# 下一代區域系集預報系統之發展及研究：
初始場擾動強化評估

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中央氣象署科技發展組

Configuration of WEPS
(CWA WRF Ensemble Prediction System)

- Model Domain
  - 2 nested domain
  - 15/3-km
- Vertical level
  - 52 levels
  - Model top at 20 hPa
- Model Version：
  - WRF v4.4.2
  - WPS v4.4.2
- A total of 20 members per 6-hrs
  - IC perturbation + BC perturbation + Model perturbation
    - IC perturbation：
      - Combine the perturbations of EAKF 6-hr forecast and NCEP GEFS by blending scheme.
    - BC perturbation ：
      - leading 10 members of NCEP GEFS as BC.
    - Model perturbation：
      - Multi-physics + SKEB + SPPT.

現行WEPS初始場產製方式

EAKF

NCEP GEFS 分析場

cut-off length
=1200km
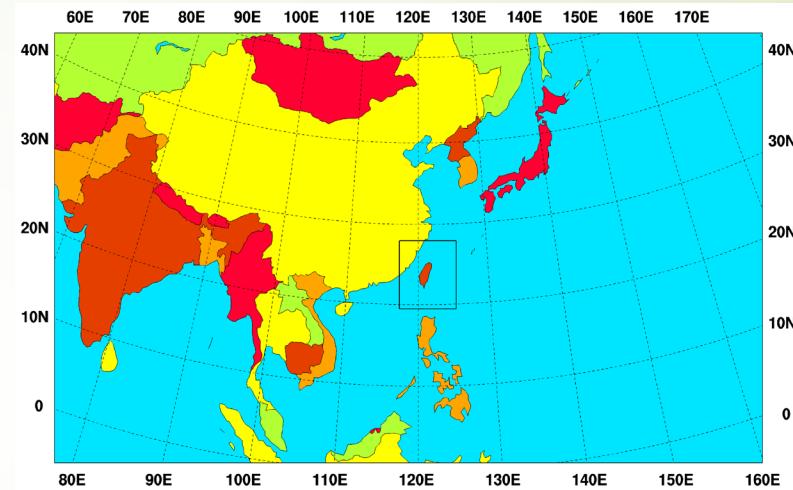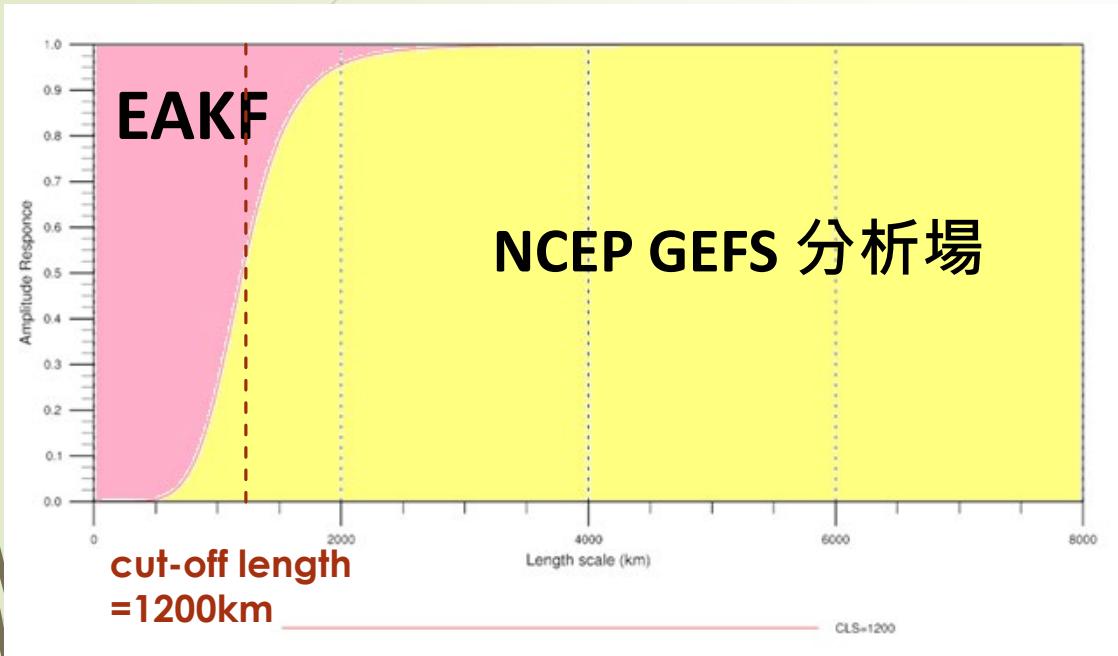
透過Blending Method，將EAKF成員分析場之「**大尺度環流系統**」，置換為**NCEP GEFS之「大尺度環流系統」**。

透過此方式，加入好的大尺度環流場（**NCEP GEFS 分析場**），
得到一組較佳的WEPS初始場。

Plan in 2024 of WEPS

- Development and evaluation of the next-generation WEPS
  - EnPC
  - 10/2 km + 64 vertical levels
 - Taiwan Global ensemble forecast system (TGEFS) in CWA

> The EnPC was tested base on WRFV.3.8.1. we hope to verify the performance of EnPC with WRFV.4.4.2 before we start to test 10/2 KM WEPS.

