

50 周年  
Anniversary

1959-2009



# 香港天氣雷達觀測五十載

50 Years of Weather Radar Observations in Hong Kong

2009

1999

1989

1979

1969

1959



香港天文台  
HONG KONG OBSERVATORY

香港的天氣雷達自1959年以來服務香港凡半個世紀。天氣雷達是監測惡劣天氣如暴雨及颱風的主要工具，是天氣預報必不可少的儀器。

此特刊回顧香港雷達氣象的歷史，以茲紀念香港天氣雷達觀測五十周年。

Weather radars have been serving Hong Kong for half a century since 1959. The weather radar is a major tool for monitoring severe weather such as rainstorms and typhoons and is indispensable in weather forecasting.

This booklet is prepared in commemoration of the 50th anniversary of weather radar observations in Hong Kong.

# 1959 第一代天氣雷達 - 追蹤颱風

## First Generation Weather Radar – Tracking Typhoons

1959年，香港天文台在大老山安裝了本港首部天氣雷達，型號是迪卡41型。

In 1959, the Hong Kong Observatory installed the first weather radar, Decca 41, at Tate's Cairn.



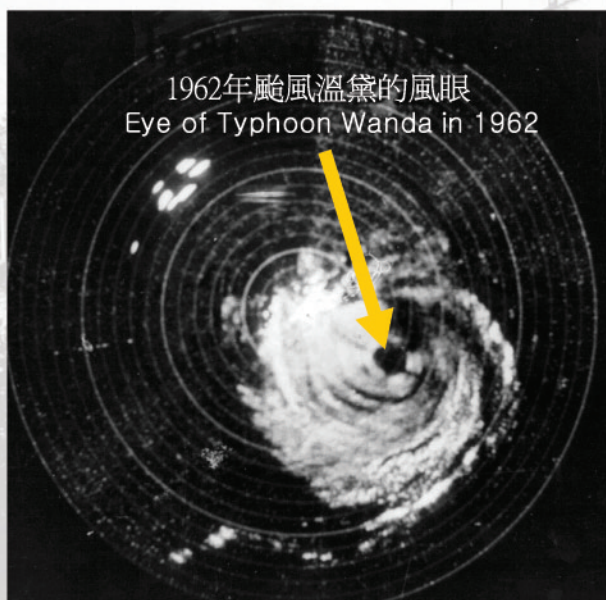
迪卡41型雷達的天線只能作水平方向的掃描，不作垂直方向的掃描。在暴雨情況下，雷達的探測範圍只有約100公里。迪卡41型雷達的天線是外露的，沒有設保護罩。在大風時，需要用繩索將天線固定，以防損壞，因此大風時雷達的效率受到限制。

The antenna of Decca 41 radar could only perform horizontal scans, but not vertical scans. In heavy rain, the radar's range of detection was only about 100 km. The antenna of Decca 41 radar was exposed and not protected by a radome. In strong winds, the antenna had to be bolted down to avoid damage, thus limiting its effectiveness during high winds.



這雷達捕捉了多個早期颱風如1962年溫黛的珍貴圖片。

This radar captured many valuable images of early typhoons, like Wanda in 1962.



# 1966

## 第二代天氣雷達 - 探測遠方暴雨 Second Generation Weather Radar – Probing Distant Rainstorms

1966年，香港天文台在大老山的迪卡41型雷達旁安裝了皮里斯43S型天氣雷達，雷達天線受天線罩保護，因此大風情況下亦可以運作。雷達的天線不單作水平方向的掃描，亦能作垂直方向的掃描。皮里斯43S型天氣雷達的有效探測範圍可達450公里，有助探測遠方的暴雨。

In 1966, the Observatory installed a Plessey 43S weather radar beside the Decca 41 weather radar at Tate's Cairn. The radar antenna was protected by a radome and thus operable in high winds. The radar antenna performed horizontal scans as well as vertical scans. The Plessey 43S radar's effective range of detection was around 450 km, enabling it to detect distant rainstorms.

