

ROYAL OBSERVATORY HONG KONG

# TROPICAL CYCLONES IN 1991



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## Hong Kong's Tropical Cyclone Warning Signals

Signal		Display		Meaning of the Signal
		Symbol	Lights	
Stand By	1		White White White	A tropical cyclone is centred within about 800 kilometres of Hong Kong and may later affect Hong Kong.
Strong Wind	3		Green White Green	Strong wind is expected or blowing in the Victoria harbour, with a sustained speed of 41–62 kilometres per hour (km/h), and gusts which may exceed 110 km/h.
NW'ly Gale or Storm	8NW		White Green Green	Gale or storm force wind is expected or blowing in the Victoria harbour, with a sustained wind speed of 63–117 km/h from the quarter indicated and gusts which may exceed 180 km/h.
SW'ly Gale or Storm	8SW		Green White White	
NE'ly Gale or Storm	8NE		Green Green White	
SE'ly Gale or Storm	8SE		White White Green	
Increasing Gale or Storm	9		Green Green Green	
Hurricane	10		Red Green Red	Hurricane force wind is expected or blowing, with sustained speed reaching upwards from 118 km/h and with gusts that may exceed 220 km/h.

## **Section 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 tapes. Starting from 1987, Part I was re-titled as 'Surface Observations in Hong Kong' but the format and contents remained 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 to 1967 inclusive. The series 'Meteorological Results Part III-Tropical Cyclone Summaries' was subsequently introduced. It contained information on tropical cyclones over the western North Pacific and the South China Sea. The first issue, which contained reports on tropical cyclones occurring in 1968, was published in 1971. Tropical cyclones within the area bounded by the Equator, 45°N, 100°E and 160°E were described. With reconnaissance aircraft reports (terminated from August 1987 onwards) and satellite pictures facilitating the tracking of tropical cyclones over the otherwise data-sparse ocean, the eastern boundary of the area of coverage was extended from 160°E to 180° from 1985 onwards. Starting from 1987, the series was re-titled as 'Tropical Cyclones in 19YY' but its contents remained largely 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. Before 1961, only daily positions were plotted on the tracks. The time of the daily positions varied to some extent in the older publications 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 are 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. By 1968, it had become necessary to produce a report on every tropical cyclone that necessitated the hoisting of tropical cyclone warning signals.

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

A TROPICAL DEPRESSION (T.D.) has maximum sustained winds of less than 63 km/h.

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.

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 are winds averaged over a 60-minute interval ending on the hour. Daily rainfall amounts are computed over a 24-hour period ending at midnight Hong Kong Time.

Over the western North Pacific and the South China Sea, tropical cyclone names are assigned by the Joint Typhoon Warning Center in Guam according to a pre-determined list that undergoes revisions from time to time. Since 1981, a common system for identification of tropical cyclones in the western North Pacific and the South China Sea has been adopted and the Japan Meteorological Agency is delegated with the responsibility of assigning to each tropical cyclone of tropical storm intensity or above a numerical code of four digits. For example, the seventh tropical cyclone of tropical storm intensity or above which occurred within the region in 1991 was assigned the code '9107'. In this publication, the appropriate code immediately follows the name of the tropical cyclone in bracket, e.g. Typhoon Amy (9107).

Surface wind data presented in this report were obtained from a network of anemometers operated by the Royal Observatory. Details of the stations are listed on next page:

Station	Position		Head of anemometer above M.S.L. (m)
	Latitude N	Longitude E	
Royal Observatory	22°18'	114°10'	72
Hong Kong Airport (NW)	22°19'	114°12'	14
Hong Kong Airport (SE)	22°19'	114°13'	16
Waglan Island	22°11'	114°18'	75
Tate's Cairn	22°22'	114°13'	588
Cheung Chau	22°12'	114°01'	92
King's Park	22°19'	114°10'	78
Star Ferry	22°18'	114°10'	17
Green Island	22°17'	114°07'	90
Tai O	22°15'	113°51'	90
Sha Tin*	22°24'	114°12'	16
Chek Lap Kok*	22°19'	113°56'	65
Lau Fau Shan*	22°28'	113°59'	50
Ta Kwu Ling*	22°32'	114°09'	28
Tuen Mun*	22°24'	113°58'	68
Wong Chuk Hang*	22°15'	114°10'	30
Cheung Sha Wan	22°20'	114°09'	30
Tai Po Kau*	22°27'	114°11'	28
Sai Kung*	22°23'	114°16'	41
Tai Mo Shan	22°25'	114°07'	969
Tsing Yi (Mobil Oil Co.)	22°21'	114°06'	18
Tamar	22°17'	114°10'	15

\* Automatic weather station

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

In Section 2, an overall review of all the tropical cyclones over the western North Pacific and the South China Sea in 1991 is presented.

The reports in Section 3 are individual accounts of the life history of tropical cyclones affecting Hong Kong in 1991. They include the following information:-

- the effects of the tropical cyclone on Hong Kong;
- the sequence of display of tropical cyclone warning signals;
- the maximum gust peak speeds and maximum hourly mean winds recorded in Hong Kong;
- the lowest barometric pressure recorded at the Royal Observatory;
- the daily amounts of rainfall recorded at the Royal Observatory and selected locations;
- the times and heights of the highest tides and maximum storm surges recorded in Hong Kong;
- satellite pictures and/or radar displays if applicable.

Statistics and information relating to tropical cyclones are presented in various tables in Section 4.

Six-hourly positions together with the corresponding estimated minimum central pressures and maximum sustained surface winds for individual tropical cyclones are tabulated in Section 5.

In this publication, different times are used in different contexts. The official reference times are given in Co-ordinated Universal Time and labelled UTC. Times of the day expressed as 'a.m.' or 'p.m.' or as 'morning', 'evening', etc. in the tropical cyclone narratives are in Hong Kong Time which is eight hours ahead of UTC.

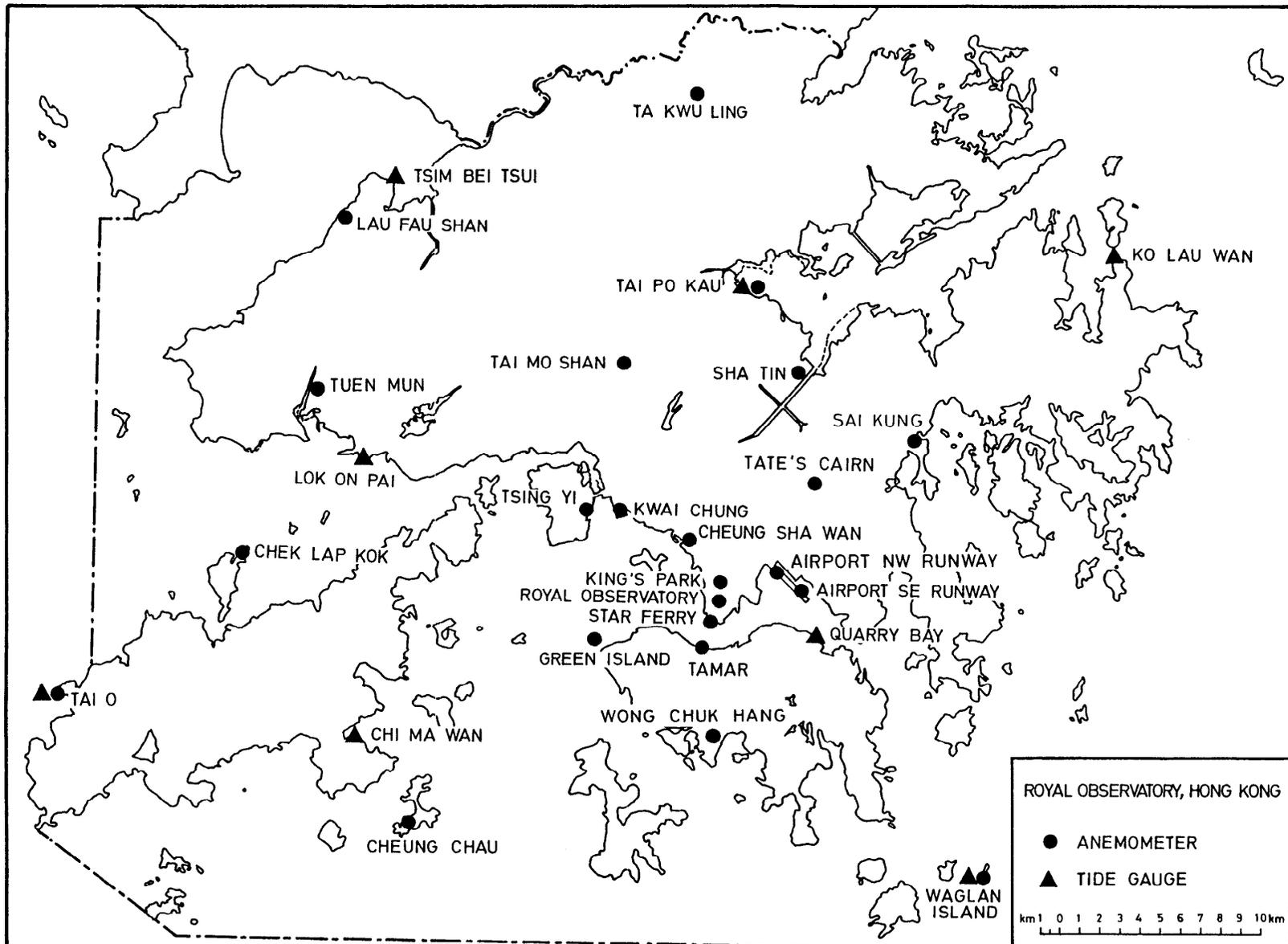


Figure 1. Locations of anemometer and tide gauge stations in Hong Kong.

## **Section 2**

# **TROPICAL CYCLONE OVERVIEW FOR 1991**

In 1991, there were 30 tropical cyclones over the western North Pacific and the adjacent seas bounded by the Equator, 45°N, 100°E and 180°. As compared to the annual average (1961-1990) of 31 tropical cyclones, 1991 is a year with near-normal tropical cyclone activity. However, the number of tropical cyclones attaining typhoon intensity is above-normal—a total of 18 typhoons in 1991 against an annual average of 15.6. The monthly distributions of the frequencies of first occurrence of tropical cyclones and that of typhoons for 1991 are shown in Figure 2. The monthly mean frequencies of these two parameters during the years 1961-1990 are shown in Figure 3.

The most intense typhoons in 1991 were Yuri (9128), Ruth (9123), Walt (9104) Mireille (9119) and Seth (9124), each packing mean winds of over 200 km/h near their centres. Both Walt and Yuri recurved over the western North Pacific and did little damage. Seth was much weakened when it reached northern Luzon. But Ruth and Mireille left a trail of destruction in the Philippines and Japan respectively. Ellie (9110) and Nat (9120) had the most unusual tracks. Ellie managed to maintain a generally westward course while moving along the so-called 'recurvature latitudes' for a period of over a week. Nat wove a convoluted storm track over the northeastern part of the South China Sea and Luzon Strait in a style reminiscent of Typhoon Wayne (8614) in 1986. But if the behaviour of Nat was most unpredictable, who could have foreseen the 'violent' ending of Yunya (9105)? Lying in its path was not just another mountain but an erupting volcano called Mount Pinatubo in Luzon. The demise of Yunya as it interacted with the extensive volcanic ash clouds was one of the most dramatic scenarios seen in the age of satellite meteorology.

On top of the havoc wreaked by the volcanic eruptions of Mount Pinatubo, the Philippines had to withstand the onslaught of nine tropical cyclones throughout a long season which started as early as March with Sharon (9101) and ended in mid November with Wilda (9127). For tropical cyclones venturing into the South China Sea, the coastal region of Guangdong in southern China was a preferred landfall location during the months of July-September. Four storms ended their journeys there and one, namely Fred (9111), went on to hit Hainan Island and northern Vietnam. The only other tropical cyclone to land in Hainan Island and northern Vietnam in 1991 was Zeke (9106) in July. By comparison, southern Vietnam and eastern China had a very quiet year. As for Taiwan, Nat hit the offshore isle of Lanyu at peak intensity during the major Chinese festival of Mid-Autumn in September. Earlier, a weakening Ellie landed in northern Taiwan in August but produced no significant effects. Five tropical cyclones approached the Kyushu Island/Korean Peninsula region but only three actually hit land. Another four moved towards eastern Honshu but only one made landfall.

In 1991, 20 tropical cyclones inflicted damage upon countries in eastern Asia. The death toll, including those missing, amounted to thousands. In the case of Thelma (9125) alone, over 6 300 people vanished as a result of catastrophic flooding in central Philippines on 5 November. Only nine days earlier, Ruth dealt a severe blow to northern Luzon and took the lives of over 100 people. For China, the most destructive storms were Zeke and Amy (9107) in July and Fred in August. The effects of Fred extended all the way to Vietnam and Thailand. Korea and Japan suffered most from Gladys (9112) in August and Mireille in September respectively.

During the year, 15 tropical cyclones occurred within the area of responsibility of Hong Kong (i.e. the area bounded by 10°N, 30°N, 105°E and 125°E). This number was slightly lower than the 30-year (1961-90) annual average of 16.4. Three of the 15 tropical cyclones developed within Hong Kong's area of responsibility. Altogether, 499 tropical cyclone warnings to ships and vessels were issued by the Royal Observatory in 1991 (see Table 2).

Local warning signals were hoisted in Hong Kong for six tropical cyclones. Four of them necessitated the hoisting of the Strong Wind Signal No. 3 and the Gale or Storm Signal No. 8 was hoisted for Severe Tropical Storm Brendan in July.

The total tropical cyclone rainfall (defined as the total rainfall recorded at the Royal Observatory from the time when a tropical cyclone was centred within 600 km of Hong Kong to 72 hours after the tropical cyclone has dissipated or moved outside 600 km of Hong Kong) in 1991 amounted to 446.1 mm, which was 40 per cent below the mean annual value of 741.0 mm (1961-1990). It accounted for 27 per cent of the year's total rainfall of 1 639.1 mm. The six tropical cyclones that necessitated the hoisting of tropical cyclone signals all came within 600 km of Hong Kong. In addition, two tropical cyclones, namely Ellie (9110) and Wilda (9127) also came within 600 km of Hong Kong during their dissipating stage. Rainfall figures associated with these tropical cyclones are given in Table 8(a).

The following is a review of all the tropical cyclones in 1991.

Sharon (9101) was the first tropical cyclone to form in 1991. It developed as a tropical depression about 1 030 km southeast of Guam on 5 March and moved westwards. Intensifying to a tropical storm the next day, it strengthened further to a severe tropical storm about 340 km south of Yap early on 10 March with maximum winds of 90 km/h near the centre. Sharon weakened again to a tropical storm later in the day and turned west-northwestwards on 11 March heading for the central Philippines. On reaching the Philippine islands, it weakened to a tropical depression early on 13 March and degenerated soon to an area of low pressure about 700 km south of Manila during the day among the isles of southern Philippines. No damage was reported in the Philippines.

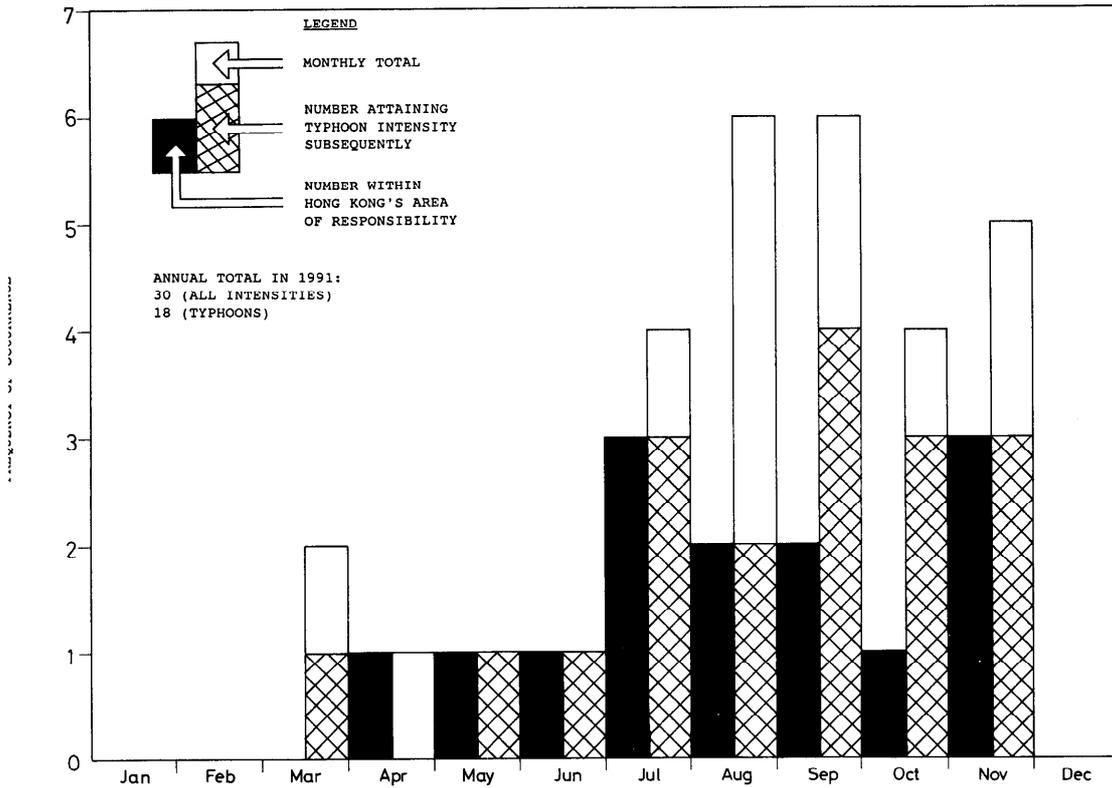


Figure 2. Monthly distributions of the frequency of first occurrence of tropical cyclones in the western North Pacific and the South China Sea in 1991.

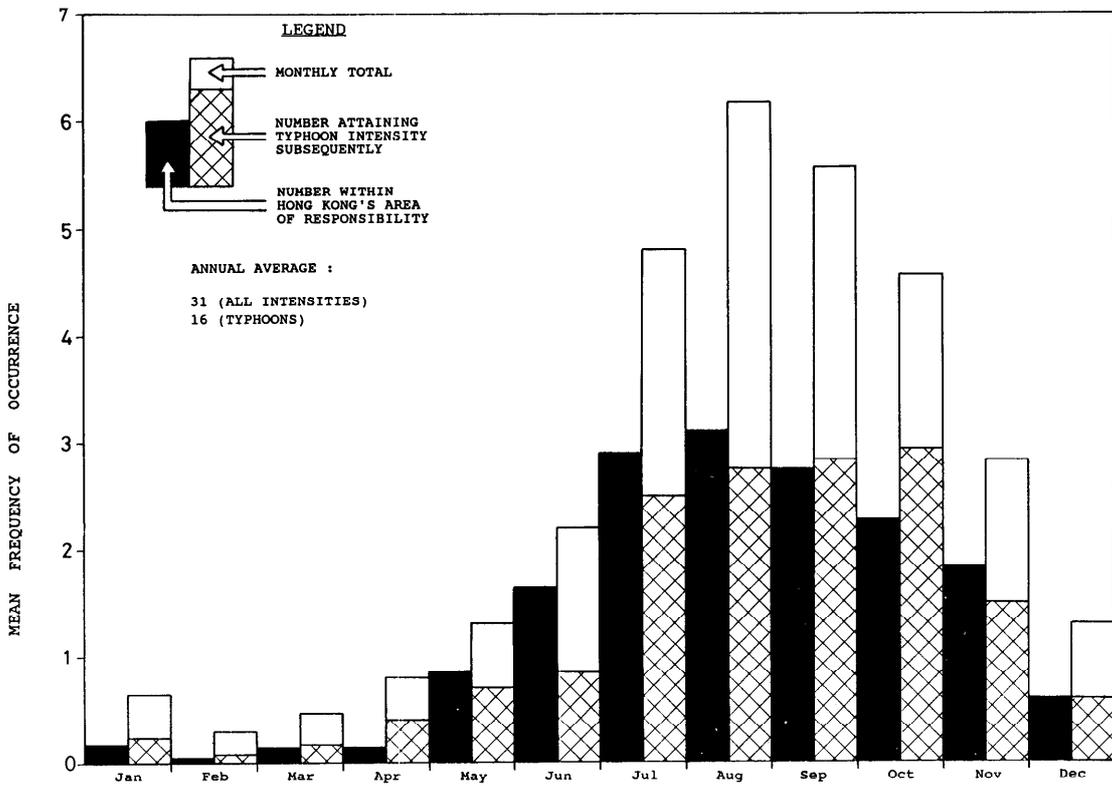


Figure 3. Monthly distributions of the mean frequency of first occurrence of tropical cyclones in the western North Pacific and the South China Sea, 1961-1990.

About a week later, another tropical cyclone Tim (9102) formed about 1 550 km east-southeast of Guam early on 21 March. Moving generally to the north-northwest at 19 km/h along a snake-like track, Tim intensified to a tropical storm about 1 120 km east-southeast of Guam on the morning of 22 March and then to a severe tropical storm about 870 km east of Guam that night. Tim started to track northward the next day and attained typhoon intensity about 850 km east-northeast of Guam in the evening. At peak intensity, maximum winds near its centre were estimated to be about 120 km/h. Recurving to the northeast, Tim started to weaken on 24 March and by that night, was downgraded to a tropical storm when it was 1 330 km east-northeast of Guam. Turning further to the east-northeast and slowing down to a speed of 12 km/h, Tim weakened to a tropical depression about 1 460 km east-northeast of Guam during the day on 25 March and became an extratropical cyclone that night.

About a month later, Vanessa (9103) formed as a tropical depression over the waters east of Mindanao about 1 190 km east-southeast of Manila on the evening of 23 April. It moved west-northwestwards across Mindanao, Negros and the Sulu Sea at 23 km/h and entered the South China Sea on the night of 25 April. Vanessa acquired tropical storm intensity the next day when it was 550 km west-southwest of Manila. It reached peak intensity that night with maximum winds of 75 km/h near its centre. Turning northwestwards at 22 km/h, Vanessa started to weaken on 27 April and became a tropical depression about 370 km east-southeast of Danang that evening. Even though it degenerated further into an area of low pressure during the night, its remnant circulation could be tracked to the east of Hainan Island on 28 April and to the coast of western Guangdong the next day.

In May, a disturbance over the Caroline Islands developed into a tropical depression named Walt (9104) about 1 100 km southeast of Guam on the morning of 6 May. At the time of formation, it was moving northwestwards at 7 km/h. By that night, it had developed further into a tropical storm about 980 km southeast of Guam. Rapid intensification continued as Walt turned more to the west-northwest on the night of 8 May. By the following morning, it had attained typhoon intensity about 380 km south-southeast of Guam and increased its forward speed to 20 km/h. Over the next three days, Walt tracked steadily in the general direction of northern Luzon. Peak intensity was reached on the night of 11 May when maximum winds of 205 km/h were estimated near the centre. On 13 and 14 May, Walt undertook a northward turn at a reduced speed of 13 km/h away from Luzon. It gradually weakened as it recurved on 15 May. Accelerating east-northeastwards, it became a severe tropical storm about 230 km south-southeast of Okinawa on the morning of 16 May and a tropical storm about 620 km east of Okinawa that evening. Walt became an extratropical cyclone the next day while moving at a high speed of 85 km/h.

Yunya (9105) was the only tropical cyclone in June and its fate was sealed by the volcanic eruptions of Mount Pinatubo in Luzon. It formed as a tropical depression on the early morning of 12 June about 910 km east-southeast of Manila. It moved northwestwards at about 20 km/h and became a tropical storm that afternoon when it was about 670 km east-southeast of Manila. Slowing down to a speed of about 10 km/h, Yunya intensified rapidly on 13 June and by that afternoon had acquired typhoon intensity about 450 km east-southeast of Manila. It reached peak intensity on the morning of 14 June with maximum winds near its centre estimated at nearly 150 km/h.

Turning to a west-northwestward track, Yunya approached the Philippines at a time when violent volcanic eruption of Mount Pinatubo in Luzon was taking place. It weakened rapidly on the night of 14 June, becoming a tropical storm during the small hours of 15 June about 120 km east-northeast of Manila. Yunya weakened further to a tropical depression that morning after making landfall over the east coast of Luzon about 90 km northeast of Manila. Its centre turned northwestwards and accelerated to a speed of about 20 km/h while crossing central Luzon. Yunya finally degenerated into an area of low pressure over the coastal waters west of northern Luzon on the night of 15 June.

Torrential rain brought by Yunya, mixed with the volcanic ash bursting from Mount Pinatubo, created heavy mucks that destroyed many buildings in central Luzon. Hundreds of people were killed or injured. The heavy rain also triggered off flooding which washed away many bridges and destroyed numerous homes in central and northern Luzon.

Then three tropical cyclones, namely Zeke (9106), Amy (9107) and Brendan (9108), traversed the northern part of the South China Sea in quick succession in July. Zeke went on to hit Hainan Island and northern Vietnam while the other two landed in southern China. They all necessitated the hoisting of tropical cyclone warning signals in Hong Kong. All three tropical cyclones left trails of havoc in their wakes. Detailed reports of Typhoon Zeke, Typhoon Amy and Severe Tropical Storm Brendan are presented in Section 3.

Meanwhile, Caitlin (9109), a contemporary of Brendan, formed as a tropical depression about 460 km north-northwest of Yap early on 23 July and moved west-northwestwards. After intensifying to a tropical storm about 1 450 km south-southeast of Okinawa early on 24 July, Caitlin adopted a north-northwestward track over the next couple of days. It became a severe tropical storm on the evening of 24 July and reached typhoon intensity about 440 km south of Okinawa on 26 July. Turning further to the north, Caitlin passed about 100 km west of Okinawa on the night of 27 July and reached peak intensity the next morning with maximum winds of almost 150 km/h near its centre. It became a severe tropical storm on 29 July and negotiated the Strait of Korea on a northeastward track. Over the Sea of Japan, Caitlin weakened to a tropical storm about 550 km west-southwest of Sapporo early on 30 July and degenerated into an area of low pressure later that afternoon.

In South Korea, two people were killed and another two were reported missing. Rainstorm caused flooding in residential areas and farmland. About 30 ships were destroyed or damaged. Railways, roads and a bridge were also damaged. The total loss in property was estimated at US\$6.3 million.

Six tropical cyclones formed in August. Except for Fred (9111) which was the first tropical cyclone to form in the South China Sea in 1991, the rest all developed over the western North Pacific at latitudes north of 20°N.

Tropical Depression Doug was located about 640 km north-northwest of Wake Island at the time of formation on 7 August. It moved northwestwards at first but turned to the west-northwest at 19 km/h the next day. It reverted to a northwestward track on 9 August and accelerated, intensifying to a tropical storm about 1 950 km east-southeast of Tokyo during the day. Peak intensity was reached that evening with winds of 75 km/h near the storm centre. Doug soon started to weaken and became a tropical depression the following morning about 1 620 km east of Tokyo. It recurved later that day and evolved into an extratropical cyclone on the morning of 11 August.

As Doug weakened, an area of cloud clusters to its south developed into Tropical Depression Ellie (9110) on the morning of 10 August about 1 840 km east of Iwo Jima. Ellie moved west-northwestwards at 13 km/h at first and increased its speed to 23 km/h the next day. By then, it had intensified to a tropical storm about 1 520 km east of Iwo Jima. Intensification continued as Ellie moved towards the Ogasawara Islands. Severe tropical storm intensity was attained on the evening of 12 August when Ellie was 710 km east-northeast of Iwo Jima. Turning more to the west on 13 August, Ellie took on a south-of-west course for the next three days with speeds ranging from 15 to 30 km/h. Passing 220 km north of Iwo Jima on the morning of 14 August, Ellie intensified to a mid-level typhoon and was at peak intensity with maximum winds of 140 km/h near its centre. But Ellie failed to maintain its strength and by the following day had weakened rapidly to a tropical storm about 600 km east of Okinawa. Although there were brief periods when Ellie gathered strength and re-gained severe tropical storm status, no significant re-intensification took place. On 17 August, it tracked north of west at 13 km/h and hit the northern tip of Taiwan during the night. It turned southwestwards into Taiwan Strait the next day and weakened further to a tropical depression about 210 km west-southwest of Taipei before dissipating over water on the night of 18 August. No damage was reported in Taiwan.

