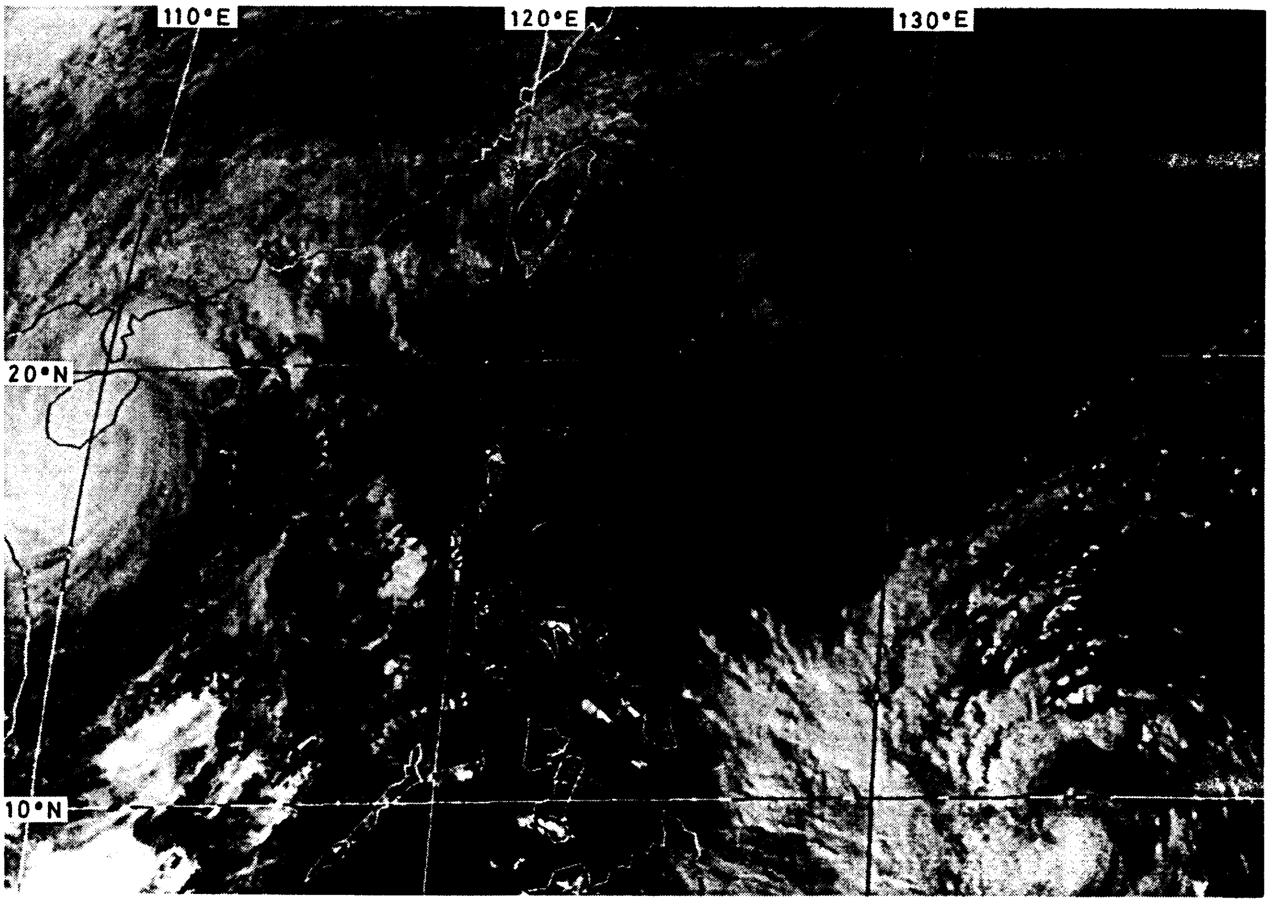

Figure 24. GMS-3 visible imagery of Typhoon Pat (8827) near Hainan around 2.00 p.m. on 22 October 1988.

(f) Typhoon Ruby (8828)

21-29 October 1988

The track of Typhoon Ruby is shown in Figure 25

Ruby formed as a tropical depression about 1 760 km east-southeast of Manila on 21 October. It moved west-southwestwards at about 16 km/h at first. Early on 22 October, Ruby intensified into a tropical storm and took on a westward course towards the southern Philippines. During that afternoon, Ruby further strengthened into a severe tropical storm and turned west-northwestwards. Its circulation was rather extensive. Ruby intensified rapidly into a typhoon early on 23 October and accelerated to a speed of about 27 km/h in its movement towards Luzon. By 24 October, the rainbands associated with Ruby covered nearly the whole of the Philippines. Ruby became a very intense typhoon at around 8 p.m. that day with maximum winds near the centre estimated to be around 205 km/h. At Catanduanes just off eastern Luzon, a sea-level pressure of 946.0 hPa and winds of 122 km/h were recorded at 2 p.m. when the centre of Ruby passed close to the station. Ruby made landfall over central Luzon early on 25 October. It passed about 100 km to the north-northeast of Manila and entered the South China Sea later that morning.

According to press reports, Ruby was the strongest typhoon to hit Luzon since Patsy in 1970. A passenger ship, the 2 845-tonne "Dona Marilyn", with more than 500 people aboard, sank in the Visayan Sea about 460 km southeast of Manila. About 210 people survived and 54 deaths were identified while the rest were reported missing. Widespread flooding also occurred, triggering landslides and washing away bridges. The death toll over land was at least 136. Over 177 000 houses were destroyed, leaving 2.3 million people homeless. In Manila, there were power failures. A Philippine freighter "Jet Nann Five" sank about 240 km south of where the "Dona Marilyn" capsized. In Zamboanga in southern Philippines, two navy ships also sank in heavy seas. However, there were no report of casualties. In the central Philippines, a bus carrying over 40 people went off a wooden bridge and plunged into a river, killing about 26 people. Another 10 people were killed when tornadoes spawned by Ruby struck remote villages on Mindanao. Near Cebu City, 150 houses were flooded in low-lying areas. Damage to crops totalled US$45.7 million and damage to roads and bridges was estimated to be about US$7 million.

The combined effect of the outer circulation of Typhoon Ruby and the northeast monsoon also brought prolonged and heavy rain to eastern Taiwan. According to press reports, one person was killed and another was missing. River levels rose sharply, flooding low-lying areas and fields.

Ruby moved westwards at about 22 km/h after it entered the South China Sea on 25 October. Its circulation was extensive and strong to gale force winds affected the Taiwan Strait and the northeastern part of the South China Sea. At 5 p.m., a ship reported northerly winds of 96 km/h when it was about 310 km northwest of the centre. During the evening of 25 October, Ruby weakened slightly and slowed down significantly, moving on an erratic track. Ruby then took on a west-northwestward track at about 20 km/h during the evening of 26 October. It weakened into a severe tropical storm early on 27 October and passed about 150 km north-northeast of Xisha that evening. A minimum sea-level pressure of 994.1 hPa was recorded at Xisha with winds of 83 km/h. A surge of the northeast monsoon gradually spread southwards from the southern coast of China and Ruby continued to weaken to a tropical storm early on 28 October. It landed over central Hainan around noon and crossed the island in the afternoon. Ruby finally weakened into an area of low pressure over the sea to the southwest of Hainan early on 29 October.

According to press reports, two people were killed and 15 were injured. When Ruby swept across Hainan, heavy rain resulted in flash floods and rises in river levels. Telephone service in the eastern and southern parts of the island was disrupted and about 73 000 hectares of rice, rubber and other crops were damaged. Flooding occurred in 46 villages, and more than 10 000 residents had to be evacuated. Altogether, more than 20 000 people were made homeless and over 20 fishing vessels were sunk. Economic losses totalled 133 million RMB.

During its passage across the South China Sea Ruby also caused high seas to Quanzhou in Fujian Province where waves of 8 metres were reported. Many fields were flooded and economic losses totalled 37 million RMB.

In Hong Kong, the Stand By Signal No. 1 was hoisted at 4.10 p.m. on 25 October when Typhoon Ruby was about 810 km to the southeast. Winds were then moderate northerly but fresh offshore. Winds became strong at times offshore the next morning. The Strong Wind Signal No. 3 was hoisted at 10.45 p.m. on 26 October when Ruby was about 570 km to the south-southeast. A surge of the northeast monsoon gradually spread south and local winds were further enhanced by the monsoon on 27 October. Winds were generally strong offshore, reaching gale force on hill tops. With Ruby moving away and winds beginning to moderate, all signals were lowered at 5.00 a.m. on 28 October. Ruby was closest to Hong Kong at 5 p.m. on 27 October when its centre was about 490 km to the south-southwest. At the Royal Observatory the lowest pressure of 1 004.1 hPa was recorded at 4 p.m. on 26 October. The maximum hourly mean and maximum gust peak speeds together with associated wind directions at selected locations during the passage of Ruby were as follows:

Location	Maximum mean hourly wind speed in km/h with direction in points		Maximum gust peak speed in km/h with direction in points	
Royal Observatory	NNE	22	NNE	51
H.K. Airport (SE)	NE	31	NNE	59
H.K. Airport (NW)	N	45	NNE	85
Waglan Island	N	59	N	76
Tate's Cairn	N	76	NE	121
Cheung Chau	N	52	N	79
King's Park	NNE	23	NE	68
Star Ferry	E	20	E	49
Tai O	N	51	N	77
Sha Tin	NE	25	NE	41
Kwai Chung	N	23	NE	52
Chek Lap Kok	NNE	43	NNE	67
Lau Fau Shan	N	34	NNE	54
Ta Kwu Ling	NNE	40	NNE	85
Tai Mo Shan	NE	76	NE	96
Tsing Yi	NE	25	NNE	52
Tuen Mun	N	40	N	81
Tamar	NNE & ENE	25	N	56
Cheung Sha Wan	NNE	30	N	70

In Hong Kong the weather was fine, sunny and warm on 25 October when the Stand By Signal No. 1 was hoisted. The weather turned cloudy the next morning with light rain setting in during the morning of 27 October. Heavier and persistent rain occurred on 28 October. The weather for the following three days was generally cool and cloudy with some light rain.

