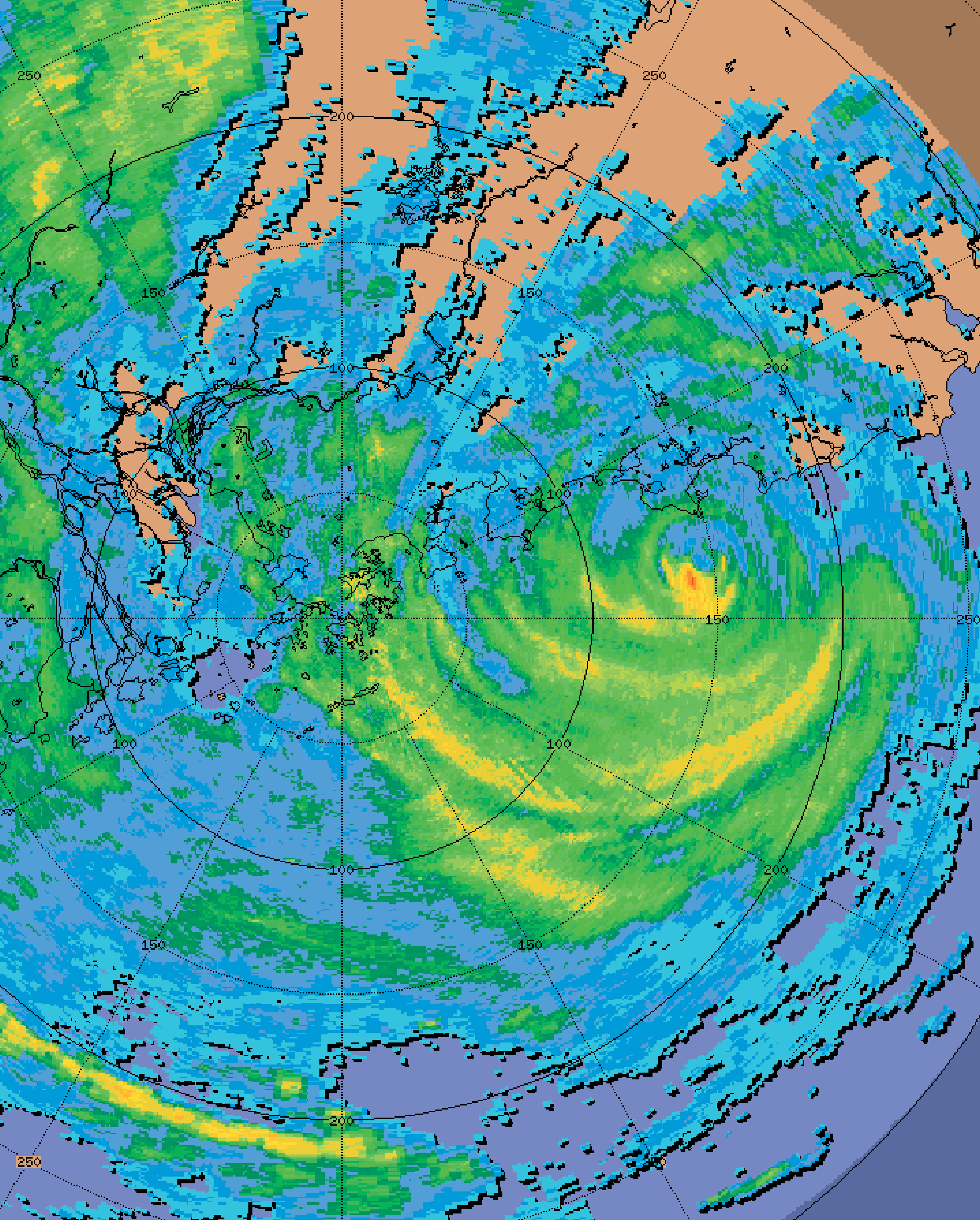


4

Modernisation of the City
城市的現代化

Close encounter with Typhoon Dujuan, September 2003
2003 年 9 月與颱風杜娟的近距離接觸

Post-war Regeneration

During the Japanese occupation, the Observatory was reorganised into a meteorological department. When Hong Kong was liberated, it was found that some of the Observatory instruments had been removed by the Japanese, including two sets of Milne-Shaw horizontal seismographs. Some out-stations, such as the terrestrial magnetic observation station at Au Tau, had been destroyed in the war and urgently required rebuilding. After the war, the Observatory was first taken over by the Royal Navy and the Royal Air Force,[146] and acted as their meteorological forecast centre. On 1 May 1946, the Hong Kong government resumed control over the Observatory and staff members began to report for duty. Among them was one employee who had been imprisoned by the Japanese invading forces. On 17 June 1946, the Royal Air Force moved its meteorological department to Kai Tak airport, and the formalities for the handover of control of the Observatory were completed by the end of 1946.[147]

Fig. 4.1 A 1939 group photograph of Hong Kong Observatory staff, taken two years before the Japanese invasion. Among them were those who requested to resume duties after the war: Lau Pak Wa (third left, second row), Chi Wen Kai (first right, second row), Pow Ka Ming (first right, third row), Pow Chi Ming (second left, fourth row). Courtesy Hong Kong Observatory

圖 4.1 日軍入侵香港前兩年 (1939年) 香港天文台職員的合照，包括戰後申請復職的職員：劉伯華 (2 排左 3) 、祁文塏 (2 排右 1) 、 鮑家銘 (3 排右 1) 、鮑志銘 (4 排左 2)。香港天文台檔案

戰後重生

在日治時期，天文台曾被改組為氣象台。香港光復後，天文台部分儀器包括兩套水平地震儀 (Milne-Shaw horizontal seismograph) 被日軍撤走，一些外站如凹頭的地磁服務站亦被戰火摧毀，急待重建。戰後，天文台先由皇家海軍及皇家空軍接管，[146] 變相成了皇家海軍與空軍的氣象預報中心。1946 年 5 月 1 日香港政府重新執掌天文台，員工亦紛紛回台復職，其中亦包括一名曾被日軍囚禁的職員。皇家空軍於6月17日將空軍氣象部遷至啟德機場，而有關天文台管治權的移交手續至 1946 年年底正式完成。[147]

1a, Caminho dos Artelheiros, Gr. Fl.,
Macau.
14th September 1945.

B. D. Evans Esq.,
Director, Royal Observatory,
Hong Kong.

Dear Sir,

We, the undersigned, hope earnestly that our congratulating telegram finds you in excellent health and with best of luck. In Macau victory celebrations were joyfully displayed for three days. We presume that there will be a [illegible] celebration for the same in Hong Kong later.

We think at the very near future all devils will steadily be driven out from Hong Kong and are quite sure that the colony will soon be orderly reestablished, particularly our Observatory Department. Since we arrived here we are under the support of British Government through the kindness of H. B. Consul in Macau. Now we are waiting your order to return.

With best regards and awaiting the favour of your early instruction.

We beg to remain,
Sir,
Your obedient servants,
Lau Pak Wa
Chi Wen Kai
Pow Ka Ming
Pow Chi Ming

Fig. 4.2 Request from Hong Kong Observatory staff to resume duties after the war. Courtesy Hong Kong Observatory

圖 4.2 戰後天文台職員聯名申請復職書函。香港天文台檔案

In the 20 years immediately after the war, the work of the Observatory was concerned primarily with surface and upper air meteorological measurements. The major components of surface observation were the same as those before the war, and included measurements of air temperature, atmospheric pressure, humidity, wind strength, cloud amount, cloud height, visibility, sunshine duration and rainfall. The major breakthrough in the post-war era was to receive meteorological messages with the wireless communications equipment used during the war.

With dramatic increases in population and bustling economic and commercial developments since the late 1940s, the volume of air traffic surged in Hong Kong. High quality meteorological services, therefore, had also become important, and there were marked improvements in such services after the war. According to statistics provided by the Civil Aviation Department, in the year 1947–48, a total of 113,326 passengers arrived in or departed from Hong Kong by air. The number of aircraft landings or take-offs totalled 7,309. In 1948–49, the number of travellers rose to 251,593 — an increase of 122% over the previous year; while the number of aircraft landings or take-offs jumped to 16,443 — an increase of 125%. In 1949–50, 275,817 passengers arrived or departed Hong Kong by air, representing an increase of 10%. The number of aircraft landings and take-offs totalled 22,073 — an increase of 34%. The amount of cargo loaded and unloaded in 1948–49 was 1,597 tonnes, which represented a 20% increase over 1947–1948 (total amount was 1,334 tonnes), while the amount in 1949–1950 reached 5,893 tonnes. This represented an increase of 269% over the previous year. Regardless of passenger or freight traffic, the rate of increase from 1947 to 1950 was the highest for the entire 1947 to 2002 period.[148] Upper air meteorological services had gained importance after the war, and the Observatory had to respond and change accordingly.

Towards the end of the 1940s, the Observatory co-operated with the British military and set up an upper air meteorological observation section at Kai Tak airport, using radar to make round-the-clock observations of wind directions and strength.[149] In 1951, this section used aircraft to carry out upper air meteorological observations. Using the data collected, it prepared two upper level weather charts at 2,000-foot, 5,000-foot and 10,000-foot levels, in accordance with the standards of the International Civil Aviation Organisation and the World Meteorological Organisation. These charts served as references for aviation personnel. Various out-stations were set up to gather more weather information on the Hong Kong region. In 1951, out-stations such as those at Tai O and Port Island provided weather reports once every six hours. On 1 December 1952 and 1 January 1953, the out-stations on Waglan Island and Cheung Chau

戰後的20年，天文台的工作仍以地面氣象監測及高空氣象監測為主。地面監測工作沿用戰前測量重點，包括氣溫、氣壓、濕度、風力、雲量、雲高、能見度、日照時間及降雨量等。戰後氣候監測工作最大的突破，就是利用戰時使用的無線電通訊器材，接收氣象訊息。

自1940年代末期起，人口急增、經濟貿易活動蓬勃發展使香港的航空交通數量大增。根據香港民航處的統計資料， 1947 至 1948 年民航處處理的抵港或離港的人數共113,326人，而降落或起飛的飛機達7,309架次；而1948至1949年的旅客增至251,593人，與前一年相較增長率為122%，而飛機抵港或離港架次則增至 16,443 ，與前一年相較有 125% 的增長率；1949 至 1950 至年抵港或離港人數增至275,817人，與前一年相較有10%有增長，而飛機的升降架次則有22,073 ，較前一年增加了 34%；1948 至 1949 年的貨物起卸量為 1,597 公噸，較 1947 至 1948 年的 1,334 公噸，增加了 20%；1949 至 1950 年的貨物起卸量達5,893公噸，較1948至49年增加269%，這三年的空運無論是客運抑貨運，增長率為 1947 至 2002 年以來最高。[148] 可見高空氣象服務在戰後相當重要，天文台也必須因應時勢作出改變。

1940年代末期，天文台與軍部合作於啟德機場設立高空氣象部，利用雷達進行 24 小時風向及風力監測。[149] 1951 年高空氣象部利用飛機進行高空氣象監

Fig. 4.3 Kai Tak International Airport control tower and meteorological office (1988). Courtesy Hong Kong SAR Information Services Department

圖 4.3 啟德國際機場控制塔及氣象所 (1988 年)。香港特別行政區政府新聞處檔案

came into operation respectively and the staff there conducted meteorological observations once every half hour, thus enhancing aviation safety.

The reports put out by the Observatory were not confined to local meteorological information; they also reported on the meteorological conditions in the Asia-Pacific region to facilitate movement of incoming and outgoing flights. The special status of the upper air meteorological observation section at the airport operating independently from the Observatory headquarters started to fade out with the official establishment of the Central Forecasting Office in 1957, when the section was transferred back to the Observatory headquarters. Since then upper air observation work has been under the control of the headquarters. In addition to serving the aviation industry, the upper air meteorological data is also important in public weather forecasting.

The rapid rise in population in the post-war years led to the development of an urbanisation strategy that differed greatly from the pre-war years. The first post-war population census carried out in 1951 gave a population figure of 2,010,000, an increase of 91% over the 1939 figure of 1,050,000. Ten years later, the figure increased by a further 56% to 3,130,000. The two decades in the 1950s and 1960s saw the highest population growth rates in the entire post-war period up to 2001.

Table 4.1 Population Growth in Hong Kong (1939–2001)

Year	Population (10 thousand)	Rate of Population Growth
1939	105	–
1951	201	+91%
1961	313	+56%
1971	393	+26%
1981	499	+27%
1991	547	+10%
2001	671	+23%

Sources:
Hong Kong Census and Statistics Department, *Demographic Trends in Hong Kong 1971–82,* Hong Kong Government Printer, 1983, p. 3.
Hong Kong Census and Statistics Department, *Hong Kong Annual Digest of Statistics,* Hong Kong Government Printer, 1992, p. 11.
Hong Kong Census and Statistics Department, *Hong Kong Statistics 1947–67,* Hong Kong Government Printer, 1969, p. 15.
Hong Kong Special Administrative Region Government, *Hong Kong 2001,* Hong Kong, Government Printer, 2002.

The rapid increases in population were due principally to the large numbers of immigrants. On one hand, these people represented the economic resources behind Hong Kong's development. On the other hand, they imposed severe pressure on the city's development in the areas of housing, transport, education

Fig. 4.4 An Observatory aviation forecaster briefing an Canadian Air Force crew on the weather conditions along the flight route (1965). Courtesy Hong Kong SAR Information Services Department

圖 4.4 天文台航空預報員向加拿大空軍講解飛行航道的高空天氣狀況（1965年）。香港特別行政區政府新聞處檔案

測，並利用所得資料按國際民航組織及世界氣象組織標準，每天製作兩張有關2,000呎、5,000呎及10,000呎高空氣象圖，供飛行人員參考；同時廣設外站以增加對香港地區氣候的蒐集，1951年大澳及赤洲等外站，每6小時提供天氣報告一次；1952年12月1日及1953年1月1日，橫瀾島與長洲等外站相繼啟用，並每半小時進行氣象監測，為飛行安全提供更大的保障。

天文台所提供的氣象報告，不僅是本地的氣象資料，同時也有亞太地區的氣象情況報導，對進出香港的航機提供了不少方便。機場的高空氣象部獨立於天文台總部的超然地位在1957年中央天氣預測站正式啟用後才逐漸淡化。1957年機場的高空氣象部被調回天文台總部，而高空氣象監測工作則由總部統籌。高空氣象資料不但為航空界服務，同時也提高公眾天氣預測的效能。

戰後的香港，人口急促增長，城市的發展策略亦隨之與戰前有相當明顯的差異。1951年戰後第一次全港人口統計，錄得的201萬較1939年的105萬增加了91%，而十年後1961年錄得的313萬人口，較10年前增加了56%，這兩個十年可說是戰後至2001年間，增長最快速的年代。

and medical services. The Observatory, in tune with the structural changes in society, also made directional adjustments to its services in the late 1950s and early 1960s. The Observatory shifted its emphasis from serving mainly government departments and various major institutions, to serving the livelihood of ordinary people. The expansion of the Observatory followed closely the pace of social development. The following description of the expansion of the Observatory's organisation structure may be useful for reference purposes.

Reorganisation of Structure

For the first 20 years after the war, the work of the Observatory remained more or less the same as that before the war, as evidenced by the unchanged organisation structure up to 1964. During this period, the main tasks were surface meteorological observation, marine weather services, geomagnetic measurements, typhoon warning services, etc. A lithographic press section was set up in 1947 to facilitate the publication of research reports, indicating that research and publication activities were gaining importance after the war. In 1957, the Central Forecasting Office was established at the headquarters to co-ordinate meteorological observations of all out-stations, including the Kai Tak Meteorological Office.

From 1965 onwards, the Observatory's structure underwent bigger changes to embrace modern sciences and new technologies. New divisions developed included the Geophysics Division (1965), the Training Division (1966), the Computer Division (1973), the Air Pollution Meteorology Research Units (1980) and the Physical Oceanography Division (1988). Such expansion was necessary for the Observatory to constantly keep up with the pace of new requirements. In 1993, the Observatory was restructured into four branches: the Forecasting and Warning Services Branch; the Development, Research and Administration Branch; the Radiation Monitoring and Assessment Branch; and the Aviation Meteorological Services Branch. The Forecasting and Warning Services Branch comprised three divisions: Central Forecasting Office Operations; Radar, Satellite and Instruments; and Special Meteorological Services and Telecommunication. The Development, Research and Administration Branch consisted of three divisions: Development, Research and Administration. The Radiation Monitoring and Assessment Branch was made up of three divisions: Operation and System Development; Training and Emergency Preparedness; and Assessment and Observational Network. The Aviation Meteorological Services Branch was made up of the Airport Meteorological Office (Kai Tak) and the Airport Meteorological Office (Chek Lap Kok).

表 4.1 全港年人口增長趨勢 (1939–2001 年)

年份	人口總數（萬）	增長率
1939	105	–
1951	201	+91%
1961	313	+56%
1971	393	+26%
1981	499	+27%
1991	547	+10%
2001	671	+23%

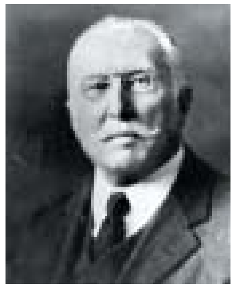
資料來源：
Hong Kong Census and Statistics Department, *Demographic Trends in Hong Kong 1971–82*, Hong Kong Government Printer, 1983, p. 3.
Hong Kong Census and Statistics Department, *Hong Kong Statistics 1947–67*, Hong Kong Government Printer, 1969, p. 15.
Hong Kong Census and Statistics Department, *Hong Kong Annual Digest of Statistics*, Hong Kong Government Printer, 1992, p. 11.
Hong Kong Special Administrative Region Government, *Hong Kong 2001*, Hong Kong, Government Printer, 2002.

迅速增長的人口以移民為主，他們一方面是香港發展的經濟資源，而另一方面，卻對城市的居住、交通、教育及醫療等的發展構成極大的壓力。天文台的服務亦因應著社會結構的改變，在 1950 年代末、 1960 年代初作出方向性的調整——從主要為政府部門及各大工商機構提供服務轉而強調社會民生服務，天文台規模的擴張緊隨社會發展的步伐，以下有關天文台組織結構擴張情況或可作參考之用。

組織重整

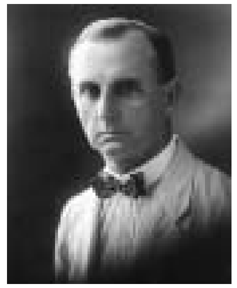
戰後的首20年天文台的工作與戰前大抵相若，這從戰後至1964年期間，天文台的組織結構不變，仍沿用舊制可以印證。這段期間主要的部門包括地面氣象觀測、海洋氣候服務、地磁觀測及颱風預警服務等，新增的部門有在 1947 年以後為方便公開發表研究報告而設的出版部，說明研究及出版是戰後部門工作的重要環節。 1957 年以後天文台總部更成立中央氣象預測部，統籌全港外站，包括啟德機場氣象站的氣象資料。

1965年起，天文台的組織有較大的變動，一些提倡新科學、新技術的部門相繼成立，如有 1965 年的地球物理學部、 1966 年的培訓部、 1973 年的電腦部、1980年的空氣污染氣象研究組和1988年的海洋物理部，使天文台的規模不斷更新及擴充。 1993 年按照當時既有的基礎，重組為四個科，分別是天氣預測及警告服務科、拓展、研究及政務科、輻射監測及評估科，以及航空氣象服務



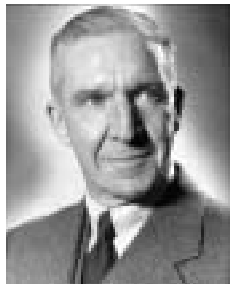
William Doberck
杜伯克 (1883–1907)

Frederick George Figg
霍格 (1907–1912)



Thomas Folks Claxton
卡勒士頓 (1912–1932)

Charles William Jeffries
謝非烈士 (1932–1941)



Benjamin Davies Evans
伊雲士 (1941–1945)

Graham Scudamore Percival Heywood
希活 (1946–1956)

Ian Edward Mein Watts
瓦特士 (1956–1965)

Gordon John Bell
鍾國棟 (1965–1981)

John Edgar Peacock
費愨 (1981–1983)

Sham Pak, Patrick
岑柏 (1984–1995)

Lau Chi-kwan, Robert
劉志鈞 (1995–1996)

Lam Hung-kwan
林鴻鋆 (1996–2003)

Lam Chiu-ying
林超英 (2003–)

Fig. 4.5 Directors of Hong Kong Observatory from past to present. Courtesy Hong Kong Observatory and Hong Kong SAR Information Services Department

圖 4.5 歷屆天文台長。香港天文台檔案及香港特別行政區政府新聞處檔案

Fig. 4.6 Group photograph of Hong Kong Observatory staff in 1960. Courtesy Hong Kong Observatory

圖 4.6 1960年香港天文台職員合照。香港天文台檔案

科。天氣預測及警告服務科又分為天氣預測總部、雷達衛星及儀器、特別氣象服務及電訊部；拓展、研究及政務科分為服務拓展、研究及行政三部份；輻射監測及評估科則分為行動及系統發展、培訓及緊急支援措施、評估及觀測網絡三部分；而航空氣象服務科分為啟德機場氣象部及赤鱲角機場氣象部。

2001年天文台再次重組，重組後組織大抵與1993年的架構相若，仍以四個科為主體。一些提供新科技的部組亦相繼增加，包括隸屬於天氣預測及警告服務科的預報拓展組及系統拓展組；隸屬於拓展、研究及政務科的電子政府、地球物理、授時及海港氣象服務組以及長期預報及水文氣象組；而航空氣象服務科的變化最為明顯，改組為風切變及湍流、惡劣飛行天氣組、機場氣象儀器、天氣雷達及衛星等新組別，使航空氣象服務的工作強調以飛行安全為本，並盡量配合繁忙的空運的發展要求。而以上的組織結構一直維持至2003年，並沒有太大的變動。

Fig. 4.7 Group photograph of Hong Kong Observatory in 2003. Courtesy Hong Kong Observatory

圖 4.7 2003 年香港天文台全體職員合照。香港天文台檔案

In 2001, another reorganisation of the Observatory took place. The organisation structure after the exercise was similar to the one in 1993, with four branches as the backbone. Sections dealing with new technologies were added, including: the Forecast Development and System Development units under the Forecasting and Warning Services Branch; the E-Government, Geophysics, Time and Port Meteorological Services unit, and the Long Range Forecasting and Hydrometeorology unit, under the Development, Research and Administration Branch. The expansion of the Aviation Meteorological Service Branch was most significant: new additions included the Windshear and Turbulence Detection unit, the Aerodrome Meteorological Instrumentation unit, and the Weather Radar and Satellites unit. The aviation meteorological services place emphasis on aviation safety, and every effort is made to meet the increasing demands of the thriving air transport industry. This structure has remained largely unchanged to 2003.

Allocation of Resources

The functions of the Observatory and its relationship with the social development of Hong Kong can be observed from the growth in expenditure and staff numbers, and the expansion of its organisation.[150] When the Observatory was first established in 1883, its annual expenditure was only HK$2,740. In 1940, one year before the fall of Hong Kong, that amount had increased to HK$136,261, a 49.7-fold increase. This was fairly in line with the 48.3-fold growth in Hong Kong government expenditure for the same period.

Between 1883 and 1940, the expenditure of the Observatory was generally on an upward trend. In descending order, the years that saw the highest expenditure increases were: 1884 (98.2%), 1890 (92.7%), 1930 (54%), 1931 (37%) and 1903 (36.6%). Within this period, there were years that registered expenditure reductions. The years with the highest reduction were: 1918 (-25.5%), 1891 (-22.1%), 1927 (-18.8%), 1924 (-14.9%) and 1898 (-12.6%). Of the period in question, there were 24 years that recorded reductions and 33 years that registered increases. The 98.2% increase in 1884 was the highest on record. This was merely a reflection of an incomplete establishment at the very beginning of operation of the Observatory in 1883. As the establishment finally took shape, expenditure rose dramatically in 1884. As such, the rise in the second year was not representative of the true expansion and development of the organisation. From the expenditure's upward trend,

資源分配

天文台的功能與香港社會發展的關係，可透過有關財政支出的增長、員工人數的增加及組織擴充略見端倪。[150] 天文台於1883年建台頭一年的全年總支出只有2,740港元，在1940年，即香港淪陷前一年已增至136,261元，增長高達48.7倍，與同期全港財政總支出的增幅47.3倍相若。

1883至1940年間，天文台財政支出的趨勢，大體上處於上升軌跡，支出最大增幅的年份有1884年(98.2%)、1890年(92.7%)、1930年(54%)、1931年(37%)及1903年(36.6%)。而其中全年經費支出亦有所減少的，減幅最大的年份有1918年(-25.5%)、1891年(-22.1%)、1927年(-18.8%)、1924年(-14.9%)及1898年(-12.6%)。與上年相較而處於減幅的年份有24年，不及處於增幅的33年多。1884年(98.2%)的增幅可說是歷年最多增幅的年份，反映創立初期仍未有固定編制，在次年才將創台支出經費大量提高，因此1884年支出的增幅當然並不能代表組織的發展擴張。從支出上升的軌跡，可看到1930和1931年的顯著增幅，代表著機構在1930年代初的快速增長。另一方面，一些年份如1891年22.1%的減幅，是基於1890年的92.7%增長後的結構性調整，未能説明機構縮減經費的主要時段。1918年支出下降25.5%、1924年的14.9%及1927年的18.8%，才真正反映了天文台有縮減開支的情況。大體來説，天文台的財政支出佔全港財政總支出的比例少於0.3%。

戰後天文台的發展，比起戰前更有過之而無不及。整體來説，財政的支出及職員的數量大部份時間是處於上升的軌道，只有四年，即1958–59年(-10.6%)、1966–67年(-1.8%)、1967–68年(-9.7%)及2000–01年(-1.3%)，經費與前一年相較有減少現象，其餘時間財政支出均處於上升軌跡，最大的升幅以戰後第一年1946–47年最為顯著，高達870%，此外1947–48年(81.3%)、1948–49年(46.1%)、1957–58年(44.7%)及1979–80年(40%)為最突出。1945–46年，戰後的頭一年，天文台的工作仍未完全投入，財政支出只有11,339元，為1946–47年的10.3%，因此以下的計算以1946–47年為評估戰後天文台財政支出增長的起點，是年的支出為109,987元；而2001–02年的支出為221,296,000元，期間共增加了2,011倍，與全港財政總支出的2,343倍增長比較，稍為遜色。縱觀1946–47至2001–02年56年間，天文台財政支出的年平均增長率為15.7%，與全港財政總支出年平均增長率15.9%相若，可見戰後天文台的發展規模與香港整體發展同步。一些經費縮減的年份，可以看作是結構性調整，如在1958–59年的減幅，是因應1957–58年的44.7%增幅的調整，未能真正代表資源投放的減少。比較值得關注的是1967–68年暴動後削減9.7%的支出，主要受到整體政治氣氛影響，是年全港財政支出與上一年相較亦有2.2%的減幅。

one can see that the spectacular rises in 1930 and 1931 marked the rapid development in the 1930s. On the other hand, the 22.1% reduction in expenditure in 1891 was due to the structural adjustments to the previous year's dramatic increase of 92.7%, and was not suggestive of the year being part of the period of major expenditure reduction. The reduction of expenditure in 1918 (-25.5%), 1924 (-14.9%) and 1927 (-18.8%), however, truly reflected the expenditure cuts suffered by the Observatory. On the whole, the Observatory accounted for less than 0.3% of Hong Kong's total public spending in a given fiscal year — a very small fraction indeed.

The pace of development of the Observatory was far quicker in the post-war period. Generally speaking, both spending and staff numbers were on a rising trend in most years. There were only four years with reduced expenditure: 1958–59 (-10.6%), 1966–67 (-1.8%), 1967–68 (-9.7%) and 2000–01 (-1.3%). All the remaining years showed expenditure growth. The highest increase in expenditure was registered in 1946–47 (870%). The other years with substantial expenditure growth were, in descending order, 1947–48 (81.3%), 1948–49 (46.1%), 1957–58 (44.7%) and 1979–80 (40%). In 1945–46, immediately after the war, expenditure only amounted to $11,339, as the Observatory had yet to resume all its services. This sum was equivalent to 10.3% of the expenditure of 1946–47. Thus the expenditure of 1946–47 of HK$109,987 is used as the baseline to evaluate the expenditure growth trend of the Observatory. The amount rose to HK$221,296,000 in 2001–02, a 2,012-fold increase. This is slightly below the 2,344-time increase in Hong Kong's public spending for the same period. For the 56 years between 1946–47 and 2001–02, the annual average rate of increase is 15.7%. This rate is almost a perfect match of the 15.9% growth rate registered in public spending. The scale of development of the Observatory is very much in line with the overall growth of Hong Kong. The years with expenditure cuts could be considered as due to structural adjustments. As an example, the reduction in expenditure in 1958–59 was in response to the 44.7% increase of 1957–58, and not really a cut in resource allocation. What is noteworthy was that the 9.7% reduction in the year of social turmoil in 1967–68 was due to the overall political atmosphere prevailing at that time. In that year, total public expenditure of Hong Kong fell by 2.2% as compared with the previous year.

Since its inception in 1883, the annual expenditure of the Observatory accounted for less than 0.3% of public spending — a minuscule percentage. It is hard to believe that weather information, which is so important to the daily lives of people in the present day, could cost so little. The economic benefits

天文台的經費支出自1883年成立以來，只佔全港財政支出的0.3%以下，比例可謂相當小，很難相信今日對市民日常生活影響重大的天氣資訊，所花的費用是這樣微小；從經濟角度來看，天文台的服務經濟效益相當高，由於機構財政支出佔全港年均總財政支出的比例相當小，故其經費的增減步伐，也未必與政府整體的財政支出相同。

從機構的人員編制來看，其增長的情況遠不及經濟資源的明顯。[151] 直至戰前主要的員工 (不包括低級職員在內) 只有24人，較1884年天文台12名員工，增長了一倍，與財政支出的增長相較相差很遠。戰後員工的增長幅度較戰前的大，從1947年的24人增至1980年的217名員工，增長為八倍，雖然遠不及財政支出的增幅，但規模明顯較戰前的龐大。一些先進氣象儀器的添置及現代的報導方式，也是天文台擴充服務的主要重點，因此人手的添加的增幅上升未能緊隨財政支出的上升軌道。

城市建設

氣象觀測的資料對香港城市現代化有著舉足輕重的作用。戰後香港的人口不斷迅速增長，開拓可用的土地資源是城市發展的首要急務——要平整土地、填海以及興建高樓大廈並不是一件容易的事。建築工程上，要利用氣象資料計算填海深度及建築需用的材料，必須先考慮到土地可抵禦風暴潮的能力和工程成本；樓宇要向高空發展則必須事先預估強大風力及最高風速的情況，以增強抵禦颱風的能力。因此，一些關鍵性的氣候資料如歷年颱風吹襲本港時的風向及風力的強度、風暴潮所引起的水位上升對沿岸衝擊的程度、降雨量的分佈等都是建設城市不可或缺的依據。天文台在每次颱風襲港期間所作的風向、風速及風力的紀錄，定期發放的雨量及潮汐報告，就成了基建工程及建築界的重要參考資料，而且更是1960年代以後，發展本地龐大基建的優先考慮的條件。[152] 表4.2是天文台歷年一些個別提供氣象資料服務的統計，其中部分服務需收取費用，從收費服務總收入不斷上升而查詢次數亦同步上升，可反映氣象資料有一定的實用價值。

derived from the Observatory's services are very great. As it represents only a very small proportion of the total public spending, the rate of increase or decrease in its funding did not always follow that of the overall government spending pattern.

Looking at staffing levels, the increase in staff numbers was not as conspicuous as the growth in economic resources.[151] Before the war commenced, there were only 24 principal officers (excluding low-ranking staff). This represented just an increase of 100% over the 1884 figure of 12. The increase was far below the increases in expenditure over the same period.

The growth of staffing levels was higher in the post-war years. From a figure of 24 in 1947, the staff numbers increased to 217 in 1980 — a nine-fold increase. Although the increase in percentage was rather insignificant relative to the growth in public spending, the staff size nevertheless had become much bigger than before the war. The procurements of advanced meteorological instruments and the introduction of modern operational procedures that characterised the expansion of the Observatory's services probably explains why the growth in manpower was not comparable with the rate of increase in expenditure.

Urban Construction

Meteorological data had a decisive influence on Hong Kong's urban construction. With the rapid rise in population after the war, the primary concern in Hong Kong's urban development was to exploit usable land resources effectively. For Hong Kong, a city desperately short of land resources, it was no easy task to level an area of land and reclaim part of the sea to build skyscrapers. Examples of construction projects that needed meteorological data include the consideration of the effects of storm surges to optimise the depth of sea to be reclaimed and the materials to be used, both of which were closely related to the construction costs; and the estimation of possible maximum wind speeds in building skyscrapers so that they can withstand the passage of typhoons in summer. Thus, vital meteorological data such as the directions and strength of typhoons passing through Hong Kong over the years, the impact on the coast of rising sea levels caused by storm surges and the rainfall distribution were all indispensable for the construction of the city. The records made by the Observatory on wind directions, speeds and strength on the passage of each typhoon, and the regular reports issued on rainfall distribution and tides, became

表 4.2 香港天文台對外服務統計（1957–2002 年）

年份	查詢總數	每年收費查詢次數	收入（港元）
1957–1960	369	16	1,686
1961–1965	578	55	2,700
1966–1970	608	100	5,600
1971–1975	664	194	18,739
1976–1980	682	179	28,470
1981–1985	2,205	710	209,341
1986–1990	2,660	752	245,647
1991–1995	4,040	962	925,547
1996–2000	4,752	1,138	1,505,226
2001–2002	1,718	316	441,971
總計	18,276	4,422	3,384,927

資料來源：
香港天文台內部資料。

潮汐預報

十九世紀潮汐漲退的資料，對漁民及航海人士最為有用。天文台成立以前，有關潮汐漲退的零散報導，主要靠私人公司提供。報章就上述資料有系統地預測潮汐漲退的報導可追溯至十九世紀末期，倫敦的航海天文曆辦公室 (Nautical Almanac Office in London) 就尖沙咀水警基地所設的潮汐自動測量計錄得的資料，預測未來一週本港每日潮水最高及最低高度，[153] 並將全港最高及最低潮汐漲退的地區羅列供參考，以減低船隻泊港及漁民出海捕魚的風險。

香港利用電子技術測量潮汐漲退的情況，最早可見於1940年代英國海洋科學學院在港所使用的電子潮汐紀錄儀。1951年1月香港首次在軍器廠基地安裝自動潮汐測量計，1952年10月移師到北角，後再被遷往鰂魚涌，用以觀察潮水漲退的規律及平均向量結構。自動潮汐測量計對香港填海工程的發展有很大的幫助，影響較深遠的填海工程有1950年港島東區的填海工程、1970年代吐露港的填海工程及沙田市中心的填海工程等。 1983 年香港天文台參考加拿大海洋科學學院潮汐的分析方法進行研究， 1987 年香港正式開始使用電腦程式預測潮汐分佈。

天文台就沿海地區所作的潮汐漲退監測及紀錄，會定期向外發表，以供有關部門及私人公司參考，潮汐漲退的資料一般包括每天潮水最高及最低的讀數、沿岸地區每天潮汐漲退的時間、颱風季節風暴潮的狀況，以及海水的平均水位等資訊。在長時期及定期的監測下，天文台會就多年來累積的風暴潮數據，預估五十年一週的特大漲潮，作為填海或建築工程計劃的重要參考資料。

important reference materials for infrastructure projects and the construction sector. These data sources have become a prerequisite to the massive scale of infrastructural development undertaken since the end of the 1960s.[152]

Table 4.2 contains statistics on the various meteorological data services provided by the Observatory. Some of the services required the payment of fees. Judging from the increasing incomes that were matched by rising number of enquiries, it shows that such data have a certain practical value.

