# 地表參數資料對FV3GFS全球及區域系統預報的影響

# Impacts of different static data on FV3GFS global and nested predictions

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## 摘　　要

本研究利用中央氣象局下一階段全球數值預報系統FV3GFS及其嵌套的區域系統，進行地表參數資料更新及其對預報影響的研究，探討地表參數資料對地表可感熱通量、潛熱通量及近地層大氣熱力變數的預報影響，以了解地表參數資料對模式預報的敏感度並作為下一版地表參數資料的更新參考。

FV3GFS所涉及與地表過程相關的關鍵地表參數包含地表利用型態(Land use type)、土壤型態(soil texture)以及植物覆蓋率(vegetation cover fraction)，其中地表利用型態及土壤型態可決定不同型態下各種代表植物、土壤物理特性的參數值，植物覆蓋率在FV3GFS的地表模式(Noah land model)中更是決定組成總蒸發散量的三項權重參考值。目前FV3GFS對於這三個地表參數的設定資料均來自NCEP EMC作業模式的資料庫(fix dataset)，資料解析度因而受制於EMC作業模式的目前解析度13公里(v15)。本研究使用的更新版資料由WRF模式資料庫提供來自較新版本的MODIS觀測資料，此資料不僅解析度提高，型態分布也與現行版本有相當差異。

測試設計先進行三個參數的個別更新，最後再將三個參數合併更新，共進行四組測試。測試時段選取2019年8月1日至15日，以每日00Z為初始時間進行120小時預報，共15天的預報實驗。平均結果顯示，從全球角度來看，更新的地表利用型態資料中常綠針葉林及常綠闊葉林分布面積均有減少趨勢，此二類植物的蒸散最小阻尼參數(300)遠超過其他植物，因此當其分布範圍減少時造成相關區域蒸散量增加同時可感熱通量減少，使得2米溼度提高及2米溫度降低。土壤型態的更新版資料除了歐亞大陸東北區域，其餘地方的土壤型態大致有黏土(clay)比例增加的變化趨勢，由於黏土的枯萎點(wilting point)較高，使得植物阻尼係數增大因而減小了蒸散量，同時助長可感熱通量增加，造成大範圍區域的2米溫度升高。新版植物覆蓋率在中非、中歐、北亞及南美的增加，使得這幾區的蒸散量權重增加，造成總蒸發量增加同時抑制了可感熱通量，這幾區的2米溫度因此降低。相反的，美洲大陸東岸的植物覆蓋率顯著減少，造成此區2米溼度降低但2米溫度升高。另一方面，整合測試則顯示當三個地表參數同時更新時，植物覆蓋率的變化有主導性影響。當以整合測試的96-120小時2米溫度預報與NCEP分析場進行校驗，發現中非、中歐、北亞及南美的暖偏差和北美東岸及澳洲大陸的冷偏差在更新資料後都得到正面的改善。

區域系統的預報實驗結果則顯示，台灣地區以地表利用型態的更新為主導，因為城市(urban)比例大幅降低，由原來的18%降為6%，農地(cropland)比例則由8%增為22%，使得台灣西部的蒸發量顯著增長，可感熱通量伴隨減少；此變化降低了原西部區域的暖偏差及乾偏差。植物覆蓋率在台灣地區的普遍增加，更增強了前述的變冷變濕趨勢。

**關鍵字:** 地表利用型態，土壤型態，植物覆蓋率

## Abstract

Updated surface static data provided for surface parameters were tested in the next-stage global numerical forecast system FV3GFS of CWB and its nested regional system to study their impacts on the surface flux and near surface thermal fields. Test results help us to understand more about the sensitivity of surface parameter data and serve as an updated reference for the next version .

The key surface parameters related to the surface process involved in FV3GFS include land-use type, soil texture and vegetation cover fraction. In addition, the land-use type and soil texture determine values of different surface parameters representing the physical properties of land-use and soil under different types. Moreover, the vegetation cover fraction in the FV3GFS surface model (Noah land model) is used to be the weight reference value of each component that compose the total evapotranspiration. The current FV3GFS setting data for these three parameters are all from the NCEP EMC operating database (fix dataset), and the data resolution is therefore subject to the current resolution (T1534, FV3_V15) of 13km. The updated data sets used in this study are adopted from WRF model database, based on a newer version of MODIS. These data not only provide an improved resolution but also have a quite different type distribution from the current version.

In this study, the experiments include update the three parameters individually, and the combination of three updated parameters. The experimental period is selected from 1 to 15 August 2019, with a daily 00Z as the initial time for a 120-hour forecast. The 15-day average result shows that the distribution area of evergreen forest has a decreasing trend in the global domain. The minimum resistance of evergreen forest is far more than that of other plants. Therefore, when their distribution area decreases, the transpiration in the relevant area will increase and the sensible heat flux will decrease, so that the humidity of 2 meters increases and the temperature of 2 meters decreases. Except for northeastern region of Eurasia, the soil texture in the rest of the world generally have a trend of increasing the proportion of clay. Due to the higher wilting point of the clay, the plant resistance increases. As a result, the transpiration is reduced. Meanwhile, the sensible heat flux is increased, resulting in an increase in the temperature of 2 meters in a large area. The increase in vegetation fraction of new version in Central Africa、Central Europe、North Asia and South America has increased the weight of transpiration, resulting in an increase in total evapotranspiration and suppressing the sensible heat flux, and the 2m temperature in these areas has therefore decreased. In contrast with these regions, the vegetation coverage on the east coast of the American continent has been significantly reduced, the opposite impact occurred in this region. The final combined test shows that the vegetation cover fraction dominant the forecasts when three surface parameters are updated at the same time. Comparing with the NCEP analysis on 2-meter temperature during the 96-120 hour forecast, the warm bias occurred in Central Africa, Central Europe, North Asia and South America and the east coast of North America and the cold bias in the Australian mainland has been positively improved after updating the static data.

While focus on nested domain, the changes in the regional system show that Taiwan region is dominated by the update of land-use type. In addition, the proportion of urban dropped from 18% to 6% and the proportion of cropland increase from 8% to 22%. These changes increase evaporation and reduce sensible heat flux apparently in the west of Taiwan, and result in the decrease of the warm and dry bias over the west region. On the other hand, the general increase in vegetation fraction in Taiwan has enhanced the trend of cooling and moistening.

**Key words:** land use type, soil texture, vegetation cover fraction