The daily amounts of rainfall recorded at selected locations were as follows:

Date	*Royal Observatory* mm	*Sai Kung* mm	*Yuen Long* mm	*Discovery Bay* mm
26 October	Nil	Nil	Nil	Nil
27 October	1.0	1.0	0.5	1.0
28 October	5.8	25.0	6.5	5.5
29 October	0.9	0.5	1.5	3.0
30 October	2.5	2.0	2.5	4.0
31 October	7.5	5.0	2.0	3.5
Total	17.7	33.5	13.0	17.0

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passage of Ruby are tabulated below:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Ko Lau Wan	3.15	26 Oct	9.56 p.m.	0.99	27 Oct	6.00 p.m.
Lok On Pai	3.03	26 Oct	10.19 p.m.	0.73	27 Oct	2.00 a.m.
Quarry Bay	3.13	26 Oct	10.13 p.m.	0.68	26 Oct	10.15 p.m.
Tai Po Kau	3.22	27 Oct	11.03 p.m.	1.13	27 Oct	6.15 p.m.
Tsim Bei Tsui	3.21	26 Oct	11.44 p.m.	0.75	26 Oct	8.00 p.m.

In Hong Kong, damage was slight. A large advertisement signboard in Western District was blown loose affecting tram service nearby. In another incident, four people were injured when boards surrounding a construction site were blown loose in Kwun Tong. Flooding was reported in Central and Sha Tin. Several shops in Central were flooded by water 10 cm high. Unusually high water levels in Shing Mun River were reported. Abnormal high tides affected Tai O for three consecutive nights, flooding more than 20 houses. During the storm a 5-metre tree also collapsed in Wong Tai Sin, blocking the road nearby.

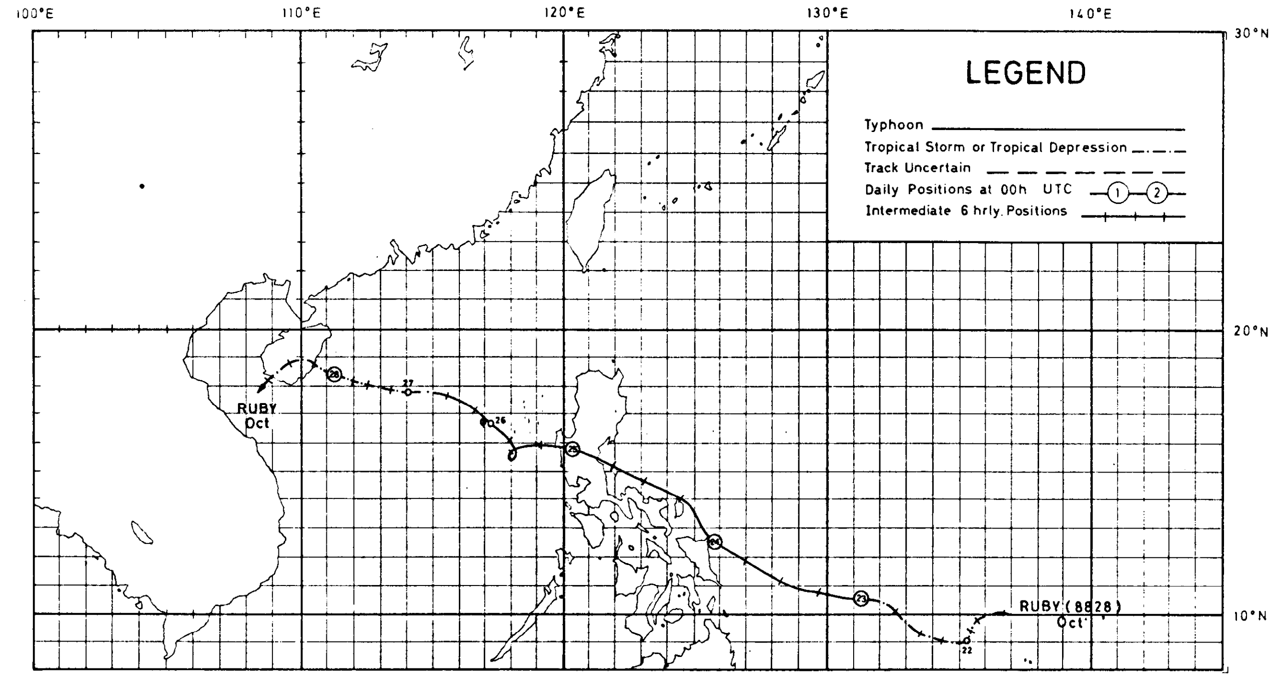

Figure 25. Track of Typhoon Ruby (8828): 21–29 October 1988.

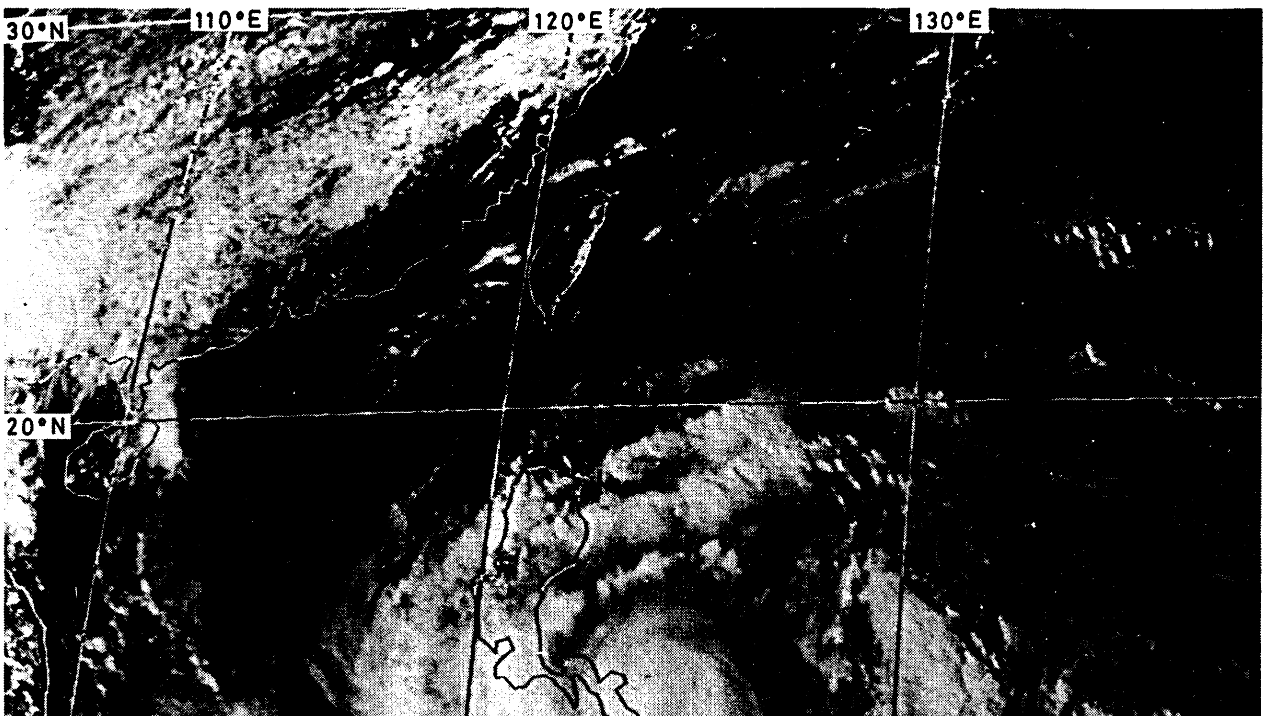

Figure 26. GMS-3 visible imagery of Typhoon Ruby (8828) around 2.00 p.m. on 24 October 1988.

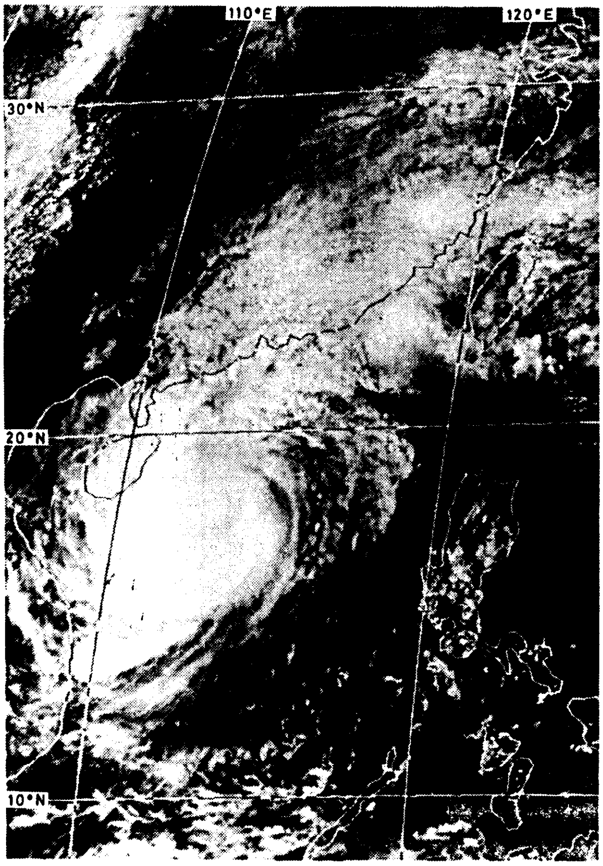

Figure 27. GMS-3 visible imagery of Typhoon Ruby (8828) around 2.00 p.m. on 27 October 1988.

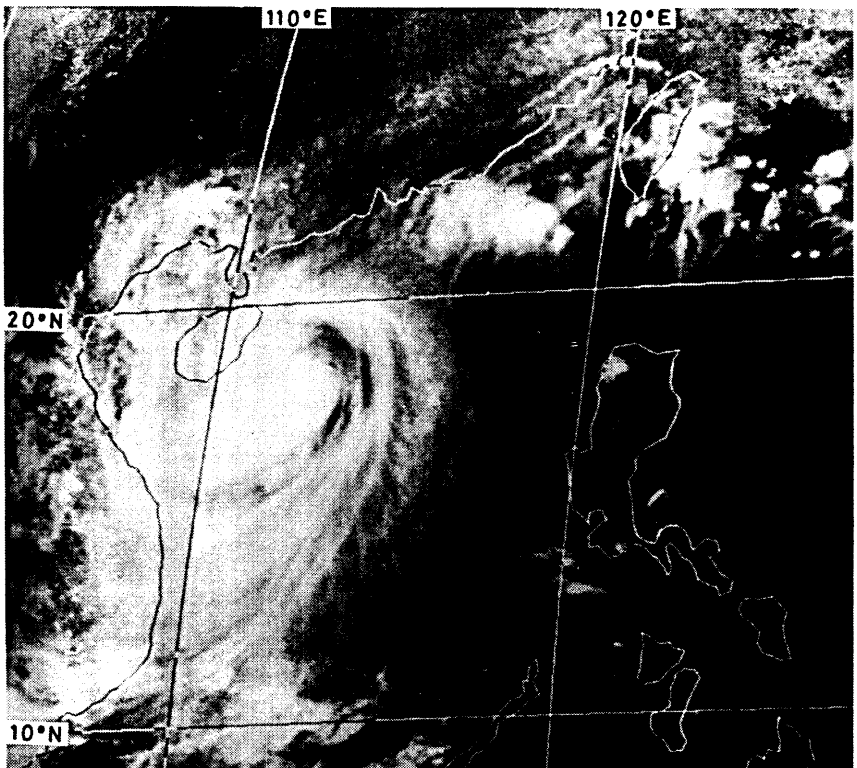

Figure 28. GMS-3 infra-red imagery of Typhoon Ruby (8828) around 8.00 p.m. on 27 October 1988.

