

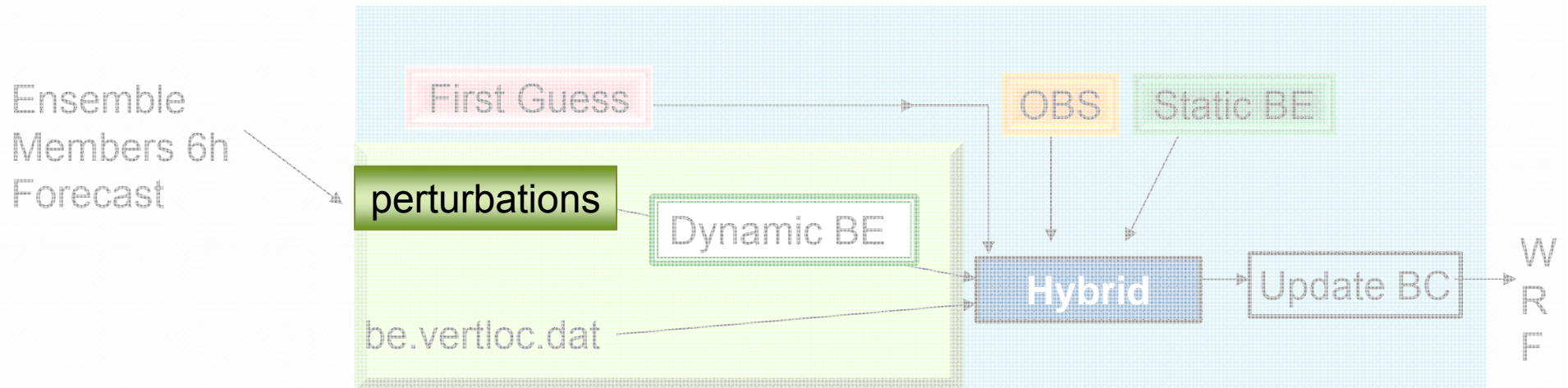
WRF-3DVAR HYBRID 資料同化系統測試與分析

2014/09/16

江琇瑛 陳美心 馮欽賜 洪景山

中央氣象局資訊中心

Running 3DVAR-Hybrid



- **EAKF : Ensemble Adjustment Kalman Filter**

- 32 members

HEAKF

- **WEPS : WRF Ensemble Prediction System (IC/BC/Physics Perturbation)**

- 20 members

HWEPS

Real Case Studies

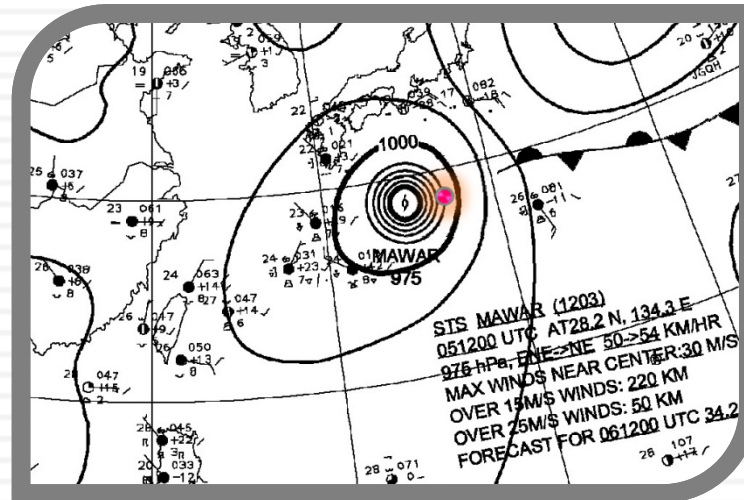
- HEAKF vs. 3DVAR (Hybrid vs. 3DVAR)
- HEAKF vs. HWEPS

Outline

- **Single Observation Tests**
 - Sensitivity of the tuning factors in hybrid system. (Ensemble members from EAKF)
 - Localization Scale Tuning
 - Ensemble Covariance Weighting Factor Tuning
 - Characteristic of the flow dependent BE from different ensemble system. (EAKF and WEPS)
- **Real Case Studies :**
 - HEAKF vs. 3DVAR (Hybrid vs. 3DVAR-CV3)
 - HEAKF vs. HWEPS