Ensemble **P**artial **C**ycling (EnPC)

- 來自CWA區域模式的Partial cycling strategy和Ensemble of Data Assimilation(EDA)架構，這個方法同樣也應用於外國的其他氣象機構的氣象模式。
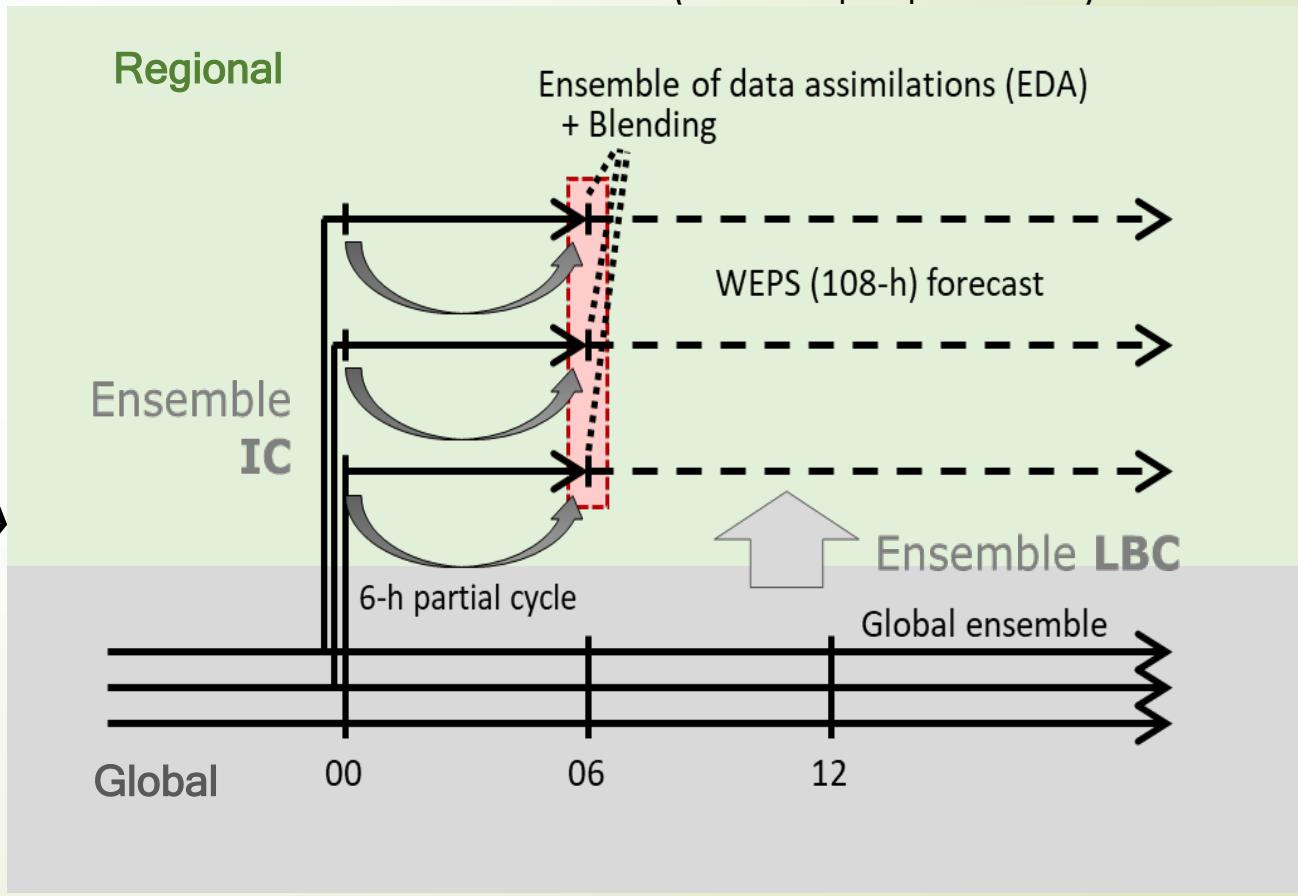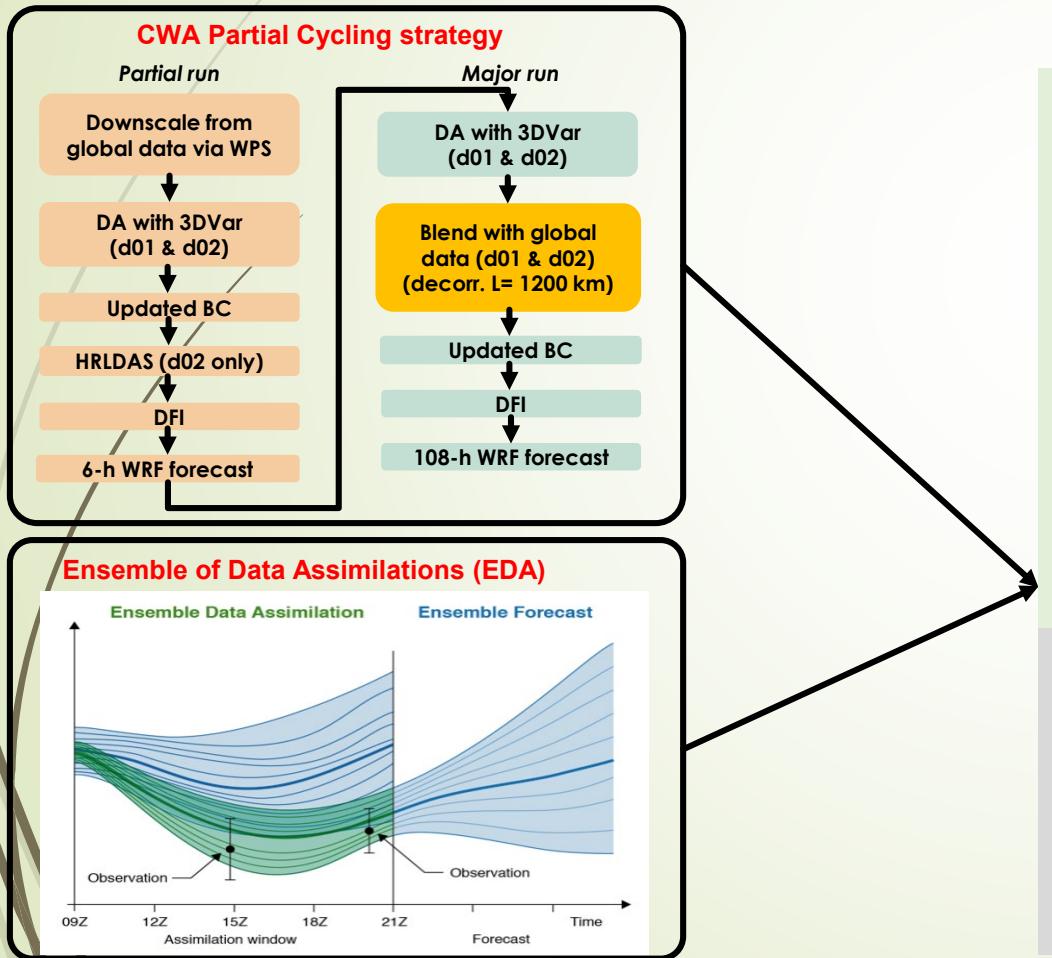
連等人 (2023,氣象學報)
Wu et al. (2024,in preparation)