Figure 29. Abnormal high tides affected Tai O for three consecutive nights on 26–28 October 1988. (By courtesy of New Evening Post).

4. DESCRIPTION OF TABLES

TABLE 1 is a list of tropical cyclones in 1988 in the western North Pacific and the South China Sea (i.e. in the area bounded by the Equator, 45°N, 100°E and 180°). The names of these tropical cyclones are those used by the U.S. Naval Oceanography Command Center/Joint Typhoon Warning Center in Guam. The four-digit numbers in parentheses are numbers assigned to each tropical cyclone of tropical storm intensity or above by the Japan Meteorological Agency. The dates cited cover the period during which the track of each tropical cyclone lay within the above-mentioned region and might not cover its full life-span. This limitation applies to all other elements in the table.

TABLE 2 gives the number of tropical cyclone warnings for shipping issued by the Royal Observatory, Hong Kong in 1988, the duration of these warnings and the time of issue of the first and last warnings for all tropical cyclones in Hong Kong's area of responsibility (i.e. the area bounded by 10°N, 30°N, 105°E and 125°E). Times are given in hours UTC.

TABLE 3 presents a summary of the occasions on which tropical cyclone warning signals were hoisted during 1988. The sequence of the signals displayed and the number of tropical cyclone warning bulletins issued for each tropical cyclone are also given. Times are given in hours and minutes in Hong Kong Time.

TABLE 4 presents a summary of the occasions on which tropical cyclone warning signals were hoisted between 1946 and 1988. Between 1946 and 1955 the Stand By Signal, No. 1, was also used to warn strong winds. A Strong Wind Signal was introduced in 1950 to warn the onset of strong winds which were not expected to reach gale force (the symbol used was a black ball). The figures in the column under the No. 3 Signal for the years between 1950 and 1955 refer to occasions for which Strong Wind Signals were hoisted due to tropical cyclones. The Strong Wind Signal, No. 3, (represented by the symbol $\perp$) was introduced in 1956 and the Stand By Signal, No. 1, was redefined the same year. At the same time the black ball symbol was utilized to warn strong or gale monsoon winds and was named the Strong Monsoon Signal. With effect from 1 January 1973 the Gale or Storm Signals 5, 6, 7 and 8 were renumbered as 8 NW, 8 SW, 8 NE and 8 SE respectively.

TABLE 5 gives the annual number of tropical cyclones in Hong Kong's area of responsibility between 1946 and 1988. The annual number of tropical cyclones which caused tropical cyclone warning signals to be raised in Hong Kong is also included.

TABLE 6 shows the maximum, mean and minimum duration of display of each tropical cyclone warning signal during the period 1946-1988.

TABLE 7 presents the casualties and damage figures associated with tropical cyclones in Hong Kong for the period 1937-1988. The information is compiled from local newspaper reports and from the Marine Department's records.

TABLE 8 contains damage caused by tropical cyclones in 1988. The information is compiled from various government departments, public utility companies and local newspapers.

TABLE 9 contains particulars of ships damaged by tropical cyclones in 1988. Information is compiled from local newspapers and records of the Marine Department.

TABLE 10 presents the maximum storm surge (the excess, in metres, of the actual water level over that predicted in the Tide Tables) for each tropical cyclone affecting Hong Kong in 1988. Information on the nearest approach, the maximum winds at the Royal Observatory and Waglan Island, the minimum mean sea-level pressure and the total rainfall recorded at the Royal Observatory are also included together with an estimate of the minimum central pressure of each tropical cyclone during its closest approach.

TABLE 11 provides some meteorological information for those typhoons which required the hoisting of the Hurricane Signal, No. 10, in Hong Kong since 1946. The information presented includes the distances and the bearings of nearest approach, the minimum mean sea-level pressures recorded at the Royal Observatory and the maximum 60-minute mean winds and maximum gust peak speeds recorded at some stations in Hong Kong.

TABLE 12 presents the 10 wettest tropical cyclones in Hong Kong for the period 1884-1939 and 1947-1988.

TABLE 1. LIST OF TROPICAL CYCLONES IN THE WESTERN NORTH PACIFIC AND THE SOUTH CHINA SEA IN 1988

Name of tropical cyclone		Beginning of track				End of track				Remarks
		Date	Time UTC	Position °N	°E	Date	Time UTC	Position °N	°E	
Typhoon Roy	(8801)	8 Jan	0000	7.5	171.6	18 Jan	0000	13.6	114.9	dissipated
Typhoon Susan	(8802)	30 May	0000	18.3	119.7	3 Jun	0000	26.1	128.7	dissipated
Tropical Storm	(8803)	4 Jun	0000	18.1	127.2	5 Jun	1800	21.7	120.1	dissipated
Typhoon Thad	(8804)	19 Jun	0600	7.9	136.5	25 Jun	0000	29.1	134.0	dissipated
Tropical Storm Vanessa	(8805)	26 Jun	1800	8.2	129.2	29 Jun	0600	21.1	113.6	dissipated
Typhoon Warren	(8806)	13 Jul	1800	12.5	141.6	19 Jul	1800	24.5	114.5	dissipated
Tropical Storm Agnes	(8807)	29 Jul	0600	21.2	141.2	31 Jul	0000	33.1	143.7	became extratropical
Severe Tropical Storm Bill	(8809)	6 Aug	0000	24.3	128.2	9 Aug	0600	32.0	112.7	dissipated
Tropical Storm Clara	(8810)	10 Aug	0000	28.7	161.5	12 Aug	0600	30.1	161.1	became extratropical
Typhoon Doyle	(8812)	15 Aug	0000	19.5	170.0	21 Aug	1800	36.3	173.4	became extratropical
Tropical Storm Elsie (I)	(8814)	28 Aug	0000	23.0	158.0	29 Aug	0000	23.6	159.6	dissipated
(II)		30 Aug	1800	31.2	159.8	1 Sep	0000	40.5	155.8	became extratropical
Typhoon Fabian	(8815)	29 Aug	1200	30.9	144.0	3 Sep	0000	39.0	157.0	became extratropical
Tropical Storm Gay	(8816)	2 Sep	0600	26.6	134.8	3 Sep	1200	30.8	140.8	became extratropical
Typhoon Uleki	(8817)	8 Sep	1200	25.5	179.0	13 Sep	0000	31.6	166.3	became extratropical
Typhoon Hal	(8818)	8 Sep	1200	18.1	156.0	17 Sep	0000	41.5	155.5	became extratropical
Severe Tropical Storm Irma	(8819)	12 Sep	0000	22.6	160.0	15 Sep	1200	29.0	155.4	dissipated
Tropical Storm Jeff	(8820)	13 Sep	1800	15.9	135.7	15 Sep	1800	24.3	141.1	dissipated
Typhoon Kit	(8821)	19 Sep	0000	16.3	125.7	22 Sep	0000	23.1	115.9	dissipated
Severe Tropical Storm Lee	(8822)	19 Sep	1200	18.0	141.0	24 Sep	1200	26.5	129.2	became extratropical
Tropical Storm Mamie	(8823)	21 Sep	1200	14.7	111.7	23 Sep	1800	22.5	114.7	dissipated
Tropical Depression		30 Sep	1800	16.3	112.0	2 Oct	0600	18.9	108.8	dissipated
Typhoon Nelson	(8824)	1 Oct	0600	12.5	137.5	8 Oct	1800	33.4	143.3	became extratropical
Tropical Storm	(8825)	7 Oct	1800	14.8	117.0	9 Oct	1800	13.9	110.3	dissipated
Typhoon Odessa	(8826)	10 Oct	1200	19.4	138.5	17 Oct	0600	27.0	132.0	became extratropical
Typhoon Pat	(8827)	18 Oct	1200	14.0	135.0	23 Oct	0000	20.6	107.0	dissipated
Typhoon Ruby	(8828)	21 Oct	0600	10.1	136.5	28 Oct	1800	18.2	108.8	dissipated
Typhoon Skip	(8829)	3 Nov	0600	8.6	140.2	12 Nov	0000	15.7	110.2	dissipated
Typhoon Tess	(8830)	3 Nov	1200	9.0	120.8	6 Nov	1800	11.5	107.8	dissipated
Tropical Storm Val	(8831)	22 Dec	1800	12.0	129.3	26 Dec	0600	15.0	124.3	dissipated

TABLE 2. TROPICAL CYCLONE WARNINGS FOR SHIPPING ISSUED IN 1988

Tropical Cyclone	No. of warnings issued	Date and time+ of issue of		Duration of warnings (hours)
		First warning	Last warning	
Typhoon Roy	19	16 Jan 0000	18 Jan 0600	54
* Typhoon Susan	29	30 May 0300	2 Jun 1500	84
Tropical Storm	11	4 Jun 2100	6 Jun 0300	30
Typhoon Thad	9	22 Jun 0900	23 Jun 0900	24
* Tropical Storm Vanessa	17	27 Jun 1200	29 Jun 1200	48
* Typhoon Warren	20	17 Jul 0900	19 Jul 1800	57
Severe Tropical Storm Bill	6	7 Aug 0600	7 Aug 2100	15
* Typhoon Kit	25	19 Sep 0300	22 Sep 0300	72
Tropical Storm Mamie	8 5	22 Sep 0300 23 Sep 0600	23 Sep 0000 23 Sep 1800	33
Tropical Depression	11	1 Oct 0600	2 Oct 1200	30
Typhoon Nelson	10	4 Oct 0900	5 Oct 1200	27
Tropical Storm	15	8 Oct 0300	9 Oct 2100	42
* Typhoon Pat	24	20 Oct 0600	23 Oct 0300	69
* Typhoon Ruby	41	24 Oct 0300	29 Oct 0300	120
Typhoon Skip	45	7 Nov 0600	12 Nov 1800	132
Typhoon Tess	13	5 Nov 0600	6 Nov 1800	36
Tropical Storm Val	27	23 Dec 1800	27 Dec 0000	78
Total	335			951

* Tropical cyclones for which tropical cyclone warning signals were hoisted in H.K.

\+ Times are given in hours UTC

TABLE 3. TROPICAL CYCLONE WARNING SIGNALS HOISTED IN HONG KONG AND NUMBER OF WARNING BULLETINS ISSUED IN 1988.

