雷達定量降雨估計與預報於臺北市短延時強降雨事件之應用

Application of Radar Quantitative Precipitation Estimation and Nowcasting to Short-Duration Heavy Rain Events in Taipei City

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摘 要

短延時強降雨受對流系統移動路徑與強度不確定性影響，對台北市即時致災預警構成挑戰。本研究以雷達定量降雨估計（QPE）與定量降雨即時預報（QPN）為基礎，評估 2026 年 6 月臺北市 5 場短延時強降雨事件（6/4、6/8、6/18、6/25、6/28）中，QPN能否提前提供行政區尺度時雨量預警參考。考量對流胞移動路徑不確定性，本研究以行政區為分析單元，並以區內格點統計分布（中位數、四分位距、95 百分位）描述各區代表雨量與空間異質性。

案例分析顯示，6/25 內湖區淹水事件中，QPN在雨勢增強前約 20 分鐘即呈現抬升訊號，其空間離散度亦與QPE觀測之強對流集中特徵相互呼應，顯示具輔助行政區短延時預警之潛力。惟擴大至全市並涵蓋其餘 4 場事件後，QPN表現呈現明顯事件間差異：部分事件時序強度與QPE大致吻合，部分事件則明顯高估雨勢並出現虛假訊號，顯示其提前預警能力具天氣系統依賴性。未來建議搭配定量指標與天氣分類，釐清QPN適用邊界。

關鍵字：雷達定量降雨估計、定量降雨即時預報、行政區尺度、短延時強降雨、劇烈對流

Abstract

Short-duration heavy rainfall events pose a challenge for real-time disaster warning in Taipei City due to the uncertainty in the movement and intensity of convective systems. This study uses radar quantitative precipitation estimation (QPE) and quantitative precipitation nowcasting (QPN) to evaluate whether QPN can provide advance, administrative-district-scale hourly rainfall guidance for five short-duration heavy rainfall events in Taipei City in June 2026 (6/4, 6/8, 6/18, 6/25, and 6/28). Given the uncertainty in convective cell movement at the grid scale, this study adopts the administrative district as the analysis unit, and describes each district's representative rainfall and spatial heterogeneity using the statistical distribution of grid values within the district (median, interquartile range, and 95th percentile).

Case analysis shows that during the flooding event in Neihu District on 6/25, QPN exhibited a rainfall increase signal approximately 20 minutes before the intensification observed in QPE, and its spatial spread corresponded with the concentrated convective features observed in QPE, suggesting QPN's potential to support short-duration warning decisions at the district scale. However, when the analysis was expanded citywide to cover the remaining four events, QPN performance showed marked event-to-event differences: in some events the timing and intensity of QPN agreed reasonably well with QPE, while in others QPN clearly overestimated rainfall intensity and produced spurious signals, suggesting that QPN's lead-time skill may be weather-system dependent. Future work is recommended to incorporate quantitative verification metrics and weather-system classification to clarify the applicable boundaries of QPN.

Keywords: Radar Quantitative Precipitation Estimation (QPE), Quantitative Precipitation Nowcasting (QPN), Administrative District Scale, Short-Duration Heavy Rainfall, Severe Convection