Single Observation Tests

■ Observation Setting



- WRFVAR V3.3.1
- 2012年6月5日12 UTC
瑪娃颱風環流上
- Temperature
- innov = 1 K, obs_err = 1 K
- Lon ~ 137.143 (x = 150)
- Lat ~ 28.2 (y = 69)
- Lev ~ 860 mb (z = 11)

Localization Scale Tuning

realized by recursive filter

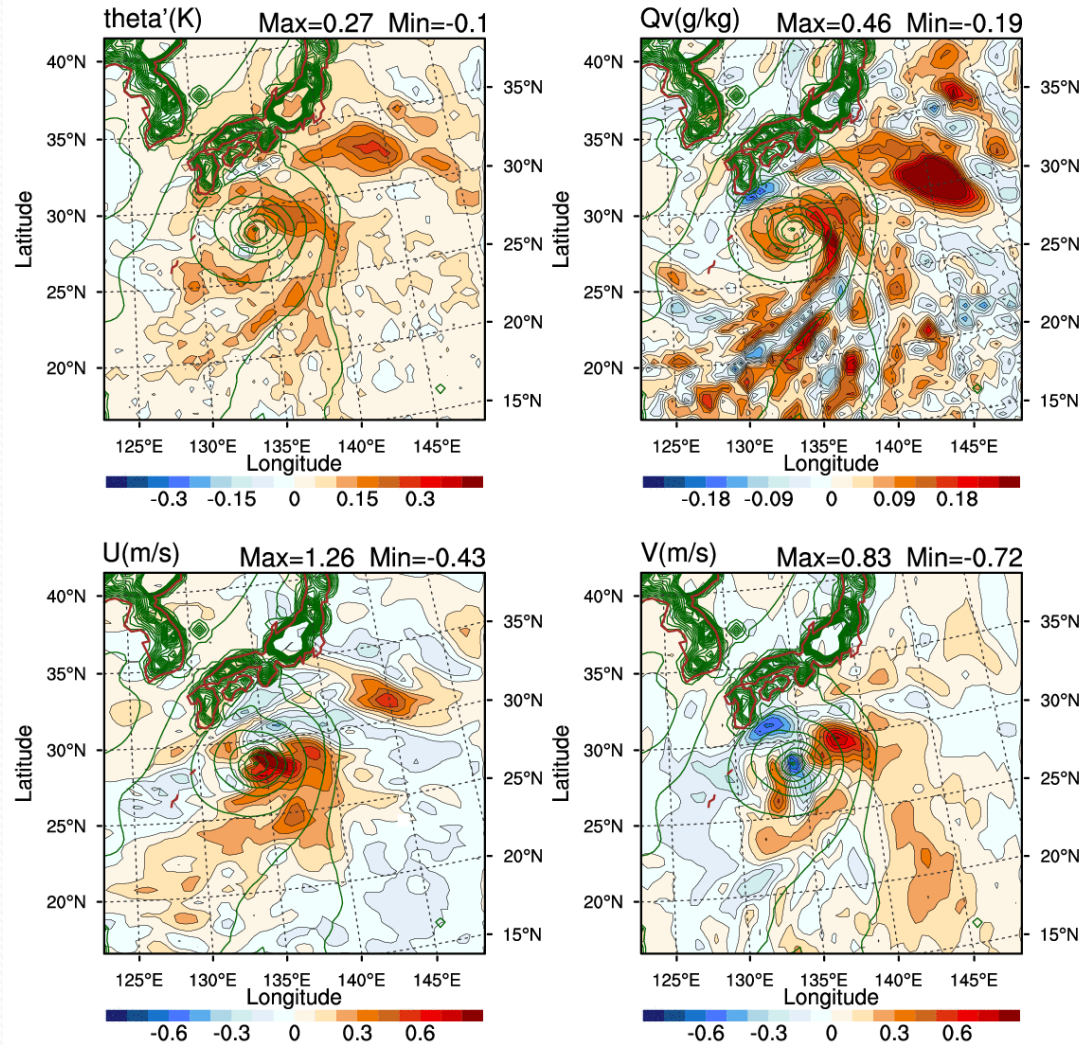
200 km

375 km

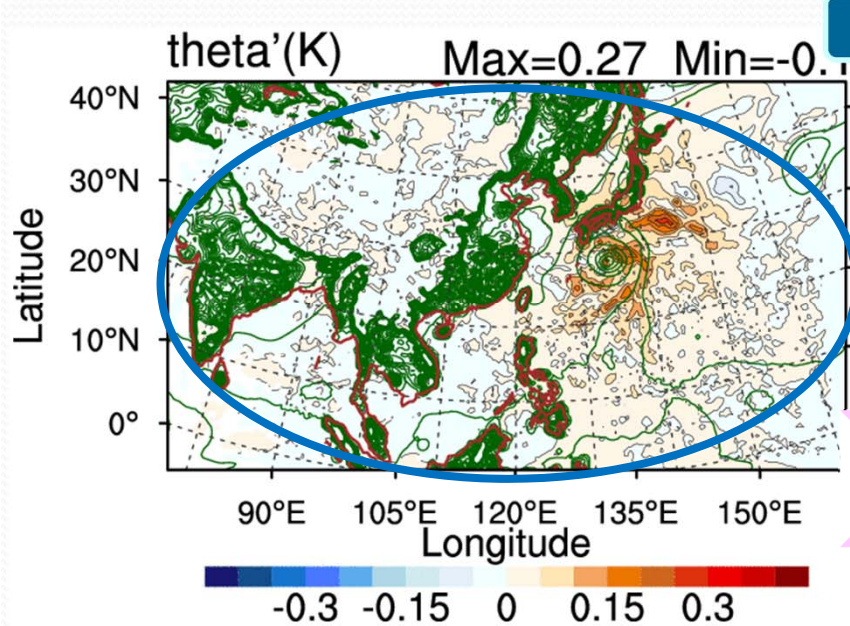
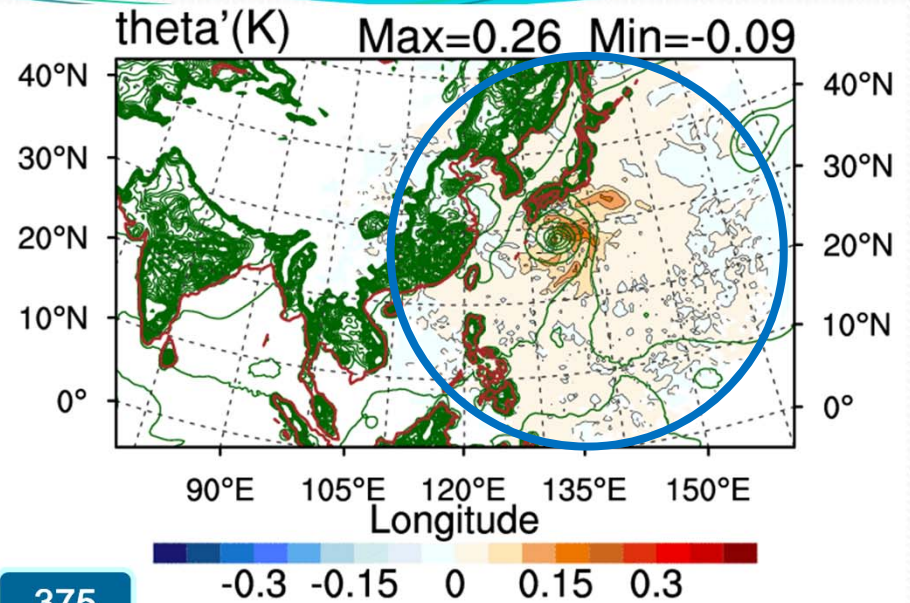
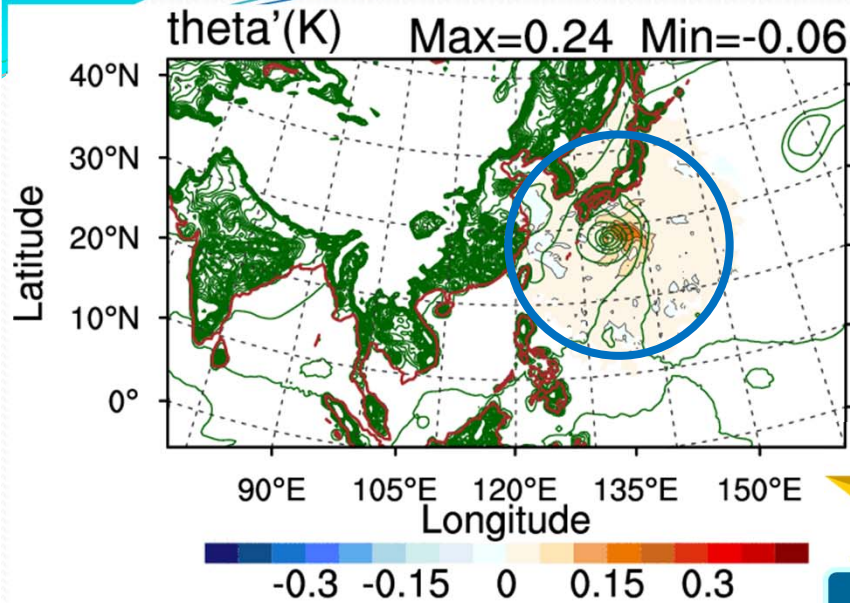
750 km