In between the formation and dissipation of Ellie, Typhoon Fred (9111) roamed the coastal waters of Guangdong, swept across the northern part of Hainan Island, traversed Vietnam and Laos before finally degenerating into an area of low pressure over Thailand on 18 August. A detailed report on Typhoon Fred is presented in Section 3.

While Ellie was approaching the Ryukyu Islands and Fred moving towards Hainan, Gladys (9112) formed as a tropical depression about 900 km east-southeast of Iwo Jima on the evening of 15 August. It moved northwestwards and intensified to a tropical storm the following morning about 710 km east-southeast of Iwo Jima. Moving west-northwest towards the Ogasawara Islands, it attained severe tropical storm strength briefly on the morning of 17 August but soon weakened to a tropical storm that afternoon as it adopted a westward track. From 18 August to 21 August, the movement of Gladys was generally to the west or west-northwest at an average speed of 12 km/h. During the process, it re-intensified to a severe tropical storm about 790 km east of Okinawa on 19 August. Maximum intensity with winds of over 110 km/h near its centre was attained on the evening of 20 August. After crossing the Ryukyu Islands, Gladys changed to a northward course on 21 August and traversed the waters west of Kyushu the next day. It swept northwestwards across the southwestern part of the Korean Peninsula on 23 August and moved into the Yellow Sea where it degenerated into an area of low pressure that evening.

The extensive circulation of Gladys brought torrential rain to Japan and triggered off landslides in the Tokyo area. Ten people were killed, one was injured, and another person was reported missing. Over 1 000 houses were flooded. The bullet train service had to be suspended due to the heavy rain. In South Korea, 64 people were killed and 36 others were reported missing. About 6 700 houses were flooded and over 1 500 houses were damaged. Over 100 hectares of farmland were inundated. The hardest-hit area was Pusan where record daily rainfall was reported. The total loss in South Korea was estimated at US\$164 million.

An area of low pressure moved westwards across the Ogasawara Islands on 25 August and developed into a tropical depression (9113) about 420 km south-southeast of Kagoshima on the evening of 27 August. At maximum intensity early on 28 August, winds near its centre were no more than 60 km/h. It moved northwestwards at 22 km/h and turned more to the north on the evening of 28 August. This tropical depression weakened to an area of low pressure as it moved over the waters west of Kyushu.

The last tropical cyclone in August, Harry (9114), formed as a tropical depression about 1 160 km south-southwest of Tokyo on the evening of 29 August. It moved north-northeastwards at 28 km/h and intensified to a tropical storm about 830 km southwest of Tokyo the next day. Accelerating to a speed of 40 km/h, Harry was at peak strength with winds of about 75 km/h as it made landfall over the south coast of Honshu on the morning of 31 August about 230 km west-southwest of Tokyo. Turning further to the northeast, it swept across southeastern Honshu before evolving into an extratropical cyclone over water about 360 km northeast of Tokyo on the afternoon of 31 August.

Six tropical cyclones developed in September. Two (Joel and Nat) affected the South China Sea and both necessitated the hoisting of tropical cyclone warning signals in Hong Kong. In fact, tropical cyclone warning

signals were hoisted on three separate occasions for Nat. The other four (Ivy, Kinna, Luke and Mireille) all recurved east of 125°E and caused considerable damage in the Japanese islands.

The first tropical cyclone in September was Ivy (9115). It formed as a tropical depression over the Caroline Islands about 1 450 km east-southeast of Guam on 2 September. It moved northwestwards initially but changed to a north-northwestward track on 4 September. It intensified to a tropical storm about 440 km east of Guam that evening and became a severe tropical storm the next morning. Typhoon intensity was attained about 630 km north-northeast of Guam early on 6 September. Ivy then swept across the northern Mariana Islands at 40 km/h and passed to the southwest of Iwo Jima that night on a northwestward track at 28 km/h. It reached peak intensity on 7 September with maximum winds of 175 km/h near its centre. Ivy recurved on 8 September and accelerated northeastwards. It weakened to a severe tropical storm about 2 780 km east of Tokyo early on 10 September and evolved into an extratropical cyclone that afternoon.

In Japan, one person was killed and four were reported missing after two fishing boats capsized off the south coast of Japan. Two people were injured in landslides triggered by heavy rain. Heavy rain also affected transportation in southern Honshu.

Following the formation of Ivy, Joel (9116) developed as a tropical depression west of northern Luzon on 3 September. It made landfall over eastern Guangdong on the night of 6 September and dissipated inland the next day. A detailed report on Joel is presented in Section 3.

Kinna (9117) developed as a tropical depression about 460 km west-northwest of Guam on 10 September. It moved northwestwards at about 35 km/h and intensified to a tropical storm about 910 km west-northwest of Guam early next morning. It became a severe tropical storm about 780 km southeast of Okinawa on the evening of 11 September. After crossing the Ryukyu Islands, Kinna attained typhoon intensity near Okinawa on 13 September and soon reached peak intensity with maximum winds of 140 km/h near the centre. In the Ryukyus, one fisherman was killed and two others were reported missing after their boat capsized in stormy weather. Recurving to the north-northeast, Kinna accelerated across Kyushu and western Honshu on 14 September. Turning further to the northeast, it traversed the waters off the northern coast of Honshu and became an extratropical cyclone later in the day. In Kyushu, 11 people were killed, two were reported missing and 53 others were injured. Seven houses were destroyed and nearly 1 000 houses were flooded. Torrential rain triggered off 44 cases of landslides. Seven bridges were washed away by swollen rivers.

A triplet of tropical cyclones, namely Luke (9118), Mireille (9119) and Nat (9120) dominated the scene in the latter half of September.

As Kinna evolved into an extratropical cyclone, Luke formed as a tropical depression about 350 km northwest of Guam on 14 September. It moved to the west-northwest over the next couple of days. During that time, it intensified to a tropical storm about 1 190 km southeast of Okinawa early on 16 September and a severe tropical storm later in the day. At peak intensity, maximum winds near the centre of Luke were estimated to be about 100 km/h. Luke recurved to the east-northeast on 18 September. It accelerated north-northeastwards on 19 September and became an extratropical cyclone about 440 km south-southwest of Tokyo that afternoon.

In Japan, 14 people were killed, four were reported missing, and 18 were injured. Heavy rain triggered off 644 cases of landslides. Thirty-seven houses were destroyed and 28 500 others were flooded. Severe weather also led to the suspension of train and air services.

Soon after the formation of Luke, Mireille developed as a tropical depression about 2 380 km east of Guam on the evening of 14 September. It moved south of west initially before taking on a west-northwestward track the next day. Between the evenings of 15 and 16 September, Mireille intensified rapidly to a typhoon. It turned westwards on 17 September and moved south of west over the next four days across the western North Pacific. Its speed increased from 11 km/h to 25 km/h as it swept across the Mariana Islands on the night of 19 September, passing about 220 km north of Guam. Mireille started to turn northwestwards on 22 September and reached peak intensity with maximum winds of 205 km/h near the centre. It moved steadily at a speed of 14 km/h for the next three days before recurving over the Ryukyu Islands on 26 September. It accelerated north-northeastwards and reached western Japan on 27 September. Following Kinna, Mireille became the second typhoon to hit Kyushu and western Honshu in two weeks. As Mireille moved into the Sea of Japan, it weakened to a severe tropical storm and evolved into an extratropical cyclone that night.

In Japan, 51 people were killed, two were reported missing and 780 were injured. Over 10 000 houses were flooded and 723 others were destroyed or damaged. Damage to 32 vessels was also reported. Power supply to six million households was cut. In South Korea, two people were killed and two were reported missing.

Nat (9120) formed as a tropical depression over the Luzon Strait on 16 September. As a contemporary of Luke and Mireille, the movement of Nat was very much affected by the successive passages of the two tropical cyclones over the western North Pacific. But after going through three cycles of intensification and weakening, the tenacious Nat out-lived both Luke and Mireille. Nat went to and fro across the Luzon Strait before finally landing over eastern Guangdong on 1 October. A detailed report on Nat is presented in Section 3.

Orchid developed as a tropical depression west of the Mariana Islands about 690 km northwest of Guam on the evening of 3 October. Moving westwards at an average speed of 10 km/h, it intensified steadily and became a severe tropical storm about 1 150 km northwest of Guam on 5 October. Typhoon intensity was attained about 980 km southeast of Okinawa the next day. Orchid turned northwestwards on 7 October and reached peak intensity with maximum winds of 185 km/h near its centre. Orchid recurved on 8 October and tracked

northeastwards over the next couple of days. It weakened to a severe tropical storm about 680 km south-southwest of Tokyo on 11 October and became a tropical storm about 540 km south-southwest of Tokyo the next morning. Accelerating to a speed of over 40 km/h, it became an extratropical cyclone early on 14 October.

The outer circulation of Orchid affected eastern and northern Japan. There was flooding due to heavy rain and 249 cases of landslide were reported. Twelve houses were destroyed, 23 damaged and 673 others flooded. One person was killed and 14 were injured.

Meanwhile, Pat (9122) formed further to the east about 1 560 km east of Guam on the morning of 5 October. It tracked westwards at 20 km/h and intensified rapidly. By the night of 6 October, Pat had become a typhoon. At the time, it was 840 km east-northeast of Guam. From 7 to 9 October, Pat moved generally to the north-northwest on a snake-like track at a reduced speed of 10 km/h. Peak intensity was reached during the period. Maximum winds near the centre of Pat were estimated to be about 165 km/h. Pat turned to the north-northeast on 10 October and accelerated to a speed of 35 km/h over the next couple of days. It weakened to a severe tropical storm on the evening of 12 October about 1 180 km east of Tokyo and to a tropical storm the next morning about 1 480 km east-northeast of Tokyo before completing its extratropical transition.

After a week's lull, Ruth formed over the Caroline Islands about 330 km south of Guam on 20 October. Moving west-northwestwards at 7 km/h, it intensified rapidly and attained typhoon intensity about 470 km west of Guam on 22 October. Ruth tracked briefly to the northwest that morning before turning westwards at 16 km/h in the evening. From 24 to 26 October, Ruth tracked steadily to the west-northwest at 19 km/h. Peak intensity was attained on 26 October when winds of 220 km/h were expected near its centre. Ruth took on a west-southwestward track on 27 October and landed in northern Luzon later that day. There was widespread destruction in the Philippines where at least 62 people were killed and several hundred people were made homeless. Over 100 houses were destroyed. Strong winds ripped off the roofs of houses, brought down power lines, and uprooted numerous trees. The city of Baguio was plunged into darkness and power supply in Manila was also interrupted. Heavy rain triggered off mudflow from the deposits of volcanic ash and sand on the slopes of Mount Pinatubo. Large areas of farmland were ruined by floods and landslides.

Over Luzon, Ruth weakened rapidly to a tropical storm. It entered the South China Sea on 28 October and recurved northeastwards the next day. Due to the intrusion of dry continental air brought by a surge of the winter monsoon, Ruth weakened rapidly and became a tropical depression later in the day about 350 km south of Gaoxiang. Over the Luzon Strait, it finally became an extratropical cyclone about 740 km southwest of Okinawa on 30 October.

The influence of Ruth extended to Taiwan where agricultural and fishery damage was reported to amount to NT\$650 million. Enhanced by the effect of a winter monsoon, gale force winds affected the adjacent seas of southeastern China. In the Taiwan Strait, a 6 300-tonne freighter, 'Tung Lung', sank with its 21 crewmen listed missing. A 2 504-tonne freighter named 'Southern Cross' and another fishing vessel foundered to the northeast of Taiwan. The captain of the fishing vessel was drowned but the rest of the crew were rescued. To the southwest of Hong Kong, twelve fishermen were airlifted to safety from their sinking vessel in the midst of rough seas and monsoon gales.

As Ruth weakened, another disturbance was brewing to the west of Marshall Islands. By 31 October, it had developed into a tropical depression named Seth (9124) about 1 280 km east of Truk Island. Over the next four days, Seth moved generally to the west-northwest, slowing down from an initial speed of 30 km/h to 20 km/h by 4 November. During that time, it continued to gather strength, intensifying rapidly on the night of 1 November to a severe tropical storm and becoming a typhoon 24 hours later when it was 490 km east of Guam. Peak intensity was reached early on 4 November when maximum winds near the centre of Seth were estimated to be about 205 km/h. After moving slowly northwestwards at 10 km/h on 5 November, Seth made a sharp left-hand turn to the west the following day. From 8 to 11 November, Seth adopted a west-southwestward course in the general direction of Luzon with speeds ranging from 7 to 16 km/h. At the same time, it started to weaken, degenerating rapidly to a tropical storm on the night of 11 November when it was 620 km east-northeast of Manila. By the following day, it had become a tropical depression about 470 km northeast of Manila and was turning to the west-northwest at 20 km/h. It moved along the Babuyan Channel round the north coast of Luzon on 13 November and weakened to an area of low pressure the next day over the coastal waters of northwestern Luzon. Under the influence of the prevailing northeast monsoon, the remnant circulation of Seth continued to drift southwestwards to the central part of the South China Sea on 14 and 15 November.

Thelma (9125) developed to the east of the Philippines as a tropical depression about 1 310 km east of Manila on 2 November. After an initial northwestward movement, Thelma turned west-southwestwards the next day. Moving at a speed of 16 km/h, it intensified to a tropical storm about 900 km east of Manila that evening before hitting the island of Leyte in the central Philippines early on 5 November at peak intensity. At the time, maximum winds near the centre of Thelma were estimated to be about 75 km/h. Thelma soon weakened to a tropical depression and accelerated to a speed of 25 km/h across the Philippine isles. Tracking westwards across the Sulu Sea and Palawan, Thelma entered the South China Sea on 6 November and headed towards the coast of southern Vietnam. It turned to the southwest on 8 November before dissipating over water that night about 370 km east-southeast of Ho Chi Minh City.

Thelma, though not particularly intense, turned out to be one of the most disastrous tropical cyclones in 1991. Torrential rain triggered off flash floods which swept away many villages in the central Philippines. On the island of Leyte, a dam collapsed and at least 3 500 people were killed in the coastal town of Ormoc alone. In Cebu, Thelma was reported to have caused about US\$400,000 worth of damage to bridges and roads. The total number of deaths and missing in the Philippines was 6 315. About 120 000 people were made homeless. Damage to crops and infrastructures amounted to millions of dollars.

While Seth was still an intense typhoon over the waters west of the Mariana Islands and Thelma was triggering off disastrous floods in the Philippines, Verne (9126) formed as a tropical depression about 1 520 km east of Truk Island on 5 November. It stayed on a west-northwestward track over the next four days, moving initially at 38 km/h and decelerating to 13 km/h by the night of 8 November. During that time, Verne intensified to a tropical storm on the evening of 6 November about 1 310 km east of Guam and reached peak intensity in the early hours of 8 November with maximum winds of 85 km/h near its centre. It picked up speed the next day and weakened momentarily to a tropical depression on 10 November. It soon re-gained tropical storm intensity that night as it started to recurve at a speed of 20 km/h. Over the next couple of days, Verne accelerated northeastwards. It weakened to a tropical depression about 1 060 km east-northeast of Iwo Jima on the evening of 12 November and soon became an extratropical cyclone during the night.

While Seth was dissipating over the South China Sea, another disturbance over the waters east of southern Philippines developed into a tropical depression named Wilda (9127) early on 14 November. At the time, it was located about 230 km west of Yap. Wilda moved initially on a westerly track at 20 km/h but soon turned west-northwestwards later that day. It intensified to a tropical storm about 750 km east-southeast of Manila on the evening of 15 November and skirted past the northeastern tip of Leyte the next morning when peak intensity was reached. Winds near the centre of Wilda at the time were estimated to be about 75 km/h. Wilda then turned westwards and swept across southern Luzon that night. During its passage, trees were uprooted and power lines were damaged. Serious flooding necessitated the evacuation of 168 people. Wilda reverted to a northwestward track on 17 November and moved into the South China Sea that evening. It weakened to a tropical depression over the South China Sea about 130 km west-northwest of Manila and degenerated into an area of low pressure about 510 km northwest of Manila on 19 November.

Yuri (9128) formed as a tropical depression on 22 November about 1 590 km east of Truk Island. Moving rather slowly at first, Yuri continued to intensify. By the morning of 24 November, it had become a severe tropical storm about 1 480 km east of Truk Island and took on a west-northwestward track at 22 km/h. Typhoon intensity was attained that night when Yuri was 1 050 km east of Truk Island. Yuri turned more to the west on 26 November and reached peak intensity the following morning packing winds of over 220 km/h near its centre. Moving northwestwards at 30 km/h, Yuri passed 140 km to the south-southwest of Guam on the evening of 27 November. After recurving on 29 November, Yuri accelerated northeastwards on 30 November and weakened to a severe tropical storm that night. By the morning of 1 December, it had degenerated into a tropical storm about 820 km east-northeast of Iwo Jima. Extratropical transition was completed soon afterwards.

As Yuri moved past Guam, another disturbance east of the Marshall Islands developed into Tropical Depression Zelda (9129) early on 28 November. At the time of formation, it was located about 2 440 km east of Truk Island. Over the next three days, it tracked west-northwestwards, accelerating from an initial speed of 20 km/h to 30 km/h by 30 November. In the meantime, it continued to intensify and became a tropical storm about 1 850 km east of Truk Island on 29 November. Despite a rather small circulation, Zelda had a very compact structure and by that evening, had developed into a midget typhoon about 1 520 km east of Truk Island. Peak intensity was reached that night with winds of 140 km/h near the centre of Zelda. Zelda started to turn northwestwards late on 30 November and recurved on the night of 1 December. By then, it had weakened to a severe tropical storm about 1 130 km west-southwest of Wake Island. It moved northeastwards at 27 km/h on 2 December and weakened further to a tropical storm about 720 km west of Wake Island that evening. Zelda evolved into an extratropical cyclone soon after it became a tropical depression about 370 km west-northwest of Wake Island on 3 December.

## **Section 3**

# **REPORTS ON TROPICAL CYCLONES AFFECTING HONG KONG IN 1991**

**(a) Typhoon Zeke (9106)****9-14 July 1991***The track of Zeke is shown in Figure 4*

Zeke started as an area of disturbance over the Pacific east of central Phillipines. After developing to a tropical depression about 830 km southeast of Manila early on 9 July, Zeke moved northwestwards at 13 km/h initially and accelerated west-northwestwards to 35 km/h as it swept across southern Luzon on 10 July. It passed about 50 km south-southwest of Manila and entered the South China Sea that evening.

Zeke intensified rapidly over the warm waters of the South China Sea on 11 July and developed into a severe tropical storm about 310 km east-southeast of Xisha by that evening. Turning to a northwestward track towards Hainan Island, Zeke passed about 60 km northeast of Xisha on 12 July. It attained typhoon intensity on the evening of 12 July and reverted to a more westward track during the night. At peak intensity with winds of 130 km/h near its centre, Zeke hit the southeast coast of Hainan Island early next morning about 150 km south of Haikou. Over land, it weakened to a severe tropical storm that afternoon. After traversing Beibu Wan, Zeke made landfall over northern Vietnam about 50 km northeast of Haiphong on the morning of 14 July. Zeke continued to weaken as it pushed further inland. It became a tropical depression about 120 km west-northwest of Hanoi that evening and soon degenerated into an area of low pressure.

Zeke incurred heavy damage in Hainan. According to press reports, 30 people were killed and 77 others were injured. About 3 700 houses collapsed and 5 800 others were damaged. At least 900 000 hectares of farmland were affected. Other damage included 9.33 million rubber trees, 83 fishing boats, and 380 hectares of fishery ponds. The total loss was estimated at about 5.1 billion RMB(yuan). In Guangxi, at least one person was killed and another was injured. Over 180 houses collapsed and 5 000 others were damaged. About 20 000 hectares of paddy field were damaged. In western Guangdong, four people were reported missing. About 1 170 houses collapsed and 11 700 others were damaged. More than 30 000 hectares of farmland were destroyed. Direct economic loss was estimated at about 19.4 million RMB(yuan).

In Hong Kong, the Stand By Signal No. 1 was hoisted at 8.50 a.m. on 12 July when Zeke was about 640 km to the south. Winds were moderate to fresh easterly during the day. As the winds continued to increase, the Strong Wind Signal No. 3 was hoisted at 10.40 p.m. that night when Zeke was about 520 km to the south-southwest. It was about this time that Zeke came closest to Hong Kong. The lowest sea-level pressure of 1 003.4 hPa was recorded at the Royal Observatory a few hours earlier at 5 and 6 p.m. During the night, winds offshore became strong. After Zeke landed over Hainan, local winds subsided. All signals were lowered at 7.10 a.m. on 13 July.

The maximum hourly mean winds and maximum gust peak speeds together with associated wind directions at various locations are as follows:

<i>Location</i>	<i>Maximum hourly mean wind speed (km/h) and direction</i>		<i>Maximum gust peak speed (km/h) and direction</i>	
Royal Observatory	E	31	E	68
H.K. Airport (SE)	E	40	E	79
H.K. Airport (NW)	E	36	SE	76
Waglan Island	ENE	54	ENE	75
Tate's Cairn	ESE	52	SE	94
Cheung Chau	SE	52	SE	81
King's Park	E	31	ESE	71
Star Ferry	E	40	E	77
Green Island	E	40	SE	81
Tai O	SSE	41	SE	79
Sha Tin	SE	14	SE	43
Chek Lap Kok	E	30	ESE	70
Lau Fau Shan	ESE	27	SE	62
Ta Kwu Ling	ESE	23	SE	59
Tuen Mun	SE	23	SE	76
Wong Chuk Hang	ENE	31	WNW	68
Tai Po	ESE	34	E & ESE	65
Tai Mo Shan	ESE	79	ESE	112
Tamar	ENE	25	ENE	59
Cheung Sha Wan	E	19	ESE	51
Tsing Yi	ESE	30	ESE	75
Kwai Chung	ESE	25	ESE	59
Sai Kung	SE	16	SE	54

The weather in Hong Kong was generally cloudy with showers on 12 July. It remained rainy the next two days with squally thunderstorms occurring late in the day. As Zeke dissipated over the northern part of Vietnam, showery activity eased off on 15 July. The weather further improved on 16 July with fine and sunny weather. The daily amounts of rainfall recorded at some selected locations are as follows:

<i>Date</i>	<i>Royal Observatory</i> mm	<i>Central</i> mm	<i>Tai Mo Shan</i> mm	<i>Yuen Long</i> mm	<i>Tai Mei Tuk</i> mm
12 July	12.1	5.5	15.0	5.0	28.0
13 July	21.8	38.0	42.0	16.5	19.5
14 July	22.8	37.0	39.0	8.0	11.5
15 July	1.0	nil	1.0	3.0	0.5
16 July	nil	nil	nil	nil	nil
Total	57.7	80.5	97.0	32.5	59.5

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

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Chi Ma Wan	2.70	12 July	8.00 a.m.	0.34	13 July	3.44 p.m.
Ko Lau Wan	2.67	13 July	7.45 a.m.	0.36	13 July	3.44 p.m.
Lok On Pai	2.84	12 July	8.47 a.m.	0.30	13 July	4.23 p.m.
Quarry Bay	2.72	12 July	8.44 a.m.	0.32	13 July	8.23 a.m.
Tai Po Kau	2.68	13 July	8.25 a.m.	0.71	13 July	5.54 a.m.

In Hong Kong, some ferry services to China were cancelled. No casualties or serious damage was reported.

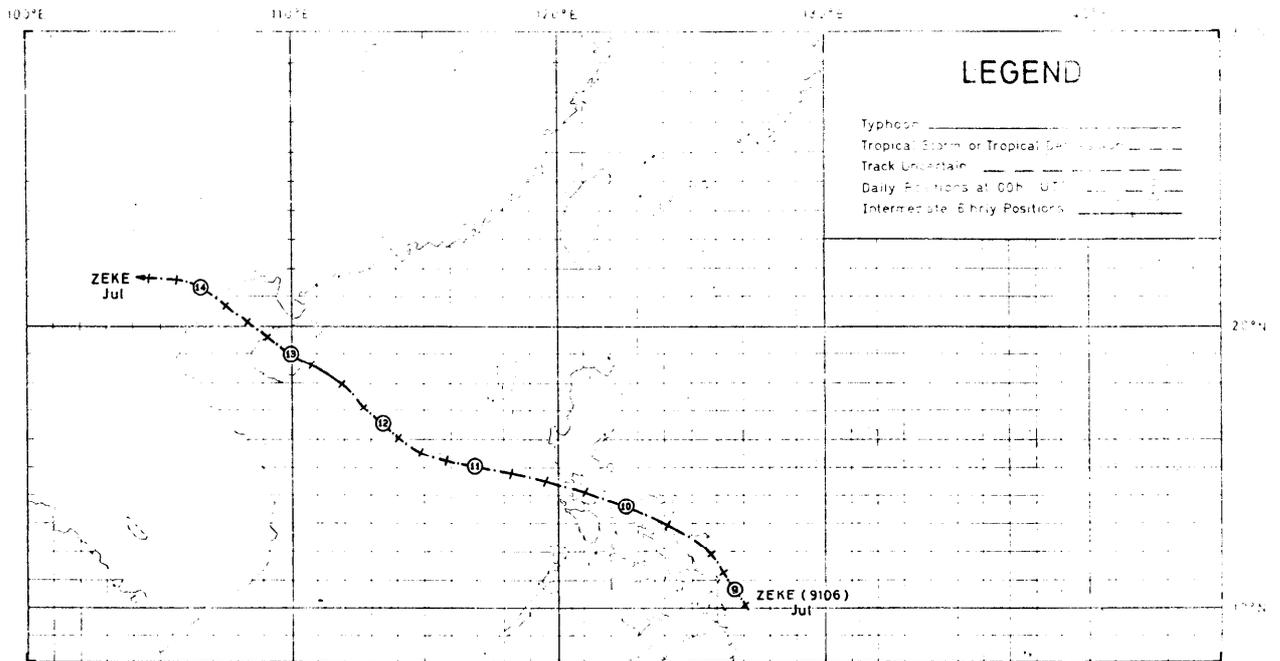


Figure 4. Track of Typhoon Zeke (9106): 9-14 July 1991.

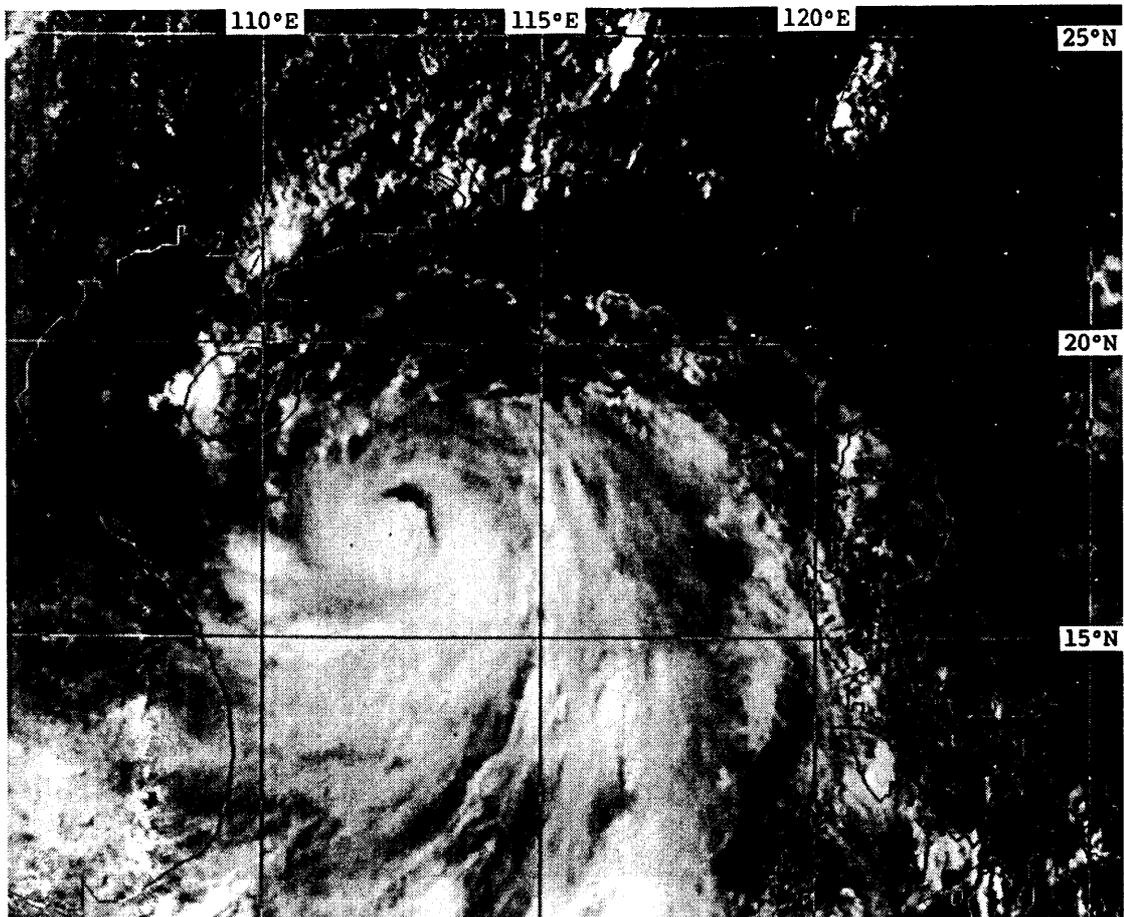


Figure 5. GMS-4 visible imagery of Zeke around 2 p.m. on 12 July 1991.