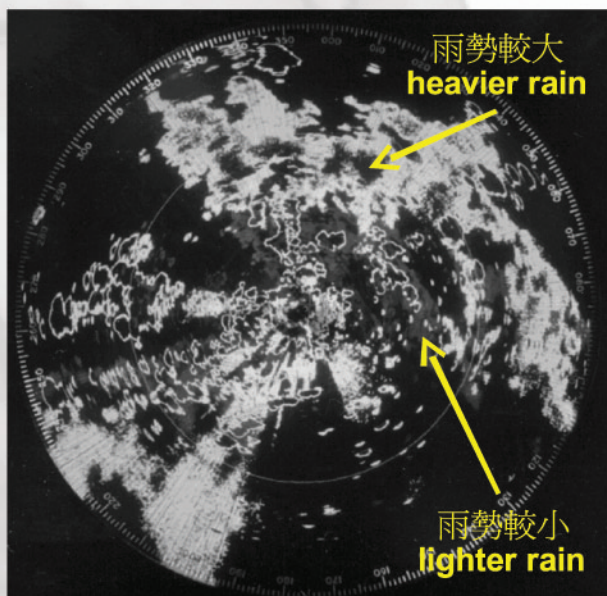


Radar images were shown on a monochromatic display screen either with a hood or in a dark room. Radar images were captured by camera.



皮里斯43S型雷達亦是模擬式雷達，並不配備儲存雷達影像的功能，圖像只在配有遮光罩或在黑房內的單色顯示屏上顯示。雷達圖像皆是用相機作紀錄。

The Plessey 43S radar was also an analogue radar. It did not come with radar image archival capability.



皮里斯43S型雷達有一特點是利用不同亮度來顯示雨區的強弱，這有助預報員估計降雨強度和監察雨區分佈情況。

The Plessey 43S radar had the capability of showing the intensity of rain areas in different brightness. This aided the weather forecasters in estimating the rain intensity and monitoring of rain distribution.

# 1983 天氣雷達數碼化年代

## Era of Digital Weather Radars

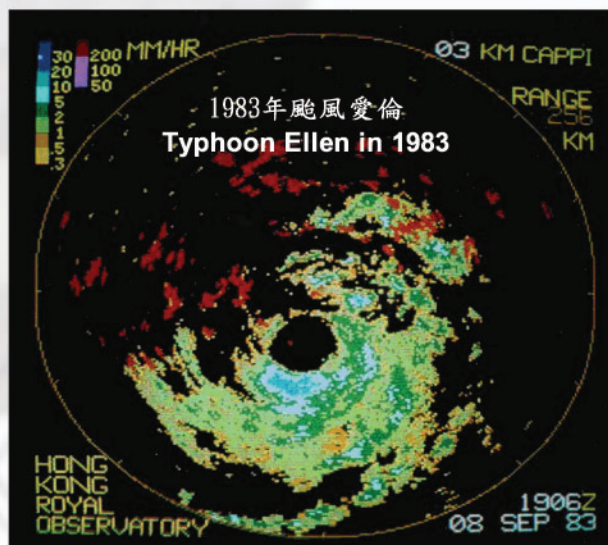


數碼天氣雷達的另一強項是將降雨的強弱，以不同顏色顯示出來。此外，電腦顯示的游標位置方便讀取經緯度，對分析熱帶氣旋中心位置大有幫助。

Another advantage of the digital weather radar was the display of rainfall intensity in different colours. It also provided direct readout of the latitude and longitude at the cursor location on the display, facilitating the location of tropical cyclones.

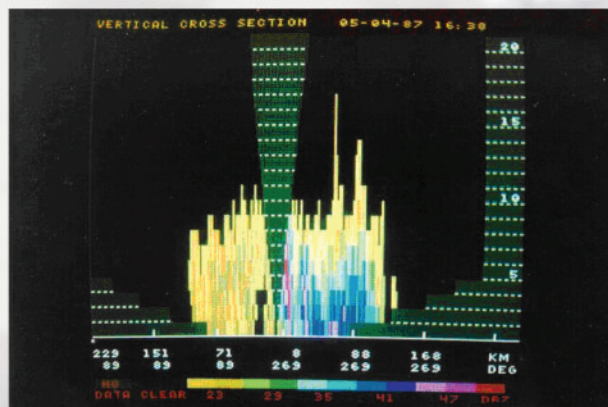
1983年，香港的天氣雷達進入數碼化年代，天文台在大老山安裝了第一台配備電腦的天氣雷達，替換 Decca 41型雷達。電腦方便儲存雷達圖像，並可以動畫形式顯示雷達影像，令天氣預報員更有效監察雨區的動向和變化。

Weather radar in Hong Kong entered the digital era as the Observatory installed the first computer-based weather radar at Tate's Cairn in 1983 to replace the Decca 41 radar. The computer enabled the archival of radar images and the display of radar pictures in animation sequence. This facilitated the weather forecasters in more effectively monitoring the movement and evolution of rain areas.