SUMMARY

Signal	No. of occasions	Total duration
1	6	119 h 55 min
3	4	84 h 15 min
8 NORTHWEST	-	-
8 SOUTHWEST	-	-
8 NORTHEAST	-	-
8 SOUTHEAST	-	-
9	-	-
10	-	-
TOTAL	10	204 h 10 min

DETAILS

Tropical Cyclone	No. of warning bulletins issued	Signal	Hoisted		Lowered	
			Date	Time*	Date	Time*
Typhoon Susan	14	1	31 May	1630	1 Jun	2100
Tropical Storm Vanessa	10	1	28 Jun	2320	29 Jun	1650
Typhoon Warren	21	1	18 Jul	1100	19 Jul	0410
		3	19 Jul	0410	20 Jul	0500
Typhoon Kit	12	1	21 Sep	0845	21 Sep	2100
		3	21 Sep	2100	22 Sep	0910
Typhoon Pat	16	1	21 Oct	0850	21 Oct	2245
		3	21 Oct	2245	22 Oct	1545
Typhoon Ruby	29	1	25 Oct	1610	26 Oct	2245
		3	26 Oct	2245	28 Oct	0500

* Hong Kong Time (UTC + 8)

TABLE 4. FREQUENCY AND TOTAL DURATION OF DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS : 1946-1988

Signals / Year	1*	3*	8 NW[+]	8 SW[+]	8 NE[+]	8 SE[+]	9	10	Total	Total duration (hours)
1946	7	-	1	0	1	2	1	1	13	154.2
1947	6	-	1	0	1	0	0	0	8	124.2
1948	5	-	1	1	3	2	0	0	12	111.5
1949	4	-	0	0	1	1	1	0	7	67.1
1950	2	3	0	0	1	1	1	0	5	153.8
1951	4	3	0	0	2	3	1	0	10	182.8
1952	2	7	0	0	1	1	0	0	4	212.7
1953	2	4	1	1	2	1	1	0	8	251.2
1954	5	4	0	0	3	2	2	0	12	210.7
1955	0	3	0	0	0	0	0	0	0	100.8
1956	5	4	0	0	0	0	0	0	9	191.4
1957	4	9	1	1	2	2	0	1	20	295.8
1958	4	5	0	0	1	0	0	0	10	214.1
1959	1	1	0	0	0	0	0	0	2	36.6
1960	11	7	0	2	2	2	1	1	26	432.6
1961	6	7	1	2	1	0	1	1	19	192.9
1962	4	3	0	1	1	0	1	1	11	158.2
1963	4	5	0	0	1	0	0	0	10	175.8
1964	11	14	1	3	5	3	3	2	42	570.3
1965	7	6	0	0	1	1	0	0	15	239.7
1966	6	5	0	0	2	2	0	0	15	284.7
1967	8	6	0	0	2	1	0	0	17	339.2
1968	7	7	0	1	1	0	1	1	18	290.2
1969	4	2	0	0	0	0	0	0	6	110.3
1970	6	8	2	1	2	0	0	0	19	286.8
1971	9	10	1	3	2	2	1	1	29	323.4
1972	8	6	0	0	1	1	0	0	16	288.3
1973	8	6	1	1	1	0	1	0	18	416.8
1974	12	10	0	0	2	1	1	0	26	525.3
1975	8	6	1	0	0	1	1	1	18	292.3
1976	6	6	0	0	1	2	0	0	15	351.5
1977	8	6	0	0	1	0	0	0	15	395.2
1978	8	9	1	1	3	2	0	0	24	462.2
1979	5	5	1	0	2	2	1	1	17	281.3
1980	10	8	0	0	1	1	0	0	20	414.1
1981	5	4	0	0	1	1	0	0	11	202.3
1982	7	4	0	0	0	0	0	0	11	247.6
1983	8	7	0	1	2	2	1	1	22	289.7
1984	6	6	0	0	1	0	0	0	13	280.0
1985	5	4	1	0	0	1	0	0	11	193.6
1986	6	7	0	1	1	0	0	0	15	305.0
1987	6	1	0	0	0	0	0	0	7	165.8
1988	6	4	0	0	0	0	0	0	10	204.2
Total	219	198	15	20	55	40	20	12	616	11025.4
Mean	6.6	6.0	0.3	0.5	1.3	0.9	0.5	0.3	14.3	256.4

* Figures in the columns under Signals No. 1 and No. 3 have different meanings prior to 1956 and care is required in interpreting these figures. Reference may be made to paragraph 4 on page 48.

[+] Gale or Storm Signals, 5, 6, 7 and 8 were renumbered as 8 NW, 8 SW, 8 NE, 8 SE respectively with effect from 1 January 1973.

The total and annual mean values for the frequency of display of Stand By Signal No. 1 and the Strong Wind Signal No. 3 are calculated for the period 1956-1988. The corresponding values for higher signals and the total duration are calculated for the period 1946-1988.

TABLE 5. NUMBER OF TROPICAL CYCLONES IN HONG KONG'S AREA OF RESPONSIBILITY AND THE NUMBER THAT NECESSITATED THE DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS IN HONG KONG : 1946-1988

Year	Number in Hong Kong's Area of responsibility	Number necessitating the display of signals in Hong Kong
1946	13	6
1947	21	6
1948	15	4
1949	17	4
1950	14	5
1951	13	7
1952	21	9
1953	19	6
1954	18	7
1955	14	3
1956	23	5
1957	12	6
1958	15	5
1959	18	2
1960	18	9
1961	24	6
1962	20	4
1963	13	4
1964	26	10
1965	16	6
1966	17	6
1967	17	8
1968	12	6
1969	11	4
1970	21	6
1971	20	9
1972	15	5
1973	17	9
1974	21	11
1975	12	7
1976	10	5
1977	10	8
1978	20	8
1979	18	6
1980	17	10
1981	15	5
1982	16	5
1983	15	7
1984	14	5
1985	15	5
1986	16	4
1987	12	5
1988	17	6
Total	708	264
Mean	16.5	6.1

TABLE 6. DURATION OF DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS IN HONG KONG : 1946 - 1988

Signal	Duration of each occasion			Duration per year		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum
1*	20 h 47 min	124 h 40 min	1 h 20 min	137 h 56 min	273 h 15 min	12 h 40 min
3*	20 36	71 45	1 00	123 34	267 45	23 55
8 NW+	7 15	15 45	1 30	2 32	15 45	0 0
8 SW+	5 31	11 10	2 30	2 34	16 10	0 0
8 NE+	10 33	35 35	2 15	13 30	61 45	0 0
8 SE+	7 37	21 45	0 20	7 5	31 15	0 0
Gale or Storm Signals	16 15	55 17	2 40	25 41	82 25	0 0
9	3 31	6 30	0 25	1 38	11 00	0 0
10	6 03	9 10	2 30	1 41	12 10	0 0

* 1956 - 1988

+ Gale or Storm Signals, 5, 6, 7, and 8 were renumbered as 8 NW, 8 SW, 8 NE, 8 SE respectively with effect from 1 January 1973.

TABLE 7. CASUALTIES AND DAMAGE CAUSED BY TROPICAL CYCLONES IN HONG KONG : 1937 - 1988

Year	Date	Name of tropical cyclone	Ocean-going vessels in trouble	Small craft sunk or wrecked	Small craft damaged	Persons dead	Persons missing	Persons injured
1937	1 - 2 Sep	Typhoon	28	1 255	600	11 000	*	*
1957	20 - 23 Sep	T. Gloria	5	2	Several	8	*	111
1960	4 - 12 Jun	T. Mary	6	352	462	45	11	127
1961	17 - 21 May	T. Alice	*	*	*	4	0	20
	7 - 10 Sep	S.T.S. Olga	0	1	0	7	0	0
1962	28 Aug - 2 Sep	T. Wanda	36	1 297	756	130	53	*
1963	1 - 9 Sep	T. Faye	0	2	0	3	0	51
1964	26 - 28 May	T. Viola	5	18	18	0	0	41
	2 - 9 Aug	T. Ida	3	7	60	5	4	56
	2 - 6 Sep	T. Ruby	20	32	282	38	6	300
	4 - 10 Sep	T. Sally	0	0	0	9	0	24
	7 - 13 Oct	T. Dot	2	31	59	26	10	85
1965	6 - 16 Jul	T. Freda	0	1	0	2	0	16
	25 - 28 Sep	T.S. Agnes	0	0	0	5	0	3
1966	12 - 14 Jul	S.T.S. Lola	0	*	6	1	0	6
1967	19 - 22 Aug	S.T.S. Kate	3	1	0	0	0	3
1968	17 - 22 Aug	T. Shirley	1	*	3	0	0	4
1969	22 - 29 Jul	T. Viola	0	3	0	0	0	0
1970	1 - 3 Aug	T.D.	0	0	0	2+	0	0
	8 - 14 Sep	T. Georgia	2	0	*	0	0	0
1971	15 - 18 Jun	T. Freda	8	0	0	2	0	30
	16 - 22 Jul	T. Lucy	10	2	13	0	0	38
	10 - 17 Aug	T. Rose	33**	303	*	110	5	286
1972	4 - 9 Nov	T. Pamela	3	0	0	1	0	8
1973	14 - 20 Jul	T. Dot	14	*	*	1	0	38
1974	7 - 14 Jun	T. Dinah	1	*	*	0	0	0
	18 - 22 Jul	T. Ivy	2	*	*	0	0	0
	15 - 19 Oct	T. Carmen	5	*	*	1	0	0
	21 - 27 Oct	T. Della	2	*	*	0	0	0
1975	10 - 14 Aug	T.D.	3	1	*	2	1	0
	9 - 14 Oct	T. Elsie	7	2	1	0	0	46
	16 - 23 Oct	S.T.S. Flossie	1	*	*	0	0	0
1976	22 Jun - 4 Jul	T. Ruby	0	0	0	3	2	2
	21 - 26 Jul	S.T.S. Violet	0	0	0	2	1	1
	5 - 6 Aug	S.T.S. Clara	0	0	0	0	0	4
	21 - 24 Aug	T.S. Ellen	0	4	7	27	3	65
	15 - 21 Sep	T. Iris	6	0	1	0	0	27
1977	4 - 6 Jul	T.D.	0	0	0	0	0	2
	3 - 5 Sep	T.S. Carla	1	0	0	0	0	1
	22 - 25 Sep	S.T.S. Freda	2	0	0	1	0	37
1978	24 - 30 Jul	S.T.S. Agnes	0	25	42	3	0	134
	9 - 12 Aug	T.S. Bonnie	2	0	0	0	0	0
	23 - 28 Aug	S.T.S. Elaine	8	5	8	1	0	51
	22 - 26 Sep	S.T.S. Kit	0	1	0	0	7	0
	7 - 16 Oct	S.T.S. Nina	0	0	0	0	0	2
	17 - 29 Oct	T. Rita	1	5	0	0	0	3
1979	1 - 6 Jul	T. Ellis	0	2	0	0	0	0
	26 - 30 Jul	T.S. Gordon	0	2	0	0	0	0
	28 Jul - 3 Aug	T. Hope	29	167	207	12	0	260
	6 - 9 Aug	T.D.	0	3	0	0	0	0
	16 - 24 Sep	S.T.S. Mac	2	12	0	1	0	67
1980	5 - 12 Jul	S.T.S. Ida	1	0	0	0	0	0
	18 - 23 Jul	T. Joe	4	0	1	2	1	59
	20 - 28 Jul	T. Kim	0	2	1	0	0	0
	29 Oct - 2 Nov	T.S. Cary	0	0	2	0	0	0
1981	3 - 7 Jul	S.T.S. Lynn	0	0	3	0	0	32
1982	27 Jun - 2 Jul	T.S. Tess	0	1	0	0	0	16
	22 - 30 Jul	T. Andy	0	0	1	0	0	0
	5 - 16 Sep	T. Irving	0	0	2	0	0	0
1983	12 - 19 Jul	T. Vera	0	1	0	0	0	0
	29 Aug - 9 Sep	T. Ellen	44	135	225	10	12	333
	10 - 14 Oct	T. Joe	2	0	3	0	0	58
	20 - 26 Oct	S.T.S. Lex	0	0	1	0	0	0
1984	27 Aug - 7 Sep	T. Ike	0	0	0	0	0	1
1985	19 - 25 Jun	T. Hal	0	4	2	0	1	13
	1 - 7 Sep	T. Tess	6	1	3	2	0	12
	13 - 22 Oct	T. Dot	0	0	0	0	0	1
1986	3 - 12 Jul	T. Peggy	3	0	3	1	0	26
	9 - 12 Aug	T.D.	0	1	5	0	0	3
	18 Aug - 6 Sep	T. Wayne	0	3	0	3	1	15+
	11 - 19 Oct	T. Ellen	1	2	1	0	0	4
1987	16 - 27 Oct	T. Lynn	0	0	0	0	0	1
1988	14 - 20 Jul	T. Warren	1	2	1	0	1	12
	19 - 22 Sep	T. Kit	0	0	1	0	0	0
	18 - 23 Oct	T. Pat	0	0	0	2	0	1
	21 - 29 Oct	T. Ruby	0	0	0	0	0	4