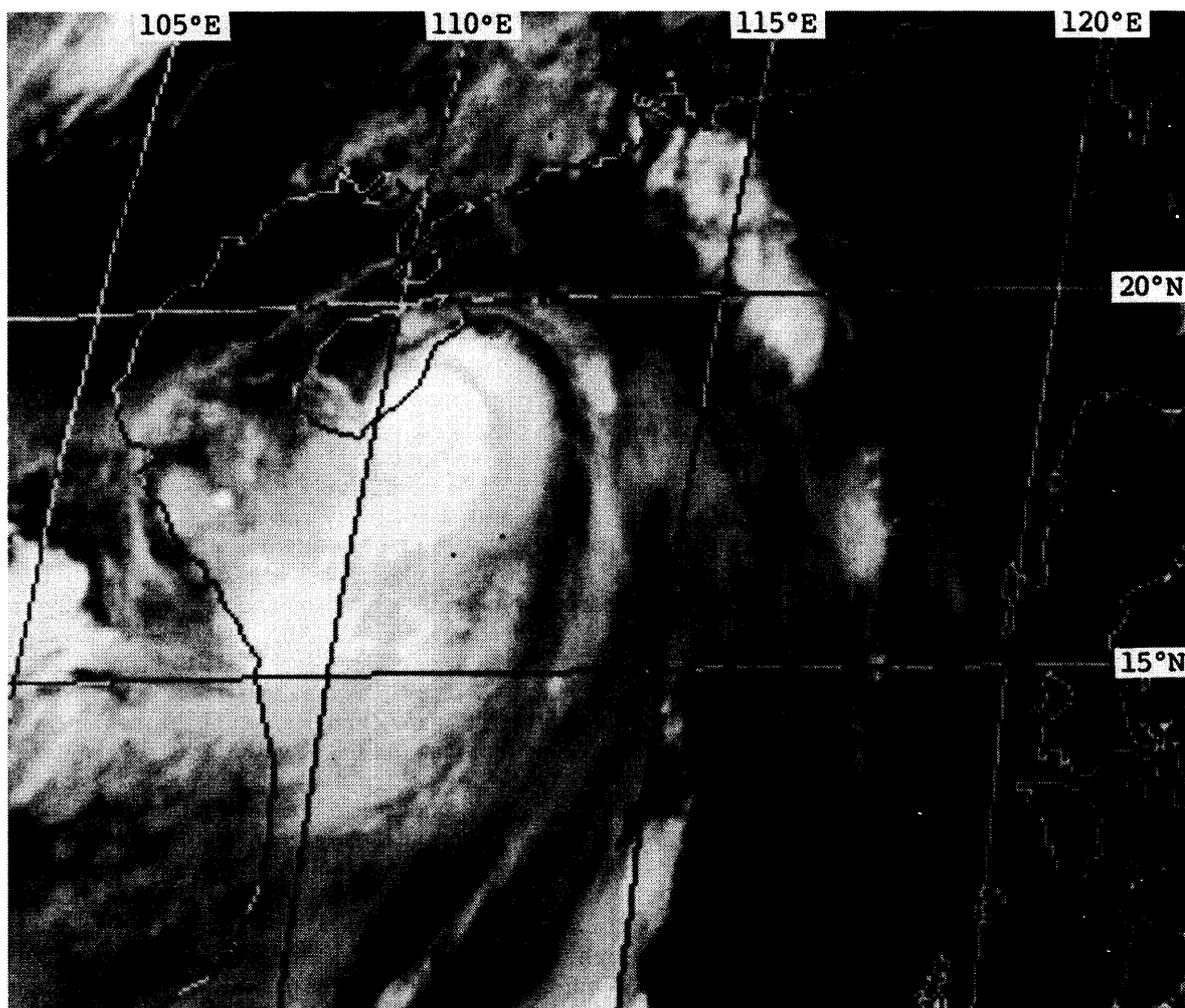


Figure 6. GMS-4 infra-red imagery of Zeke around 2 a.m. on 13 July 1991.

**(b) Typhoon Amy (9107)****16-19 July 1991***The track of Amy is shown in Figure 7*

Amy developed as a tropical depression about 590 km north-northwest of Yap on 15 July. Moving northwestwards at 20 km/h, it soon intensified to a tropical storm about 670 km north-northwest of Yap during the night. Amy further intensified to a severe tropical storm early on 17 July when it was about 1 260 km east-southeast of Gaoxiong. After moving westwards for a while, Amy turned west-northwestwards and attained typhoon intensity about 1 000 km east-southeast of Gaoxiong during the day on 17 July. It reached peak intensity 24 hours later with winds of 185 km/h near its centre.

Amy crossed the Bashi Channel on the night of 18 July at an increased speed of 30 km/h and continued to move swiftly west-northwestwards towards the coast of eastern Guangdong. It landed near Shantou late in the afternoon on 19 July and rapid weakening took place. By early morning on 20 July, Amy had become a tropical depression about 240 km west-northwest of Shantou and soon dissipated over northern Guangdong.

The circulation of Amy was quite extensive. In the Philippines, volcanic ash from Mount Pinatubo was blown towards Manila and forced the closure of the airport. Volcanic debris from Mount Pinatubo's slopes loosened by heavy rain destroyed about 500 houses near the river banks and swept away two bridges. Near the coast, a 460-tonne ship capsized. Two people were killed and two others were reported missing. In the Taiwan Strait, a Cypriot ship 'Blue River' with 30 crew members on board vanished in high seas.

Amy inflicted heavy damage upon Guangdong. The hardest-hit area was Shantou and the neighbouring region. According to press reports, 99 people were killed and 5 239 others were injured. About 400 000 houses collapsed or were damaged, and 200 000 hectares of farmland were affected. Other damage included 214 bridges, 408 boats, 792 kilometres of road and many irrigation facilities. The total loss was estimated at 23.6 billion RMB (yuan). The airports at Shantou and Xiamen were forced to close. In southern Fujian, Zhangzhou suffered the most. At least 30 people were injured and 1 300 houses collapsed. Over 6.2 million banana trees and another 700 000 trees were damaged. Other major losses included over 10 000 hectares of paddy field and 13 000 hectares of sugar-cane. A 20-tonne fishing vessel was sunk. The total loss in Zhangzhou was estimated at 2.4 billion RMB (yuan).

In Hong Kong, the Stand By Signal No. 1 was hoisted at 10.45 p.m. on 18 July when Typhoon Amy was about 780 km to the east. Winds were light to moderate westerly at first. With Amy approaching at a very high speed, the Strong Wind Signal No. 3 was hoisted at 11.10 a.m. on 19 July when Amy was about 400 km to the east. The lowest sea-level pressure of 993.7 hPa was recorded at the Royal Observatory at 4 p.m., an hour before Amy made landfall. Winds turned fresh southwesterly in the evening and became strong offshore. Amy moved closest to Hong Kong around 9 p.m. on 19 July when it was about 190 km to the northeast. With Amy weakening and moving northwestwards further inland, local winds gradually subsided. All signals were lowered at 10.10 a.m. on 20 July.

The maximum hourly mean winds and maximum gust peak speeds together with associated wind directions at various locations are as follows:

<i>Location</i>	<i>Maximum hourly mean wind speed (km/h) and direction</i>		<i>Maximum gust peak speed (km/h) and direction</i>	
Royal Observatory	SW	34	SW	69
H.K. Airport (SE)	SSW	38	SSW	75
H.K. Airport (NW)	S	36	SSW	63
Waglan Island	SSW	59	SW & SSW	83
Tate's Cairn	WNW	40	WSW	88
Cheung Chau	SW	51	SW	83
King's Park	S	31	SW	65
Star Ferry	S	30	W	70
Green Island	SSW	52	SSW	83
Tai O	SW	36	SW	70
Sha Tin	SW	30	SW	67
Lau Fau Shan	S	43	SSW	72
Ta Kwu Ling	N	13	NNE	38
Tuen Mun	NW	23	SSW	67
Wong Chuk Hang	S	23	S	58
Tai Po	WNW	25	SW	59
Tai Mo Shan	SSW	70	SSW	104
Tamar	WNW	19	W	65
Cheung Sha Wan	SSW	36	SSW	62
Tsing Yi	S	27	S	79
Kwai Chung	SSW	27	SW	58
Sai Kung	NW	22	NW	56

The weather was fine and sunny on 18 July. With Amy approaching from the east, a seventh highest July temperature of 34.5 degrees was recorded on 19 July. Rain began to affect the territory after Amy landed near Shantou. The remnant of Amy continued to bring squally showers and thunderstorms on 20 and 21 July. Showers died out on 22 July and the weather turned fine. The daily amounts of rainfall recorded at some selected locations are as follows:

<i>Date</i>	<i>Royal Observatory</i> mm	<i>Kwun Tong</i> mm	<i>Tai Mei Tuk</i> mm	<i>Yuen Long</i> mm	<i>Sha Tin</i> mm
19 July	0.2	nil	1.0	nil	0.5
20 July	27.5	21.0	24.5	7.0	60.5
21 July	34.6	34.5	21.5	31.5	35.5
22 July	7.2	7.0	14.5	6.0	7.0
Total	69.5	62.5	61.5	44.5	103.5

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

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Chi Ma Wan	2.06	20 July	3.24 a.m.	0.26	20 July	5.37 a.m.
Ko Lau Wan	2.19	20 July	3.09 a.m.	0.46	19 July	10.29 p.m.
Lok On Pai	2.23	20 July	4.01 a.m.	0.33	20 July	6.50 a.m.
Quarry Bay	2.14	20 July	4.01 a.m.	0.33	20 July	6.18 a.m.
Tai O	2.15	20 July	4.38 a.m.	0.22	20 July	7.07 a.m.
Tai Po Kau	2.10	20 July	2.33 a.m.	0.55	19 July	10.41 p.m.

In Hong Kong, scaffoldings at North Point collapsed in strong winds. In another incident, a man in Sai Kung was injured when he was blown down from a ladder. Two small crafts were damaged at Chai Wan and Stanley. The ferry service from Hong Kong to Shantou was cancelled.

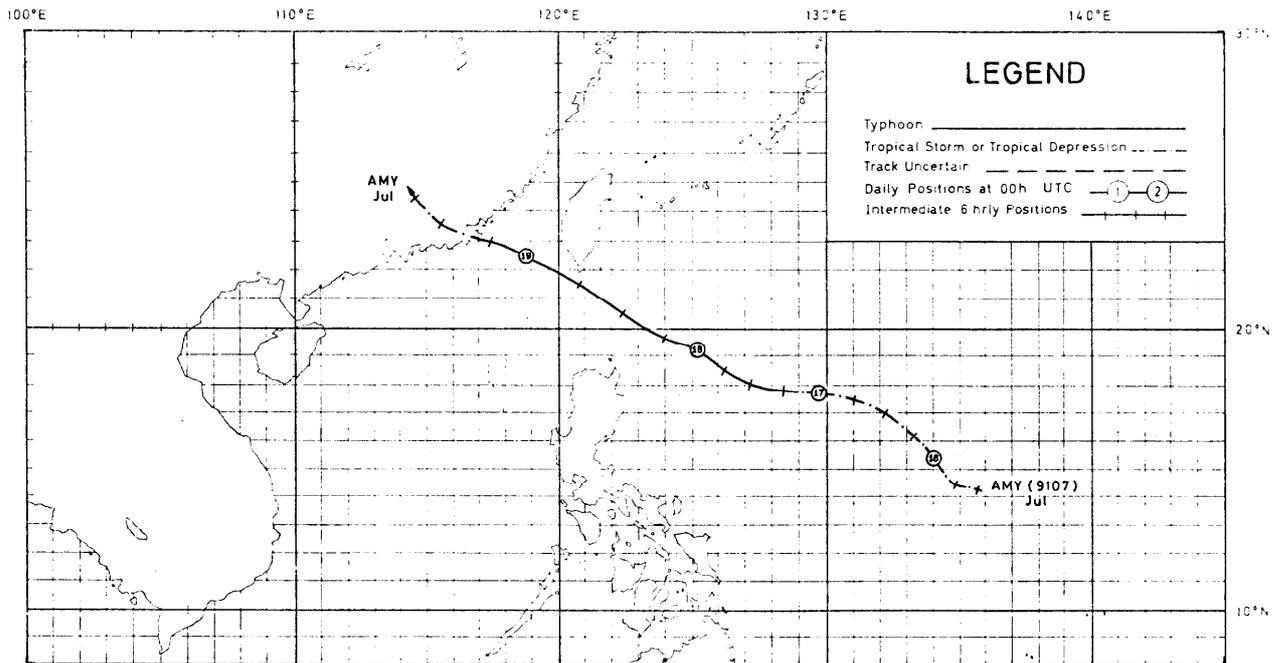


Figure 7. Track of Typhoon Amy (9107): 16-19 July 1991.

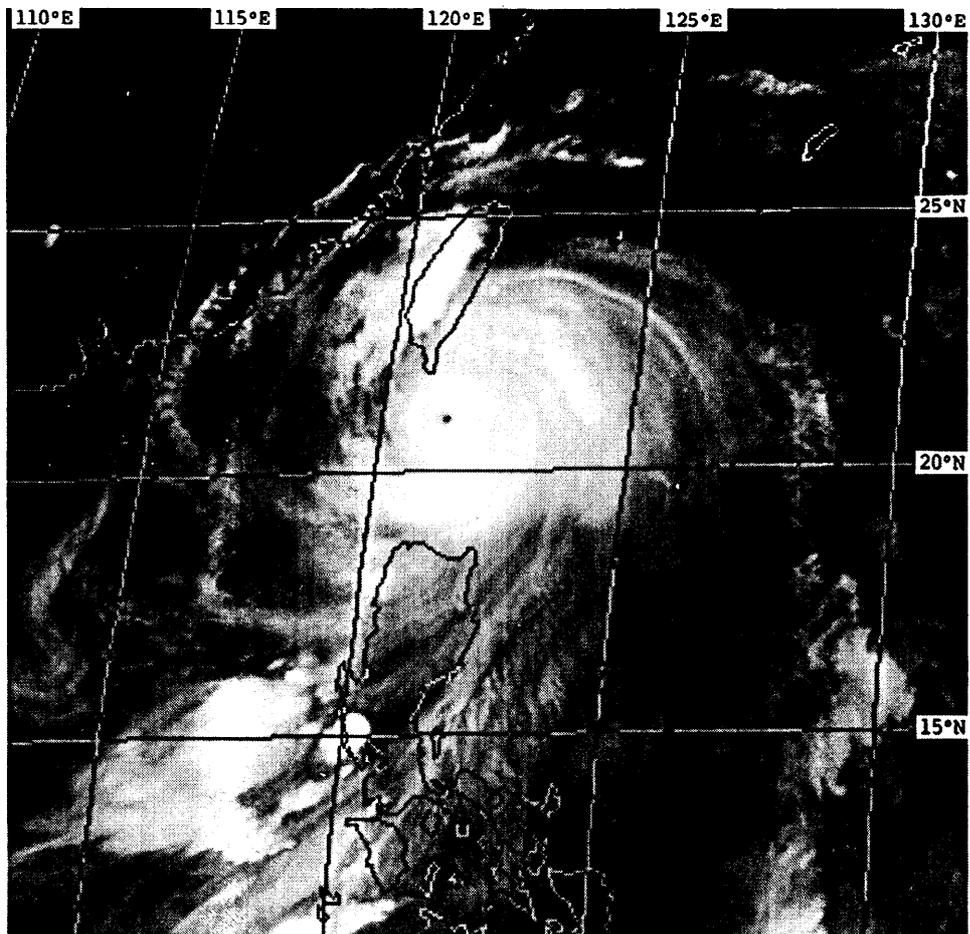


Figure 8. GMS-4 infra-red imagery of Amy around 11 p.m. on 18 July 1991.

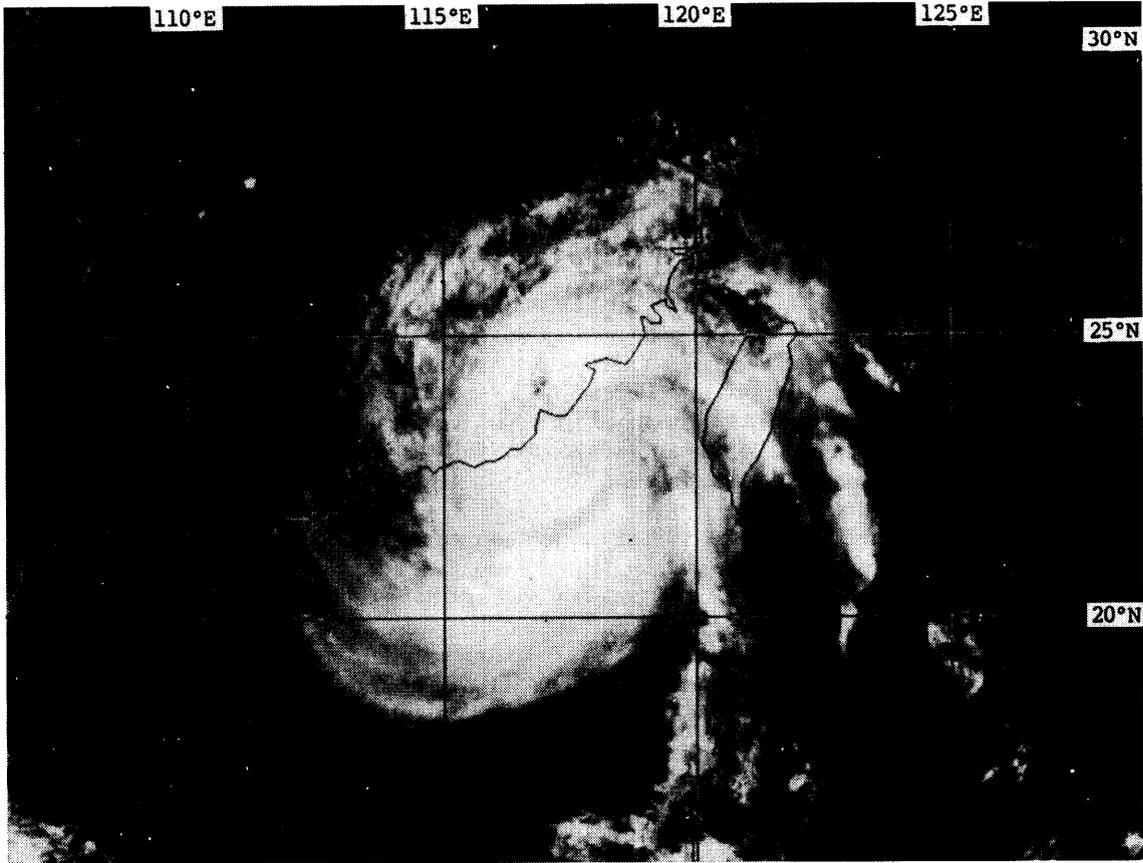


Figure 9. GMS-4 visible imagery of Amy around 2 p.m. on 19 July 1991.

## (c) Severe Tropical Storm Brendan (9108)

20-24 July 1991

*The track of Brendan is shown in Figure 10*

An area of disturbance over the western North Pacific east of the Philippines developed into a tropical depression about 690 km east of Manila on 20 July. Moving west-northwestwards at about 20 km/h, it rapidly intensified to a tropical storm named Brendan early next morning. Intensification continued and Brendan became a severe tropical storm about 310 km northeast of Manila on the evening of 21 July before making landfall over the east coast of northern Luzon the next day.

Brendan entered the Balintang Channel and accelerated to 30 km/h. Moving along a generally west-northwestward track, it moved past Dongsha near midday on 23 July. According to press reports, the centre of Brendan crossed the path of the cargo ship, 'Mei Yuan', shortly after 1 p.m. on 23 July. The ship drifted for more than eight hours in stormy weather whipped up by Brendan.

Brendan slowed down to 19 km/h as it approached the Pearl River estuary. It made landfall near Zhuhai in western Guangdong on the morning of 24 July and weakened rapidly as it moved further inland. By that evening, Brendan had weakened to a tropical depression about 230 km west of Guangzhou and soon degenerated to an area of low pressure over Guangxi.

In the Philippines, at least four people were killed during the passage of Brendan. Heavy rain associated with Brendan unleashed torrents of volcanic debris which poured into villages near Mount Pinatubo. Mudflow of up to five metres high swamped 12 villages. About 1 400 houses were buried or swept away.

In western Guangdong, two people were killed and four others were severely injured. A total of 64 houses collapsed and 1 019 houses were damaged. Over 78 000 hectares of farmland were affected. Other damage included roads, telecommunication wires, and irrigation facilities. The total loss was estimated at 1.32 billion RMB(yuan). In Guangxi, 28 people were killed and 185 people were injured. About 2 100 houses collapsed and 16 000 hectares of paddy field were inundated. The total loss was estimated at 25 million RMB (yuan).

With Brendan passing about 30 km to the southwest of Macau, two Chinese fishermen were reported missing after their boat capsized. In Macau, severe flooding was reported in low-lying areas. There were also reports of uprooted trees and collapse of scaffoldings and hoardings. The Macau-Taipa bridge was closed during the approach of Brendan.

In Hong Kong, the Stand By Signal No. 1 was hoisted at 10.10 p.m. on 22 July when Brendan was about 780 km to the east-southeast. Winds were light easterly at first. As Brendan accelerated towards the south China coast, the Strong Wind Signal No. 3 was hoisted at 10.00 a.m. on 23 July. At that time, Brendan was about 410 km east-southeast of Hong Kong. Winds became strong from the northeast in the afternoon and continued to increase in the evening.

The Gale or Storm Signal No. 8 NE was hoisted at 9.00 p.m. on 23 July when Brendan was about 140 km to the southeast. Gale force winds were experienced at high grounds and offshore. The Gale or Storm Signal No. 8 SE replaced No. 8 NE at 3.20 a.m. on 24 July as Brendan moved to the southwest quadrant of Hong Kong. The closest approach occurred round about 4 a.m. when Brendan was 80 km south-southwest of Hong Kong. The lowest sea-level pressure of 993.0 hPa was recorded at the Royal Observatory an hour earlier. The Gale or Storm Signal No. 8 SE was replaced by the Strong Wind Signal No. 3 at 10 a.m. on 24 July when Brendan had landed to the west of the Pearl River estuary and the southerly winds began to subside. All signals were lowered at 3.10 p.m. that afternoon as Brendan no longer posed a threat to Hong Kong.

The maximum hourly mean winds and maximum gust peak speeds together with associated wind directions at various locations during the approach of Brendan are as follows:

<i>Location</i>	<i>Maximum hourly mean wind speed (km/h) and direction</i>		<i>Maximum gust peak speed (km/h) and direction</i>	
Royal Observatory	E	54	E	110
H.K. Airport (SE)	SE	63	ENE	106
H.K. Airport (NW)	SE	65	ENE	117
Waglan Island	E	104	ESE	146
Tate's Cairn	E	94	E	161
Cheung Chau	ESE	101	E	139
King's Park	ENE	48	NE	108
Star Ferry	E	62	E	96
Green Island	NE	88	NE	131
Tai O	S	63	S	128
Sha Tin	SSE	31	ENE	85
Lau Fau Shan	N	56	ESE	104
Ta Kwu Ling	ESE	38	SE	90
Tuen Mun	S	45	SSE	96
Tai Po	E	63	ESE	117

<i>Location</i>	<i>Maximum hourly mean wind speed (km/h) and direction</i>		<i>Maximum gust peak speed (km/h) and direction</i>	
Wong Chuk Hang	E	51	WSW	108
Tai Mo Shan	ESE	117	SE	161
Tamar	E	38	E	99
Cheung Sha Wan	ENE	40	NE	115
Tsing Yi	S	51	ENE	94
Kwai Chung	E	43	E	87
Sai Kung	NE	51	NE	108

The weather was fine on the night of 22 July and the morning of 23 July. Squally showers from the spiral rainbands of Brendan began to affect Hong Kong near midday. The weather deteriorated further that afternoon. Outbreaks of rain and severe squalls persisted till the next morning. With Brendan dissipating inland, showers became less frequent and the weather turned generally fine on 25 July. The daily amounts of rainfall recorded at some selected locations are as follows:

<i>Date</i>	<i>Royal Observatory</i>	<i>Central</i>	<i>Tsuen Wan</i>	<i>Tai Mei Tuk</i>	<i>Sai Kung</i>
	mm	mm	mm	mm	mm
23 July	37.1	48.5	50.5	40.0	51.5
24 July	33.5	62.0	41.5	25.0	16.5
25 July	0.4	Nil	Nil	2.0	1.5
<b>Total</b>	<b>71.0</b>	<b>110.5</b>	<b>92.0</b>	<b>67.0</b>	<b>69.5</b>

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

<b>Location</b>	<b>Highest tide above chart datum</b>			<b>Maximum storm surge above astronomical tide</b>		
	<b>Height (m)</b>	<b>Date</b>	<b>Time</b>	<b>Height (m)</b>	<b>Date</b>	<b>Time</b>
Chi Ma Wan	2.96	24 July	6.18 a.m.	0.89	24 July	4.44 a.m.
Ko Lau Wan	3.04	24 July	5.37 a.m.	0.96	24 July	5.37 a.m.
Lok On Pai	2.98	24 July	8.20 a.m.	0.76	24 July	8.20 a.m.
Quarry Bay	3.00	24 July	6.36 a.m.	0.90	24 July	6.36 a.m.
Tai O	3.21	24 July	7.50 a.m.	0.84	24 July	7.50 a.m.
Tai Po Kau	3.11	24 July	5.35 a.m.	1.15	24 July	3.04 a.m.

In Hong Kong, 17 people were injured. Most of the injuries were caused by falling objects or broken glass. Total loss in public utilities was estimated at about HK\$0.94 million. There were ten cases of landslip in Shing Mun catchwater, Tai Lam Chung catchwater, near Jubilee Reservoir, Sha Tin, Sha Tin Tau, and Sau Mau Ping. In Sau Mau Ping, 30 people from eight families had to be evacuated. A small retaining wall in Sha Tin collapsed. Four squatter huts were affected and about 30 people had to be evacuated. In Diamond Hill, 13 people from four families had to be evacuated due to a fallen tree. Fallen trees were also reported in North Point, Causeway Bay, the Mid-levels, Happy Valley, Stanley, Homantin, Sheung Shui and Tai Po. In Wanchai, scaffoldings of 60 metres in height collapsed. Collapsed or endangered scaffoldings were also reported in Yau Ma Tei, Tai Kok Tsui and Causeway Bay.