相比早期的天氣雷達，數碼天氣雷達的優點是可以製作不同類型的雷達產品，包括平面的雷達圖像及垂直剖面圖等，以供天氣預報員使用。

In comparison with earlier weather radars, the digital radar had the merit of generating different product types, including planer radar image and vertical cross-section, for use by weather forecasters.

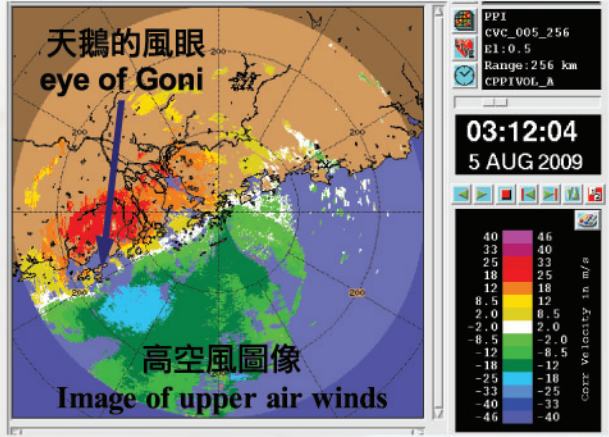


# 1994 多普勒天氣雷達年代

## Era of Doppler Weather Radars

1994年，香港進入「多普勒」雷達的年代。香港的第一台多普勒天氣雷達矗立在大老山上，這雷達不單探測雨區的強弱，更能探測雨點的移動速度，顯示高空的風向風速變化，可以用於分析熱帶氣旋中心的風力，及雷暴的結構。

In 1994, Hong Kong entered the "Doppler" era as the first Doppler weather radar was installed at Tate's Cairn. This radar detected not only the intensity of rain areas, but also the speed of movement of raindrops, indicating the variation of wind direction and speed aloft. This is useful for analyzing the wind strength near the centre of tropical cyclones as well as the structure of thunderstorms.

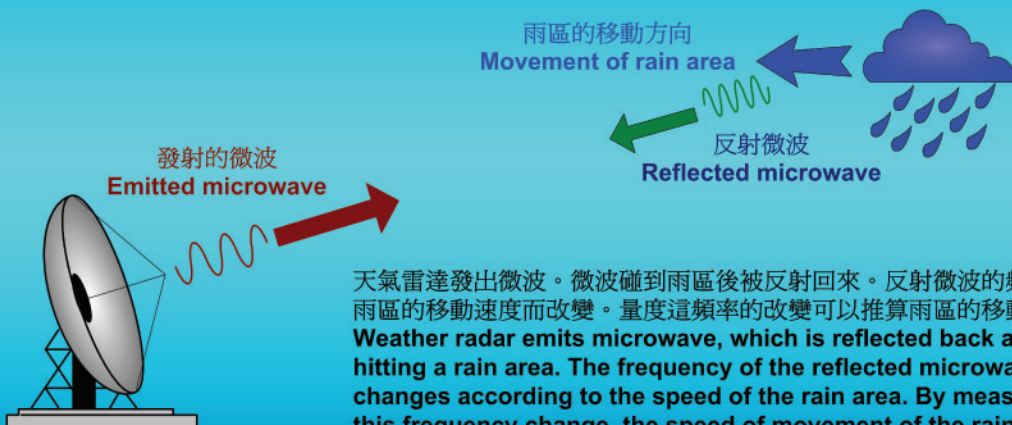


大老山多普勒天氣雷達功能較上一代數碼天氣雷達更強，多項工作可以自動化，例如自動儲存雷達數據，方便日後分析和研究之用。另亦自動製作雷達產品，而產品的類型較過往更多，幫助天氣預報員分析天氣的變化。

The Doppler weather radar at Tate's Cairn is more powerful than the digital weather radar. Many tasks can be automated. For instance, radar data are automatically archived for later analysis and research. The radar also automatically generates a greater variety of weather products to aid weather forecasters in weather analysis.