Table 4.2 Statistics on External Services Rendered by the Observatory (1957–2002)

Year	Total Number of Enquiries	Number of Charged Enquiries	Revenue (HK$)
1957–1960	369	16	1,686
1961–1965	578	55	2,700
1966–1970	608	100	5,600
1971–1975	664	194	18,739
1976–1980	682	179	28,470
1981–1985	2,205	710	209,341
1986–1990	2,660	752	245,647
1991–1995	4,040	962	925,547
1996–2000	4,752	1,138	1,505,226
2001–2002	1,718	316	441,971
Total	18,276	4,422	3,384,927

Source:
Internal records of the Hong Kong Observatory.

Tidal Predictions

In the nineteenth century, data on the ebb and flow of tides were essential to fishermen and seafarers. Before the establishment of the Observatory, reports on tides were provided sporadically, mainly by private companies. Systematic reporting in newspapers of tidal predictions can be traced back to the late nineteenth century. The Nautical Almanac Office in London, making use of the tidal data collected by the automated instruments installed at the Marine Police base in Tsim Sha Tsui, provided forecasts of Hong Kong's daily maximum and minimum tidal heights for the coming week.[153] It also listed the areas in Hong Kong with the highest and lowest tides, so as to reduce the risks faced by ships mooring and fishermen going out to sea.

The earliest use of electronic technology to measure the ebb and flow of tides was in the 1940s when the British Oceanic Institute installed electronic tide recorders to measure the tides. In January 1951, Hong Kong set up its own automatic tide gauges at the Arsenal base for the first time. In October

Fig. 4.8 Tsim Bei Tsui Tide Station (2000). Courtesy Hong Kong Observatory

圖 4.8 尖鼻嘴潮汐觀測站（2000年）。香港天文台檔案

Fig. 4.9 Waglan Island Tide Station (1993). Courtesy Hong Kong Observatory

圖 4.9 橫瀾島潮汐觀測站（1993年）。香港天文台檔案

1952, the instrument was moved to North Point and later to Quarry Bay. The purpose was to observe the pattern of tidal flows and the structure of the mean vector. These automatic tide gauges were a great help to land reclamation projects. Examples include the Eastern District reclamation project on Hong Kong Island in 1950, and the reclamation works carried out at Tolo Harbour and Sha Tin New Town in 1970s. In 1983, the Observatory conducted research on tides, based on the analytical methodology developed by the Canadian Marine Institute. By 1987, Hong Kong officially employed computer programmes to predict the distribution of tides.

The Observatory periodically disseminates the tidal data collected from selected locations along the coast as reference materials to relevant departments and private companies. Information provided includes the daily highest- and lowest-tide readings, the daily tide times at selected locations, storm surge conditions during the typhoon season and the mean sea levels. With observations carried out at regular intervals over a long period, the Observatory makes use of the storm surge data accumulated to make predictions on the 'super' storm surge that happens once every 50 years. This is important information for reclamation and construction projects.

Tide stations have been established since the 1950s to cater for the development needs of the city. They provide tidal and storm surge data for land reclamation works, ensuring that reclaimed land complies with safety standards while attaining maximum economic efficiency. In the 1950s the tide stations were situated mainly on the eastern side of Hong Kong Island, such as at North Point and Quarry Bay, and also at Tai Po Kau in the New Territories.[154] In 1975, following the development of the Sha Tin New Town, Ma On Shan and Sai Kung, new tide stations were established in Sha Tin, Ma On Shan and Ko Lau Wan. To observe the storm surges associated with typhoons and making measurements at the highest sea level point, stations were set up at locations close to the coastline such as Waglan Island, Mui Wo, Cheung Chau, Sai Kung, Tuen Mun and Yuen Long. From 1986 onwards, there were a total of nine tide stations and they were situated at the Royal Navy base at Tamar, Quarry Bay, Ko Lau Wan, Tai Po, Tsim Bei Tsui, Lok On Pai, Tai O, Chi Ma Wan and Waglan Island. Due to advances in computer technology, it is now possible to make use of the records on wind speed, wind region, strength and wave heights, and the interrelationship between these elements, to predict wave heights and sea conditions. To carry out tidal measurements, it is no longer necessary to have tide stations located at all principal development districts. As at 2003, the six principal tidal observation locations are: Quarry Bay, Tai Po Kau, Joss House Bay, Waglan Island, Tsim Bei Tsui and Shek Pik.

天文台所設的潮汐觀測站，自1950年代以來，均配合著城市發展的需要，為填海工程提供潮汐漲退及風暴潮的資料，確保新建成的土地符合安全標準及達到最高經濟效益。1950年代潮汐觀測站主要分佈於港島東區，如北角、鰂魚涌，及新界大埔滘。[154] 1975年，隨著沙田市中心、馬鞍山及西貢的發展，新的潮汐觀測站改設於沙田中心區、馬鞍山及高流灣。至於觀察颱風季節風暴潮及最高海平面的潮汐觀測點，則設在全港的邊沿地區如橫瀾島、梅窩、長洲、西貢、屯門及尖鼻嘴等。自1986年起，全港的潮汐觀察站有9個，包括添馬艦海軍基地、鰂魚涌、高流灣、大埔滘、尖鼻嘴、樂安排、大澳、芝麻灣及橫瀾島。由於電腦技術的發展，海浪高度及海面情況可利用傳統的風速、風區、海浪高度等長期以來的紀錄及相互的關係來預測，故潮汐觀測已不必刻意地設在重點發展的區域。2003年潮汐測量站主要設在一些重要的地理位置，6個測量潮汐的重點分別位於鰂魚涌、大埔滘、大廟灣、橫瀾島、尖鼻嘴及石壁。

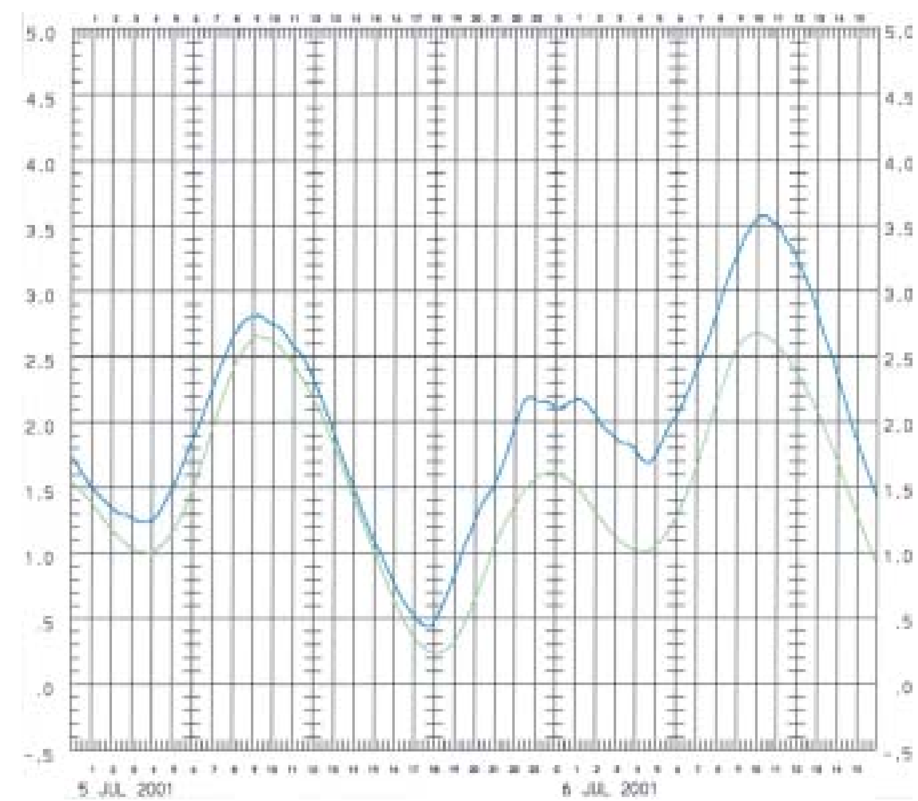


Fig. 4.10 On 6 July 2001, during the passage of Typhoon Utor, storm surges appeared in Lau Fau Shan and Tai O area. At 10 AM, the tide reached a level of about 3.6 metres. Courtesy Hong Kong Observatory

圖 4.10 2001年7月6日颱風尤特襲港，流浮山及大澳一帶出現風暴潮，7月6日上午10時潮水漲至約3.6米。香港天文台檔案

Hydrometeorology

Hydrometeorological observations have a decisive role in the conservation and allocation of water resources. Hydrometeorology is mainly concerned with the analysis of the different states of water — water vapour, liquid water and ice — that enter the atmosphere from the oceans, the land, animals and plants through evaporation and transpiration, and eventually return to the earth's surface through a series of processes. Since the end of the twentieth century, the most important contribution made by local hydrometeorological research has been to ensure the safety of people in their daily lives. As 60% of Hong Kong is made up of hilly terrain, loose materials on the slopes due to wind erosion will, after severe rainstorms, subside rapidly as loose rubble and soil, and can cause the collapse of large areas of surface rock.[155] The risk is particularly high during storms in the colluvium belt of hilly areas where granite rocks come into contact with volcanic rocks.[156] Thus, rainfall distribution, rain forecasts and warnings, are all indispensable in landslide prevention.

Apart from being closely related to the prevention of landslides, rainfall data are also linked to the allocation of fresh water resources. Since 1862, when the Hong Kong government planned to build reservoirs to store rainwater as the principal source of drinking water for Hong Kong people, calculations were carried out after the wet season (May to October) to work out the annual rainfall, the reservoir storage levels, water from subterranean sources and the flow rates from streams so as to plan a timetable of fresh water supply for the following year. In years when abnormally low rainfall was registered, the government would implement water restriction measures from November to April the following year. This was to ensure that Hong Kong's drinking water storage would be adequate to meet the basic needs of its people before the arrival of the rainy season.[157]

In the 1840s, reports of rainfall in the newspapers placed emphasis on a description of the rainy conditions and the duration of rain without giving an account of the amount of rainfall. By the 1850s, some sporadic figures on rainfall amounts were found. In 1906, the Observatory set up at Tai Po Police Station the first rainfall out-station and found that the recorded rainfall there differed from that recorded at the headquarters in Tsim Sha Tsui by 20%.[158] After 1910, more rainfall out-stations were set up and they were usually located at police stations in the New Territories and at voluntary organisations. In the 1930s, the pressure on fresh water supply due to population growth forced the government to assess the rainfall situation in major reservoirs. In 1938, the

水文氣象

水文氣象觀測對水資源的保護與分配，有決定性的作用。水文氣象觀測主要是分析不同型態的水——水汽、液態水及冰——自海洋、陸地及動植物透過蒸發及蒸騰進入大氣，再經過一連串的運動返回地球表面的過程。二十世紀以後本地的水文氣象研究最重要的貢獻是保障市民日常生活的安全。由於香港60%的面積為陡坡地，坡面上風化碎屑在暴雨衝擊下，容易導致快速的地表物質流及泥流或礫石剝落，甚至岩屑大面積崩塌；[155] 而花崗岩與火山岩相接觸的崩積帶的山區，在暴雨期間風險極高。[156] 因此降雨量的統計、分佈、預測及警示等，對預防山泥傾瀉都有很大的幫助。

降雨量觀測除了與預防山泥傾瀉有密切的關係以外，更影響著香港淡水資源的分配。自 1862 年當香港政府計劃興建水塘儲存天雨，作為全港市民飲用水的主要來源之後，政府每年必須在雨季 (5 至 10 月) ，計算全年的降雨情況，統計全港水塘的存量、地下水源及溪流流量，計劃來年自來水的供水時間。在全年降雨量偏低的年份，政府會在11月至翌年的4月間實施限時供水的措施，確保在雨季來臨前，全港的飲用水存量可維持市民基本生活需要。[157]

Fig. 4.11 Rainfall measurement performed manually in 1964. Courtesy Hong Kong SAR Information Services Department

圖 4.11 1964 年利用人手量度雨量的情況。香港特別行政區政府新聞處檔案

Observatory co-operated with the Waterworks Office of the Public Works Department (now the Water Supplies Department) to collect rainfall data in major reservoirs. They were Tai Tam, Tai Tam Tuk, Pokfulam, Aberdeen, Wong Nei Chung, Shek Lei Pui, Kowloon and Shing Mun reservoirs (see Table 4.3 for statistics on rainfall stations).

Table 4.3 Statistics on Rainfall Stations — Hong Kong Observatory (1906–1939)

Year	Number of Rainfall Stations	Locations
1906–1909	1	Tai Po Police Station
1910–1913	2	Tai Po Police Station, Botanical Garden
1914–1928	3	Tai Po Police Station, Botanical Garden, Matilda Hospital
1929	4	Tai Po Police Station, Botanical Garden, Matilda Hospital, The Royal Hong Kong Golf Club (Fanling)
1930	5	Tai Po Police Station, Botanical Garden, Matilda Hospital, The Royal Hong Kong Golf Club (Fanling), Naval Hospital
1931–1936	4	Tai Po Police Station, Botanical Garden, Matilda Hospital, The Royal Hong Kong Golf Club (Fanling)
1937	8	Tai Po Police Station, Botanical Garden, Matilda Hospital, The Royal Hong Kong Golf Club (Fanling), Cheung Chau Police Station, Sai Kung Police Station, Lok Ma Chau Police Station, Ping Shan Police Station
1938–1939	20	Tai Po Police Station, Botanical Garden, Matilda Hospital, The Royal Hong Kong Golf Club (Fanling), Cheung Chau Police Station, Sai Kung Police Station, Lok Ma Chau Police Station, Ping Shan Police Station, Victoria Peak, Pokfulam, Aberdeen, Wong Nei Chung, Tai Tam, Tai Tam Tuk, Kowloon Reservoir, Shek Lei Bui, Shing Mun No. 1, Shing Mun No. 2, Shing Mun No. 3, Yuen Long

(Remark: The rainfall stations did not include the Observatory headquarters)
Sources:
Hong Kong Observatory, *Meteorological Observations Made at the Hong Kong Observatory in the Year 1908,* Hong Kong, Noronha & Co., 1909.
Hong Kong Observatory, 'Report of the Director of the Hong Kong Observatory', Hong Kong Government, 1907–1940.
Hong Kong Observatory website, <http://www.hko.gov.hk>

With the increased number of rainfall stations and a wider area of coverage, the frequency of data transmissions to the Observatory headquarters also went up. In addition to better understanding the weather conditions in the different districts, it was also helpful in forecasting the occurrence of severe rainstorms. After the war, the network of the rainfall stations reached Sai Kung to the east, Tai Tam to the south, Ping Shan to the west and Lok Ma Chau to the north. The locations for collection of rainfall data concentrated on the fisheries and agricultural regions so as to provide the farmers with more information on farmland irrigation and flooding. In addition, in the 1950s and 60s, the authorities had also built many rainfall out-stations in the vicinity of the planned

Fig. 4.12 Precipitation alarm (1972). Courtesy Hong Kong SAR Information Services Department

圖 4.12 下雨警報器 (1972 年)。香港特別行政區政府新聞處檔案

Fig. 4.13 Automatic rain gauge (1972). Courtesy Hong Kong SAR Information Services Department

圖 4.13 自動記錄雨量器 (1972年)。香港特別行政區政府新聞處檔案

reservoir sites. In 1952, there were 50 rainfall out-stations in Hong Kong. By 1969, the number had increased to 122, with a total of 154 rain gauges — the year with the highest number of rain gauges on record. In 2001, 65 rainfall stations were in operation. Forty-six of these stations were manned and the remaining ones were automatic stations. In 2003, the number of rainfall stations has already reached 90. Some of these stations are operated by voluntary associations, religious groups and schools. They regularly send rainfall records to the Observatory for analysis. The dense network of rainfall stations copes well in monitoring the rather uneven distribution of rainfall in Hong Kong. Their data also help to improve the exploitation of the city's water resources.

Table 4.4 Rain Gauges and Rainfall Stations — Hong Kong Observatory (1952–2003)

Year	Number of Rain Gauges	Number of Rainfall Stations
1952–53	50	–
1959–60	92	–
1969–70	154	122
1979–80	130	98
2003	108	90

Sources:
Hong Kong Annual Departmental Report by the Director, Royal Observatory, for the financial years 1952–53, 1959–60, 1969–70, 1979–80, Hong Kong, Government Printer.
Internal records of the Hong Kong Observatory.

Methods of rainfall measurement include the use of measuring cylinders to directly find out the amount of rainfall collected, and the use autographic rain gauges such as the tilting-siphon and the tipping-bucket rain gauges. In the late 1970s, the technology for real-time transmission of rainfall data to the Observatory headquarters became available. Today, in addition to real-time rainfall data from its own network, the Observatory can also access real-time rainfall data from a network of automatic rain gauges operated by the Geotechnical Engineering Office through computer links.

The rainfall data were disseminated via weather bulletins released by the Observatory. After collation, the data were used to produce regional rainfall distribution charts and published in the *Monthly Weather Summary*. Records of rainfall stations, in particular the annual rainfall data, were published in the *Summary of the Hong Kong Meteorological Observations, Surface Observations in Hong Kong, Meteorological Results Part I* and *Hong Kong Rainfall and Runoff*. Besides, an independent research report is prepared for each severe rainstorm to find out the relationship between rainstorms and the weather systems.

從報章上看到：1840年代的氣象報告，對降雨的紀錄側重描述降雨的情況、時間的長短，卻沒有降雨量的統計數字；1850年代可零星地找到降雨量的統計數字。1906年天文台於大埔警署設立第一個雨量外站，發現其所錄得的數字與尖沙咀天文台紀錄相差20%；[158] 1910年以後雨量外站才陸續增加，所設的地點多以新界警署及志願組織及團體為主。1930年代人口的增長所造成的供水壓力，使政府急需全面掌握各大水塘的降雨情況。1938年天文台與水務署合作，蒐集香港各大水塘如大潭、大潭篤、薄扶林、香港仔、黃泥涌、石梨貝、九龍、城門等的降雨紀錄 (有關1906至1939年全港量雨站的統計，請參閱附表4.3)。

表 4.3 香港天文台雨量收集地點概覽 (1906–1939年)

年份	量雨站數目	地點
1906–1909	1	大埔警署
1910–1913	2	大埔警署、香港植物公園
1914–1928	3	大埔警署、香港植物公園、明德醫院
1929	4	大埔警署、香港植物公園、明德醫院、粉嶺香港皇家高爾夫球會
1930	5	大埔警署、香港植物公園、明德醫院、粉嶺香港皇家高爾夫球會、海軍醫院
1931–1936	4	大埔警署、香港植物公園、明德醫院、粉嶺香港皇家高爾夫球會
1937	8	大埔警署、香港植物公園、明德醫院、粉嶺香港皇家高爾夫球會、長洲警署、西貢警署、落馬洲警署、屏山警署
1938–1939	20	大埔警署、香港植物公園、明德醫院、粉嶺香港皇家高爾夫球會、長洲警署、西貢警署、落馬洲警署、屏山警署、扯旗山、薄扶林、香港仔、黃泥涌、大潭、大潭篤、九龍水塘、石梨貝、城門1號、城門2號、城門3號、元朗

(註：以上量雨站並不包括天文台總部在內)
資料來源：
Hong Kong Observatory, *Meteorological Observations Made at the Hong Kong Observatory in the Year 1908,* Hong Kong, Noronha & Co., 1909.
Hong Kong Observatory, 'Report of the Director of the Hong Kong Observatory', Hong Kong Government, 1907–1940.
香港天文台網頁，<http://www.hko.gov.hk>。

雨量站分佈的範圍愈廣、數量愈多，傳遞紀錄至總部的時間愈頻密，不但對了解各區氣候有極大的幫助，同時對預測暴雨的出現也有很大的幫助。戰後量雨外站所覆蓋的範圍東至西貢、南至大潭、西至屏山、北至落馬洲，雨量資料的蒐集主要集中在漁農業發達的區域，為農民提供更多灌溉農田及水浸的資料。另一方面，1950年代及1960年代為興建水塘，在擬建水塘地區附近，當局更廣置量雨外站。1952年全港量雨外站數量達50個，1969年全港的雨量站有122個，而量雨計則有154個，為有史以來最多雨量計紀錄的年份。2001年全港設有65個雨量站，其中駐有觀測員的雨量站有46個，自動雨量站19個。2003年全港

In 1997, the Observatory developed a 'nowcasting' system and a rainstorm warning system SWIRLS (Short-range Warning of Intense Rainstorms in Localised Systems). In essence, SWIRLS makes use of the data captured by the Doppler weather radar within a 256-km radius of Hong Kong, satellite cloud images, local surface rainfall data as well as parameters of atmospheric stability to predict the movement and development of rain areas for the next three hours.[159] After considering the short-term objective rainstorm forecasts, rainstorm warning signals will be issued as and when necessary. The new system reduces the chance of false alarms, thereby raising the awareness of the public to mitigate unnecessary casualties caused by landslides and flooding. The new system also addresses the needs of economic activities in Hong Kong by minimising disruptions due to false alarms.

The Observatory was not only tasked to perform detailed analysis and forecasts of rainy weather, it was also occasionally invited to play rainmaker during dry spells. In 1954 and 1955, the Observatory performed detailed research into man-made rain, such as dry ice seeding, silver iodide seeding and water

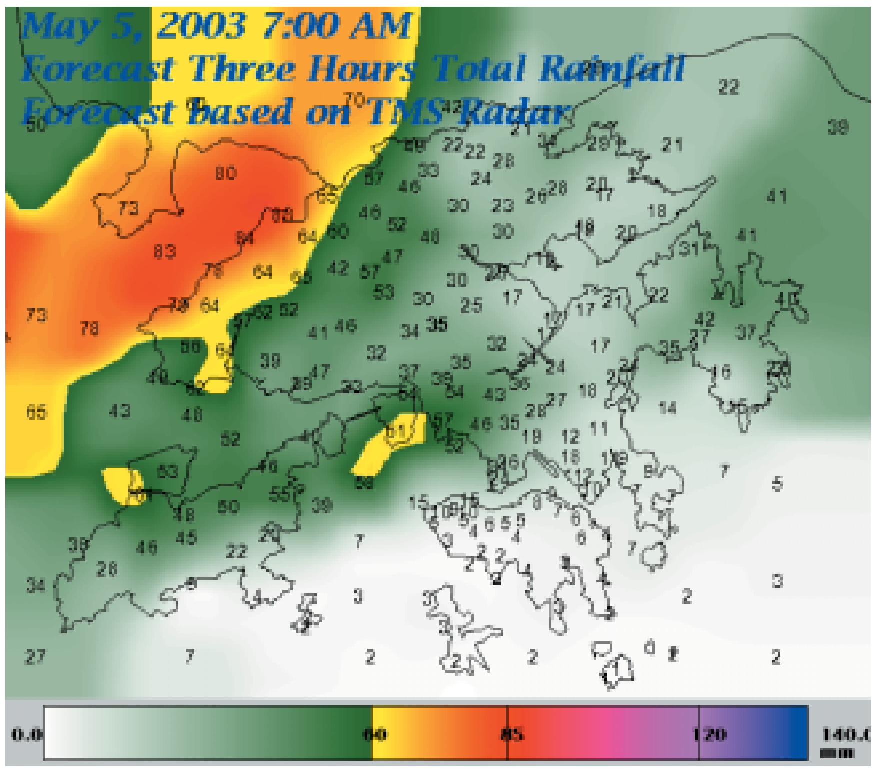


Fig. 4.14 A SWIRLS rainfall warning system product, for rainfall nowcasting. Courtesy Hong Kong Observatory

表 4.14 使用臨近暴雨警告系統 (SWIRLS) 作臨近降雨量預報。香港天文台檔案

的雨量站有 90 個。一些志願團體、宗教團體、學校紛紛加入雨量蒐集工作的行列，將記錄到的雨量統計送交天文台分析。降雨量監測可謂大大彌補了香港雨量分佈極不均勻這先天的缺陷，並且不斷改善城市水資源的條件。(有關 1952 至 2003 年全港量雨站的總數請參閱附表 4.4)。

表 4.4 香港天文台量雨筒及量雨站總數 (1952–2003 年)

年份	量雨筒數目	量雨站數目
1952–53	50	–
1959–60	92	–
1969–70	154	122
1979–80	130	98
2003	108	90

資料來源：
Hong Kong Observatory, *Hong Kong Annual Departmental Report by the Director, Royal Observatory,* for the Financial Years 1952–53, 1959–60, 1969–1970, 1979–1980, Hong Kong: Government Printer.
香港天文台內部資料。

量度雨量的方法，除利用量杯蒐集雨水，直接量度雨量外，亦有用虹吸式自記儀及翻斗式自記儀等有自動記錄雨量功能的儀器。不過，記錄到的數字可直接即時傳送至天文台總部的技術要到 1970 年代後期才能真正實現。目前除上述的量度方法外，天文台更可透過電腦，直接獲取土力工程處遙感雨量器網絡的雨量資料。

雨量計的資料會由天文台以天氣報告形式報導，整理後的數據有製成地區雨量分佈圖於《每月天氣摘要》發表；各雨量站的紀錄、全港年均雨量等資料會在《香港氣象觀測摘要》、《香港地面觀測年報》、《氣象資料第一部分——地面觀測》及《香港雨量和徑流》等刊物刊登。此外，個別暴雨亦有獨立的研究報告，作個案分析，了解暴雨和天氣系統的關係。

1997年，天文台發展臨近天氣預報技術，同時開發本地臨近暴雨警告系統 (SWIRLS)，預測方法主要是綜合多普勒雷達在香港 256 公里範圍內探測的數據、衛星雲圖的資料、本地地面量雨計的紀錄以及大氣穩定度分析，預估未來三小時雨區的移動、發展及降雨狀況。[159] 根據短期暴雨預測分析後酌情發出暴雨預警信號，新系統不但可減少暴雨預警信號誤報的情況，提高市民的警覺，減少不必要尤其是山泥傾瀉、水浸等的意外傷亡，同時也可盡量兼顧經濟需要，減低預估錯誤對日常活動的干擾。

水文氣象工作者既然能對天雨進行如此慎密的分析和預測，在旱季時，也有被邀請去製造人造雨。1954年及1955年天文台曾就製造人造雨作過深入研究，

seeding. In May 1954, it once attempted the dry ice seeding method to make rain in the skies over the catchment areas of Shing Mun and Kowloon Reservoirs. Planes were employed to drop dry ice on the large cumulus clouds and spray water on the relatively smaller warm cumuli. This experimental programme was suspended as a result of heavy rainfall in June that same year. In January and April 1955, the Observatory sent out planes to Victoria Peak and Mount Gough and attempted to create rain by spraying water on the cumuli.[160] Unfortunately, the exercise was unable to increase the rainfall for the year.[161] In 1963, Hong Kong was in the grip of a severe drought and the Observatory once again adopted the dry ice seeding method and spread dry ice at a height of 7,000 feet over Cheung Chau. The result, too, was unsuccessful despite repeated attempts.

From the latter half of the nineteenth century to the mid-twentieth century, collection of rainfall data mainly served the purpose of reservoir building, of facilitating irrigation for agricultural regions and fisheries in the New Territories, and of flood prevention and warning. The rainfall records and regional rainstorm warnings in the 1960s were aimed at reducing the impact of heavy rainstorms on densely populated urban areas and on crudely built structures. Warnings related to rainstorms ranged from landslide warnings, flood warnings and colour-coded warnings to represent different rainfall intensities, with the ultimate aim of minimising the impact of heavy rainfall on slopes and densely populated areas. Some practical research projects were initiated; for example, the making of artificial rain to meet water needs, the control of drinking water quality, the rendering of assistance in selecting sites for new reservoirs, as well as the development of new technology to forecast the time and place of rainfall. They were all closely related to the daily lives of people. With improving economic conditions in the late twentieth century, the focus of hydrometeorology was on the development of modern technologies, research and the application of new instruments. Radars, satellites and the dense network of automatic rainfall stations have enabled significant improvements in the accuracy of rainfall monitoring. At present, although hydrometeorologists have not yet mastered completely the technology of forecasting rainfall, difficulties will become surmountable with modern technologies.

New Developments With the New Airport

After the 1960s, the Observatory's aviation meteorological services mainly catered for the needs of the aviation industry, airlines and aviation personnel, as well as fulfilling obligations to international aviation organisations to provide

造雨方法有多種，包括乾冰種雨 (dry ice seeding)、碘化銀種雨 (silver iodide seeding) 及水種雨 (water seeding)，1954年5月天文台曾嘗試在城門水塘及九龍水塘集水區的上空，利用飛機在大片的積雲上投放乾冰及向較細小的暖積雲層射水，該試驗計劃因是年6月大量降雨而停頓。1955年1月及4月，當局移師至太平山及歌賦山，再用積雲射水方式製造人造雨，[160] 可惜並未能增加是年的降雨量。[161] 1963年香港大旱，當局再用乾冰種雨方法在長洲7000呎上空散佈乾冰，可惜屢試屢敗。

十九世紀後半期至二十世紀中期，雨量資料的蒐集以開發水塘、為新界漁農業發展地區提供農田的灌溉、防洪預警資料為主，而1960年代的降雨紀錄及地區性暴雨預警，是針對暴雨對市區密集的人口及簡陋的建築物影響而設。預警信號從山泥傾瀉警告、水浸警告至用顏色區分降雨量的多寡的暴雨警告，均以減低暴雨對陡坡及人口密集的地區的衝擊為本。一些實用性的研究工作，如在旱季製造人工雨以應急需、控制飲用水質量、協助水塘選址、開發預測降雨時間及地區的新科技等，均與市民的日常生活息息相關。二十世紀末，香港經濟環境改善，水文氣象的發展重點便放在新技術的開發、研究及新儀器的應用上，雷達、衛星及廣佈自動量雨站，都使雨量觀測準確程度邁進一大步。目前，水文氣象工作者雖未能完全掌握預測降雨量的技術，但隨著新科技的突破，困難相信可迎刃而解。

新機場新氣象

天文台的航空氣象服務在1960年代以後，除為航空服務單位、航空公司、飛行人員及其他國際航空機構等提供航空天氣報告、飛行航路及航站預報外，自1970年代中期起，更為籌建新機場進行氣象觀測。在政府倡議興建第二個機場後，有關新機場的選址，一直備受各方關注。[162] 1973年民航處委託柏誠公司 (Ralph M. Parson Co.) 就本港的航空運輸系統的發展作全面及長遠計劃評估。1973至1975年間該公司在全港20個地區包括稔灣、新田、赤門海峽、長洲、南丫島及赤鱲角等進行考察，研究興建新機場的理想地點，顧問公司綜合建築成本、經濟效益、環境問題、航空交通安全區域發展等要點後，認為赤鱲角是新機場的最佳選址。1975至1977年航空諮詢委員會就顧問公司的建議作進一步研究，1979年政府正式開展北大嶼山發展規劃。[163] 1979年天文台於赤鱲角設置氣象站，就該區天氣、海洋氣候、湍流及風切變等進行觀測，[164] 1979至1982年年間天文台曾就赤鱲角及鄰近地區氣象情況發表研究報告。[165] 而另一方面，香港皇家空軍同時亦負責考察赤鱲角風切變的情況，為新機場的航空安全蒐集氣候數據。

weather reports, route and aerodrome forecasts. In the mid-1970s, a new dimension emerged — preparation for a new airport. When the government's proposal to build a second airport was announced, the choice of a site came under close scrutiny from all quarters.[162]

In 1973, the Civil Aviation Department engaged Ralph M. Parson Co. to perform a comprehensive and long-term evaluation of the development of the aviation transport system in Hong Kong. Between 1973 and 1975, that company inspected 20 sites which included Nim Wan, San Tin, Channel Water, Cheung Chau, Lamma Island and Chek Lap Kok to look for the best site for the new airport. The consultants considered the major issues of construction costs, economic benefits, environmental factors, aviation safety and regional development, and came up with the conclusion that Chek Lap Kok was the best site for the new airport. In 1975 to 1977, the Aviation Advisory Board conducted further research on the consultants' recommendation. In 1979, the government formally began to plan for the development of northern Lantau Island.[163] In the same year, the Observatory

Fig. 4.15 An aerial view of Chek Lap Kok Island, before its reclamation. A temporary meteorological station was located at the top of the hill (1980). Courtesy Hong Kong SAR Information Services Department

圖 4.15 1980 年尚未填海的赤鱲角島，圖中央為建於山頂的臨時氣象站。香港特別行政區政府新聞處檔案

Fig. 4.16 Hong Kong Observatory staff making weather observations at the Chek Lap Kok temporary meteorological station (1979). Courtesy Hong Kong SAR Information Services Department

圖 4.16 天文台職員在赤鱲角臨時氣象站進行天氣監測 (1979年)。香港特別行政區政府新聞處檔案

Fig. 4.17 Chek Lap Kok airport was officially opened in 1998. Courtesy Hong Kong SAR Information Services Department

圖 4.17 大嶼山赤鱲角機場於 1998 年正式啟用。香港特別行政區政府新聞處檔案

set up a meteorological station at Chek Lap Kok to carry out observations of weather, marine conditions, turbulence, windshear, etc.[164] Between 1979 and 1982, the Observatory published research reports on the meteorological conditions at Chek Lap Kok and the nearby region.[165] Concurrently, the Royal Air Force was responsible for making windshear observations in Chek Lap Kok, collecting climatological data to ensure safety at the new airport.

