

臺灣極端高溫事件之區域特性及其大氣環流型態分析

Regional Characteristics and Atmospheric Circulation Patterns of Extreme Heat Events in Taiwan

李亭萱¹ (Lee T.-H.) 羅資婷¹ (Lo T.-T.) 童裕翔² (Tung Y.-S.) 駱世豪³ (Lo S.-H.)

¹中央氣象署 ²國家災害防救科技中心 ³中央研究院

¹Central Weather Administration

²National Science and Technology Center for Disaster Reduction

³Academia Sinica

摘 要

近年全球暖化導致極端高溫事件發生頻率與強度持續增加，臺灣亦呈現高溫紀錄不斷刷新之趨勢。然而，受複雜地形及區域氣候差異影響，臺灣不同地區的高溫事件具有不同的時空特徵，及其對應之大尺度環流型態亦有所差異。本研究利用臺灣高解析度格點資料 (Taiwan Station-based analysis dataset, TaiSA)，依據高溫事件空間分布將臺灣劃分為北、中、南、東四區，並以高溫事件之持續時間、影響面積、事件強度及事件規模等指標，分析各區高溫事件之特性；同時，結合ERA5 (ECMWF Reanalysis v5)再分析資料之大尺度環境變數，利用K-means分群分析辨識高溫事件的主要環流型態。

結果顯示，臺灣高溫事件可區分為三種主要環流型態，包括副熱帶高壓型、西南風環境型及熱帶系統影響型。副熱帶高壓型主要發生於7至8月，此型態為各區最主要的高溫事件型態，但事件持續時間及影響範圍仍呈現區域差異；西南風環境型具有較明顯之季節性，其中南部於5至6月易發生持續時間較長且影響範圍較大的高溫事件；熱帶系統影響型則透過JTWC (Joint Typhoon Warning Center) 最佳路徑資料，進一步確認熱帶系統與高溫事件之關聯，並統整各區域影響高溫事件之熱帶系統之位置及其路徑特徵。

本研究建立臺灣高溫事件之環流分類架構，並說明不同區域高溫事件特徵與大尺度環流型態，提供未來高溫事件分析及高溫預警研究之參考。

關鍵字：極端高溫、高解析度格點資料、氣候變遷

Abstract

In recent years, global warming has led to a continued increase in the frequency and intensity of extreme heat events, and Taiwan has also experienced record-breaking high temperatures in recent years. However, owing to its complex topography and regional climate differences, extreme heat events in different parts of Taiwan exhibit distinct spatiotemporal characteristics, and their associated large-scale atmospheric circulation patterns also vary. This study uses the Taiwan Station-based Analysis dataset (TaiSA), a high-resolution gridded dataset, to investigate extreme heat events in four regions of Taiwan (northern, central, southern, and eastern Taiwan). Event duration, affected area, event intensity, and event scale are then used to characterize regional heat-event features. In addition, large-scale environmental variables from the ERA5 (ECMWF Reanalysis v5) reanalysis dataset are incorporated, and K-means clustering is applied to identify the major atmospheric circulation patterns associated with extreme heat events.

The results show that extreme heat events in Taiwan can be classified into three major circulation types: the subtropical high type, the southwesterly wind type, and the tropical-system-influenced type. The subtropical high type occurs mainly from July to August and represents the dominant heat-event type in all four regions, although event duration and affected area still exhibit clear regional differences. The southwesterly wind type shows more

pronounced seasonality, with southern Taiwan being particularly prone to longer-lasting and more spatially extensive heat events from May to June. For the tropical-system-influenced type, Joint Typhoon Warning Center (JTWC) best-track data are further used to examine the relationship between tropical systems and extreme heat events, and to summarize the locations and track characteristics of tropical systems associated with heat events in each region.

This study establishes a circulation-based classification framework for extreme heat events in Taiwan and clarifies the relationship between regional heat-event characteristics and large-scale atmospheric circulation patterns. The results provide a useful reference for future analyses of extreme heat events and for research on heat warning systems.

Key words : Extreme heat, High-resolution grid data, Climate change.