### 多普勒天氣雷達的原理

### Principle of operation of Doppler weather radar



天氣雷達發出微波。微波碰到雨區後被反射回來。反射微波的頻率會因雨區的移動速度而改變。量度這頻率的改變可以推算雨區的移動速度。  
Weather radar emits microwave, which is reflected back after hitting a rain area. The frequency of the reflected microwave changes according to the speed of the rain area. By measuring this frequency change, the speed of movement of the rain area can be deduced.

# 1997

## 風切變預警天氣雷達

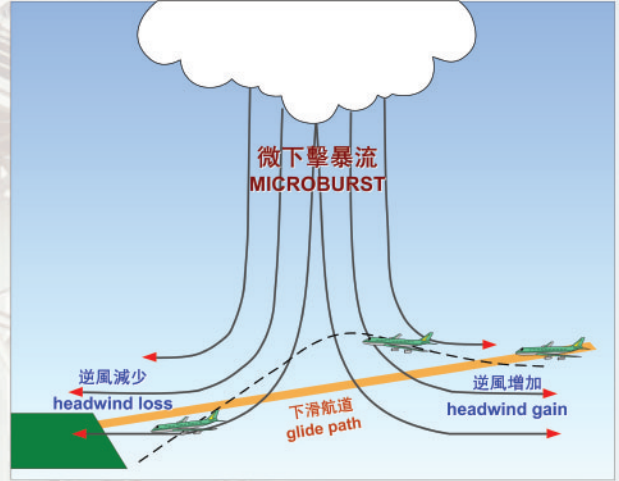
### – 保障航空安全

## Windshear Alerting Weather Radar

### – Ensure Aviation Safety



微下擊暴流能令飛機偏離航道，甚至引致飛行意外。  
Microbursts may cause an aircraft to deviate from its intended flight path and may even cause aircraft accident.



當機場多普勒天氣雷達探測到微下擊暴流時，會自動發出預警，經航空交通管制員即時傳送至飛機，保障航空安全。

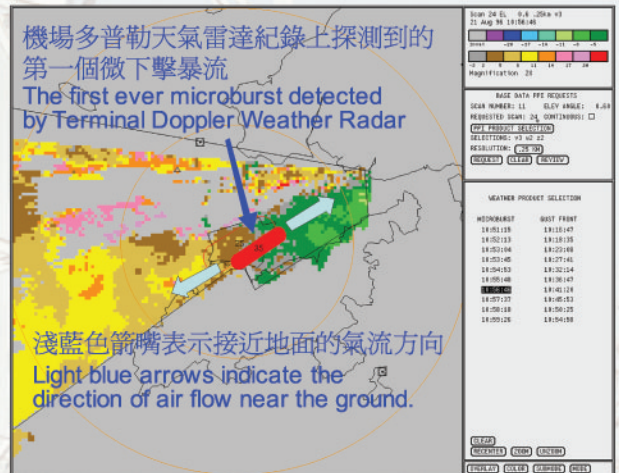
When the TDWR detects a microburst, it will issue an alert, which will be immediately relayed to the aircraft via the air traffic controllers, to assure aviation safety.

1997年，天文台在大欖涌裝置了一台機場多普勒天氣雷達。顧名思義，這台雷達是專為機場而設的。它的任務是探測由雷暴引起的微下擊暴流和風切變。

機場多普勒天氣雷達備有先進的設備，能全自動的處理雷達數據，識別微下擊暴流的位置和強度。

In 1997, the Observatory installed a Terminal Doppler Weather Radar (TDWR) at Tai Lam Chung. As its name suggests, the TDWR was purposely built to serve the terminal area of the airport. Its mission is to detect microburst and windshear associated with thunderstorms.

The TDWR is equipped with sophisticated facilities to automatically process radar data and identify the location and intensity of microbursts.



# 1999

## 雙雷達運作時代

## Era of Dual Radars in Action



1999年，天文台於香港的最高山峰大帽山安裝了第二台多普勒天氣雷達。在這位置，雷達不會受附近的地形阻擋，令雷達的覆蓋範圍更全面。大帽山與大老山的多普勒天氣雷達聯網，兩台雷達相輔相成，全天候監測鄰近香港的天氣狀況。