實驗設計

WEPS2.4

Major run (+0 h)

EAKF *blended* with downscaled GEFS analyses with cut-off length = 1200 km

↓

DFI

↓

108-h WRF ensemble forecast (SKEB + SPPT + Multi-physics + SPP_PBL)

蘇等人 (2023,氣象學報)

WEPS2.4 EnPC

Partial run (-6 h)

GEFS analyses (20 members) downscaled via WPS

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DFI

↓

6-h WRF ensemble forecasts (SKEB + SPPT + Multi-physics + SPP_PBL)

Major run (+0 h)

6-h WRF ensemble forecasts *blended* with downscaled GEFS analyses with cut-off length = 1200 km

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EDA of 3DVar (d01 & d02)

↓

Updated BC

↓

DFI

↓

108-h WRF ensemble forecast (SKEB + SPPT + Multi-physics + SPP_PBL)

實驗設計

- 兩組實驗：
  - 現行WEPS(WEPS2.4)
  - WEPS_EnPC(WEPS2.4_EnPC)
- 時間：
  - 2023年夏季(2023/8/5~2023/8/20)
  - 2023年小犬颱風(2023/9/30~2023/10/6)
  - 2023年冬季(2024/1/1~2024/1/15)

- 00Z、12Z為起始時間，預報72小時

與台灣地面測站校驗
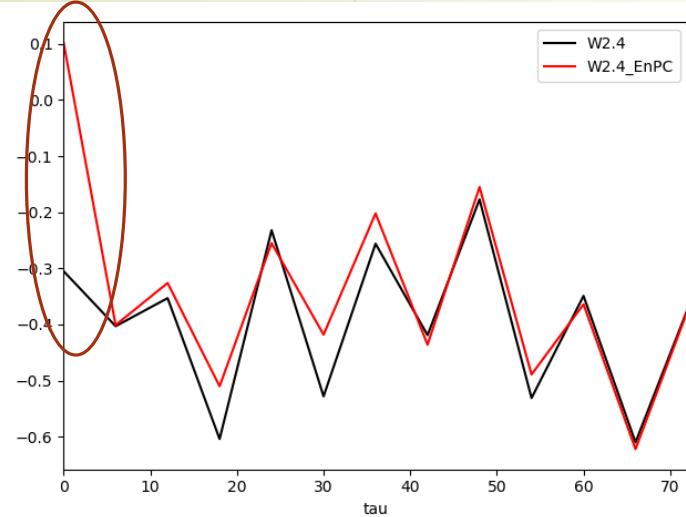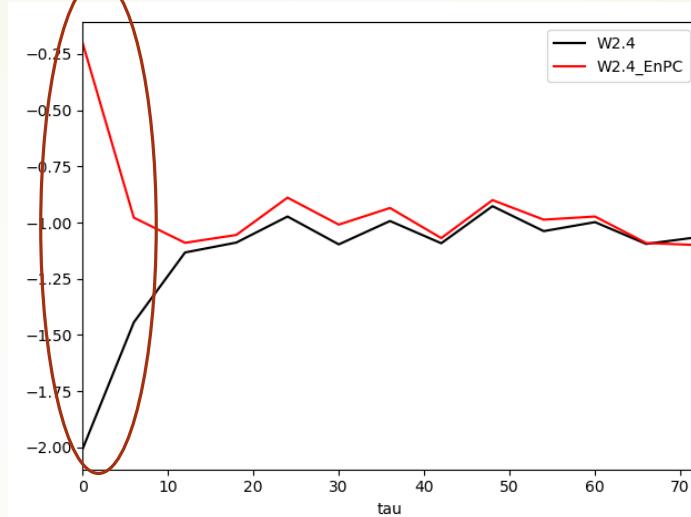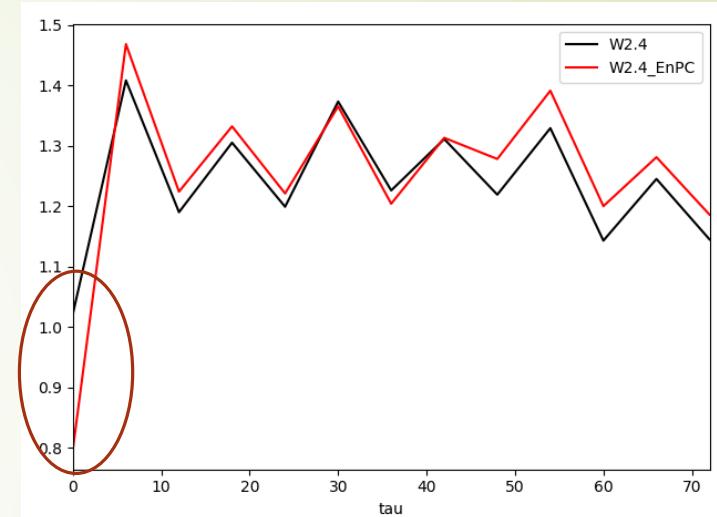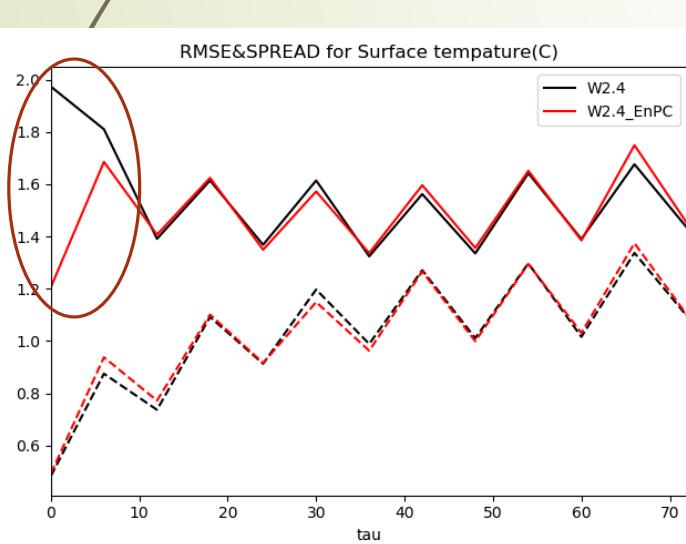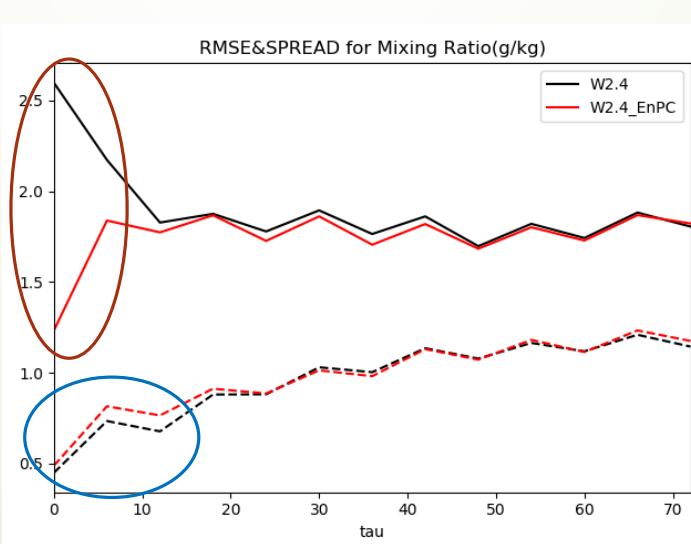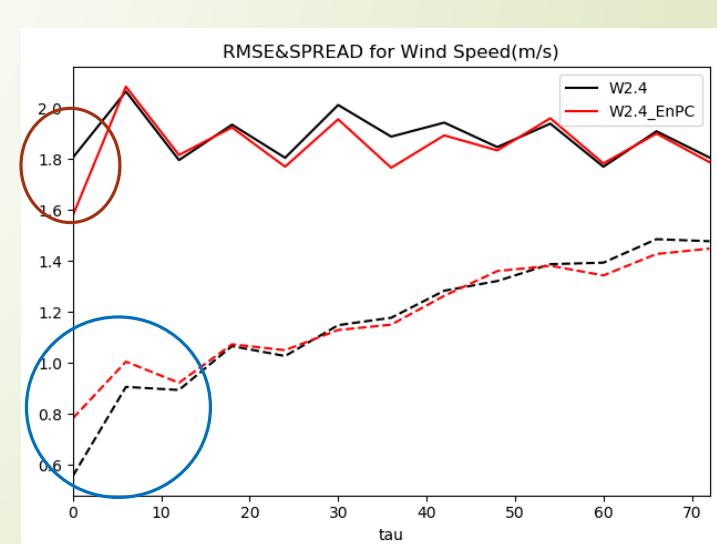
# 與台灣地面測站校驗
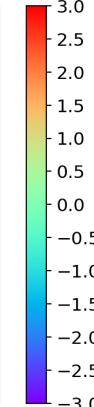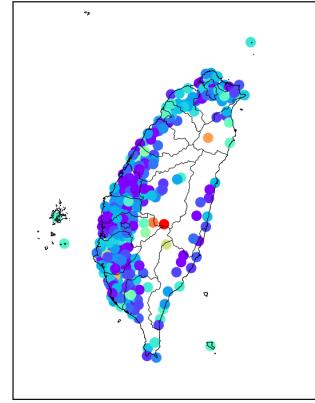
WEPS2.4   WEPS2.4_EnPC
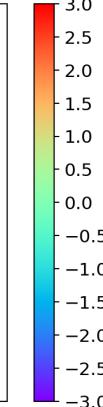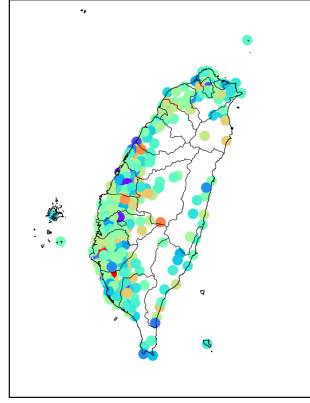
0hr初始場

