

CWB WRF作業模式2013年 版本更新（OP25）之 預報效能評估

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中央氣象局資訊中心

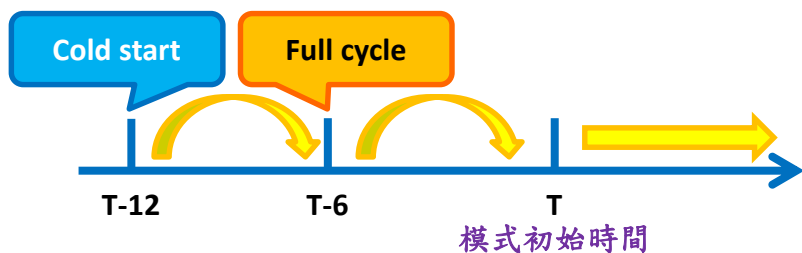
2013/05/14

WRF-based資料同化系統

- 由WRF 3DVAR和WRF建構而成
- 解析度：45/15/5公里
- 垂直分層：45層
- 每日執行四次，並預報84小時

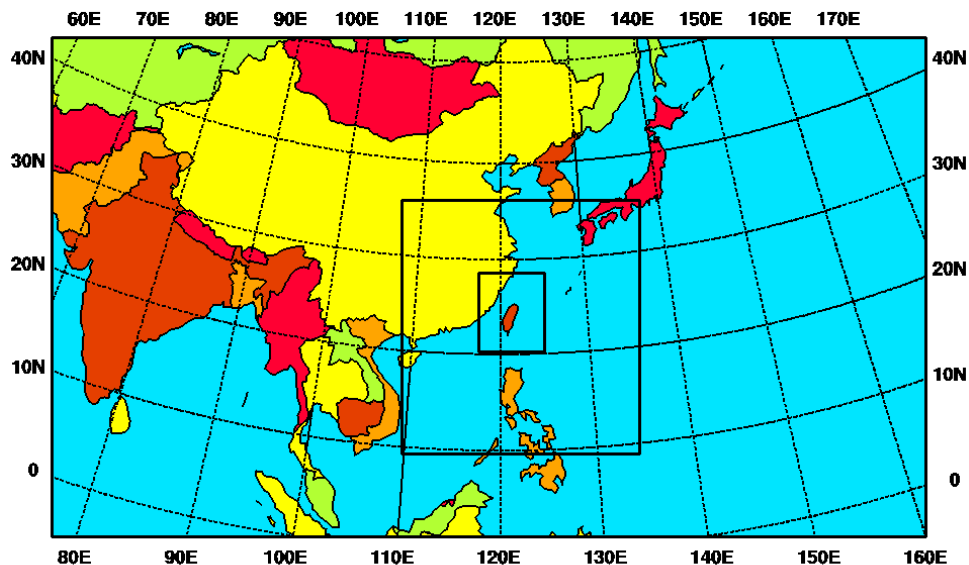
資料同化策略

- 採用Partial cycle
 - 模式初始時間前12小時以NCEP GFS分析場Cold start，間隔6小時進行循環更新。



- 邊界條件來自NCEP GFS analysis
- 背景誤差協方差使用CV3 BES
- 同化來自GTS的觀測資料，以及GPSRO和ZTD。

Domain of CWB WRF



模式物理參數法設定

- 微物理：Goddard GCE scheme
- 邊界層：YSU scheme v3.1.1
- 積雲：Kain-Fritsch with new trigger
- 長波輻射：RRTM scheme
- 短波輻射：Goddard shortwave
- 地面層：Monin-Obukhov scheme
- Land surface：NOAH scheme

主要更新項目

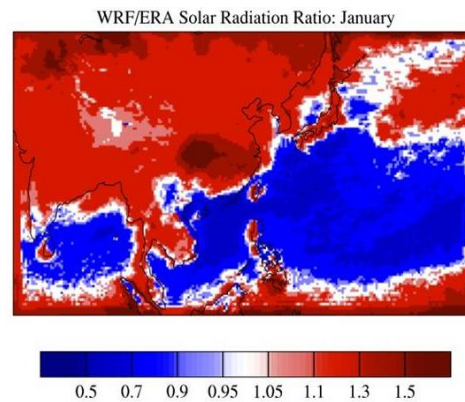
● WPS

- Vegetation fraction
 - USGS -> MODIS
- 修改 Real P -> sigma 垂直內插方法
 - 二次式 -> Cubic spline

增加地表植物分布率
可改變地表和大氣之間能量交換，
其影響可降低地面溫度預報。

● WRF

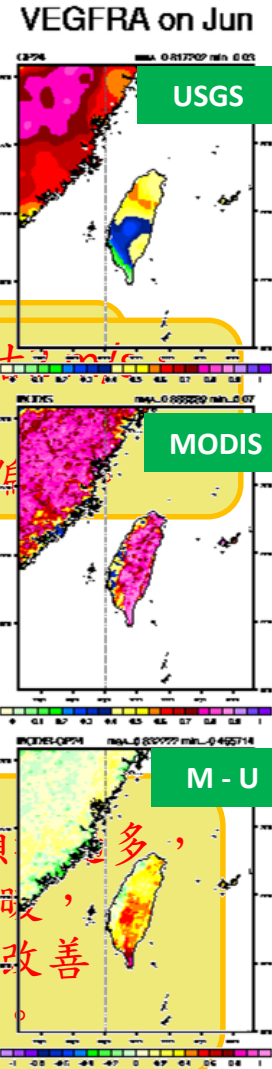
- 地面風速修正
 - 透過次網格地形差異增大
- 更換輻射參數法
 - 長波：rrtm -> rrtmg
 - 短波：Goddard -> rrtmg



修正方案
面風速預報偏

消散。

模式於陸地之向下短波輻射預多，
可能導致陸地溫度預報過暖，
更換輻射參數法後可有效改善
陸地溫度預報之暖偏差。



實驗設計

- 本次更新項目皆已完成單元測試，以下進行整合測試。
- 實驗名稱：
 - OP24 – 現行作業版本。
 - OP25 – 本次更新版本。
- 時間：
 - Domain 1：2012/06/01 – 2012/06/30，共60個個案。
 - Domain 2&3：2012/06/01 – 2012/06/15，共30個個案。

資料同化策略採用Partial Cycle，進行72小時預報。
- 校驗：
 - 綜觀天氣預報得分 – 與NCEP GFS分析場校驗
 - 地面校驗 – 與測站校驗
 - 定量降水預報校驗 – 與雨量站校驗