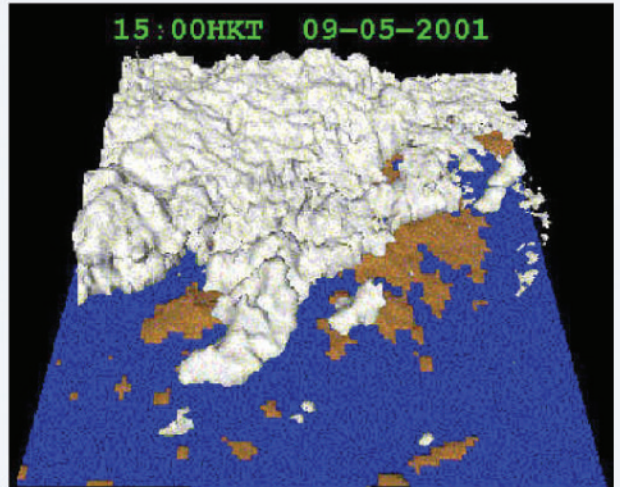
In 1999, the Observatory installed a Doppler weather radar at Tai Mo Shan, the highest peak in Hong Kong. At this location, the radar will not be blocked by neighbouring terrain, providing more comprehensive coverage. The two Doppler weather radars at Tai Mo Shan and Tate's Cairn are networked together, allowing continuous monitoring of the weather conditions in the vicinity of Hong Kong.

大帽山多普勒天氣雷達備有多項先進的功能，當中包括：

- 採用先進的發射器，使探測雨區時的表現更穩定
- 製作立體雨區圖片
- 自動探測和警報惡劣天氣如暴雨、雷暴、冰雹等。

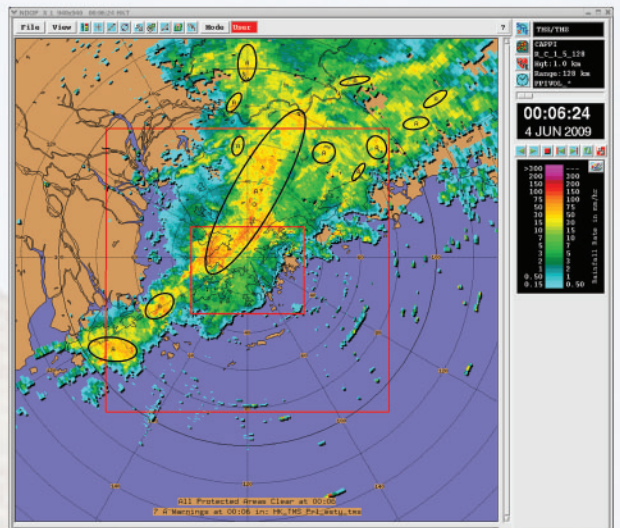
The Tai Mo Shan Doppler weather radar is equipped with a number of advanced features:

- an advanced transmitter for a more stable performance in detecting rain areas
- generation of 3-dimensional image of rain areas
- automatic detection and warning of severe weather such as rainstorm, thunderstorm and hail.



2001年5月的立體雷達圖像顯示一道廣闊的雷雨區正影響新界和大嶼山大部份地區。

3-dimensional radar image of an extensive rain and thunderstorms affecting most parts of the New Territories and Lantau Island in May 2001.



2009年6月一道雨帶影響香港時的雷達圖像。雷達自動地識別暴雨區域（橢圓形區域）。

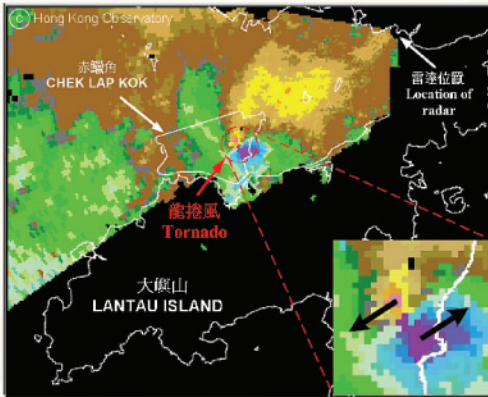
The image above depicts a rain band affecting Hong Kong in June 2009. The radar automatically identifies regions of heavy rain (in ellipses).

# 天氣雷達產品及應用

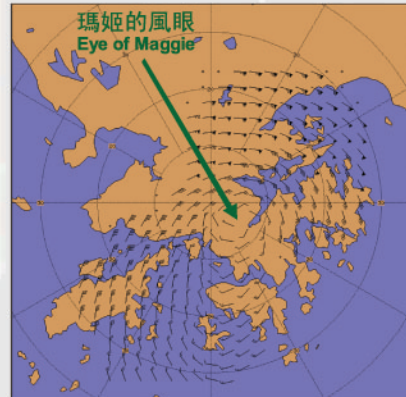
## Weather Radar Products and Applications

天氣雷達不單對監測暴雨、熱帶氣旋等大型的天氣現象很有幫助，亦可以觀測到細緻的天氣現象如龍捲風及颱風的風眼。

Weather radars not only monitor large-scale weather phenomena such as rainstorms and tropical cyclones, but they also capture such small scale features as tornado and typhoon eye.



