# 福爾摩沙衛星七號掩星資料於FV3GFS下之使用評估與觀測誤差調整

# Assimilation impact of FORMOSAT-7 GNSS-RO data with Finite-Volume Cubed-Sphere Global Forecast System and the sensitivity of observation error specification for the GNSS-RO data

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## 摘　　要

氣象局全球模式團隊已成功在現行CWBGFS作業預報系統中同化福爾摩沙衛星七號（福衛七號）之掩星（radio occultation）資料，為全球天氣預報帶來全面性的正面影響，並在熱帶區域有特別顯著的改善，已於2020年9月15日正式上線作業。然而對於在即將作為氣象局新一代全球數值天氣預報系統之Finite-Volume Cubed-Sphere Global Forecast System（FV3GFS）中的同化影響，我們需要做進一步的評估。

本研究在FV3GFS系統中同化福衛七號掩星資料，並比較使用多種觀測誤差進行同化的結果，包括：Gridpoint Statistical Interpolation（GSI）同化系統（2015年版本）內預設的掩星資料觀測誤差、在CWBGFS作業系統下估計而得的觀測誤差（Lien et al. 2021）、NCEP在其新版FV3GFS作業系統下估計而得的觀測誤差，以上三者皆以觀測之緯度劃分，定義不同緯度區間內隨高度變化之觀測誤差。研究結果顯示，相對於CWBGFS作業預報系統中所呈現之顯著改善，福衛七號資料在FV3GFS中亦帶來正面的預報改進，但較不明顯，此結果可能代表觀測誤差需要進一步的調整。因此，我們參考Met Office最新提出之方法（Bowler 2020），以模式20公里以下平均溫度劃分區間，並以Desroziers方法估計各溫度區間隨高度變化的掩星資料觀測誤差，此方法對福衛七號資料同化的效益將與傳統依緯度區間給定觀測誤差的方法做比較。

**關鍵字**：福爾摩沙衛星七號、Desroziers' method、掩星資料同化

## Abstract

The global model team of Central Weather Bureau (CWB) have successfully assimilated the Global Navigation Satellite Systems radio occultation (GNSS-RO) data from the FORMOSAT-7 satellites with the operational CWB Global Forecast System (CWBGFS). The results showed that the FORMOSAT-7 data can bring significantly positive impacts on the model forecast, especially in the tropical region. The FORMOSAT-7 GNSS-RO assimilation has been in operation since 15 September 2020. However, for the FORMOSAT-7 impact in the Finite-Volume Cubed-Sphere Global Forecast System (FV3GFS), which is planned to be the next operational global forecast system in CWB, further evaluations are needed.

This study investigates the assimilation impact of the FORMOSAT-7 GNSS-RO data with the FV3GFS, and compare the results using various observation error specifications, including the default

observation errors for the GNSS-RO data in the Gridpoint Statistical Interpolation (GSI) (2015 version), the observation errors estimated with the operational CWBGFS (Lien et al. 2021), and the observation errors estimated by the NCEP with their new FV3GFS system. All of the above three observation errors are specified as error profiles in terms of observational height for each different latitude intervals. Experimental results show that the FORMOSAT-7 GNSS-RO assimilation can also lead to positive impacts on the forecasts in the FV3GFS, but not as significant as those we obtained with the CWBGFS. This suggests that the observation errors for GNSS-RO data may needs to be further tuned for the FV3GFS. Therefore, we adopt a new method for the GNSS-RO observation error specification proposed by Bowler (2020) in the Met Office, which defines the error profiles with heights for each interval based on the model average temperature below 20 km, estimated by the Desroziers' method. The impact of this new method for the FORMOSAT-7 GNSS-RO assimilation will be studied and compared with the traditional methods specifying the observation errors based on latitude intervals.

**Key words:** FORMOSAT-7, Desroziers' method, GNSS-RO assimilation