利用系集系統同化雙偏極化雷達差異反射率之新方法

鍾高陞[1]　莊秉學[1]　張偉裕[1]　蔡直謙[2]

國立中央大學[1]　國家災害防救科技中心[2]

摘　要

本研究基於系集卡爾曼濾波器的架構上開發「平均粒徑更新法」。「平均粒徑更新法」直接利用雙偏極化雷達觀測資料更新質量權重平均粒徑，而非透過更新雨水混合比與雨水總數量濃度來間接修改平均粒徑。這個新的更新方法期望利用模擬模擬差異反射率與雨水平均粒徑的高相關性引入更多差異反射的觀測資訊來修正模式雲微物理變數。本研究將使用兩組不同的中尺度劇烈天氣系統來執行同化實驗以評估「平均粒徑更新法」的效益，包含一個颱線個案以及一個颱風個案。結果顯示使用了「平均粒徑更新法」能更近一步地降低差異反射率的誤差，對應到有使用「平均粒徑更新法」的實驗能夠對模式高估的雨水平均粒徑做出更多的修正。除了差異反射率的分析場有所改善外，回波的分析場在使用了「平均粒徑更新法」也有較低的誤差。「平均粒徑更新法」進一步改善了雲微物理的分析場，且分析場的改善也反映到了降雨預報的表現上。使用「平均粒徑更新法」後決定性預報能夠有更高的預報技術得分，並能提升強降雨的可預報度。整體而言，在執行資料同化前適當的使用變數轉換能夠讓雙偏極化雷達觀測資料更好的描述雲微物理結構並提升降雨預報的表現。

關鍵字：系集卡爾曼濾波器、差異反射率、質量權重平均粒徑

A Novel Approach to Assimilate Z_{DR} Observations with an Ensemble Data Assimilation System

Chung K.-S.[1] Zhuang B.-X.[1] Chang W.-Y.[1] Tsai C.-C.[2]

[1]National Central University, [2]National Science and Technology Center for Disaster Reduction

Abstract

The mean diameter update (MDU) approach is developed based on the EnKF in this study. The MDU approach updates mass-weighted mean diameter (D_m) explicitly instead of updating rainwater mixing ratio and total number concentration (N_{Tr}) to update D_m implicitly. This novel approach is expected to make use of the high correlation between simulated Z_{DR} and D_m to generate more correction on microphysical states. Two real cases, including a squall line case and a typhoon case, are selected to conduct the assimilation experiment to evaluate the MDU approach. The results shows that the MDU approach can reduce more Z_{DR} analysis errors than the experiment without it. The improvement of the Z_{DR} analysis corresponds to that the MDU approach can make more correction on the overestimated D_m. In addition to the improvement of the Z_{DR} analysis, the MDU approach can also improve the Z_H analysis. With a better illustration in the microphysical states, the performance of the quantitative precipitation forecast (QPF) consequently becomes more accurate with the implementation of the MDU approach, and the predictability of the heavy rainfall increases. In conclusion, an appropriate background variable transformation makes better use of dual-pol radar observations to illustrate the microphysical states and make the QPF after assimilation perform better.

Keywords: EnKF, Differential Reflectivity, Mass-Weighted Mean Diameter