N.B. Information compiled from Hong Kong newspapers and from Marine Department's records
* Data unavailable
\+ Struck by lightning.

****Note: Number of Ocean-going vessels in trouble is revised on 30 Jul 2021.**

TABLE 8. DAMAGE CAUSED BY TROPICAL CYCLONES IN HONG KONG, 1988

Name of tropical cyclone	Month	Damage in physical terms					Damage in monetary terms (million HK$)					
		Agricultural	Public works facilities	Public utilities	Private property	landslide & collapse of slope	Agricultural	Public works facilities	Public utilities	Private property	Others	Total
T. Warren	Jul	fishponds : 100 hectares farmland : 270 hectares livestock : 134 370 heads vegetable : 3 600 tonnes fish : 220 tonnes	4 catchwaters	2 sites	50 units	22	13.5	0.2	0.5	-	-	14.2
T. Pat	Oct	-	-	-	1 unit	-	-	-	-	-	-	-

TABLE 9. SHIPS DAMAGED BY TROPICAL CYCLONES IN HONG KONG, 1988

Name of tropical cyclone	Date	Type of Vessel	Location of incident	Nature of incident
T. Warren	18-20 Jul	One Dry Cargo Ship	Buoy A10	Anchor chain broken

TABLE 10. A SUMMARY OF METEOROLOGICAL OBSERVATIONS RECORDED IN HONG KONG DURING THE PASSAGES OF TROPICAL CYCLONES IN 1988

(a)

Name of tropical cyclone	Month	Nearest approach to Hong Kong						Minimum hourly M.S.L. pressure at the Royal Observatory			Maximum storm surge							
		Day	Time*	Direction	Distance	Movement	Estimated minimum central pressure	Day	Time*	Pressure	Ko Lau Wan	Lok On Pai	Quarry Bay	Tai Po Kau	Tsim Bei Tsui	Tamar	Waglan Island	Tai O
					km	km/h	hPa			hPa	m	m	m	m	m	m	m	m
T. Susan	May	31	0700	SE	430	NE 6	975	1	1700	998.5	-	0.57	0.37	-	0.92	0.40	0.45	0.40
T.S. Vanessa	Jun	29	1700	WSW	120	NNW 22	992	29	1600	1003.3	-	0.34	0.15	0.31	0.58	0.55	-	0.19
T. Warren	Jul	19	2100	NE	180	NW 25	980	19	1900	995.3	0.63	0.42	0.31	0.67	1.09	0.17	-	0.34
T. Kit	Sep	22	1100	NE	170	WNW 20	990	22	0300	1000.8	0.85	0.78	0.32	0.82	0.71	0.30	-	-
T. Pat	Oct	22	0600	SSW	540	WNW 30	980	21	1600	1008.0	0.62	0.58	0.51	0.82	0.55	0.46	-	-
T. Ruby	Oct	27	1700	SSW	490	W 13	975	26	1600	1004.1	0.99	0.73	0.68	1.13	0.75	-	-	-

* Hong Kong Time (UTC + 8)

(b)

Name of tropical cyclone	Month	Maximum 60-min mean wind in points and km/h		Maximum 10-min mean wind in points and km/h		Maximum gust peak speed in km/h with direction in points		Rainfall at the Royal Observatory (mm)				
		Royal Observatory	Waglan Island	Royal Observatory	Waglan Island	Royal Observatory	Waglan Island	(i) 600 km	(ii) 24 hours	(iii) 48 hours	(iv) 72 hours	(i) + (iv)
T. Susan	May	N 14	N 40	N 19	N 41	N 36	NNW 58	6.3	-	-	-	6.3
T.S. Vanessa	Jun	E 30	E 41	E 36	W 56	E 58	ESE 67	6.6	16.1	20.3	20.3	26.9
T. Warren	Jul	SW 41	WSW 68	S 51	WSW 83	SW 99	ESE 115	220.2	27.7	30.4	30.4	250.6
T. Kit	Sep	WNW 22	N 52	NNE 23	N 58	NNE 41	N 72	0.8	3.2	11.5	11.7	12.5
T. Pat	Oct	E 34	E 67	E 36	E 67	E 63	E 85	Trace	25.7	27.2	27.2	27.2
T. Ruby	Oct	NNE 22	N 59	NNE 25	N 59	NNE 51	N 76	6.7	1.0	1.0	11.0	17.7

N.B. (i) during the period when the tropical cyclone was centred within 600 km of Hong Kong.
(ii) during the 24-hour period after the tropical cyclone moved outside (or dissipated within) the 600 km radius.
(iii) during the 48-hour period after the tropical cyclone moved outside (or dissipated within) the 600 km radius.
(iv) during the 72-hour period after the tropical cyclone moved outside (or dissipated within) the 600 km radius.

TABLE 11 TYPHOONS WHICH REQUIRED THE HOISTING OF THE HURRICANE SIGNAL NO. 10 DURING THE PERIOD 1946-1918

Name of typhoon	Date	Nearest approach to Royal Observatory km	Minimum M.S.L. pressure (hPa)		Maximum 60-min mean winds in points and km/h								Maximum gust peak speed in km/h with direction in points							
			Hourly	Inst.	Royal Observatory	Hong Kong Airport	Waglan Island	Cheung Chau	Tate's Cairn	Cape Collinson	Green Island	Castle Peak	Royal Observatory	Hong Kong Airport	Waglan Island	Cheung Chau	Tate's Cairn	Cape Collinson	Green Island	Castle Peak
-	18 Jul 1946	S 70	985.7	-	NE -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gloria	22 Sep 1957	SW 55	986.2	984.3	ESE 115	ESE 72	E 113	-	-	-	-	-	E 187	ENE 158	ENE 185	-	-	-	-	-
Mary	9 Jun 1960	WNW 10	974.3	973.8	SSE 96	SSE 92	SSW 112	-	-	-	-	-	SSE 191	SE 164	SSW 194	-	-	-	-	-
Alice	19 May 1961	0	981.6	981.1	ENE 83	E 70	ESE 90	ENE 76	-	-	-	-	E 166	ENE 139	SW 128	ENE 135	-	-	-	-
Wanda	1 Sep 1962	SSW 20	955.1	953.2	N 133	N 108	NW 148	NW 118	SE 189	-	-	-	N 259	N 229	NNW 216	NW 232	ESE 284	-	-	-
Ruby	5 Sep 1964	SW 30	971.0	968.2	E 110	N 118	ENE 148	NE 113	ESE 167	SSE 153	-	-	NNE 227	NW 203	E 230	NNE 216	E 268	S 221	-	-
Dot	13 Oct 1964	E 35	978.9	977.3	NNW 88	N 67	N 117	NNW 96	NNE 157	N 101	-	-	N 175	N 198	N 184	WNW 205	NE 220	NNE 187	-	-
Shirley	21 Aug 1968	0	968.7	968.6	N 68	N 75	NNE 124	SSW 90	NNE 126	SSW 85	-	-	N 133	N 151	NE 209	SSW 167	NNE 203	N 173	-	-
Rose	17 Aug 1971	WSW 20	984.5	982.8	SE 103	SE 122	ESE 140	SE 131	S 148	SSW 137	-	-	ESE 224	ESE 211	ESE 189	SE 194	S 221	S 191	-	-
Elsie	14 Oct 1975	S 50	996.4	996.2	ENE 58	NNW 67	NNE 118	N 106	NE 130	-	NNW 118	N 65	NE 140	N 140	ENE 176	NE 158	NNE 180	-	NE 167	N 121
Hope	2 Aug 1979	NNW 10	961.8	961.6	W 75	W 115	SW 144	SSW 117	NW 115	-	W 108	- 96	W 175	WNW 182	SW 198	WSW 185	WNW 229	-	W 167	- 173
Ellen	9 Sep 1983	SW 45	983.9	983.1	E 92	E 112	ESE 169	ESE 171	E 126	-	S 137	SE 94	E 185	E 203	E 227	SSE 238	ENE 218	-	S 220*	SE 171

* estimated, exceeding upper limit of anemogram.