Since the opening of Chek Lap Kok airport in July 1998, questions have been raised regarding the safety of aircraft landing and taking off. Of most concern is the issue of windshear. Windshear refers to the encountering in flight of a change in wind direction or wind speed, which leads to a change in headwind. This change affects the lift of the aircraft and causes the aircraft to divert from its intended flight path. If windshear occurs during landing or take-off, a pilot has to take corrective action, or else the plane may land prematurely, overshoot the runway or result in take-off failure.[166] Windshear can be caused by many factors such as strong winds passing hills, sea breezes, low-level jet streams, strong monsoon winds, tropical cyclones, thunderstorms, cold and warm fronts, etc.[167] Windshear that occurs at Chek Lap Kok airport

Fig. 4.18 Situated in the centre of the city, Kai Tak International Airport had its runway built into the sea, making it prone to accidents during adverse weather conditions. In 1993, an aircraft overshot the runway and ploughed into the harbour. Courtesy Hong Kong SAR Information Services Department

圖 4.18 位於市中心區的啟德國際機場，跑道建於海上，遇上惡劣天氣，易生意外。圖為1993年的空難實況。香港特別行政區政府新聞處檔案

自1998年7月大嶼山赤鱲角機場正式啟用以來，飛機升降的安全問題一直被受質疑，而其中最受關注的是風切變 (windshear) 的問題。風切變是指飛機在飛行期間遇到風向或風速的轉變，引致逆風改變，影響空氣對飛機的浮力，使飛機偏離原有航道。如風切變在航機升降時發生，機師必須作出適當的調整，否則飛機會過早著陸、飛越跑道或起飛失敗。[166] 風切變的成因有許多，包括吹過山脈的強風、海風、低空急流、強烈季候風、熱帶氣旋、雷暴和冷暖鋒等。[167] 在香港赤鱲角機場出現的風切變，大多由吹越機場南面的大嶼山山脈的強風引致。[168] 由於大嶼山山勢陡峭，最高的山峰海拔超過900米，當風速每小時達15海里 (約等於28公里) 或以上的風由東、東南、南或西南面吹過大嶼山山脈時，接近位於大嶼山北部的赤鱲角機場，可能會產生風切變或湍流 (turbulence)。[169]

赤鱲角機場這個面積達956公頃，而650公頃土地從填海得來的人工島，特殊的地理位置，一直讓人懷疑其風切變發生的頻率會否較其他地區高。有關赤鱲角機場自1998年運作以來，風切變發生的頻率，官方及民間有頗不相同的報導。1999年8月23日的星島日報在是年8月22日華航客機失事酚釀成3死211受傷空難後稱，赤鱲角機場自運作以來，發生風切變的頻率高達17%，[170] 類似的報導紛紛被提出，並引起了機場選址是否正確的討論，其實該統計數據較2001年官

Fig. 4.19 Chek Lap Kok airport meteorological tower (2002). Courtesy Hong Kong Observatory

圖 4.19 赤鱲角機場氣象塔 (2002 年)。香港天文台檔案

are mainly caused by strong winds blowing across the hills of Lantau Island to the south of the airport.[168] The hills on Lantau Island are steep, with the highest mountain reaching a height of over 900 metres above sea level. When winds with wind speeds reaching 15 knots (equivalent to 28 kilometres per hour) or above blow from the east, south-east, south or south-west over the hills on Lantau Island, windshear or turbulence may occur at Chek Lap Kok airport at the northern part of Lantau Island.[169]

Chek Lap Kok airport has an area of 950 acres; 650 acres of which lies on a reclaimed island. Due to its unique geographical location, it has long been suspected that the frequency of windshear will be higher than other regions. Since the Chek Lap Kok airport commenced operation in 1998, reports on the windshear frequency differ significantly between government and non-government sources. On 23 August 1999, the *Sing Tao Daily* reported the crash of a China Airlines passenger plane on the previous day while landing at Chek Lap Kok, killing three people and injuring 211 others. It claimed that since the opening of the airport in 1998, the frequency of windshear occurrence was 17%.[170] There were similar reports from other sources and widespread discussions ensued on the appropriateness of the new airport site. This reported figure was considerably higher than the official figure released in 2001 on windshear frequency. According to government statistics, between August 1998 and December 2000, there were 636 windshear events in the air space near Chek Lap Kok airport. The figure represented 0.15% of total number of inbound and outbound flights during the two-and-a-half-year period. Since the airport was opened, 29 flights had to abort landing due to windshear. Five of the aircraft had to fly to other airports and the remaining 24 planes were able to land successfully on a second attempt.[171] For the three-and-a-half-year period between August 1998 and December 2001, the Observatory reported in 2002 that the windshear frequency was one for every 700 flights, which worked out to 0.14% of the total inbound and outbound flights. For every 2,500 flights, there was one reported incidence of severe turbulence — equivalent to 0.04% of the total inbound and outbound flights.[172] The windshear figures of the Observatory for 2001 to 2002 came primarily from flight reports, which might have differed from the actual figures. However, according to the Observatory's statistics for the period from 1998 to 2002, cases of strong winds (wind speed of 41 to 62 kilometres per hour) represented only 0.31% and cases of gales exceeding 63 kilometres per hour accounted for a mere 0.03%.[173] Based on these statistics, it would be impossible for windshear to occur 17% of the time. Actually, for a city like Hong Kong that is short of land resources, to find a site for the new airport that is free from windshear is virtually impossible.

方有關風切變的頻率報告高很多——根據官方資料赤鱲角機場啟用首 2 年半 (即 1998 年 7 月至 2000 年 12 月間) 航機在赤鱲角附近空域遇上風切變的報告共 636 宗，約佔進出機場航班的0.15%；啟用以來共有29班航機因著陸途中受風切變影響需復飛，當中 4 班轉飛其他地方，其餘 25 班於復飛後成功著陸。[171] 天文台在 2002 年的報告指出 1998 年 7 月至 2001 年 12 月的 3 年半內，每 700 班航機有一航機報告遇到風切變，約佔進出機場航班的0.14%；每2,500班航機有一航機報告遇到強烈湍流，約佔進出機場航班的 0.04%。[172] 雖然天文台就 2001 至 2002 年有關風切變的紀錄，主要來自航班報告，與實際發生風切變的次數可能有差距。但根據天文台 1998 至 2002 年在赤鱲角機場的強風統計紀錄 (時速介乎 41 至 62 公里) 每年亦只有 0.31%，超過時速 63 公里的烈風更低至 0.03%，[173] 可推想風切變發生的頻率不可能高達17%。其實要在香港這個土地資源不很充足的城市內，找一塊完全沒有風切變的土地蓋建新機場，幾乎是不可能的事。

為改善飛機升降的安全情況，天文台早在機場啟用前，在機場附近裝置多項測量風切變的儀器，改善風切變的警報信號。 1996 年中，天文台在大欖涌安裝一部來自美國的多普勒天氣雷達 (Doppler weather radar)，該儀器可自動探測因雷暴、熱帶氣旋等引起的風切變。[174] 另在大嶼山的沙螺灣及小蠔灣，天文台安

Fig. 4.20 Observatory staff carrying out meteorological observations at the Chek Lap Kok Meteorological Station (2002). Courtesy Hong Kong Observatory

圖 4.20 天文台職員在赤鱲角機場氣象站進行天氣監測 (2002 年)。香港天文台檔案

To improve aircraft safety in take-off and landing, the Observatory had set up, long before the opening of the airport, various instruments in the vicinity of the airport to measure windshear and to improve the windshear alert system. In mid-1996, the Observatory installed a US-made Doppler weather radar at Tai Lam Chung. The radar was able to detect automatically windshear caused by systems such as thunderstorms and tropical cyclones.[174] At Sha Lo Wan and Siu Ho Wan on Lantau Island, the Observatory also installed wind profilers to measure the winds at different heights in the lower atmosphere to provide information on vertical windshear. In addition, the Observatory also established anemometer stations near the airport. They included Sha Chau, Tai Mo To, Siu Ho Wan, Yi Tung Shan, Nei Lak Shan, Sham Wat and Tai O. The Observatory made use of the wind direction measurements and wind speed data to study how terrain affected the air currents over Chek Lap Kok airport and to calculate terrain-induced low-level windshear.

In 2002, the Observatory deployed two weather buoys in the waters about one kilometre west of Chek Lap Kok airport. The weather buoys collect meteorological data on wind, air pressure, temperature and relative humidity; and provide meteorological information over the waters for evaluation of windshear events. Weather buoys are able to detect windshear caused by sea breezes from the west earlier than land-based automatic weather stations.

In August 2002, the Observatory completed the acceptance testing of a Doppler LIght Detection And Ranging (LIDAR) system. The LIDAR is located near the centre of Chek Lap Kok airport. Through a laser beam, the system detects the movement of aerosols in the air and monitors the occurrence of windshear and turbulence on the two runways even when there is no rain.[175]

In the four years between 1998 and 2002, the number of aircraft landings and take-offs rose by an average of 5.1% per annum. The figure increased from 164,072 in 1997–98 to 197,743 in 2001–02. During the same period, the air passenger numbers grew by an annual average rate of 4.4% — rising from 27,288,882 to 32,117,879; while airfreight volumes grew by an average of 4.5% and increased from 1,795,740 tonnes to 2,119,620 tonnes. These figures show clearly the immense potential of Hong Kong's aviation transport industry.[176]

Environmental Monitoring

In the 1950s and 60s, Hong Kong's processing industries were developing rapidly. Some commercialised and industrialised districts were heavily populated

裝了氣流剖析儀，量度大氣低層各高度的風向風速，以便推斷垂直風切變的資料。此外在機場的鄰近地點包括沙洲、大磨刀、小蠔灣、二東山、彌勒山、深屈及大澳設置測風站。利用風速表的風向、風速數據監測地形對赤鱲角機場上空氣流所產生的影響，及計算由地形所引致的低空風切變。

2002年在赤鱲角機場西陲1公里水域內，天文台增設兩台浮標氣象站，收集風、氣壓、氣溫和濕度等氣象數據，提供海域的氣象資訊，用以評估風切變的產生。浮標氣象站可及早偵測由西面吹往跑道的海風，從而有效地預警由這機制產生的風切變。

2002年8月天文台完成激光雷達 (LIDAR) 的驗收及試驗性運作程序，該雷達座落於機場近中央的位置，透過激光探測空氣中塵粒和微細粒子的移動，可監測兩條跑道於天晴時的風切變及湍流。[175]

1998至2002年4年間赤鱲角機場飛機的升降次數平均每年增加5.1％，飛機進出境架次從1997–98年的164,072次增至2001–02年的197,743次；1998至2002年4年間旅客的年均增長率為4.4％，客運人次從1997–98年的27,288,882人次增至2001–02年的32,117,879人次，而貨運在1998至2002年4年間的年均增長率為4.5％，貨運數量從1997–98年的1,795,740公噸增至2001–02年的2,119,620公噸，充分發揮了香港空運業務巨大的發展潛力。[176] 機場的使用率的不斷提升，可說明針對赤鱲角機場的特殊地形及氣候所作的天氣預警措施發揮效用，機場能正常運作，實是香港作為國際大都會的先決條件。

環境保護

1950、1960年代香港加工工業蓬勃發展，一些工商業發達的地區，紛紛成了人口密集聚居之處，也成了城市污染的源頭。1950、1960年代城市人對環境保護的意識並未能與全力開發經濟資源同時起步，但當經濟環境有所改善，富裕的城市人又開始擔心污染的環境對健康產生負面影響。1980年代中期興建大亞灣核電站的恐懼潮，就是經濟發展與個人生命安全相互鬥爭的表癥，天文台的輻射監測工作在這場矛盾中，扮演了穩定民心的重要角色。

and became urban pollution sources. The population at that time was fully engaged in developing the economy, without paying due attention to the protection of the environment. But when the economy was thriving, the public who had become well to do began to worry about the health hazards posed by environmental pollution. The widespread fears in the mid-1980s about the building of a nuclear power plant at Daya Bay, Guangdong, were symbolic of the struggle between economic development and personal safety. The Observatory's radiation monitoring work has played an important reassuring role in allaying public fears.

Radiation Monitoring

The fact that the Observatory was tasked with monitoring the radiological impact of the Guangdong Nuclear Power Station at Daya Bay had its historical origins. Back in June 1958, the Observatory, for the first time, measured the level of atmospheric radioactivity. This aim was to monitor the effects of atmospheric nuclear testing in the 1950s on air quality.[177] The findings were presented in the

Fig. 4.21 Guangdong Daya Bay Nuclear Power Station (2002). Courtesy Hong Kong Observatory

圖 4.21 廣東大亞灣核電站 (2002 年)。香港天文台檔案

輻射監測

與大亞灣核電站有關的環境輻射監測工作由天文台負責是有其歷史淵源的。1958年6月天文台首度進行大氣放射性元素含量的量度，目的是監測1950年代核試對空氣質素的影響。[177] 量度結果一方面會在天文台出版的《氣象報告》發表，以供世界氣象組織的研究人員使用，另一方面會送到印度與當地的潘那氣象台 (Puna Observatory) 的地區錄數比較。[178] 1960年天文台的輻射監測從大氣輻射監測增加至雨水及食水的放射性水平監測。自 1961 年始京士柏輻射站抽取樣本的方法大抵如下：

1. 利用一直徑 2.2 吋的玻璃纖維過濾紙抽取空氣樣本。
2. 利用一直徑 20 吋的容器，盛載半吋水，每 48 小時蒐集大氣中的塵埃一次。
3. 每 24 小時自量雨計抽取雨水樣本。
4. 抽取九龍半島水龍頭的食水樣本。

Fig. 4.22 Lingao Nuclear Power Station (2002). Courtesy Hong Kong Observatory

圖 4.22 嶺澳核電站 (2002 年)。香港天文台檔案

Meteorological Report, published by the Observatory, for research use by the World Meteorological Organisation. The findings were also sent to the Puna Observatory in India for comparison with its local findings.[178] In 1960, apart from atmospheric radioactivity monitoring, the Observatory also undertook radioactivity monitoring of rain and drinking water. In 1961, sample collection at the King's Park Radiation Monitoring Station followed the procedures below:

1. Use a fibreglass filter with a diameter of 2.2 inches to collect air samples.
2. Fill a 20-inch diameter container with half an inch of water and collect airborne particulates once every 48 hours.
3. Collect samples of rainwater from rain gauges once every 24 hours.
4. Collect drinking water samples from water taps in Kowloon Peninsula.

The samples were sent to the radiology unit at Queen Mary Hospital for testing. In 1965, the scope of monitoring included gross gamma radioactivity and caesium-137 radioactivity concentration level measurement.

Fig. 4.23 Staff carrying out a radioactivity check on imported livestock (2002). Courtesy Hong Kong Observatory

圖 4.23 工作人員正為進口牲畜進行輻射檢驗 (2002 年)。香港天文台檔案

Fig. 4.24 Radiation measurement instruments at the King's Park Meteorological Station (2002). Courtesy Hong Kong Observatory

圖 4.24 京士柏輻射監測儀器 (2002 年)。香港天文台檔案

Fig. 4.25 Mobile Radiation Monitoring Station (2002). Courtesy Hong Kong Observatory

圖 4.25 輻射監測流動車 (2002 年)。香港天文台檔案

In 1983, when the decision to build the Daya Bay Nuclear Power Station was made, residents of Hong Kong were deeply concerned with safety. A background radiation monitoring programme was implemented as a result. The objective was to determine the baseline radiation level before the Daya Bay Nuclear Power Station commenced operation, and to evaluate the changes in radiation levels after the nuclear power plant started to operate. Major components of the programme included measuring the ambient gamma radiation level, and the alpha, beta and gamma radioactivity levels of the environmental samples. For this project, the government allocated an initial sum of HK$2 million for equipment procurement. In 1985, samples collected were limited to drinking water, inter-tidal sediments, soil and seawater.[179] In 1987 the scope of the monitoring programme was expanded to cover measuring the radioactivity of air, drinking water, soil and foodstuffs.

To monitor radiation exposure through the atmosphere, enviromental gamma radiation levels are measured round-the-clock by 10 high pressure ionization chambers in the territory. Another of 27 thermoluminescent dosimeters were placed in Hong Kong, Kowloon and the New Territories to measure the accumulated ambient gamma dose. Each year, the Observatory carries out four upper air radioactivity observations and collects samples of airborne particulates and wet deposition at King's Park, Sha Tau Kok and Yuen Ng Fan.

To monitor the exposure pathway through water, samples of drinking water, subterranean water, seawater, seafood, seaweed and sediments are collected for analyses. Soil samples are collected from 39 designated locations including Pak Tam Au Country Park, Pak Sha O, Tai Po Tau Treatment Works, The Hong Kong Golf Club (Fanling), Sha Tau Kok Police Station, Tai Mei Tuk Pumping Station, Shing Mun Reservoir, Tsuen Wan Treatment Works, Tai Lam Chung Reservoir, etc. The Observatory employs portable gamma spectrometric instruments to carry out in-situ gamma analysis of the soil samples taken from these locations.

Food samples are taken from produce originating from Hong Kong and Shenzhen. They include rice, milk, beef, pork, pig's innards, chickens, ducks, bak choy (Chinese cabbage), choy sum (flowering Chinese cabbage), bananas, lychees, sugar cane, tangerines, etc. — food items that are largely available all year round. Sampling is carried out once every three months.

The Observatory also uses a helicopter and a specially equipped car to conduct aerial and land (at selected locations) radiological surveys.[180] It has

樣本會交由瑪麗醫院輻射組化驗。1965年輻射測量範圍包括測量伽馬放射性總活度及銫-137的放射性活度濃度。

1983年在深圳大亞灣興建核電站計劃落實後，香港市民極度憂慮核電站的安全問題，一項名為本底輻射監測的計劃於1984年因應大亞灣的興建而展開，目的是在大亞灣核電廠投產前制定一套本底輻射水平基線，用以評估核電廠投產後輻射水平的改變，以及監測輻射洩漏的情況。監測內容包括全港的環境伽馬輻射水平及各環境樣本內放射性核素的阿爾法、貝他及伽馬放射性活度濃度，政府為是項計劃首期撥款200萬元作為購置儀器之用。1985年監測抽取樣本包括食水、潮間帶土、土壤及海水，[179] 1987年輻射監測工作變得更全面，監測範圍包括定期測量空氣、食水、土壤及食品樣本的放射性。

大氣途徑的監測方面，港九新界共有10個高壓電離室，24小時實時監測環境伽瑪輻射水平，另有27個放置熱釋光劑量計，測量長時間累積的環境伽馬輻射劑量的固定監測點。天文台並於每年進行四次高空輻射探測，另在京士柏、沙頭角和元五墳三地收集大氣飄塵和濕沉積物樣本。

水體途徑的輻射監測範圍包括飲用水、地下水、海水、水生食物、海藻和沉澱物。土壤樣本分別取於香港境內39個指定地點，包括北潭凹郊野公園、白沙澳、大埔頭濾水廠、粉嶺香港哥爾夫球會、沙頭角警署、大尾篤抽水站、城門水

Fig. 4.26 Aerial Monitoring System (1998). Courtesy Hong Kong Observatory

圖 4.26 輻射監測飛行隊（1998年）。香港天文台檔案

direct links with the mainland's meteorological agencies and the authorities in charge of nuclear emergencies to strengthen information exchange. A contingency plan has been formulated for nuclear emergencies, and has put in place a warning system for abnormally high radiation levels. In the case of radiological emergencies, the Observatory co-ordinates emergency monitoring with other government departments and renders support.

The work of environmental radiation monitoring of the Observatory has spanned over 40 years, from a limited scope in monitoring atmospheric radioactivity in the 1950s to the present full-fledged environmental monitoring programme that took shape in the 1980s. Such a development was in line with the changing needs of society. Since the establishment of the capability, there has not been a single incident requiring the Observatory to execute the contingency procedures. However, the monitoring results that are published at regular intervals are not only of important scientific research value, but they also form the basis for the government to formulate its contingency plans. The monitoring work is indispensable in assuring the health of the public of Hong Kong.

Ultraviolet Index Application

With the rapid development of the world's economy, the damage inflicted on the environment has risen sharply. In the mid-1980s, scientists discovered that in the Southern Hemisphere, during the spring season from September to November, the ozone concentration in the atmosphere dropped drastically. Ozone is usually most abundant at 20 to 25 km above the earth's surface. The fact that the atmosphere can absorb the sun's ultraviolet (UV) rays depends largely on the presence of ozone, which makes up less than 1% of the atmosphere.[181] Without the protection of the ozone layer, the UV radiation will pass through the atmosphere unimpeded and endanger some of the living species on earth. On days when there is plenty of sunshine, UV radiation will be strong. People who are exposed to UV radiation unprotected for a long period can suffer skin and eye damage. For serious cases this can lead to skin cancer and cataracts.[182]

In 1985, 28 countries from all over the world reached an agreement in Vienna on ozone layer protection — the Vienna Convention for the Protection of the Ozone Layer. On 16 September 1987, 26 nations met in Montreal, Canada, and signed the 'Montreal Protocol on Substances that Deplete the

塘、荃灣濾水廠及大欖涌水塘等，天文台以便攜式伽馬譜法儀就上述地點土壤的放射性核素作伽馬譜法分析。

食品樣本的抽驗以本地和深圳生產的食物，如米、奶、牛肉、豬肉、豬隻肝臟、雞、鴨、白菜、菜心及香蕉等全年均有供應的食物為主，取樣頻率為每三個月一次。

此外天文台更利用直升機及巡邏車進行空中及境內不同地區的輻射水平監測。[180] 與內地輻射緊急應變部門和氣象局直接聯繫，加強資訊流通，並制定一套發生事故時的應變措施，如輻射水平超標的警報系統，於輻射劑量異於尋常時，與其他政府部門配合提供支援。

輻射監測工作從1950年代末期大氣監測，過渡到1980年代環境輻射監測，至今已有40多年的經驗，其發展的方向是因應社會發展的需要而轉變的。自監測計劃推行以來，緊急的應變措施雖一直未有機會實施，但監測的結果定期發佈，不但有極高的科學研究參考價值，同時也是政府制定城市緊急事故預防及應變措施的重要依據，實是現代城市人保證健康生活必不可少的環節。

紫外線指數的應用

全球經濟的急促發展，使地球環境受破壞的程度加劇。1980年代中期，科學家發現南半球的春季——即9至11月期間，南極上空大氣層臭氧濃度大幅減少。臭氧一般集結於離地面約20至25公里。大氣層能吸收太陽光的紫外線，主要是依靠大氣含量不足1%的臭氧。[181] 沒有大氣層臭氧的阻隔，太陽的紫外線直接照射地球，會危害地球上部分生物。陽光充沛的日子，紫外光強度高，人類在無保護下長期曝曬會對皮膚及眼睛造成傷害，嚴重者可引致皮膚癌及白內障。[182]

1985年全球28個國家於維也納達成保護臭氧層協議 (Vienna Convention)。1987年9月16日全球26個國家共同於加拿大蒙特利爾簽署「蒙特利爾破壞臭氧層物質管制協議」(Montreal Protocol on Substances that Deplete the Ozone Layer)，管制使用氟氯碳化物，該協議於1989年1月1日正式生效。[183] 1992年聯合國的環境及發展會議發表「21世紀議程」(Agenda 21)，將大氣臭氧流失與紫外線輻射對人類健康影響列為重點研究項目，世界氣象組織、世界衛生組織、聯合國環境組、國際癌病研究組織及非電離輻射防衛委員會於是次會議後成立全球泛太陽計劃 (INTERSUN)，旨在推廣有關研究，並引起全球關注紫外線輻射對人體健康的影響。1994年該計劃制定紫外線監測指數，並建議世界各地將紫外線指數列入天氣報告範圍內。[184]

Ozone Layer' to control the use of chlorofluorocarbons. The protocol came into force on 1 January 1989.[183] At the United Nations Conference on Environment and Development held in 1992, the 'Agenda 21' plan was adopted; this plan of action called for urgent research on the effects of the depletion of the stratospheric ozone layer and the UV radiation on human health. After this conference, the World Meteorological Organisation, the World Health Organisation, the United Nations Environment Programme, the International Agency for Research on Cancer and the International Commission on Non-Ionising Radiation Protection established a global UV project — INTERSUN. The goal was to promote research into UV radiation and to draw the world's attention to the effects of UV radiation on human health. In 1994, the project formulated the UV monitoring index and recommended to all meteorological agencies that the index be included in weather reports.[184]

Of the different radiation wavelengths emitted by the sun, UV waves are invisible to the human eye. UV radiation can be classified according to wavelengths into UV-A (with wavelengths of 315 to 400 nanometres), UV-B (with wavelengths of 280 to 315 nanometres) and UV-C (with wavelengths of 100 to 280 nanometres). Any UV radiation with wavelengths smaller than 280 nanometres will have little effect at ground level, as such radiation would have been absorbed by the ozone layer before it reaches the earth's surface. UV-A and UV-B radiation have longer wavelengths and can penetrate the atmosphere; prolonged exposure could result in skin cancer and cataracts. The intensity of ultraviolet radiation varies in different regions, weather conditions and time periods. The UV intensity will be high at noontime, when the position of the sun is high, on snow surface and at high-altitudes.[185]

The UV Index as promoted by INTERSUN measures the intensity of solar UV radiation at different wavelengths up to 400 nanometres. It then multiplies these UV intensities by the weighting factors at the corresponding wavelengths in the erythemal action spectrum to reflect the human skin's response to each wavelength. The index ranges between 1 and 15. The higher the index, the higher the probability of causing harm to human health. In general, Asians can tolerate a UV Index lower than 6.[186] In accordance with the British standard, when the UV Index reaches 6, people should not be directly exposed to the sun for more than one or two hours. A UV Index reading of 10 indicates a high level of risk and humans could be harmed just by being exposed to the sun for half an hour.[187]

太陽釋放出來不同波段的輻射中，人的肉眼並不能看見紫外線，而紫外線可按其波長分A (波長315至400納米)、B (波長280至315納米)及C (波長100至280納米) 三種，低於280納米波長的紫外線C未到達地面時已被臭氧層吸收，對人體影響極微；而波長較長的紫外線A及B可穿越大氣層，過量吸收可導致皮膚癌及白內障。不同地區、不同氣候、不同時間，紫外線的強度亦不相同，如每天的正午時份，陽光直射地面，紫外線強度極高；另外，在強烈反射紫外線的雪地、在空氣稀薄的高地，紫外線的強度也會較高。[185]

全球泛太陽計劃 (INTERSUN) 所推出的紫外線指數，計算的方法主要是量度直至400納米不同波長的太陽紫外線強度，再利用「紅斑作用光譜曲線」內對應的加權數值去反映人類皮膚對紫外線的反應。紫外線指數分為1至15度，紫外線指數越高，對人類造成傷害的機會越大。一般亞洲人可接受的紫外線輻射指數為6度以下。[186] 根據英國標準，紫外線指數達到6，市民不適宜受陽光直接照射超過1至2小時；指數達10度屬高風險，陽光可能於半小時內曬傷人體。[187]

香港天文台於1999年10月15日按國際組織標準，首次在網上向市民公布本港地區紫外線的照射程度，方便市民作出防護措施。2000年4月1日起更每天

Fig. 4.27 UV measurement instrument (2002). Courtesy Hong Kong Observatory

圖 4.27 紫外線儀 (2002 年) 。香港天文台檔案

On 15 October 1999, the Hong Kong Observatory followed the international standard and started, for the first time, to inform the public through its website the UV Index in Hong Kong, and to urge people to adopt protective measures. From 1 April 2000 onwards, the Observatory broadcast the daily UV Index on radio and television, as well as through the UV Index telephone advisory service. The index was classified into five categories: low, medium, high, very high and extreme. On 8 August 2002, the Observatory revised the UV Index classification scheme; the new scheme changed the 'high' category (UV Index 5) under the existing scheme to 'moderate' category, and the 'extreme' category (UV Index 9 and 10) to 'very high' category. A UV Index of 11 or above was categorised as 'extreme'. This classification system is still in use in 2003.

At present, places which monitor and broadcast the UV Index include the US, Britain, Germany, Australia, New Zealand, Japan, Taiwan and Hong Kong, but the alert classification system varies (see Table 4.5).

Table 4.5 UV Index and Exposure Categories (1999–2003)

UV Index	Exposure Category		
	15 Oct 1999–7 Aug 2002 Hong Kong	8 Aug 2002–2003 Hong Kong	2002–2003 US and Taiwan
0	Low	Low	Light
1	Low	Low	Light
2	Low	Low	Light
3	Medium	Medium	Low
4	Medium	Medium	Low
5	High	Medium	Medium
6	High	High	Medium
7	Very High	High	High
8	Very High	Very High	High
9	Extreme	Very High	High
10	Extreme	Very High	Very High
>11	Extreme	Extreme	Very High

Sources:
Hong Kong Observatory website, <http://www.hko.gov.hk>.
USA Today website, <http://www.usatoday.com/weather/wuv2.htm>.
Environmental Protection Administration, Republic of China website, <http://www.epa.gov.tw/monitoring/uvi7/tm/missuv2.htm>.

According to the Observatory's 2001 records, there were 853 hours (47.8% of the annual sunshine duration) during that year with an hourly mean UV Index of 5 or above. Of that figure, 124 hours had a UV Index of 9 or above, representing 6.9% of the annual sunshine duration.[188] The 10 days with the highest recorded UV Index from August 1999 to December

在電台、電視報導紫外線指數及電話查詢紫外線指數服務。紫外線曝曬級數更按指數高低，分為低、中等、高、甚高和極高五等。2002年8月8日天文台修改紫外線指數分級法，新制定的分級法將原來被列為高度危險的5度改為中級，而危險程度極高的9度及10度的紫外線指數降級為危險程度甚高，而相當或高於11度的紫外線指數列為危險程度極高， 2003年仍然沿用。

目前，觀測及發佈紫外線指數的地區包括美、英、德、澳、紐、日、台及香港等，但各地就紫外線指數強度所使用的警告訊號等級稍有不同，茲列舉於表4.5 。

表4.5 紫外線指數與曝曬級數分級表 (1999–2003年)

紫外線指數	曝曬級數		
	1999年10月15日–2002年8月7日 香港	2002年8月8日–2003 香港	2002–2003 美國及台灣
0	低	低	輕微
1	低	低	輕微
2	低	低	輕微
3	中	中	低
4	中	中	低
5	高	中	中
6	高	高	中
7	甚高	高	高
8	甚高	甚高	高
9	極高	甚高	高
10	極高	甚高	甚高
>11	極高	極高	甚高

資料來源：
台灣行政院環保署網頁，<http://www.epa.gov.tw/monitoring/uvi7/tm/missuv2.htm>。
香港天文台網頁，<http://www.hko.gov.hk>。
USA Today website, <http://www.usatoday.com/weather/wuv2.htm>.

根據天文台的紀錄，2001年每小時平均紫外線指數達5度或以上者有853小時，佔是年全年日照時間47.8% ，其中9度以上者達124小時佔6.9% 。[188] 1999年8月至2002年年底天文台錄得的十天最高的紫外線指數紀錄主要分佈在5至8月，而2001年6月17日最高的紫外線指數達13.9度，遠遠超過人體可抵受的太陽輻射強度，天文台利用各種媒體發放有關信息，提醒市民作預防措施。

2002 mainly occurred between May and August. On 17 June 2001, the UV Index reached a maximum of 13.9, which far exceeded the human tolerance level. Through various media, such information was released to the public, alerting them to take all necessary precautionary measures.

Table 4.6 Hong Kong's Highest UV Index (1 August 1999–31 August 2003)

Position	Maximum UV Index of the Day (15-minute mean)	Date
1	15	23 Jul 2003
2	14	12 Jul 2003
3	13.9	17 Jun 2001
4	13.7	5 Aug 2001
5	13.4	22 Jun 2002
6	13.3	6 Aug 2000
7	13.3	6 Aug 2001
8	13.2	21 Jun 2002
9	13.1	24 Jun 2000
10	13.1	13 Jul 2000

Source:
Internal records of the Hong Kong Observatory.

The formulation of the exposure categories based on the UV Index makes it easier for the public to comprehend the meaning of the index. Since the launch of the index, Hong Kong people have become aware of the intensity of sunlight during outdoor activities. This shows that the introduction of the index has succeeded in educating the public and reduced the possible harm that UV radiation can inflict on humans.

Prepared for a Rainy Day

Weather Forecasting

It has taken a very long time for weather reporting to evolve from being used exclusively by mariners in the latter half of the nineteenth century to becoming an important piece of information for today's general public.

表 4.6 全港最高紫外線紀錄 (1999 年 8 月 1 日 –2003 年 8 月 31 日)

名次	當日錄得最高紫外線指數 (15 分鐘平均值)	日期
1	15	2003 年 7 月 23 日
2	14	2003 年 7 月 12 日
3	13.9	2001 年 6 月 17 日
4	13.7	2001 年 8 月 5 日
5	13.4	2002 年 6 月 22 日
6	13.3	2000 年 8 月 6 日
7	13.3	2001 年 8 月 6 日
8	13.2	2002 年 6 月 21 日
9	13.1	2000 年 6 月 24 日
10	13.1	2000 年 7 月 13 日

資料來源：
香港天文台內部資料。

利用紫外線指數作基礎所制定的曝曬級數分級制，使普羅大眾更容易明瞭指數的意義。自紫外線指數推出以後，市民十分關注戶外活動期間太陽照射的強弱程度，可見有關指引已達到了教育市民的目的，減低了太陽輻射可能會對人類造成傷害的機會。

未雨綢繆

天氣預報

天氣報告從十九世紀後半期專門為航海人士而設，演變至今天成為每個市民日常生活的重要指引，經歷了一段頗長的時間。

預報形式的改進

十九世紀後半期的天氣報告並不是生活必需的資訊，甚至不能對普通市民產生重要的影響。原因是整個十九世紀後半期，天氣報導的方式以專業、學術為本，專供航海人士參考。這特性可從報章有關天氣報導的格式及內容窺見。1840 至 50 年代刊登在英文報章上如《中國郵報》(*China Mail*)，《中國之友》(*The Friend of China*) 的天氣專欄，甚至不是當天的天氣資料，而主要是前一天甚或上一個月的氣象紀錄，包括最高最低氣溫、最高最低氣壓狀況及風向等，並無天氣預測成份。

Improvement in Weather Forecasting

The weather reports of the latter half of the nineteenth century had no appreciable impact on the daily lives of ordinary people. The weather reports during that period served mainly professional and academic purposes, and were used as reference by seafaring people. This was reflected from the format and contents of the newspapers' weather reports. In the 1840s, there was no weather information of the day in the weather columns in English language newspapers such as *China Mail* and *The Friend of China,* but only those of the day before or the previous month. Their weather reports included information on the maximum and minimum temperatures, the highest and the lowest atmospheric pressure, wind directions, etc. There was nothing on weather forecasts.

