

同化雷達觀測及其反演風場資料對颱風環流預報之評估

Evaluation of radar data and associated retrieval assimilation on circulation forecast of tropical cyclones

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摘 要

渦流初始化一直以來都是颱風模擬中的重要議題，而資料同化是唯一使用觀測資料進行渦流初始化的方法。本研究評估同化資料類型對颱風環流演變之影響，其中包括都卜勒速度場的前處理方式以及雷達反演風的應用。本研究比較同化雷達原始極座標速度場 (VRP)、內插至模式格點等高面之速度場 (VRC) 以及雙都卜勒合成風場 (UV) 對預報結果之影響。理想實驗顯示在兩個雷達以上覆蓋的區域，同化 VRP 或 VRC 兩種資料後的分析風場均與雙都卜勒合成風場相同；然而後者因為內插至模式格點後，資料在空間上的分佈均勻，不因與雷達距離較遠而變得稀疏，因此可延伸其在雷達觀測徑向方向的影響範圍。

2017年尼莎颱風與2015年蘇迪勒颱風的模擬結果顯示，同化 VRC 資料所模擬的颱風移速與颱風內核風場均較同化 VRP 與雙都風者 (UV) 接近觀測資料，而同化雙都風場的結果則與同化 VRP 者相近；因此路徑與風場校驗結果以同化 VRC 者最佳。蘇迪勒颱風的實驗中除了同化 VRC 可模擬出接近觀測的路徑以及颱風登陸前近中心次強風區發展的現象，其餘實驗均無法模擬出正確的內核風場演變過程，且模擬路徑均呈現不正確向南偏折。上述的模擬結果顯示同化 VRC 資料可能有助渦流初始化後的結果較為合理，進而使模擬之颱風環流與路徑更接近真實狀況。

關鍵字：雷達反演、資料同化、熱帶氣旋、颱風

Abstract

It has been an important issue for TC simulation to initialize a vortex properly. One of the vortex initialization methods, data assimilation, is the only one uses observation data. In this study, the radar data assimilation strategy which is able to simulate a proper circulation evolution of tropical cyclones (TCs) is evaluated. For a proper vortex initialization, this study assesses on two perspectives: Doppler velocity pre-process/thinning methods and application of radar retrievals (Dual-Doppler synthetic wind). Two Doppler velocity pre-processing methods, data in polar coordinate (VRP) and interpolating onto model grid (VRC), are used. The idealized experiment result shows that the wind field where covered by two radars is identical to dual-Doppler synthetic wind after assimilation by using both methods. However, the latter one shows that the effect of Doppler velocity can be extended along radar radial direction because of the data distribution are more spacing-even through interpolation.

The simulation results of TY Nesat (2017) and TY Soudelor (2015) show that the track and wind root mean square error of VRC is better than those of VRP in both cases. It was found that assimilating the VRC can simulate the moving speed and the inner-core structure more accurately than those of assimilating dual-Doppler synthetic winds or the VRP. Most of the experiments of TY Soudelor (2015) fail to simulate the second wind maximum initiated from the southwest sector nearby the TC center and the simulation track behaves unreal southward deflection before their landfall except the ones assimilating the VRC. It is also found that the initiation of the second wind maximum is associated with the initiation of inflow in those outperformed experiments. It is suggested that assimilating VRC would be able to properly initial a vortex and has a positive impact on simulating TC circulation evolution.

Key words: radar retrieval, data assimilation, tropical cyclone, typhoon,