模式初始場整體明顯偏乾，EnPC有效改善此問題
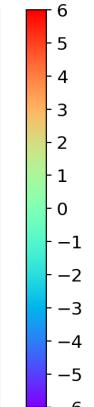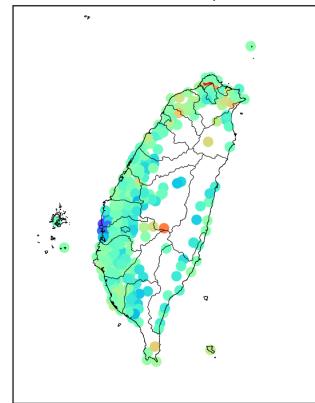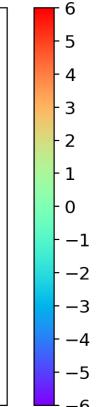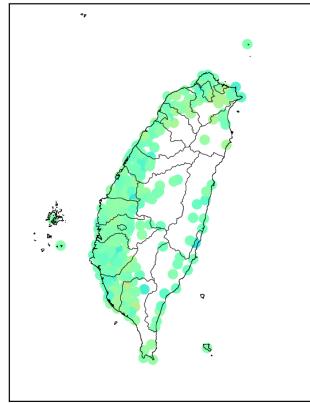
EnPC有較好的溫度初始場