Shade : Increment
Green Line : Geopotential Height
of Ensemble Forecast
6hr Mean.

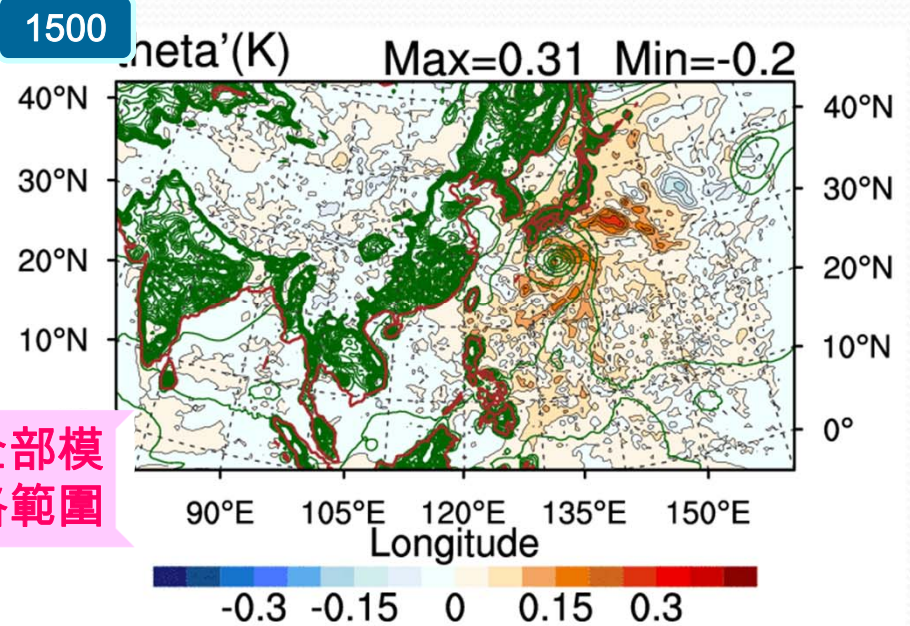
Analysis Increments form Single Obs. T at sigma Lev=11, Lat=28.2001, Lon=137.143