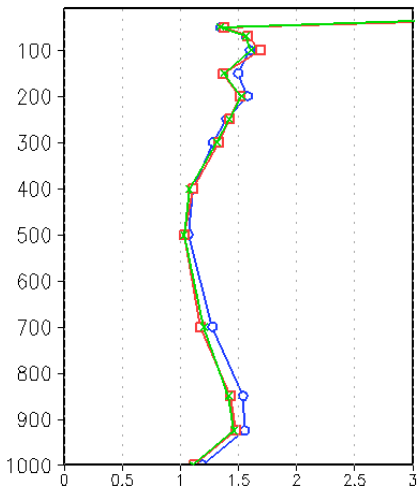
06/01 – 06/30 Domain 1 平均

結果分析 –

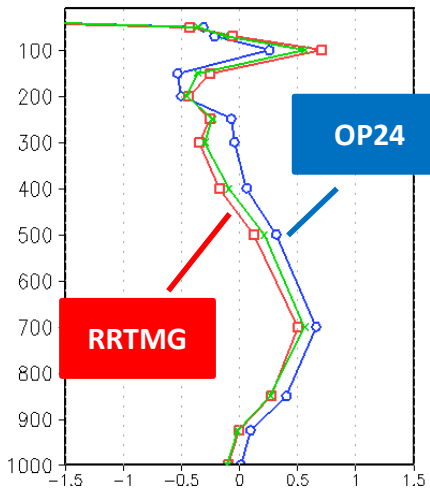
2012/06 綜觀天氣預報得分

rrtmg
單元測試

OP24-d1-1206_0072
Aerosol-d1-1206_0072
T RMS

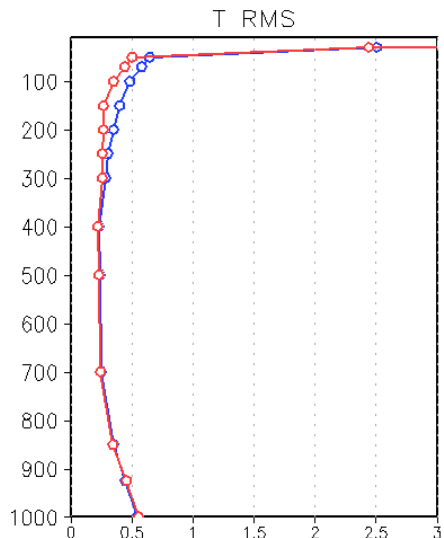


RRTMG-d1-1206_0072
T MEAN ERROR

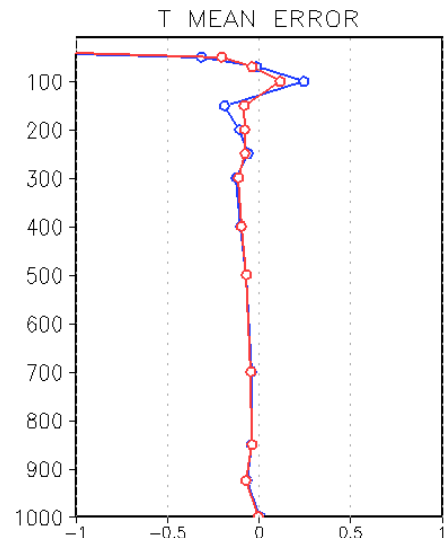


Cubic spline
單元測試

OP24-d1-1206_0000



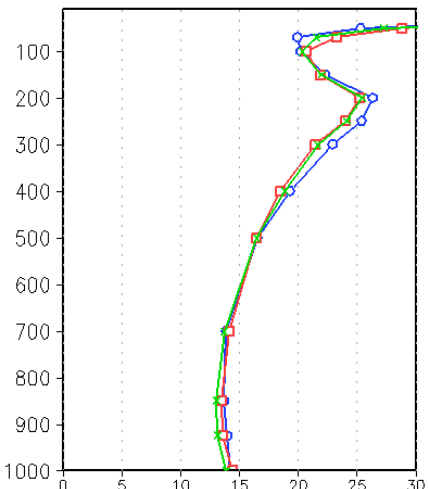
CS-d1-1206_0000



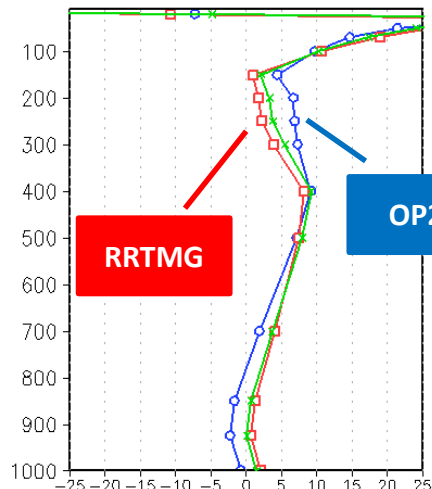
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rrtmg
單元測試

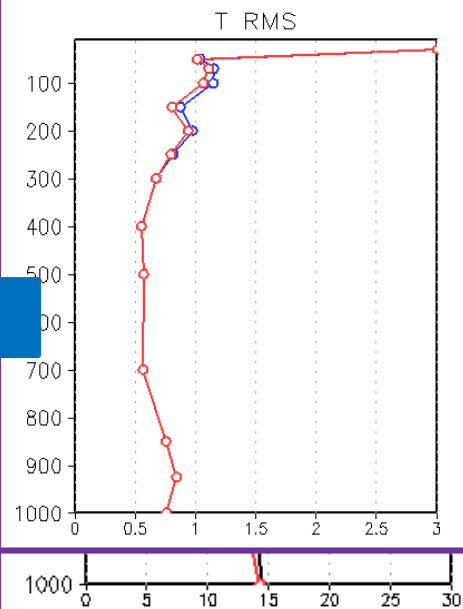
OP24-d1-1206_0072
Aerosol-d1-1206_0072
H RMS



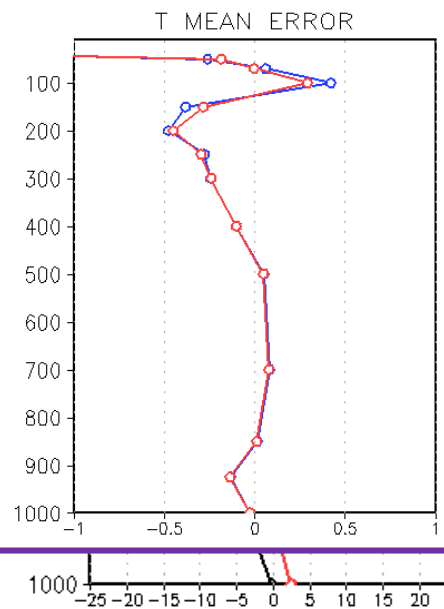
RRTMG-d1-1206_0072
H MEAN ERROR



OP24-d1-1206_0012



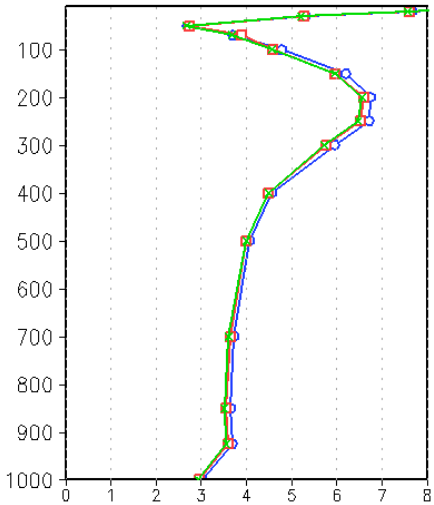
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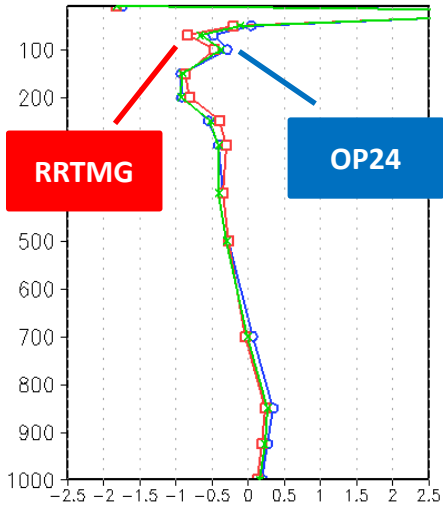
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rrtmg
單元測試