與EC分析場0.1度校驗
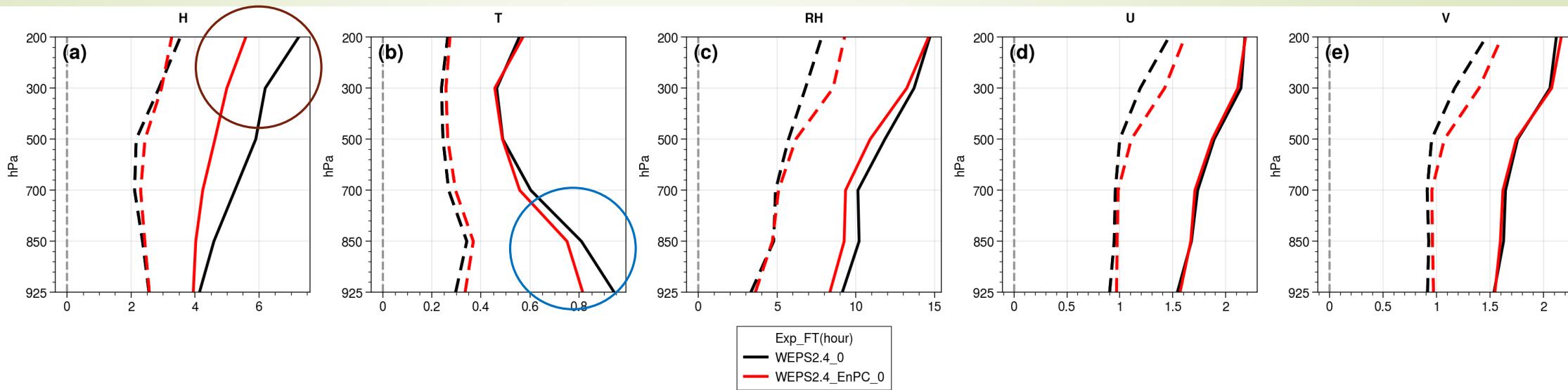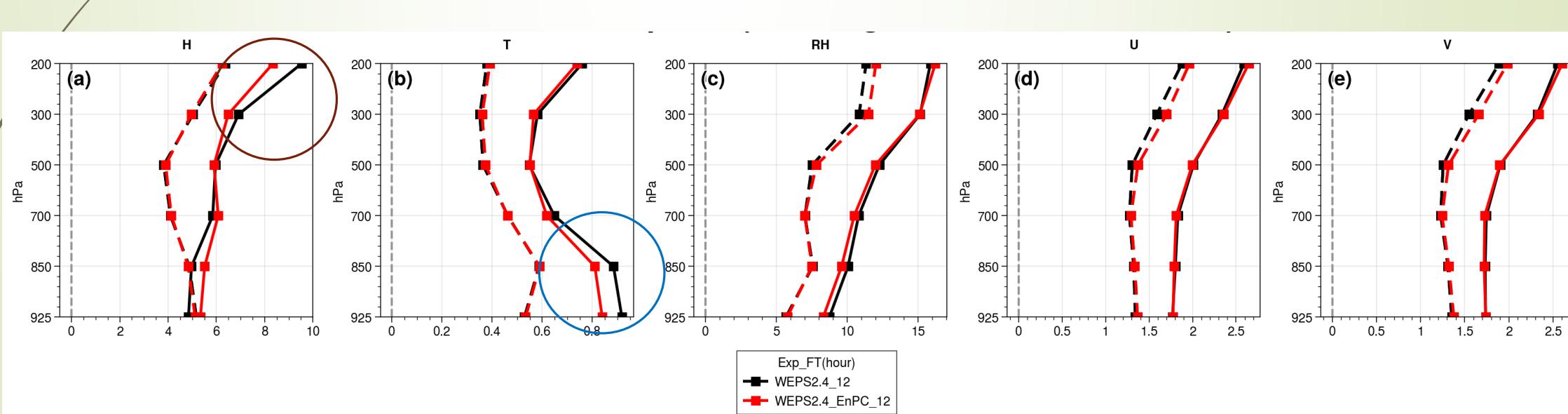
與EC分析場0.1度校驗

24hr
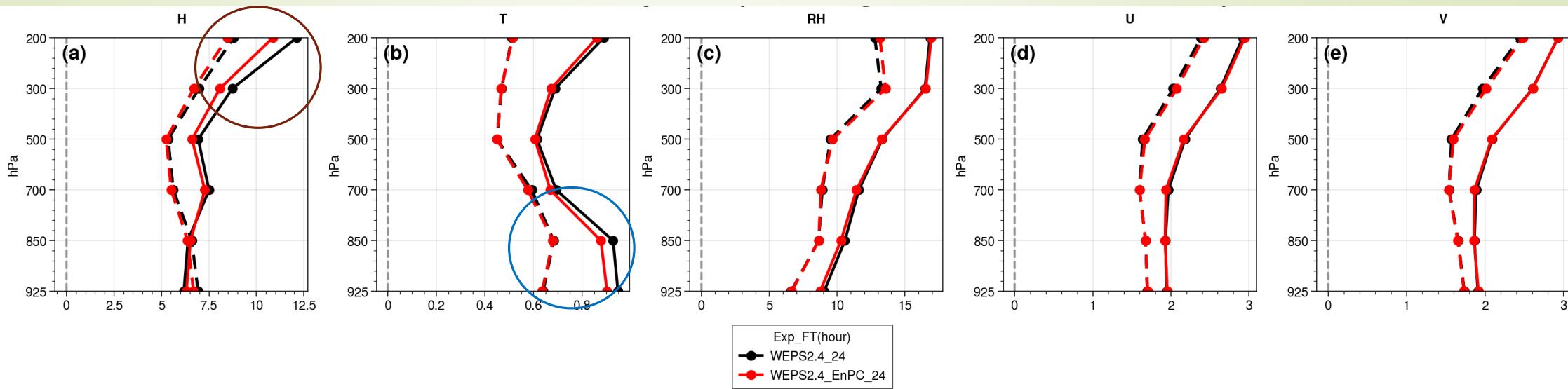
72hr
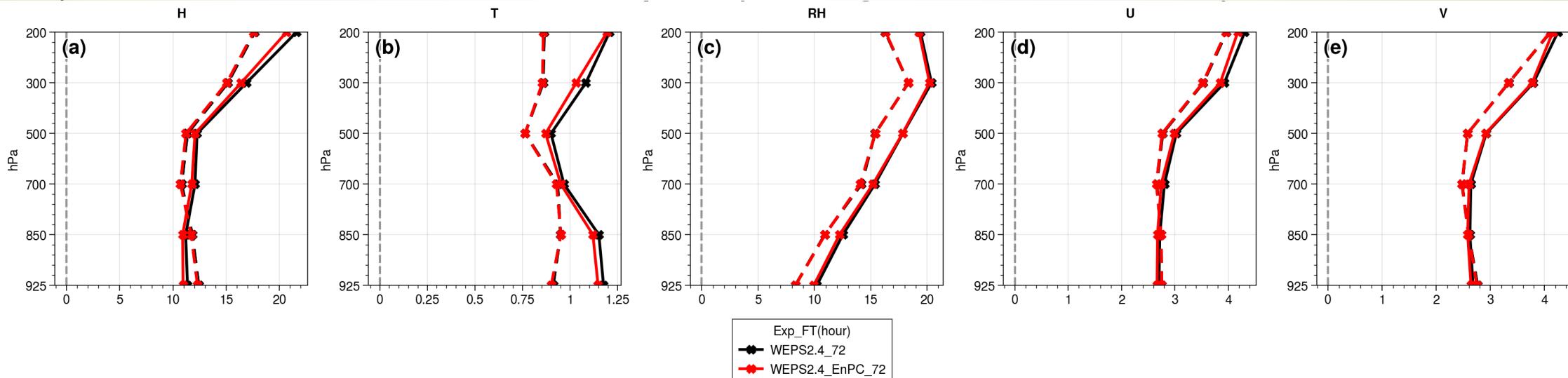

