海軍新一代全球預報系統之冬季風浪預報研究分析

Research on Winter Wind and Wave Forecasting Using the Navy's New Generation Global Forecast System

利雅玲[1] (Li Y.-L.) 陳致穎[2] (Chen Z.-Y.) 蔡世樵[3] (Tsai S.-C.) 葉南慶[4] (Yeh, N.-C.)

[1,3]國防大學理工學院環境資訊及工程學系 [2]中央研究院 [4]空軍航空技術學院

[1,3]Department of Environmental Information and Engineering, Chung Cheng Institute of Technology, National Defense University

[2]Academia Sinica

[4]Air Force Institute of Technology

摘　　要

海軍氣象單位計劃引進由美國國家海洋暨大氣總署（NOAA）開發的全球統一預報系統（Unified Forecast System, UFS）作為新的全球氣象預報模式。UFS整合了多種先進的數值預報技術，旨在提供更高解析度和準確性的全球天氣預報。本研究聚焦於UFS在冬季期間於臺灣海峽的風浪預報能力，並對其性能進行了初步評估。本研究分析了2022年11月24日海軍運補小艇落水個案，以UFS全球模式(1度解析度)自2022年11月20、21、22、23、24日0000UTC預報120小時，與現行作業模式（27公里解析度）進行臺灣海峽風力預報能力之評估。並將UFS預報結果作為WRF、NWW3邊界條件進行區域風浪模擬，針對金門地區外海12浬的風力與浪湧進行詳細分析，並與ERA5再分析場資料進行比較。模式使用的初始場資料來自於NCEP的GFS模式。初步結果顯示，UFS在風速、風向及浪高預報方面均表現出色，預報偏差顯著低於現有模式。具體來說，UFS能夠更準確地預報臺灣海峽冬季期間的風浪情況，特別是在強風和大浪事件中的表現尤為突出。這些結果表明UFS在海軍氣象預報應用中的潛力，對於提升海軍作戰和航行安全具有重要意義。整體而言，UFS能夠提升臺灣海峽冬季風浪預報中的表現。此外，UFS模式具海氣耦合模擬之特性，可強化大氣與海洋交互作用變化，優化模式預報準確度。顯示其在海軍氣象預報應用中之潛能。未來的研究應進一步驗證UFS在不同季節和氣象條件下的預報性能，為海軍作戰和航行安全提供更可靠的氣象保障。

關鍵字：Unified Forecast System (UFS)、Weather Research and Forecasting model(WRF)、NOAA WaveWatch III Model(NWW3)、預報、臺灣海峽、風浪

Abstract

The Naval Meteorological Unit plans to adopt the Unified Forecast System (UFS), developed by the National Oceanic and Atmospheric Administration (NOAA), as its new global weather forecasting model. UFS integrates multiple advanced numerical prediction technologies, aiming to provide higher resolution and more accurate global weather forecasts. This study focuses on the UFS's capability to forecast wind and wave conditions in the Taiwan Strait during the winter season and conducts a preliminary assessment of its performance.

This research analyzes the naval supply boat incident that occurred on November 24, 2022. Using the UFS global model (1-degree resolution), forecasts were made for 120 hours from 0000

UTC on November 20, 21, 22, 23, and 24, 2022. These forecasts were compared with the current operational model (27 km resolution) to evaluate wind forecast capabilities in the Taiwan Strait. The UFS forecast results were used as boundary conditions for the WRF and NWW3 models to simulate regional wind and wave conditions, specifically analyzing the wind and wave height within 12 nautical miles off the coast of Kinmen. These results were compared with ERA5 reanalysis data. The initial field data used in the model were derived from NCEP's GFS model.

Preliminary results indicate that UFS performs exceptionally well in forecasting wind speed, wind direction, and wave height, with forecast deviations significantly lower than the existing model. Specifically, UFS can more accurately predict wind and wave conditions in the Taiwan Strait during the winter, particularly in strong wind and large wave events. These findings suggest the potential of UFS in naval meteorological applications, significantly enhancing naval operations and navigation safety. Overall, UFS demonstrates superior performance in winter wind and wave forecasting in the Taiwan Strait. Additionally, the UFS model's capability for coupled ocean-atmosphere simulations can enhance the accuracy of forecasts through improved simulation of atmospheric and oceanic interactions. This underscores its potential in naval meteorological forecasting applications. Future research should further validate UFS's forecasting performance under different seasons and meteorological conditions to provide more reliable meteorological support for naval operations and navigation safety.

Key words : Unified Forecast System (UFS), Weather Research and Forecasting model(WRF), NOAA WaveWatch III Model(NWW3),Forecast, Taiwan Strait, Wind and waves