At the airport, 22 international flights were delayed, diverted or cancelled. Public transport on land came to a standstill on the night of 23 July as Brendan made its closest approach to Hong Kong. A beach platform in Shek O broke its anchor and was blown ashore. Ferry services, including services to China, were suspended. The 'Orient Princess' near the Stonecutters Island drifted for 1.5 km before it was safely anchored again. Fourteen small crafts were damaged in Hebe Haven, Sham Wan and Tai Tam, and a yacht capsized at Marina Cove.

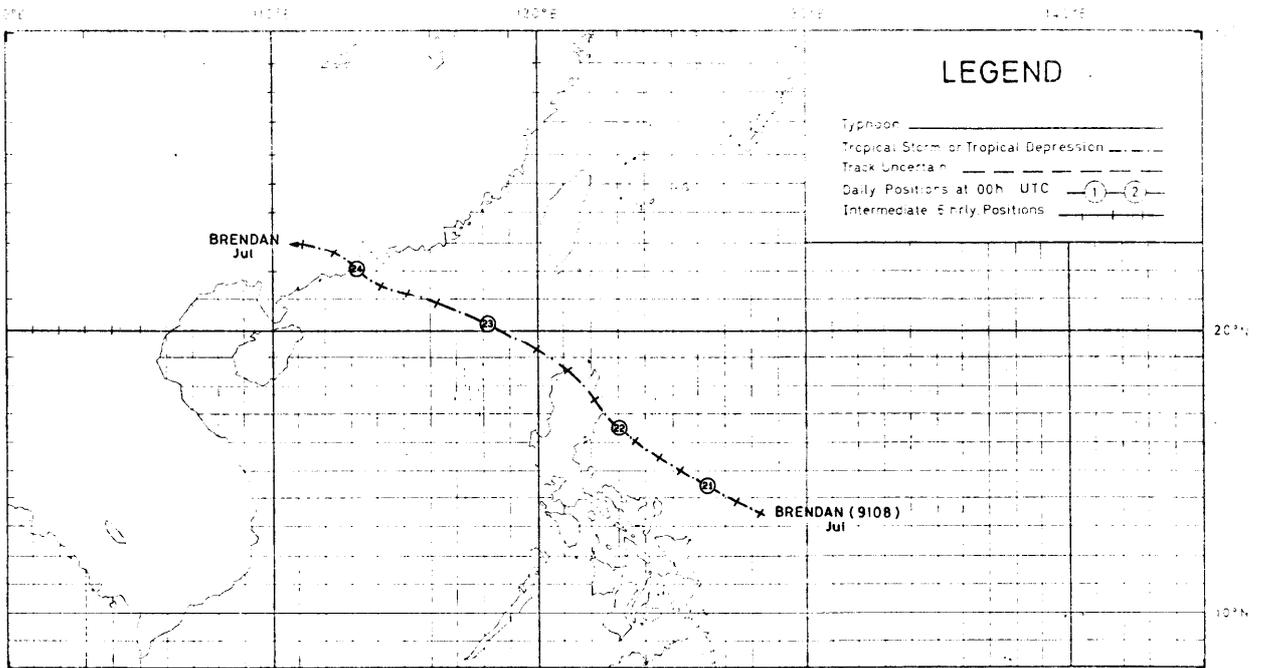


Figure 10. Track of Severe Tropical Storm Brendan (9108): 20-24 July 1991.

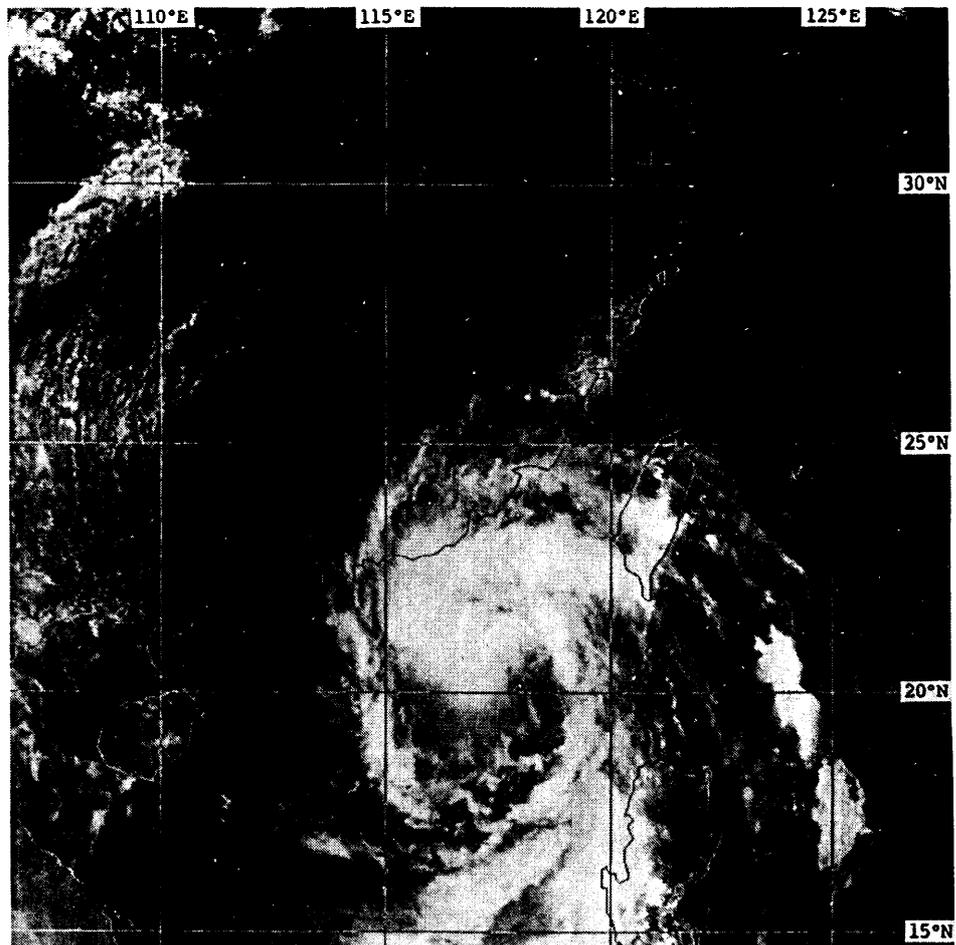


Figure 11. GMS-4 visible imagery of Brendan around 11 a.m. on 23 July 1991.

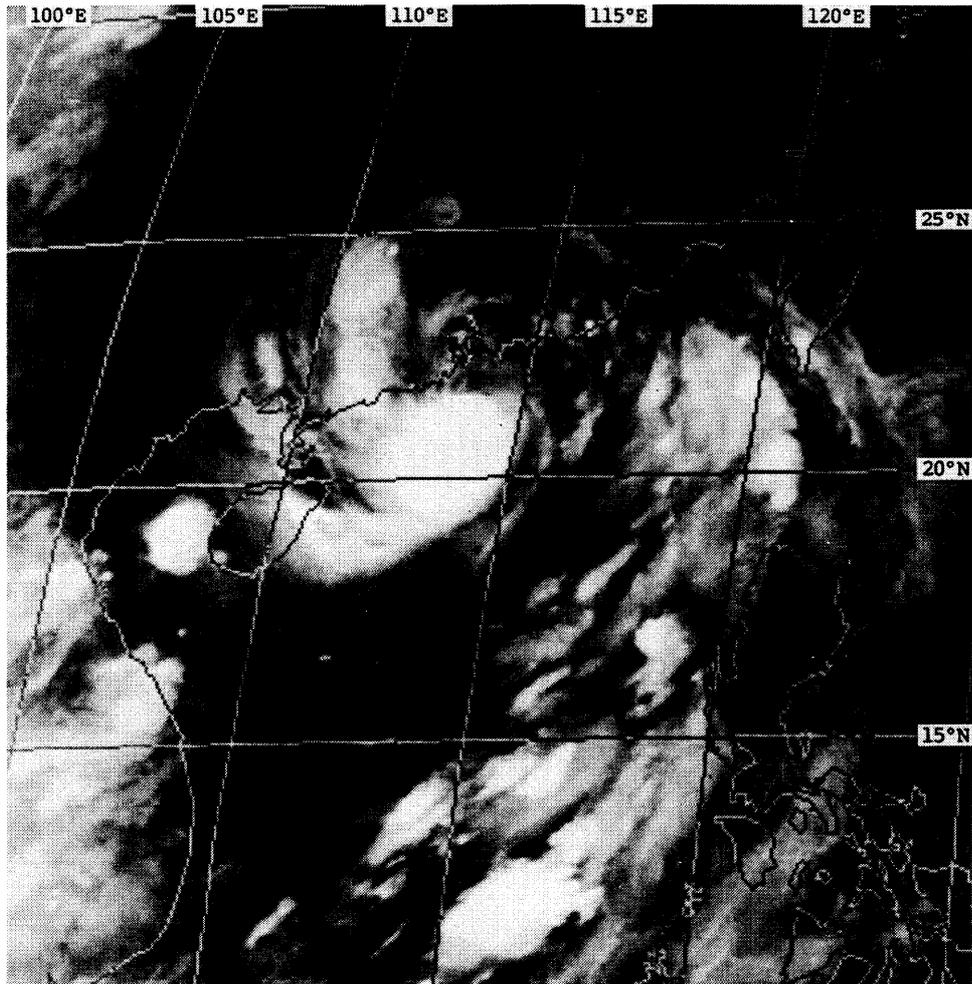


Figure 12. GMS-4 infra-red imagery of Brendan around 2 a.m. on 24 July 1991.

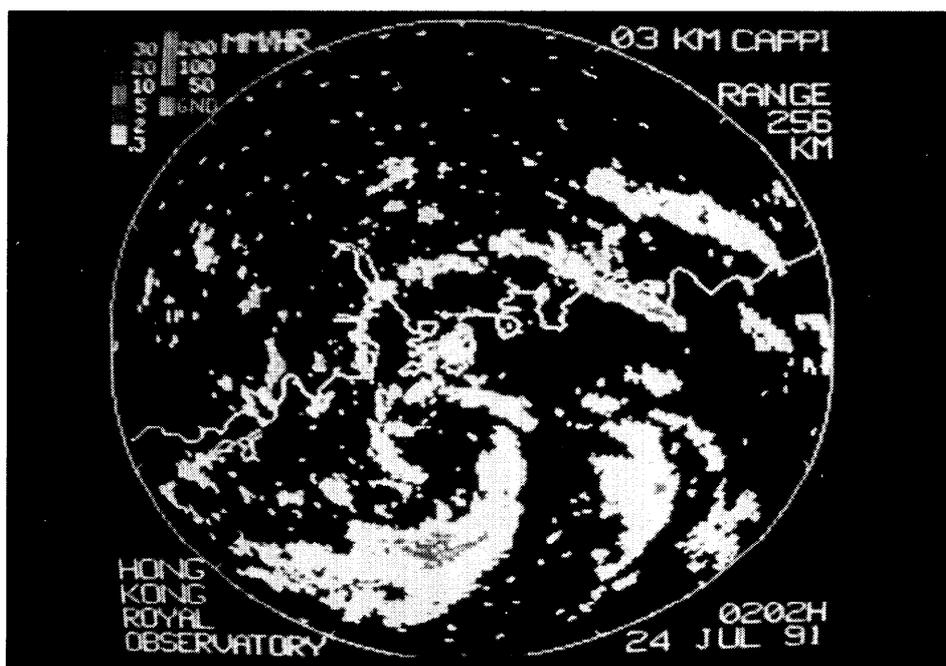


Figure 13. Radar display of the rain echoes of Brendan at 2.02 a.m. on 24 July 1991.

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Figure 14. The collapse of a 15-metre tree damaged a tram cable near Victoria Park in Causeway Bay (by courtesy of Ming Pao).

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Figure 15. A 6-metre tree collapsed and damaged a hut in Diamond Hill (by courtesy of Ming Pao).

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Figure 16. Collapsed scaffoldings in Anton Street, Wanchai (by courtesy of Ming Pao).

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Figure 17. A beach platform was swept ashore in Shek O (by courtesy of Ming Pao).

**(d) Typhoon Fred (9111)****13-18 August 1991***The track of Fred is shown in Figure 18*

Fred originated from an area of disturbance to the east of the Philippines. After crossing northern Luzon on 12 August, it developed into a tropical depression over the South China Sea about 450 km east-southeast of Dongsha on the morning of 13 August and moved west-northwestwards at about 10 km/h. As intensification continued, Fred soon became a severe tropical storm about 130 km south-southeast of Dongsha on 14 August. It passed about 100 km south-southwest of the island that evening and attained typhoon intensity about 230 km south of Hong Kong the next day. The M.V. 'Kowloon Bay' reported winds of 92 km/h about 90 km from the centre of the typhoon on the morning of 15 August. In stormy weather and rough sea conditions, a derrick barge with 195 people on board capsized about 100 km east of Hong Kong. Sixteen of the barge crew were killed and six others were reported missing.

Moving westwards at 19 km/h, Fred passed closest to Hong Kong on the afternoon of 15 August when it was 210 km to the south-southwest. It reached peak intensity that night with maximum winds of about 150 km/h near its centre. At the same time, it started to track west-southwestwards. It made landfall over northern Hainan about 50 km west of Haikou on the morning of 16 August and weakened to a severe tropical storm. After traversing the northwestern part of Hainan, Fred moved into Beibu Wan that night. Approaching the coast of Vietnam at a speed of 17 km/h, it landed about 290 km northwest of Danang on 17 August and swept across Vietnam and Laos. Fred weakened to a tropical storm about 240 km east-southeast of Vientiane as it moved from Laos into Thailand during the night. It gradually degenerated into an area of low pressure over Thailand the next day.

In the coastal areas of Guangdong, about 9 400 houses collapsed and over 90 000 houses were damaged. Agricultural land affected totalled 250 000 hectares. Other damage included telephone lines, roads and dams. The direct loss was estimated at about 350 million RMB (yuan).

In Hainan, five people were killed and ten others were injured. About 5 800 houses collapsed and over 67 000 houses were damaged. About 65 000 hectares of farmland were affected. Ruined plantation included 3.3 million rubber trees, 1.8 million fruit trees and 14 million lumber trees. Fishing vessels affected totalled nearly 600. Other damage included dams, dykes, roads, bridges, electricity and communication poles. The total loss was estimated at about 304 million RMB. In Haikou, the severance of a main power cable caused a blackout in the city. Heavy rain also led to flooding in some parts of the city. A Philippine cargo ship, 'Biyayang Ginto', with 24 crew members on board, vanished about 50 km west-northwest of Haikou on the morning of 16 August. Six bodies were found a week later.

In Vietnam, at least five people were killed and 16 others were injured. Over 3 000 houses were destroyed, 22 000 hectares of farmland were inundated, and about 90 vessels were sunk.

In Thailand, five people were killed. Over 3 000 houses were damaged. Paddy fields were flooded and power lines were broken.

In Macau, torrential rain resulted in minor flooding in low-lying areas. The Macau-Taipa Bridge was closed to traffic due to gale force winds.

In Hong Kong, the Stand By Signal No. 1 was hoisted at 11.15 p.m. on 13 August when Fred was about 630 km southeast of Hong Kong. Winds were light from the east at first but became moderate northeasterly the following evening. The Strong Wind Signal No. 3 was hoisted at 7.10 p.m. on 14 August when Fred was about 360 km to the southeast. The northeasterly winds strengthened considerably on 15 August. Areas inside the harbour were buffeted by generally strong winds. There were also occasional severe squalls associated with the spiral rainbands of Fred. Gale force winds affected high grounds and offshore areas. Sea conditions offshore were particularly rough. A fully arisen sea with huge 10-metre waves was reported. Fred came closest to Hong Kong at around 3 p.m. on 15 August when it was about 210 km to the south-southwest. It was then that the lowest sea-level pressure of 997.4 hPa was recorded at the Royal Observatory. All signals were lowered at 5.00 a.m. on 16 August when Fred was off the north coast of Hainan about 400 km west-southwest of Hong Kong. As Fred moved away, winds remained fresh easterly inside the harbour and strong at times offshore.

The maximum hourly mean winds and maximum gust peak speeds together with associated wind directions at various locations during the passage of Fred are tabulated below:

<i>Location</i>	<i>Maximum hourly mean wind speed (km/h) and direction</i>		<i>Maximum gust peak speed (km/h) and direction</i>	
Royal Observatory	E	47	E	112
H.K. Airport (SE)	E	47	E	112
H.K. Airport (NW)	E	49	E	137
Waglan Island	NNE	101	NNE	148
Tate's Cairn	ESE	87	E	139
Cheung Chau	E	79	E	130
King's Park	ESE	38	E	95
Star Ferry	E	52	E	90

<i>Location</i>	<i>Maximum hourly mean wind speed (km/h) and direction</i>		<i>Maximum gust peak speed (km/h) and direction</i>	
Green Island	NE & ENE	72	ENE	124
Tai O	SE	58	SE	135
Sha Tin	ENE	27	ENE	92
Lau Fau Shan	E	45	NE	85
Ta Kwu Ling	E	31	E	75
Tuen Mun	NNE	20	NE & NNE	76
Tai Po	E	54	E	96
Wong Chuk Hang	ENE	40	ENE	94
Tai Mo Shan	E	99	ESE	185
Tamar	ENE	41	ENE	88
Cheung Sha Wan	ENE	40	ENE	103
Tsing Yi	E	40	E	90
Kwai Chung	E	34	E	85
Sai Kung	ENE	43	ENE	99

The weather was fine on the night of 13 August. Squally showers and thunderstorms set in late in the afternoon on 14 August. Deterioration in weather continued on 15 and 16 August with periods of heavy rain and squalls. The rain died out on 17 August and it became fine the next day. The daily rainfall figures at some selected locations are given as follows:

<i>Date</i>	<i>Royal Observatory</i>	<i>Happy Valley</i>	<i>Tsuen Wan</i>	<i>Tai Mei Tuk</i>	<i>Yuen Long</i>
	mm	mm	mm	mm	mm
13 August	1.7	3.0	Nil	Nil	Nil
14 August	20.9	13.0	10.5	25.5	14.5
15 August	65.2	59.0	91.5	46.5	56.0
16 August	56.0	77.5	65.5	32.0	21.0
17 August	12.2	16.0	10.5	27.0	5.5
Total	156.0	168.5	178.0	131.0	97.0

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

<b>Location</b>	<b>Highest tide above chart datum</b>			<b>Maximum storm surge above astronomical tide</b>		
	<b>Height (m)</b>	<b>Date</b>	<b>Time</b>	<b>Height (m)</b>	<b>Date</b>	<b>Time</b>
Chi Ma Wan	2.44	16 Aug	0.38 a.m.	0.93	15 Aug	4.08 p.m.
Lok On Pai	2.42	16 Aug	1.09 a.m.	0.71	15 Aug	6.13 p.m.
Quarry Bay	2.36	16 Aug	0.45 a.m.	0.77	15 Aug	3.38 p.m.
Tai Po Kau	2.48	15 Aug	1.41 p.m.	0.94	15 Aug	10.03 a.m.

In Hong Kong, heavy rain caused some minor flooding in the New Territories. There were no reports of casualties. Four cases of landslides were reported. Over one hundred tons of rocks and mud tumbled down a hill slope blocking the traffic at Castle Peak Road. Landslides also occurred in the Shing Mun and Tai Lam Chung catchwater areas. The total loss in public utilities was estimated at about HK\$0.27 million. Scaffoldings in Chai Wan were blown askew. Toppled trees were reported in Pokfulam Road and in the Peak area. A fishing vessel sank in Tai Po Kau. All ferry and helicopter services between Hong Kong and Macau/China were suspended. In the aftermath of the storm, pent-up container truck traffic caused near chaos conditions in the Tsuen Wan area and western Kowloon. Severe congestion occurred in the trunk roads with tailback stretching up to 15 kilometres on 16 August.

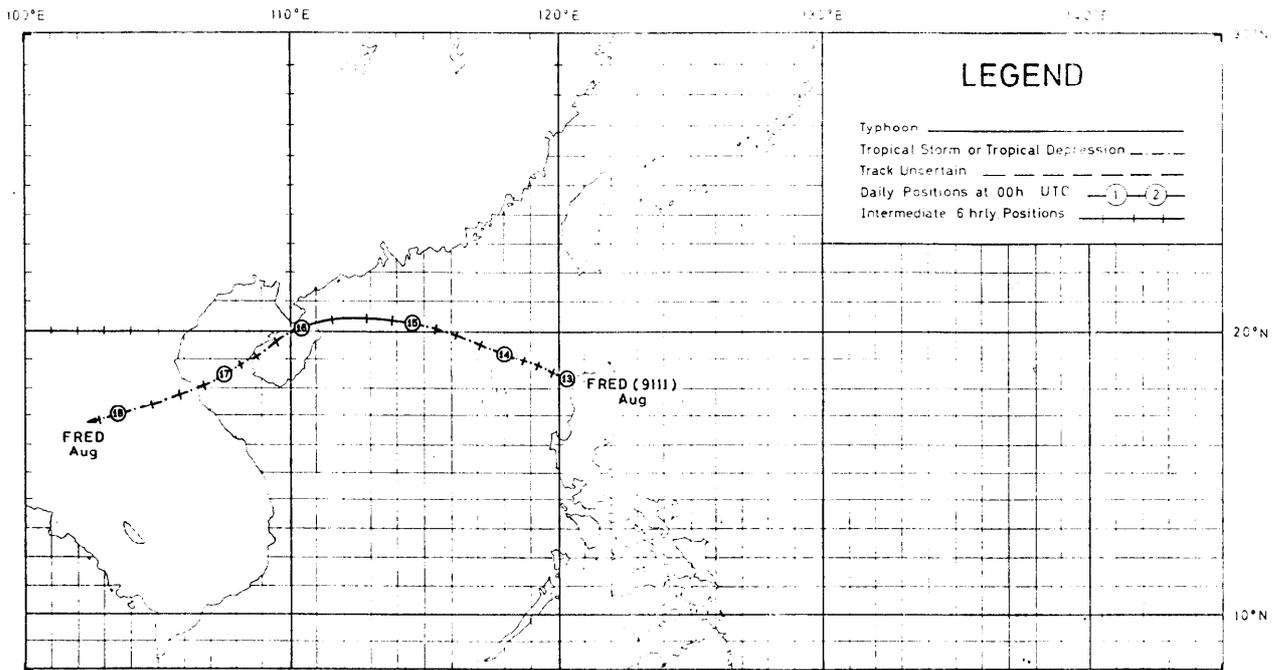


Figure 18. Track of Typhoon Fred (9111): 13-18 August 1991.

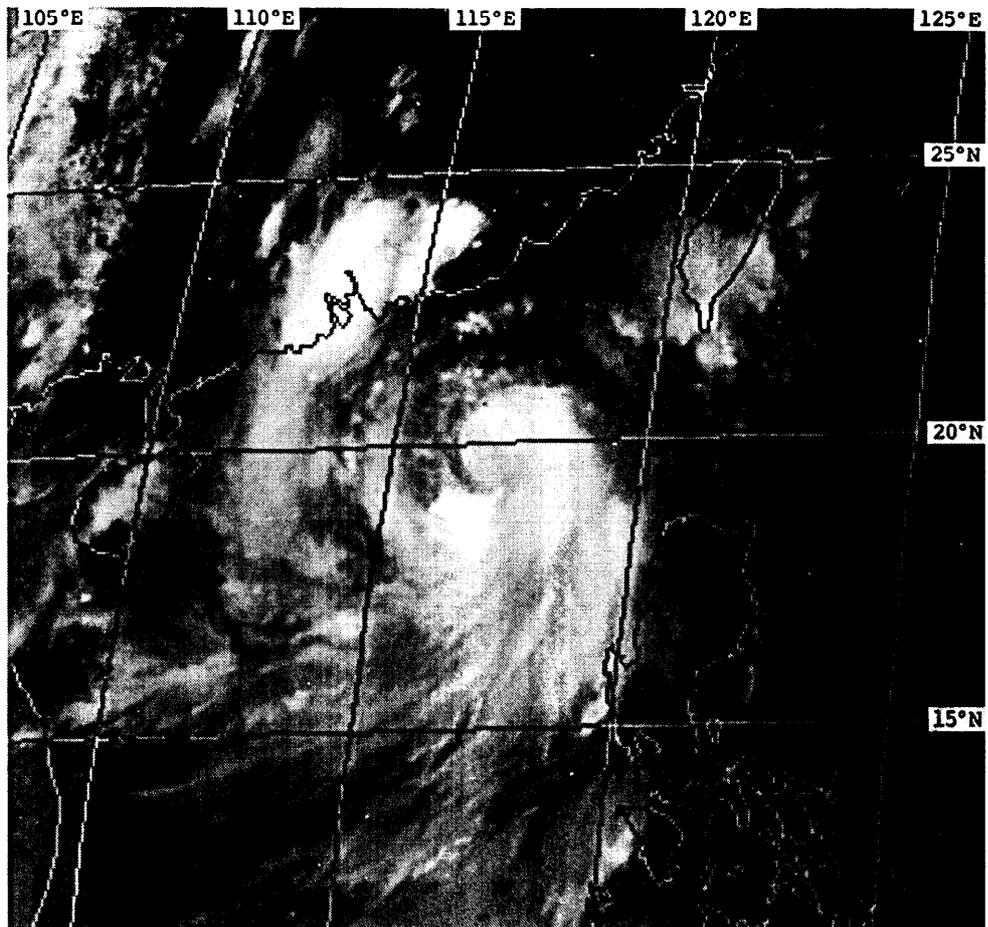
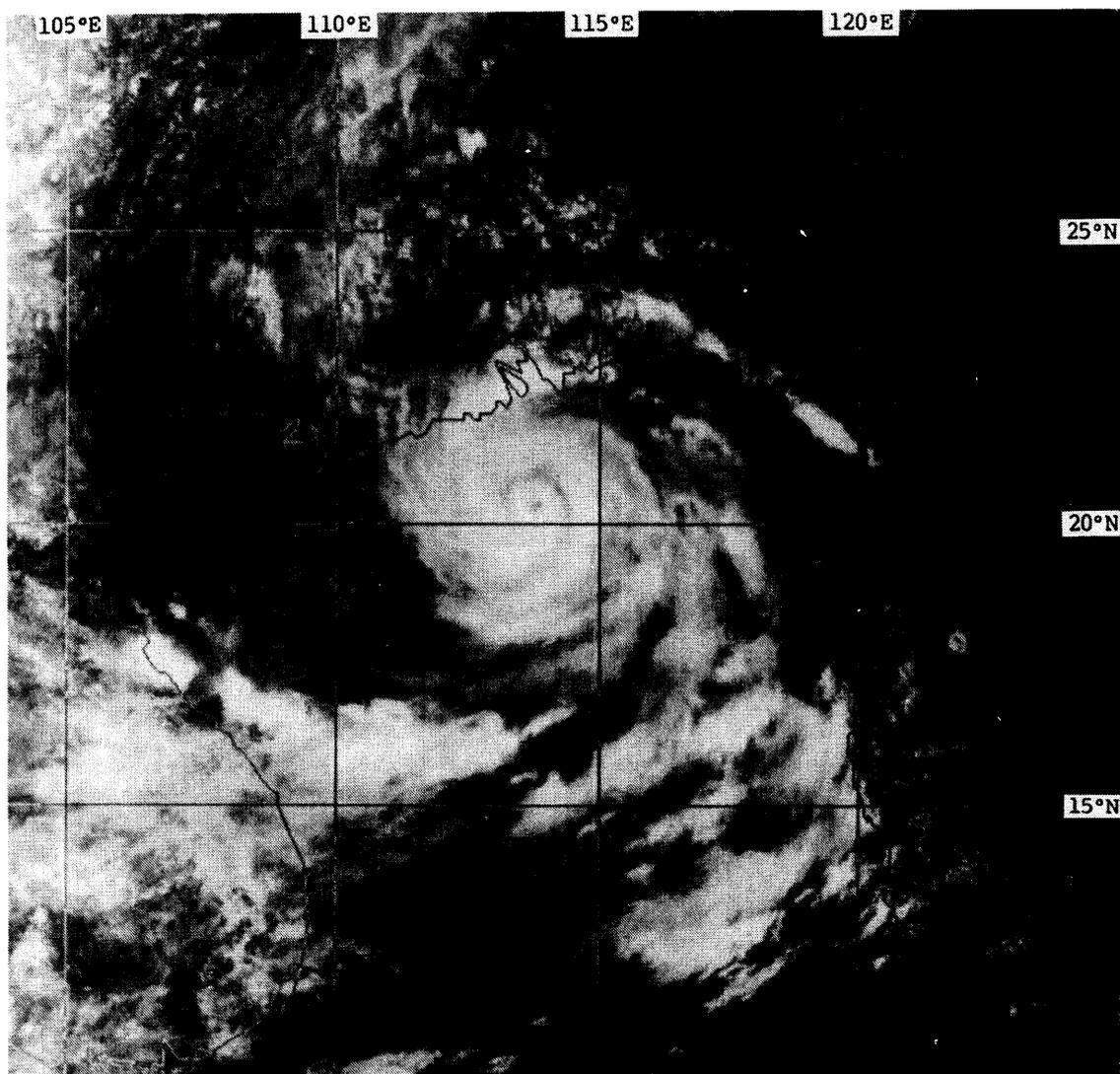
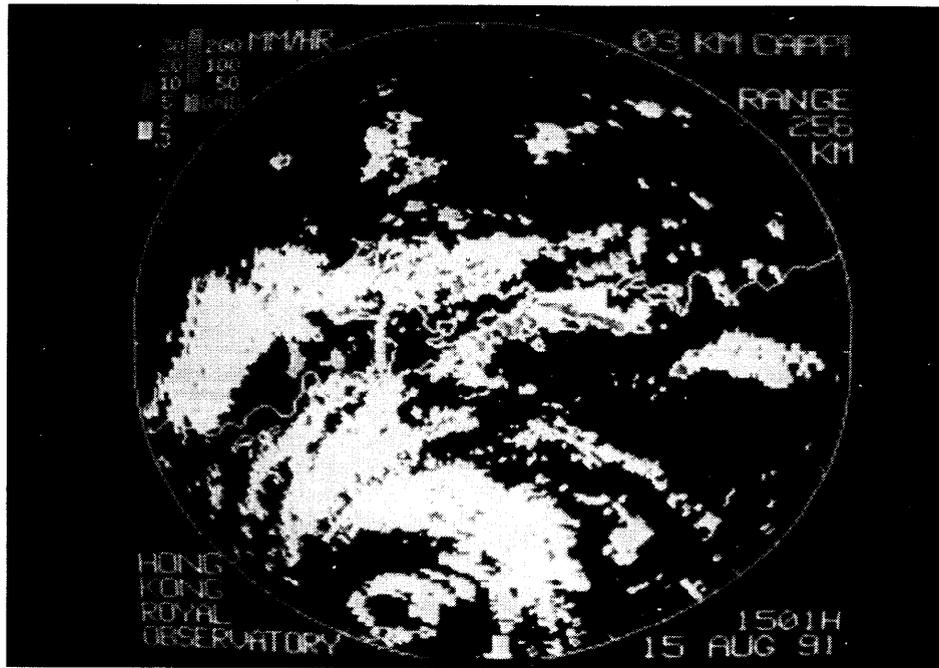


Figure 19. GMS-4 infra-red imagery of Fred around 5 p.m. on 14 August 1991.