OP24-d1-1206_0072
Aerosol-d1-1206_0072

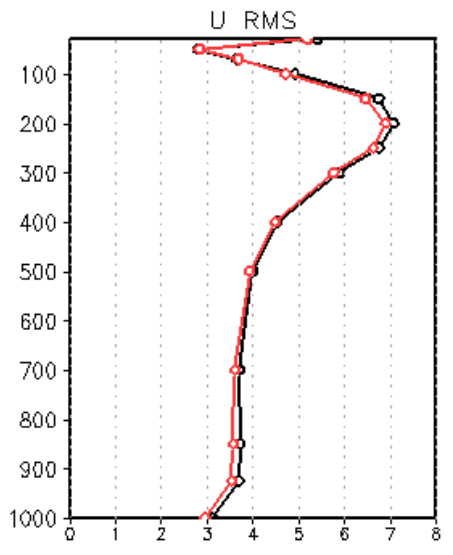


RRTMG-d1-1206_0072

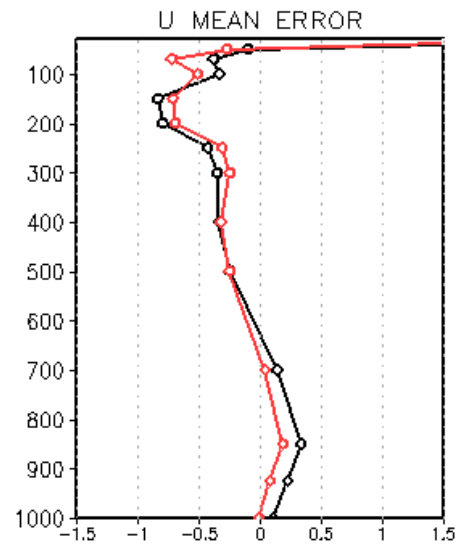


72

OP24_CTL_06_0072

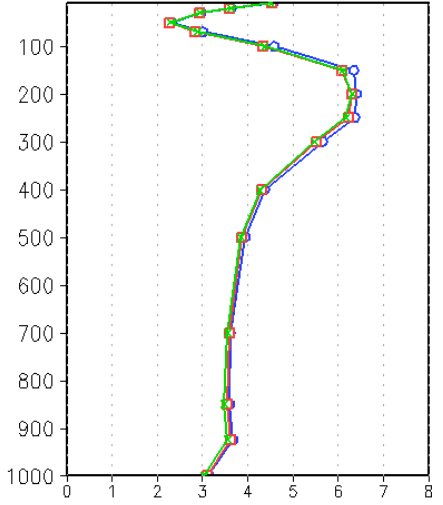


OP25_06_0072

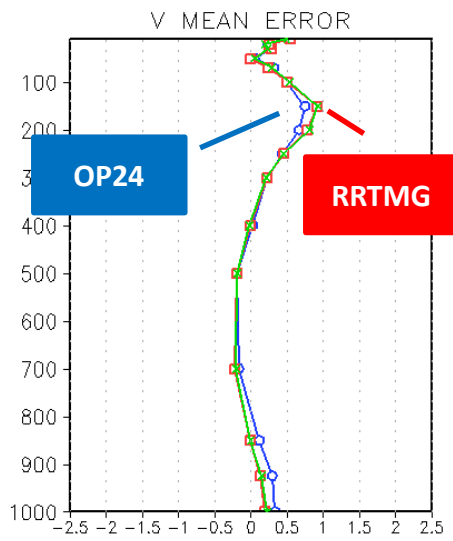


rrtmg
單元測試

OP24-d1-1206_0072
Aerosol-d1-1206_0072

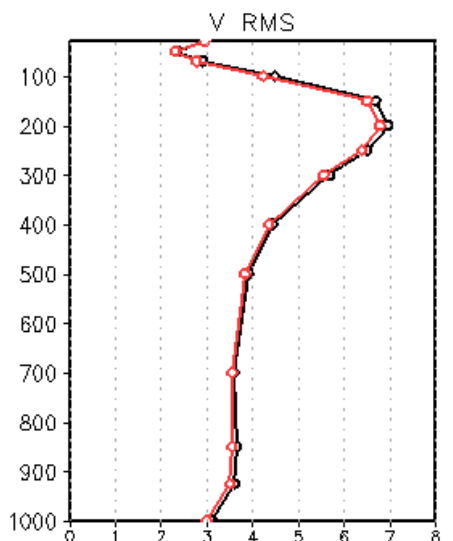


RRTMG-d1-1206_0072

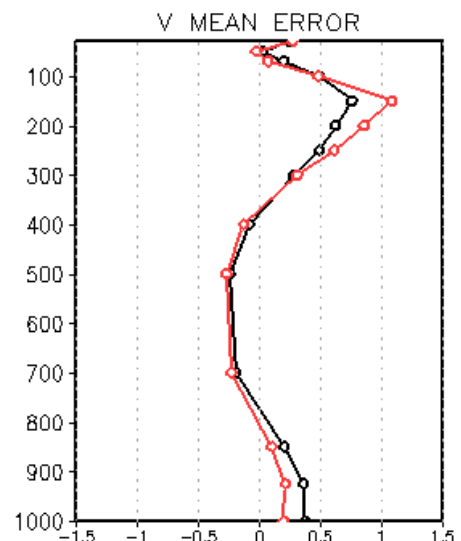


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OP24_CTL_06_0072



OP25_06_0072

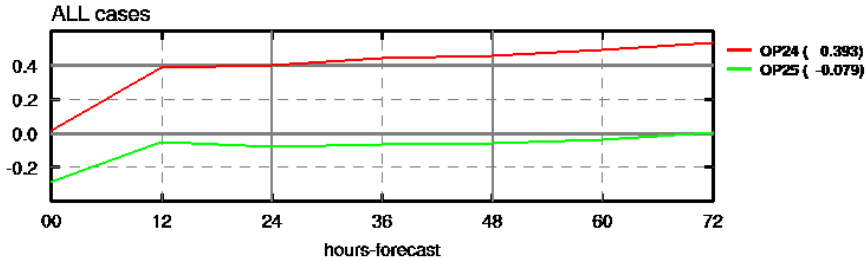


Domain 1 : 06/01 – 06/30 平均

Domain 2 & 3: 06/01 – 06/15 平均

結果分析 – 2012年6月地面校驗

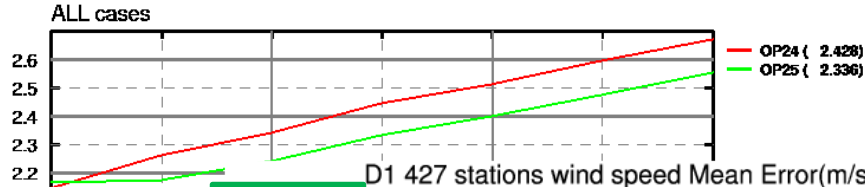
Mean Error of Surface Temperature (°C) CWB WRF (45km)



Domain 1 TEMPERATURE (° C) against OP24

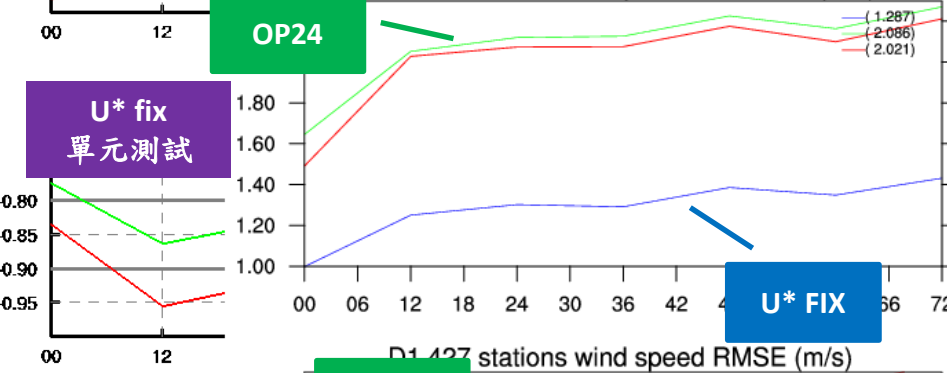
	Mean error	RMSE
U* fix	+0.027	+0.011
VEGFRA	-0.144	-0.032
rrtmg	-0.364	-0.061
OP25	-0.482	-0.088

RMSE of Surface Temperature (°C) CWB WRF (45km)



Wind speed

D1 427 stations wind speed Mean Error(m/s)

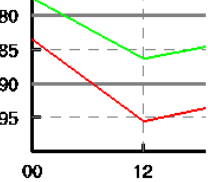


D1 427 stations wind speed Mean Error(m/s)

