前言

Preface

臺灣位於歐亞大陸板塊與菲律賓海板塊交界處，屬於環太平洋地震帶的一部分，地震活動頻繁。因地震觀測設備解析能力的提高，依近年統計，在臺灣附近發生的大小地震每年超過20,000次，因此地震災害已成為臺灣主要天然災害之一。中央氣象局為加強對臺灣地區地震活動的監測工作，降低地震災害，於民國78年7月1日成立地震測報中心。本中心主要任務為：

- 監測臺灣地區地震活動
- 發布有感地震報告與海嘯警報
- 執行強烈地動觀測計畫
- 研究各種地震前兆現象
- 提供地震資訊服務與地震防護宣導

Taiwan, an island located on the border between the Eurasia plate and the Philippine Sea plate, is part of the circum-Pacific seismic belt. From recent statistics, more than 20,000 seismic activities on average in and around Taiwan have been detected every year, up from the 18,000 counts due to the improving capabilities of observation equipment. Earthquake hazards are thus a major natural disaster in Taiwan. In order to monitor and report seismic activities for hazard mitigation, the Central Weather Bureau founded the Seismological Center on July 1, 1989. Main missions of the center are as follows:

- Monitoring seismic activities in and around Taiwan
- Releasing reports of felt earthquakes and issuing tsunami warnings
- Executing Taiwan Strong-Motion Instrumentation Program
- Studying various phenomena relating to earthquake precursors
- Providing seismic information services and educating the public on earthquake precautions
地震觀測網
Seismic Observation Network

- 連續型地震儀 Short-period velocity-type seismograph
- 加速度地震儀 Accelerograph
- 同頻地震儀 Broadband seismograph
- 全球定位系統觀測網 GPS network

1990年迄今ML ≥ 7.0震央地震震央位置
Epicenters of earthquake since 1990 with magnitude ≥ 7.0 and causing disasters

監測臺灣地區地震活動
Monitoring seismic activities in and around Taiwan

利用數據專線將各測站的速測型及加速度型地動信號即時傳輸至本中心進行分析處理及存承，達到即時監測地震活動的功能。目前已覈錄超過20萬次的地震資料，地震紀錄近300萬筆。對於監測斷層活動或大地震前的異常活動以及諸如地震構造、地震活動性、震源特性、場址效應等相關研究均極具應用價值。

In order to monitor seismic activities, we transmit ground motion digital signals of both velocity and acceleration types to the center by leased transmission lines. The data is then stored for processing, analyzing, and archiving. So far, we have collected more than 200,000 events with nearly 3 million seismograms. This data is invaluable for monitoring fault activity and unusual signs before large earthquakes, as well as studying tectonic structure, seismic watching, source characteristics, and strong motion shaking site effects.

發布有感地震報告與海嘯警報
Issuing reports of felt earthquakes and releasing tsunami warnings

強震速報系統的構置與完成，有效縮短地震分析研判自動化作業時間，本局為提升地震報告作業效能、持續改善硬體設備與軟體，對於發生在臺灣島內的中大型地震，已由先前45秒縮短至30秒即可完成地震速報作業，並在3至5分鐘以內透過多重管道迅速對外發布地震消息。

The completion of the Rapid Earthquake Information Release System has effectively reduced the operational time necessary for automatic data processing and analyzing. The Seismological Center has enhanced its abilities to detect and locate an inland medium-strong earthquake within 30 seconds after its occurrence, compared to the 45 seconds years ago due to substantive enhancement of related facilities. The earthquake information is then released to the public within three to five minutes.
為了防範海嘯的侵襲，本中心為位於美國夏威夷的太平洋海嘯警報中心通報之對象，在研判確定海嘯警報對臺灣地區的影響後，迅速將海嘯警訊傳送到各相關岸巡、災害防救主管機構及大眾傳播媒體，同時將近海地震所可能引起海嘯的警報作業與地震速報系統結合，適時發布海嘯警訊，並透過管道迅速傳達給相關單位。

To minimize tsunami damage, the center works closely with the Pacific Tsunami Warning Center (PTWC) in Hawaii, USA. When a tsunami is deemed to have an impact on Taiwan, we immediately deliver the news to appropriate coastal emergency authorities and the mass media. For tsunamis triggered by nearby earthquakes, we communicate with the Rapid Earthquake Information Release System to allow prompt issuance of tsunami warnings and to transmit relevant data to the public and related private sectors.