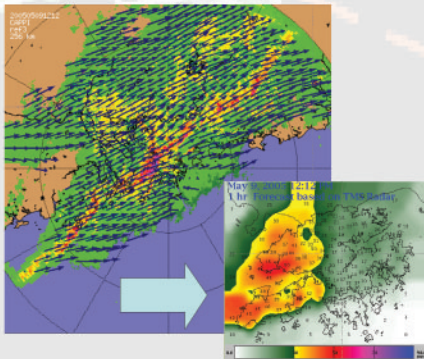
機場出現的龍捲風  
Tornado at airport



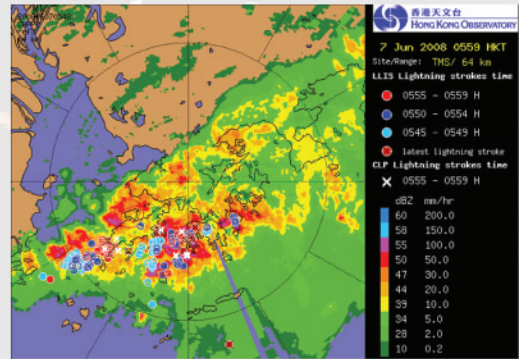
1999年颱風瑪姬  
Typhoon Maggie in 1999

利用天氣雷達的資料可以推算未來幾小時的降雨量，亦可結合閃電定位資料，為機場提供雷暴和閃電的預警。

Weather radar data can be used to project the rainfall in the next few hours and, in combination with lightning location data, to provide thunderstorm and lightning alerts for the airport.



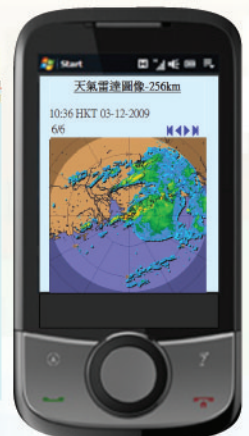
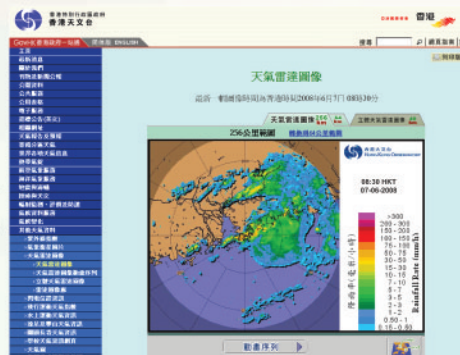
基於天氣雷達數據推算的雨區移動及預測降雨強度  
Forecast movement of rain areas and projected rainfall intensity based on weather radar data



為機場提供雷暴和閃電的預警  
Thunderstorm and lightning alerts for airport

天文台除了在互聯網上提供天氣雷達圖像，亦提供電子手賬專用的天氣雷達圖像網頁，方便市民觀看。

The Observatory provides weather radar images on the Internet, as well as PDA version of weather radar images.





# 雷達英雄傳 - 也有風雨也有情

## Through Rain and Storms – Stories of Radar Heroes

香港天氣雷達24小時的運作，為市民探測惡劣天氣，保障大眾的安全，這實有賴自始以來努力不懈的一班同事。這裡輯錄了同事們對往日工作的回憶，以茲紀念。

Weather radars in Hong Kong operate round-the-clock to detect hazardous weather, protecting public safety. This would not have been possible without the efforts of many colleagues who worked diligently over the years. Here is a collection of their memories as a testimony to their work.

