應用 WRF FDDA 同化雙都卜勒雷達反演風以改善 TWRF 模式颱風預報之研究

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摘　要

氣象雷達具有全天候觀測的特性，其提供之高時空解析度資料，可解析降雨系統內部中尺度特徵，並可結合地面觀測資料進行天氣分析診斷。近年來為改善極短期預報之能力，雷達資料扮演不可或缺的角色，在資料同化上可彌補洋面上觀測資料不足的限制，強化數值預報模式初始場對水氣與風的解析能力，進一步提升極短期預報之合理性。雙都卜勒雷達反演風為利用兩個都卜勒雷達的徑向風，進而反演出接近真實風場的技術，而臺灣地區密集的都卜勒雷達網連，對於颱風鄰近陸地時的颱風環流強度能進行更直接的觀測，其高時空解析度的風場資料，對於颱風降水及環流結構的了解提供很大的幫助，在颱風預報作業中已成為不可或缺的重要觀測資訊來源。

WRF Four-Dimensional Data Assimilation (FDDA)技術為一種四維的資料同化技術，主要使用納進(nudging)的方法，在模式積分的過程中，可以高頻率同化格點資料或不均勻分布的觀測資料。本研究將應用氣象局之 TWRF 數值颱風模式，以 FDDA 技術同化雙都卜勒雷達反演風資料，此策略可透過數值模式積分過程在初始場中產生動力與熱力平衡且較接近觀測之颱風結構，以改善數值模式之颱風預報能力。本研究首先分析雷達反演風的資料特性並進行資料稀化及品質控制，選取 2017 年尼莎(NESAT)颱風為個案，以 TWRF 模式運用 FDDA 技術同化雷達反演風場後進行預報。本文亦就其預報結果，分析對風場、雨量、結構、路徑的效應，並與未進行同化的預報實驗對照組做比較。詳細結果將於研討會中報告。

Application of WRF FDDA to improve TWRF predictions on typhoon by utilizing Dual-Doppler radar retrieving wind

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Abstract

WRF Four-Dimensional Data Assimilation (FDDA) is a data assimilation method that continuously assimilates observations into the mesoscale models through a nudging/Newtonian relaxation approach and forces the model state toward the observational state by adding artificial error correction terms to model equations, it can assimilate observation or grid data on high frequency during the model integrating. Typhoon WRF (TWRF) model based on the Advanced Research Weather Research and Forecasting Model (ARW WRF) is the operational tropical cyclone predictions system at the Central Weather Bureau (CWB) (Hsiao et al., 2020). The high temporal and spatial resolution data that weather radar provides can analyze the internal structure of the mesoscale rainfall system. In recent years, to improve the ability of short-term forecasting, radar data has played an indispensable role. In data assimilation, radar data can make up for the lack of observation data on the ocean, and improve the first guess of numerical forecasting models for water vapor and wind. The dual-Doppler radar retrieving wind is a technology that using the radial wind of the two Doppler radars to invert the real wind. By the dense Doppler radar network in Taiwan and high temporal and spatial resolution of radar data, we can better analyze the structure of the typhoon that close to Taiwan and improve the rainfall forecast on Taiwan. Radar has become an indispensable and important observation data source in recent years.

This study adopted the FDDA in TWRF model to assimilate dual-Doppler radar retrieving wind. We apply a quality control scheme to effectively thin out bad radar winds before assimilation into FDDA objective analyses. Typhoon Nesat in 2017 which made landfall and accompanied with heavy rainfall on the Taiwan island was selected to examine the impact. The results pointed out that adopt the FDDA with the radar wind, not only improved the representativeness of the initial typhoon structure but also advanced the prediction on the typhoon track, rainfall of the TWRF. The detail discussion will be presented in the conference.

Keywords: FDDA, nudging, dual-Doppler radar retrieving wind

Reference:

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