執行強烈動觀測計畫
Executing Taiwan Strong-Motion Instrumentation Program

為了綜合發展地震觀測、速報、預測科技，將成果應用於地震防災工作，以有效降低地震災害損失，自民國81年開始執行強烈動觀測計畫，以6年為一期之中程計畫進度，逐步完成都會區強烈動觀測網，建置地震速報系統、發展強震即時警報系統，達成防災、減災的目的。

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地動特性分析
Analyzing seismic characteristics

地震速報作業
Speeding up the reporting process

強震預估
Estimating earthquake intensity

強震即時警報
Strong-motion early warning

加強地震海嘯監測
Strengthening the monitoring of earthquakes and tsunamis

建置高品質深井地震觀測站
Building high-quality borehole seismic stations

整合海陸地震觀測網
Expanding seismic monitoring capabilities

拓展地震即時警報資訊於救災利用
Promoting the utilization of early warning information for disaster prevention

加強地震潛勢分析研究
Fostering research on earthquake potentiality
The Taiwan Strong-Motion Instrumentation Program (TSMIP) is a comprehensive, proactive, and continuous project.

- The first phase of the project is building a monitoring system and a network in urban areas with free-field strong motion stations. This includes gathering strong motion data around Taiwan for institutions related to engineering and disaster prevention, as a basis for revising building codes for earthquake resistant construction.

- The second phase is mainly constructing a Rapid Earthquake Information Release System. The goal is to reduce the communication time for emergency response with related units.

- The third phase of the project focuses on the Earthquake Early Warning System. We emphasize research and development on the early warning system of seismic strong motions, setting up the Geophysical Database Management System (GDMS), establishing seismic hazard prediction modes, enhancing seismic Geographic Information System (GIS), and developing earthquake prediction technology. The ultimate goal of the Earthquake Early Warning System is to predict the arrival waves of strong shaking waves and to warn people located 100 km away from the epicenter of the earthquake with 10 to 20 seconds lead time before the strong shaking arrives. (The right figure shows how the Early Warning System works for Taipei metropolis as an example.)

- The fourth phase (2010-2015) of the project has currently been conducted, which focuses on building cable-based ocean bottom seismographic (OBS) stations, installing high-quality borehole seismic stations, and integrating a multi-purpose, high resolution seismic monitoring network, with the goal of broadening the applications of earthquake early warning information to hazard mitigation.

- A 45 km-long submarine cable has been installed in the eastern offshore area of Taiwan through the Marine Cable Hosted Observatory (MACHO) project to improve the capabilities of offshore earthquake monitoring. A multi-purpose node attached varied instruments including seismograph, pressure gauge, among others is deployed at the end of the cable. The whole system started operation on November 14, 2011.
研究各種地震前兆現象
Studying various phenomena relating to earthquake precursors

1. GPS觀測
地殼受擠壓逐漸使地形產生微量變化，長期調查地形變化以推測淺層大地震的發生，是目前地震預測模式中，學界認為最有可能成功的方法之一。總數超過150站的密集GPS連續觀測網，可長期掌握地殼應變累積的時空變化及其地震活動的關係。
GPS observation
The best earthquake prediction method is through investigating long-term topographical deformation. With the dense GPS network of more than 150 continuous stations, we are able to observe the relationships between the accumulated spatiotemporal crustal deformation and seismic activities.

2. 電離層電子濃度變化觀測
地震前地殼擠壓或微小振動所引起的地電及地磁變化，可感應大氣及電離層中的帶電粒子，進而影響電離層電子濃度變化，藉由GPS觀測資料推算電離層電子濃度變化，以即時掌握前述變化與地震發生之關聯性。
Observation of variance in ionospheric electron density
Crustal deformation or subtle vibrations before an earthquake causes variation in both geoelectricity and geomagnetism. This affects the ionospheric electron density. Hence, we could use the long-term GPS data to compare the seismic occurrences with the variations in ionospheric electron density in order to try to predict earthquakes. This research is still in preliminary stage.

3. 地下水位變化觀測
地震前岩體因受應力作用而產生微小裂隙，導致孔隙率與滲透率改變，進而產生地下水位變化，因此觀測地下水位的變化將有助於地震前兆現象的掌握。以連續記錄方式，長期記錄地下水位變動的相關研究資料，作為地震前兆偵測的研判。
Groundwater level monitoring
Preceding an earthquake, applied tectonic stress causes underground rocks to deform and break. As micro-cracks grow, porosity and permeability change, thus causing changes in groundwater level. Observing fluctuations in groundwater level may be a way to keep track of earthquake occurrence. Through such observations we hope to obtain some references for the detection and analysis of earthquake precursors.

提供地震資訊服務與地震防護宣導
Providing seismic information services and educating the public on earthquake precautions
各類地震資料申請服務
24小時專線諮詢服務
接待參訪團體
參與各項防災展覽與地震教育訓練
製作地震防護宣導文宣
Serving the public needs with earthquake data.
Earthquake information consulting services through a 24-hour hotline.
Receiving site tour visitors and organizations.
Participating in earthquake precautions outreach and public education programs.
Publishing education leaflets and pamphlets.