高層重力位及低層溫度有明顯改善

颱風校驗

KOINU WEPS Exps: 00 UTC 30 9 2023 ~ 00 UTC 06 10 2023 (13 runs)

颱風校驗

WEPS2.4   WEPS2.4_EnPC

dtg:
24100400
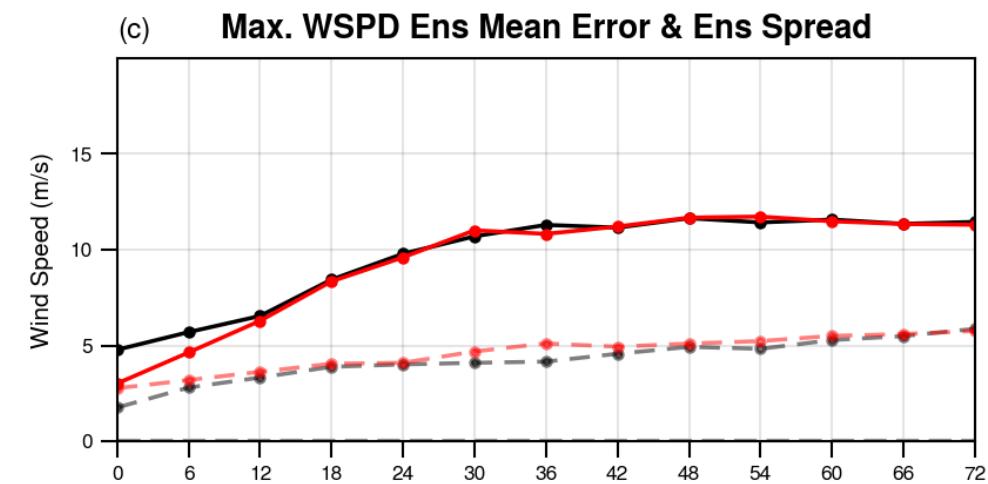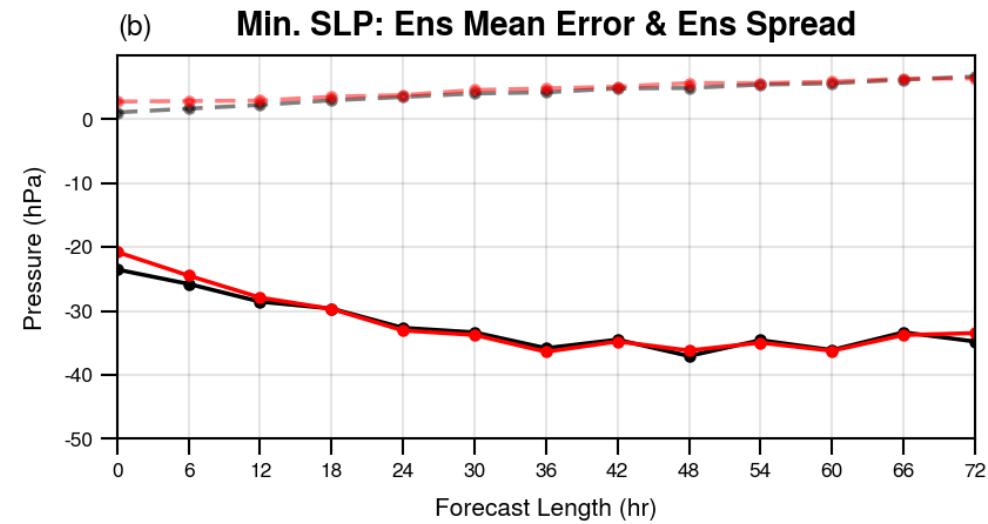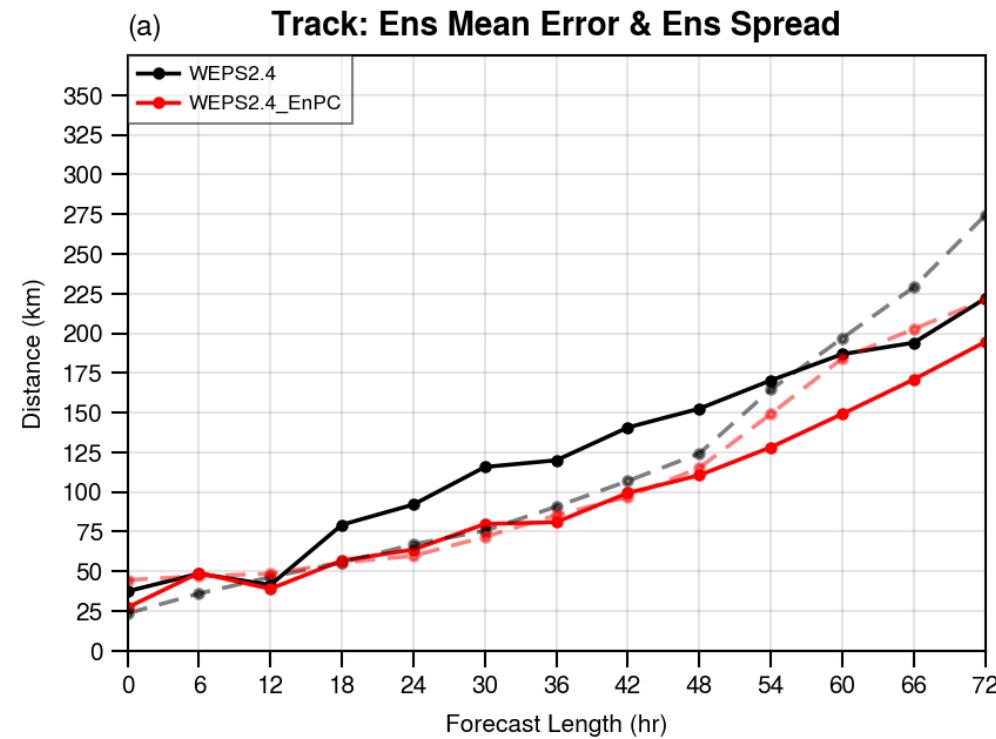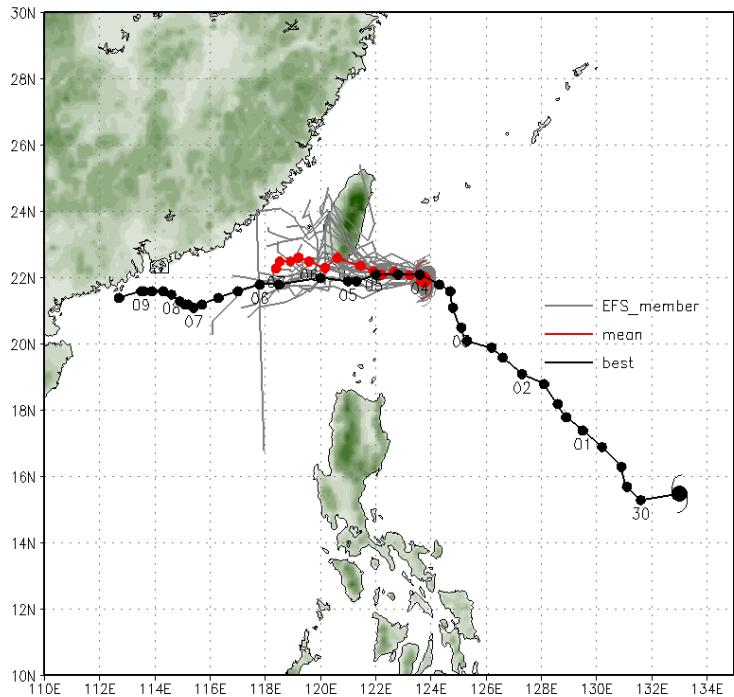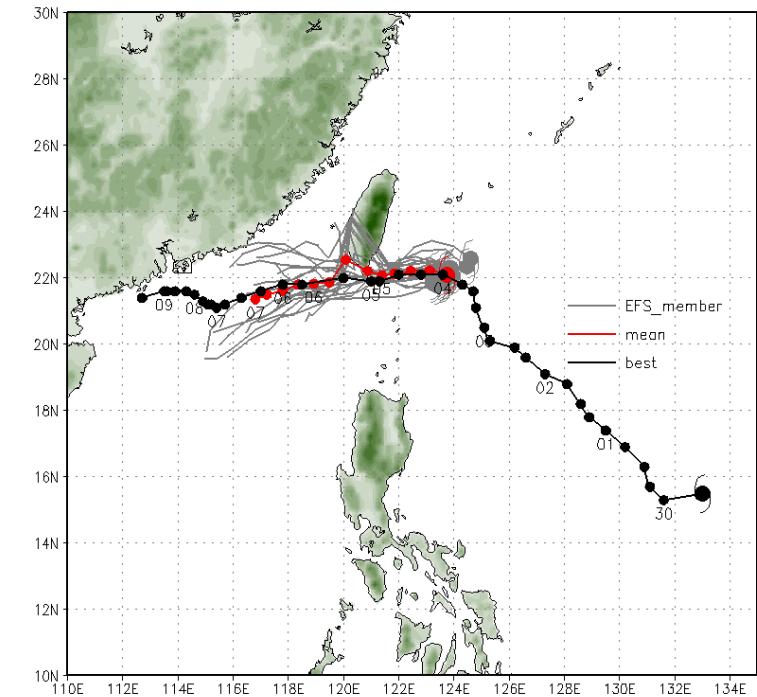

