

颱風暴潮假想路徑系集預報系統之開發與評估

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摘 要

本研究所發展之暴潮系集預報模式，基於中央氣象局現有之COMCOT暴潮模式（COrnell Multi-Grid COupled Tsunami Model – Storm Surge）為基礎，以非線性淺水波方程式計算並分析風暴潮之生成、傳播以及近岸溯上等完整歷程，針對臺灣特有之地理環境建構網格計算，透過決定性預報路徑及過往預報路徑之誤差機率密度分布曲線產生多組假想路徑作為系集成員，並且發展相關機率預報產品。

研究中選用2016年登陸台灣之颱風案例測試多組系集路徑成員組合於暴潮預報中的表現，目前已知在理想颱風氣象場下，颱風中心位置越靠近測站位置將較有機會引起較高的暴潮水位，且颱風移動速度及近岸角度亦有可能受測站周圍地形影響而有較高的水位；隨著系集成員數考量得越多，亦即考量越多颱風路徑偏移及前進速度變化的可能性，進而從系集預報中得到較高且延時較長的暴潮水位分布情形。以統計分析參數來看，決定性預報有普遍較高的預兆得分，但對於防災的角度來說，決定性預報僅能包含部分的暴潮，對於大部分的情況下，利用決定性預報來考量台灣沿海的溢淹災害是不足的，仍需要靠系集預報來進行補強。

關鍵字：風暴潮、系集預報、誤差機率密度分布函數

Development and assessment of the hypothetical tracks ensemble storm surge forecast system

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Abstract

A probabilistic storm surge forecast system based on the existing COMCOT storm surge model (Cornell Multi-Grid COupled Tsunami Model-Storm Surge) of the Central Meteorological Bureau is developed. It calculates and analyzes the generation of storm surges based on the nonlinear shallow water wave equation in the nested grid scheme. The ensemble model generates hypothetical typhoon tracks from analyzed best track and probability density function of historical forecast track errors as members, and output ensemble-based products.

Three typhoons that made landfall in Taiwan in 2016 was selected to evaluate the best group of ensemble members. The study shows that under an idealized parametric wind field, the closer the typhoon center is to the station, the more likely it is to cause a high surge elevation, and the moving speed, attack angle of a typhoon and local bathymetry around a tide gauge may also contribute to this result. As more of the ensemble members are considered, the more typhoon track and forward speed deviations are considered, which results in obtaining a higher and longer-duration high-surge envelope from the forecast. By evaluating the ensemble performance in terms of statistical analysis, deterministic forecasts generally have higher threat scores in all case studies due to lower false alarm ratio. However, from the perspective of disaster prevention, deterministic forecasts can only include part of extreme conditions. In most cases, it is insufficient to anticipate the coastal flooding of Taiwan by deterministic forecasts, and they still need to be reinforced by ensemble forecasts.

Keywords: Storm surge, ensemble forecast, error probability density function