**Figure 20. GMS-4 visible imagery of Fred around 2 p.m. on 15 August 1991.**



**Figure 21.** Radar displays (top-digital radar; bottom-43S radar) of the rain echoes of Fred at about 3 p.m. on 15 August 1991.  
 (Note: The 43S radar at Tate's Cairn, used as a back-up system to the digital radar, captured distinctly the developing eye of Typhoon Fred during the closest approach of the storm about 210 kilometres south-southwest of Hong Kong at 3 p.m. on 15 August. After serving Hong Kong for 25 years, the 43S radar was dismantled in late 1991 to make way for a new system. The tracking of Typhoon Fred was the final contribution in the long, distinguished service record of this sturdy weather radar.)

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Figure 22. Tons of rocks and mud tumbled down a hill slope in Castle Peak Road (by courtesy of Ming Pao).

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Figure 23. Heavy traffic on the road leading to the container terminal in Kwai Chung as trucks tried to make up for lost time as a result of Fred's passage (by courtesy of Ming Pao).

## (e) Severe Tropical Storm Joel (9116)

3-7 September 1991

*The track of Joel is shown in Figure 24*

Joel originated from an area of disturbance which moved across northern Luzon on 2 September. It developed into a tropical depression over the South China Sea about 240 km southeast of Dongsha on the evening of 3 September. It moved west-northwestwards at about 9 km/h initially and accelerated northwestwards the next day. The centre of Joel passed about 60 km west-southwest of Dongsha that afternoon before taking on a westward track in the evening at 19 km/h. It became slow-moving early on 5 September as it gathered strength over the waters south of Hong Kong. After becoming a tropical storm about 240 km south-southeast of Hong Kong on the afternoon of 5 September, Joel moved to the north-northeast towards the coast of eastern Guangdong at 12 km/h. It turned gradually to the north-northwest the next day and attained severe tropical storm strength with winds of about 90 km/h near its centre. It made landfall around midnight of 6 September over eastern Guangdong near Shanwei about 110 km east-northeast of Hong Kong. Joel became a tropical storm about 140 km north-northeast of Hong Kong on the morning of 7 September and degenerated rapidly into an area of low pressure soon afterwards.

In Shanwei, telecommunication, transportation, electricity and water supply were severely disrupted. Heavy rain occurred in eastern and northern Guangdong. Five people were killed, three were reported missing and at least 75 people were injured. About 4 000 houses collapsed, 8 680 houses were flooded and 78 000 hectares of farmland were affected. Other damage included more than 130 bridges, 257 irrigation facilities, and over 70 hectares of fish ponds. The direct loss in Guangdong was estimated at 400 million RMB (yuan).

In Hong Kong, the Stand By Signal No. 1 was hoisted at 9.45 p.m. on 3 September when Joel was about 540 km to the southeast. Winds were light and mainly from the east at first but freshened from the northeast on the evening of 4 September. The Strong Wind Signal No. 3 was hoisted at 10.30 p.m. on 4 September when Joel was 210 km to the south-southeast. Winds were strong offshore on 5 September as Joel turned towards the coast of eastern Guangdong, and became generally strong inside the harbour on the evening of 6 September. Joel came closest to Hong Kong at about 1 a.m. on 7 September when it was about 110 km to the northeast over Guangdong. The lowest sea-level pressure of 993.5 hPa was recorded at the Royal Observatory two hours later. All signals were lowered at 9.30 a.m. on 7 September as Joel continued to weaken over land.

The maximum hourly mean winds and maximum gusts together with associated wind directions at various locations are given as follows:

<i>Location</i>	<i>Maximum hourly mean wind speed (km/h) and direction</i>		<i>Maximum gust peak speed (km/h) and direction</i>	
Royal Observatory	W	41	WNW	68
H.K. Airport (SE)	WNW	45	WNW	92
H.K. Airport (NW)	NW	38	NNE	75
Waglan Island	ENE & WNW	58	WNW	94
Tate's Cairn	N	63	ENE	101
Cheung Chau	WNW	58	WNW	92
King's Park	W	28	W	61
Star Ferry	W	49	W	72
Green Island	NNW	45	NNE	76
Tai O	N	36	NE	67
Sha Tin	N & WSW	16	W	54
Lau Fau Shan	WNW	56	WNW	83
Ta Kwu Ling	NNE	20	NNE	52
Tuen Mun	NW	30	NW	79
Tai Po	WNW	34	W	72
Tai Mo Shan	N	76	NNW	113
Tamar	WNW	34	WNW	59
Cheung Sha Wan	N	20	N	54
Tsing Yi	NNE	22	NNE & NE	47
Kwai Chung	NNW	27	NNW	62
Sai Kung	NNE	34	W	79

In Hong Kong, the weather was fine on 3 September. It became cloudy the next day with intermittent light rain and evening thunderstorms. Over the next couple of days, rain became more frequent, particularly on 6 September. Although Joel dissipated on 7 September, rain associated with its remnant continued to affect Hong Kong until the morning of 8 September. The daily amounts of rainfall recorded at some selected locations are given as follows:

<i>Date</i>	<i>Royal Observatory</i>	<i>Tsuen Wan</i>	<i>Tai Mei Tuk</i>	<i>High Island</i>
	mm	mm	mm	mm
3 Sep	Nil	Nil	Nil	Nil
4 Sep	3.2	17.5	7.5	8.0
5 Sep	2.8	0.5	1.0	11.0
6 Sep	11.0	17.0	8.5	15.5
7 Sep	0.4	2.5	16.5	1.0
8 Sep	0.2	1.0	0.5	0.5
Total	17.6	38.5	34.0	36.0

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

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Chi Ma Wan	2.50	6 Sep	6.20 a.m.	0.27	5 Sep	9.23 p.m.
Lok On Pai	2.48	6 Sep	7.49 a.m.	0.24	5 Sep	5.03 p.m.
Quarry Bay	2.55	6 Sep	6.16 a.m.	0.30	6 Sep	4.28 a.m.
Tai Po Kau	2.50	6 Sep	7.37 a.m.	0.51	6 Sep	2.39 a.m.

In Hong Kong, a minor landslide occurred in Lam Tin. Nineteen people from five families were made homeless. Some ferry services to the outlying islands and China were suspended.

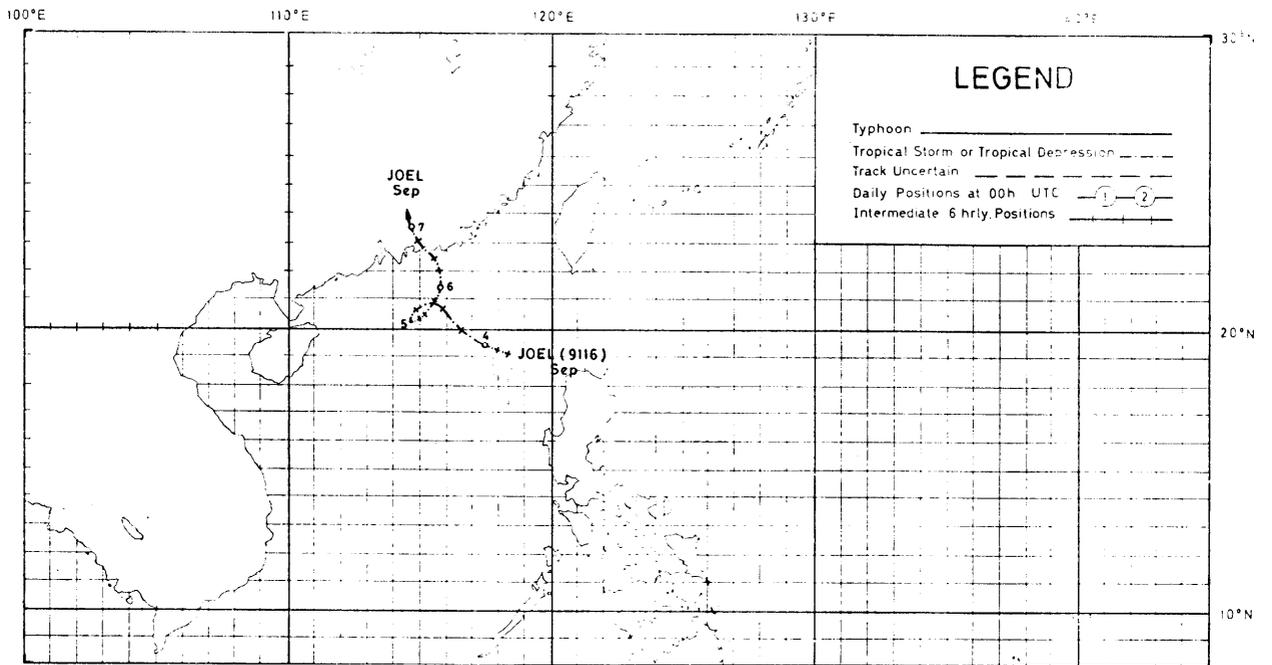


Figure 24. Track of Severe Tropical Storm Joel (9116): 3-7 September 1991.

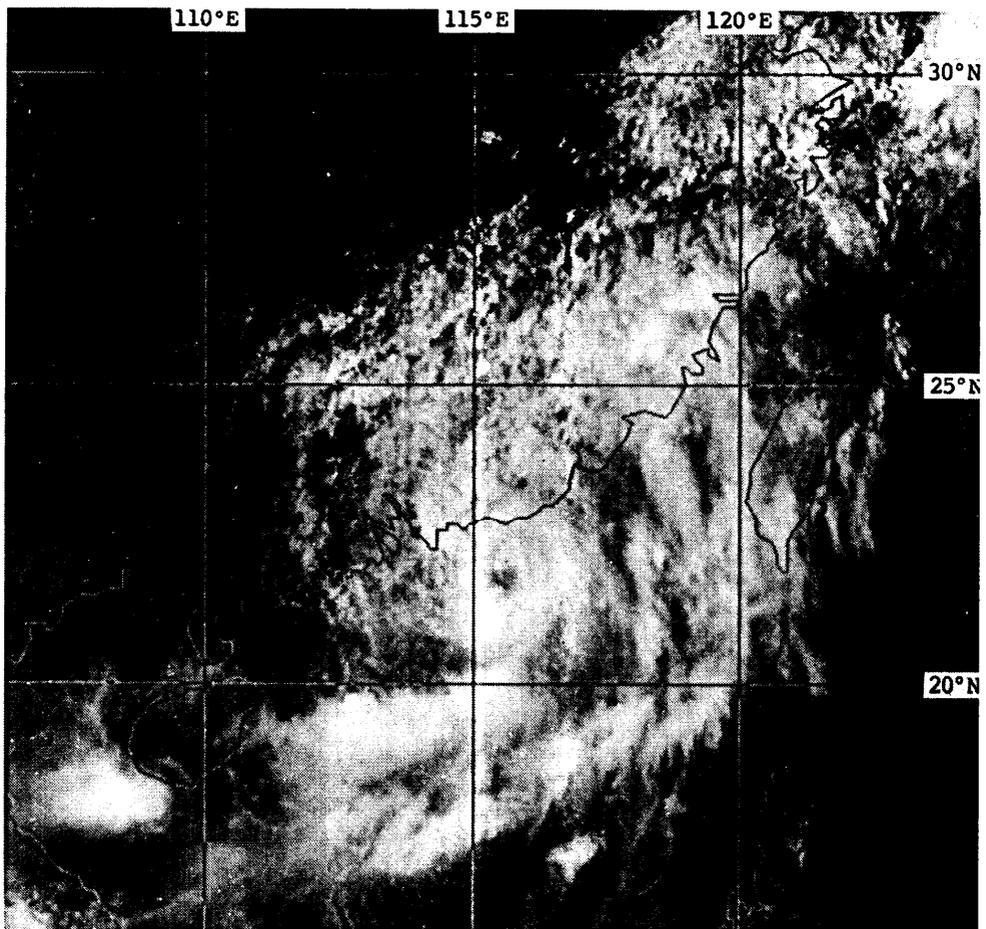


Figure 25. GMS-4 visible imagery of Joel around 2 p.m. on 6 September 1991.

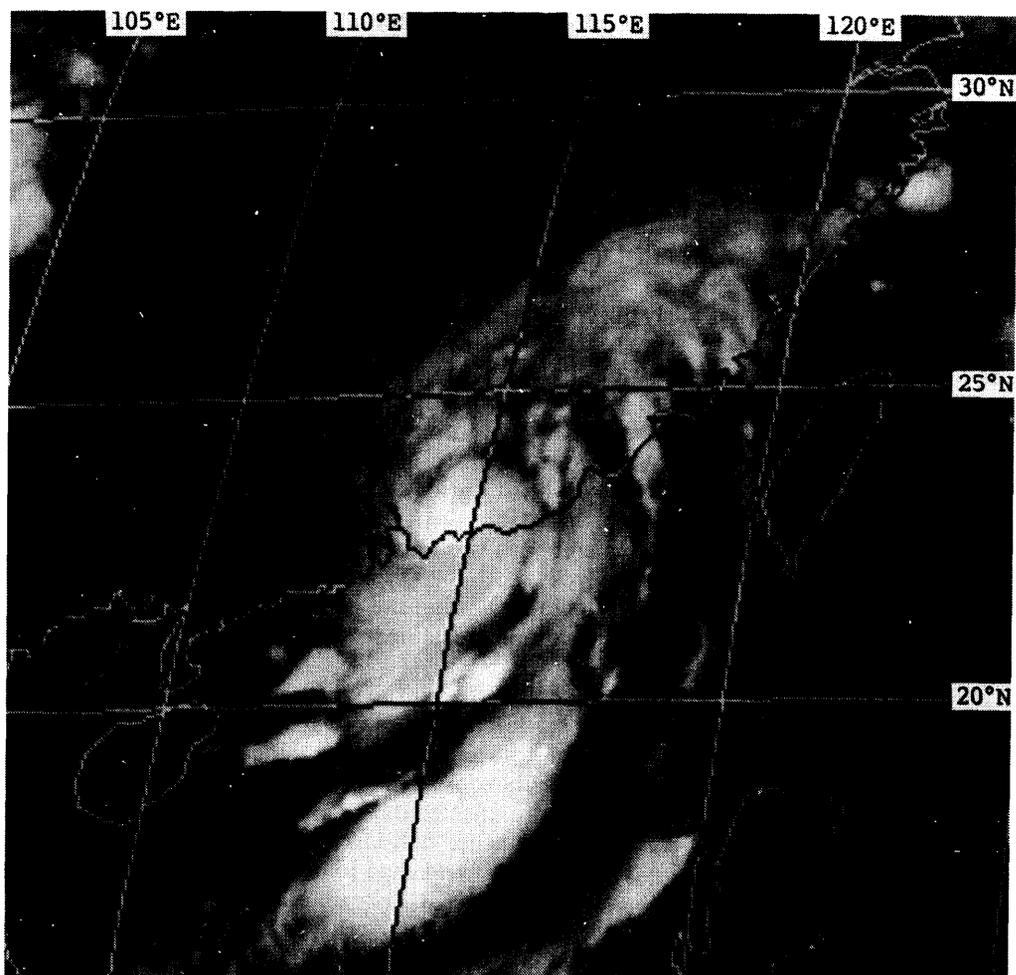


Figure 26. GMS-4 infra-red imagery of Joel around 2 a.m. on 7 September 1991.

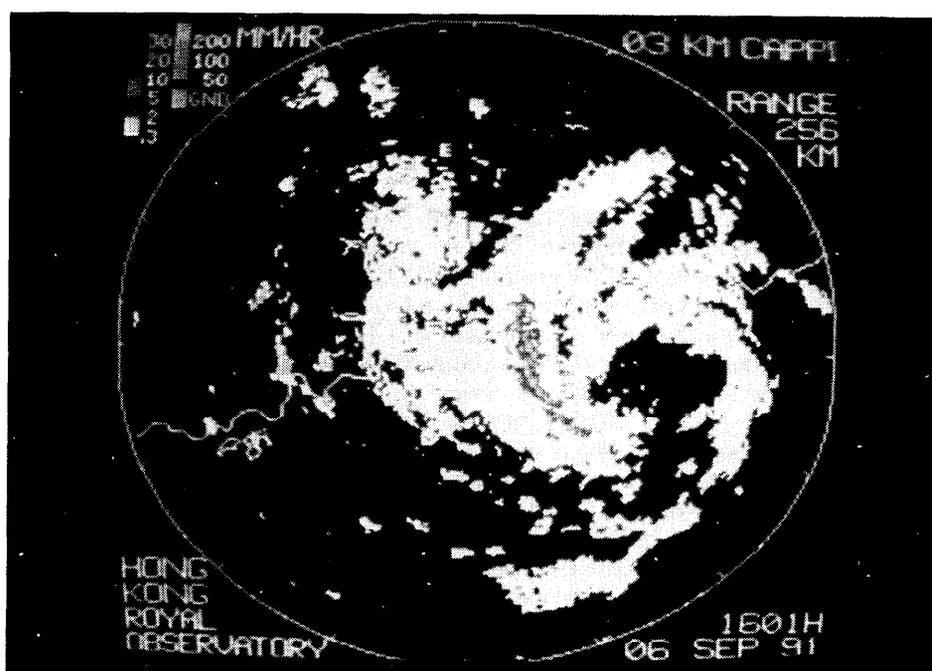


Figure 27. Radar display of the rain echoes of Joel at 4.01 p.m. on 6 September 1991.

**(f) Typhoon Nat (9120)****16 September-2 October 1991***The track of Nat is shown in Figure 28*

The movement of Typhoon Nat was most unusual. The complexity of its track rivalled that of Typhoon Wayne in 1986. The behaviour of Nat was very much affected by the successive passages of two tropical cyclones, namely Luke and Mireille, over the western North Pacific. After going through three cycles of intensification and weakening, the tenacious Nat out-lived both Luke and Mireille. In Hong Kong, Nat prompted the hoisting of tropical cyclone warning signals on three separate occasions, repeating the feat performed by Wayne five years ago. But unlike Wayne, Nat did not seriously affect the weather of Hong Kong in any of its three approaches.

Nat originated from an area of low pressure to the east of Luzon. It moved west-northwestwards and developed into a tropical depression over the Luzon Strait about 370 km south-southeast of Gaoxiong on the morning of 16 September. Moving at 12 km/h, Nat soon intensified to a tropical storm later that day. Over the northeastern part of the South China Sea, it weakened momentarily to a tropical depression on the evening of 17 September as it tracked to the west-southwest. Nat soon re-gained tropical storm intensity early on 18 September as it took on a slow eastward movement. After a detour to the southeast during the day, it started to track northeastwards that evening. Moving at 15 km/h, Nat turned east-northeastwards on 19 September and returned to the western North Pacific. Its movement became hesitant on 21 September as Nat intensified to a severe tropical storm about 530 km east-southeast of Gaoxiong. Strengthening rapidly, Nat attained typhoon intensity about 560 km east-southeast of Gaoxiong later that day as a distinctive eye emerged. During the night, it picked up speed and headed west. Peak intensity was attained the next day when maximum sustained winds of 155 km/h were expected near the centre of Nat.

Turning slightly to the west-northwest on 22 September, Nat hit the offshore Taiwanese island of Lanyu at full force on the night of the Mid-Autumn Festival. A sea-level pressure of 950.8 hPa was recorded at Lanyu during its passage. Nat went on to cross the southern tip of Taiwan before weakening to a severe tropical storm on the morning of 23 September about 60 km southeast of Gaoxiong. In southern Taiwan, electricity supply to more than 14 000 households was cut. Transportation was also affected due to landslides.

Over the southern part of the Taiwan Strait, Nat weakened considerably as it encountered dry continental air from the north. By the early hours of 24 September, it had weakened to a tropical depression about 140 km west of Gaoxiong. Nat then started to move south-southwestwards at 13 km/h on 24 September and passed just to the southeast of Dongsha the next morning. Moving south and then south-southeast on 26 September, Nat turned slowly to the northeast that night and underwent a clockwise loop the following day. It started to move west-northwestwards on 28 September at 5 km/h. Over the warm waters to the west of Luzon, it re-intensified to a tropical storm about 500 km west-northwest of Manila early on 29 September before making another directional change to the north-northeast later that day. Maintaining a speed of 18 km/h, Nat intensified further to a severe tropical storm about 200 km south of Dongsha on 30 September and tracked northwards that night. On its final approach to land, Nat turned to the north-northwest on the evening of 1 October and weakened to a tropical storm about 70 km east of Shantou. It made landfall that night near the Guangdong-Fujian border about 60 km east-northeast of Shantou. It moved northwestwards inland and dissipated rapidly over eastern Guangdong about 100 km north of Shantou early next day.

In Shantou, two people were killed, seven were reported missing and 22 others were injured. Nearly 500 houses collapsed and about 21 500 hectares of farmland were affected. Power supply to the area was interrupted. The direct economic loss was 90 million RMB. In Zhangzhou, over 800 houses collapsed and 18 000 hectares of farmland were affected. Large quantities of sugar-cane and banana were ruined. Water and power supplies to the area were also cut.

In Hong Kong, the Stand By Signal No. 1 was hoisted at 7.30 p.m. on 16 September when Nat was about 730 km to the east-southeast. Despite some fresh winds offshore, winds inside the harbour were mostly light from the north. With Nat weakening and retreating to the western North Pacific, the Stand By Signal No. 1 was lowered at 11.15 a.m. on 18 September when the storm was about 620 km to the east-southeast.

Nat returned to the South China Sea after crossing southern Taiwan on 23 September. The Stand By Signal No. 1 was hoisted at 1.30 p.m. that day when Nat was about 600 km east of Hong Kong. Winds were light in the afternoon, but became moderate northerly offshore during the night. With a much weaker circulation of Nat moving south-southwestwards away from Hong Kong, the Stand By Signal No. 1 was lowered at 2.30 p.m. on 25 September when Nat was centred about 390 km to the southeast.

After gathering strength over the warm waters to the west of Luzon, Nat backtracked towards the coast of southeastern China. The Stand By Signal No. 1 was hoisted for the third time at 9.45 p.m. on 29 September when Nat was about 580 km south-southeast of Hong Kong. Winds were moderate to fresh from the northeast due to the combined effect of Nat and the winter monsoon. With Nat heading towards Fujian and not expected to come significantly closer, the Stand By Signal No. 1 was lowered at 10.40 p.m. on 30 September when Nat was centred about 410 km to the east-southeast.

Nat eventually landed about 350 km east-northeast of Hong Kong on the night of 1 October. Its closest approach to Hong Kong was during its second passage when it was about 340 km to the east-southeast at 4 a.m. on 25 September. However, the lowest sea-level pressure of 1 002.2 hPa was recorded at the Royal Observatory during the first approach of Nat at 4 p.m. on 17 September when the storm was about 580 km to the east-southeast.

The maximum hourly mean winds and maximum gust peak speeds together with associated wind directions at various locations during the three approaches of Nat are given as follows:

Location	Maximum hourly mean wind speed(km/h) and direction						Maximum gust peak speed(km/h) and direction					
	First passage		Second passage		Third passage		First passage		Second passage		Third passage	
Royal Observatory	W	20	W	22	E	14	NNE	30	E	41	E	31
H.K. Airport (SE)	N	23	E	23	E	19	N	47	E	45	E	43
H.K. Airport (NW)	NNE	27	N, E & ESE	19	N, NE & NNW	14	N	56	E	67	N	67
Waglan Island	NNE	36	E	45	NE	34	N	54	E	59	NE	51
Tate's Cairn	N	38	N	38	ENE	30	N	51	N	49	NE	51
Cheung Chau	N	31	N	30	NNE	23	N	52	E	45	N	36
King's Park	N	14	ESE	18	E	14	N	26	ESE	39	E	31
Star Ferry	W	22	W	25	E	19	W	31	ENE	40	E	34
Tai O	N	17	N	14	N	14	N	24	N	20		
Sha Tin	NNW	12	E	9	N	9	NE	25	E	25	NNE	22
Lau Fau Shan	NNW	25	WNW	30	N	20	NW, NNW	34	WNW	38	NE	31
Ta Kwu Ling	N	14	N	12	ESE	9	NE	40	ESE	30	NE	25
Tuen Mun	NNE	20	NNE	16	NNE	20	NNE	36	NNE	36	NNE	36
Tai Po	WNW	19	E	19	E	14	WNW, NW	31	E	36	E	22
Wong Chuk Hang	NW	14	ENE	16	NE	16	WNW	38	ENE	41	NNE	40
Tai Mo Shan	N	40	N	36	NE	43	NNW	54	N	51	NE	54
Tamar	WNW	20	NW	16	NE	19	WNW	31	W	31	ENE	34
Cheung Sha Wan	N	20	N	13	N	14	N	47	NNE	31	N	34
Tsing Yi	WNW	13	W	20	NE	14	N, NNW	30	W	36	ENE	31
Kwai Chung	NNW	14	WNW	14	NE	12	NNW, N	31	E	25	ENE	25
Sai Kung	NNE	19	NNE	22	NNE	19	NNE	49	NNE, N	41	NNE	38

In Hong Kong, no damage was reported during the three passages of Nat. The prolonged presence of Nat over the northeastern part of the South China Sea only served to induce a persistent dry continental airflow from the inland regions to the coastal areas of Guangdong. As a result, the weather in Hong Kong was mostly fine, only interrupted momentarily by some cloudy interludes and occasional light rain churned up by short bursts of weak northeast monsoon surges. The most significant rain episode occurred on the afternoon and evening of 25 September during the second passage of Nat. The weather was cloudy with some light rain patches on 28 and 29 September, but it soon turned fine as Nat made landfall and dissipated in early October.