Before the establishment of the Hong Kong Observatory, companies that specialised in calibrating chronometers such as Messrs G. Falconer & Co. were the providers of weather reports. Each day, at 9 AM and 4 PM, these companies used the wet bulb thermometers, dry bulb thermometers and barometers to measure temperature and atmospheric pressure. The findings would then be sent to newspapers for publication; one could only find out the weather conditions from the temperature and atmospheric pressure readings. No explanations or illustrations were given. Such data were meaningless to ordinary people who did not understand the functions of thermometers and barometers.[189] After the Observatory's founding, weather reports became more detailed and comprehensive. Apart from reporting on the day's atmospheric pressure, temperature, relative humidity and wind directions, the Observatory also covered the weather in 43 neighbouring cities. These cities included the main cities located along the South China coast and islands in the Pacific such as the Philippines. This bore testimony to the notion that weather reports served primarily the mariners. No changes were made in the reporting format; weather conditions were still briefly explained in numerical and alphabetical form. There were still no attempts to promote the understanding of weather among the public.

In the latter part of the nineteenth century, the weather reports in the Chinese language newspapers covered less details than in the English language newspapers and they were not published daily. The weather reports occasionally appearing in the newspapers were mostly data of the month before. News of unexpected events such as typhoons and adverse weather was the highlight of weather reports, which were mainly translated from English language sources. The most common reports were thermometer and barometer readings, with professionals as the target audience; the data were still beyond the grasp of general readers.

在天文台尚未成立之前，一些專為航海人士調校航海時計的公司如法康納公司 (Messrs G. Falconer & Co.) 是天氣消息的提供者，每日在上午9時及下午4時，它們會將公司的濕球溫度計、乾球溫度計及氣壓計所量度到的氣溫及氣壓狀況在報章上發表。天氣狀況主要透過溫度及氣壓讀數得知，完全沒有文字的解釋及說明。[189] 對溫度計或氣壓計的功能並不認識的普羅大眾來說，這些資料並無特殊意義。天文台成立以後，有關天氣報導的內容變得較詳盡和廣泛，由只報導香港當日的氣壓、氣溫、濕度、風向、風力及氣候，增加至區內43個城市的天氣報告、有關鄰近地區包括南中國海各大城市，以至南太平洋的島嶼如菲律賓等的天氣狀況，這亦正好證明天氣報告主要是服務航海人士的說法。報導的形式沒有改變，純粹以數字或英文字母簡寫表達天氣狀況，並未致力將天氣知識普及化。

十九世紀末中文報章報導天氣的篇幅較英文報章的小，天氣報導並非每天刊登，偶然看到的天氣報導大多是前一個月的資料，而突發性消息如颱風動向及惡劣天氣等的報導，是天氣報告的重心，內容多是一些翻譯自英文原稿的資料，常見的有溫度計讀數和氣壓計 (barometer) 的讀數的報導，對象仍以具專業知識者為主，一般讀者實難明白箇中含義。

在1850年代有關天氣預測的報導，只是一些綜合過往氣候狀況的報導。例如年曆會按過往的經驗將每月最高及最低氣壓、氣溫及風向等的資料預先寫上，市民可透過年曆大約估計到季節的變動，當然不會知道每日的天氣狀況。在報章上可看到短期天氣預測，以二十世紀初的報導為最早，由於當時的天氣報告仍主要以昨天的天氣狀況為重點，如區內的氣壓分佈形勢、氣溫及風向等，有關天氣預測的篇幅相當短，主要是當天的天氣預測，內容側重風向、降雨情況及天氣概況等。

戰後的20年，天氣報告的形式仍未有改變，1930至50年代，天氣報告的內容亦大抵與二十世紀初相若，仍以前一天的溫度、日照、雨量、濕度、風向及風速等為主，而當日的天氣預告重點亦無甚大變動。1906年及1937年的嚴重風災發生前，亦未有就颱風動向作廣泛報導，反映當時仍未把天氣預報的重要性提高。

1960年代，香港發生了多次嚴重的自然災害，包括1962年的溫黛風災和1963年的旱災，使天氣成為全港市民關注的課題，天氣報告變成報章每天的頭條新聞，也是傳播媒介爭相討論的重點，天氣報導的內容因而變得多元化，除區內氣壓分佈形勢，以及一般天氣資料如氣溫、濕度、風向及風力外，更不時有全日雨量統計的報導，或提供同期的歷史資料予以比較，但天氣預測卻只能增至未來24小時的天氣變化。較長遠期的天氣預測要到二十世紀末才出現， 1999 年天氣預測開始增至三天，至於今日所能參考的五天天氣預測則是在 2000 年以後才實施的。

In the 1850s, weather reporting was merely a summary of the climatological conditions of the past. For example, the calendar would contain information such as the monthly maximum and minimum atmospheric pressure, temperatures and wind directions, based on information obtained in the past. Through reading the calendar, ordinary people got a rough understanding of the seasonal changes, but not the daily weather conditions. It was only in the early twentieth century that one could find short-term weather forecasts in the newspapers. The weather reports still primarily covered the previous day's weather conditions such as atmospheric pressure distribution, temperature and wind directions, with only a brief section on the forecast of the day. The elements included in the forecast were mainly wind direction, rainfall and the general weather situation.

For the 20 years immediately after the Second World War, no changes in the reporting format took place. From the 1930s to 50s, the substance of weather reports remained basically the same as in the early years of the nineteenth century, covering mainly the temperature, sunshine duration, rainfall, humidity, wind directions and speeds of the day before. The focus of the one-day weather forecast also saw no appreciable change. The public had not been adequately warned before the catastrophic typhoons struck in 1906 and 1937. This illustrated the relative unimportance attached to weather warnings.

Hong Kong suffered many natural disasters in the 1960s. The onslaught of Typhoon Wanda in 1962 and the drought of 1963 made inclement weather a consuming concern of the whole community. Weather reports made newspaper headlines every day and became the hottest topic pursued by the mass media. Consequently, weather reports became multifaceted. Besides covering the pressure pattern within the region and the general weather information such as temperatures, relative humidity, wind direction and speed, there were also regular reports on the daily rainfall statistics and historical figures for comparison. Nevertheless, weather forecasts were still limited to 24 hours ahead. Longer-term forecasts only appeared towards the end the twentieth century. The year 1999 saw the introduction of three-day weather forecasts and the present five-day forecasts were launched from 2002.

Today's weather forecasts are generally similar in content to those in the early twentieth century, but with a completely different reporting format. A special feature of today's weather report is the combined use of text and visual illustrations. The related weather data are also more detailed and multifaceted, with satellite cloud pictures and surface pressure charts. Reporting is often

今天我們看到的天氣預測報導的內容，大抵與二十世紀初的相若，但報導的形式卻完全不同——圖文並茂是其中的一大特色，另外有關天氣的資料內容亦變得多元化及翔實，有衛星雲圖，有氣壓分佈圖。而報導亦盡量透過圖象，甚至動畫人物説明，使普羅大眾更容易明白其中內容，令預知天氣消息成為生活的重要一環。一些重要的訊息，除用符號表達以外，更特別分類成為惡劣天氣警報，對避免意外發生有一定的預防作用。此外，報導的媒介亦相當多，除報章和電台廣播外，更有電視台報導、電話查詢服務及網上天氣報導。天文台的天氣網頁更是過去數年市民獲取大量即時及昔日天氣資訊的工具，亦是天文台與市民直接接觸的主要渠道。自 1998 年起，瀏覽天文台網頁的次數大幅增長。香港天文台為聯合國世界氣象組織建立的首個涵蓋全球官方城市天氣預報的網站 (http://www.worldweather.org) 亦廣受歡迎，使 一些低度開發的國家也可以首次在國際舞台上展示他們的官方天氣預報。

表 4.7 香港市民查詢天氣次數統計 (1985–2002)

(單位：千次)

年份	透過電話錄音服務「打電話問天氣」	透過電話／傳真服務「查詢資料電話系統」
1985	56	–
1988	1,000	–
1989	1,300	–
1990	1,700	–
1991	4,300	–
1992	7,700	–
1994	12,000	–
1995	20,000	–
1996	23,000	–
1997	23,000	–
1998	24,000	520
1999	25,000	1,250
2000	23,000	1,030
2001	23,000	980
2002	20,000	820

資料來源：
香港天文台內部資料。

illustrated by pictures and images such us cartoon characters to facilitate easy understanding by the public. This has made foreknowledge of the changes in weather an important part of daily life. Certain types of important information, in addition to the use of symbols, are also categorised into different types of hazardous weather warnings; they play a role in the prevention of weather-related accidents. In addition, various media are employed in weather reporting, including newspapers, radio broadcasts, television reporting, telephone enquiry service and the internet. The Observatory's website is a portal for the public to gain access to a wealth of current and past weather information. It is also one of the Observatory's key channels to interact with people in Hong Kong and all over the world. The number of visits to the Observatory's website has grown phenomenally since 1998. The world's first website on global official city weather forceasts (http://www.worldweather.org), developed by the Observatory under the auspices of the World Meteorological Organisation, has also gained tremendous popularity, enabling some least developed countries to make their official forecasts widely known to the international community for the first time.

Table 4.7 Statistics on Weather Enquiries (1985–2002)

(Unit: 1,000)

Year	Through the Telephone Recorded Dial-a-Weather Service (Via Telephone)	Through the Telephone Information Enquiry System (Via Telephone/Fax)
1985	56	–
1988	1,000	–
1989	1,300	–
1990	1,700	–
1991	4,300	–
1992	7,700	–
1994	12,000	–
1995	20,000	–
1996	23,000	–
1997	23,000	–
1998	24,000	520
1999	25,000	1,250
2000	23,000	1,030
2001	23,000	980
2002	20,000	80

Source:
Internal records of the Hong Kong Observatory.

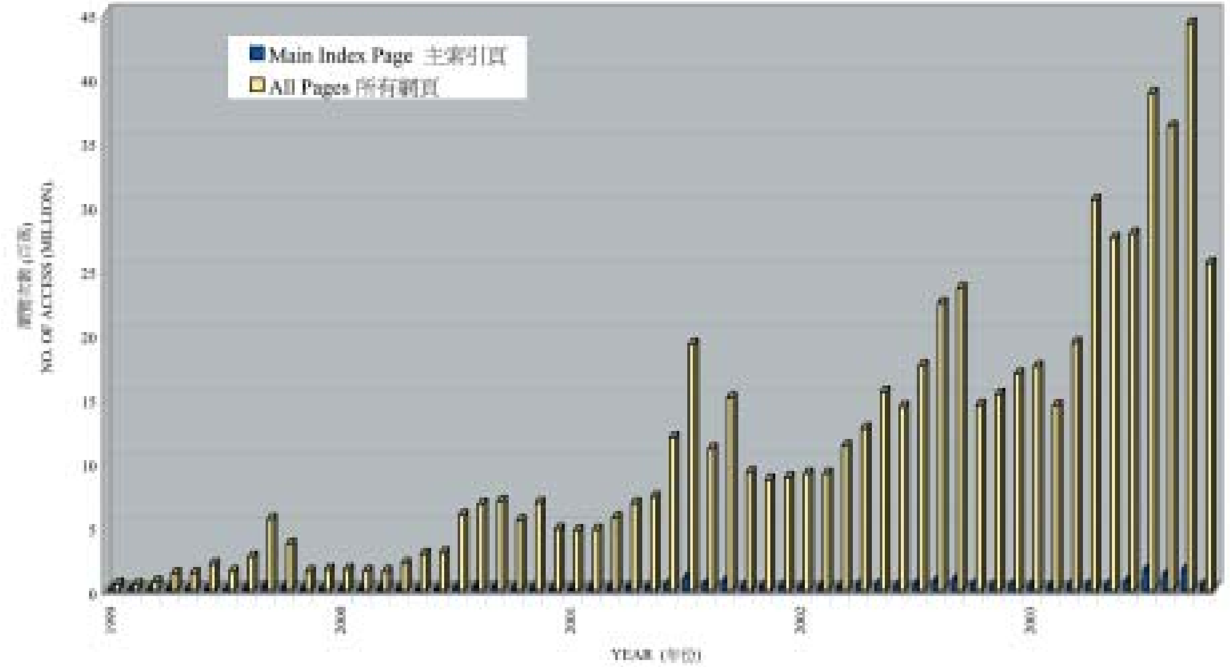


Fig. 4.28 Steady growth of visits to the Observatory's website, 1999–2003. Courtesy Hong Kong Observatory

圖 4.28 1999至2003年間瀏覽天文台網頁的次數有穩定增長趨勢。香港天文台檔案

準確性的提高

天氣預告能取得市民信賴，成為現代生活不可或缺的一環，最主要的原因是天氣預告的準確性日漸提高。探測儀器的進步、電腦技術的改進和國際資訊網絡的發達，使氣象資料的蒐集面不斷擴闊及加深，對提高氣象預測的準確性有很大的幫助。

1959年，天文台在大老山安裝了香港第一台的天氣雷達——笛卡41 (Decca 41) 型雷達，該雷達操作波長3厘米，視程較短而只能利用平面位置指示器 (Plan Position Indicator [PPI]) 顯示於單色陰極射線管上。1966年天文台在笛卡型雷達附近安裝了一座皮里斯43S (Plessey 43S) 型雷達，操作波長10厘米，該雷達擁有較大的天線和高能量發射器，探測範圍440公里，並設有較佳的衰減器，可從回波強度估計降雨強度，使天氣觀測更方便。但無論是1959年抑或1966年的雷達都是一些簡陋的單色視像雷達，不但不能儲存影像，且必須在密室中才能看到模糊的影像，因此，不會長時期啟動，只會在有需要時使用。 1983 年天文台在大老山第一台笛卡雷達舊址安裝了數碼雷達，解決了上述的技術困難，為天氣預報提供了充實的資料，該雷達系統由三個部分組成——大老山雷達站、天文台總部的電腦及顯示器、機場氣象所與總部連接的遙距顯示器，24小時大氣監察，並可每六分鐘作大氣體積掃描，提供等高平面位置顯示 (Constant Altitude Plan Position Indicator [CAPPI])。透過不同時段的雷達圖片，天文台可監察雨區的移動和發展，從而預測雨雲的移動位置。

Improved Accuracy

The success of weather forecasts in gaining people's trust and becoming an indispensable part of modern living depends largely on gradual improvements made in forecasting accuracy. A combination of advancement in measurement instruments, progress in computer technology and development in international information networks have continuously widened and deepened the dimensions of meteorological data collection, and contributed significantly to improved forecasting accuracy.

In 1959, the Observatory installed its first weather radar, a Decca 41 radar system, at Tate's Cairn, with a 3-cm wavelength that limited its vision field. It could only exhibit a Plan Position Indicator (PPI) image on a monochrome cathode-ray tube display. A Plessey 43S radar was installed adjacent to the Decca 41 radar in 1966, with an operating wavelength of 10 cm. The latter radar possessed a bigger antenna and a high power transmitter, with a 440-km radius detection range. It was also equipped with a better attenuator that enabled the forecaster to estimate the rain intensity based on the echo strength and thus facilitating weather observations. However, both

Fig. 4.29 The Doppler acoustic radar system used by the Observatory to measure wind speed and wind directions (1983). Courtesy Hong Kong SAR Information Services Department

圖 4.29 天文台使用多普勒雷達系統，探測風速及風向 (1983年)。香港特別行政區政府新聞處檔案

Fig. 4.30 Observatory staff manually aligning an aerial to receive images from a US weather satellite, at a home-made tracker station. (1965). Courtesy Hong Kong SAR Public Records Office

圖 4.30 天文台使用人手調校天線接收美國天氣衛星的影像 (1965年)。香港特別行政區歷史檔案館館藏

Fig. 4.31 Satellite receiving station at the Observatory headquarters (1980). Courtesy Hong Kong SAR Information Services Department

圖 4.31 天文台總部地面人造衛星接收站 (1980 年)。香港特別行政區政府新聞處檔案

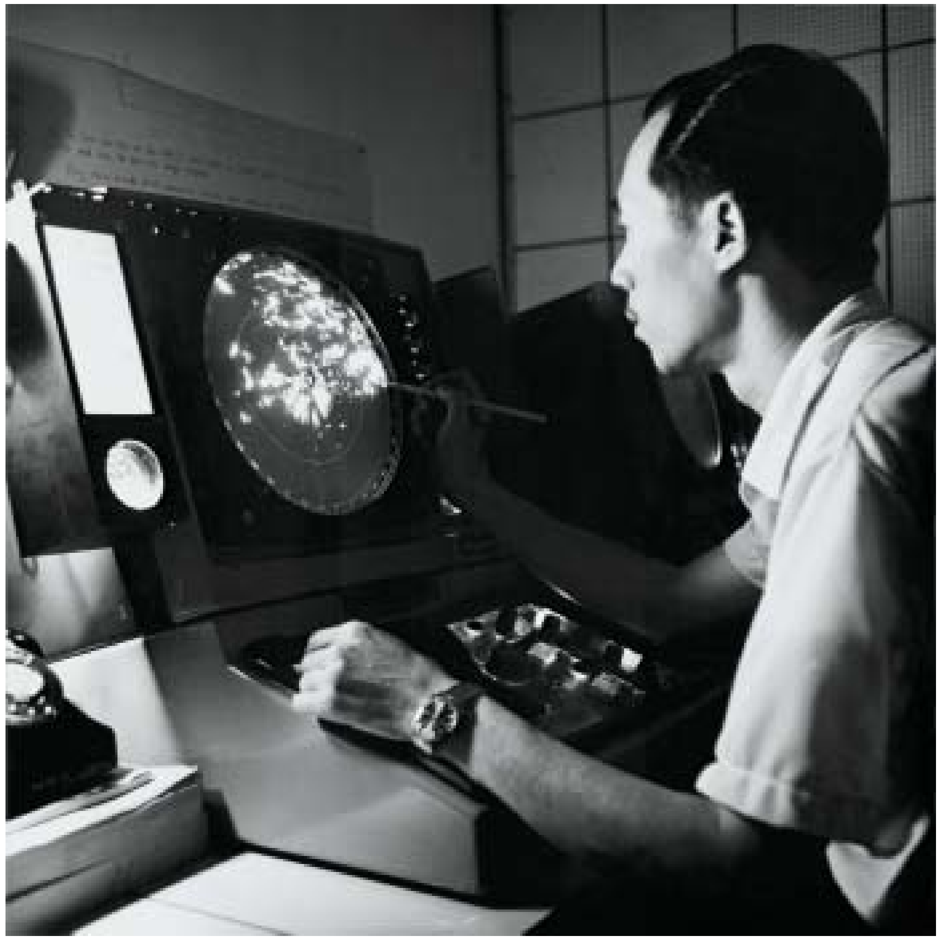


Fig. 4.32 A weather forecaster keeping a close eye on the weather radar (1968). Courtesy Hong Kong SAR Information Services Department

圖 4.32 天文台預報員觀看雷達氣象資料 (1968 年)。香港特別行政區政府新聞處檔案

the 1959 and 1966 radars were primitive monochrome instruments that were unable to store images, and the blurred images could only be viewed inside a dark room. Thus, they would not be turned on continuously but were only used in times of need. In 1983, at the site previously occupied by the Decca 41 radar, the Observatory installed a digital radar; this solved the previous technical problems and provided weather forecasters with useful data. This radar system was made of three parts: the Tate's Cairn Radar Station, the computers and monitors at the Observatory headquarters, and the remote monitors that linked the Airport Meteorological Office to the headquarters. With the use of digital video signal processing technology to display the PPI and the Range Height Indicator (RHI) in colour, round-the-clock weather observations were made possible; and Constant Altitude Plan Position Indicator

Fig. 4.33 The first digital weather radar was installed at Tate's Cairn in 1983. Courtesy Hong Kong SAR Information Services Department

圖 4.33 1983 年天文台在大老山設置首部數字化天氣雷達。香港特別行政區政府新聞處檔案

Fig. 4.34 Weather forecasters drawing weather charts (1965). Courtesy Hong Kong SAR Information Services Department

圖 4.34 氣象觀測員繪畫天氣圖 (1965 年)。香港特別行政區政府新聞處檔案

Fig. 4.35 Observatory forecasters analysing the weather situation with the use of real-time meteorological display (2003). Courtesy Hong Kong Observatory

圖 4.35 天文台預報員利用實時氣象資料顯示分析天氣形勢 (2003)。香港天文台檔案

(CAPPI) pictures were provided by volume scans of the atmosphere performed every six minutes. Through the radar pictures taken at different times, the Observatory was able to monitor the movement and development of rain areas and enabled it to forecast the movements of rain-bearing clouds.

In 1994, the Observatory added a Doppler weather radar to its operation. In addition to the provision of information on rain intensity and rain area movements by way of images, the new radar was able to produce vertical cross-section charts of the atmosphere, automatic warning signals, maximum rainfall rates, accumulated rainfall charts, vertically integrated water charts, echo-top maps, three-dimensional wind vector processing as well as storm forecast track.[190] Advances in weather radar technology have equipped weather forecasters with very useful data and captured meteorological conditions over a larger geographical area, such as the intensity of rainfall; the strength of a typhoon, its position and movements; and the determination of wind speed and direction at different altitudes.[191]

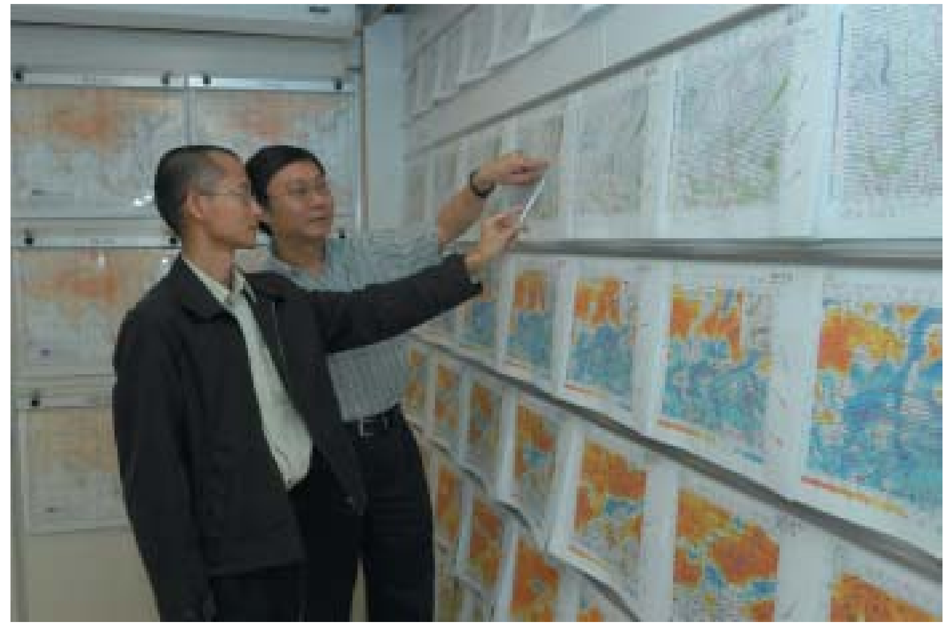


Fig. 4.36 Observatory forecasters formulating 5-day weather forecasts on the basis of objective guidance from numerial models (2003). Courtesy Hong Kong Observatory

圖 4.36 天文台預報員參考數值模式的客觀指引制定5天天氣預報 (2003年)。香港天文台檔案

1994年天文台再添置多普勒天氣雷達系統，除可透過顯示圖提供降雨強度及雨區移動情況外，更可製作大氣垂直剖面圖、自動警報訊號、最高降雨率、累積雨量圖、垂直累積分液態水圖、回波頂部圖、高速度處理立體資料及預測風暴路徑等報告。[190] 天氣雷達技術的改進為氣象預報提供了紮實的數據和較大範圍氣象變化情況，例如雨量的大小、颱風的強度、移動的位置、計算上空不同高度的風速及風向。[191]

天氣預報日益準確，1970年代初期電腦技術的改進可以說是技術突破的第二步，新式電腦一改舊式電腦容量太少的缺點，使儲存天氣資料的資料庫得以擴充，資料亦可透過電腦方程式運算，準確而迅速地進行分析。其中數值天氣預報技術就利用了高速電腦模擬大氣層變化的定律，預測大氣層的演變。運算方程式中的氣象變數包括風、濕度、氣壓、水汽含量等。

目前長達五天的中期天氣預報，天文台會使用歐洲中期天氣預報中心以GRIB 格式發放的較高分辨率數值產品、英國氣象局的數值天氣預報模式數據、日本氣象廳的數值天氣預報及美國國家環境預報中心的產品。1999年12月天文台建立了一套「業務區域譜模式」(Operational Regional Spectral Model [ORSM]) 作為提供未來一兩天本地短期天氣預報的基礎。該套模式以克雷電腦 (Cray SV1-1A) 作為運算平台。電腦系統有 16 個中央處理器， 20 公里內模式

Breakthroughs were achieved in weather forecasting, and the advancement of computer technology in the early 1970s represented the second stage of technological breakthrough. New computers overcame the storage limitation of machines of the earlier generation and enabled the expansion of the meteorological information database. The data could also be analysed quickly and accurately with the use of computer programmes. For example, the numerical weather prediction technique uses high-speed computers to simulate the physical laws governing changes in the atmosphere and forecast the evolution of the atmosphere. The variables involved in the mathematical equations include wind, temperature, air pressure, moisture content, etc.

For the present five-day medium-range weather forecast, the Observatory uses the high-resolution Grid Point Value (GPV) products in GRIB format from the European Centre for Medium-Range Weather Forecasts, the United Kingdom Meteorological Office, the Japan Meteorological Agency, and the US National Centre for Environmental Prediction. In December 1999, the Observatory adopted the Operational Regional Spectral Model (ORSM) as the basis for making one- to two-day short-term weather forecasts. Such a model is run on the platform of a Cray SV1-1A supercomputer, which has 16 central processing units with a peak performance of 19.2 gigaflops. The 20-km (inner domain) ORSM is run eight times a day while the 60-km (outer domain) ORSM is run four times a day. The forecast information will be visualised using two-dimensional and three-dimensional weather charts. To facilitate the dissemination of local weather forecasts, data such as surface wind, temperature, humidity, cloud cover and cumulative rainfall over Hong Kong are extracted from the model.

The number of weather out-stations has also been on the increase since the end of the Second World War. From 1984 onwards, the Observatory increased the number of automatic weather stations that were linked directly to the headquarters to make observations of the wind speed, wind directions, humidity, air pressure and rainfall of Hong Kong region. At present, there are three stations that are manned 24 hours a day — the Hong Kong Observatory headquarters, King's Park Meteorological Station and Chek Lap Kok Airport Meteorological Office. In 2002, there were a total of 62 automatic weather stations: 24 of which were installed with the same instruments as those in the manned stations; nine stations were equipped with anemometers only; 21 stations were rain gauge stations; eight anemometer stations were located in the airport areas and dedicated to the Wind Analyser System; as well as two weather buoys placed in the waters west of Chek Lap Kok airport. The data collected from the

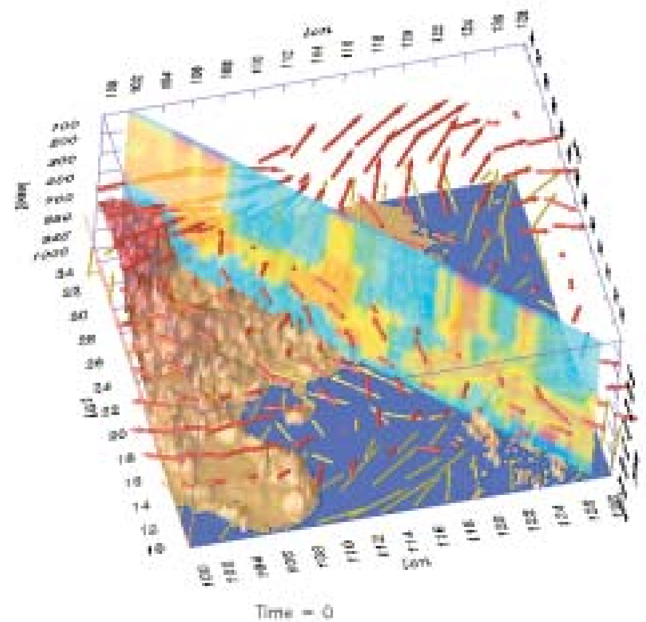


Fig. 4.37 A three-dimensional representation of the state of the atmosphere, a product of the Observatory's regional numerical model. Courtesy Hong Kong Observatory

表4.37 天文台區域數值模式的一項產品，顯示大氣的三維結構 (2003) 。香港天文台檔案

每日運算8次，60公里外模式每日運算4次，預報資料會被繪製成二維及三維的天氣圖，使進行本地天氣預測時，可從模式中抽取地面風、氣溫、濕度、雲量及累積雨量等資料。

此外，氣象監測外站的數目自戰後不斷增加。1984年起，隨著電腦技術的發達，天文台自行設計製造的自動氣象站，可觀測本港地區的風速、風向、濕度、氣壓和雨量。目前設有專人負責全日24小時觀測的氣象站有三個，分別位於天文台總部、京士柏氣象站和赤鱲角機場。2002年全港設有62個固定自動氣象站， 24 個設有觀測上述天氣狀況的觀測儀， 9 個只設有風速表， 21 個為雨量站，8個為機場的風分析系統，另有2個位於機場西面水域的浮標氣象站。自動氣象站蒐集到的資料，可直接利用微波或電話線直接傳送到天文台總部，這些設備都是天文台預測本區天氣的珍貴資源。

天氣預報能成為現代人每天早上計劃一天活動的依據，最主要是氣象資料的可讀性大大提高，天氣報告不再是一些單調枯燥的數據，反而是一些與日常生活有密切關係的資訊。天文台無論在報導或回答市民查詢的方式，都花了不少心思，希望能盡量造到快捷、方便、一目了然。另一方面，天氣預報在現代科技的協助下準確性不斷提高，報導資料的範圍也不斷擴充，從當天天氣預測至24小時的天氣，再臻至三天、五天的中期天氣預測，預測的地區不但包括本地，更遍及世界各大城市；在資訊及交通發達的二十一世紀，氣象資訊的全球化引領香港與世界潮流同步前進。

Fig. 4.38 Shatin Racecourse Automatic Weather Station (2002). Courtesy Hong Kong Observatory

圖 4.38 沙田馬場自動氣象站 (2002 年)。香港天文台檔案

Fig. 4.39 Temperature readings are taken daily under the palm thatch hut at the Tsim Sha Tsui Hong Kong Observatory headquarters (1983). Courtesy Hong Kong SAR Information Services Department

圖 4.39 位於尖沙嘴天文台總部的草棚，一直以來都是擺放溫度計的地方，也是天文台每天氣溫紀錄的所在地 (1983年)。香港特別行政區政府新聞處檔案

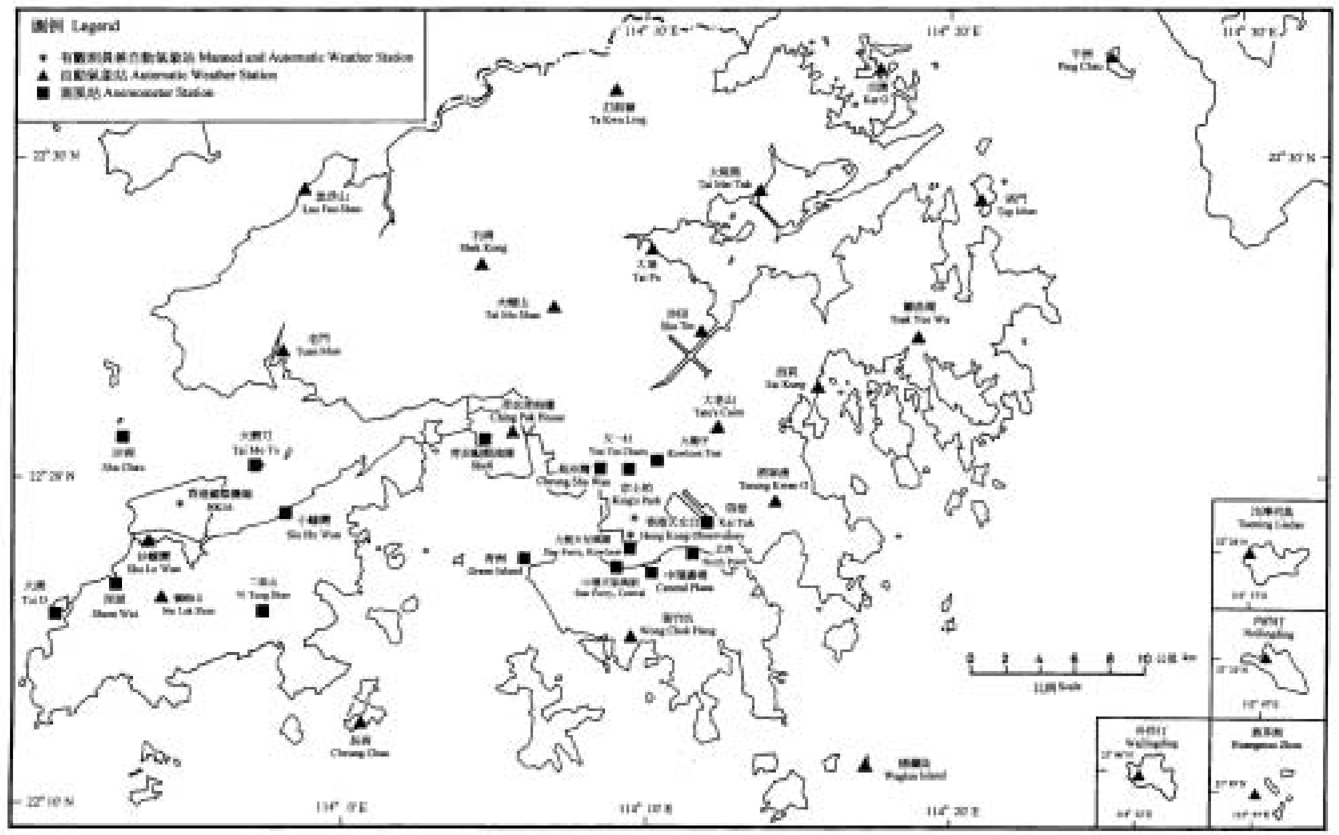


Fig. 4.40 Distribution of automatic weather stations and anemometer stations in 2003. Courtesy Hong Kong Observatory

圖 4.40 2003 年本港自動氣象站及測風站分佈圖。香港天文台檔案

automatic weather stations are transmitted in real time to the Observatory headquarters via telephone lines or UHF radio links. These facilities are precious resources to the Observatory's efforts in making weather forecasts for this region.

Today, most people rely upon the morning weather forecasts when making plans for the day. The accessibility of the most vital weather data has risen dramatically. Weather reports are no longer boring sets of figures; they provide information closely related to daily living. In both its reporting and in the manner it responds to public enquiries, the Observatory has endeavoured to achieve speed, convenience and clarity for the public. Modern technology has continuously upgraded the accuracy and widened the scope of weather forecasts, and has extended their range from 24 hours ahead, to the medium-range three- and five-day forecasts. The geographical coverage has also extended beyond Hong Kong to all the major cities of the world. The twenty-first-century world is well connected by efficient transportation and information technology, and Hong Kong has benefited from the globalisation of meteorological information.