X-Y平面 Level - 11



涵蓋全部模式網格範圍



Ensemble Covariance Weighting Factor Tuning



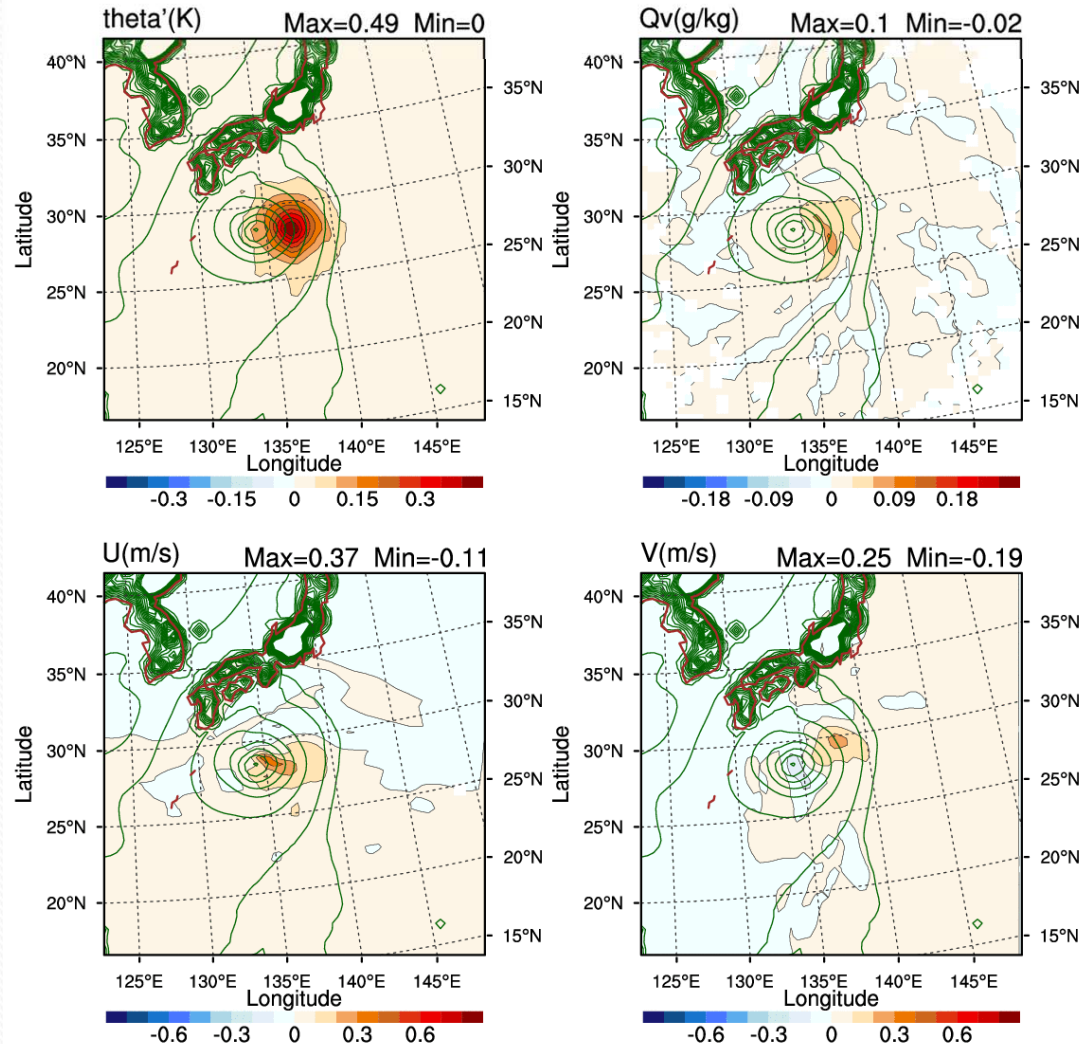
Full

75%

50%

Shade : Increment
Green Line : Geopotential Height
of Ensemble Forecast
6hr Mean.

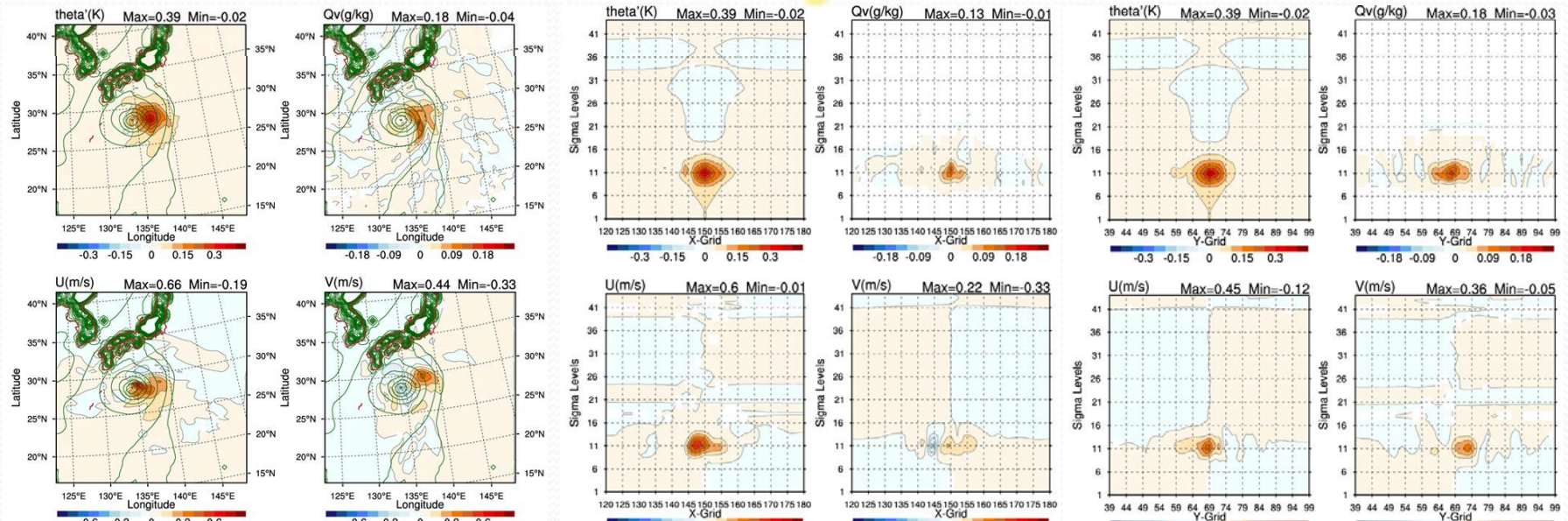
Analysis Increments from Single Obs. T at sigma Lev=11, Lat=28.2001, Lon=137.143