The daily amounts of rainfall recorded at some selected locations are given as follows:

Date	Royal Observatory mm	Kwun Tong mm	Tai Mei Tuk mm	Yuen Long mm
16 Sep	Nil	Nil	Nil	Nil
17 Sep	Nil	Nil	Nil	Nil
18 Sep	4.2	1.0	Nil	14.0
19 Sep	Nil	Nil	Nil	Nil
20 Sep	Trace	Nil	Nil	Nil
23 Sep	Nil	Nil	Nil	Nil
24 Sep	3.0	Nil	Nil	Nil
25 Sep	28.0	4.0	14.0	0.5
29 Sep	2.1	1.5	1.0	1.0
30 Sep	Nil	Nil	Nil	Nil
1 Oct	Trace	Nil	Nil	Nil
2 Oct	Nil	Nil	Nil	Nil
Total	37.3	6.5	15.0	15.5

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passages of Nat are tabulated as follows:

First passage:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Chi Ma Wan	2.22	18 Sep	4.08 a.m.	0.30	16 Sep	9.48 p.m.
Ko Lau Wan	2.37	17 Sep	3.22 a.m.	0.38	16 Sep	8.23 p.m.
Lok On Pai	2.20	17 Sep	2.51 a.m.	0.29	18 Sep	7.53 p.m.
Quarry Bay	2.30	17 Sep	2.29 a.m.	0.33	18 Sep	8.17 a.m.
Tai Po Kau	2.33	17 Sep	3.16 a.m.	0.39	17 Sep	4.01 p.m.
Waglan Island	2.25	18 Sep	4.10 a.m.	0.20	18 Sep	6.01 a.m.

Second passage:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Chi Ma Wan	2.31	25 Sep	10.27 p.m.	0.27	25 Sep	5.34 a.m.
Ko Lau Wan	2.40	24 Sep	9.49 a.m.	0.35	25 Sep	5.51 a.m.
Lok On Pai	2.37	25 Sep	10.38 p.m.	0.29	25 Sep	5.39 a.m.
Quarry Bay	2.34	23 Sep	8.56 a.m.	0.30	25 Sep	5.30 a.m.
Tai O	2.41	25 Sep	10.50 p.m.	0.36	25 Sep	6.01 a.m.
Tai Po Kau	2.38	25 Sep	10.40 a.m.	0.68	25 Sep	6.01 a.m.
Waglan Island	2.29	23 Sep	8.50 a.m.	0.31	24 Sep	5.02 p.m.

Third passage:

Location	Highest tide above chart datum			Maximum storm surge above astronomical tide		
	Height (m)	Date	Time	Height (m)	Date	Time
Chi Ma Wan	2.50	30 Sep	0.59 a.m.	0.39	29 Sep	6.25 p.m.
Ko Lau Wan	2.65	30 Sep	1.20 a.m.	0.50	30 Sep	1.05 a.m.
Lok On Pai	2.55	30 Sep	0.52 a.m.	0.35	29 Sep	9.04 a.m.
Quarry Bay	2.56	30 Sep	0.52 a.m.	0.31	29 Sep	6.41 p.m.
Tai O	2.58	30 Sep	1.20 a.m.	0.46	29 Sep	9.03 a.m.
Tai Po Kau	2.63	30 Sep	1.32 a.m.	0.57	30 Sep	1.29 p.m.
Waglan Island	2.49	30 Sep	0.50 a.m.	0.23	29 Sep	7.25 p.m.

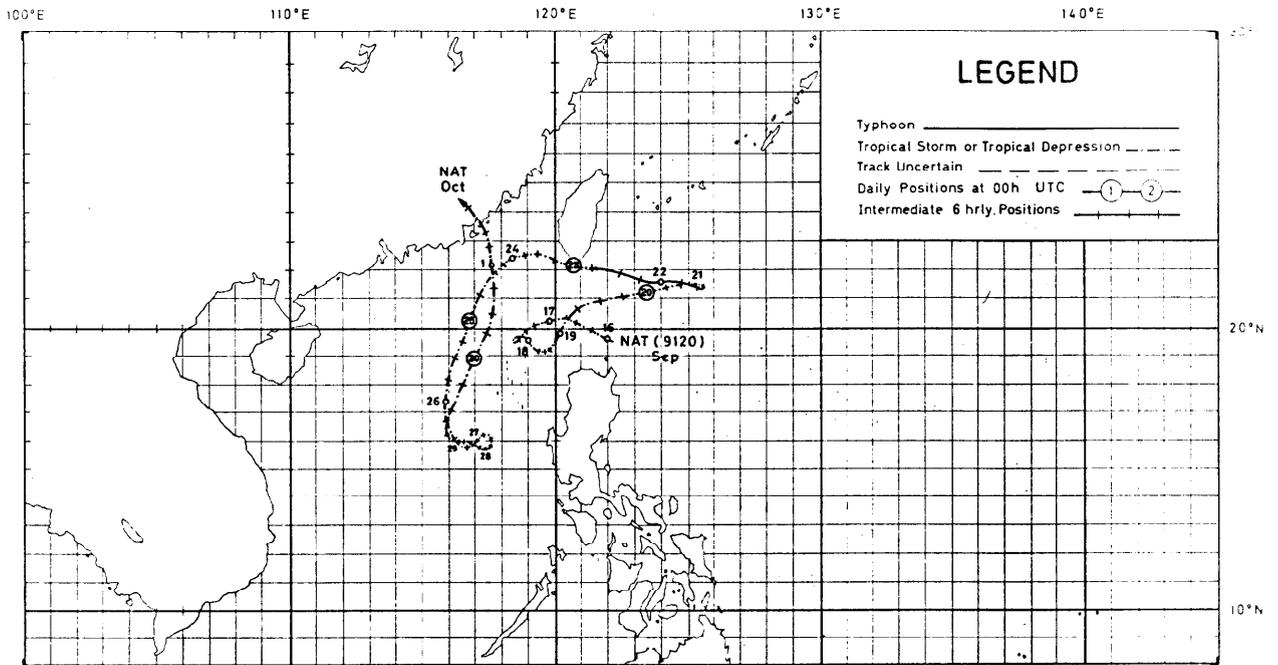


Figure 28. Track of Typhoon Nat (9120): 16 September–2 October 1991.

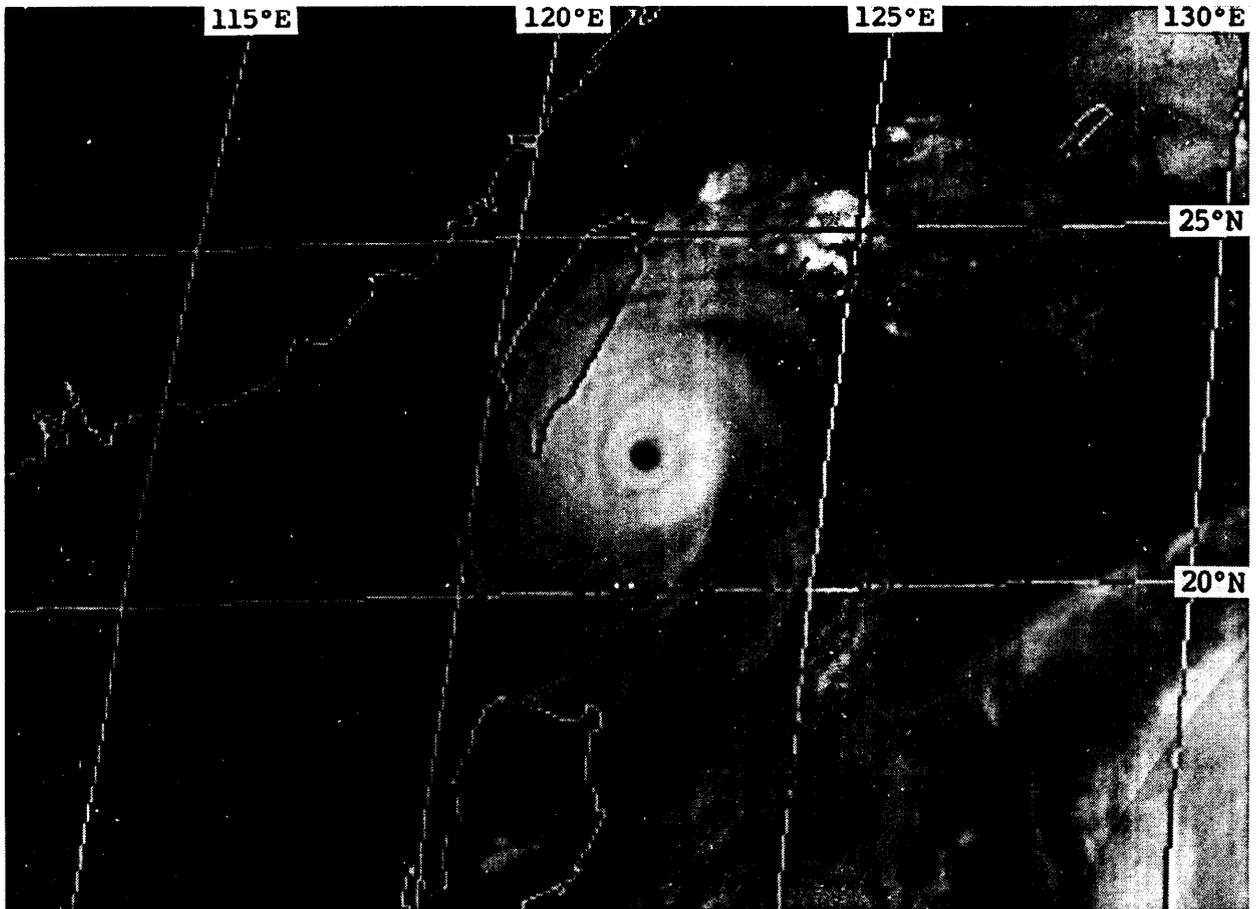


Figure 29. GMS-4 infra-red imagery of Nat around 8 p.m. on 22 September 1991.

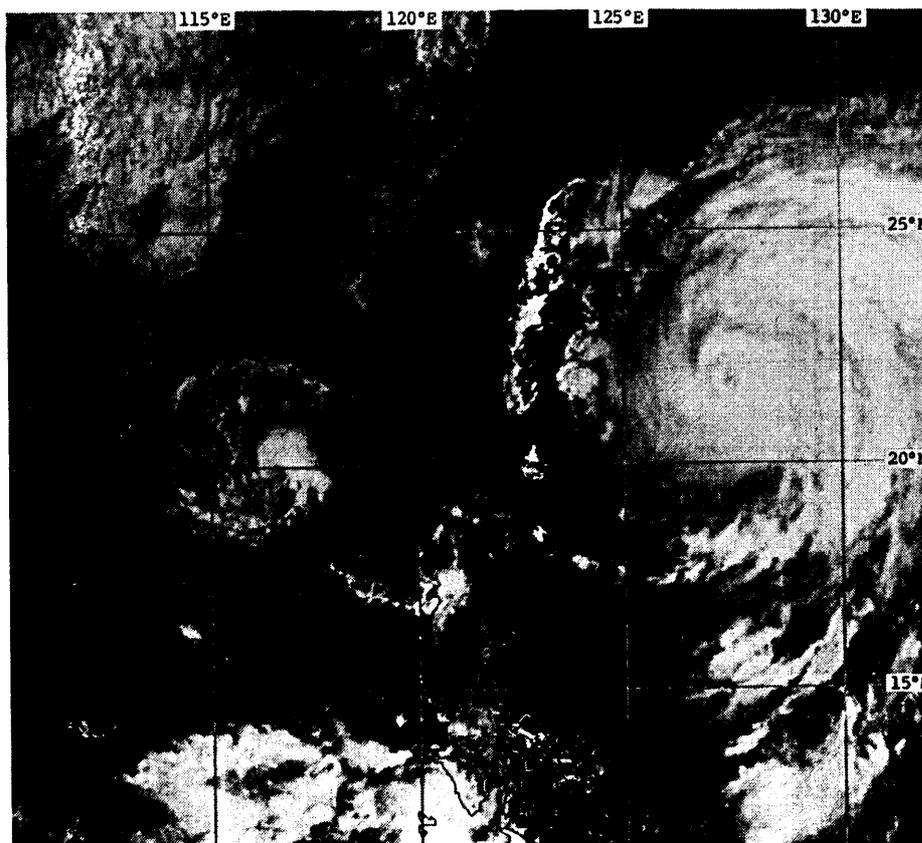


Figure 30. GMS-4 visible imagery of Nat over the South China Sea around 11 a.m. on 25 September 1991. The typhoon to the east over the western North Pacific is Mireille.

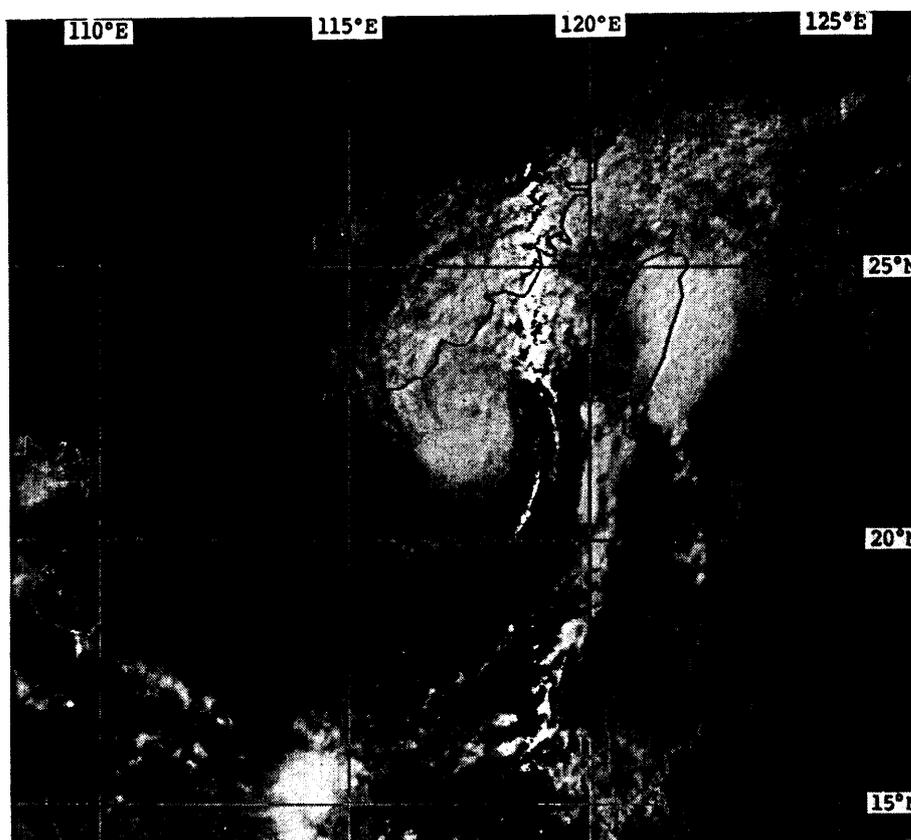


Figure 31. GMS-4 visible imagery of Nat around 11 a.m. on 1 October 1991.

## **Section 4**

# **TROPICAL CYCLONE STATISTICS AND TABLES**

TABLE 1 is a list of tropical cyclones in 1991 in the western North Pacific and the adjacent seas (i.e. the area bounded by the Equator, 45°N, 100°E and 180°). The dates cited are the residence times of each tropical cyclone within the above-mentioned region and as such might not cover the 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 in 1991, the durations of these warnings and the times 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 and minutes in UTC.

TABLE 3 presents a summary of the occasions/durations of the hoisting of tropical cyclone warning signals in 1991. 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/durations of the hoisting of tropical cyclone warning signals from 1956 to 1991 inclusive.

TABLE 5 gives the annual number of tropical cyclones in Hong Kong's area of responsibility between 1956 and 1991. The annual number of tropical cyclones causing tropical cyclone warning signals to be raised in Hong Kong is also included.

TABLE 6 shows the maximum, mean and minimum durations of the tropical cyclone warning signals hoisted during the period 1956-1991.

TABLE 7 is a summary of meteorological information for each tropical cyclone affecting Hong Kong in 1991. Information on the nearest approach together with an estimate of the minimum central pressure of each tropical cyclone during its closest approach, the maximum winds at the Royal Observatory and Waglan Island, the minimum mean sea-level pressure recorded at the Royal Observatory and the maximum storm surge (the excess, in metres, of the actual water level over that predicted in the Tide Tables) are included.

TABLE 8 tabulates the amount of rainfall associated with each tropical cyclone that came within 600 km of Hong Kong in 1991 and highlights the 10 wettest tropical cyclones in Hong Kong for the period 1884-1939 and 1947-1991.

TABLE 9 provides some meteorological information for those typhoons requiring the hoisting of the Hurricane Signal No. 10 in Hong Kong since 1946. The information presented includes the distances and 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 10 contains damage caused by tropical cyclones in 1991. The information is compiled from reports by various government departments, public utility companies and local newspapers.

TABLE 11 presents the casualties and damage figures associated with tropical cyclones in Hong Kong for the past 30 years. The information is compiled from local newspaper reports and from the Marine Department's records.

TABLE 1. LIST OF TROPICAL CYCLONES IN THE WESTERN NORTH PACIFIC AND THE SOUTH CHINA SEA IN 1991

Name of tropical cyclone		Beginning of track			End of track			Remark
		Date	Time UTC	Position °N °E	Date	Time UTC	Position °N °E	
Severe Tropical Storm Sharon	(9101)	5 Mar	0600	5.8 150.0	13 Mar	0000	9.7 125.1	Dissipated
Typhoon Tim	(9102)	20 Mar	1800	6.0 156.7	25 Mar	1200	20.6 157.2	Became Extratropical
Tropical Storm Vanessa	(9103)	23 Apr	1200	8.6 130.0	27 Apr	1200	15.0 111.5	Dissipated
Typhoon Walt	(9104)	6 May	0000	6.4 151.8	17 May	0000	30.0 142.0	Became Extratropical
Typhoon Yunya	(9105)	11 Jun	1800	11.0 128.5	15 Jun	1200	16.9 120.0	Dissipated
Typhoon Zeke	(9106)	8 Jul	1800	10.1 127.1	14 Jul	1200	21.7 104.7	Dissipated
Typhoon Amy	(9107)	15 Jul	1200	14.3 135.7	19 Jul	1800	24.4 114.6	Dissipated
Severe Tropical Storm Brendan	(9108)	20 Jul	1200	13.6 128.3	24 Jul	1200	23.0 111.1	Dissipated
Typhoon Caitlin	(9109)	22 Jul	1800	12.8 135.5	30 Jul	0600	41.5 135.5	Dissipated
Tropical Storm Doug		7 Aug	0600	24.8 165.0	10 Aug	1800	39.0 158.7	Became Extratropical
Typhoon Ellie	(9110)	10 Aug	0000	22.2 159.2	18 Aug	1800	24.2 119.1	Dissipated
Typhoon Fred	(9111)	13 Aug	0000	18.4 120.3	18 Aug	0600	16.9 102.8	Dissipated
Severe Tropical Storm Gladys	(9112)	15 Aug	1200	21.2 149.2	23 Aug	1200	35.3 125.9	Dissipated
Tropical Depression	(9113)	27 Aug	1200	28.4 132.9	29 Aug	0000	33.1 128.6	Dissipated
Tropical Storm Harry	(9114)	29 Aug	1200	26.7 133.5	31 Aug	0600	38.2 142.2	Became Extratropical
Typhoon Ivy	(9115)	2 Sep	0000	7.4 156.5	10 Sep	0600	38.6 155.3	Became Extratropical
Severe Tropical Storm Joel	(9116)	3 Sep	1200	19.1 118.3	7 Sep	0000	23.5 114.6	Dissipated
Typhoon Kinna	(9117)	10 Sep	0000	14.8 140.8	14 Sep	0600	36.3 134.9	Became Extratropical
Severe Tropical Storm Luke	(9118)	14 Sep	0600	15.7 142.5	19 Sep	0600	31.8 138.6	Became Extratropical
Typhoon Mireille	(9119)	14 Sep	1200	13.7 166.9	27 Sep	1200	35.2 132.0	Became Extratropical
Typhoon Nat	(9120)	16 Sep	0000	19.7 122.0	1 Oct	1800	24.2 116.8	Dissipated
Typhoon Orchid	(9121)	3 Oct	1200	18.3 140.6	13 Oct	1800	39.9 149.9	Became Extratropical
Typhoon Pat	(9122)	5 Oct	0000	14.8 159.3	13 Oct	0000	40.5 155.5	Became Extratropical
Typhoon Ruth	(9123)	20 Oct	0600	10.6 144.5	30 Oct	0600	21.3 122.8	Became Extratropical
Typhoon Seth	(9124)	31 Oct	0600	6.4 163.4	14 Nov	0000	18.5 120.0	Dissipated
Tropical Storm Thelma	(9125)	2 Nov	0000	12.2 132.9	8 Nov	1200	9.1 109.6	Dissipated
Tropical Storm Verne	(9126)	5 Nov	0600	9.5 165.5	12 Nov	1200	28.9 151.0	Became Extratropical
Tropical Storm Wilda	(9127)	13 Nov	1800	9.5 136.0	19 Nov	0000	17.8 117.5	Dissipated
Typhoon Yuri	(9128)	22 Nov	1200	4.5 165.9	1 Dec	0000	27.3 149.0	Became Extratropical
Typhoon Zelda	(9129)	27 Nov	1800	7.0 174.0	3 Dec	0600	20.8 163.5	Became Extratropical

TABLE 2. TROPICAL CYCLONE WARNINGS FOR SHIPPING ISSUED IN 1991

Tropical cyclone	No. of warnings issued	Date and time <sup>+</sup> of issue of		Duration of warnings (hours)
		First warning	Last warning	
Severe Tropical Storm Sharon	6	13 Mar 0900	14 Mar 0000	15
Tropical Storm Vanessa	31	25 Apr 0600	28 Apr 2100	87
Typhoon Walt	10	14 May 0600	15 May 0900	27
Typhoon Yunya	30	13 Jun 0900	17 Jun 0000	87
*Typhoon Zeke	39	9 Jul 1800	14 Jul 1200	114
*Typhoon Amy	18	18 Jul 0000	20 Jul 0300	51
*Severe Tropical Storm Brendan	29	21 Jul 0900	24 Jul 2100	84
*Typhoon Fred	49	11 Aug 1800	17 Aug 1800	144
Typhoon Ellie	21	16 Aug 2100	19 Aug 0900	60
*Severe Tropical Storm Joel	30	3 Sep 1200	7 Sep 0300	87
*Typhoon Nat	36	16 Sep 0300	20 Sep 1200	105
	84	21 Sep 1500	2 Oct 0000	249
Typhoon Ruth	32	26 Oct 1800	30 Oct 1500	93
Tropical Storm Thelma	27	5 Nov 0000	8 Nov 0600	78
Typhoon Seth	25	12 Nov 0300	15 Nov 0300	72
Tropical Storm Wilda	32	16 Nov 0300	20 Nov 0000	93
<b>Total</b>	<b>499</b>			<b>1446</b>

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

<sup>+</sup> Times are given in hours UTC

TABLE 3. TROPICAL CYCLONE WARNING SIGNALS HOISTED IN HONG KONG AND NUMBER OF WARNING BULLETINS ISSUED IN 1991

## SUMMARY

Signal	No. of occasions	Total duration
1	8	196 h 25 min
3	6	140 h 30 min
8 NORTHWEST	-	-
8 SOUTHWEST	-	-
8 NORTHEAST	1	6 h 20 min
8 SOUTHEAST	1	6 h 40 min
9	-	-
10	-	-
Total	16	349 h 55 min

## DETAILS

Tropical cyclone	No. of warning bulletins issued	Signal	Hoisted		Lowered	
			Date	Time*	Date	Time*
Typhoon Zeke	12	1	12 Jul	0850	12 Jul	2240
		3	12 Jul	2240	13 Jul	0710
Typhoon Amy	17	1	18 Jul	2245	19 Jul	1110
		3	19 Jul	1110	20 Jul	1010
Severe Tropical Storm Brendan	29	1	22 Jul	2210	23 Jul	1000
		3	23 Jul	1000	23 Jul	2100
		8 NE	23 Jul	2100	24 Jul	0320
		8 SE	24 Jul	0320	24 Jul	1000
		3	24 Jul	1000	24 Jul	1510
Typhoon Fred	25	1	13 Aug	2315	14 Aug	1910
		3	14 Aug	1910	16 Aug	0500
Severe Tropical Storm Joel	43	1	3 Sep	2145	4 Sep	2230
		3	4 Sep	2230	7 Sep	0930
Typhoon Nat	41	1	16 Sep	1930	18 Sep	1115
		50	23 Sep	1330	25 Sep	1430
		26	29 Sep	2145	30 Sep	2240

\* Hong Kong Time (UTC + 8)

TABLE 4. FREQUENCY AND TOTAL DURATION OF DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS : 1956-1991

Signals Year	1	3	8 NW	8 SW	8 NE	8 SE	9	10	Total duration	
									h	min
1956	5	4	0	0	0	0	0	0	191	25
1957	4	9	1	1	2	2	0	1	295	45
1958	4	5	0	0	1	0	0	0	214	5
1959	1	1	0	0	0	0	0	0	36	35
1960	11	7	0	2	2	2	1	1	432	35
1961	6	7	1	2	1	0	1	1	192	55
1962	4	3	0	1	1	0	1	1	158	10
1963	4	5	0	0	1	0	0	0	175	50
1964	11	14	1	3	5	3	3	2	570	15
1965	7	6	0	0	1	1	0	0	239	40
1966	6	5	0	0	2	2	0	0	284	40
1967	8	6	0	0	2	1	0	0	339	10
1968	7	7	0	1	1	0	1	1	290	10
1969	4	2	0	0	0	0	0	0	110	15
1970	6	8	2	1	2	0	0	0	286	45
1971	9	10	1	3	2	2	1	1	323	25
1972	8	6	0	0	1	1	0	0	288	20
1973	8	6	1	1	1	0	1	0	416	50
1974	12	10	0	0	2	1	1	0	525	20
1975	8	6	1	0	0	1	1	1	292	20
1976	6	6	0	0	1	2	0	0	351	30
1977	8	6	0	0	1	0	0	0	395	10
1978	8	9	1	1	3	2	0	0	462	10
1979	5	5	1	0	2	2	1	1	281	15
1980	10	8	0	0	1	1	0	0	414	5
1981	5	4	0	0	1	1	0	0	202	20
1982	7	4	0	0	0	0	0	0	247	35
1983	8	7	0	1	2	2	1	1	289	42
1984	6	6	0	0	1	0	0	0	280	2
1985	5	4	1	0	0	1	0	0	193	35
1986	6	7	0	1	1	0	0	0	305	0
1987	6	1	0	0	0	0	0	0	165	45
1988	6	4	0	0	0	0	0	0	204	10
1989	7	8	0	0	2	2	0	0	306	10
1990	6	4	0	0	0	0	0	0	245	10
1991	8	6	0	0	1	1	0	0	349	55
Total	240	216	11	18	43	30	13	11	10358	4
Mean	6.7	6.0	0.3	0.5	1.2	0.8	0.4	0.3	287	43

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 : 1956 - 1991

Year	Number in Hong Kong's area of responsibility	Number necessitating the display of signals in Hong Kong
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
1989	17	7
1990	18	6
1991	14	6
<b>Total</b>	<b>592</b>	<b>226</b>
<b>Mean</b>	<b>16.4</b>	<b>6.3</b>