Evolution of Warning Signals

Typhoon Warning Signals

In 1884, a year after its establishment, the Observatory began to disseminate tropical cyclone information from Guam or Manila through the daily newspapers; as well as hoisting typhoon signals at the harbour to warn passing ships.[192] Up until 1886, the tropical cyclone monitoring task was handled by the Hong Kong Observatory in conjunction with the Harbour Master's Office (now the Marine Department).[193] In 1888, the Observatory also gathered information on tropical cyclones within the region from ocean-going vessels. [194] Since 1890, the government agreed to release news on tropical cyclones that were active in the South China Sea at regular intervals.[195] As a result, the Observatory began to issue tropical cyclone warning signals to ships four times a day at three-hour or six-hour intervals to ensure journey safety. The areas that came under typhoon observation were quite extensive and covered the region lying within 10–30º North, 105–125º East. Apart from using numerical signals to disseminate typhoon information to sailing vessels, the Observatory also hoisted warning signals at stipulated places such as Hong Kong and Kowloon Wharf and Godown Co.'s Pier and the Harbour Master's Office.[196] Warning signals had gone through several rounds of reform and by

預警信號的演變

颱風信號

1884年天文台在成立後的一年，開始每天在報章上發佈來自關島或馬尼拉的熱帶氣旋消息，並於海港內懸掛颱風信號向輪船示警，[192] 直到1886年監測熱帶氣旋的工作，仍由天文台與船政廳 (即後來的海事處) 聯手負責，[193] 1888 年天文台更向遠洋輪船蒐集區域內的颱風情況。[194] 1890年起，政府因應社會的要求，定期發放有關南中國海的颱風消息，[195] 天文台遂開始向區內的船隻提供每三小時或六小時一次，每天共四次警報信號，保障航運安全。有關颱風狀態的觀測範圍相當廣泛，包括北緯10–30º，東經105–125º以內的地區，天文台除使用數字信號向海上航行的船隻報導颱風消息以外，更於港口指定的地方如九龍倉公司碼頭及船政廳總部等懸掛信號球示警。[196] 颱風警報系統經歷過多次改革，1917年起又分為本地與非本地颱風警告信號，[197] 兩套系統并行使用至 1950 年代末才被取締。

1884 年的颱風信號球主要以帆布製成，但很快已被藤器取代。[198] 1884 年至 1891 年年間颱風信號球主要有鼓形、倒三角形、圓形及三角形四種，分別顯示來自東、南、西及北方的烈風方向。 1891 年起風力的強弱可倚靠信號球的顏色辨別，紅色信號球表示颱風位於海港300哩的範圍以外，而黑色信號球則表示颱風在海港 300 哩以內。是年開始，天文台更於晚間懸掛紅色及白色的燈號三盞，以示颱風情況。[199] 1903 年起，港督仿效當時上海的報風方法，於訊號山Signal Hill) 懸旗示風，[200] 該措施因執行困難，在 1906 年停止使用。[201] 為更清楚顯示颱風吹襲的方向， 1904 年天文台將指示風向的四個信號球作兩個一組合併，如鼓形代表吹東風、倒三角形是吹南風，當兩信號球一併懸掛時，代表吹東南風，於是吹東南、東北、西南、西北的風向指示信號因而產生。 1911 年，天文台首次就強烈暴風的最強風力作測量，提供有關颱風更準確的資料。[202]

1913 年 5 月，遠東區多個國家於東京召開氣象會議，提議統一區內的颱風警告信號，可惜是次會議未能達成共識，無法制定一套統一的系統。[203] 受到是次會議影響，香港在 1917 年首先就當時既有的颱風警告信號試行改革，除信號球外，更加設由 1 到 7 數字信號顯示風力強度， 1 號風球是初步警戒信號，而 2 、 3 、 4 、 5 號表示颱風吹襲的不同方向， 6 號風球表示風力達烈風程度，相等於後來的8號風球，而7號則表示風力達颶風程度，相等於後來的10號風球。雖然香港天文台積極游說中國海其他地區使用該改良的風暴信號系統，可惜並未為中國海關總監接受，[204] 但是次行動卻促成另一套颱風警告信號——本地颱風警告信號的誕生。

1917 different warning signal systems were adopted for local and non-local tropical cyclones.[197] The two systems co-existed until their abolition at the end of the 1950s.

In 1884, the typhoon signal balls were made of canvas, but were soon replaced by those made of rattan.[198] Between 1884 and 1891, the signal balls came in the shapes of drum, upturned triangle, circle and triangle; to represent gusts from east, south, west and north. From 1891 onwards, the wind strength could be identified by colour: a red signal meant that the typhoon was over 300 miles from Hong Kong, whereas a black signal would indicate that the typhoon was within 300 miles of Hong Kong. In the same year, the Observatory also hoisted three red and white lights to make known the typhoon conditions.[199] In 1903, the Hong Kong government followed the practice of Shanghai and had a typhoon signal flag hoisted on Signal Hill.[200] This practice was abandoned in 1906 due to practical difficulties.[201] In 1904, to better illustrate the wind direction, the Observatory combined the four signals and used them in pairs. For example, when the drum (indicating winds from the east) and the upturned triangle (indicating winds from the south) were hoisted together, it meant that winds were coming in from a southeasterly direction. This gave rise to the warning signal system that classifies winds as coming in from the direction of southeast, northeast, southwest or northwest. In 1911, the Observatory measured the maximum speed of gusts and storm force winds for the first time and provided more accurate information on typhoons.[202]

In May 1913, several countries in the Far East held a meteorological conference in Tokyo to discuss meteorological matters and proposed to unify the typhoon warning system. Unfortunately, consensus was not reached and a unified system could not be formulated.[203] Influenced by that meeting, the Observatory attempted to reform its existing warning signal system in 1917. Apart from the signal balls, numbered signals from 1 to 7 were added to indicate wind strength. The No. 1 signal was a stand-by warning signal. Signal Nos. 2, 3, 4 and 5 signified gale force winds expected from the four quadrants. The No. 6 signal indicated gale or storm force winds and was equivalent to the No. 9 signal introduced later. The No. 7 signal represented hurricane force winds, and was later amended to signal No. 10. Although the Observatory had actively persuaded other countries in the South China Sea region to adopt the reformed system, it was not adopted by the Chinese Maritime Customs.[204] This reform exercise, however, prompted the adoption of a new typhoon warning system and gave rise to Hong Kong's tropical cyclone warning signals.

Fig. 4.41 The signal station on Victoria Peak, 1,825 ft above sea level, in the early twentieth century. Different flag signs were employed to indicate weather conditions. Courtesy Hong Kong SAR Public Records Office

圖 4.41 二十世紀初海拔 1825 呎的太平山訊號站。當時天文台以不同旗號作天氣指標。香港特別行政區歷史檔案館館藏

Since 1917, Hong Kong had actively promoted the reformed warning signal system and released detailed reports on the movements of typhoons near Hong Kong. On the other hand, Hong Kong also used the typhoon warning system used by other regions in the South China Sea to accede to the request of the Hong Kong General Chamber of Commerce.[205] Thus, from 1917 onwards, two systems of warning signals were used concurrently: one was for local tropical cyclones and the other for non-local ones.[206] When a tropical cyclone was outside Hong Kong's warning zone, only non-local warning signals were hoisted.[207] Once it entered Hong Kong's warning zone, both local and non-local warning signals would be issued. To avoid confusion, different warning signal shapes and hoisting places were used. The Harbour Master's Office, Hong Kong and Kowloon Wharf and Godown Co.'s Pier and Signal Hill were the main bases for hoisting non-local warning signals; while local signals were hoisted principally at the Observatory headquarters in Tsim Sha Tsui.[208] From 1934 onwards, the local signals were raised at different places according to the time of day. They were hoisted both day and night at the Observatory headquarters, the Harbour Department, Tamar, Lei Yue Mun, Gough Hill Police Station and La Salle College on Prince Edward Road in Kowloon. Places where signals were hoisted only in daytime were Green Island, Hong Kong and Kowloon Wharf and Godown Co., Lai Chi Kok, the roof of No. 49 Godown and Tai Po. At night, these signals appeared only on the clock tower of the Kowloon-Canton Railway Tsim Sha Tsui terminus.[209] Typhoon warning signals were also hoisted at some out-stations such as Min Chau, Waglan Island, Stanley, Chai Wan, Aberdeen, Sai Kung, Sha Tau Kok and Tai Po.[210]

Actually, local residents did not pay much attention to the typhoon warning signals, as they were alerted by other means. The Observatory would fire one to three shots from a gun at the harbour to warn of the typhoon approach, with the wind strength signified by the number of shots.[211] In 1907, the typhoon gun firing was replaced by cannon firing, and later by setting off explosives. This system of using the noise of the gun, cannon and explosives to warn people of the impending arrival of a tropical cyclone was used until its abolition in 1937.[212] According to the Observatory, when a tropical typhoon came close to Hong Kong, the authorities used gun firing (1884–1907), cannon firing (1907–1937), wireless broadcasts towards the end of the first decade of the twentieth century,[213] notices posted at the piers and newspaper reports as the principal information sources; rather than the warning signals hoisted by the Observatory.

1917年以後，香港天文台積極推廣該套檢定的風暴警告信號，詳細報導香港境內的颱風動態。但另一方面，因應香港總商會的要求，[205] 本港同時使用南中國海其他地區的颱風警告信號，於是1917年起，本地與非本地颱風警報告信號在香港並行使用。[206] 當颱風在本港之警戒範圍以外，本港只會懸掛非本地信號；[207] 當颱風進入本港範圍內，本地颱風警告信號與非本地颱風警告信號會同時懸掛。為免混淆，兩套系統的示風信號球的形狀及懸掛地點均有所不同：非本地颱風警告信號仍以船政廳、九龍貨倉碼頭及訊號山為主要發佈消息基地，本地颱風警告信號則以尖沙咀天文台總部為主。[208] 1934 年以後本地颱風警告信號的懸掛地點，日間與夜間懸掛信號的地點不同: 日夜間均懸掛颱風信號的地點為天文台總部、船政署、添馬艦、鯉魚門、歌賦山警署和九龍太子道喇沙書院；只在日間懸掛的地點則包括青洲、九龍貨倉公司、荔枝角、 49 號貨倉屋頂和大埔；只在夜間懸掛的則有九廣鐵路總站尖沙咀鐘樓，[209] 以及一些附加的外站，包括岷洲、橫瀾、赤柱、柴灣、香港仔、筲箕灣、西貢、沙頭角及大埔等地。[210]

其實本地居民甚少會注意有關颱風動態的警告信號，因當颱風逐漸接近香港區域時，天文台會於港口鳴槍一至三響作為強風襲港的警報，而槍聲的多寡亦分別說明了颱風的強烈程度。[211] 1907 年鳴槍示警的方法被鳴炮取代，以槍聲，再以炮聲，繼而以炸藥的爆炸聲的報風方法，一直沿用到1937年才正式被取締。[212]

Fig. 4.42 A signalling cannon on Victoria Peak in the early twentieth century. Courtesy Hong Kong SAR Public Records Office

圖 4.42 二十世紀初位於太平山頂的風暴警告信號炮。香港特別行政區歷史檔案館館藏

Since the Observatory began to use wireless telegraphy towards the end of the 1910s to broadcast typhoon news, the numbered signal system grew in importance. Through the simple numbered system the public could readily understand the latest tropical cyclone situation. In 1934, the Observatory abolished signal Nos. 2, 3 and 4 and added Nos. 8, 9 and 10. The No. 1 signal remained as the stand-by signal, whereas Nos. 5 to 8 signified gale winds from the four quadrants. The No. 9 signal represented gale to storm force winds that were increasing or expected to increase in strength, while signal No. 10 indicated that hurricane force winds were blowing or expected.[214] This warning signal system largely laid the foundation for the present day tropical cyclone warning system. The No. 3 strong wind signal was added in 1956 to the existing signals. To deal with the misconception held by the public that wind strength increased with the change in signal number from 5 to 8, the Nos. 5 to 8 signals were replaced by signal No. 8 NW (winds blowing from the northwesterly direction), No. 8 SW (southwesterly direction), No. 8 NE (northeasterly direction) and No. 8 SE (southeasterly direction). Such a system has been in use ever since (see Table 4.8 for the evolution of tropical cyclone warning signals).[215]

Before the 1960s, the warning signals issued by the Observatory were concerned mostly with destructive tropical cyclones. In the early twentieth century, the precautionary measures promoted by the government largely centred on assisting fishermen to move their fishing boats to the typhoon shelters during the passage of the tropical cyclone. The typhoon measures adopted after the 1960s also dealt with the safety issue of the general public, apart from the usual threats faced by the fishermen. When dealing with popular issues such as public transport services, guides on school attendance and work arrangements, the emphasis is placed on safety. The aim is to reduce accidents induced by sudden changes in meteorological conditions.

從 1884 至 1907 年的鳴槍、1907 至 1937 年的鳴炮、1910 年代末開始使用的無線電廣播、[213] 碼頭張貼的通告，以及報章的報導，都是本地居民獲得颱風消息的主要途徑，天文台所懸掛的信號球資訊反而未為香港市民廣泛關注使用。

自1910年代末天文台使用無線電廣播系統報風後，數字警報信號變得愈來愈重要；因透過簡單的數字符號市民很容易知道颱風的動向。1934 年天文台將颱風警報信號的 2、3、4 號取消，改用 8、9、10 號，其中 1 號是預先警戒信號而 5 號至 8 號為颱風風向指示信號，9 號則代表颱風加劇，10 號代表十分強勁的颱風，[214] 大抵上奠定了今日颱風警告信號系統的基礎。1956年颱風警告信號增設 3 號強風信號。1973 年 1 月 1 日為改變市民以為 5 至 8 號信號數字上的遞增，代表著風力不斷遞增這誤解，當局將5至8號信號改為8號西北、8號西南、8號東北及8號東南的警告信號，這套警告信號一直沿用至今 (有關颱風警告信號的演變可參閱附表 4.8)。[215]

1960年代以前，天文台所提供有關惡劣氣候的警報訊號，以破壞力較大的颱風為本；在二十世紀初政府提倡的應變措施，主要是協助漁戶於颱風襲港期間找到避風的港灣。1960 年代後的颱風應變措施，除考慮到最受風雨威脅的漁民外，亦顧及普羅大眾的安全問題，一些受市民關注的措施如公共交通服務、上班及上學的指引，都側重公共公開活動的安全，目的在減少氣候突然變化所引起的意外。

Table 4.8 Development of Hong Kong Storm Signal Code (1884–1973)

1884		1891		1904			1917				1920[1]			1934				1935[2]				1938			1938–1962		1956				1973			
Symbol	Direction	Symbol	Direction	Symbol		Direction	Signal	Symbol	Night Signal	Wind Speed & Direction	Signal	Symbol	Direction of Motion	Signal	Symbol	Night Signal	Wind Speed & Direction	Signal	Symbol	Night Signal	Wind Speed & Direction	Signal	Symbol	Night Signal	Signal	Symbol	Signal	Symbol	Night Signal	Wind Speed & Direction	Signal	Symbol	Night Signal	Wind Speed & Direction
	E		E			E	1			Stand-by signal	1		Severe	1			Stand-by signal	1			Stand-by signal	1			1		1			Stand-by signal. Centred within about 400 nautical miles	1			Stand-by signal
	S		S			S	2			N	2		Severe					2			Strong wind with squalls SW				2									
	W		W			W	3			S	3		Severe					3			Strong wind with squalls SE				3		3			Strong wind with a sustained speed of 22–33 knots	3			Strong wind
	N		N			N	4			E	4		Severe					4			Typhoon dangerous				4									
			E			SE	5			W				5			NW	5			NW	5			5		5			NW storm with a sustained speed of 34 knots (63 km/h) or above	8 NW	NW		NW gale or storm with a sustained speed of 34–63 knots (63–117 km/h)
			S			NE	6			Gale expected	6		Intensity unknown	6			SW	6			SW	6			6		6			SW storm with sustained wind speed of 34 knots (63 km/h) or above	8 SW	SW		SW gale or storm with a sustained wind speed of 34–63 knots (63–117 km/h)
			W			SW	7			Winds of hurricane force expected	7		Intensity unknown	7			NE	7			NE	7			7		7			NE storm with a sustained wind speed of 34 knots (63 km/h) or above	8 NE	NE		NE gale or storm with a sustained wind speed of 34–63 knots (63–117 km/h)
			N			NW					8		Intensity unknown	8			SE	8			SE	8			8		8			SE storm with a sustained wind speed of 34 knots (63 km/h) or above	8 SE	SE		SE gale or storm with sustained wind speed of 34–63 knots (63–117km/h)
											9		Intensity unknown	9			Gale expected to increase	9			Gale expected to increase	9			9		9			Increasing gale or storm	9			Increasing gale or storm
														10			Wind of typhoon force expected	10			Wind of typhoon force expected	10			0		10			Hurricane force with sustained speed reaching over 64 knots (118 km/h)	10			Hurricane force with sustained speed reaching over 64 knots (118 km/h) and gust exceeding 120 knots (220 km/h)

Notes:
Red signals indicate a distance exceeding 300 miles, and black signals a distance less than 300 miles.
Non-local signals are presented with pink background, while the local signals are presented with light yellow background.
[1] Royal Observatory, *Hong Kong Storm Signals,* Hong Kong Prison, Stanley, 1938.
[2] This local storm signal system came into force on 28 February 1935 but the No. 4 Signal was seldom used in Hong Kong.

Sources:
Hong Kong Government, *Hong Kong Administrative Reports 1917,* Appendix F, F7–8; *Wah Kiu Yat Po,* 29 May 1966.
Huazi ribao, 1 January 1904.
Royal Observatory Hong Kong, *File No. 23, Meteorological Messages and Storm Warnings (1916–1933);* Royal Observatory Hong Kong, *Hong Kong Storm Signals,* Hong Kong Prison, Stanley, 1938, p. 2.
Royal Observatory, Hong Kong, *Hong Kong Observatory Director's Report 1891,* Hong Kong, Government Printer, p. 1.
Royal Observatory Hong Kong, *Hong Kong Storm Signals,* Hong Kong Prison, Stanley, 1938, p. 1.
Sing Tao Daily, 2 September 1962; *Wah Kiu Yat Po,* 29 May 1966.
Wah Kiu Yat Po, 16 March 1973.

表 4.8 香港颱風警告訊號的演變（1884–1973 年）

1884 訊號球	1884 風向	1891 訊號球	1891 風向	1904 訊號球		1904 風向	1917 編號	1917 訊號球	1917 夜間訊號	1917 風速風向
🟥	東風	🟥	東風	🟥	⬛	東風	1	🔺	○○○	預警訊號
🔻	南風	🔻	南風	🔻	▼	南風	2	▲	○🟢🟢	北風
🔴	西風	🔴	西風	🔴	⚫	西風	3	▼	🟢○○	南風
🔺	北風	🔺	北風	🔺	▲	北風	4	⚫	🟢🟢○	東風
		⬛	東風	🔻🟥	▼⬛	東南風	5	⬛	○○🟢	西風
		▼	南風	🔺🟥	▲⬛	東北風	6	⧗	🟢🟢🟢	烈風將增強
		⚫	西風	🔻🔴	▼⚫	西南風	7	✚	🔴🟢🔴	已達或將達颶風程度
		▲	北風	🔺🔴	▲⚫	西北風				

1920[1] 編號	1920 訊號球	1920 颱風移動情況	1934 編號	1934 訊號球	1934 夜間訊號	1934 風速風向	1935[2] 編號	1935 訊號球	1935 夜間訊號	1935 風速風向
1	┃	嚴峻	1	┳	○○○	預警訊號	1	┳	○○○	預警訊號
2	━	嚴峻					2	━	○🟢○	強烈西南暴風
3	┻	嚴峻					3	┻	🟢○🟢	強烈東南暴風
4	┳	嚴峻					4	◆	○○🔴	颶風有危險性
			5	▲	○🟢🟢	西北風	5	▲	○🟢🟢	西北颶風
6	▲	風勢不詳	6	▼	🟢○○	西南風	6	▼	🟢○○	西南颶風
7	▼	風勢不詳	7	▲▲	🟢🟢○	東北風	7	▲▲	🟢🟢○	東北颶風
8	◆	風勢不詳	8	▼▼	○○🟢	東南風	8	▼▼	○○🟢	東南颶風
9	■	風勢不詳	9	⧗	🟢🟢🟢	風勢增劇	9	⧗	🟢🟢🟢	風勢增劇
			10	✚	🔴🟢🔴	颶風抵步	10	✚	🔴🟢🔴	颶風抵步

1938 編號	1938 訊號球	1938 夜間訊號	1938–1962 編號	1938–1962 訊號球	1956 編號	1956 訊號球	1956 夜間訊號	1956 風速風向	1973 編號	1973 訊號球	1973 夜間訊號	1973 風速風向
1	┳	○○○	1	┃	1	┳	○○○	預警訊號進入香港 400 浬範圍	1	┳	○○○	預警訊號
			2	━								
			3	┻	3	┻	🟢○🟢	強風訊號風力時速達 22–33 浬	3	┻	🟢○🟢	強風訊號
			4	┳								
5	▲	○🟢🟢	5	✚	5	▲	○🟢🟢	西北暴風風力時速達 34 浬以上 (63 公里)	8 西北	▲ NW	○🟢🟢	西北烈風或暴風風力時速達 34–63 浬 (63–117 公里)
6	▼	🟢○○	6	▲	6	▼	🟢○○	西南暴風風力時速達 34 浬 (63 公里)以上	8 西南	▼ SW	🟢○○	西南烈風或暴風風力時速達 34–63 浬 (63–117 公里)
7	▲▲	🟢🟢○	7	▼	7	▲▲	🟢🟢○	東北暴風風力時速達 34 浬 (63 公里)以上	8 東北	▲▲ NE	🟢🟢○	東北烈風或暴風風力時速達 34–63 浬 (63–117 公里)
8	▼▼	○○🟢	8	◆	8	▼▼	○○🟢	東南暴風風力時速達 34 浬 (63 公里)以上	8 東南	▼▼ SE	○○🟢	東南烈風或暴風風力時速達 34–63 浬 (63–117 公里)
9	⧗	🟢🟢🟢	9	■	9	⧗	🟢🟢🟢	暴風料加強	9	⧗	🟢🟢🟢	暴風料加強
10	✚	🔴🟢🔴	0	⧗	10	✚	🔴🟢🔴	颶風時速達 64 浬 (118 公里)以上	10	✚	🔴🟢🔴	颶風時速達 64 浬 (118 公里)以上陣風時速達 120 浬 (220 公里)以上

註：
紅色訊號球代表熱帶氣旋距離香港 300 哩以外，黑色訊號球則表示已進入本港 300 哩範圍以內。
粉紅色暗底訊號為非本地颱風警告訊號；淺黃色底訊號為本地颱風警告訊號。
[1] 參閱 Royal Observatory, *Hong Kong Storm Signals,* Hong Kong Prison, Stanley, 1938 。
[2] 該套颱風訊號系統於 1935 年 2 月 28 日生效，4 號颱風訊號很少在香港使用。

資料來源：
《星島日報》，1962 年 9 月 2 日；《華僑日報》，1966 年 5 月 29 日。
《華字日報》，1904 年 1 月 1 日。
《華僑日報》，1973 年 3 月 16 日。
Hong Kong Administrative Reports 1917, Hong Kong Government, Appendix F, F7–8;《華僑日報》1966 年 5 月 29 日。
Royal Observatory, Hong Kong, *File No. 23, Meteorological Messages and Storm Warnings (1916–1933);* Royal Observatory Hong Kong, *Hong Kong Storm Signals,* Hong Kong Prison, Stanley, 1938, p. 2.
Royal Observatory, Hong Kong, *Hong Kong Observatory Director's Report 1891,* Hong Kong, Government Printer, p. 1.
Royal Observatory, Hong Kong, *Hong Kong Storm Signals,* Hong Kong Prison, Stanley, 1938, p. 1.

Other Warnings for Severe Weather

The government gradually realised that the priority placed on the tropical cyclone warning system, which was only relevant during the typhoon season, failed to raise the community's awareness over severe weather. To help the public to be better prepared for changing weather, warnings for severe weather were introduced. This started with the introduction of the thunderstorm and heavy rain warnings in 1967, followed by the landslip warning for emergency organizations in 1977, and then the flood warning and the landslip warning for the public in 1983. The heavy rain warning introduced in 1967 was exclusively for the use by government departments and was issued when the hourly rainfall exceeded 50 mm. It sought to enhance the capability of government departments to take preventive measures against natural disasters and was not disseminated to the public. The principal reason was that rainfall amount could vary significantly between regions and issuing such a warning might cause undue inconvenience to those areas not affected by heavy rain.

Since the introduction of the fire danger warning system in 1972 to show the degree of dryness of the atmosphere by means of different coloured warnings, the warning systems have become more refined. The original colour-coded amber and red landslip warning signals introduced in 1977 to alert various emergency organizations was simplified in 1983 to a single warning serving all sectors of the community. The heavy rain warning in 1967 was also modified in 1992 to a rainstorm warning system with green, amber, red and black signals to warn the different degrees of severity of rainstorms. These precautionary measures augmented the degree of preparedness against the destruction triggered by severe weather conditions. In 1999, the cold weather warning was introduced to give early warnings to people suffering from respiratory diseases, the very young and the elderly, while the very hot weather warning advised the public to be protected from the possibility of heatstroke. These highly effective early warning measures and weather reports have gradually become important guidelines for the public in their daily lives (see Table 4.9 for the evolution of warning symbols for severe weather).

其他惡劣天氣警告信號

政府逐漸發現只側重於颱風季詳的警報系統，未能完全提高市民在惡劣天氣下的警覺性。為教育市民在天氣變化時的應變方法，天文台提出一系列的惡劣天氣警報系統。 1967 年雷暴及暴雨警告信號是繼颱風警告信號後，首先實施的惡劣天氣預警信號。1977年增加了只發放給應急機構的山泥傾瀉警告，然後1983年引入了公開發佈的水浸警告信號和山泥傾瀉警告信號。暴雨警告信號最初是以每小時降雨量多於 50 毫米時發出的，專供政府部門內部使用，以提高政府部門對自然災朗的預防工作能力，而不公開發報，最主要原因是降雨量在不同區域可能會有相當大的差異，一些公開發佈的預警措施可能會引起沒有下雨區域的不便。

自1972年利用不同顏色火災危險警告訊號顯示空氣的乾燥程度後，天文台逐步以不同顏色顯示自然災朗的危險程度，警報信號系統慢慢變得更仔細。1977年只提供給應急機構的黃色及紅色山泥傾瀉警報系統，在 1983 年已被簡化和公開發報；1967年的暴雨警告亦演進為1992年的綠色、黃色、紅色及黑色的暴雨警告信號，配合不同程度的惡劣天氣。這一切可以說為預防惡劣天氣帶來嚴重災朗作了防範未然的準備。 1999 年增加了寒冷天氣警告，照顧患有呼吸氣道疾病及年幼或年老者的健康；而酷熱天氣警告則提醒市民中暑的危險。預警措施的細緻使市民的日敘生活因而得到全面照顧，天氣報告亦逐漸成為每一位市民預備每天起居的重要指標 (有關各惡劣天氣警告信號的演變可參閱表 4.9)。

Table 4.9 Evolution of Warning Symbols for Severe Weather

Warning Type	Year	Warning Icon	Warning Name	Description
Thunderstorm	Apr 1967		Thunderstorm Warning	Rainstorms and thunderstorms are expected within six hours.
	1997		Thunderstorm Warning	Thunderstorms expected within four hours.
Rainstorm	Apr 1967		Rainstorm Warning Signal	More than 50 mm (2 in) of rainfall recorded during the past hour.
	1992		Green Rainstorm Signal	Significant amount rainfall is forecast within the next 12 hours.
			Yellow Rainstorm Signal	More than 50 mm of rainfall is forecast in the Hong Kong region within six hours.
			Red Rainstorm Signal	Rainstorm has commenced and within the last hour or less, more than 50 mm of rainfall has fallen over a wide area.
			Black Rainstorm Signal	More than 100 mm of rainfall has fallen within the past two hours or less.
	Mar 1998		Yellow Rainstorm Warning	Heavy rain has fallen or is expected to fall, exceeding 30 mm in an hour. The heavy rain may lead to the red or black warning symbol.
			Red Rainstorm Warning	Heavy rain has fallen or is expected to fall, exceeding 50 mm in an hour. The heavy rain may lead to the black warning symbol.
			Black Rainstorm Warning	Very heavy rain has fallen or is expected to fall, exceeding 70 mm in an hour, and is likely to continue.
Flood	1971		Shing Mun Reservoir Flood Warning	The Shing Mun Reservoir or the Lower Shing Mun Reservoir water level has exceeded the security line and may lead to overflowing.
	1983		Flooding Warning	The issuance criterion is based on rainfall amount.
	Mar 1998		Special Announcement on Flooding in the Northern NT	Issued whenever heavy rain affects the area and flooding is expected to occur or is occurring in the low-lying plains of the northern New Territories.
Landslip	Apr 1977		Yellow Landslip Warning	–
			Red Landslip Warning	–
	1983		Landslip Warning	–
	1998		Landslip Warning	Apart from the rainfall rate of the day, reference is made to the rainfall amount and conditions of the previous 15 days. When Hong Kong comes under heavy rain and more rainfall is expected within the next few hours, the Observatory will consult the Geotechnical Engineering Office and issue a landslip warning if they consider that landslips are likely to occur as a result.
Strong Monsoon	1947		Strong Monsoon Signal	Mainly issued in winter when strong monsoons are blowing. During 1954–55, this service was suspended as the Chinese government stopped providing Hong Kong with meteorological information.

表 4.9 惡劣天氣警告信號的演變

警告訊號類別	年份	警告訊號圖示	警告信號名稱	內容
雷暴	1967 年 4 月		雷暴警告	6 小時內會發生暴雨或雷暴。
	1997 年		雷暴警告	未來 4 小時內會發生雷暴。
暴雨	1967 年 4 月		暴雨警告信號	表示過去 1 小時內錄得超過 50 毫米 (2 吋) 的雨量。
	1992 年		綠色暴雨警告信號	預測未來 12 小時內可能有顯著的雨量。
			黃色暴雨警告信號	預料在未來 6 小時內，香港境內會有超過 50 毫米的雨量。
			紅色暴雨警告信號	表示暴雨已經開始，在過去一小時或更短的時間內，香港廣泛地區錄得超過 50 毫米雨量。
			黑色暴雨警告信號	在過去的兩小時或更短時間內，香港境內錄過 100 毫米雨量。
	1998 年 3 月		黃色暴雨警告信號	表示香港廣泛地區已錄得或預料會有每小時得超雨量超過 30 毫米的大雨。大雨將可能進一步發展至紅色或黑色暴雨警告。
			紅色暴雨警告信號	表示香港廣泛地區已錄得或預料會有每小時超過 50 毫米的大雨，雨勢可能持續。
			黑色暴雨警告信號	表示香港廣泛地區已錄得或預料會有每小時雨量超過 70 毫米的豪雨，雨勢可能持續。
水浸	1971 年		城門水塘水浸警告	城門水塘或城門下水塘存水量超越警界線，可能導致水塘滿溢。
	1983 年		水浸警告	發出此警告的準則是根據降雨量多少。
	1998 年 3 月		新界北部水浸特別報告	當新界北部低窪地帶受到大雨影響並預料會出現水浸。
山泥傾瀉	1977 年 4 月		黃色山泥傾瀉警告	–
			紅色山泥傾瀉警告	–
	1983 年		山泥傾瀉警告	–
	1998 年		山泥傾瀉警告	除根據當日降雨率外，並參考過去 15 日左右的雨量及下雨情況。當本港受大雨影響並預料未來數小時仍然有大雨，香港天文台與土力工程處商議後認為可能發生山泥傾瀉，會發出因大雨引致山泥傾瀉的警告。
強烈季候風	1947 年		強烈季候風信號	主要是冬季出現強烈季候風時懸掛，1954–55年曾因中國停止提供香港氣象資料而終止。
	1997 年		強烈季候風信號	當香港正受強烈季候風影響或預料未來 12 小時內港內和沿岸海域將會吹強烈季候風信號，風速已經或將會超過每小時 40 公里。在十分空曠的地十分空曠的地方，季候風的風速可能超過每小時 70 公里。此項警告不適用於由熱帶氣旋引起的強風。預計東北季候風強勁，寒冷及乾燥，將造成新界空曠地區若干農作物受損傷害。

Strong Monsoon (cont.)	1997		Strong Monsoon Signal	Issued when strong monsoon winds are blowing or expected within the next 12 hours with wind speed in excess of or are expected to exceed 40 km/h. In very exposed places, monsoon winds may exceed 70 km/h. This warning is not issued when tropical cyclone signals are in force. The strong, cold and dry northeasterly monsoon may cause damage to crops in exposed regions in the New Territories.
Fire	1968		Hill Fire Warning Signal	The dry weather is prone to the outbreak of hill fires. This warning signal was only used during holidays.
	Oct 1972		Yellow Fire Danger Warning	When the atmospheric relative humidity drops to a certain level the vegetation dries out and poses a fire risk. This warning is issued when the fire risk is high.
			Red Fire Danger Warning	This warning is issued when the fire risk is extreme.
Frost	Nov 1968		Frost Warning Signal	This warning is issued whenever ground frost is expected to occur on high ground or inland in the New Territories.
Cold weather	1999		Cold Weather Warning	It is expected that Hong Kong will come under the influence of cold weather.
Very hot weather	1999		Very Hot Weather Warning	It is expected that the weather will be very hot and sunny.

Sources:
HKSAR Government Home Affairs Department website, <http://www.info.gov.hk/had>.
Hong Kong Observatory, *Hong Kong Annual Departmental Report by the Director, Royal Observatory,* for the financial years 1954–55, 1966–67, 1968–69, 1970–71, 1972–73, 1977–78, 1999–2000, Hong Kong, Government Printer, 1955, 1967, 1969, 1971, 1973, 1978, 2000.
Hong Kong Observatory pamphlets: 'Rainstorm Warnings', July 1997; 'Strong Monsoon Signal', February 2002; 'North New Territories Flood Warnings', May 1998; 'Landslide Warnings', May 1998; 'Fire Warnings', 'Cold Weather Warnings and Very Hot Weather Warnings'.
Hong Kong Observatory weather website, <http://www.weather.gov.hk>.
Ming Pao, 9 February 1972; 18 June 1983.
Sing Tao Daily, 9 December 1969.
Tai Kung Pao, 21 June 1993; 28 July 1994.
Tsing Ma Management website, <http://tsingma.com.hk>.
Wen Wei Po, 17 April 1998.