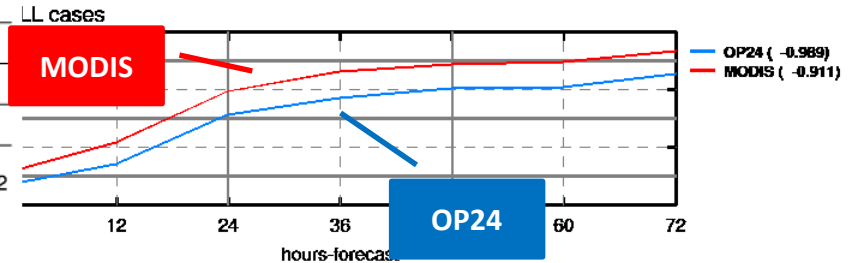


U* fix
單元測試

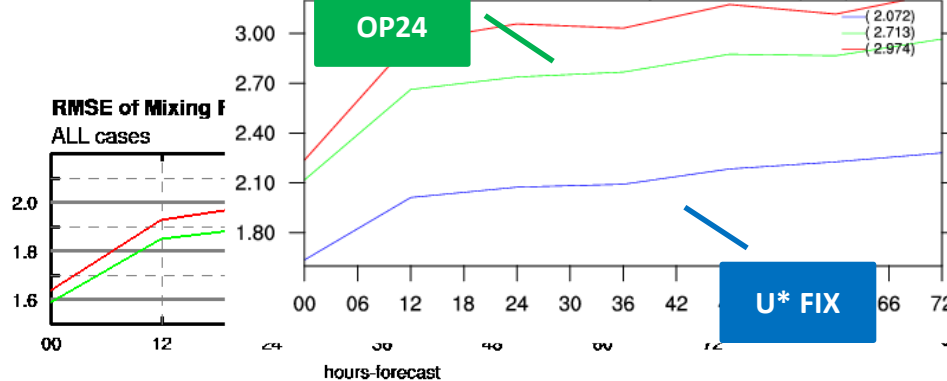
VEGFRA
單元測試



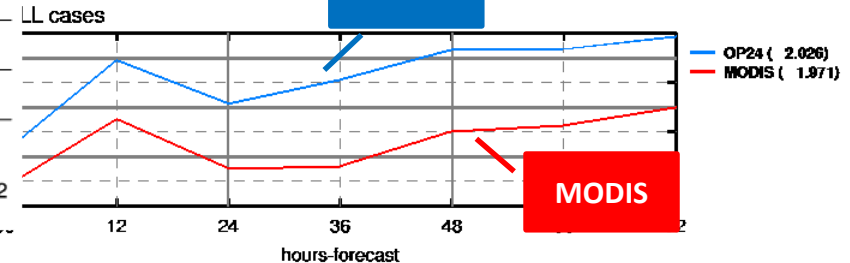
Mean Error of Mixing Ratio (g/kg)



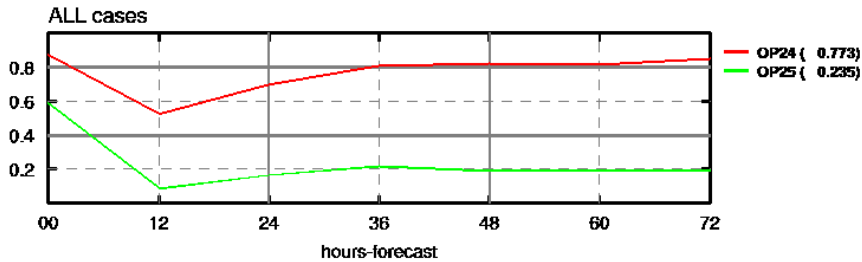
D1 427 stations wind speed RMSE (m/s)



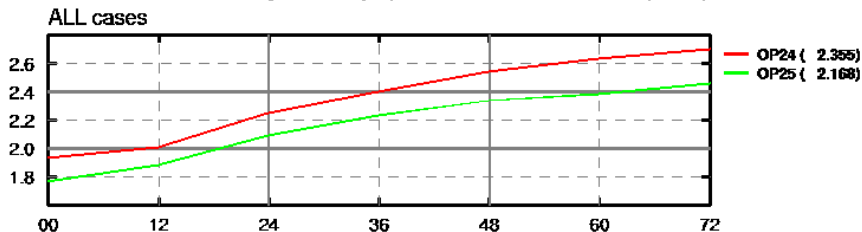
MSE of Mixing Ratio (g/kg)



Mean Error of Surface Temperature (°C) CWB WRF (15km)

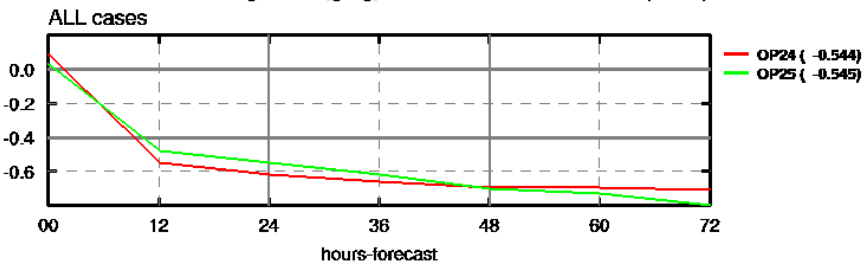


RMSE of Surface Temperature (°C) CWB WRF (15km)

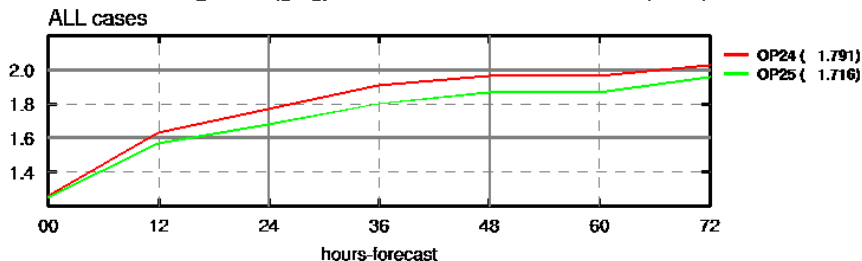


Q@2m

Mean Error of Mixing Ratio (g/kg) CWB WRF (15km)



RMSE of Mixing Ratio (g/kg) CWB WRF (15km)



Domain 2 TEMPERATURE (° C) against OP24

	Mean error	RMSE
U* fix	+0.024	+0.022
VEGFRA	-0.131	-0.060
rrtmg	-0.449	-0.160
OP25	-0.538	-0.187

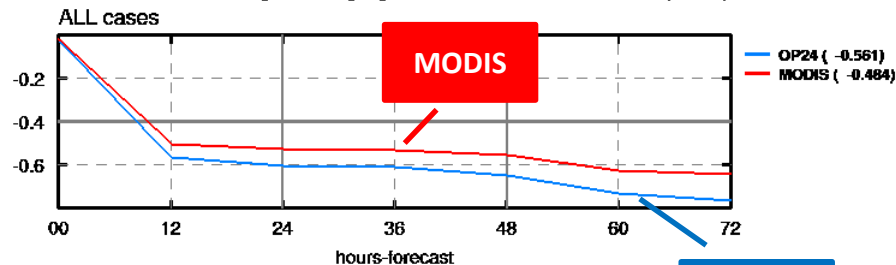
Wind speed

D2 93 stations wind speed Mean Error(m/s)