TABLE 12 THE 10 WETTEST TROPICAL CYCLONES IN HONG KONG (1884-1939, 1947-1988)

Tropical Cyclone			Rainfall at the Royal Observatory (mm)				
Year	Month	Name	(i) 600 km	(ii) 24 hours	(iii) 48 hours	(iv) 72 hours	(i) + (iv)
* 1926	Jul	-	34.8	534.0	561.1	562.2	597.0
* 1916	Jun	-	494.8	27.9	59.4	67.2	562.0
1965	Sep	AGNES	404.6	8.9	64.3	126.1	530.7
1978	Jul	AGNES	502.4	12.3	12.3	16.6	519.0
1976	Aug	ELLEN	90.7	394.2	421.0	425.4	516.1
1982	Aug	DOT	41.2	322.5	403.1	450.5	491.7
* 1904	Aug	-	446.5	NIL	3.7	26.7	473.2
1974	Oct	CARMEN	307.6	150.3	161.7	162.1	469.7
* 1960	Jun	MARY	427.5	NIL	2.6	13.3	440.8
* 1911	Aug	-	270.5	168.3	168.3	168.3	438.8

N.B. (i) during the period when the tropical cyclone was centred within 600 km of Hong Kong.

(ii) during the 240-hour period after the tropical cyclone moved outside (or dissipated within) the 600 km radius.

(iii) during the 48-hour period after the tropical cyclone moved outside (or dissipated within) the 600 km radius.

(iv) during the 72-hour period after the tropical cyclone moved outside (or dissipated within) the 600 km radius.

* For years prior to 1961, (i) is the sum of daily rainfall on those days when the tropical cyclone was centred within 600 km of Hong Kong, (ii) to (iv) are the daily rainfall figures of the following three days.

5. TROPICAL CYCLONE POSITION AND INTENSITY DATA, 1988

Six-hourly position and intensity data are tabulated for the following tropical cyclones in 1988 in the western North Pacific and the South China Sea (i.e. the area between the equator and 45°N, and between 100°E and 180°).

Surface winds in this section refer to wind speeds averaged over a period of 10 minutes.

SIX-HOURLY POSITION AND INTENSITY DATA OF
TYPHOON ROY (8801)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jan	8	0000	T.D.	990	16	7.5	171.6
		0600	T.S.	985	18	7.6	170.5
		1200	T.S.	980	21	7.9	169.4
		1800	T.S.	980	23	8.4	168.1
	9	0000	S.T.S.	975	25	8.4	166.7
		0600	S.T.S.	970	28	8.3	165.3
		1200	S.T.S.	965	31	8.3	163.9
		1800	S.T.S.	965	31	8.3	162.1
	10	0000	T.	960	36	8.6	159.7
		0600	T.	955	41	9.1	157.4
		1200	T.	950	46	9.7	155.2
		1800	T.	950	49	10.6	153.2
	11	0000	T.	950	49	11.2	151.8
		0600	T.	950	49	11.8	150.4
		1200	T.	950	49	12.4	149.1
		1800	T.	950	49	12.9	147.8
	12	0000	T.	950	49	13.3	146.6
		0600	T.	950	49	13.7	145.4
		1200	T.	950	49	14.1	144.2
		1800	T.	945	49	14.5	143.3
	13	0000	T.	940	51	15.0	142.5
		0600	T.	940	51	15.3	141.8
		1200	T.	940	49	15.3	141.1
		1800	T.	945	43	14.8	140.2
	14	0000	T.	950	41	14.0	139.2
		0600	T.	950	41	13.3	137.7
		1200	T.	950	41	12.6	135.9
		1800	T.	950	41	12.3	134.0
	15	0000	T.	950	41	12.3	131.9
		0600	T.	955	41	12.7	129.7
		1200	T.	960	41	12.9	127.8
		1800	T.	965	36	13.0	126.1
	16	0000	T.	970	33	12.9	124.4
		0600	T.	975	33	13.0	123.2
		1200	S.T.S.	980	31	13.6	122.2
		1800	S.T.S.	990	28	13.7	121.2
	17	0000	T.S.	995	21	13.3	119.7
		0600	T.S.	995	21	13.6	117.9
		1200	T.S.	1000	18	13.7	116.9
		1800	T.S.	1000	18	13.7	115.9
	18	0000	T.D.	1005	16	13.6	114.9

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TYPHOON SUSAN (8802)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
May	30	0000	T.D.	1000	13	18.3	119.7
		0600	T.D.	995	16	17.9	119.2
		1200	T.D.	995	16	18.3	118.8
		1800	T.S.	990	21	18.6	118.4
	31	0000	S.T.S.	985	25	18.7	118.2
		0600	S.T.S.	980	28	18.9	117.9
		1200	S.T.S.	980	28	19.4	117.7
		1800	T.	975	33	19.9	117.6
Jun	1	0000	T.	970	33	20.2	117.7
		0600	T.	965	36	20.6	118.2
		1200	T.	965	36	21.1	118.9
		1800	T.	970	33	21.5	119.8
	2	0000	T.	970	33	22.1	120.9
		0600	S.T.S.	975	28	23.2	122.6
		1200	S.T.S.	980	25	24.2	124.4
		1800	T.S.	990	18	25.3	126.6
	3	0000	T.D.	995	16	26.1	128.7

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
THE TROPICAL STORM (8803) of 4-6 JUNE

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jun	4	0000	T.D.	1000	13	18.1	127.2
		0600	T.D.	1000	13	18.3	126.1
		1200	T.D.	1000	13	18.6	125.2
		1800	T.S.	998	18	19.7	124.7
	5	0000	T.S.	996	21	20.2	123.6
		0600	T.S.	998	18	21.0	122.3
		1200	T.D.	1000	16	21.4	121.0
		1800	T.D.	1002	13	21.7	120.1

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TYPHOON THAD (8804)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jun	19	0600	T.D.	1000	16	7.9	136.5
		1200	T.D.	1000	16	8.2	135.7
		1800	T.D.	1000	16	8.4	134.8
	20	0000	T.D.	1000	16	8.8	133.5
		0600	T.S.	995	18	9.4	132.5
		1200	T.S.	990	21	10.1	132.1
		1800	T.S.	985	23	11.8	131.5
	21	0000	T.S.	985	23	13.0	130.1
		0600	T.S.	985	23	13.9	128.8
		1200	T.S.	985	23	14.6	127.7
		1800	S.T.S.	980	25	15.2	126.6
	22	0000	S.T.S.	980	25	15.6	125.8
		0600	S.T.S.	975	31	16.0	125.1
		1200	S.T.S.	975	31	16.7	124.4
		1800	S.T.S.	975	31	17.8	124.2
	23	0000	T.	965	33	18.9	124.5
		0600	T.	965	33	20.0	124.8
		1200	T.	965	33	21.3	125.5
		1800	S.T.S.	970	31	22.8	126.5
	24	0000	S.T.S.	980	25	24.2	127.5
		0600	T.S.	985	23	25.5	128.7
		1200	T.S.	990	21	26.7	130.0
		1800	T.S.	993	18	27.9	131.7
	25	0000	T.D.	995	16	29.1	134.0

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF TROPICAL STORM VANESSA (8805)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jun	26	1800	T.D.	1000	13	8.2	129.2
	27	0000	T.D.	995	16	9.4	127.6
		0600	T.D.	995	16	10.7	126.3
		1200	T.D.	995	16	11.7	124.2
		1800	T.D.	995	16	12.3	122.1
	28	0000	T.D.	995	16	13.1	120.3
		0600	T.D.	995	16	14.2	118.4
		1200	T.S.	992	18	15.8	116.8
		1800	T.S.	992	18	17.9	116.0
	29	0000	T.S.	992	18	19.4	114.8
		0600	T.S.	992	18	21.1	113.6

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TYPHOON WARREN (8806)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jul	13	1800	T.D.	1000	16	12.5	141.6
	14	0000	T.S.	995	18	12.6	140.9
		0600	T.S.	995	18	12.6	140.2
		1200	T.S.	990	21	12.7	139.6
		1800	T.S.	990	23	12.8	138.9
	15	0000	S.T.S.	985	25	12.9	138.2
		0600	S.T.S.	980	28	13.0	137.5
		1200	S.T.S.	980	28	13.3	136.3
		1800	S.T.S.	975	31	13.6	134.9
	16	0000	T.	970	33	14.1	133.5
		0600	T.	965	39	14.7	132.0
		1200	T.	955	43	15.3	130.4
		1800	T.	945	46	15.7	128.8
	17	0000	T.	935	51	16.3	127.3
		0600	T.	935	51	16.9	125.7
		1200	T.	940	49	17.6	124.0
		1800	T.	945	46	18.2	122.6
	18	0000	T.	945	46	18.7	121.6
		0600	T.	950	43	19.3	120.5
		1200	T.	950	43	20.0	119.3
		1800	T.	955	41	20.7	118.3
	19	0000	T.	960	41	21.5	117.3
		0600	T.	965	39	22.5	116.5
		1200	S.T.S.	980	31	23.4	115.5
		1800	T.S.	990	21	24.5	114.5

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF TROPICAL STORM AGNES (8807)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jul	29	0600	T.D.	985	16	21.2	141.2
		1200	T.S.	980	18	22.3	140.7
		1800	T.S.	975	21	24.1	140.5
	30	0000	T.S.	975	21	25.9	141.2
		0600	T.S.	975	18	27.7	141.5
		1200	T.S.	980	18	29.4	142.0
		1800	T.S.	980	18	31.2	142.6
	31	0000	T.S.	980	23	33.1	143.7

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF
SEVERE TROPICAL STORM BILL (8809)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	6	0000	T.D.	1000	13	24.3	128.2
		0600	T.D.	1000	13	24.8	128.2
		1200	T.D.	998	16	25.6	127.9
		1800	T.S.	995	18	26.6	126.9
	7	0000	T.S.	990	23	27.5	125.6
		0600	S.T.S.	985	25	28.3	124.3
		1200	S.T.S.	985	25	29.1	122.9
		1800	S.T.S.	980	31	29.8	121.0
	8	0000	S.T.S.	987	28	30.4	119.4
		0600	T.S.	985	23	30.9	117.8
		1200	T.S.	990	18	31.2	116.3
		1800	T.S.	990	18	31.5	114.8
	9	0000	T.D.	995	16	31.8	113.7
		0600	T.D.	995	16	32.0	112.7

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TROPICAL STORM CLARA (8810)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	10	0000	T.D.	1000	16	28.7	161.5
		0600	T.D.	1000	16	28.7	161.0
		1200	T.D.	1000	16	28.7	160.7
		1800	T.D.	1000	16	28.6	160.4
	11	0000	T.S.	997	18	28.4	160.2
		0600	T.S.	995	21	28.2	160.6
		1200	T.S.	997	18	28.8	160.8
		1800	T.D.	1000	16	29.2	160.9
	12	0000	T.D.	1000	16	29.6	161.0
		0600	T.D.	1000	16	30.1	161.1