TABLE 6. DURATION OF TROPICAL CYCLONE WARNING SIGNALS HOISTED IN HONG KONG : 1956-1991

Signal hoisted	Number of occasions	Duration of each occasion			Total duration per year		
		Mean h min	Maximum h min	Minimum h min	Mean h min	Maximum h min	Minimum h min
1 or higher	236	43 53	161 0	9 35	287 43	570 15	36 35
3 or higher	167	31 40	124 15	6 55	146 55	306 35	23 55
8 or higher	51	17 8	66 50	2 40	24 16	100 55	0 0
8 NW	11	6 51	15 45	1 30	2 6	15 45	0 0
8 SW	18	5 17	10 45	2 30	2 39	16 10	0 0
8 NE	43	8 44	35 35	2 35	10 26	40 20	0 0
8 SE	30	7 31	21 45	0 20	6 16	31 15	0 0
9 or higher	14	7 18	11 33	3 35	2 50	19 25	0 0
10	11	6 10	9 10	2 30	1 53	12 10	0 0

TABLE 7. A SUMMARY OF METEOROLOGICAL OBSERVATIONS RECORDED IN HONG KONG DURING THE PASSAGES OF TROPICAL CYCLONES IN 1991

(a)

Name of tropical cyclone	Month	Nearest approach to Hong Kong						Minimum hourly M.S.L. pressure at the Royal Observatory				Maximum storm surge (metres)							
		Day	Hour*	Direction	Distance (km)	Movement (km/h)	Estimated minimum central pressure (hPa)	Month	Day	Hour*	Pressure (hPa)	Chi Ma Wan	Ko Lau Wan	Lok On Pai	Quarry Bay	Tai O	Tai Po Kau	Tsim Bei Tsui	Waglan Island
T. Zeke	Jul	12	23	SSW	520	WNW 40	970	Jul	12	17,18	1003.4	0.34	0.36	0.30	0.32	-	0.71	-	-
T. Amy	Jul	19	21	NE	190	WNW 43	975	Jul	19	16	993.7	0.26	0.46	0.33	0.33	0.22	0.55	-	-
S.T.S Brendan	Jul	24	4	SSW	80	WNW 19	975	Jul	24	3	993.0	0.89	0.96	0.76	0.90	0.84	1.15	-	-
T. Fred	Aug	15	15	S	210	W 19	960	Aug	15	15	997.4	0.93	-	0.71	0.77	-	0.94	-	-
S.T.S. Joel	Sep	7	1	NE	110	NW 13	975	Sep	7	3	993.5	0.27	-	0.24	0.30	-	0.51	-	-
T. Nat (1 <sup>st</sup> passage)	Sep	18	5	ESE	530	NE 14	990	Sep	17	16	1002.2	0.30	0.38	0.29	0.33	-	0.39	-	0.2
T. Nat (2 <sup>nd</sup> passage)	Sep	25	4	ESE	340	SSW 16	1000	Sep	24	17	1005.9	0.27	0.35	0.29	0.30	0.36	0.68	-	0.31
T. Nat (3 <sup>rd</sup> passage)	Oct	2	2	NE	340	NW 19	995	Sep	30	16,17	1006.5	0.39	0.50	0.35	0.31	0.46	0.57	-	0.23

(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	
		Royal Observatory	Waglan Island	Royal Observatory	Waglan Island	Royal Observatory	Waglan Island
T. Zeke	Jul	E 31	E 56	E 35	E 58	E 68	ENE 75
T. Amy	Jul	SW 34	SW 61	SW 39	SW 63	SW 69	SW,SSW 83
S.T.S. Brendan	Jul	E 54	E 104	E 59	E 104	E 110	ESE 146
T. Fred	Aug	E 47	NNE 101	E 53	NNE 115	E 112	NNE 148
S.T.S. Joel	Sep	W 41	WNW 58	W 40	ENE 70	WNW 68	WNW 94
T. Nat (1 <sup>st</sup> passage)	Sep	W 20	NNE 36	W 21	NNE 36	NNE 30	N 54
T. Nat (2 <sup>nd</sup> passage)	Sep	W 22	E 44	E 22	E 49	E 41	E 59
T. Nat (3 <sup>rd</sup> passage)	Sep	E 14	NE 34	E 18	NE 34	E 31	NE 51

\* Hong Kong Time (UTC + 8)

TABLE 8 (a). Rainfall associated with tropical cyclones that came within 600 km of Hong Kong (with or without hoisting of tropical cyclone warning signals) in 1991.

Name of tropical cyclone	Period* when tropical cyclone within 600 km of Hong Kong ( $T_1 \triangleright T_2$ )	Rainfall at the Royal Observatory (mm)				
		(i) 600 km ( $T_1 \triangleright T_2$ )	(ii) 24 hours after $T_2$	(iii) 48 hours after $T_2$	(iv) 72 hours after $T_2$	(i) + (iv) Total $T_1 \triangleright (T_2 + 72 \text{ hours})$
T. Zeke	12 Jul 1300 - 13 Jul 1400	12.7	30.6	35.6	35.6	48.3
T. Amy	19 Jul 0400 - 20 Jul 0500	2.2	31.6	66.2	67.3	69.5
S.T.S. Brendan	23 Jul 0400 - 24 Jul 2000	70.6	0.4	0.4	0.4	71.0
T. Ellie #	18 Aug 2300 - 19 Aug 1400	Nil	Trace	34.7	34.7	34.7
T. Fred	14 Aug 0200 - 16 Aug 1600	139.0	15.3	15.3	19.7	158.7
S.T.S. Joel	3 Sep 1700 - 7 Sep 1200	17.4	0.2	9.0	9.0	26.4
T. Nat (1 <sup>st</sup> Passage)	17 Sep 1200 - 18 Sep 1000	Trace	4.2	4.2	4.2	4.2
T. Nat (2 <sup>nd</sup> Passage)	23 Sep 1400 - 26 Sep 1100	31.0	Nil	Nil	2.1	33.1
T. Nat (3 <sup>rd</sup> Passage)	29 Sep 2100 - 2 Oct 0200	Trace	Nil	Nil	Nil	Trace
T.S. Wilda #	19 Nov 1100 - 20 Nov 0100	Trace	0.2	0.2	0.2	0.2

N.B. # Tropical cyclones without hoisting of tropical cyclone warning signals.

\* Hour in Hong Kong Time (UTC + 8)

(b). THE 10 WETTEST TROPICAL CYCLONES IN HONG KONG  
(1884-1939, 1947-1991)

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
1989	May	Brenda	410.2	22.5	22.9	29.4	439.6

N.B. (i) during the period in hours when the tropical cyclone was centred within 600 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.

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

TABLE 9. TYPHOONS REQUIRING THE HOISTING OF THE HURRICANE SIGNAL NO. 10 DURING THE PERIOD 1946-1991

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
-	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 10. DAMAGE CAUSED BY TROPICAL CYCLONES IN HONG KONG, 1991

Name of tropical cyclone	Month	Damage in physical terms					Damage in monetary terms (million HK\$)					
		Agricultural	Public works facilities	Public utilities	Private property	Landslip & collapse of slope	Agricultural	Public works facilities	Public utilities	Private property	Others	Total
S.T.S Brendan	Jul	-	-	-	-	10 cases	-	-	0.944	-	-	0.944
T. Fred	Aug	-	-	-	-	4 cases	-	-	0.265	-	-	0.265

TABLE 11. CASUALTIES AND DAMAGE CAUSED BY TROPICAL CYCLONES IN HONG KONG : 1962-1991

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
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	1
	3 - 5 Sep	T.S. Carla	1	0	0	0	0	2
	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
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
1989	16 - 21 May	T. Brenda	0	3	5	6	1	119
	11 - 19 Jul	T. Gordon	1	0	8	2	0	31
	8 - 14 Oct	T. Dan	1	0	1	0	0	0
1990	15 - 19 May	T. Marian	0	0	1	0	0	0
	15 - 19 Jun	S.T.S. Nathan	1	0	2	5	1	1
	21 - 30 Jun	T. Percy	0	0	0	1	0	0
	27 - 31 Jul	S.T.S. Tasha	0	1	0	0	0	1
	25 - 30 Aug	T. Becky	0	0	0	0	1	0
	10 - 20 Sep	T. Ed	0	0	0	0	0	1
1991	15 - 20 Jul	T. Amy	1	0	2	0	0	1
	20 - 24 Jul	S.T.S. Brendan	1	1	13	0	0	17
	13 - 18 Aug	T. Fred	0	1	0	0	0	0

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.

## **Section 5**

# **TROPICAL CYCLONE POSITION AND INTENSITY DATA, 1991**

Six-hourly position and intensity data are tabulated for the following tropical cyclones in 1991 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°).

<b><i>Name of Tropical Cyclone</i></b>	<b><i>Page</i></b>
Severe Tropical Storm Sharon (9101)	67
Typhoon Tim (9102)	68
Tropical Storm Vanessa (9103)	69
Typhoon Walt (9104)	70
Typhoon Yunya (9105)	71
Typhoon Zeke (9106)	72
Typhoon Amy (9107)	73
Severe Tropical Storm Brendan (9108)	74
Typhoon Caitlin (9109)	75
Tropical Storm Doug	76
Typhoon Ellie (9110)	77
Typhoon Fred (9111)	78
Severe Tropical Storm Gladys (9112)	79
Tropical Depression of 27-29 August (9113)	80
Tropical Storm Harry (9114)	81
Typhoon Ivy (9115)	82
Severe Tropical Storm Joel (9116)	83
Typhoon Kinna (9117)	84
Severe Tropical Storm Luke (9118)	85
Typhoon Mireille (9119)	86
Typhoon Nat (9120)	87
Typhoon Orchid (9121)	88
Typhoon Pat (9122)	89
Typhoon Ruth (9123)	90
Typhoon Seth (9124)	91
Tropical Storm Thelma (9125)	92
Tropical Storm Verne (9126)	93
Tropical Storm Wilda (9127)	94
Typhoon Yuri (9128)	95
Typhoon Zelda (9129)	96

Surface winds in this section refer to wind speeds averaged over a period of 10 minutes given in the unit of m/s.  
(Note: 1 m/s is about 2 knots or 4 km/h)

SIX-HOURLY POSITION AND INTENSITY DATA OF  
SEVERE TROPICAL STORM SHARON (9101)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Mar	5	0600	T.D.	1000	13	5.8	150.0
		1200	T.D.	1000	13	5.9	149.3
		1800	T.D.	1000	16	6.0	148.6
	6	0900	T.D.	1000	16	6.1	148.0
		0600	T.S.	995	18	6.2	147.4
		1200	T.S.	995	18	6.4	146.8
	7	1800	T.S.	995	18	6.6	146.3
		0000	T.S.	995	18	6.8	145.7
		0600	T.S.	995	18	6.9	145.1
	8	1200	T.S.	995	18	6.9	144.5
		1800	T.S.	995	18	6.8	144.0
		0000	T.S.	990	21	6.7	143.6
	9	0600	T.S.	990	21	6.5	143.0
		1200	T.S.	990	21	6.3	142.3
		1800	T.S.	990	21	6.2	141.6
	10	0000	T.S.	985	23	6.2	140.8
		0600	T.S.	990	21	6.2	140.0
		1200	T.S.	985	23	6.3	139.1
	11	1800	S.T.S.	980	25	6.4	138.2
		0000	S.T.S.	980	25	6.5	137.3
		0600	T.S.	985	23	6.6	136.3
	12	1200	T.S.	985	23	6.7	135.3
		1800	T.S.	985	23	6.9	134.4
		0000	T.S.	990	21	7.2	133.5
	13	0600	T.S.	995	18	7.5	132.6
		1200	T.S.	990	21	8.1	131.5
		1800	T.S.	990	21	8.8	130.4
	14	0000	T.S.	990	21	9.4	129.1
		0600	T.S.	995	18	10.0	127.6
		1200	T.S.	995	18	10.2	126.3
	15	1800	T.S.	995	18	10.1	125.6
		0000	T.D.	1000	16	9.7	125.1

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON TIM (9102)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Mar	20	1800	T.D.	995	13	6.0	156.7
	21	0000	T.D.	995	13	6.4	156.7
		0600	T.D.	995	13	7.0	156.5
		1200	T.D.	995	13	7.8	155.9
		1800	T.D.	995	16	8.6	155.0
	22	0000	T.S.	990	18	9.7	154.3
		0600	T.S.	990	18	11.0	154.0
		1200	T.S.	990	21	12.0	153.5
		1800	S.T.S.	985	25	12.9	152.8
	23	0000	S.T.S.	980	28	13.8	152.5
		0600	S.T.S.	975	31	14.7	152.4
		1200	T.	970	33	15.6	152.4
		1800	T.	970	33	16.5	152.6
	24	0000	S.T.S.	975	31	17.4	153.0
		0600	S.T.S.	980	28	18.4	153.8
		1200	S.T.S.	980	28	19.2	154.8
		1800	T.S.	985	23	19.7	155.5
	25	0000	T.S.	990	18	20.0	156.0
		0600	T.D.	995	16	20.3	156.6
		1200	T.D.	995	13	20.6	157.2

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TROPICAL STORM VANESSA (9103)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Apr	23	1200	T.D.	998	16	8.6	130.0
		1800	T.D.	998	16	8.9	128.7
24	0000	0600	T.D.	1000	13	9.1	127.3
		1200	T.D.	998	16	9.2	126.1
		1800	T.D.	998	16	9.4	124.9
		0000	T.D.	998	16	9.5	124.1
		0600	T.D.	1000	13	10.0	122.9
25	0600	1200	T.D.	1000	13	10.6	121.8
		1800	T.D.	1000	13	11.1	120.5
		0000	T.D.	1000	13	11.5	119.2
		0600	T.D.	998	16	11.9	117.8
26	0600	1200	T.S.	995	18	12.1	116.6
		1800	T.S.	990	21	12.5	115.3
		0000	T.S.	990	21	12.9	114.1
27	0000	0600	T.S.	995	21	13.4	113.0
		1200	T.S.	995	18	14.1	112.1
		1800	T.D.	998	16	15.0	111.5

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON WALT (9104)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
May	6	0000	T.D.	1000	16	6.4	151.8
		0600	T.D.	1000	16	6.7	151.5
		1200	T.D.	1000	16	6.9	151.2
		1800	T.S.	995	18	7.1	150.9
	7	0000	T.S.	995	18	7.4	150.5
		0600	T.S.	995	18	7.8	150.0
		1200	T.S.	990	21	8.1	149.5
		1800	T.S.	985	23	8.5	149.1
	8	0000	S.T.S.	980	25	8.9	148.5
		0600	S.T.S.	980	25	9.3	147.9
		1200	S.T.S.	975	28	9.7	147.3
		1800	S.T.S.	975	28	10.1	146.7
	9	0000	T.	965	33	10.4	146.1
		0600	T.	955	39	10.9	145.1
		1200	T.	955	39	11.2	144.1
		1800	T.	955	39	11.5	143.1
	10	0000	T.	945	43	11.8	142.0
		0600	T.	940	46	12.0	140.9
		1200	T.	950	41	12.3	139.6
		1800	T.	950	41	12.6	138.3
	11	0000	T.	945	43	13.0	137.0
		0600	T.	935	49	13.3	135.5
		1200	T.	925	54	13.6	134.1
		1800	T.	920	57	14.0	132.8
	12	0000	T.	920	57	14.4	131.6
		0600	T.	925	54	14.8	130.6
		1200	T.	930	51	15.2	129.6
		1800	T.	930	51	15.7	128.5
	13	0000	T.	930	51	16.0	127.8
		0600	T.	930	51	16.3	127.1
		1200	T.	930	51	16.7	126.3
		1800	T.	935	49	17.2	125.8
	14	0000	T.	940	46	17.7	125.4
		0600	T.	940	46	18.3	125.0
		1200	T.	945	43	19.0	124.8
		1800	T.	945	43	19.7	124.6
	15	0000	T.	950	41	20.5	124.7
		0600	T.	955	39	21.2	125.1
		1200	T.	960	36	22.3	125.8
		1800	T.	965	33	23.4	126.8
	16	0000	S.T.S.	970	31	24.2	128.2
		0600	S.T.S.	980	25	25.3	130.7
1200		T.S.	985	23	26.8	133.9	
1800		T.S.	985	23	28.1	137.2	
17	0000	T.S.	985	23	30.0	142.0	

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON YUNYA (9105)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jun	11	1800	T.D.	1000	13	11.0	128.5
	12	0000	T.D.	1000	16	11.7	127.6
		0600	T.S.	995	18	12.4	126.8
		1200	T.S.	995	21	12.6	126.4
		1800	T.S.	995	23	13.0	126.0
	13	0000	S.T.S.	985	28	13.4	125.6
		0600	T.	980	33	13.7	125.1
		1200	T.	970	36	13.8	124.8
		1800	T.	965	39	13.9	124.6
	14	0000	T.	960	41	14.1	124.2
		0600	T.	970	33	14.3	123.5
		1200	S.T.S.	980	25	14.6	122.8
		1800	T.S.	990	18	14.9	122.1
	15	0000	T.D.	1000	13	15.2	121.5
		0600	T.D.	1000	13	15.9	120.5
		1200	T.D.	1000	13	16.9	120.0

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON ZEKE (9106)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jul	8	1800	T.D.	1000	13	10.1	127.1
	9	0000	T.D.	1000	13	10.7	126.7
		0600	T.D.	1000	16	11.3	126.3
		1200	T.D.	995	16	11.8	125.8
		1800	T.D.	995	16	12.9	124.2
	10	0000	T.D.	995	16	13.6	122.5
		0600	T.D.	995	16	14.1	121.1
		1200	T.D.	995	16	14.4	119.7
		1800	T.S.	990	18	14.7	118.3
	11	0000	T.S.	985	21	15.0	116.9
		0600	T.S.	985	23	15.3	115.8
		1200	S.T.S.	980	25	15.6	114.9
		1800	S.T.S.	980	28	16.0	114.1
	12	0000	S.T.S.	975	31	16.5	113.5
		0600	S.T.S.	975	31	17.1	112.8
		1200	T.	970	33	18.0	112.0
		1800	T.	965	36	18.6	110.8
	13	0000	T.	965	36	18.9	109.9
		0600	S.T.S.	975	31	19.5	109.2
		1200	S.T.S.	975	31	20.1	108.4
		1800	S.T.S.	980	28	20.7	107.5
	14	0000	S.T.S.	980	28	21.3	106.6
		0600	T.S.	990	21	21.6	105.7
		1200	T.D.	995	13	21.7	104.7

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON AMY (9107)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jul	15	1200	T.D.	995	16	14.3	135.7
		1800	T.S.	990	18	14.6	134.8
16	0000	0600	T.S.	990	18	15.4	134.0
		1200	T.S.	985	21	16.2	133.3
		1800	T.S.	980	23	17.0	132.2
		0000	S.T.S.	975	28	17.5	131.0
17	0600	1200	S.T.S.	970	31	17.7	129.7
		1800	T.	965	33	17.8	128.4
		0000	T.	960	36	18.1	127.3
		0600	T.	950	41	18.6	126.3
18	1200	1800	T.	940	46	19.3	125.2
		0000	T.	930	51	19.7	124.0
		0600	T.	930	51	20.5	122.4
		1200	T.	940	43	21.4	120.8
19	1800	0000	T.	950	39	22.4	118.8
		0600	T.	960	33	23.0	117.4
		1200	S.T.S.	970	25	23.6	115.6
		1800	T.D.	990	16	24.4	114.6

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
SEVERE TROPICAL STORM BRENDAN (9108)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jul	20	1200	T.D.	1000	13	13.6	128.3
		1800	T.D.	1000	16	14.0	127.4
	21	0000	T.S.	995	18	14.5	126.3
		0600	T.S.	990	23	15.1	125.3
		1200	S.T.S.	980	28	15.6	124.4
		1800	S.T.S.	980	28	16.1	123.7
	22	0000	S.T.S.	975	31	16.6	123.0
		0600	S.T.S.	975	31	17.6	122.1
		1200	S.T.S.	980	28	18.6	121.1
		1800	S.T.S.	985	25	19.4	119.9
	23	0000	S.T.S.	985	25	20.2	118.1
		0600	S.T.S.	980	28	20.9	116.2
		1200	S.T.S.	980	28	21.2	115.1
		1800	S.T.S.	975	31	21.5	114.1
	24	0000	S.T.S.	980	28	22.1	113.2
		0600	T.S.	985	23	22.7	112.3
		1200	T.D.	995	16	23.0	111.1

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON CAITLIN (9109)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Jul	22	1800	T.D.	995	13	12.8	135.5
	23	0000	T.D.	995	13	13.1	134.8
		0600	T.D.	995	13	13.4	134.0
		1200	T.D.	990	16	13.7	133.3
		1800	T.S.	985	18	14.0	132.5
	24	0000	T.S.	980	21	14.4	131.9
		0600	T.S.	975	23	15.1	131.2
		1200	S.T.S.	970	25	16.0	130.7
		1800	S.T.S.	965	28	16.8	130.4
	25	0000	S.T.S.	965	28	17.5	130.1
		0600	S.T.S.	965	28	18.4	129.7
		1200	S.T.S.	960	31	19.4	129.0
		1800	S.T.S.	960	31	20.3	128.4
	26	0000	S.T.S.	960	31	21.3	127.9
		0600	T.	955	33	22.3	127.5
		1200	T.	955	33	23.0	127.1
		1800	T.	955	33	23.7	126.7
	27	0000	T.	950	36	24.3	126.3
		0600	T.	950	36	25.1	126.4
		1200	T.	950	36	26.2	126.6
		1800	T.	950	36	27.3	126.8
	28	0000	T.	940	41	28.4	126.9
		0600	T.	940	41	29.4	127.1
		1200	T.	945	39	30.6	127.3
		1800	T.	945	36	31.8	127.4
	29	0000	S.T.S.	950	31	33.0	128.0
		0600	S.T.S.	955	28	34.3	129.1
		1200	S.T.S.	960	28	35.8	130.5
		1800	T.S.	970	23	37.3	131.9
	30	0000	T.S.	980	21	39.3	133.6
		0600	T.S.	985	18	41.5	135.5

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TROPICAL STORM DOUG

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	7	0600	T.D.	1000	13	24.8	165.0
		1200	T.D.	995	16	25.0	164.7
		1800	T.D.	995	16	25.6	164.1
	8	0000	T.D.	1000	13	26.7	163.0
		0600	T.D.	1000	13	27.3	162.0
		1200	T.D.	1000	13	27.6	161.0
	9	1800	T.D.	1000	13	28.0	160.0
		0000	T.D.	1000	13	28.4	159.4
		0600	T.S.	990	18	29.0	159.0
	10	1200	T.S.	985	21	29.8	158.4
		1800	T.S.	990	18	30.7	157.8
		0000	T.D.	995	16	32.1	156.8
		0600	T.D.	995	13	34.2	156.2
		1200	T.D.	995	13	36.5	157.0
		1800	T.D.	995	13	39.0	158.7

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON ELLIE (9110)

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	13	22.2	159.2
		0600	T.D.	1000	13	22.9	158.4
		1200	T.D.	1000	13	23.3	157.8
		1800	T.D.	1000	16	23.7	157.2
	11	0000	T.S.	995	18	24.2	156.3
		0600	T.S.	995	18	24.7	155.0
		1200	T.S.	990	21	25.1	153.6
		1800	T.S.	985	23	25.5	152.2
	12	0000	T.S.	985	23	25.9	150.9
		0600	T.S.	985	23	26.4	149.5
		1200	S.T.S.	980	25	26.7	148.1
		1800	S.T.S.	980	25	27.0	146.7
	13	0000	S.T.S.	975	28	27.2	145.5
		0600	S.T.S.	975	28	27.4	144.3
		1200	S.T.S.	975	28	27.4	143.0
		1800	S.T.S.	970	31	27.0	141.8
	14	0000	T.	960	39	26.7	140.8
		0600	T.	965	36	26.7	139.5
		1200	T.	965	33	26.6	138.2
		1800	S.T.S.	970	31	26.5	136.7
	15	0000	S.T.S.	975	25	26.4	135.2
		0600	T.S.	980	23	26.3	133.7
		1200	T.S.	980	21	26.0	132.0
		1800	S.T.S.	975	25	25.7	130.3
	16	0000	T.S.	980	23	25.6	129.0
		0600	T.S.	980	23	25.4	127.8
		1200	T.S.	980	23	25.1	126.6
		1800	T.S.	980	23	24.9	125.3
	17	0000	S.T.S.	975	25	24.9	124.4
		0600	S.T.S.	975	25	24.9	123.5
		1200	T.S.	980	23	25.0	122.8
		1800	T.S.	990	23	25.2	121.9
	18	0000	T.S.	990	18	25.3	120.8
		0600	T.S.	990	18	24.9	120.0
		1200	T.D.	995	13	24.5	119.5
		1800	T.D.	995	13	24.2	119.1

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON FRED (9111)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	13	0000	T.D.	995	13	18.4	120.3
		0600	T.D.	995	16	18.6	119.8
		1200	T.S.	990	18	18.8	119.3
		1800	T.S.	985	21	19.0	118.7
	14	0000	T.S.	980	23	19.3	118.0
		0600	S.T.S.	975	25	19.6	117.1
		1200	S.T.S.	975	25	19.9	116.2
		1800	S.T.S.	970	28	20.1	115.4
	15	0000	T.	965	33	20.3	114.6
		0600	T.	960	36	20.4	113.8
		1200	T.	955	41	20.5	112.8
		1800	T.	955	41	20.4	111.6
	16	0000	T.	960	36	20.2	110.5
		0600	S.T.S.	965	28	19.7	109.5
		1200	S.T.S.	970	25	19.1	108.8
		1800	S.T.S.	965	28	18.8	108.2
	17	0000	S.T.S.	965	28	18.5	107.5
		0600	S.T.S.	970	25	18.2	106.7
		1200	S.T.S.	970	25	17.8	105.8
		1800	T.S.	980	21	17.5	104.8
	18	0000	T.D.	985	16	17.1	103.6
		0600	T.D.	990	13	16.9	102.8

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
SEVERE TROPICAL STORM GLADYS (9112)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	15	1200	T.D.	995	13	21.2	149.2
		1800	T.D.	990	16	21.7	148.4
	16	0000	T.S.	985	18	22.5	147.8
		0600	T.S.	980	21	23.5	147.3
		1200	T.S.	975	23	24.3	146.6
	17	1800	T.S.	975	23	24.9	145.3
		0000	S.T.S.	970	25	25.2	143.8
		0600	T.S.	975	23	26.2	142.7
		1200	T.S.	980	21	26.4	141.1
		1800	T.S.	975	23	26.4	139.8
		18	0000	T.S.	980	21	26.3
	0600		T.S.	980	21	26.2	137.8
	1200		T.S.	980	21	26.5	137.1
	1800		T.S.	975	23	27.1	136.6
	19	0000	S.T.S.	970	25	27.1	135.6
		0600	S.T.S.	970	25	27.1	134.7
		1200	S.T.S.	970	25	27.7	134.8
		1800	S.T.S.	970	25	28.0	134.4
	20	0000	S.T.S.	970	25	28.2	133.8
		0600	S.T.S.	970	28	28.4	133.0
		1200	S.T.S.	965	31	28.4	131.7
		1800	S.T.S.	970	28	28.8	131.0
	21	0000	S.T.S.	970	25	28.9	130.6
		0600	S.T.S.	970	25	28.8	130.1
		1200	T.S.	975	23	29.4	130.0
		1800	T.S.	980	21	30.0	129.8
	22	0000	T.S.	985	18	30.6	129.5
		0600	T.S.	985	18	31.3	129.4
		1200	T.S.	980	21	32.0	129.3
		1800	T.S.	975	23	32.7	128.7
23	0000	T.S.	975	21	33.6	128.4	
	0600	T.S.	980	18	34.5	128.0	
	1200	T.D.	985	16	35.3	125.9	

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
THE TROPICAL DEPRESSION OF 27-29 AUGUST (9113)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Aug	27	1200	T.D.	992	13	28.4	132.9
		1800	T.D.	988	16	29.2	131.9
	28	0000	T.D.	988	16	29.9	130.7
		0600	T.D.	990	13	30.5	129.7
		1200	T.D.	992	13	31.4	129.0
		1800	T.D.	992	13	32.5	128.6
	29	0000	T.D.	992	13	33.1	128.6