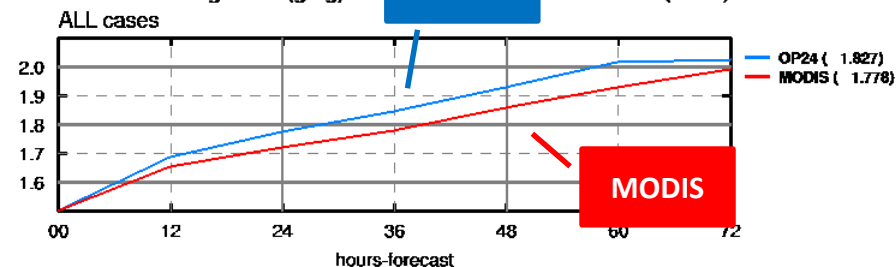
VEGFRA
單元測試

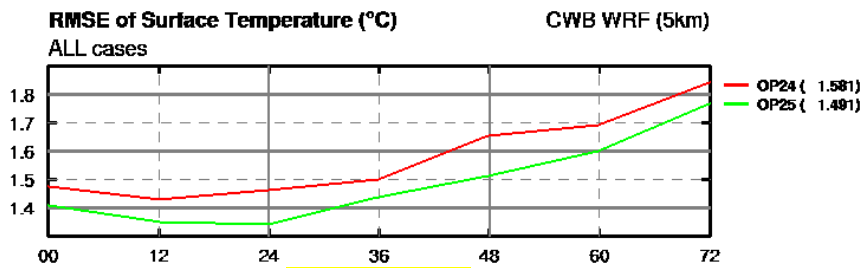
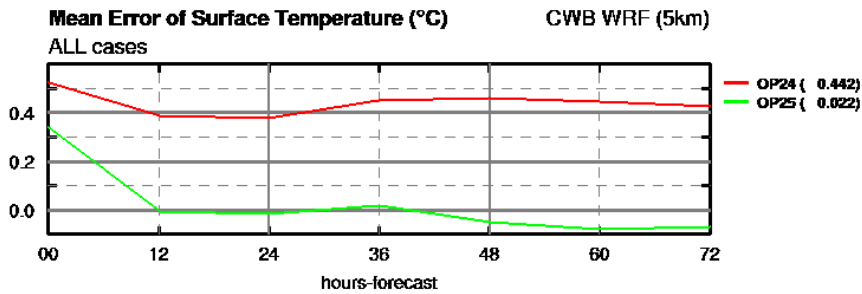


Mean Error of Mixing Ratio (g/kg) CWB WRF (15km)

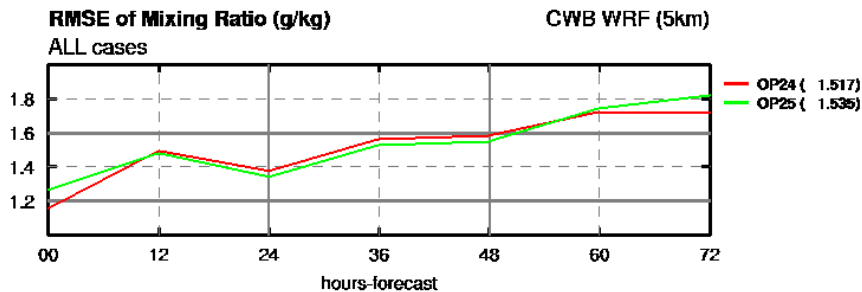
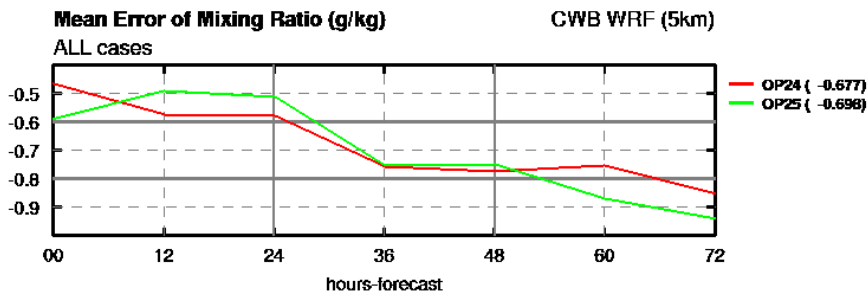


RMSE of Mixing Ratio (g/kg) CWB WRF (15km)





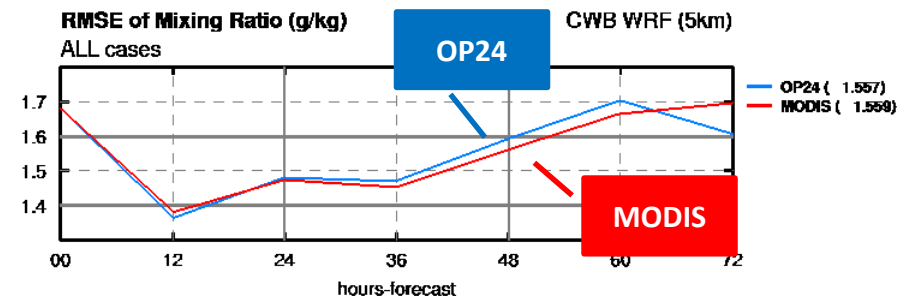
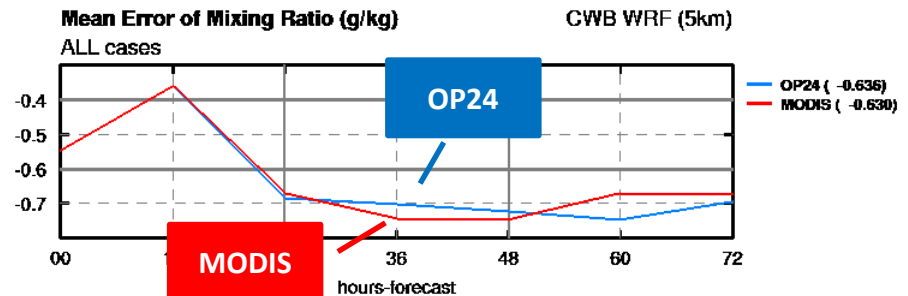
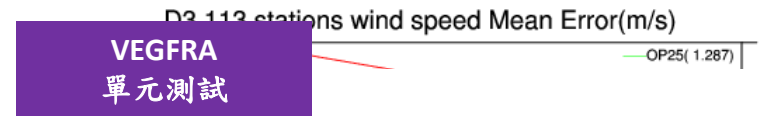
Q@2m



Domain 3 TEMPERATURE (°C) against OP24

	Mean error	RMSE
U* fix	-0.053	-0.054
VEGFRA	-0.138	-0.018
rrtmg	-0.241	-0.061
OP25	-0.420	-0.090