Relief for the Needy

Hong Kong's climate and geographical conditions have placed it under the perennial threat of typhoon, flood, rainstorm and drought. Natural disasters were the major impediment to Hong Kong's development before the 1980s. What caused the most concern was the unpredictability and destructiveness of natural disasters. In pace with the progress made on the economic front after the Second World War, Hong Kong was able to commit vast economic resources to enhance its defence capability against such disasters. The will to

火災	1968 年		山火警告信號	表示天氣乾燥容易發生山火，此警告信號只在假期發佈。
	1972 年 10 月		黃色火災危險警告	當大氣的相對濕度下降至某限度而草木乾燥，就會發出火災危險警告。黃色火災危險警告表示火災危險性頗高。
			紅色火災危險警告	當大氣的相對濕度下降至某限度而草木乾燥，就會發出火災危險警告。紅色火災危險警告表示火災危險性極高。
霜凍	1968 年 11 月		霜凍警告	預料高山上或新界內陸地區可能出現地面霜。
寒冷	1999 年		寒冷天氣警告	預料香港會受到寒冷天氣影響。
酷熱	1999 年		酷熱天氣警告	預料天氣酷熱及天色晴朗。

資料來源：
Hong Kong Observatory, *Hong Kong Annual Departmental Report by the Director of Observatory,* for the financial years 1954–55, 1966–67, 1968–69, 1970–71, 1972–73, 1977–78, 1999–2000, Hong Kong, Government Printer, 1955, 1967, 1969, 1971, 1973, 1978, 2000.
《大公報》，1993 年 6 月 21 日；1994 年 7 月 28 日。
《文匯報》，1998 年 4 月 17 日。
《明報》，1972 年 2 月 9 日；1983 年 6 月 18 日。
《星島日報》，1969 年 12 月 9 日。
青馬管理公司網頁，<http://tsingma.com.hk>。
香港天文台，「雷暴警告」單張，1997 年 7 月；「暴雨警報係統」單張，1998 年修訂本；「新界北部水浸特別報告」單張，1998 年 5 月；「山泥傾瀉警告」單張，1998 年 5 月；「強烈季候風信號」單張，2002 年 2 月；「火災危險警告」單張；「寒冷及酷熱天氣警告」單張。
香港天文台網頁，<http://www.weather.gov.hk>。
香港特別行政區政府民政事務總署網頁，<http://www.info.gov.hk/had>。

濟急扶危

香港的客觀自然氣候及地理環境，使香港長年受到風災、水災、雨災及旱災的威脅，自然災害仍是 1980 年代以前香港社會發展的主要障礙。天災的駭人之處，在其不能預估的突發性及驚人的破壞力。隨著社會經濟的進步，香港社會戰後開始投入大量經濟資源，提高防禦自然災害的能力，這種敢於面對大自然挑戰的毅力，正好反映著二十世紀中期以後社會發展的潛能。

根據第二章有關自然災害的回顧的資料顯示，自十九世紀末至二十一世紀初，百多年以來本港發生最大的自然災害以 1874 年的風災、 1906 年的風災、 1937 年的風災、 1962 年的風災、 1963 年的旱災及 1972 年的雨災最為嚴重。1960年代以前的自然災害，巧合地每隔30年左右出現一次，而其中以風災的損毀性較嚴重。

meet the challenge of nature is a reflection of the pace of social development in the late nineteenth and early twentieth centuries.

According to the review made in Chapter 2 on natural disasters from the late nineteenth century to early twenty-first century, the most destructive episodes were the typhoons of 1874, 1906, 1937 and 1962, the drought in 1963 and the rainstorms in 1972. By sheer coincidence, the natural disasters that struck before the 1960s took place once every 30 or so years, and typhoons tended to wreak the most havoc.

Priceless Life

Looking at the natural disasters in the past century or so, one discovers that the last years of the nineteenth century and the early years of the twentieth century had the highest human casualty numbers. The casualties of the 1874, 1906 and 1937 disasters were probably higher than the official figures, as most of the casualties were fisherfolk and the newspaper reports failed to include the migrant population in the death toll. As society developed, the casualty figures from natural disasters went on a downward trend. The two most destructive natural disasters after the war were inflicted by Typhoon Wanda in 1962 and the landslides on 18 June 1972, with hundreds of deaths and thousands of people injured. However, these figures pale when compared to the casualties of the 1906 and 1937 typhoon disasters. Changes in government disaster relief policies have contributed significantly to reduced casualties.

From the mid-nineteenth to mid-twentieth centuries, the government had placed emphasis on rehabilitation work in the wake of natural disasters instead of taking preventive measures. The rehabilitation measures had two aspects — rescue and relief. Rescue work was carried out by various government departments, with the relief work largely assumed by non-government bodies of different backgrounds.

In general, the pre-1930s official rescue efforts were mainly the domain of the police, with the other disciplined services playing supporting roles. Before the setting up of professional rescue teams in the 1960s, disaster rescue work was only a temporary work assignment for the police.[216] The nature of the work changed according to the specific needs of each incident: from rescuing victims, to recovering victims' bodies, giving assistance to victims' families on burial arrangements, and rebuilding homes.[217] The government had not set up specific departments to handle disasters, so the services rendered were rather restricted. The government had adopted a passive attitude mainly

生命有價

縱觀一個多世紀以來的自然災害，發現人命傷亡的情況，以十九世紀末二十世紀初最為嚴重。估計1874年、1906年和1937年的實際傷亡數字最多，由於死者多為流動的水上人口，報章紀錄實難以反映實況。隨著社會的發展，天災中傷亡數字亦有逐漸減少的趨勢。被視為戰後傷亡最嚴重的1962年溫黛風災及1972年六一八山泥傾瀉，雖然死亡人數多達數百，受傷者有數千，但遠較1906年及1937年的風災為少。政府的救災政策的改變，是傷亡人數減少的主因。

自十九世紀中期至二十世紀中期的整整一個世紀，政府處理災難的緊急應變措施，側重災後的善後工作，少作預防準備，而善後的措施又可分為救援及賑濟兩部分，救援工作由政府多個部門協力承擔，而災後的賑濟則主要由來自不同背景的民間團體提供支援。

整體來說，1930年代以前的救援工作，政府部門主要以警隊為主力，其他的紀律部隊只扮演支援的角色；在1960年代專業救援隊伍成立以前，救災只是當值警員的臨時職務。[216] 而救援服務的性質亦因應每次災難的需求而改變。從拯

Fig. 4.43 Temporary shelters were severely overcrowded during Typhoon Carmen's onslaught in 1974. Courtesy Hong Kong Museum of History

圖 4.43 1974年颱風卡門襲港，臨時庇護站擠得水洩不通。香港歷史博物館館藏

because it believed that natural disasters were unpreventable and that human efforts could never overcome nature. This was well illustrated by the incident on 30 August 1923 when Legislative Councillor H. E. Pollock proposed at a Legislative Council meeting for the establishment of rescue facilities at Victoria Harbour during typhoons to rescue ships in distress. This suggestion was roundly rejected by the then Acting Colonial Secretary, A. G. M. Fletcher, as being unfeasible. His citation of the typhoon onslaught in 1906 which the government was only able to render scant assistance, demonstrated clearly the passive stance of the government.[218] The Harbour Master's Department even levied charges for towing services during typhoons. The towing fees were determined by wind strength and different charge categories were devised in accordance with the hoisting of the red wind warning, the black wind warning and the black

Fig. 4.44 Typhoon victims looking helpless and forlorn after losing their homes (1964). Courtesy Hong Kong SAR Information Services Department

圖 4.44 因颱風而痛失家園的災民，一臉失望無助（1964年）。香港特別行政區政府新聞處檔案

救遇難者、找尋遇難者的屍體，到協助遇事者家屬辦理後事、重建家園，[217] 救援工作覆蓋範圍相當廣泛及繁瑣，政府當局卻沒有因應繁瑣的工作，設立專責部門，可想而知所提供的服務是有一定的限制的。政府對救援工作採取被動態度，主要是因為政府仍認為天災是不可預防，及人是無法戰勝大自然的；以下事例便是一個明證：1923 年 8 月 30 日定例局（現立法會）會議中議員普樂（H. E. Pollock）請求颱風期間在維多利亞港設置海港救援措施，拯救遇難船隻，為當時的代布政司費力查（A. G. M. Fletcher）力指不可行，並援引1906年颱風的情況為例，印證風雨期間政府當局難以伸出援手，可窺見政府面對天災採被動的做法。[218] 政府船政署於颱風期間提供的拖船服務需徵收拖帶費，收費一般按照風力

Fig. 4.45 In the aftermath of Typhoon Wanda in 1962, the government distributed rice to the victims. The extent of poverty in the 1960s was such that spades and paper bags were used for distribution. Courtesy Hong Kong SAR Information Services Department

圖 4.45 1962 年溫黛風災後，政府向災民分發米飯。從當局用鐵鏟分飯，災民用紙袋盛載米飯的情景，可見 1960 年代老百姓的生活貧困。香港特別行政區政府新聞處檔案

cross wind warning. The higher the wind strength the higher the towing charge; the highest rate could cost as much as half the annual ship licence fees.[219] Ships that were in distress within the harbour and sought assistance were not regarded as emergency cases. This clearly shows that rescue work was neglected. Fortunately, the government still put considerable resources into rehabilitation work such as the repair of roads, piers, government structures and public facilities. The Public Works Department carried out comprehensive evaluation of the extent of damage after each major disaster. After the government had considered the financial implications, resources would be allocated for the reconstruction works.[220]

Before the mid-twentieth century, disaster relief work was mostly led by religious bodies, community groups and private organisations. The more prominent groups were the Hong Kong General Chamber of Commerce, Chinese Chamber of Commerce, Tung Wah Hospital, Po Leung Kuk, Jardine, Matheson & Co., John Swire & Sons, Chung Sing Benevolent Society, the Protestant and Catholic groups, etc. Besides distributing clothes and food to the victims to meet their short-term needs, these groups also provided temporary shelters and help them deal with their personal problems. Government relief was usually made in the name of consulates or foreign ministries; rarely was money allocated directly by the government.

In the first half of the twentieth century, of all the preventive measures promoted by the government, typhoon shelters proved to be most effective. When a typhoon was approaching, fishing boats would take refuge in the typhoon shelters. The first shelter — Causeway Bay Typhoon Shelter — was constructed in 1883, with a breakwater of 1,400 feet,[221] but it could only accommodate a very limited number of vessels.[222] Due to financial restraints, the government had not been able to build a second typhoon shelter; it was also facing many difficulties expanding the existing shelter. In 1904 and 1906, under interrogation from members of the Legislative Council, the government still failed to respond to the proposal made by the Hong Kong General Chamber of Commerce and the legislators for an extension to the Causeway Bay Typhoon Shelter.[223] On 18 September 1906, a typhoon destroyed over 3,650 fishing boats and killed nearly 15,000 people.[224] It was a horrifying experience and the Causeway Bay Typhoon Shelter extension issue drew widespread discussions. In March 1908, the government accepted the 16 July 1904 extension proposal made by the Hong Kong General Chamber of Commerce. The depth of the shelter was increased by nine feet. After the extension, the Causeway Bay Typhoon Shelter had an area of 75 acres. On the other hand,

的大小分為三等：懸掛紅色風球、黑色風球及黑色十字風球收費均不同，風力愈大收費愈高，最高可達該船隻半年的牌照費，[219] 港口的船隻遇事需協助竟未列為緊急救援，可見拯救工作備受輕視。幸而政府仍會將資源放在災難的善後工作，如道路、碼頭、政府建築物等公共設施的重修。每次巨大的災難以後的重建工作，由工務局就本港的損毀程度作全面的評估，再經過政府考慮財政狀況，作審慎的調配。[220]

在二十世紀中期以前，賑濟災民的工作，主要由宗教組織、民間團體及私人機構領導，較受社會重視的民間組織包括西商會、華商會、東華醫院、保良局、怡和洋行、太古洋行、鐘聲慈善社、基督教及天主教修會等等，民間慈善團體除向災民派發短期內所需衣物和食品外，更提供暫居的地方，解決災民困苦，政府的賑濟，多以領使館或外交部名義施予，鮮有由政府直接撥款。

Fig. 4.46 Government agencies provided emergency relief for the disaster victims (1971). Courtesy Hong Kong SAR Information Services Department

圖 4.46 政府部門向災民發放緊急救援資助，紓解民困 (1971年)。香港特別行政區政府新聞處檔案

a sum of HK$1,540,000 was allocated to build another typhoon shelter at the bay in front of Mong Kok Tsui (Yau Ma Tei), with an area of around 166 acres.[225] The legislation to approve the construction was passed in 1909,[226] and the project was completed in August 1915. Known as the Yau Ma Tei Typhoon Shelter, it overran the budget by HK$649,000.[227] In 1953, the government needed to carry out reclamation works at the site occupied by the Causeway Bay Typhoon Shelter and the shelter was relocated to the northern part of the original site.[228]

On 2 September 1937, Hong Kong waters were again under the onslaught of a severe typhoon, with Cheung Chau the hardest hit area. This revealed the inadequacy of having just two typhoon shelters to protect fishermen. On the brink of the Sino-Japanese War, the government did not have either the time or resources to improve typhoon precautionary measures. Although the government had once considered the establishment of a typhoon shelter harbour at Cheung Sha Wan, Stonecutters Island or even the bay area of Kennedy Town, it was not until 1962 that Hong Kong had the third typhoon shelter — the Aberdeen Typhoon Shelter. The two earlier-built typhoon shelters were, however, the main places of refuge for fishing boats during the passage of typhoons before the 1960s. They were under the joint administration of the Marine Police and the Marine Department.[229] Large-scale construction of typhoon shelters only began in earnest in the early 1960s.

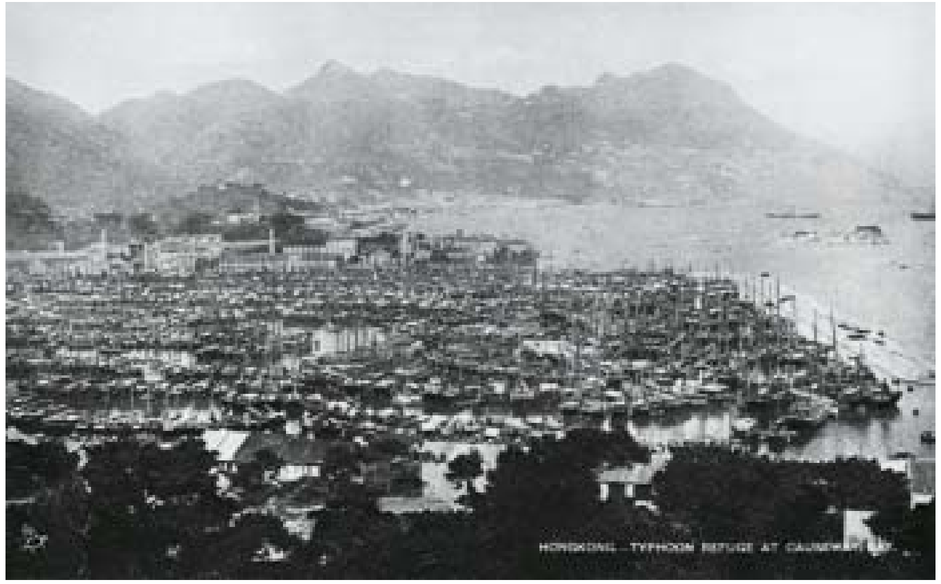


Fig. 4.47 The Causeway Bay Typhoon Shelter was built in 1883 (ca. 1910s). Courtesy Hong Kong Museum of History

圖 4.47 建成於 1883 年的銅鑼灣避風塘 (1910 年代)。香港歷史博物館館藏

在二十世紀前半期，政府所推行的各種防災措施，以興建避風塘最具防災能力。每當風雨吹襲，漁船必先往避風塘暫避，逃過災難。香港的第一個避風塘——銅鑼灣避風塘，於1883年建成，初建時防波堤長1,400呎，[221] 可容納船隻甚少，[222] 但礙於資源缺乏，政府一直無法增建另一避風港，甚至要擴建原有的銅鑼灣避風塘也感到困難重重。1904年、1906年，面對定例局議員的質詢，政府仍未能就西商會及議員對擴建銅鑼灣避風塘的建議作回應。[223] 1906年9月18日的颱風，吹毀的漁船多達3,650多艘，喪生者接近1.5萬，[224] 觸目驚心，擴建避風塘的問題，得到廣泛討論。1908年3月，政府接受西商會於1904年7月16日的建議，加深銅鑼灣避風塘港灣9呎，擴建後的銅鑼灣避風塘面積達75英畝 。另一方面，又計劃動用資金154萬港元，於望角咀 (油麻地) 對開的港灣，興建另一個面積約有 166 英畝的避風港，[225] 1909 年正式立法通過興建，[226] 工程於 1915 年8月竣工，油麻地避風塘所動用的經費較原先計劃多了64.9萬港元。[227] 1953年，政府需在原有的銅鑼灣避風塘進行填海工程，故將銅鑼灣避風塘移往原址北端。[228]

Fig. 4.48 Yau Ma Tei Bay in the 1880s. It was transformed into a typhoon shelter in 1915. Courtesy Hong Kong Museum of History

圖 4.48 1880 年代的油麻地港灣，該地於 1915 年建為避風塘。香港歷史博物館館藏

In August 1960, the government set up a committee to investigate the typhoon shelters and the berthing situation, under the chairmanship of the Director of the Marine Department. Statistics provided by the Marine Department found that, in the year 1959–60, there were a total of 31,263 registered fishermen households. But the 1960 census statistics showed only 24,137 such households, while the 1961 figures were 21,292. It was thought that the census statistics excluded fisherman who had gone out to sea. The investigating committee pointed out that for a floating population of 31,263 households, a shelter area of 611 acres would be required to berth the fishing boats during the passage of a typhoon. This figure did not include the fishing boats sailing in from China during the typhoon. Based on observations carried out during the passage of Typhoon Mary, the migrant boat population was about 18,868 households. It would have required another 397 acres of shelter space to accommodate these boats.

With the above figures, the committee worked out that the required typhoon shelter space for Hong Kong should be based on the average of Hong Kong's fishermen and migrant households. It estimated that in 1960 Hong Kong needed approximately 504 acres of typhoon shelter space. The distribution should be: 109 acres for the western district, 350 acres for Victoria Harbour and the outlying islands, and 45 acres for the eastern district. The actual situation was: the western district had 42 acres, Victoria Harbour and the outlying islands had 180 acres, the eastern district had 45 acres; with a total space of only 267 acres — a shortfall of 237 acres. The shelter space was far too inadequate and it was estimated that 53% of the fishing boats were unable to find shelter during adverse weather.

To keep a tight rein on the berthing situation, the government only allowed local fishing boats and small vessels to berth in typhoon shelters on a permanent basis. An annual sum of HK$110,000 was allocated to the Marine Department to provide enforcement manpower and the government planned to add more typhoon shelters in various districts. In the early 1970s, if the fishermen household numbers had remained unchanged, the existing shelters would have been adequate. It cost an average of HK$3,150 per fishing boat or HK$525 per fisherman to extend the shelter space. At the same time, the government gave special incentives to fishermen who were willing to go on shore and resettle. The resettlement cost per household was between HK$330 and $465. Since the 1960s, the floating population of Hong Kong has been on the decline. In 1971, the floating population fell from 136,802 in 1961 to 79,894, a drop of 41.6%. By 2001, the floating population was further

1937年9月2日，香港海面再一次受颱風蹂躪，其中以長洲的損毀程度最為嚴重，反映當時僅存的兩個避風塘並未能照顧漁民需求。由於中日戰爭爆發在即，政府沒有時間及資源改善防風措施，雖然政府曾考慮在長沙灣、昂船洲，甚至堅尼地城的港灣興建避風港，但一直要到1962年香港才於香港仔興建第三個避風塘。銅鑼灣及油麻地兩大避風塘在1960年代以前，是香港漁船主要的避風港，一直由水警及海事處共同管理。[229] 避風塘的興建，要到1960年代初期才大規模開展。

1960年8月，政府組成避風塘及船隻停泊狀況調查委員會，由海事處處長出任主席。該調查委員會根據海事處資料統計：1959至60年全港登記的漁民有31,263戶。但根據政府1960年的人口統計，是年漁民只有24,137戶，1961年則有21,292戶，估計該統計數字並未包括已出海作業的漁民在內。委員會指出全港31,263漁戶遇颱風侵襲時，約需611英畝的港灣停泊船隻。該數字並未包括颱風襲港時來自中國海域的漁船。據1960年颱風瑪利襲港時觀測所得，流動的漁船約有18,868戶，約需避風港面積397英畝作停泊船隻之用。

委員會根據上述數字推算：颱風季節本港所需的避風塘應為全港登記漁戶及臨時駛入漁船二者的平均數。故估計本港在1960年約需504英畝的避風塘，其分佈應為西區109英畝、維港及離島350英畝、東區45英畝。當時全港的避風港的實際面積為西區42英畝、維港及離島180英畝、東區45英畝，總數只有267

Fig. 4.49 Aberdeen harbour in 1920s. It was transformed to a typhoon shelter in 1962. Courtesy Hong Kong SAR Public Records Office

圖 4.49 1920年代的香港仔，該地於1962年建為避風塘。香港特別行政區歷史檔案館館藏

reduced to only 5,895. Urbanisation was a major factor behind the drastic fall in the floating population.[230]

Improved Living Conditions

The capability to defend against natural disasters has grown in tandem with society's economic progress, but the rapid population rise, especially the working population, has made the implementation of preventive measures increasingly difficult. The following statistics on people residing in cottage areas and temporary housing areas reveal clearly the seriousness of the situation. According to surveys made by the Census and Statistics Department and the Housing Department, the population in temporary housing areas has until recently been on an escalating trend since the 1950s. In 1954, approximately 46,000 Hong Kong residents lived in cottage areas. That number rose to 88,000 in 1961, with another 800,000 residing in temporary housing areas. By 1971, the cottage area population came to 56,000, with another 320,000 living in temporary housing areas, and 287,000 residing in squatters. This suggested a slightly downward trend; but it was not until the 1980s that significant reductions were observed. In 1996, the temporary housing population came down to 42,000, while the squatters housed another 236,000.[231] Those residing in substandard housing were the main victims of natural disasters. From the 1950s to 1970s, the bulk of damage inflicted by natural disasters was due to collapsed houses. Improvements in living conditions had to be deferred until 1980s when the government began its large-scale public housing estate construction programmes.

Disaster Relief Measures

The 1950s could be seen as a watershed: government disaster relief work was shifting from passive to active mode, and from performing merely post-disaster rehabilitation work to undertaking precautionary measures. In line with Hong Kong's rapid economic development and population increase, the government had far more resources at its disposal. In response to social demands, it established specific departments responsible for disaster relief and rehabilitation work in order to mitigate the destructiveness of natural disasters. Consequently, the Social Welfare Department was established in 1958, to be responsible for rendering help to disaster victims. The General Chinese Charities Fund and the Chinese Temples Fund administered by the Social Welfare Department were the main donors towards disaster relief. In addition, civic associations

英畝，較應有的504英畝少了237英畝，可見避風塘面積狹小，估計約有53%的漁船在惡劣天氣下無處容身。因此，政府需一方面控制船隻停泊避風塘的情況，只准許本港漁船及船隻長期停泊於避風港內，而海事處派出人手控制需撥款每年11萬港元。政府計劃於本港多區興建更多避風塘，倘在1970年代初，漁戶的數目維持不變，則避風塘的數目可足夠應用，而擴建避風塘費用約為每艘漁船3,150元或每個漁民525元。另一方面，政府為自願放棄漁船上岸的漁戶推行優先安置計劃，每戶需費約330至465元。全港水上人口數字自1960年代以來不斷下降，1971年全港水上人口從1961年的136,802人減至79,894人，減幅達41.6 %；2001年全港水上人口只有5,895人，[230] 城市的發展是水上人口減少的原因之一。

Fig. 4.50 The Aberdeen Typhoon Shelter in 1988 was very different from the one in the 1920s. Courtesy Hong Kong SAR Information Services Department

圖 4.50 1988年的香港仔避風塘的面貌與1920年代的實有天淵之別。香港特別行政區政府新聞處檔案

that came under the supervision of the government, such as the Kai Fong welfare advancement associations and the New Territories rural committees, also made active contributions towards the relief efforts.[232] The involvement by other non-government bodies such as chambers of commerce, village associations and clanship associations in relief work was relatively reduced. The Social Welfare Department assumed the co-ordinating role in the distribution of food and clothing, and the arrangement of temporary shelters for the victims.

Towards the end of the 1960s, the government set up emergency control centres to provide round-the-clock emergency rescue services. The participating government departments included the Hong Kong Observatory, Public Works Department, Hong Kong Police Force, Fire Services Department, Marine Department, Civil Aviation Department, Social Welfare Department, Medical and Health Department, Resettlement Department, New Territories Administration, Radio Hong Kong, Department of Agriculture and Fisheries and the Information Services Department.[233] In the 1970s, several units were set up to handle the rehousing of people living in boats, rooftop huts and unsafe wooden buildings. They were to warn the residents through broadcasts of the possible danger and render rehabilitation assistance after disasters struck.[234] Temporary shelters were put in place on Hong Kong Island, and in Kowloon and the New Territories. Take Typhoon Elsie as an example. This typhoon affected Hong Kong between 12 and 15 October 1975. At the time there were 50 temporary shelters on the Island, 61 in Kowloon and three in the New Territories. The shelters were mainly set up in community and social centres, and on primary and secondary school premises.[235] During the passage of Typhoon Hope between 1 and 3 August 1979, the government opened 191 temporary shelters, arranged temporary housing and distributed food and other necessities to over 3,000 people.[236] In 1983, the number of temporary shelters rose to 250.[237] By the early 1990s, the government had markedly improved its relief services during cold weather spells. As well as opening more temporary shelters to those in need, it also sent social workers to visit old people living on their own.[238] In early 2000, to prevent the spread of influenza among the elderly and the very young, the government provided free influenza vaccinations for the old and the young.

After the destructive landslides of 1972, the government established the Geotechnical Engineering Office in 1977 to improve and maintain slope safety, and scrutinise closely newly built slopes, with an annual budget of about $600 million.[239] For the year 2001, although the government still received around

改善居住條件

防禦天然災害的能力隨著社會經濟條件改善不斷提高，但在實施上亦隨著人口的急劇增加而變得愈來愈困難，其中勞動人口的不斷增加使防災工作舉步維艱，以下有關木屋區及臨時房屋人口的統計數據可說明情況的嚴峻程度。根據香港政府統計處及房屋署的統計，居住在臨時房屋的居民自 1950 年代起有不斷上升的趨勢，1954 年全港約有 4.6 萬居住在木屋的居民，1961 年增至 8.8 萬，而居住在臨時房屋者有 60 萬人。1971 年居住在木屋區者有 5.6 萬，臨時房屋者有 32 萬人，寮屋則有 28.7 萬；雖然有輕微下降趨勢，但要到 1980 年代才有較明顯改善。1996 年全港居住在臨時房屋者有 4.2 萬，居住在寮屋者有 23.6 萬。[231] 住房條件較差的居民是天災的主要受害者，1950年代至1970年代，天災所造成的破壞集中在房屋倒塌，而情況要到 1980 年代政府大規模興建公共屋苑才有所改善。

救災措施

政府的救災工作從被動到主動，從賑濟到防災，1950 年代可以說是分水嶺。隨著香港的經濟發展及人口急增，政府在經濟資源較充沛的情況下，因應社會的需求，設立一些專責救災工作的部門去減低自然災害所造成的破壞，因此，1958年社會福利署成立，專責賑濟災民，由社會福利署直接管轄的慈善基金包括華人慈善基金、華人廟宇基金都是賑災的主力；此外，街坊福利會、新界鄉村事務委員會等一些由政府監管的民間社團亦積極肩負起賑災的任務。[232] 一些民間的私人團體如商會、同鄉會、氏族宗親會等所發揮的賑災力量相對地減弱了。而有關臨時衣物、食品的派送及提供臨時居所等工作，亦由社會福利署統籌辦理。

1960年代末期，政府設立緊急控制中心，提供全日24小時緊急救災服務。參予戒備工作的政府部門包括天文台、諮詢指導處、工務署、警務署、消防事務處、海事處、民航處、社會福利署、醫務衛生處，徙置事務署、新界民政署、香港電台、漁農處及政府新聞處。[233] 1970年代，一些專為水上、天台木屋、木樓危樓居民安置的專責小組紛紛成立，為居住環境惡劣的居民提供事先預警及善後援助服務。[234] 颱風的庇護站更分設於港島、九龍及新界各區，以 1975 年 10 月 12 至 15 日，颱風愛茜襲港事件為例，當時港島的避風站有 50 個、九龍 61 個、新界則有 3 個，避風站主要是一些社區中心及中小學校，[235] 1979 年 8 月 1 至 3 日，颱風荷貝襲港期間，政府開設的庇護站達191個，安排臨時住宿、派發食物及濟急物品，逾 3,000 多人受惠，[236] 1983 年庇護站增至 250 個。[237] 1999 年代開始，政府就嚴寒氣候對社會的服務有明顯的增加，除於氣候寒冷時開放更多的

300 to 400 reported incidents involving man-made slopes, retaining walls and natural slopes, most of them were damage caused by slope surface erosion. The incidence of landslips resulting in human casualties and blocked roads has been greatly reduced.

By the latter part of the 1970s, threats posed by natural disasters had discernibly weakened. The relevant government departments actively led the relief work and promoted new preventive measures such as the provision of additional typhoon and temporary shelters. Instead of relying on voluntary organisations, the government, on its own initiative, distributed money, food and clothing to disaster victims, as well as rendering other forms of assistance. Its efforts extended beyond short-term remedial work; it also actively educated the public on the importance of adopting disaster prevention measures. All this work has confirmed the proactive stance of the government. The improving ability to defend against natural disasters and increasingly high values placed on human lives also symbolise society's progress.

Conclusion

The meteorological observation services of the post-war Observatory have moved in step with the progress made in society and become multifaceted. Shedding its pre-war image of serving exclusively the marine and aviation sectors, it has become part of the lives of ordinary people. It has revised its service contents and nature, and assumed the important responsibility of promoting scientific knowledge within the community.

From the end of the Second World War to the mid-1960s, the Observatory strove to keep up the professional image of the department that existed prior to the outbreak of war. Meteorological reports were released via scientific research findings. Improvements in service quality depended largely on the introduction of new scientific knowledge and technologies from overseas. The development of meteorological observation work was dictated by resource allocations. Using its pre-war services as the basis and making adjustments to its development direction based on social needs could be seen as a moderate and safe option. In the first 20 years after the war there was considerable development in Hong Kong's aviation industry and rightfully the focus of the Observatory's services during that period was on aviation weather services.

庇護中心予貧病者，更派社工探訪獨居老人。[238] 2000年初，為預防更多老年人與小孩因寒流患病，開始替年老及年幼者注射預防流感疫苗。

在1972年的山泥傾瀉後，1977年香港政府增設土力工程處以改善及維修斜坡至安全標準，嚴格審核新建斜坡，政府每年動用約六億元經費。[239] 至2001年，雖然政府每年平均仍收到300至400宗人造斜坡、擋土牆和天然山坡事故的報告，但大多只是山坡表面受侵蝕的損毀報告，因山泥傾瀉導致人命傷亡或堵塞道路的情況比率大大減少。

踏進1970年代後期，自然災難對社會的威脅性明顯地減弱，政府的有關部門積極領導救援工作，推出新的防災措施，如加建避風塘、庇護站，不再倚賴志願團體的幫助，主動向災民發放善款、食物和衣物等；提供援助，不僅著重於一些短期的補救工作，更著力推廣預防災難的教育工作，表現了政府積極防災的態度。預防災難的能力的不斷提升，人的生命愈來愈珍貴，亦象徵著社會的進步。

小結

戰後香港天文台的氣象觀測服務，隨著社會的進步變得多元化。天文台的形象一改戰前專為航海及航空界服務的局限，走進每一個市民的生活圈子中，其服務的內容及性質所經歷的調適，背負著推廣科學知識的重責。

戰後至1960年代中期，天文台仍努力維持戰前部門的專業形象，透過科研結果發表氣象報告，因此服務的質素的提升主要倚賴引進新科學及技術，資源的調配主導了氣象觀測工作的發展；而以戰前已開發的服務為基礎，再配合當時的社會需要作發展方向的調整，可以說是一種比較穩健的做法。由於戰後首20年香港空運業務相當發達，故航空氣象服務成了此段時期的服務重點。

1960年代，香港整個城市快速擴張，大型的基建項目如擴建啟德機場、遍及港島、九龍半島、新界等地的大規模填海工程、興建大型水庫、發展衛星城市、擴張公共交通網絡等，政府急需天文台提供如颱風、潮汐漲退及降雨量等的氣象觀測資料，作為工程可行性研究調查的依據；氣象資料因而成了城市建設的安全指標——它綜合及分析了歷年嚴重風災和雨災的經驗，提供災難的數據評估，排除工程計劃對惡劣天氣的疑慮，是1960年代以後香港城市規模得以擴展的關鍵。

In the 1960s, the whole of Hong Kong underwent a period of rapid expansion. Large-scale infrastructure projects included the extension of Kai Tak airport; the reclamation works throughout Hong Kong Island, Kowloon Peninsula and the New Territories; the construction of large reservoirs; the development of satellite towns and the expansion of transportation networks. The government urgently required the Observatory to provide meteorological data on typhoons, tides and rainfall, to be used as reference materials in feasibility studies. Meteorological data thus became safety guidelines for urbanisation. The Observatory summarised and analysed all the serious typhoons and rainstorms of the past and provided data evaluation of disaster incidence. The removal of the severe weather concern from engineering projects was the key to Hong Kong's massive infrastructural expansion since the 1960s.

The involvement of meteorological observations in infrastructural development has drawn the Observatory closer to the lives of ordinary people. In the 1980s, the Observatory took on an additional task of monitoring the environment and provided the public with new information to ensure a healthy life. Reports on radiation monitoring and the ultraviolet index are indispensable reading for twenty-first-century city people. They are also perfect examples of the expansion of services rendered by the Observatory.

In recent years, the Observatory has made a major breakthrough with its image — due largely to improving forecasting accuracy and a reporting style that is increasingly appealing to the public. The Observatory's ground meteorological data for Hong Kong are being enhanced with the assistance of other government departments — such as the Water Supplies Department and the Civil Engineering Department — as well as other private organisations and educational institutions. Meteorological stations are now located all over Hong Kong and have enriched the meteorological database of Hong Kong. The application of modern technologies such as digital radars, satellites and new computer technologies has made enormous contributions to improving the accuracy of weather forecasts. In addition, new dissemination channels such as electronic media and video broadcasts have transformed the traditional and boring weather reporting format to one that is exciting and relevant. The public can now receive simple weather news promptly and show much greater interest in meteorological information. For people living in the twenty-first century, the following are indispensable information for the preservation of their personal safety and health: local weather reports and forecasts, severe weather warnings, and weather reports and forecasts of the major world cities. Such information is vital to the daily lives of ordinary people.