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TROPICAL STORM HARRY (9114)

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.	995	13	26.7	133.5
		1800	T.D.	995	16	28.2	133.8
	30	0000	T.S.	990	18	29.7	134.5
		0600	T.S.	990	18	31.2	135.4
		1200	T.S.	990	18	32.9	136.6
		1800	T.S.	985	21	34.7	137.9
	31	0000	T.S.	990	18	36.1	139.7
		0600	T.S.	995	18	38.2	142.2

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON IVY (9115)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	2	0000	T.D.	995	13	7.4	156.5
		0600	T.D.	995	13	7.9	155.8
		1200	T.D.	995	13	8.4	155.2
	3	1800	T.D.	990	16	8.9	154.6
		0000	T.D.	990	16	9.4	153.8
		0600	T.D.	990	16	10.1	153.0
	4	1200	T.D.	990	16	10.6	152.1
		1800	T.D.	990	16	11.2	151.2
		0000	T.D.	990	16	11.8	150.3
	5	0600	T.D.	990	16	12.5	149.5
		1200	T.S.	985	18	13.5	148.9
		1800	T.S.	980	23	14.0	148.4
	6	0000	S.T.S.	975	25	14.9	148.0
		0600	S.T.S.	970	28	16.0	147.7
		1200	S.T.S.	965	31	17.5	147.0
	7	1800	T.	960	33	19.1	146.2
		0000	T.	955	36	20.6	145.2
		0600	T.	950	39	22.1	143.9
	8	1200	T.	945	43	23.3	142.3
		1800	T.	940	46	24.3	141.0
		0000	T.	935	49	25.3	139.9
	9	0600	T.	935	49	26.2	138.9
		1200	T.	940	46	27.3	138.0
		1800	T.	940	46	28.2	137.5
	10	0000	T.	940	46	29.2	137.2
		0600	T.	945	41	30.3	137.6
		1200	T.	950	36	31.1	138.1
	11	1800	T.	955	33	32.0	139.1
0000		T.	955	33	32.9	140.6	
0600		T.	955	33	33.8	142.6	
12	1200	T.	955	33	34.7	145.2	
	1800	S.T.S.	960	31	35.8	148.4	
	0000	S.T.S.	970	28	37.2	151.8	
		0600	S.T.S.	970	28	38.6	155.3

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
SEVERE TROPICAL STORM JOEL (9116)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	3	1200	T.D.	995	13	19.1	118.3
		1800	T.D.	995	13	19.2	117.9
	4	0000	T.D.	995	13	19.4	117.4
		0600	T.D.	995	13	19.9	116.5
		1200	T.D.	990	16	20.7	115.8
		1800	T.D.	990	16	20.6	114.8
		0000	T.D.	990	16	20.2	114.6
	5	0600	T.S.	985	18	20.3	114.9
		1200	T.S.	985	18	20.4	115.1
		1800	T.S.	985	18	20.8	115.5
		0000	T.S.	980	21	21.4	115.7
	6	0600	T.S.	980	21	22.0	115.7
		1200	S.T.S.	975	25	22.5	115.4
		1800	S.T.S.	975	25	23.0	114.9
	7	0000	T.S.	985	18	23.5	114.6

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON KINNA (9117)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	10	0000	T.D.	1000	13	14.8	140.8
		0600	T.D.	1000	13	15.6	139.9
		1200	T.D.	1000	16	16.6	138.8
		1800	T.S.	995	18	17.8	137.6
	11	0000	T.S.	990	21	19.0	136.1
		0600	T.S.	985	23	20.1	134.6
		1200	S.T.S.	980	25	21.2	133.0
		1800	S.T.S.	980	25	22.2	131.4
	12	0000	S.T.S.	975	28	23.0	130.2
		0600	S.T.S.	970	31	23.9	129.2
		1200	S.T.S.	965	31	24.7	128.5
		1800	S.T.S.	965	31	25.6	127.9
	13	0000	T.	955	36	26.8	127.7
		0600	T.	950	39	28.4	127.9
		1200	T.	960	33	30.0	128.4
		1800	S.T.S.	970	28	31.8	129.2
	14	0000	T.S.	980	23	34.1	130.9
		0600	T.S.	985	18	36.3	134.9

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
SEVERE TROPICAL STORM LUKE (9118)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	14	0600	T.D.	1000	13	15.7	142.5
		1200	T.D.	995	16	16.3	141.6
		1800	T.D.	995	16	16.8	140.5
	15	0000	T.D.	995	16	17.3	139.4
		0600	T.D.	995	16	17.7	138.3
		1200	T.D.	995	16	18.2	137.2
	16	1800	T.S.	990	21	18.8	136.1
		0000	T.S.	985	23	19.7	135.1
		0600	S.T.S.	980	25	20.6	134.3
	17	1200	S.T.S.	975	28	21.4	133.6
		1800	S.T.S.	980	25	22.1	133.1
		0000	S.T.S.	980	25	22.8	132.7
	18	0600	S.T.S.	980	25	23.5	132.3
		1200	S.T.S.	980	25	24.2	131.8
		1800	S.T.S.	980	25	24.9	131.4
	19	0000	S.T.S.	980	25	25.7	130.9
		0600	S.T.S.	980	25	26.7	130.6
		1200	S.T.S.	980	25	27.4	132.0
	19	1800	S.T.S.	980	25	27.7	133.5
		0000	S.T.S.	980	25	28.7	136.3
			0600	T.S.	975	23	31.8

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON MIREILLE (9119)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	14	1200	T.D.	1000	13	13.7	166.9
		1800	T.D.	995	16	13.5	165.9
	15	0000	T.D.	995	16	13.3	164.5
		0600	T.D.	995	16	13.6	163.0
		1200	T.D.	995	16	13.9	161.6
		1800	T.S.	985	21	14.4	159.9
	16	0000	S.T.S.	975	25	14.7	158.5
		0600	S.T.S.	965	31	15.0	157.4
		1200	T.	955	36	15.2	156.7
		1800	T.	950	39	15.5	155.9
		0000	T.	960	33	15.9	155.1
	17	0600	T.	960	33	16.1	154.3
		1200	T.	960	33	16.2	153.6
		1800	T.	960	33	16.2	153.0
	18	0000	T.	960	33	16.1	152.4
		0600	T.	960	33	15.9	151.8
		1200	T.	955	36	15.5	151.0
		1800	T.	955	36	15.4	150.0
		0000	T.	955	36	15.4	149.0
	19	0600	T.	955	36	15.5	147.5
		1200	T.	950	39	15.5	146.0
		1800	T.	955	36	15.4	144.4
	20	0000	T.	955	36	15.3	143.1
		0600	T.	955	36	15.2	141.8
		1200	T.	955	36	15.1	140.5
		1800	T.	955	36	14.7	139.2
		0000	T.	950	39	14.4	138.2
	21	0600	T.	940	43	14.4	137.2
		1200	T.	935	49	14.8	136.2
		1800	T.	925	54	15.1	135.2
	22	0000	T.	925	54	15.3	134.3
		0600	T.	920	57	15.8	133.7
		1200	T.	920	57	16.3	133.1
		1800	T.	920	57	16.9	132.5
		0000	T.	925	54	17.5	132.0
	23	0600	T.	925	54	18.2	131.4
		1200	T.	925	54	18.7	130.9
		1800	T.	925	54	19.0	130.1
	24	0000	T.	930	51	19.3	129.7
		0600	T.	935	49	19.9	129.2
		1200	T.	935	46	20.4	128.8
		1800	T.	935	46	21.0	128.1
		0000	T.	940	43	21.5	127.7
	25	0600	T.	950	36	22.1	127.5
		1200	T.	945	41	23.0	126.7
		1800	T.	940	43	23.7	126.2
	26	0000	T.	930	49	24.4	125.8
		0600	T.	925	51	25.3	125.7
		1200	T.	925	51	26.5	125.9
		1800	T.	925	51	28.0	126.4
		0000	T.	930	49	29.9	127.5
	27	0600	T.	940	43	32.4	129.2
		1200	S.T.S.	960	31	35.2	132.0

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON NAT (9120)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Sep	16	0000	T.D.	1000	16	19.7	122.0
		0600	T.S.	995	18	19.9	121.4
		1200	T.S.	990	21	20.2	120.8
	17	1800	T.S.	990	21	20.3	120.4
		0000	T.S.	990	21	20.2	119.9
		0600	T.S.	990	18	20.1	119.3
	18	1200	T.D.	995	16	19.9	118.9
		1800	T.S.	990	21	19.6	118.7
		0000	T.S.	990	21	19.7	119.0
	19	0600	T.S.	990	21	19.2	119.4
		1200	T.S.	990	21	19.2	119.6
		1800	T.S.	990	21	19.3	119.8
	20	0000	T.S.	990	21	19.8	120.2
		0600	T.S.	990	21	20.7	120.9
		1200	T.S.	990	21	20.9	121.8
	21	1800	T.S.	990	21	21.1	122.6
		0000	T.S.	985	23	21.3	123.4
		0600	T.S.	985	23	21.4	124.2
	22	1200	T.S.	985	23	21.5	124.8
		1800	S.T.S.	980	25	21.5	125.1
		0000	S.T.S.	975	31	21.5	125.3
	23	0600	T.	965	33	21.5	125.6
		1200	T.	950	39	21.4	125.4
		1800	T.	955	36	21.6	124.7
	24	0000	T.	950	39	21.6	124.0
		0600	T.	940	43	21.7	123.3
		1200	T.	940	43	21.9	122.5
	25	1800	T.	950	39	22.1	121.4
		0000	S.T.S.	975	28	22.2	120.7
		0600	T.S.	985	23	22.4	120.0
	26	1200	T.S.	990	18	22.6	119.4
		1800	T.D.	995	16	22.6	118.9
		0000	T.D.	995	16	22.4	118.4
	27	0600	T.D.	995	16	22.2	118.2
		1200	T.D.	1000	13	21.9	117.8
		1800	T.D.	1000	13	21.1	117.3
28	0000	T.D.	1000	13	20.3	116.8	
	0600	T.D.	1000	13	19.6	116.6	
	1200	T.D.	1000	13	18.9	116.3	
29	1800	T.D.	1000	13	18.2	116.0	
	0000	T.D.	1000	13	17.5	115.9	
	0600	T.D.	1000	13	16.8	115.9	
30	1200	T.D.	1000	13	16.1	116.2	
	1800	T.D.	1000	13	15.8	116.8	
	0000	T.D.	1000	13	16.1	117.1	
Oct	1	0600	T.D.	995	16	16.3	117.3
		1200	T.D.	1000	13	16.2	117.6
		1800	T.D.	1000	13	15.9	117.6
2	0000	T.D.	995	16	15.8	117.4	
	0600	T.D.	995	16	15.8	117.2	
	1200	T.D.	995	16	15.9	117.9	
3	1800	T.S.	990	18	16.0	116.6	
	0000	T.S.	990	21	16.1	116.3	
	0600	T.S.	990	21	16.3	115.9	
4	1200	T.S.	990	21	17.1	116.1	
	1800	T.S.	990	23	18.0	116.6	
	0000	S.T.S.	985	25	18.9	117.0	
5	0600	S.T.S.	985	25	19.8	117.4	
	1200	S.T.S.	985	28	20.6	117.8	
	1800	S.T.S.	985	28	21.4	117.8	
6	0000	S.T.S.	985	28	22.2	117.7	
	0600	S.T.S.	980	31	22.8	117.6	
	1200	T.S.	990	23	23.4	117.4	
7	1800	T.S.	995	18	24.2	116.8	

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON ORCHID (9121)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Oct	3	1200	T.D.	1000	13	18.3	140.6
		1800	T.D.	1000	13	18.5	139.6
	4	0000	T.D.	995	16	18.7	138.6
		0600	T.S.	990	18	18.9	137.8
		1200	T.S.	990	18	19.0	137.2
	5	1800	T.S.	985	21	19.1	136.8
		0000	T.S.	980	23	19.2	136.5
		0600	S.T.S.	975	25	19.3	135.9
	6	1200	S.T.S.	970	28	19.2	135.1
		1800	S.T.S.	965	31	19.1	134.2
		0000	S.T.S.	965	31	19.0	133.7
	7	0600	T.	960	33	18.9	133.0
		1200	T.	950	39	18.9	132.5
		1800	T.	940	43	18.9	132.0
	8	0000	T.	935	49	19.0	131.5
		0600	T.	930	51	19.4	131.0
		1200	T.	935	49	19.9	130.8
	9	1800	T.	940	46	20.3	130.5
		0000	T.	940	43	20.8	130.3
		0600	T.	945	41	21.4	130.3
	10	1200	T.	945	41	22.1	130.5
		1800	T.	945	41	23.0	131.0
		0000	T.	945	41	23.9	131.6
	11	0600	T.	945	41	24.9	132.4
		1200	T.	945	41	25.8	133.1
		1800	T.	945	41	26.4	133.8
	12	0000	T.	950	39	27.1	134.6
		0600	T.	950	39	27.7	135.3
		1200	T.	950	39	28.3	135.8
	13	1800	T.	950	39	29.0	136.4
		0000	T.	955	33	29.7	136.7
		0600	S.T.S.	960	31	30.0	136.9
	14	1200	S.T.S.	965	28	30.3	137.1
		1800	S.T.S.	965	25	30.7	137.5
		0000	T.S.	970	23	31.1	137.9
	15	0600	T.S.	970	23	31.7	138.6
1200		T.S.	970	21	32.1	139.5	
1800		T.S.	975	21	32.7	140.9	
16	0000	T.S.	975	21	33.7	142.9	
	0600	T.S.	975	21	35.4	144.9	
	1200	T.S.	975	21	37.4	147.0	
		1800	T.S.	975	18	39.9	149.9

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON PAT (9122)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Oct	5	0000	T.D.	1000	13	14.8	159.3
		0600	T.D.	1000	16	14.9	158.1
		1200	T.S.	995	18	14.9	156.9
		1800	T.S.	990	21	15.0	155.7
	6	0000	T.S.	985	23	15.2	154.6
		0600	S.T.S.	975	28	15.4	153.7
		1200	S.T.S.	970	31	15.6	153.0
	7	1800	T.	965	33	15.7	152.3
		0000	T.	960	36	16.2	151.9
		0600	T.	955	39	16.6	151.6
		1200	T.	950	41	17.0	151.4
	8	1800	T.	945	43	17.3	151.3
		0000	T.	940	46	17.7	151.1
		0600	T.	940	46	18.2	151.1
		1200	T.	940	46	18.8	151.1
	9	1800	T.	940	46	19.5	150.9
		0000	T.	940	46	20.2	150.6
		0600	T.	940	46	20.8	150.3
		1200	T.	940	46	21.3	149.9
	10	1800	T.	940	46	21.7	149.7
		0000	T.	940	46	22.1	149.6
0600		T.	940	46	22.7	149.6	
1200		T.	950	41	23.4	149.8	
11	1800	T.	960	36	24.2	150.1	
	0000	T.	960	39	25.0	150.5	
	0600	T.	955	39	26.2	151.0	
	1200	T.	955	39	27.5	151.3	
12	1800	T.	955	39	29.4	151.6	
	0000	T.	955	39	31.3	151.7	
	0600	T.	960	36	33.4	151.9	
	1200	S.T.S.	970	31	36.0	152.8	
13	1800	S.T.S.	975	25	38.5	154.2	
	0000	T.S.	985	21	40.5	155.5	

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON RUTH (9123)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Oct	20	0600	T.D.	995	16	10.6	144.5
		1200	T.S.	990	18	10.9	144.2
		1800	T.S.	985	21	11.1	143.8
	21	0000	T.S.	985	23	11.2	143.4
		0600	S.T.S.	980	25	11.4	143.0
		1200	S.T.S.	975	28	11.6	142.6
	22	1800	S.T.S.	970	31	11.8	142.2
		0000	T.	965	33	12.2	141.7
		0600	T.	965	33	12.8	141.2
	23	1200	T.	960	36	13.5	140.7
		1800	T.	955	39	13.9	139.8
		0000	T.	945	43	14.0	138.8
	24	0600	T.	940	46	14.1	138.0
		1200	T.	930	51	14.2	137.1
		1800	T.	925	54	14.3	136.2
	25	0000	T.	920	57	14.5	135.2
		0600	T.	920	57	14.7	134.2
		1200	T.	920	57	15.1	133.1
	26	1800	T.	920	57	15.4	132.1
		0000	T.	920	57	15.8	131.2
		0600	T.	920	57	16.1	130.3
	27	1200	T.	920	57	16.5	129.5
		1800	T.	915	59	17.0	128.5
		0000	T.	925	54	17.5	127.5
	28	0600	T.	930	49	17.9	126.5
		1200	T.	935	46	18.3	125.6
		1800	T.	940	43	18.5	124.6
	29	0000	T.	940	43	18.5	123.5
		0600	T.	940	43	18.3	122.6
		1200	T.	945	41	18.0	122.0
30	1800	T.	955	33	17.8	121.5	
	0000	S.T.S.	970	25	17.7	121.0	
	0600	T.S.	975	23	17.8	120.6	
31	1200	T.S.	980	21	18.1	120.1	
	1800	T.S.	985	18	18.6	119.7	
	0000	T.S.	985	18	19.1	119.6	
32	0600	T.D.	990	16	19.7	120.0	
	1200	T.D.	995	13	20.1	120.6	
	1800	T.D.	995	13	20.4	121.3	
33	0000	T.D.	990	16	20.8	122.0	
	0600	T.D.	990	16	21.3	122.8	

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON SETH (9124)

Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
31	0600	T.D.	1000	13	6.4	163.4
	1200	T.D.	1000	13	7.0	161.9
	1800	T.D.	995	16	7.5	160.4
1	0000	T.D.	995	16	8.0	158.8
	0600	T.D.	995	16	8.7	157.3
	1200	T.S.	990	21	9.3	155.9
	1800	S.T.S.	990	25	10.1	154.5
2	0000	S.T.S.	990	25	10.9	153.2
	0600	S.T.S.	980	25	11.8	151.9
	1200	S.T.S.	970	31	12.7	150.6
	1800	T.	960	36	13.4	149.4
3	0000	T.	950	41	14.1	148.4
	0600	T.	940	46	14.7	147.3
	1200	T.	925	54	15.4	146.2
	1800	T.	920	57	15.9	145.1
4	0000	T.	925	54	16.4	144.0
	0600	T.	930	51	16.9	142.9
	1200	T.	930	51	17.4	142.0
	1800	T.	935	49	17.9	141.3
5	0000	T.	940	46	18.4	140.8
	0600	T.	940	46	18.8	140.3
	1200	T.	945	43	19.1	139.9
	1800	T.	945	43	19.4	139.7
6	0000	T.	950	41	19.6	139.5
	0600	T.	950	41	19.8	139.2
	1200	T.	955	39	19.8	138.9
	1800	T.	960	36	19.7	138.6
7	0000	T.	965	33	19.5	138.3
	0600	T.	960	36	19.5	137.7
	1200	T.	950	41	19.5	137.0
	1800	T.	940	46	19.6	136.4
8	0000	T.	940	49	19.7	135.8
	0600	T.	940	49	19.6	135.2
	1200	T.	940	49	19.5	134.6
	1800	T.	945	46	19.3	134.1
9	0000	T.	950	43	18.9	133.3
	0600	T.	955	41	18.7	132.5
	1200	T.	960	36	18.5	131.6
	1800	T.	960	36	18.4	130.7
10	0000	T.	955	39	18.3	129.9
	0600	T.	950	41	18.3	129.2
	1200	T.	950	41	18.3	128.5
	1800	T.	955	39	18.1	127.9
11	0000	T.	960	36	17.9	127.4
	0600	T.	965	33	17.7	126.9
	1200	S.T.S.	975	28	17.5	126.5
	1800	T.S.	985	23	17.4	126.0
12	0000	T.S.	990	21	17.3	125.4
	0600	T.D.	995	16	17.3	124.4
	1200	T.D.	1000	13	17.7	123.5
	1800	T.D.	1000	13	18.3	122.7
13	0000	T.D.	1000	13	18.7	121.9
	0600	T.D.	1000	13	18.9	121.0
	1200	T.D.	1000	13	18.8	120.6
	1800	T.D.	1000	13	18.7	120.3
14	0000	T.D.	1000	13	18.5	120.0

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TROPICAL STORM THELMA (9125)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Nov	2	0000	T.D.	1000	13	12.2	132.9
		0600	T.D.	1000	16	12.5	132.3
		1200	T.D.	1000	16	12.9	131.8
		1800	T.D.	1000	16	13.2	131.4
	3	0000	T.D.	1000	16	13.3	130.8
		0600	T.D.	1000	16	13.4	130.0
		1200	T.S.	995	18	13.2	129.2
		1800	T.S.	995	18	13.0	128.4
	4	0000	T.S.	995	18	12.7	127.8
		0600	T.S.	995	18	12.4	127.1
		1200	T.S.	995	18	12.1	126.4
		1800	T.S.	990	21	11.8	125.7
	5	0000	T.S.	995	18	11.6	125.0
		0600	T.S.	995	18	11.2	124.1
		1200	T.D.	1000	16	10.9	123.1
		1800	T.D.	1000	16	10.6	122.0
	6	0000	T.D.	1005	13	10.3	120.9
		0600	T.D.	1005	13	10.5	119.4
		1200	T.D.	1005	13	10.9	118.0
		1800	T.D.	1005	13	11.3	116.6
	7	0000	T.D.	1005	13	11.4	115.2
		0600	T.D.	1000	16	11.2	113.8
		1200	T.D.	1000	16	10.9	112.8
		1800	T.D.	1000	16	10.6	111.9
8	0000	T.D.	1000	16	10.2	111.0	
	0600	T.D.	1000	16	9.7	110.2	
	1200	T.D.	1005	13	9.1	109.6	

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TROPICAL STORM VERNE (9126)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Nov	5	0600	T.D.	1000	13	9.5	165.5
		1200	T.D.	1000	13	10.0	163.5
		1800	T.D.	995	16	10.7	161.2
	6	0000	T.D.	995	16	11.3	159.6
		0600	T.D.	995	16	11.9	158.2
		1200	T.S.	990	18	12.4	156.9
	7	1800	T.S.	990	21	12.9	155.6
		0000	T.S.	990	21	13.4	154.4
		0600	T.S.	990	21	13.8	153.3
	8	1200	T.S.	990	21	14.2	152.2
		1800	T.S.	985	23	14.6	151.1
		0000	T.S.	990	21	15.0	150.0
	9	0600	T.S.	990	18	15.3	149.2
		1200	T.S.	990	18	15.6	148.5
		1800	T.S.	990	18	15.9	147.8
	10	0000	T.S.	990	18	16.2	147.0
		0600	T.S.	990	18	16.5	146.1
		1200	T.S.	990	18	16.9	145.0
	11	1800	T.S.	990	18	17.4	143.6
		0000	T.S.	990	18	18.0	142.2
		0600	T.D.	995	16	18.8	141.0
	12	1200	T.D.	995	16	19.8	140.3
		1800	T.S.	990	18	21.0	140.2
		0000	T.S.	990	18	22.0	140.5
	11	0600	T.S.	990	18	23.0	141.0
		1200	T.S.	990	18	24.0	141.9
		1800	T.S.	990	18	25.0	143.4
	12	0000	T.S.	990	21	26.0	145.4
		0600	T.S.	995	18	27.3	147.8
		1200	T.D.	1000	16	28.9	151.0

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TROPICAL STORM WILDA (9127)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Nov	13	1800	T.D.	1000	13	9.5	136.0
	14	0000	T.D.	1000	16	9.1	134.0
		0600	T.D.	1000	13	9.3	132.3
		1200	T.D.	1000	13	9.7	131.0
		1800	T.D.	1000	13	10.0	130.0
	15	0000	T.D.	1000	16	10.3	129.0
		0600	T.D.	1000	16	10.7	128.0
		1200	T.S.	995	18	11.2	127.0
		1800	T.S.	995	18	11.9	126.0
	16	0000	T.S.	990	21	12.8	125.3
		0600	T.S.	990	21	13.4	124.4
		1200	T.S.	990	21	13.7	123.3
		1800	T.S.	990	21	13.9	122.2
	17	0000	T.S.	995	18	14.1	121.3
		0600	T.S.	995	18	14.4	120.5
		1200	T.D.	995	16	14.9	119.8
		1800	T.D.	1000	13	15.5	119.3
	18	0000	T.D.	1000	13	16.2	119.0
		0600	T.D.	1000	13	16.8	118.6
		1200	T.D.	1000	13	17.2	118.3
		1800	T.D.	1000	13	17.5	118.0
	19	0000	T.D.	1000	13	17.8	117.5

Dissipated

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON YURI (9128)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E
Nov	22	1200	T.D.	1000	13	4.5	165.9
		1800	T.D.	1000	16	4.6	165.9
	23	0000	T.D.	1000	16	4.7	165.8
		0600	T.S.	995	18	4.8	165.8
		1200	T.S.	990	21	5.0	165.7
	24	1800	T.S.	985	23	5.3	165.5
		0000	S.T.S.	980	25	5.6	165.1
		0600	S.T.S.	980	25	6.2	164.0
		1200	S.T.S.	970	31	6.5	162.8
	25	1800	T.	965	33	6.9	161.4
		0000	T.	960	36	7.2	159.9
		0600	T.	960	36	7.5	158.4
		1200	T.	955	39	8.1	156.8
		1800	T.	950	41	8.7	155.1
	26	0000	T.	935	49	9.1	153.2
		0600	T.	925	54	9.3	151.5
		1200	T.	920	57	9.5	149.8
		1800	T.	915	59	9.9	148.2
	27	0000	T.	910	61	10.7	146.8
		0600	T.	915	59	11.7	145.5
		1200	T.	920	57	12.5	144.0
		1800	T.	925	54	13.2	142.6
	28	0000	T.	925	54	14.1	141.5
		0600	T.	930	51	15.0	140.5
		1200	T.	930	51	15.9	139.7
		1800	T.	935	49	16.9	139.1
	29	0000	T.	935	49	17.8	138.8
		0600	T.	935	49	18.7	138.8
		1200	T.	940	46	19.6	139.1
		1800	T.	945	43	20.4	139.7
30	0000	T.	955	39	21.1	140.5	
	0600	T.	960	36	22.1	142.1	
	1200	S.T.S.	970	31	23.5	144.1	
	1800	S.T.S.	975	25	25.1	146.6	
Dec	1	0000	T.S.	985	21	27.3	149.0

Became Extratropical

SIX-HOURLY POSITION AND INTENSITY DATA OF  
TYPHOON ZELDA (9129)

Month	Day	Time UTC	Intensity	Estimated minimum central pressure (hPa)	Estimated maximum surface wind (m/s)	Lat. °N	Long. °E	
Nov	27	1800	T.D.	1000	13	7.0	174.0	
		28	0000	T.D.	995	16	7.2	173.0
	0600		T.D.	995	16	7.4	172.0	
	1200		T.D.	995	16	7.7	171.0	
	1800		T.D.	995	16	7.9	170.0	
	29		0000	T.S.	990	21	8.1	168.6
		0600	S.T.S.	980	28	8.5	167.1	
		1200	T.	970	33	8.8	165.6	
	30	1800	T.	960	39	9.2	164.1	
		0000	T.	970	33	9.7	162.5	
		0600	T.	970	33	10.3	161.0	
		1200	T.	970	33	11.1	159.5	
		1800	T.	970	33	12.1	158.1	
	Dec	1	0000	T.	970	33	13.1	157.0
			0600	T.	970	33	14.0	156.4
1200			T.	970	33	15.0	156.2	
1800			S.T.S.	975	31	16.2	156.5	
2		0000	S.T.S.	980	28	17.3	157.3	
		0600	S.T.S.	980	25	18.2	158.5	
		1200	T.S.	985	23	18.9	159.8	
		1800	T.S.	990	21	19.6	161.1	
3		0000	T.S.	990	18	20.2	162.4	
		0600	T.D.	995	16	20.8	163.5	

Became Extratropical