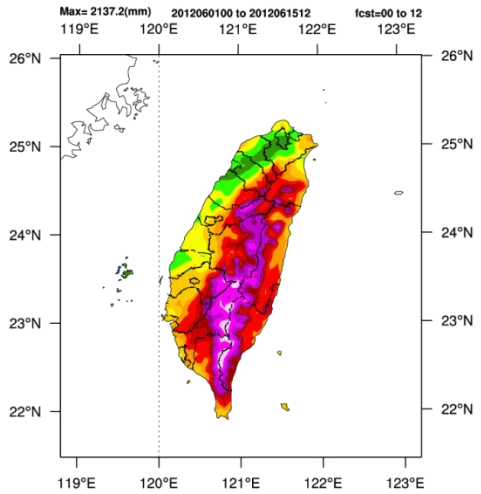
Wind speed



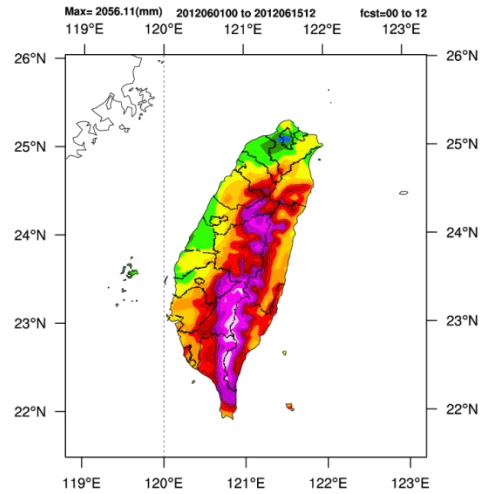
06/01 – 06/15 Domain 3

結果分析 – 定量降水預報校驗

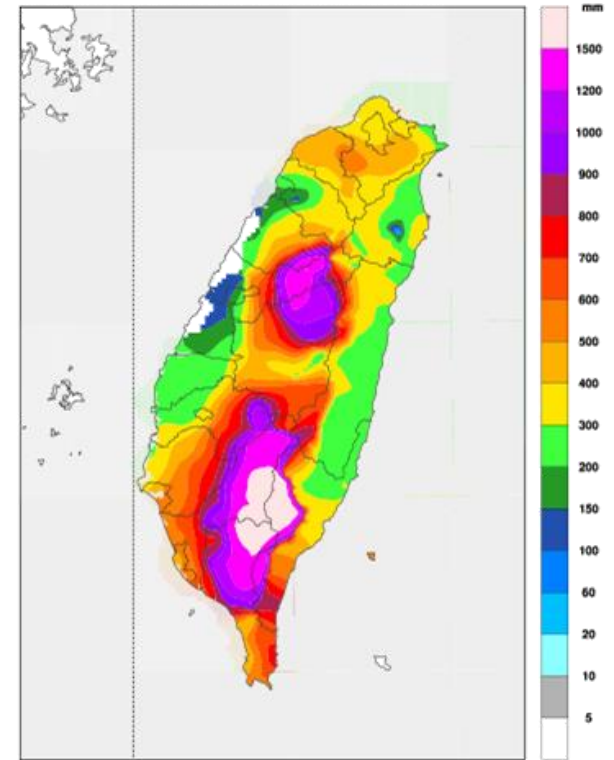
OP24_CTRL_PC Accumulated Rainfall



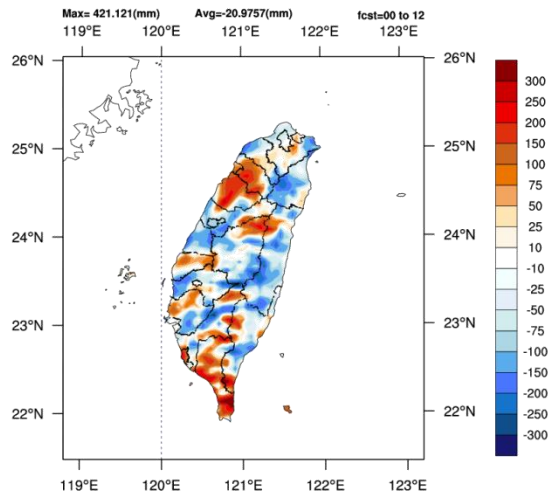
OP25_test Accumulated Rainfall



Accu. rainfall from 12060100 to 12061600 UTC

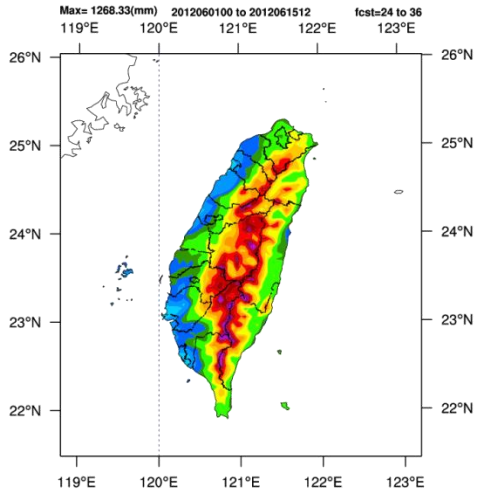


OP25_test-OP24_CTRL_PC Accumulated Rainfall

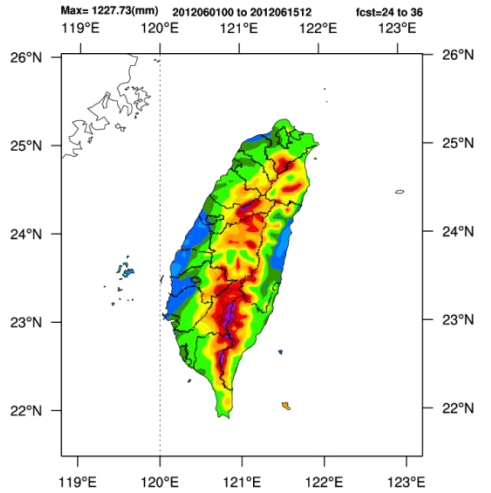


Forecast 00 – 12 hr
15天累積降水

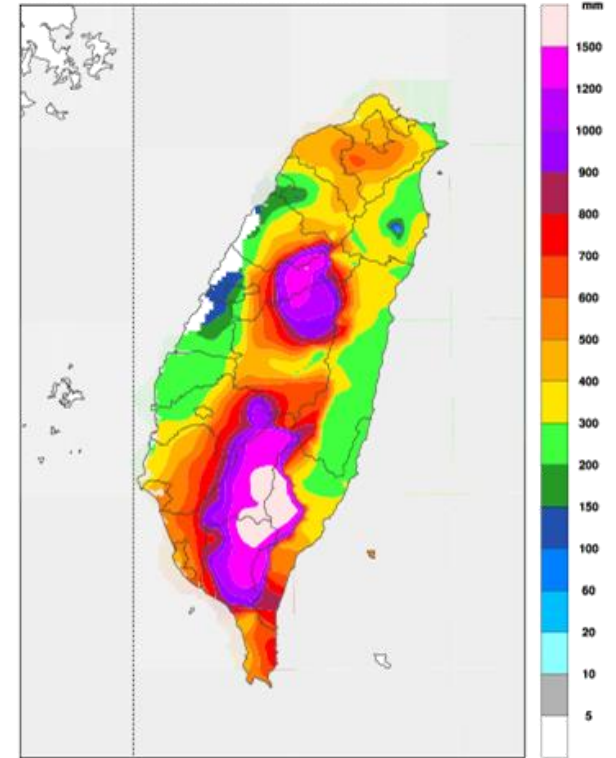
OP24_CTRL_PC Accumulated Rainfall



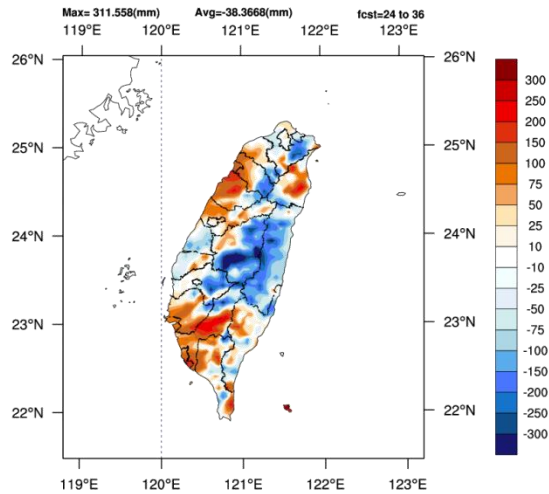
OP25_test Accumulated Rainfall



