臺灣陣風因子特性與強風預警系統建置

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摘　　要

　　強陣風是台灣導致災害的氣象因素之一。先前的研究指出，陣風除了受氣象因素（如風速、風向、大氣穩定度、天氣類型等）影響外，也受非氣象條件（如地形、上風處的粗糙度等）影響。陣風因子（Gust Factor）是陣風與平均風速的比率，可用來評估強陣風發生的條件。本研究使用中央氣象局2011年至2021年的觀測資料，分析了31個人工氣象站、176個自動氣象站和450個自動風速計的數據。測站被區分為離島、沿海、山區和都會區等四類，並使用Kahl（2020）開發的氣象分級陣風因子方法，將風向分成8個方位，以5m/s為風速等級，分析了每個測站的風速與陣風之間的關係。對於外島彭佳嶼站，由於島上沒有遮蔽，不同風向的陣風因子變化不大，陣風因子介於1.4至1.8之間，且隨著風速增大而減小。而沿海測站如梧棲、蘇澳、高雄和成功，受當地地形和建築物影響，風速和風向的分布不均勻，陣風因子分布約在1.5至2.8之間。

研究建立了陣風分級模式，透過數值模式的風力預報，利用系集多成員的方式推估平均風可能的狀態。在颱風期間，也可以透過路徑位置的修正，獲得較準確的風力預估，並利用基於不同測站風速和風向分級建立的陣風因子模式，進行陣風推估。這使得在颱風影響期間，可以估計強陣風風險，提供不同區域可能發生強陣風的時空分布，供防災預警決策參考。

關鍵字：陣風、陣風分成模式、預警

Characteristics of Taiwan's Gust Factor and Development of Strong Wind Early Warning System

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Abstract

Wind gusts are one of the meteorological factors leading to disasters in Taiwan. Previous studies have indicated that gusts are influenced by meteorological (wind speed, direction, stability, and weather type) and non-meteorological conditions (terrain and roughness). The gust factor is the ratio of gusts to wind speed. This study analyzed observational data from the CWB for the years 2011 to 2021, including 31 weather stations, 176 automatic weather stations, and 450 automatic anemometers. The stations were classified into four categories: islands, coastal areas, mountainous regions, and urban areas. According to the meteorologically stratified gust factors method developed by Kahl (2020), the wind directions divided into eight sectors and the wind speed divided into one level by 5 m/s threshold, to analyze the relationship between wind speed and gusts at each station. For example, at the Pengjia Yu station on an offshore island, where there is little obstruction, the gust factor shows little variation with wind direction and value ranges from 1.4 to 1.8, decreasing with wind speed increasing. And, at coastal stations (Wuqi, Su'ao, Kaohsiung, and Chenggong) the distribution of wind speed and direction is affected by local terrain and buildings, resulting in gust factors ranging from approximately 1.5 to 2.8.

A gust stratified model was developed in this study, utilizing wind speed forecasts from numerical ensemble models to estimate the potential states of average winds. During typhoon events, more accurate wind speeds forecasting can be obtained by adjusting the typhoon path. By utilizing the gust factor model based on wind speed and direction from different stations, gust estimates can be conducted. This enables the estimation of gust during typhoon affected and provides spatial and temporal distributions of potential strong wind gust occurrences in different regions, serving as a reference for disaster reduction and emergency operation decision-making.

Key word：Wind gust, gust stratified model, early warning