投入社會建設使氣象觀測與普羅大眾現實生活的距離愈來愈近。踏進1980年代，兼顧環境監察工作的天文台，更為每一個市民的健康生活提供新的資訊：輻射監測和紫外線指數報導等服務，就是天文台服務擴展工作範圍的最好例子。

近年來天文台的形象有了很大的突破，天氣預報的準確性不斷提高，以及氣象資料報告的形式愈來愈大眾化，都是主要原因。香港區內地面氣象觀測資料，在政府其他部門如水務署、土木工程署和私人機構、教育機構等協助下，數量日益增加。遍佈全港每一個角落的氣象觀測站，充實了本區氣象觀測的資料庫；而數碼雷達、人造衛星和新電腦技術等現代科學技術及資訊的應用，對提高天氣預測的準確性作出不少貢獻。另一方面，電子媒體和視像廣播等新傳播方法，使天氣報告從傳統枯燥乏味的報導形式變得更生活化，市民可迅速地接收到簡單的氣象訊息，對氣象資訊的興趣也大大提高。今天，本地天氣狀況的報告及預測、惡劣天氣預警報告和世界各大城市的天氣報告、氣象預測，是二十一世紀城市人保障個人生活健康與安全的必要資訊，是市民日常生活的重要環節。

CONCLUSION

Hong Kong has made a remarkable transformation from being a mere fishing village in the mid-nineteenth century into a thriving entrepôt, then a leading processing industry base, and by the end of the twentieth century, a premier international financial centre. External economic and political factors such as the emergence of the Asia Pacific region as a trade power, political changes in China and the rest of the world have contributed to its development. However, the pace of development in the past one and a half centuries has not taken place in tandem with external changes. Its rhythm is distinctive, as the impetus behind the city's development has been shaped by the uniqueness of Hong Kong society. This research into the 120-year history of the Hong Kong Observatory not only traces its establishment and its subsequent development, it also gives a fresh look into the arduous struggles that the people of Hong Kong have put up against nature's challenges. The study represents a new reference source on the unique characteristics that forge the evolution of Hong Kong society.

Due to a dearth of land and other natural resources, before the mid-nineteenth century, Hong Kong only had military value to China as a frontier stronghold but was historically insignificant. In the early 1840s, when Britain established its colonial rule, its intentions were to use Hong Kong as a temporary trading port and an important military outpost in Asia Pacific. No blueprint was drawn up for its long-term development; such state of affairs persisted until the early twentieth century, when significant changes took place.

Fickle climatic conditions had been the major stumbling block to Hong Kong's development in the late nineteenth century. In late spring, just before the arrival of summer, the warm and humid weather conditions are perfect for mosquito breeding and the proliferation of bacteria and viruses that can quickly spread infectious diseases. The summer is hot and rainy, with frequent flooding, while typhoons pose a constant threat to humans and livestock during the summer and autumn months. Such climatological conditions not only impinged on the health and safety of the residents, but also seriously hindered the city's development. To build the infrastructure of the colonial city, the government had to commit vast amounts of resources to counteract such climatic drawbacks. In an environment of inadequate manpower and tight resources, the early colonial officials already encountered great difficulties in adjusting to the harsh tropical climate. The periodic onslaughts of typhoons and rainstorms constantly threatened the construction of the city's infrastructure. While the government

總結

十九世紀中期的香港從一個漁港，發展為貿易中轉站，再臻至加工工業集散地、國際金融中心，外在的經濟及政治因素諸如亞太地區貿易的興起、中國及世界政局的變動等，都是城市發展的動力；但百多年來城市的發展步伐卻沒有完全與外在環境一致，是獨具香港本身的節奏，歸根究底這都是因為城市發展的原動力主要來自香港社會。是次有關香港天文台120年的歷史研究，除展示了香港天文台創立與發展的進程外，更重新回顧近百多年港人面對大自然的挑戰，艱苦奮鬥的經歷，是了解香港社會演變的特質的新塑材。

由於缺乏土地及天然資源，在十九世紀中期以前，香港地區只是中國邊陲的軍事要塞，從未在中國歷史上扮演過重要角色。及至 1840 年代，英國佔領香港建立殖民地初期，亦主要以香港為臨時通商口岸及亞太地區主要軍事據點，並未制定長遠的發展藍圖。這個客觀的事實，一直到了二十世紀初期，才開始有較大的改變。

自然氣候的不穩定，是十九世紀下半期香港發展的主要絆腳石。香港的氣候，春夏之交溫暖潮濕，容易滋生蚊蟲及細菌，加速傳染病的蔓延；夏季炎熱且多雨，水災頻仍；夏秋之際，更有颱風侵襲，人畜安全每受威脅。這些特性不但直接影響居民的健康，更嚴重阻礙了城市的發展，殖民地政府要興建城市的基本設施，必須投放龐大的人力物力，才可補償先天的不足。在人才短缺、資源緊絀的年代，初來港的殖民地政府官員要適應亞熱帶氣候已困難重重，而頻繁的暴風雨，更不斷打擊建城的信心。政府要發展香港為貿易港的信念是相當堅定的，但在欠缺周詳計劃，加上資源匱乏的環境下，城市的發展顯得被動及遲緩。

自然災害雖是早期城市發展的主要障礙，但天氣預測卻未能成為1883年創立的天文台的首要任務，這與 1880 年代天災不可預測的觀念仍相當牢固有關。而另一方面，城市的發展明顯地偏重改善經濟而忽視社會民生。在海上貿易興盛的十九世紀末期，天文台創台的報時服務及有關鄰近地區包括澳門、廣州、海口、開屏、汕頭、福州、開封、東京、長崎、馬尼拉及婆羅乃等地的氣候資訊報導，準確地讓遠洋輪船知道身處的經度，及亞太地區的氣候消息狀況，切合了航海人士及工商業機構的需要，更奠定了香港作為亞太地區轉口貿易重鎮的地位。可惜香港仍未能大力提昇城市防禦天災的能力，居住環境較差的漁民、貧民，依舊是自然災害最大的犧牲者。

香港殖民地政府引入西方的天文觀測方法，既然是以改善港口設施為主，早期的氣象報告自然是著重報導的準確性及客觀性，較少關注天文知識的普及化與其對民生的貢獻，因此，民間仍保留傳統計算時間及預測天氣的方法，與天文台

was unswerving in its commitment to develop Hong Kong into an entrepôt, it lacked comprehensive planning and resources; consequently, the development of the city was sluggish and passive.

Although natural disasters were the main obstacle to the growth of the enclave in the early years, weather forecasting was not given a prominent role on the establishment of the Observatory in 1883. This had much to do with the commonly and strongly-held belief in the 1880s that natural disasters were unpredictable and hence unavoidable. On the other hand, the city's development was leaned heavily in favour of economic enhancements at the expense of social considerations. In the thriving maritime trade era of the late nineteenth century, the time service provided by the Observatory and its weather reporting service on neighbouring cities such as Macau, Guangzhou, Haikou, Kaiping, Shantou, Fuzhou, Kaifeng, Tokyo, Nagasaki, Manila and Brunei had enabled the ocean-going vessels to accurately determine their longitudinal positions and be kept well informed of the weather in the Asia Pacific region. Such services had satisfied the needs of the mariners and the commercial organisations and helped Hong Kong attain its position as a leading entrepôt in Asia Pacific. Despite such achievements, the capability to defend against natural calamities had not been boosted significantly. People who were subjected to substandard living conditions, such as fishermen and the poor, continued to bear the brunt of attacks by the elements.

The colonial government introduced Western astronomical observation methods with the principal aim of improving the harbour facilities. Naturally, the early weather reports would stress on accuracy and objectivity, with scant efforts made on popularising astronomical knowledge and improving people's daily lives. As a result, traditional methods of time measurements and weather forecasting were still employed, which were in marked contrast to the Western scientific norms embraced by the Observatory. In the first half of the twentieth century, the Observatory followed the development modes of other leading meteorological agencies and zealously introduced new meteorological services. It pioneered the implementation of several advanced services that included the earthquake monitoring and the upper air meteorological measurements in 1921 — innovative services that far surpassed the needs of the time — and cemented Hong Kong's prominent position in the international meteorological community. After the Second World War, the Observatory tailored its aviation weather services to serve the burgeoning air transport industry and assisted Hong Kong's successful transformation from an entrepot into an aviation centre in Asia Pacific. The successful supporting role played by the Observatory in

強調西方科學的準則截然不同。在二十世紀上半期，天文台仿效西方天文機構的發展模式，積極開拓新的氣象監測方法，率先開創多項先進服務，包括 1921 年的地震監測及高空氣象監測等，肯定了香港天文台在國際氣象組織中的重要地位，這些嶄新的服務都遠遠超過當時香港社會的實際需要。戰後，天文台利用已開展的航空氣象服務，積極配合日漸增加的空運業務，協助香港從轉口貿易港轉型為亞太地區的航空中心。天文台在航空事業上所扮演的後勤角色，對香港的經濟發展及建立國際形象有很大的幫助。

天文台的工作從推動經濟發展轉而以社會民生服務為主，象徵著社會的進步，但道路是相當漫長的。第二次世界大戰後，香港由於鄰近中國，又加上政治地位特殊，吸引了大量的中國移民來港定居。大量的廉價勞動力是城市轉型為加工工業中心的必要條件，卻同時也是城市發展的負擔。城市防禦天災的能力，未能緊隨戰後香港經濟的起飛而加強，新移民在山坡上大量興建的臨時房屋，反而增加了颱風及暴雨季節的破壞力。政府深明經濟發展必須與改善社會民生同步，方能創造新的局面， 1950 年代起，興建一些應急而發展的建築，如設備比較簡陋又可容納大量居民的徙置區，自十九世紀末起開始興建而在 1960 年代不斷增加及擴充的避風塘等，都是1950、1960年代保障民生而使香港能不斷吸收新勞動力的措施。這反映了戰後幾十年城市的發展，朝著力求制勝自然災害，改善民生的方向前進，而天文台所掌握的氣象資料，正是城市擴張不可或缺的重要依據，基礎穩固而不斷向高空發展的建築物，也成了香港的城市特色。

1960年代中期以後，除了提供專業資訊外，天文台更肩負起推廣現代天文知識的責任。因應著社會的訴求，一系列的惡劣天氣預警報告，包括 1967 年的雷暴、暴雨， 1968 年的霜凍、山火， 1971 年的水浸， 1977 年的山泥傾瀉，1999年的寒冷、酷熱等警告信號應運而生，而天文台報告天氣的方式一改已往作風，以簡結生動為主，積極推動天氣預報資料的普及性與實用性。市民預防天災的主動性相應提高，社會甚至進一步要求天文台提供惡劣天氣下活動的指引。科學技術進步使天氣預報的準確性不斷提高，是這些訴求出現的主要原因之一，而市民對氣象資料的認知水平與日俱增是另一原因。市民對氣象訊息的依賴，使天氣預報變成日常生活起居的必需。

二十一世紀的香港，狂風暴雨只能影響日常生活的規律，不可能再肆意破壞市民的生命財產，因為大眾的防災意識相當高，只要知道天氣稍有變化便會馬上作好預防工作，對資訊的準確性及傳遞的速度亦有一定的要求。社會對惡劣天氣預防工作及市民的預防意識的提高，象徵著社會在文化及經濟兩方面的進步。近年來，天氣資訊更擴張至改善個人身體健康及生活環境，天文台提供的輻射、寒冷、酷熱天氣警告和紫外線監測等服務，就是最好的例子。

the development of the aviation industry has contributed immensely to Hong Kong's economic development and its international reputation.

The gradual change in the mission of the Observatory from promoting mainly economic development to meeting the needs of the public symbolises the progress of society, but this had taken a long time to achieve. After the war, due to its close proximity to China and unique political status, Hong Kong had attracted large inflows of immigrants from China. An abundant supply of cheap labour was a prerequisite for the transformation into a processing industry hub. However, such incoming labour source also put a severe strain on the enclave's development. The defence against natural catastrophes had not been reinforced in line with the economy's take-off. The temporary houses built by new immigrants on hill slopes were vulnerable to the elements and thus added to the destructiveness of typhoons and rainstorms. The government realised that, to make Hong Kong successful, economic development had to proceed hand in hand with improvements in people's living conditions. The building of numerous resettlement estates since the 1950s and the typhoon shelter construction programme that commenced in the late nineteenth century and underwent much expansion in the 1960s, were emergency measures adopted in the 1950s and 1960s to safeguard human lives and facilitated the smooth assimilation of the newly-arrived labour into the workforce. These measures reflected that post-war development of the city was directed at overcoming the challenges posed by nature and bettering the livelihoods of its citizens. The Observatory's meteorological data proved to be indispensable to the city's development, reflected by the subsequent construction of ever taller buildings atop firm foundations that became a distinctive cultural feature of Hong Kong.

Since the mid-1960s, in addition to the provision of professional services, the Observatory also took on the responsibility of popularising modern meteorological knowledge. In response to the demands of the local community, a series of severe weather early warnings and announcements were introduced. They included warning signals for thunderstorms and rainstorms (1967), frost and hill fires (1968), flooding (1971), landslips (1977), cold weather and very hot weather (1999). The Observatory also improved its reporting style to make it lively and simple, as well as putting a great deal of effort in popularising the weather forecast information and its practical use. As a result, the public has become more proactive in taking precautions against natural disasters and has come to expect the Observatory to issue guidelines on inclement weather conditions. Advances in science and technology have continually improved

目前擁有三百多名員工的香港天文台，論規模或資源絕不是政府優先發展的部門，但其影響力卻不遜於任何政府重要部門。對外來說，強調氣象資料的科學化與現代化的研究方針，使天文台的服務早在 1920 年代已取得國際氣象組織認可；其所引入的天文觀測方法，本著科學研究的執著與堅持，更使西方天文知識能突破中西文化的差異，獨當一面，受到本地社會認同。香港能成為一個資訊開放的社會，對西方文化包容與吸收，是經過百多年的揣摸與認知，氣象知識溶入香港文化的過程，正是中西文化融匯貫通的寫照。

weather forecasting accuracy, largely due to popular demand, and also the public's increasing knowledge of weather information. Reliance on meteorological information has made weather forecasts a vital part of daily lives of the public.

In twenty-first-century Hong Kong, typhoons only create disruptions to daily routines, and no longer pose severe threats to lives and property. The public is now on its guard and will take all necessary precautions as dictated by the weather conditions. Therefore, there is a need for accurate weather information and its timely broadcast. The proactive stance of society towards extreme weather and the heightened public awareness towards prevention exemplify the cultural and economical progress made in society. In recent years, weather information has expanded its service scope further to cover also personal health issues and the living environment. Prime examples include environmental radiation monitoring, cold and very hot weather warnings, and the provision of an ultraviolet radiation index.

With a staff of just over 300, the Observatory is not a department that ranks high on the government list of priorities in terms of size and resources. However, its far-reaching and pervasive influence has put it on a par with any important government department. The emphases on meteorological data gathered scientifically and modern research guidelines already won the Observatory recognition from its international counterparts in the 1920s. The innovative astronomical observation methods that the Observatory implemented have managed, through dedication and perseverance, to resolve the conflicts between Eastern and Western cultures and made Western astronomy acceptable to the local community. To become the open information society it is today, Hong Kong has accommodated and absorbed Western cultural values via a trial-and-error process that has taken more than a hundred years to develop and refine. The assimilation of Western meteorological knowledge into Hong Kong's culture is a picture of harmonious fusion of the East and the West.

NOTES 註釋

1. 金烈修，張嗣衍纂，《新修廣州府志》，乾隆24年刻本，卷一，〈氣候〉。[Jin Lie and Zhang Siyan, ed., 'On Weather', in *Xinxiu Guangzhou fuzhi* (New Edition of Guangzhou Gazette), Volume 1, Qing Qianlong (1759) edition.]
2. 〈太平御覽〉轉引自陳昌齋，《廣東通志》，卷八十九，〈輿地明七〉，頁21–22。[*Taiping yulan* quoted from Chen Changzhai, ed., 'Topography, Ming 7', in *Guangdong tongzhi* (Guangdong Gazette), Volume 89, pp. 21–22.]
3. 清舒懋官修，王崇熙等纂，嘉慶25年刊，《新安志》，上卷，〈氣候〉，頁60–63。[Shu Maoguan (Qing), Wang Chongxi, ed., 'On Weather', in *Xinan xianzhi* (Xinan District Gazette), Volume I, Qing Jiaqing (1819) edition, pp. 60–63.]
4. 張二果修，《東莞縣志》，卷四，〈氣候〉。[Zhang Erguo, ed., 'On Weather', in *Dongguan xianzhi* (Dongguan District Gazette), Volume 4, 1927.]
5. 屈大均撰，《廣東新語》，香港，中華書局，1975年，頁9。[Qu Dajun, *Guangdong xinyu* (New Interpretations on Guangdong), Hong Kong, Zhonghua shuju, 1975, p. 9.]
6. 〈南北堂書鈔〉轉引自陳昌齋，《廣東通志》，卷八十九，〈輿地明七〉，頁21。[*Nanbeitang shuchao* (Written Records of Nanbeitang) quoted by Chen Changzhai, ed., 'Topography, Ming 7', in *Guangdong tongzhi* (Guangdong Gazette), Volume 89, p. 21.]
7. 清舒懋官修，王崇熙等纂，嘉慶25年刊，《新安縣志》，卷二，〈月令〉，頁61–62。[Shu Maoguan (Qing), Wang Chongxi, ed., 'On Seasons', in *Xinan xianzhi* (Xinan District Gazette), Volume 2, Qing Jiaqing (1819) edition, pp. 61-62.]
8. 梅文鼎，《梅氏叢書》，卷46，〈曆學疑問〉，台北，藝文印書館，1971年，頁106。[Mei Wending, 'Questions on Studies on the Calendar', in *Meishi congshu* (Collection of Meishi), Volume 46, Taibei, Yiwen yinshuguan, 1971, p. 106.]
9. 廣州地方志編纂委員會，《廣州地區舊志氣候史料匯編與研究》，廣東，人民，1993年。[Guangzhou difangzhi bianzuan weiyuanhui, ed., *Guangzhou diqu jiuzhi qihou shiliao huibian yu yanjiu* (Compilation and Analyses of Meteorological Data From Guangzhou Gazette), Guangdong, Renmin, 1993.]
10. CO133/1, *Meteorological Table,* 15 July 1844–13 April 1845, pp. 89–94.
11. *The Hong Kong Government Gazette,* 17 October 1874, p. 579.
12. CO129/14, *Treasury Chambers,* 6 November 1845; CO129/20, *Police Department to Colonial Secretary,* 21 July 1874.
13. *The Friend of China and Hong Kong Gazette,* 28 November 1845, p. 1008.
14. *The Friend of China,* 5 November 1853.
15. *The Hong Kong Government Gazette,* 17 November 1883, pp. 880–883.
16. CO129/35, *Comelate J. G. Leave of Absence,* 8 May 1850, p. 150; CO129/35, *Morrison to Comelate, Chief Treasurer Clerk, Recommends Him for Other Employment in a More Healthy Climate,* 28 February 1850, pp. 180–181; CO129/37, *Health of the Troops,* 21 July 1851, pp. 163–176; CO129/161, *Removal to a Healthier Climate,* 22 April 1872, pp. 149–152; CO129/161, *Dr. Murray's Unfitness for Further Service in a Tropical Climate,* 19 April 1872, pp. 260–267; CO129/304, *Mr. Ladds, Veterinary Surgeon Is Not Physically Fit for Climate,* 16 March 1901, pp. 414–415; CO129/309, *Requests on Grounds of Ill Health in Tropical Climate,* 16 March 1901, pp. 255–257.
17. Cooper, F. A., 'Report on the Water Supply of the City of Victoria and Hill District', *Hong Kong Sessional Papers,* 1896, pp. 264–268.
18. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory,* Hong Kong, Noronha & Co., 1885, pp. 124–125.
19. *The Colonial Surgeon's Report,* CO133/18, p. 117; CO133/20, p. 115; CO 133/21, p. 129; CO133/23, p. 131; CO133/24, p. 135; CO133/25, p. 135; CO133/26, p. 146; CO133/27, p. 137; *The Hong Kong Government Gazette,* 7 March, 1863, p. 78; 17 March 1866, p. 134; 23 March 1872, p. 138; 17 April 1875, p. 178; Annual Report of Colonial Surgeon, *Hong Kong Blue Book 1876,* Table XIV; *Hong Kong Blue Book 1878,* Table XVIII; 'Reports of Colonial Surgeon and Other Sanitary Papers', *Hong Kong Administrative Reports,* 1879.
20. The temperature records retrieved from the government reports represent the daily highest and lowest temperatures, but not the temperatures recorded at 9:00 AM and at 3:00 PM as suggested by the information. The temperature records at 9:00 AM seem too low while those at 3:00 PM seem too high. It is believed that during the late nineteenth century the thermometer had a self-registering system that could register the daily highest and lowest temperatures automatically. The Observatory staff were responsible for the daily registrations at 9:00 AM and at 3:00 PM.
21. Information provided by Hong Kong Observatory. Published reports include: Royal Observatory, *Meteorological Results Part I — Surface Observations (yearly),* Hong Kong, 1884–1939, 1947–1986; Royal Observatory, *Surface Observations in Hong Kong (yearly),* Hong Kong, 1987–1992; Hong Kong Observatory, *Summary of Meteorological Observations in Hong Kong,* Hong Kong, 1993–2002.
22. Hong Kong Observatory data; Peacock, J. E., ed., *Hong Kong Meteorological Records and Climatological Notes 60 Years,* Hong Kong Royal Observatory, 1951; Royal Observatory, *Meteorological Results Annual Report,* Hong Kong, 1951–1990; Royal Observatory, *Surface Observations in Hong Kong,* Hong Kong, 1991–1992; Royal Observatory, *Summary of Meteorological Observations in Hong Kong,* Hong Kong, 1993–1997; Hong Kong Observatory, *Summary of Meteorological Observations in Hong Kong,* Hong Kong, 1998–2002.

23. 見皇家香港天文台，《颱風》，香港，1992年，頁24。[See Royal Observatory, *Typhoons,* Hong Kong, 1992, p. 24.]
24. 見皇家香港天文台，《颱風》，香港，1992年，頁8。[See Royal Observatory, *Typhoons,* Hong Kong, 1992, p. 8.]
25. 該書為沈懷遠於5世紀中期撰寫，在公元453至463年間，沈氏曾被貶至廣州，《南越志》是他對嶺南地區的所見所聞。[*Nanyue zhi* (Gazette of South China) was written by Shen Huaiyuan in the mid-fifth century, while he was demoted to Guangzhou between 453 and 463 AD, and recorded his experiences in South China.]
26. 轉引自劉昭民，《中華氣象學史》，台灣，商務印書館，1970年，頁79。[Quoted from Liu Zhaomin, *Zhonghua qixiangxueshi* (A History of Chinese Meteorology), Taiwan, The Commercial Press, 1970, p. 79.]
27. 婁元禮，《田家五行》，上海，古籍出版社，1995年重印。[Lou Yuanli, *Tianjia wuxing* (Five Elements of Agriculture), Reprint. Shanghai, Guzhi chubanshe, 1995.]
28. 戴侗，《六書故》，乾隆49年版。[Dai Tong, *Liushu gu* (Ancient Stories From Six Books), Qianlong (1784), 1784.]
29. 轉引自中國科學院自然科學史研究所，地學史組編，《中國古代地理學史》，北京，科學出版社，1984年，頁111。[Quoted from The Institute for the History of Natural Science, Chinese Academy of Sciences, *Zhongguo gudai dili xueshi* (Ancient Chinese Historical Geography), Beijing, Kexue chubanshe, 1984, p. 111.]
30. 《福州府志》，北京，書目文獻，1990年，按明萬曆 (24年) 1596年刻本影印。[*Fuzhou fuzhi* (Local Gazette of Fuzhou), Ming Wanli (1596) edition, Beijing, Shumu wenxian, 1990.]
31. 印光任，《澳門紀略》，台北，廣文書局，1968年重印，頁9–10。[Yin Guangren, *Aomeng jilue* (A Collection of Records of Macao), Taibei, Guangwen shuju, 1968, pp. 9–10.]
32. 李杰、徐勝一，《颱風》，香港，廣角鏡，1986年，頁6–7。[Li Jie and Xu Shengyi, *Typhoons,* Hong Kong, Guangjiao jing, 1986, pp. 6–7.]
33. 香港天文台，《一九九九年熱帶氣旋》，香港，2000年，頁14–20。[Hong Kong Observatory, *Tropical Cyclones in 1999,* Hong Kong, 2000, pp. 14–20.]
34. 歐文•克銳克，洛斯柯•福蘭著，薛繼壎譯，《氣象與人生》，台灣，中華文化出版事業社，1959年，頁103 [Ke Ruike and Fulan, *Qihou yu rensheng* (Relationship Between Weather and Human Lives), trans. Xue Jixun, Taiwan, Zhonghua wenhua chuban shiyeshe, 1959, p. 103]; Gordon E. Dunn, *Atlantic Hurricanes,* Baton Rouge, Louisiana State University Press, 1964, p. 35.
35. D. M. Gray, 'Tropical Cyclones', *The Junk,* June 1989, pp. 27–31.
36. Royal Observatory, *Meteorological Results,* Hong Kong, 1946–1986; Hong Kong Observatory, *Tropical Cyclones in 1999,* 2000, pp. 72–73.
37. 《華僑日報》，1989年4月23日。[*Wah Kiu Yat Po,* 23 April 1989.]

38. Hong Kong Observatory, *Hong Kong Typhoons* (pamphlet), Table XVII, Hong Kong, p. 18.
39. 《華僑日報》，1964年5月29日；1964年10月18日；1966年5月29日。[*Wah Kiu Yat Po,* 29 May 1964; 18 October 1964; 29 May 1966.]
40. 《華字日報》，1906年9月26日[*Huazi ribao,* 26 September 1906]；《華字日報》，1906年10月2日[*Huazi ribao,* 2 October 1906]；《華僑日報》，1961年5月21日[*Wah Kiu Yat Po,* 21 May 1961]；*China Mail,* 18 August, 1923.
41. 《華字日報》，1906年9月29日。[*Huazi ribao,* 29 September 1906.]
42. Li Woon Yee, 'The Typhoon of 18 September 1906', *Royal Observatory, Occasional Paper No. 36,* Hong Kong, July 1976, p. 5.
43. So, C. L., 'Mass Movements Associated With the Rainstorm of June 1996 in Hong Kong', in *Transactions of the Institute of British Geographers,* 1971, pp. 53, 55–56; Lumb, P., 'Slope Failures in Hong Kong', *Quarterly Journal of Engineering Geology,* 1975, No. 8, pp. 31–65.
44. 《星島日報》，1957年9月24日；1957年9月26日。[*Sing Tao Daily,* 24 September 1957; 26 September 1957.]
45. 《華僑日報》，1964年5月29日。[*Wah Kiu Yat Po,* 29 May 1964.]
46. 《華僑日報》，1977年9月25日。[*Wah Kiu Yat Po,* 25 September 1977.]
47. 《華僑日報》，1973年8月22日。[*Wah Kiu Yat Po,* 22 August 1973.]
48. 《華僑日報》，1970年5月14日。[*Wah Kiu Yat Po,* 14 May 1970.]
49. 《華字日報》，1908年8月17日；1925年4月14日。[*Huazi ribao,* 17 August 1908; 14 April 1925.]
50. 《星島日報》，1962年9月2日；1983年9月10日。[*Sing Tao Daily,* 2 September 1962; 10 September 1983.]
51. 《華字日報》，1919年8月1日；1921年2月26日。[*Huazi ribao,* 1 August 1919; 26 February 1921.]
52. 《大公報》，1966年7月18日。[*Ta Kung Pao,* 18 July 1966.]
53. 《華僑日報》，1959年8月12日。[*Wah Kiu Yat Po,* 12 August 1959.]
54. 《華僑日報》，1966年7月15日。[*Wah Kiu Yat Po,* 15 July 1966.]
55. 《華僑日報》，1964年8月10日。[*Wah Kiu Yat Po,* 10 August 1964.]
56. 《一九七二年雨災調查委員會中期報告書》，香港，政府印務局，1972年8月；《一九七二年雨災調查委員會最後報告書》，香港，政府印務局，1972年11月；《華僑日報》，1972年6月20日；《明報》，1972年6月24日。[Hong Kong Commission of Inquiry on Rainstorm Disasters, *Interim Report on 1972 Rainstorms,* Hong Kong, Government Printer, August, 1972; Hong Kong Commission of Inquiry on Rainstorm Disasters, *Final Report on 1972 Rainstorms,* Hong Kong, Government Printer, November, 1972; *Wah Kiu Yat Po,* 20 July 1972; *Ming Pao,* 24 June 1972.]
57. 土力工程署，《山泥傾瀉》，香港，2000年。[Geotechnical Engineering Office, *Landslide,* Hong Kong, 2000.]

58. 《星島日報》，1966年6月14日。[*Sing Tao Daily,* 14 June 1966.]
59. 《星島日報》，1966年6月14日。[*Sing Tao Daily,* 14 June 1966.]
60. 《星島日報》，1959年6月17日。[*Sing Tao Daily,* 17 June 1959.]
61. 陳健碩，《香港的斜坡安全》，香港，土力工程處，2002年。[Chan, Kin-sek, *The Safety of Hong Kong Slopes*, Hong Kong, Geotechnical Engineering Office, 2002.]
62. 土力工程署，《山泥傾瀉》，香港，2000年。[Geotechnical Engineering Office, *Landslide,* Hong Kong, 2000.]
63. So, C. L., 'Mass Movements Associated With the Rainstorm of June 1996 in Hong Kong', in *Transactions of the Institute of British Geographers,* 1971, pp. 53, 55–56; Lumb, P., 'Slope Failures in Hong Kong', *Quarterly Journal of Engineering Geology,* 1975, No. 8, pp. 31–65.
64. So, C. L., 'Problems of Slope in Hong Kong', in *Geografiska Annaler,* Series A, 1976, No. 3, pp. 149–154.
65. 《星島日報》，1956年1月10日。[*Sing Tao Daily,* 10 January 1956.]
66. 《星島日報》，1999年12月24日。[*Sing Tao Daily,* 24 December 1999.]
67. 《星島日報》，1999年9月13日至14日。[*Sing Tao Daily,* 13–14 September 1999.]
68. 《星島日報》，1999年9月13日至14日; 1999年8月21日至22日。[*Sing Tao Daily,* 13–14 September 1999; 21–22 August 1999.]
69. 《星島日報》，1967年1月16日；1967年1月17日。[*Sing Tao Daily,* 16–17 January 1967.]
70. 《星島日報》，1967年1月16日；1971年1月4日至5日，9至10日，及12日；1973年12月31日；1976年1月12日；1992年11月11日。[*Sing Tao Daily,* 16 January 1967; 4–5, 9–10, 12 January 1971; 31 December 1973; 12 January 1976; 11 November 1992.]
71. 《星島日報》，1973年12月26日；1973年12月27日。[*Sing Tao Daily,* 26–27 December 1973.]
72. 《華僑日報》，1992年11月11日。[*Wah Kiu Yat Po,* 11 November 1992.]
73. 《星島日報》，1976年1月12日。[*Sing Tao Daily,* 12 January 1976.]
74. 《星島日報》，1961年1月17日至22日。[*Sing Tao Daily,* 17–22 January 1961.]
75. 何佩然，《點滴話當年——香港供水一百五十年》，香港，商務印書館，2001年，頁183–189。[Ho, Pui Yin, *Water for a Barren Rock: 150 Years of Water Supply in Hong Kong,* Hong Kong, The Commercial Press, 2001, pp. 183–189.]
76. Surveyor General J. M. Price to the Acting Colonial Secretary, 'Time Ball in Victoria Harbour', *The Hong Kong Government Gazette,* 17 November 1877, pp. 510–512.
77. Palmer, H. Spencer, 'On a Determination of Latitude at Mount Elgin, in the Kau-Lung Peninsula', *The Hong Kong Government Gazette,* 4 March 1882, p. 227.

78. Surveyor General J. M. Price to the Acting Colonial Secretary, 'Time Ball in Victoria Harbour', *The Hong Kong Government Gazette,* 17 November 1877, pp. 510–512.
79. Admiral Alfred P. Ryder to the Acting Colonial Secretary, 'The Establishment of a Time Ball at Hong Kong in an Observatory', *The Hong Kong Government Gazette,* 17 November 1877, pp. 512–513.
80. Dyson, Anthony, *From Time Ball to Atomic Clock,* Hong Kong, Government Printer, 1983, p. 19; Malone, D. J., 'History and General Organisation of the Royal Observatory, Hong Kong', Hong Kong Observatory, *Occasional Papers, No. 34*; Starbuck, L., *A Brief General History of the Royal Observatory,* Hong Kong Observatory, 1951, p. 1; Starbuck, L., 'A Condensed History of the Royal Observatory, Hong Kong', *The Marine Observer,* April, 1953; 林超英，〈香港天文台史話〉，《氣象知識》，1977年，第3期，總第95期。[Lam Y. C., 'Xianggang tianwentai shihua' (History of the Hong Kong Observatory), *Qixiang zhishi* (Knowledge of Meteorology), 1977, No. 3, Total No. 95].
81. 'On the Proposal to Establish a Physical Observatory at Hong Kong', *The Hong Kong Government Gazette,* 3 September 1881, p. 801.
82. Doberck, W., 'Report for 1884 from the Government Astronomer', *Observations and Researches Made at the Hong Kong Observatory,* Hong Kong, Noronha & Co., 1884, p. 123.
83. 'On the Proposal to Establish a Physical Observatory at Hong Kong', *The Hong Kong Government Gazette,* 3 September 1881, p. 810.
84. 'Return of All Public Works, Civil Roads, Canals, Bridges, Building, &c., Not of a Military Nature, Which Have Been Undertaken During the Year 1883', *Hong Kong Blue Book 1883,* Hong Kong, Noronha & Co., 1884, F8.
85. 馮復京，《六家詩名物疏》，卷47，轉引自《四庫全書》，經部詩類80冊，上海，古籍出版社，1987年版。[Feng Fujiang, *Liujia shiming wushu* (Notes and Commentaries on Poems and Matters of Six Schools), Volume 47, quoted from *Siku quanshu* (A Complete Collection of Four Treasures), jingbu shilei, Book 80, Shanghai, Guji chubanshe, 1987.]
86. 賈公彥，《周禮肴疏》，卷17，台北，世界書局，1963年版。[Jia Gongyan, *Zhouli zhushu* (Notes and Commentaries on Rites and Ceremonies of Zhou Dynasty), Volume 17, Taibei, Shijie shuju, 1963.]
87. 余蕭客，《古經解鉤沉》，卷12，轉引自《四庫全書》，經部五經穀義類194冊，上海，古籍出版社，1987年版。[Yu Xiaoke, *Gujing jiegouchen* (Interpretation of Ancient Classics), Volume 12, quoted from *Siku quanshu,* jingbu wujing zongyilei, Book 194, Shanghai, Guji chubanshe, 1987.]
88. 張英、王士禛，《御定淵鑑類函》，卷349，轉引自《四庫全書》，子部類書類982–933冊，上海，古籍出版社，1987年版。[Zhang Ying, Wang Shizhen, *Yuding yuanjian leihan* (Imperial Collection of Correspondence and Reference

Materials), Volume 349, quoted from *Siku quanshu,* zibu leishulei, Books 932–933, Shanghai, Guji chubanshe, 1987.]