### 十年人事 (only in Chinese)

### 天文台第一代雷達機械師 洪日昇

光陰似箭，不經不覺間，我已經退休十年。

十年是一段頗長的時光，尤其是在科技領域裡，十年時間足以帶來驚天動地的變化。基於此，我敬重那些仍緊守崗位、默默耕耘、不斷學習、不斷進步的昔日同事們。偶爾聽到他們對工作上的一些感想，我亦感同身受。

回想初入行時，半導體尚未流行，集成電路更是

未曾面世，一切電子產品都是以真空管為骨幹。當時實在難以想像到，在不經意間，真空管會逐漸被取代，甚至於被淘汰！當然，在整個過渡過程裡，我們經歷了不少艱辛，亦身體力行地見證了「與時並進」的重要性。

對於儀器的維修，我堅持一個信念，就是：一件本來可以正常運作的儀器，在清除毛病後，必定可以回復運作。所以，除非在不得已的情況下，我不贊成隨便去更改待修儀器的原本設計，以圖達到「修復」的目的。說得明白點，我認為「維修」是去清除毛病，不是去改動設計。事實是：不適當的改動往往會引發始料不及的惡果，最常見的是數據變異或偏差。無可否認地，這會為使用者帶來不便。

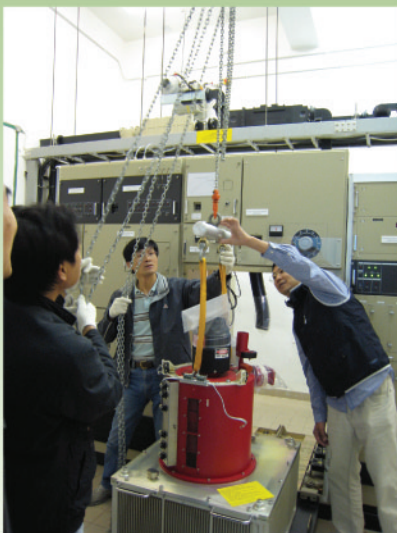
不過，話說回來，現今的維修方式與老一輩的已經大不相同。從前是以更換零件為主，現在則是更換「模組」。時代轉變，處事方式亦相應地在變。表面上看來，現今做維修工作好像是比從前容易了，因為技術員再無須在千絲萬縷的電路板上追尋毛病的元兇；但實際是，現今的產品設計愈來愈追求完美與精密，複雜的設計，加上密封的組裝方式，令維修變得困難重重，往往要追查出來是那個部組出了毛病已經不易，更何況要在零件甚至軟件層面上追尋病源？看來，同事需要不斷努力，繼續與時並進！



同事們共同研究雷達天線的操作  
Colleagues investigating the operation  
of radar antenna together



「全副武裝」準備檢查雷達天線  
Fully equipped to check radar antenna



合力更換雷達的發射器組件  
Joining hands to replace  
transmitter components



在高台上進行維修工作  
Performing maintenance work  
on an elevated platform

# 雷達英雄傳 - 也有風雨也有情

## Through Rain and Storms – Stories of Radar Heroes

### 颱風襲港時在雷達站遇險記

(only in Chinese)

天文台雷達機械師 陳嘉華、盧偉雄

在天文台工作多年，在颱風襲港時而需要懸掛十號風球的就只有一九九九的約克。十年後回想起來，我們在十號風球期間於大帽山雷達站當值兩夜三日，依然是非常難忘難得的工作經歷。

大帽山雷達站位於全港的最高峰，在颱風吹襲下，你便會感受到風的震撼力。當年九月十五日掛起三號強風信號後，我們便一同上大帽山雷達站工作，以便有需要時為雷達進行緊急維修。由於這是我們第一次在十號風球期間在山上當值，心情總是有點緊張。從雷達圖像可以看到風眼正續步逼近香港。當天山上的天氣非常惡劣，不但風大雨大，耳朵也感覺到氣壓在轉變時產生的不適。

十六日清晨，站內的電力突然中斷，幸好後備發電機及時啟動，經檢查後，雷達系統仍正常運作。但不幸在當晚，發電機亦告故障而停止運作，迫不得已下我們只好利用「不間斷電源供應系統」僅餘的電力把雷達系統逐一關上，以減低雷達受損的風險。由於正值夜間，在緊急照明電力慢慢耗盡後，我們便置身於漆黑一片當中。及後，我們發覺已不能透過任何途徑與外界溝通，以至我們被誤以為失蹤。

在狂風暴雨中，我們在雷達站默默地等待，終於到十七日凌晨兩時左右，我們聽到站外響起拍門聲，原來總部同事已為我們報警求助，消防員到站「營救」。及後經機電工程署修理後備發電機，我們才於那天傍晚下山，足足逗留山上三日兩夜才得以脫險！這真是畢生難忘的經歷！