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF TYPHOON DOYLE (8812)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	15	0000	T.S.	995	18	19.5	170.0
		0600	T.S.	990	21	19.7	169.0
		1200	T.S.	985	23	20.0	168.0
		1800	S.T.S.	980	25	20.1	167.0
	16	0000	S.T.S.	970	31	20.2	166.2
		0600	T.	955	39	20.4	165.4
		1200	T.	940	46	20.8	164.8
		1800	T.	940	46	21.4	164.5
	17	0000	T.	935	51	22.0	164.3
		0600	T.	930	57	22.9	164.2
		1200	T.	935	51	23.8	164.3
		1800	T.	940	46	24.7	164.6
	18	0000	T.	945	43	25.9	165.3
		0600	T.	945	43	27.0	166.0
		1200	T.	950	41	28.0	166.7
		1800	T.	955	39	28.9	167.7
	19	0000	T.	960	36	29.6	168.6
		0600	T.	960	36	30.1	169.2
		1200	T.	965	33	30.6	169.9
		1800	S.T.S.	970	31	31.1	170.6
	20	0000	S.T.S.	970	31	31.6	171.4
		0600	S.T.S.	975	28	32.0	172.3
		1200	S.T.S.	980	25	32.5	173.0
		1800	S.T.S.	980	25	33.3	173.3
	21	0000	T.S.	985	23	34.1	173.3
		0600	T.S.	985	23	34.9	173.3
		1200	T.S.	990	21	35.6	173.3
		1800	T.S.	995	18	36.3	173.4

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF TROPICAL STORM ELSIE I (8814)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	28	0000	T.D.	1002	13	23.0	158.0
		0600	T.D.	1002	13	22.7	158.4
		1200	T.D.	1000	16	22.5	158.8
		1800	T.D.	1000	16	22.9	159.2
	29	0000	T.D.	1002	13	23.6	159.6

Dissipated

TROPICAL STORM ELSIE II (8814)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	30	1800	T.D.	995	16	31.2	159.8
	31	0000	T.S.	985	23	32.7	158.5
		0600	T.S.	985	23	34.2	157.0
		1200	T.D.	990	16	36.0	156.0
		1800	T.D.	990	16	38.1	155.6
Sep	1	0000	T.D.	995	13	40.5	155.8

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF TYPHOON FABIAN (8815)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	29	1200	T.D.	1000	16	30.9	144.0
		1800	T.D.	1000	16	31.1	144.4
	30	0000	T.S.	995	18	31.1	145.0
		0600	T.S.	995	21	31.1	146.0
		1200	T.S.	995	21	31.1	146.8
		1800	T.S.	990	23	31.1	147.7
	31	0000	S.T.S.	985	25	31.1	148.7
		0600	S.T.S.	985	25	31.0	149.9
		1200	S.T.S.	985	25	31.0	151.0
		1800	S.T.S.	985	25	31.0	152.0
Sep	1	0000	S.T.S.	985	25	31.0	152.9
		0600	S.T.S.	985	25	31.5	153.5
		1200	S.T.S.	980	28	32.0	153.5
		1800	S.T.S.	975	31	32.5	153.6
	2	0000	T.	970	36	33.0	153.6
		0600	T.	975	33	34.0	153.7
		1200	S.T.S.	980	31	35.5	153.9
		1800	S.T.S.	980	31	37.1	154.6
	3	0000	S.T.S.	985	28	39.0	157.0

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF TROPICAL STORM GAY (8816)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	2	0600	T.D.	1000	13	26.6	134.8
		1200	T.D.	998	16	27.0	136.0
		1800	T.S.	995	18	27.6	137.2
	3	0000	T.S.	995	18	28.6	138.1
		0600	T.S.	995	18	29.7	139.1
		1200	T.D.	998	16	30.8	140.8

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF TYPHOON ULEKI (8817)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	8	1200	T.	955	41	25.5	179.0
		1800	T.	955	41	26.0	177.6
	9	0000	T.	955	41	26.5	176.5
		0600	T.	955	41	27.0	175.3
		1200	T.	950	43	27.3	174.4
		1800	T.	950	43	27.4	173.7
	10	0000	T.	955	41	27.5	173.0
		0600	T.	955	41	27.7	172.2
		1200	T.	960	39	28.1	171.5
		1800	T.	955	41	28.6	171.1
	11	0000	T.	945	46	29.2	170.6
		0600	T.	945	46	29.9	170.1
		1200	T.	955	39	30.3	169.7
		1800	T.	965	33	30.7	169.4
	12	0000	S.T.S.	970	31	31.0	169.0
		0600	S.T.S.	975	28	31.2	168.5
		1200	S.T.S.	980	25	31.4	167.8
		1800	S.T.S.	980	25	31.4	167.1
	13	0000	T.S.	985	23	31.6	166.3

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF TYPHOON HAL (8818)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	8	1200	T.D.	1000	16	18.1	156.0
		1800	T.D.	1000	16	19.0	154.8
	9	0000	T.S.	995	18	19.8	153.1
		0600	T.S.	990	21	20.4	152.0
		1200	T.S.	990	21	20.9	150.9
		1800	T.S.	990	21	21.1	150.0
	10	0000	T.S.	985	23	21.1	149.3
		0600	T.S.	985	23	21.0	148.6
		1200	S.T.S.	980	25	20.9	148.0
		1800	S.T.S.	970	31	20.8	147.4
	11	0000	S.T.S.	970	31	20.5	146.9
		0600	T.	965	33	20.1	146.3
		1200	T.	955	39	19.8	146.0
		1800	T.	955	39	19.7	145.9
	12	0000	T.	950	41	19.9	145.9
		0600	T.	950	41	20.6	146.3
		1200	T.	945	43	21.4	145.8
		1800	T.	945	43	22.2	145.3
	13	0000	T.	945	43	23.1	144.9
		0600	T.	940	46	24.0	144.4
		1200	T.	935	49	25.0	144.0
		1800	T.	935	49	26.0	143.7
	14	0000	T.	935	49	27.1	143.3
		0600	T.	945	43	28.2	143.2
		1200	T.	955	39	29.4	142.9
		1800	T.	960	36	30.5	142.4
	15	0000	T.	965	33	31.3	142.0
		0600	T.	965	33	32.2	142.4
		1200	T.	965	33	33.1	143.0
		1800	T.	965	33	34.3	143.7
	16	0000	T.	965	33	35.7	144.8
		0600	S.T.S.	970	31	36.9	146.1
		1200	S.T.S.	980	25	38.4	148.6
		1800	T.S.	990	21	40.0	152.0
	17	0000	T.S.	995	18	41.5	155.5

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF SEVERE TROPICAL STORM IRMA (8819)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	12	0000	T.S.	995	18	22.6	160.0
		0600	T.S.	995	18	23.2	160.0
		1200	T.S.	995	18	23.7	159.6
		1800	T.S.	995	18	24.2	159.0
	13	0000	T.S.	990	21	24.7	158.4
		0600	T.S.	985	23	25.1	158.1
		1200	T.S.	985	23	25.5	158.0
		1800	T.S.	985	23	25.7	157.9
	14	0000	S.T.S.	980	25	26.3	157.8
		0600	S.T.S.	980	25	26.7	157.6
		1200	S.T.S.	980	25	27.1	157.3
		1800	S.T.S.	980	25	27.3	157.0
	15	0000	T.S.	985	23	27.6	156.6
		0600	T.S.	990	21	28.1	156.0
		1200	T.D.	995	16	29.0	155.4

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TROPICAL STORM JEFF (8820)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	13	1800	T.D.	1000	16	15.9	135.7
	14	0000	T.S.	995	18	16.6	136.6
		0600	T.S.	995	21	17.3	137.4
		1200	T.S.	995	21	18.2	138.2
		1800	T.S.	990	21	19.4	139.0
	15	0000	T.S.	990	21	20.7	139.6
		0600	T.S.	990	21	21.8	140.1
		1200	T.S.	995	18	23.0	140.6
		1800	T.D.	1000	16	24.3	141.1

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF TYPHOON KIT (8821)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	19	0000	T.D.	1002	13	16.3	125.7
		0600	T.D.	1000	16	17.3	123.9
		1200	T.D.	1000	16	17.4	122.8
		1800	T.D.	1000	16	17.4	121.6
	20	0000	T.D.	1000	16	18.0	120.3
		0600	T.D.	1000	16	18.7	119.7
		1200	T.S.	995	18	19.5	119.1
		1800	T.S.	990	23	19.9	118.7
	21	0000	S.T.S.	985	25	20.3	118.4
		0600	S.T.S.	980	28	20.8	117.8
		1200	T.	970	33	21.4	117.3
		1800	S.T.S.	980	28	22.4	116.6
	22	0000	T.S.	990	21	23.1	115.9

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
SEVERE TROPICAL STORM LEE (8822)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	19	1200	T.D.	1007	13	18.0	141.0
		1800	T.D.	1007	13	18.0	140.0
	20	0000	T.D.	1005	16	18.1	139.1
		0600	T.D.	1004	16	18.3	138.0
		1200	T.D.	1004	16	18.5	136.7
		1800	T.S.	998	18	18.5	135.5
	21	0000	T.S.	997	18	18.3	134.5
		0600	T.S.	995	21	18.2	133.3
		1200	T.S.	990	23	18.3	132.3
		1800	S.T.S.	985	25	18.5	131.5
	22	0000	T.S.	992	21	19.2	130.6
		0600	T.S.	992	21	19.7	129.8
		1200	S.T.S.	985	26	20.1	128.9
		1800	S.T.S.	982	29	20.5	127.7
	23	0000	S.T.S.	982	29	21.3	127.7
		0600	T.S.	990	23	22.1	127.1
		1200	T.S.	990	23	22.6	126.4
		1800	T.S.	992	21	23.6	126.6
	24	0000	T.S.	994	18	24.2	127.6
		0600	T.S.	996	18	25.5	128.2
		1200	T.D.	998	16	26.5	129.2

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF TROPICAL STORM MAMIE (8823)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	21	1200	T.D.	995	16	14.7	111.7
		1800	T.D.	995	16	14.9	111.8
	22	0000	T.S.	990	21	15.5	112.1
		0600	T.S.	990	21	16.6	112.6
		1200	T.S.	985	23	17.8	112.7
		1800	T. S.	990	21	19.0	112.8
	23	0000	T.S.	990	21	19.9	113.5
		0600	T.S.	995	18	20.8	114.6
		1200	T.S.	998	18	22.1	114.6
		1800	T.S.	998	18	22.5	114.7