原WEPS2.4之系集預報路徑較偏北，速度也偏慢，EnPC較接近實際的颱風路徑

雨量校驗
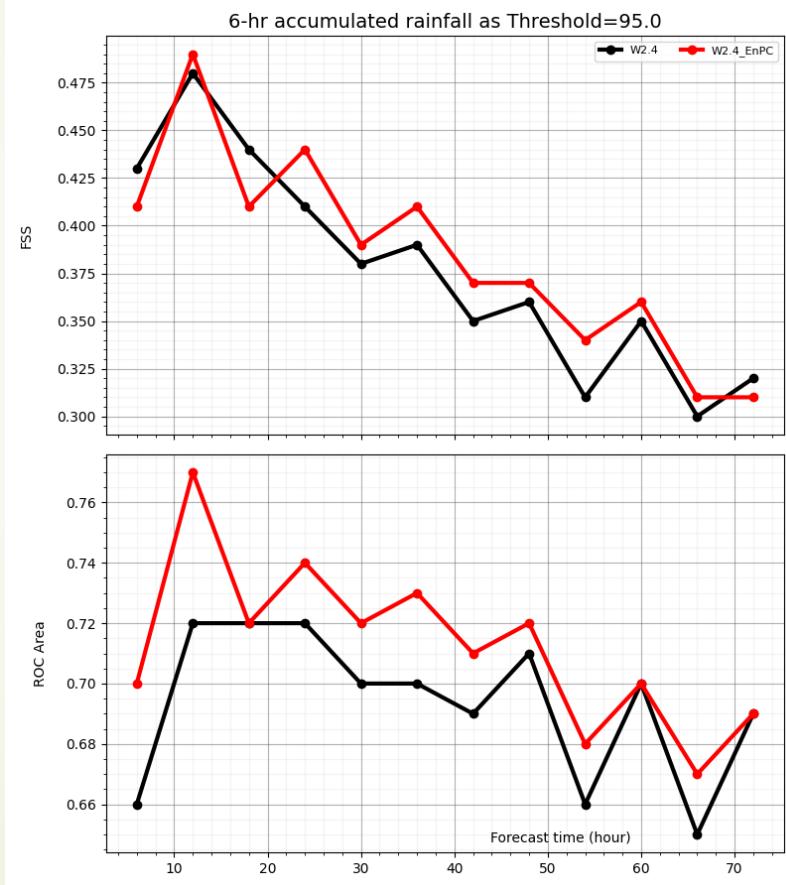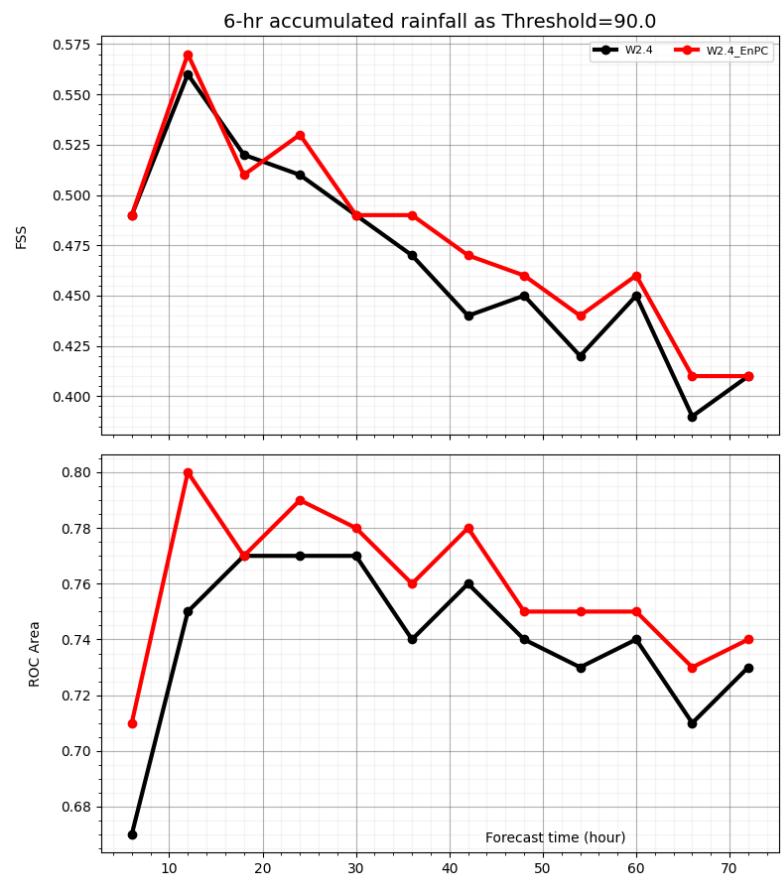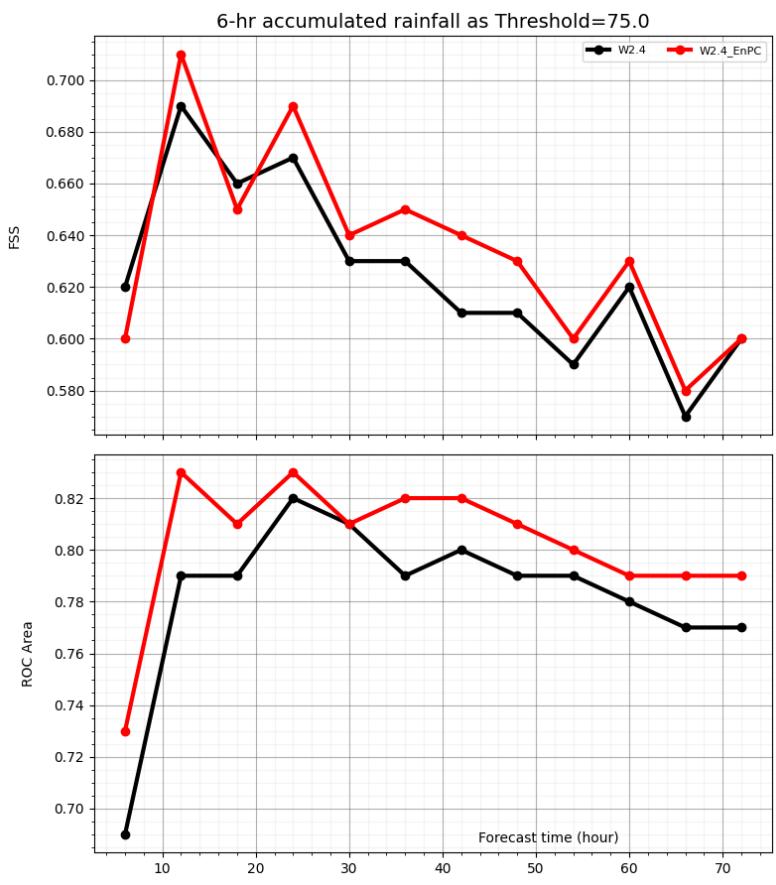
結論

- EnPC可大幅改善初始場，對於預報初期的模式表現提升十分顯著，能大幅降低誤差並提升離散度，尤其是高層重力位高度場及低層溫度場。

- 颱風預報方面，整體而言EnPC路徑預報誤差較小，強度預報亦相同。

- 整體而言，EnPC策略有助於提升模式表現，未來將繼續嘗試於10/2KM進行測試。