一九九九年九月颱風約克襲港時的立體雷達圖像  
3-dimensional radar image of Typhoon York hitting Hong Kong in September 1999



安裝設備後進行詳細測試  
Carefully testing equipment after installation

# 雷達英雄傳 - 也有風雨也有情

## Through Rain and Storms – Stories of Radar Heroes

### 天文台氣象雷達的掌故

天文台雷達機械師 袁富達

### 與時並進

天文台雷達機械師 張嘉榮

(only in Chinese)

香港經常受到颱風威脅，天文台明白到社會對颱風預警的需要，及了解到要做好颱風預警，必須好好利用科技。故早着先機，遠早過鄰近地區，在上一世紀五十年代末，已引進第一台作為氣象用途的雷達。

隨着新舊交替，香港天文台陸續引入更為先進的氣象雷達系統，亦見證氣象雷達系統的演變，包括有：

探測範圍：從短程雷達到遠程雷達；

電子設計：從真空管到固體物理組件；

信號處理：從模擬到數碼；

探測功能：從雨勢強度到多普勒風；

處理能力：從單一台雷達到雙台雷達運作。

這種種的變遷，為對雷達有興趣的同事帶來一展所長的機會。

光陰似箭，日月如梭！轉瞬間，在天文台任職雷達機械師已逾二十三年多了！

回想最初的十六年在雷達組期間，有幸見證了天文台的雷達系統，由第二代採用真空管及半導體的雷達系統、發展到第三代的「數碼化雷達」系統、到第四代的「多普勒天氣雷達」系統、及為赤鱗角機場而安裝的「機場多普勒天氣雷達」系統。我也曾為上述的各個系統提供過維修及保養服務。身為雷達組的一員，過去我曾多次在颱風襲港期間，進駐在大老山及大欖涌的雷達站，提供緊急支援服務。

眼看天文台在雷達系統上的發展，我亦感受到天文台在科技發展上，緊隨著時代的步伐而一起前進。



聚精會神地觀看維修天氣雷達的示範  
Taking a lesson in maintenance of weather radar



定期檢查天氣雷達的操作  
Regular checking of weather radar operation

## Joy in Work

(只以英文發表)

YAU Lai Kin

Radar Specialist Mechanic, Hong Kong Observatory

The Terminal Doppler Weather Radar (TDWR) is one of the key systems that support the operation of the new Hong Kong International Airport at Chek Lap Kok. After more than 12 years of round-the-clock operation, it is still running continuously, providing timely windshear warning for the safe operation of the Airport. It has been a pleasure for me to participate in different stages of TDWR system implementation like site preparation, field installation, acceptance tests, system optimization, maintenance and repair. I always feel excited when the maintenance team brings the system back to normal after its very rare failures.



檢查雷達天線確保運作正常  
Checking the radar antenna to ensure normal operation

50周年  
Anniversary

1959-2009



## 香港天氣雷達佈局 Distribution of Weather Radars in Hong Kong



大欖涌  
Tai Lam Chung



大帽山  
Tai Mo Shan



大老山  
Tate's Cairn

大帽山及大老山天氣雷達主要用於公眾天氣服務，大欖涌的機場多普勒天氣雷達專用於機場的風切變預警服務。

The weather radars at Tai Mo Shan and Tate's Cairn are used mainly for public weather services whereas the TDWR at Tai Lam Chung is dedicated for windshear alerting at the airport.

## 展望將來 Paving Way for the Future

香港天文台正與鄰近氣象單位聯繫，共同研究交換天氣雷達雷達數據，以製作大範圍的雷達拼圖以及三維的風場反演，以助加強天氣監測。

天文台現致力發展基於地理信息系統的產品，例如在普及的地理信息系統上可以觀看雷達圖像的動畫。未來將會進一步開發免費定點服務，使市民可以輕鬆的隨時查看當地附近的天氣雷達圖像及預測，方便計劃活動。

The Hong Kong Observatory is exploring with neighbouring meteorological organizations the possibility of exchanging weather radar data to enable the generation of large-scale radar composite image and 3-dimensional wind field to enhance weather monitoring.

The Observatory is developing products based on Geographical Information System (GIS), such as animation sequence of radar images overlaid on a popular GIS platform. In the future, the Observatory will further develop free, site-specific products, to enable members of the public to check the weather radar images and forecast at their location of interest, to facilitate their planning of activities.