Accu. rainfall from 12060200 to 12061700 UTC

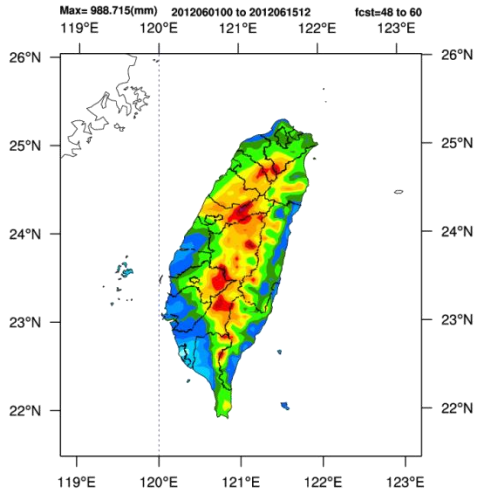


OP25_test-OP24_CTRL_PC Accumulated Rainfall

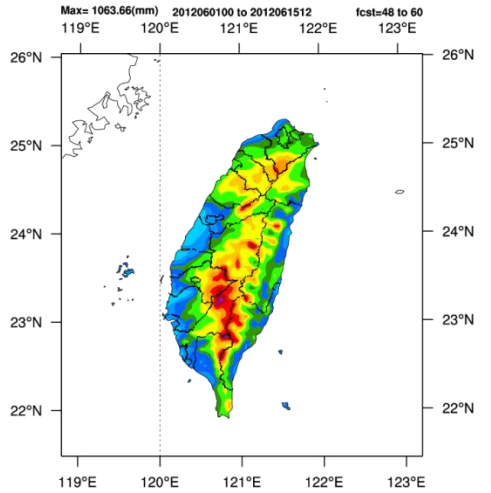


Forecast 24 – 36 hr
15天累積降水

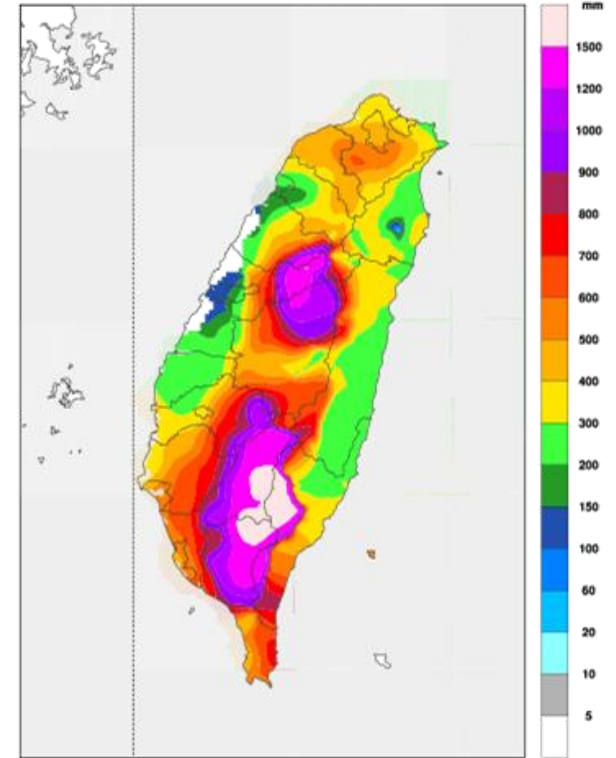
OP24_CTRL_PC Accumulated Rainfall



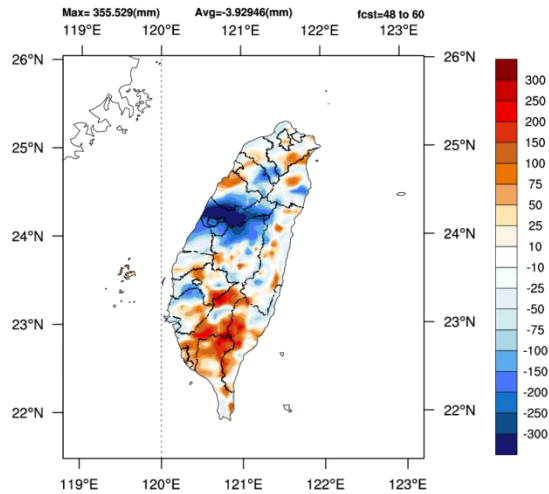
OP25_test Accumulated Rainfall



Accu. rainfall from 12060300 to 12061800 UTC

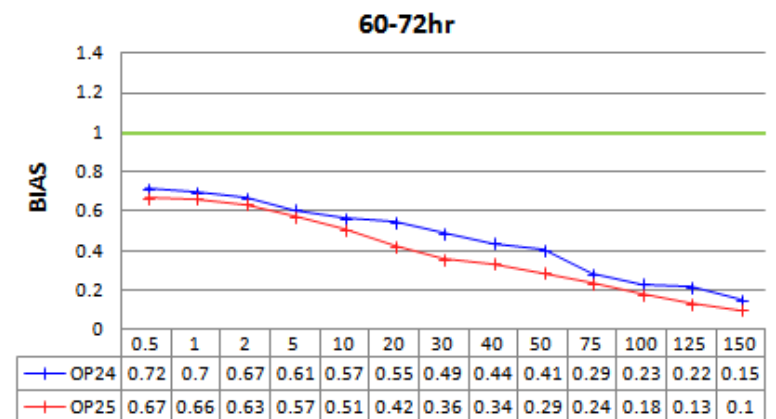
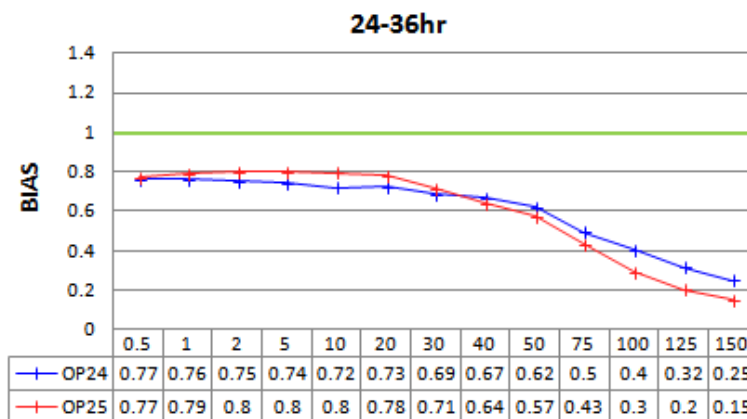
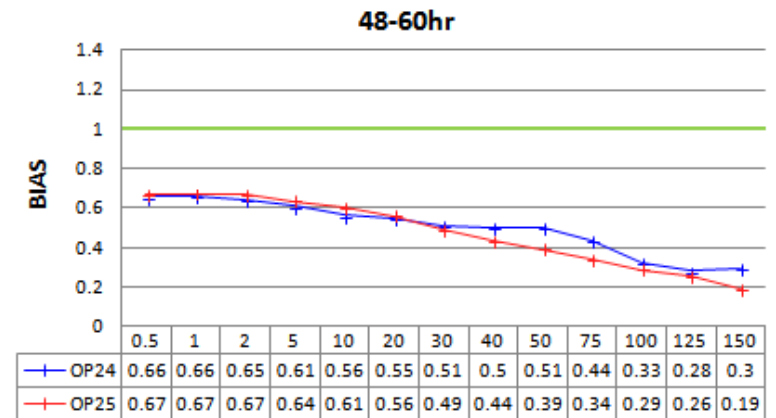
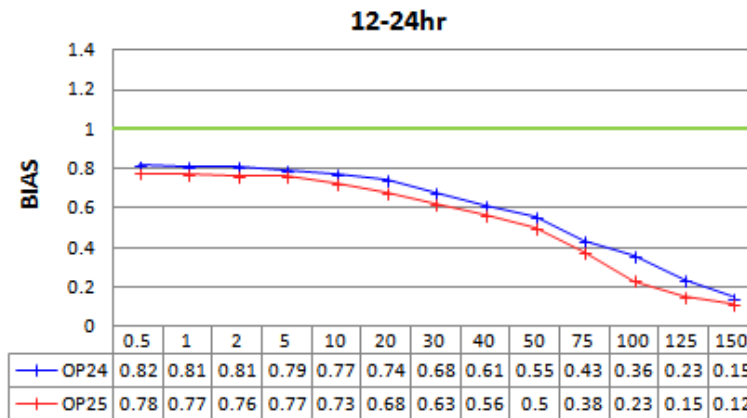
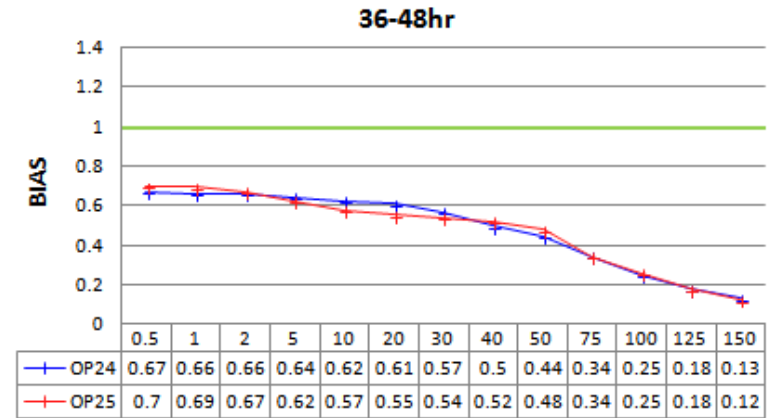
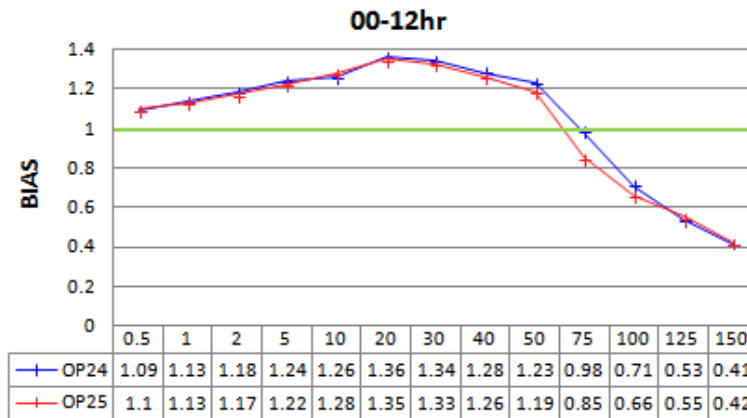