89. 秦蕙田，《五禮通考》，卷218，轉引自《四庫全書》，經部禮類135–142冊，上海，古籍出版社，1987年版。[Qin Huitian, *Wuli tongkao* (General Introduction of Five Rites and Ceremonies), Volume 218, quoted from *Siku quanshu,* jingbu lilei, Books 135–142, Shanghai, Guji chubanshe, 1987.]

90. 歐陽修，《新唐書》，卷47，轉引自《四庫全書》，史部正史類272-286冊，上海，古籍出版社，1987年版。[Ouyang Xiu, *Xin tangshu* (New History of the Tang Dynasty), Volume 47, quoted from *Siku quanshu,* shibu zhengshilei, Books 272–286, Shanghai, Guji chubanshe, 1987.]

91. 潘自牧，《紀纂淵海》，卷29，轉引自《四庫全書》，子部類書類930–932冊，上海，古籍出版社，1987年版。[Pan Zimu, *Jizuan yuanhai* (A Comprehensive Chronology), Volume 29, quoted from *Siku quanshu,* zibu leishulei, Books 930–932, Shanghai, Guji chubanshe, 1987.]

92. 托克托，《金史》，卷56，轉引自《四庫全書》，史部正史類290–291冊，上海，古籍出版社，1987年版。[Tuo Ke Tuo, *Jin shi* (History of Jin), Volume 56, quoted from *Siku quanshu,* shibu zhengshilei, Books 290–291, Shanghai, Guji chubanshe, 1987.]

93. 谷應泰，《明史紀事本末》，卷73，轉引自《四庫全書》，紀事本末類364冊，上海，古籍出版社，1987年版。[Gu Yingtai, *Mingshi jishi benmo* (Comprehensive Chronology of the Ming Dynasty), Volume 73, quoted from *Siku quanshu,* jishi benmolei, Book 364, Shanghai, Guji chubanshe, 1987.]

94. 《皇朝通志》，卷67，轉引自《四庫全書》，史部政書類644–645冊，上海，古籍出版社，1987年版；《欽定大清會典》，卷86，轉引自《四庫全書》，史部政書類619冊，上海，古籍出版社，1987年版。[*Huangchao tongzhi* (General Gazette of Qing Dynasty), Volume 67, quoted from *Siku quanshu,* shibu zhengshulei, Books 644–645, Shanghai, Guji chubanshe, 1987; *Qinding daqing huidian* (Books and Records of the Qing Dynasty Made by Imperial Order), Volume 86, quoted from *Siku quanshu,* shibu zhengshulei, Book 619, Shanghai, Guji chubanshe, 1987.]

95. 《中國年鑑》，上海，商務印書館，1924年，頁40，208 [*Zhongguo nianjian* (China Year Book), Shanghai, The Commercial Press, 1924, pp. 40, 208]; *The China Year Book 1914-1938,* Shanghai, North China Daily News & Herald；「附錄：天文五千年」網頁 [‘Appendix: 5,000 Years of Astronomy’ website], <http://home.kimo.com.tw/chis_project_eva/ast-5000.htm>.

96. 中國科學院上海天文台網頁 [Shanghai Astronomical Observatory, Chinese Academy of Sciences website], <http://center.shao.as.cn>.

97. 中國天文學史整理研究小組，《中國天文學史》，北京，科學出版社，1981年，頁243。[Zhongguo tianwenxue shi zhengli yanjiu xiaozu, *Zhongguo tianwenxue shi* (History of Chinese Astronomy), Beijing, Kexue chubanshe, 1981, p. 243.]

98. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1885,* Hong Kong, Noronha & Co., 1886, p. 1.

99. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1884,* Hong Kong, Noronha & Co., 1885, p. 124.

100. Doberck,W., ‘Report for 1883 From the Government Astronomer’, *The Hong Kong Government Gazette,* Hong Kong, Noronha & Co., 17 November, 1883, p. 878.

101. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1886,* Hong Kong, Noronha & Co., 1887, p. 1

102. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1887,* Hong Kong, Noronha & Co., 1888, p. 1.

103. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1890,* Hong Kong, Noronha & Co., 1891, p. 2.

104. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1893,* Hong Kong, Noronha & Co., 1894, p. 1.

105. Figg, F. G., ‘Report of the Director of the Observatory, for the Year 1902’, *Hong Kong Sessional Papers,* Hong Kong, Noronha & Co., 1903, No. 6, p. 29.

106. Claxton, T. F., ‘Report of the Director of the Royal Observatory, Hong Kong, for the Year 1914’, *Hong Kong Administrative Reports for the Year 1914,* Appendix E., Hong Kong, Noronha & Co, 1915, E5.

107. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1888,* Hong Kong, Noronha & Co., 1889, pp. 1–2.

108. Figg, F. G., ‘Report of the Director of the Observatory’, *Hong Kong Administrative Reports for the Year 1909,* Appendix E, Hong Kong, Noronha & Co., 1910, E1.

109. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1891,* Hong Kong, Noronha & Co., 1892, p. 1.

110. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1892,* Hong Kong, Noronha & Co., 1893, p. 2.

111. Figg, F. G., ‘Report of the Director of the Observatory’, *Hong Kong Administrative Reports for the Year 1910,* Appendix E, Hong Kong, Noronha & Co., 1911, E2.

112. Claxton, T. F., ‘Report of the Director of the Royal Observatory, Hong Kong, for the Year 1915’, *Hong Kong Administrative Reports 1915,* Appendix F, Hong Kong, Noronha & Co., 1916, F6.

113. Claxton, T. F., ‘Report of the Director of the Royal Observatory, Hong Kong, for the Year 1915’, *Hong Kong Administrative Reports for the Year 1915,* Hong Kong, Noronha & Co., 1916, F5.

114. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory in the Year 1888,* Hong Kong, Noronha & Co., 1889, p. 3.

115. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1913', *Hong Kong Administrative Reports 1913,* Appendix E, Hong Kong, Noronha & Co., 1914, E7.
116. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1920' *Hong Kong Administrative Reports for the Year 1920,* Appendix F, Hong Kong, Noronha & Co., 1921, F11.
117. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1912', *Hong Kong Administrative Reports for the Year 1912,* Appendix E, Hong Kong, Noronha & Co., 1913, E10.
118. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1914', *Hong Kong Administrative Reports for the Year 1914,* Appendix E, Hong Kong, Noronha & Co., 1915, E14.
119. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1919', *Hong Kong Administrative Reports for the Year 1919,* Appendix F, Hong Kong, Noronha & Co., 1920, F15.
120. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1918', *Hong Kong Administrative Reports for the Year 1918,* Appendix F., Hong Kong, Noronha & Co., 1919, F18.
121. Jeffries, C.W., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1933', *Hong Kong Administration Reports for the Year 1933,* Appendix F, Hong Kong, Noronha & Co., 1934, F8.
122. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1927', *Hong Kong Administrative Reports 1927,* Appendix F, Hong Kong, Noronha & Co.,1928, F15.
123. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1921', *Hong Kong Administrative Reports for the Year 1921,* Appendix F, Hong Kong, Noronha & Co., 1922, F12; Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1923', *Hong Kong Administrative Reports for the Year 1923,* Appendix F, Hong Kong, Noronha & Co., 1924, F11.
124. Jeffries, C. W., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1933', *Hong Kong Administration Reports for the Year 1933,* Appendix F, Hong Kong, Noronha & Co., 1934, F8.
125. 薄樹人，《中國天文學史》，台北 ，天津出版社，1996年，頁220。[Bo Shuren, *Zhongguo tianwenxue shi* (History of Chinese Astronomy), Taibei, Tianjin chubanshe, 1996, p. 220.]
126. 林尹注譯，《周禮今看今譯》，北京，新華書店北京發行所， 1985 年，頁 352 。[Lin Yin, trans., *Zhouli jinzhu jinyi* (Rites and Ceremonies of the Zhou Dynasty With Contemporary Interpretation and Explanatory Notes), Beijing, Xinhua shudian Beijing faxingsuo, 1985, p. 352.]
127. 林尹注譯，《周禮今看今譯》，北京，新華書店北京發行所， 1985 年，頁 313 。[Lin Yin, trans., *Zhouli jinzhu jinyi,* Beijing, Xinhua shudian Beijing faxingsuo, 1985, p. 313.]
128. 顏之推，《顏氏家訓》，卷六〈書證〉，轉引自《續修四庫全書》雜家類 1121 冊，上海，上海古籍出版社， 1995 年，頁 665 。[Yan Zhitui, 'Shuzheng' (Verification of Books), *Yanshi jiaxun* (The Yan's Family Creed), Volume 6, quoted from *Xuxiu siku quanshu,* zajialei, Book 1121, Shanghai, Guji chubanshe, 1995, p. 665.]
129. 姚思廉，《陳書——紀傳》(一冊)，北京，中華書局出版社，1972年，頁61。[Yao Silian, *Chenshu jizhuan* (History of Chen Dynasty — Biography), Volume 1, Beijing, Zhonghua shuju chubanshe, 1972, p. 61.]
130. 瞿蛻園，《中國社會史料叢鈔》，甲集三冊，台北，台灣商務印書館， 1965 年，頁863。[Qu Tuiyuan, *Zhongguo shehui shiliao congchao* (Collection of Materials on Chinese Social History), Volume 1 (with 3 books), Taibei, The Commercial Press, 1965, p. 863.]
131. 宋廉等，《元史》(十三冊傳) ，〈齊履謙傳〉，北京，中華書店北京發行所， 1976 年，頁 4028–4030。[Song Lian, 'Qi Luqian zhuan' (Biography of Qi Liqian), *Yuan shi* (History of the Yuan Dynasty), Volume 13, Beijing, Zhonghua shudian Beijing faxingsuo, 1976, pp. 4028–4030.]
132. 劉若愚，《明宮史》，卷 2，轉引自《四庫全書》，史部政書類 651 冊，上海，古籍出版社， 1987 年。[Liu Ruoyu, Minggong shi (History of Ming Dynasty), Volume 2, quoted from *Siku quanshu,* shibu zhengshulei, Book 651, Shanghai, Guji chubanshe, 1987.]
133. 來保等，《欽定平金川方略》，卷 13，轉引自《四庫全書》，史部紀事本末類 356 冊，上海，古籍出版社， 1987 年。[Lai Bao et al., *Qinding pingjinchuan fanglue* (General Plan on Suppression of Jinchuan Made by Imperial Order), Volume 13, quoted from *Siku quanshu,* shibu jishi benmolei, Book 356, Shanghai, Guji chubanshe, 1987.]
134. The set of instruments included two theodolites, 10 Dines meteorographs, one microscope for measuring meteorgrams, 10 hygrometers, 400 pilot balloons, 2 Manheim slide rules, cf. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1920', *Hong Kong Administrative Report for the Year 1920,* Appendix F, Hong Kong, Government Printer, 1921, F14–F15.
135. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1920', *Hong Kong Administrative Reports for the Year 1920,* Appendix F, Hong Kong, Noronha & Co., 1921, F14–F15.
136. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1923', *Hong Kong Administrative Reports for the Year 1923,* Appendix F, Hong Kong, Noronha & Co., 1924, F17.

137. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1922', *Hong Kong Administrative Reports for the Year 1922,* Appendix F, Hong Kong, Noronha & Co., 1923, F14, F16.
138. Jeffries, C. W., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1936', *Hong Kong Administration Reports for the Year 1936,* Appendix F, Hong Kong, Noronha & Co.1937, F6.
139. Jeffries, C. W., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1938', *Hong Kong Administration Report for the Year 1938,* Appendix F, Hong Kong, Government Printer, 1939, F6.
140. Jeffries, C. W., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1939', *Hong Kong Administration Report for the Year 1939,* Appendix F, Hong Kong, Government Printer, 1940, F1, F6–7.
141. Hong Kong Observatory, 'Seismology, Correspondence With Various Institutes on Earthquake', HKRS 842–1–13, File 22.
142. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1918', *Hong Kong Administrative Reports for the Year 1918,* Appendix F, Hong Kong, Noronha & Co., 1919, F15–F16.
143. Claxton, T. F., 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1920', *Hong Kong Administrative Reports for the Year 1920,* Appendix F, Hong Kong, Noronha & Co., 1921, F15–F16.
144. Hong Kong Observatory, 'Seismology, Correspondence With Various Institutes on Earthquake', HKRS 842–1–13, File No. 22.
145. Hong Kong Observatory, 'Materials on Weather Observations During World War II', HKRS 845.
146. 'Correspondence With Zi Ka Wei Observatory 1946-50', HKRS 841–1/56, File No. RO 8/49.
147. 'Director of Royal Observatory to Father Ghergi, 11 December 1947', *Zi Ka Wei Correspondence,* HKRS 842–1/56, File No. RO 8/49.
148. Civil Aviation Department, *Annual Report,* Hong Kong, Government Printer, 1961; 2002.
149. 'Director of Royal Observatory to Colonial Secretary 3/5/1947', *Memo to Government Departmental Duties,* HKRS 842–1/52, File No. RO 104/48.
150. *Hong Kong Blue Book,* Hong Kong, Noronha Co., 1883–1940; Royal Observatory, *Report of the Director Royal Observatory Hong Kong,* Hong Kong, Government Printer, 1883–1985; Hong Kong Census and Statistics Department, *Hong Kong Statistics, 1947–67,* Hong Kong, Government Printer, 1969; Hong Kong Treasury, *Annual Report by the Accountant-General for the Year Ended 31st March,* Hong Kong, Noronha & Co., 1950; Hong Kong Treasury, *Departmental Report by the Accountant General,* Hong Kong, Government Printer, 1951–2002.

151. Royal Observatory, *Hong Kong Annual Departmental Report by the Director, Royal Observatory,* Hong Kong, Government Printer, 1948–1980.
152. Faber, S. E. and Bell, G. J., 'Typhoons in Hong Kong and Building Design', in *Proceedings of Engineering Society of Hong Kong,* Vol. 17, 1963–1964.
153. *China Mail,* 12 March 1897.
154. Ip, C. S. F. and Wai, H. G., *An Application of Harmonic Method to Tidal Analysis and Prediction in Hong Kong,* Hong Kong, Royal Observatory, 1990.
155. So, C. L., 'Mass Movements Associated With the Rainstorm of June 1996 in Hong Kong', *Transactions of the Institute of British Geographers,* 1971, pp. 53, 55–56; Lumb, P., 'Slope Failures in Hong Kong', *Quarterly Journal of Engineering Geology,* 1975, No. 8, pp. 31–65.
156. 土力工程署，《山泥傾瀉》，香港，2000。[Geotechnical Office, *Landslide,* Hong Kong, 2000.]
157. Chatham, W., 'Report of the Acting Director of Public Works for 1893', *Hong Kong Sessional Papers, 1893,* Hong Kong, Noronha & Co., 1984.
158. 香港天文台，「香港雨量的量度及水文氣象」(單張)。[Hong Kong Observatory, 'Rainfall Measurement and Hydrometeorology' (pamphlet).]
159. Lai, Edwin S. T., Li, P. W. and Lam, C. Y., 'Typical MCS Characteristics on Satellite IR Images for 1997 & 1998 Rainstorm Cases in Hong Kong', in *Proceedings of International Conference on MCCS and Heavy Rain in East Asia,* Seoul, 24–26 April 2000; Cheung, P. and Lai, Edwin S. T., 'Short-range Rainfall Forecast in Hong Kong', *ATC3 Workshops on Heavy Rain Induced Landslip,* Hong Kong Observatory, 13 December 2001, Reprint 451.
160. Royal Observatory, *Hong Kong Annual Departmental Report by the Director, Royal Observatory for the Financial Year 1954–55,* Hong Kong, Government Printer, 1955, p. 22.
161. Watts, I. E. M., *Hong Kong Annual Departmental Report by the Director, Royal Observatory for the Financial Year 1955–56,* Hong Kong, Government Printer, 1956, p. 20.
162. 黃良會、薛鳳璇，《香港新機場的挑戰與爭議》，香港，京港學術交流中心，1990年。[Huang Lianghui and Xue Fengxuan, *Xianggang xinjichang de tiaozhan yu zhengyi* (Challenges and Disputes on the New International Airport), Hong Kong, Jinggang xueshu jiaoliu zhongxin, 1990.]
163.《港口及機場發展策略：香港的發展基礎》，香港，政府印務局，1991年，頁20–27。[*Hong Kong Port and Airport Development Strategy: A Foundation for Growth,* Hong Kong, Government Printer, 1991, pp. 20–27.]
164. Bell, G. J., *Hong Kong Annual Progress Report by the Director of the Royal Observatory for the Financial Year 1979–80,* Hong Kong, Government Printer, 1980, p. 8.
165. Lam, C. Y., 'Meteorological Conditions at Chek Lap Kok' (First and Second Reports), Occasional Paper, Royal Observatory, 1981; Lam, C. Y.,

'Preliminary Report on the Wind Tunnel Experiment to Study Turbulence and Wind Shear in the Vicinity of Chek Lap Kok', Occasional Paper, Royal Observatory, 1981; Lam, C. Y., 'An Investigation of Turbulence and Wind Shear in the Vicinity of Chek Lap Kok Using a Light Aircraft, Dec. 1979–Nov. 1981', Occasional Paper, Royal Observatory, 1981; Lam, C. Y., and Yeung, K. H., 'Chek Lap Kok Meteorological and Oceanographic Investigations 1979–1982', Occasional Paper, Royal Observatory, 1982; Wong, S. C., 'Preliminary Report on the Chek Lap Kok Basin Storm Surge Numerical Modeling Investigation' (First and Second Reports), Occasional Paper, Royal Observatory, 1981 and 1982.

166. 劉心怡，〈香港國際機場風切變個案研究〉，載中國民用航空總局空中交通管理局，《航空氣象服務學術交流會》，2000年9月5–9日，頁4。[Lau, C. Y., 'Case Study of Windshear and Turbulence at Hong Kong International Airport', in Zhongguo minyong hangkong zongju kongzhong jiaotong guanliju, ed., *Hangkong qixiang fuwu xueshu jiaoliu hui* (Academic Exchange Conference on Aviation Services), 5–9 Sept 2000, p. 4.]
167. 香港天文台，《在香港出現的風切變及湍流——供飛行員參考的資料》，2002，頁4。[Hong Kong Observatory, *Windshear and Turbulence in Hong Kong: Information for Pilot,* 2002, p. 4.]
168. 香港天文台，《在香港出現的風切變及湍流——供飛行員參考的資料》，2002，頁13。[Hong Kong Observatory, *Windshear and Turbulence in Hong Kong: Information for Pilot,* 2002, p. 13.]
169. 劉心怡，〈香港國際機場風切變個案研究〉，載中國民用航空總局空中交通管理局，《航空氣象服務學術交流會》，2000年9月5–9日，頁1。[Lau, C. Y., 'Case Study of Windshear and Turbulence at Hong Kong International Airport', in Zhongguo minyong hangkong zongju kongzhong jiaotong guanliju ed., *Hangkong qixiang fuwu xueshu jiaoliu hui* (Academic Exchange Conference on Aviation Services), 5–9 Sept 2000, p. 1.]
170. 《星島日報》，1999年8月23日。[*Sing Tao Daily,* 23 August 1999.]
171. 〈經濟局局長李淑儀書面答覆立法會十四題：風切變〉，2001年2月21日。['Written Reply by Secretary for Economic Services Li Suk Yee to the 14 Questions on Windshear Raised by the Legislative Council', 21 February 2001.]
172. 香港天文台，《在香港出現的風切變及湍流——供飛行員參考的資料》，2002，頁5。[Hong Kong Observatory, *Windshear and Turbulence in Hong Kong: Information for Pilot,* 2002, p. 5.]
173. 香港天文台內部資料[Hong Kong Observatory Internal Records]；黃良會、薛鳳旋，《香港替代性機場選點研究》，香港，基建研究組織機場研究所，1991，頁17 [Huang Lianghui and Xue Fengxuan, *Xianggang tidaixing jichang xuandian yanjiu* (Alternative Sites for Hong Kong's Replacement Airport: A Pre-feasibility Study), Hong Kong, Jijian yanjiu xuzhi jichang yanjiusuo, 1991, p. 17]。

174. *Hong Kong Observatory 1997–98,* Hong Kong, Government Printer, 1998, p. 2.
175. Hong Kong Observatory website, <http://www.hko.gov.hk>.
176. Civil Aviation Department, *Annual Report of the Director of Civil Aviation,* Hong Kong, 1948/49–49/50; Civil Aviation Department, *Annual Departmental Report by the Director of Civil Aviation for the Financial year,* Hong Kong, Government Printer, 1952/53–75/76; Civil Aviation Department, *An Annual Review by the Director of Civil Aviation for the Financial Year,* Hong Kong, Government Printer, 1976/77–80/81; Civil Aviation Department, *Annual Review of Civil Aviation in Hong Kong by the Director of Civil Aviation for the Financial Year,* Hong Kong, 1981/82–1994/95; Civil Aviation Department, *Review of Civil Aviation in Hong Kong by the Director of Civil Aviation,* Hong Kong, 1997/98–2001/02.
177. 2002年6月5日訪問天文台台長林超英先生紀錄。[Interview with Director of Hong Kong Observatory, Mr C. Y. Lam, 5 June 2002.]
178. Watts, I. E. M., *Hong Kong Annual Departmental Report by the Director, Royal Observatory for the Financial Year 1960–61,* Hong Kong, Government Printer, 1961, p. 19.
179. 《華僑日報》，1984年7月31日。[*Wah Kiu Yat Po,* 31 July 1984.]
180. 香港天文台，〈香港環境輻射監測技術報告第21號〉，香港，2001。[Hong Kong Observatory, 'Environmental Radiation Monitoring in Hong Kong Report No. 21', Hong Kong, 2001.]
181. Hong Kong Observatory website, <http://www.hko.gov.hk>; 張文瀾，〈談紫外線輻射〉，《文匯報》，1999年11月5日[Zhang Wenlan, *Tan ziwaixian fushe* (On UV Radiation), *Wen Wei Po,* 5 November 1999].
182. 《蘋果日報》，1999年10月16日。[*Apple Daily,* 16 October 1999.]
183. 台灣行政院環保署網頁[Environmental Protection Administration of Taiwan website]，<www.epa.gov.tw/monitoring/1–1/uv.htm>。
184. World Health Organisation, Intersun Global UV Project website, <http://www.who.int/peh-uv/intersunprogr.htm>；七美風情網，「如何解讀紫外線指數？」，載《康健雜誌》，1999年5月，[Chimei website, 'How to Read UV Levels?' from *Health Magazine,* May 1999]，<http://chimei.idv.tw/health/health014.htm>。
185. Hong Kong Observatory website, <http://www.hko.gov.hk>.
186. 《成報》，2000年3月24日。[*Sing Pao Daily News,* 24 March 2000.]
187. 《明報》，1999年10月16日。[*Ming Pao,* 16 October 1999.]
188. 《明報》，2002年8月8日；香港天文台，《香港氣象觀測摘要2001》，表八「2001年京士柏每日穀日照時間」。[*Ming Pao,* 8 August 2002; Hong Kong Observatory, *Summary of Meteorological Observation in Hong Kong,* Table 8, 2001.]
189. *China Mail,* 7 October 1869; 4 October 1879.
190. 香港天文台網頁，「香港氣象雷達觀測」[Hong Kong Observatory website,

'Weather Radar Observation']，<http://www.hko.hk/wservice/tsheet/radmetc.htm>。

191. 甄榮磊，「大帽山最先進天氣雷達」[Ginn, Wing-lui, (Tai Mo Shan's Most Advanced Weather Radar)]，<http://www.hko.gov.hk/education/newsarticle/991210.htm>。

192. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory, in the Year 1884,* Hong Kong, Noronha & Co., 1885, p. 127.

193. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory, in the Year 1886,* Hong Kong, Noronha & Co., 1887, p. i.

194. Doberck, W., *Observations Made at The Hong Kong Observatory, in the Year 1888,* Hong Kong, Noronha & Co., 1889, p. 1.

195. Royal Observatory, Hong Kong, *Director's Report,* 1890, Hong Kong, pp. 1–4.

196.《華字日報》，1904 年 1 月 1 日。[*Huazi ribao,* 1 January 1904.]

197. Royal Observatory, Hong Kong, *Hong Kong Storm Signals,* Hong Kong, 1938, p. 2.

198. Doberck, W., *Observations and Researches Made at the Hong Kong Observatory, in the Year 1884,* Hong Kong, Noronha & Co., 1885, p. 120.

199.《華字日報》，1897 年 9 月 20 日。[*Huazi ribao,* 20 September 1897.]

200.《華字日報》，1903 年 6 月 22 日。[*Huazi ribao,* 22 June 1903.]

201. Royal Observatory, Hong Kong, *Hong Kong Storm Signals,* Hong Kong, 1938, p. 2.

202. Hong Kong Observatory, *Hong Kong Typhoons* (pamphlet), Table XVII, Hong Kong, p. 18.

203. Director of Royal Observatory, Hong Kong, 'Memorandum on the Circumstances Which Led to the Introduction of the Hong Kong Storm Warning Codes of 1917', File No. 23, *Meteorological Messages & Storm Warnings (1916–1933),* Hong Kong, Royal Observatory, 7 November 1917.

204. Royal Observatory, Hong Kong, 'Letter From the Chief Secretary of Hong Kong to the Inspectorate General of Customs of Peking', *Royal Observatory Correspondence,* No. 4261, General, Hong Kong, 14 January 1918.

205. 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1917', *Hong Kong Administrative Reports, 1917,* Appendix F, Hong Kong, Noronha & Co., 1918, F7.

206. Government Notification No. 283, Hong Kong, *The Hong Kong Government Gazette,* 15 June 1917.

207. Letter from Director of Royal Observatory, Hong Kong to Father Gauthier on 31 March 1919, File No. 23, *Meteorological Messages & Storm Warnings (1916–1933),* Hong Kong, Royal Observatory.

208. Royal Observatory, Hong Kong, *Hong Kong Typhoon Signals* (pamphlet) Hong Kong; 'Report of the Director of the Royal Observatory, Hong Kong, for the Year 1921', *Hong Kong Administrative Reports, 1921,* Appendix F, Hong Kong, Noronha & Co., 1922, F8.

209. Royal Observatory, Hong Kong, 'Hong Kong Local Storm Signal Code', File No. 23, *Meteorological Messages & Storm Warnings (1916–1933),* Hong Kong, Royal Observatory.

210.《華字日報》，1907 年 6 月 4 日；1907 年 7 月 31 日。[*Huazi ribao,* 4 June 1907; 31 July 1907.]

211. Royal Observatory, Hong Kong, *Hong Kong Storm Signals,* Hong Kong, 1938, p. 1.

212. Hong Kong Observatory website, <http://www.hko.gov.hk>.

213.《工商日報》，1927 年 2 月 28 日。[*Gongshang ribao,* 28 February 1927.]

214.《工商日報》，1934 年 12 月 12 日。[*Gongshang ribao,* 12 December 1934.]

215.《華僑日報》，1973 年 3 月 16 日。[*Wah Kiu Yat Po,* 16 March 1973.]

216.《華字日報》，1923 年 8 月 24 日。[*Huazi ribao,* 24 August 1923.]

217.《星島日報》，1976 年 1 月 12 日。[*Sing Tao Daily,* 12 January 1976.]

218. *Hong Kong Hansard 1923,* 'Hong Kong Legislative Council', 30 August 1923, pp. 78-83；《華字日報》，1923 年 8 月 23 日[*Huazi ribao,* 23 August 1923]。

219. *The Hong Kong Government Gazette,* 22 June 1923, Hong Kong, Noronha & Co., 1924, p. 207；《華字日報》，1921年5月9日[*Huazi ribao,* 9 May 1921]。

220.《華字日報》，1927 年 8 月 22 日至 23 日。[*Huazi ribao,* 22–23 August 1927.]

221.《華僑日報》，1968年8月25日；1960年6月19日。[*Wah Kiu Yat Po,* 25 August 1968; 19 June 1960.]

222.《華字日報》，1906 年 11 月 2 日。[*Huazi ribao,* 2 November 1906.]

223.《華字日報》，1906 年 11 月 2 日。[*Huazi ribao,* 2 November 1906.]

224. 皇家香港天文台，《颱風》，香港，1992 年。[Royal Observatory, *Typhoon,* Hong Kong, 1992.]

225. 'Correspondence Regarding the Typhoon Shelter at Mongkoktsui and the Proposed Temporary Increase in Light Dues', *Hong Kong Sessional Papers,* No. 24, 1908, Hong Kong, Noronha & Co., 1909, pp. 506–507.

226. *The Hong Kong Government Gazette,* 15 July 1910, Hong Kong Government, 1911, p. 280.

227. *Hong Kong Sessional Papers,* 'Typhoon Refuge', No. 17, 1915, Hong Kong, Noronha & Co., 1916, p. 53.

228.《華僑日報》，1960 年 6 月 19 日。[*Wah Kiu Yat Po,* 19 June 1960.]

229.《星島日報》，1949 年 8 月 8 日。[*Sing Tao Daily,* 8 August 1949.]

230. *Hong Kong Blue Book,* Hong Kong, Noronha Co., 1848–1857; *Hong Kong Sessional Paper* No. 30/91, No. 26/97, No. 16/1901, No. 17/1911, No. 15/1921 and No. 5/1931, Hong Kong, Government Printer; S. Young, *Report on the 1961 Census,* Hong Kong, Government Printer,

1961–62; *Report on the 1966 By-Census,* Hong Kong, Government Printer, 1968; D. R. Rick, *Hong Kong By-Census, 1976: Main Report,* Hong Kong, Government Printer, 1978–79; *Hong Kong 1981 Census: Main Report,* Hong Kong, Government Printer, 1982；政府統計處，《1996 年期人口統計簡要報告》，香港，1996 [Census and Statistics Department,*1996 Population by Census, Summary Result,* Hong Kong, 1996]；政府統計處，《人口普查 2001 簡要報告》，香港，2001 [Census and Statistics Department, *2001 Population Census Summary Result,* Hong Kong, 2001]。

231. *Hong Kong Statistics,* 1947–1967, Hong Kong, 1969; Young, S., *Report on the 1961 Census,* Hong Kong, Government Printer, 1961-62; *Hong Kong 1981 Census Main Report Volume 1,* Hong Kong, Government Printer, 1982; *Annual Departmental Report by the Commissioner for Resettlement,* Hong Kong, Government Printer 1968/69-72/73; *Hong Kong Housing Authority Annual Report,* Hong Kong, The Housing Authority, 1973/74-96/97; *Hong Kong 1986 by Census Main Report Volume 1,* Hong Kong, Government Printer, 1988; Census and Statistics Department, *Hong Kong 1991 Population Census Main Report,* Hong Kong, 1992；政府統計處，《人口普查 2001 主要報告—第一冊》，香港，2001 [Census and Statistics Department, *Hong Kong 2001 Population Census Main Report,* Hong Kong, Vol. 1., 2001]。
232. 《工商日報》，1936 年 8 月 17 日。[*Gongshang ribao,* 17 August 1936.]
233. 《星島日報》，1968 年 8 月 22 日。[*Sing Tao Daily,* 22 August 1968.]
234. 《工商日報》，1971 年 8 月 20 日。[*Gongshang ribao,* 20 August 1971.]
235. 《星島日報》，1975 年 10 月 15 日；《明報》，1975 年 10 月 15 日。[*Sing Tao Daily,* 15 October 1975；*Ming Pao,* 15 October 1975.]
236. 《星島日報》，1979 年 8 月 3 日。[*Sing Tao Daily,* 3 August 1979.]
237. 《星島日報》，1983 年 9 月 9 日。[*Sing Tao Daily,* 9 September 1983.]
238. 《星島日報》，1996年2月24日；1999年12月18日；1999年12月19日。[*Sing Tao Daily,* 24 February 1996; 18 December 1999; 19 December 1999.]
239. 陳健碩，《香港的斜坡安全》，香港，土力工程處，2002。[Chan, Kin-sek, *The Safety of Hong Kong Slopes,* Hong Kong, Geotechnical Office, 2002.]

Weathering the Storm
風雲可測

Hong Kong Observatory and Social Development
香港天文台與社會的變遷

The arduous struggles of the people of Hong Kong to overcome the challenges of nature vividly depict the development of modern-day Hong Kong.

Weathering the Storm is divided into two parts. The first part, based on valuable historical texts and photographs, describes the characteristics of Hong Kong's climate and the natural disasters that struck in the past. The second part details the establishment and development of the Hong Kong Observatory and analyses society's gradual adoption of Western sciences and research attitude. The history of the Hong Kong Observatory is an illustration of the distinct features of Hong Kong's progress.

Professor Ho Pui-yin, a graduate of the Chinese University of Hong Kong with a history major, obtained her Maîtrise and Doctorat degrees in Paris University. Her postgraduate research emphases were on prosopography study and social history. She previously worked as a research consultant at the Organization for Economic Co-operation and Development (OECD) in Paris, and now teaches in the History Department of the Chinese University of Hong Kong. Her current researches are mainly on Hong Kong's social and economic history.

香港人克服大自然挑戰的艱苦奮鬥經歷，是近代香港成長的寫照。

《風雲可測》分上、下兩篇。上篇根據歷年來有關香港地區自然氣候的珍貴歷史資料及圖片，對香港的自然氣候特徵及歷年自然災害作深入的描寫。下篇詳述香港天文台的創立與發展，分析西方科學知識和研究精神在香港植根及融入社會的過程，從而探討近代香港社會的演變的特色。

何佩然教授　香港中文大學文學士 (主修歷史)、巴黎大學碩士、博士。留法期間曾參與法國巴黎高等社會科學研究院 (EHESS) 年鑑學派群體生平學研究，並出任經濟合作與發展組織 (OECD) 研究顧問，現任教於香港中文大學歷史系，近年專注香港社會經濟史研究。

香港大學出版社
HONG KONG UNIVERSITY PRESS
www.hkupress.org