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
THE TROPICAL DEPRESSION OF 1-2 OCTOBER

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	30	1800	T.D.	997	16	16.3	112.0
Oct	1	0000	T.D.	996	16	16.9	111.6
		0600	T.D.	996	16	17.5	111.1
		1200	T.D.	996	16	18.3	110.6
		1800	T.D.	998	16	18.6	109.9
	2	0000	T.D.	1000	16	18.7	109.2
		0600	T.D.	1000	16	18.9	108.8

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TYPHOON NELSON (8824)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Oct	1	0600	T.D.	1002	13	12.5	137.5
		1200	T.S.	998	18	12.6	136.5
		1800	T.S.	996	18	12.9	135.4
	2	0000	T.S.	992	23	13.4	134.3
		0600	T.S.	992	23	14.0	133.0
		1200	S.T.S.	985	25	14.3	132.0
		1800	S.T.S.	975	31	14.9	130.8
	3	0000	T.	970	36	15.3	129.5
		0600	T.	965	39	16.1	128.5
		1200	T.	955	43	16.7	127.5
		1800	T.	950	46	17.5	126.5
	4	0000	T.	940	51	18.4	125.9
		0600	T.	925	57	19.4	125.2
		1200	T.	915	61	20.1	124.7
		1800	T.	918	61	20.7	124.3
	5	0000	T.	918	61	21.3	124.3
		0600	T.	918	61	21.9	124.5
		1200	T.	925	57	22.6	125.2
		1800	T.	935	51	23.3	125.9
	6	0000	T.	935	51	23.9	126.7
		0600	T.	940	49	24.6	127.7
		1200	T.	940	49	25.2	128.7
		1800	T.	942	49	25.8	129.8
	7	0000	T.	942	49	26.6	131.0
		0600	T.	942	49	27.6	132.2
		1200	T.	945	46	28.5	133.5
		1800	T.	950	43	29.5	134.8
	8	0000	T.	955	41	30.4	136.3
		0600	T.	960	36	31.5	138.4
		1200	S.T.S.	970	31	32.6	140.5
		1800	S.T.S.	975	28	33.4	143.3

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF
THE TROPICAL STORM (8825) OF 8-10 OCTOBER

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Oct	7	1800	T.D.	1003	13	14.8	117.0
	8	0000	T.D.	1000	16	14.8	116.0
		0600	T.S.	995	18	14.6	115.1
		1200	T.S.	995	18	14.2	114.2
		1800	T.S.	994	21	14.3	113.5
	9	0000	T.S.	992	21	14.4	112.6
		0600	T.S.	992	21	14.1	111.7
		1200	T.S.	992	21	13.9	111.0
		1800	T.D.	998	16	13.9	110.3

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TYPHOON ODESSA (8826)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Oct	10	1200	T.D.	1000	16	19.4	138.5
		1800	T.D.	1000	16	18.9	137.0
	11	0000	T.D.	998	16	18.8	135.7
		0600	T.D.	998	16	19.1	134.1
		1200	T.S.	995	18	19.3	132.5
		1800	T.S.	995	18	19.3	131.2
	12	0000	T.S.	990	21	19.1	130.4
		0600	T.S.	990	21	19.0	129.5
		1200	T.S.	985	23	19.4	129.2
		1800	T.S.	990	21	20.4	129.2
	13	0000	S.T.S.	982	25	21.1	128.9
		0600	S.T.S.	975	31	21.7	128.8
		1200	T.	960	39	22.0	129.0
		1800	T.	960	39	22.1	129.3
	14	0000	T.	960	39	22.5	129.5
		0600	T.	955	41	23.1	130.3
		1200	T.	960	39	23.4	130.9
		1800	T.	960	39	24.4	131.3
	15	0000	T.	960	39	25.0	131.8
		0600	T.	950	43	25.3	132.3
		1200	T.	960	39	25.5	132.9
		1800	T.	965	36	25.7	133.3
	16	0000	T.	970	33	25.7	133.5
		0600	S.T.S.	980	28	25.9	134.1
		1200	T.S.	995	18	26.0	134.3
		1800	T.D.	1000	16	26.2	132.8
	17	0000	T.D.	1000	16	26.6	132.2
		0600	T.D.	1000	16	27.0	132.0

Became extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF
TYPHOON PAT (8827)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Oct	18	1200	T.D.	1001	13	14.0	135.0
		1800	T.D.	1000	16	15.3	133.5
	19	0000	T.S.	998	18	16.2	131.8
		0600	T.S.	992	23	16.4	130.9
		1200	S.T.S.	990	25	16.5	130.1
		1800	S.T.S.	990	25	16.5	128.5
	20	0000	S.T.S.	987	28	16.2	126.1
		0600	S.T.S.	985	28	16.3	124.6
		1200	S.T.S.	985	28	16.5	123.0
		1800	S.T.S.	990	25	16.5	120.2
	21	0000	S.T.S.	985	28	16.4	117.9
		0600	S.T.S.	980	31	16.6	116.6
		1200	S.T.S.	980	31	16.9	114.9
		1800	S.T.S.	980	31	17.4	113.4
	22	0000	T.	975	33	17.9	111.9
		0600	T.	975	33	18.4	110.4
		1200	S.T.S.	985	25	19.0	108.8
		1800	T.S.	992	21	20.0	107.2
	23	0000	T.D.	998	16	20.6	107.0

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF TYPHOON RUBY (8828)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Oct	21	0600	T.D.	1001	13	10.1	136.5
		1200	T.D.	998	16	9.8	135.5
		1800	T.S.	995	18	9.5	135.3
	22	0000	T.S.	992	21	9.1	135.1
		0600	S.T.S.	985	25	9.1	134.2
		1200	S.T.S.	980	28	9.4	133.4
		1800	S.T.S.	975	31	10.1	132.5
	23	0000	T.	972	33	10.6	131.1
		0600	T.	970	33	10.8	129.6
		1200	T.	965	36	11.2	128.2
		1800	T.	960	39	11.9	126.9
	24	0000	T.	950	41	12.6	125.6
		0600	T.	940	49	14.1	124.4
		1200	T.	930	57	14.7	123.0
		1800	T.	935	54	15.2	121.8
	25	0000	T.	945	49	15.8	120.3
		0600	T.	955	43	15.9	119.1
		1200	T.	965	39	15.7	117.9
		1800	T.	968	36	16.1	117.9
	26	0000	T.	968	36	16.7	117.2
		0600	T.	970	33	16.7	116.9
		1200	T.	970	33	17.2	116.5
		1800	T.	970	33	17.6	115.4
	27	0000	S.T.S.	975	31	17.8	114.0
		0600	S.T.S.	975	31	17.9	113.3
		1200	S.T.S.	980	28	18.1	112.5
		1800	T.S.	985	23	18.3	111.9
	28	0000	T.S.	985	23	18.5	111.3
		0600	T.S.	990	21	18.8	110.4
		1200	T.S.	995	18	18.8	109.5
		1800	T.D.	1000	16	18.2	108.8

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TYPHOON SKIP (8829)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Nov	3	0600	T.D.	1000	13	8.6	140.2
		1200	T.D.	1000	13	8.7	140.0
		1800	T.D.	995	16	8.7	139.8
	4	0000	T.S.	990	21	8.7	139.4
		0600	S.T.S.	985	25	8.6	138.5
		1200	S.T.S.	985	28	8.6	137.8
		1800	S.T.S.	980	31	8.6	136.9
	5	0000	T.	975	33	8.8	135.7
		0600	T.	975	33	9.1	134.7
		1200	T.	970	36	9.5	133.5
		1800	T.	970	39	9.5	132.3
	6	0000	T.	970	41	9.7	131.1
		0600	T.	965	43	10.0	129.9
		1200	T.	965	43	10.3	128.7
		1800	T.	965	43	10.6	127.4
	7	0000	T.	965	46	11.0	126.0
		0600	T.	960	49	11.6	124.6
		1200	T.	960	51	12.3	123.2
		1800	T.	965	46	12.5	121.7
	8	0000	T.	970	39	12.6	120.2
		0600	T.	975	33	12.8	119.1
		1200	T.	975	33	13.3	118.1
		1800	T.	975	33	13.7	117.1
	9	0000	S.T.S.	980	31	14.2	116.1
		0600	S.T.S.	985	28	14.6	115.0
		1200	S.T.S.	985	28	14.9	114.3
		1800	S.T.S.	985	28	15.1	113.6
	10	0000	S.T.S.	985	28	15.3	113.0
		0600	S.T.S.	985	28	15.5	112.4
		1200	T.S.	990	23	15.7	111.9
		1800	T.S.	990	23	15.6	111.6
	11	0000	T.S.	990	23	15.4	111.4
		0600	T.S.	990	23	15.1	111.0
		1200	T.S.	995	21	15.2	110.5
		1800	T.S.	995	21	15.4	110.3
	12	0000	T.D.	1000	16	15.7	110.2

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF TYPHOON TESS (8830)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Nov	3	1200	T.D.	1000	16	9.0	120.8
		1800	T.D.	1000	16	9.3	120.1
	4	0000	T.D.	1000	16	9.4	119.4
		0600	T.S.	995	18	9.4	118.8
		1200	T.S.	990	18	9.4	117.9
		1800	T.S.	985	21	9.4	117.0
	5	0000	S.T.S.	980	25	9.6	116.0
		0600	S.T.S.	980	25	9.9	114.9
		1200	S.T.S.	975	31	10.4	113.5
		1800	T.	970	36	10.7	112.3
	6	0000	T.	970	36	11.0	111.2
		0600	S.T.S.	975	31	11.2	110.2
		1200	T.S.	990	23	11.3	109.1
		1800	T.S.	995	18	11.5	107.8

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF
TROPICAL STORM VAL (8831)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Dec	22	1800	T.D.	1000	13	12.0	129.3
	23	0000	T.D.	997	16	12.3	127.9
		0600	T.D.	997	16	13.1	126.7
		1200	T.S.	995	18	13.6	125.7
		1800	T.S.	990	21	14.1	124.7
	24	0000	T.S.	987	23	14.5	124.6
		0600	T.S.	990	21	14.5	124.3
		1200	T.S.	990	21	14.6	124.2
		1800	T.S.	992	18	14.7	124.1
	25	0000	T.S.	992	18	14.9	124.1
		0600	T.D.	995	16	15.1	124.1
		1200	T.D.	995	16	15.3	124.1
		1800	T.D.	995	16	15.4	123.8
	26	0000	T.D.	995	16	15.1	123.8
		0600	T.D.	998	13	15.0	124.3

Dissipated