# FV3GFS全球模式之資料同化於氣象局之建置與初步評估

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## 摘　　要

中央氣象局已規劃使用美國國家環境預報中心（NCEP）的新一代有限體積法立方網格全球預報系統（Finite-Volume Cubed-Sphere Global Forecast System；FV3GFS）作為其作業全球數值天氣預報模式，取代現行作業的 CWBGFS 模式。其中 FV3GFS 模式部份，在氣象局高速計算環境上的建置與預報表現評估已於去年完成；接續該工作，基於 Gridpoint Statistical Interpolation（GSI）的資料同化模組也於今年成功建置於氣象局。此 FV3GFS－GSI 系統目前可使用的資料同化方案包括三維變分同化（3DVar）、採用序列 Ensemble Square-Root Filter（EnSRF）方案的系集卡爾曼濾波器（Ensemble Kalman Filter；EnKF）、以及混成三／四維系集－變分同化（hybrid 3D/4DEnVar）；已測試過的模式解析度包括 C384T（約 25 公里）與 C192T（約 50 公里）的決定性預報解析度，分別搭配 C192T 與 C96T（約 100 公里）的系集解析度。此外，需分別執行先期（major）與後期（post）分析的作業同化流程也已建置完成。除可同化 GSI 內建的 BUFR 格式觀測資料外，亦已添加氣象局作業使用之 FGGE 格式觀測資料的同化功能。

我們執行了一個月的 C384T（決定性預報）／C192T（系集）解析度之循環週期資料同化實驗，用以作為初始效能評估，此實驗同化的觀測資料與現行 CWBGFS 作業使用的資料相同，唯剔除 ECMWF 模式虛擬（bogus）資料與颱風渦漩虛擬資料。結果顯示此測試實驗已達到優於現行 CWBGFS 作業系統的預報表現。以此初版氣象局 FV3GFS－GSI 全球預報系統為基礎，我們已進行 TC vital（即颱風中心最低海平面氣壓）同化與在混合資料同化中採用 time-lagged ensemble 方案的建置與研究，同時，也著手 Local Ensemble Transform Kalman Filter（LETKF）同化方法的測試。我們將致力於在未來幾個月內開始運行近即時（near-real-time）資料同化測試，並希望能在明年間上線作業。

關鍵字：FV3GFS、資料同化、全球模式

# Development and preliminary evaluation of the data assimilation for the FV3GFS global model at CWB

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## Abstract

Central Weather Bureau (CWB) has planned to use the U.S. NCEP's new generation Finite-Volume Cubed-Sphere Global Forecast System (FV3GFS) for its operational numerical weather prediction, replacing the current operational CWBGFS model. The implementation and evaluation of the FV3GFS model component in CWB's supercomputing environment had been completed last year. Following that work, the data assimilation component with the Gridpoint Statistical Interpolation (GSI) system has been successfully implemented this year. Currently, the data assimilation schemes ready for use include the 3-dimensional variational method (3DVar), ensemble Kalman filter (EnKF) with the serial ensemble square-root filter (EnSRF) scheme, and the hybrid 3/4-dimensional ensemble-variational method (3D/4DEnVar). The model resolutions that have been tested include C384T (~25 km) and C192T (~50 km) deterministic resolutions coupled with C192T and C96T (~100 km) ensemble resolutions, respectively. The operational workflow with separate early (major) and post analyses has also been implemented. Moreover, the CWB operational observation data in FGGE-format can be assimilated in addition to the GSI's default BUFR-format data.

For an initial evaluation purpose, a one-month cycling data assimilation experiment is conducted at C384T (deterministic)/C192T (ensemble) resolution, assimilating the same observation data as those used in the current CWBGFS operation while excluding the ECMWF bogus data and the typhoon bogus data. Results show that this test experiment already achieves a forecast performance exceeding the current CWBGFS operational system. On the basis of this early version of the FV3GFS-GSI system at CWB, the TC vital (i.e., tropical cyclone central minimum sea level pressure) assimilation and the time-lagged ensemble scheme for the hybrid EnVar have been implemented and studied, and the local ensemble transform Kalman filter (LETKF) scheme has also started to be tested. We aim to begin the near-real-time assimilation testing of this system in the next several months and hopefully the operational production in the next year.

Keywords: FV3GFS, data assimilation, global model