OP25_test-OP24_CTRL_PC Accumulated Rainfall

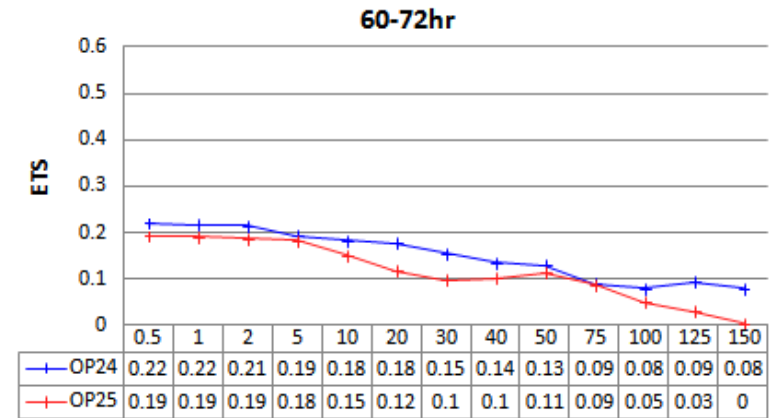
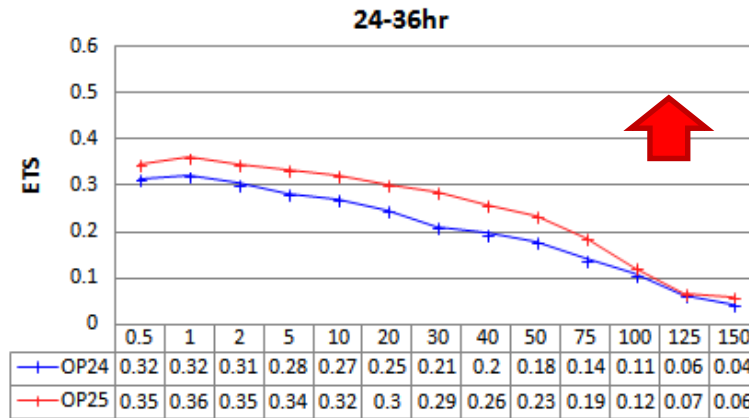
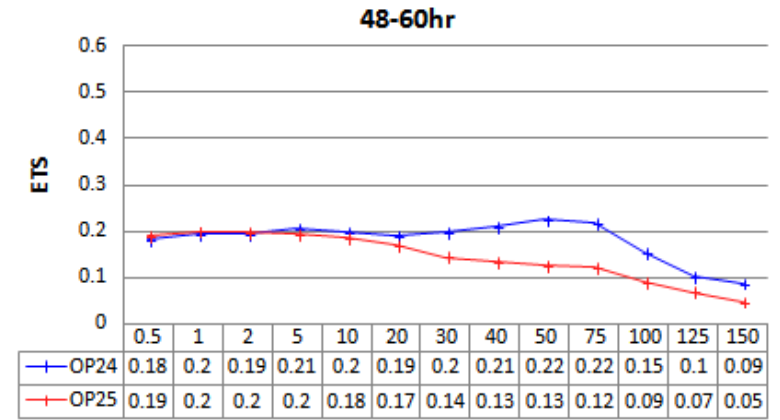
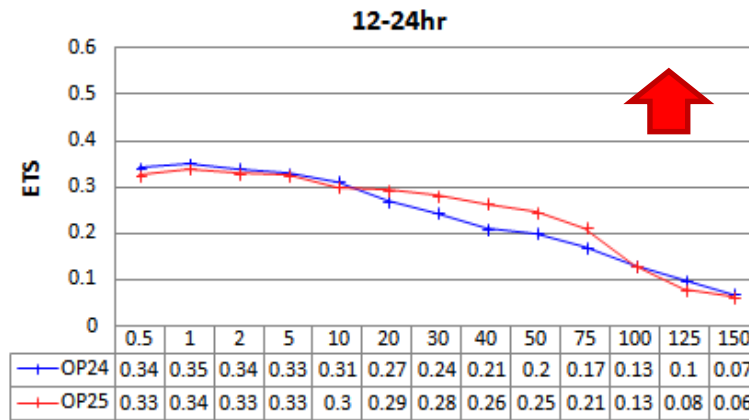
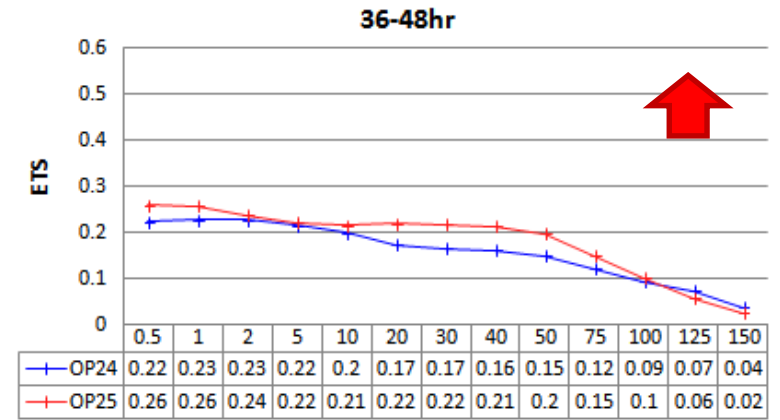
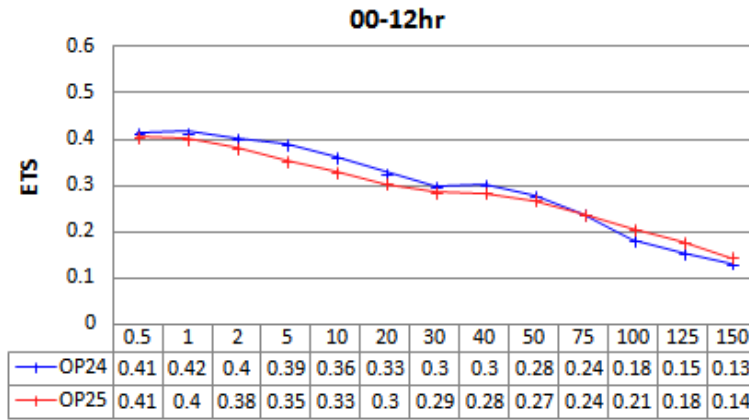


Forecast 48 – 60 hr
15天累積降水

BIAS



ETS



總結

- 綜觀天氣預報得分方面，OP25的分析場和預報場都優於OP24，分析場是受到更換Real垂直內插方法的影響，預報場則是更換輻射參數法的結果。
- 地面校驗的結果：
 - 溫度預報之暖偏差有明顯改善，更換輻射參數法和更新植物分布率皆有貢獻。
 - 濕度預報方面和OP24相去不遠。
 - 風速預報過強之情形明顯改善，主要貢獻來自地面風速修正方案。
- Domain 3 定量降水預報之結果，OP25可改善12 – 48小時中雨的雨量預報，但在48 – 72小時對大雨的預報較OP24差；此外OP25整體對降雨事件數目預報較OP24少。

謝謝指教