Ensemble Covariance from Different Ensemble Forecast System

Localization Scale = 200 km
 $\beta_e : \beta_b = 75\% : 25\%$

HEAKF

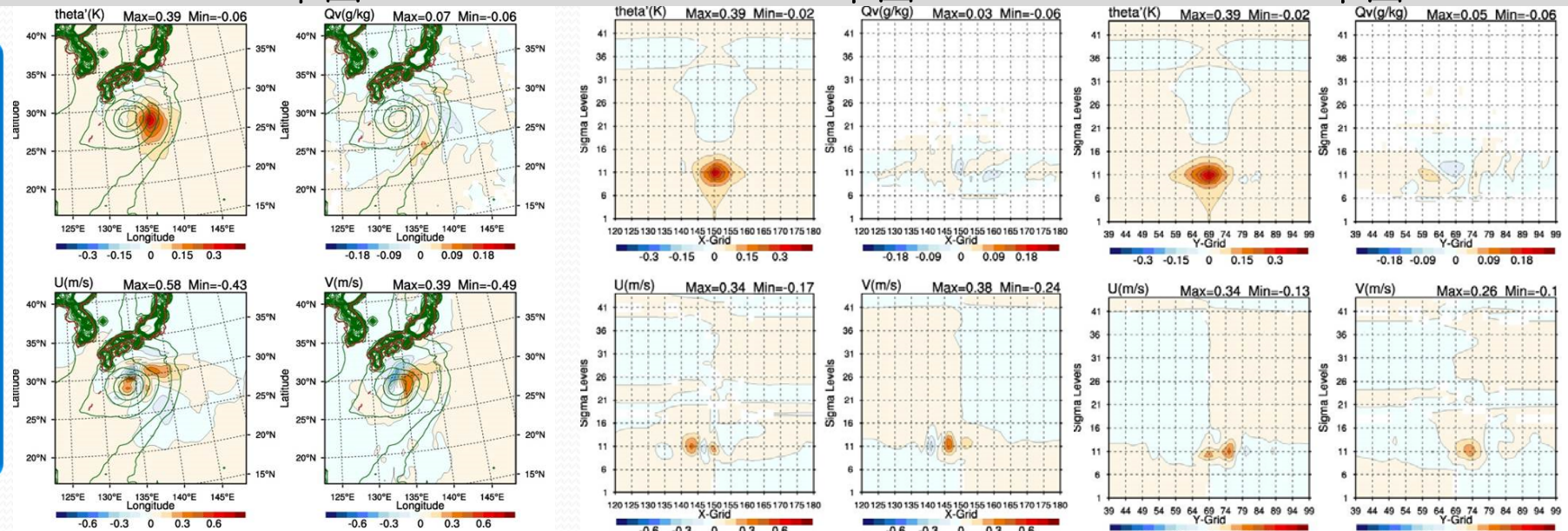


X-Y平面

Y-Z平面

X-Z平面

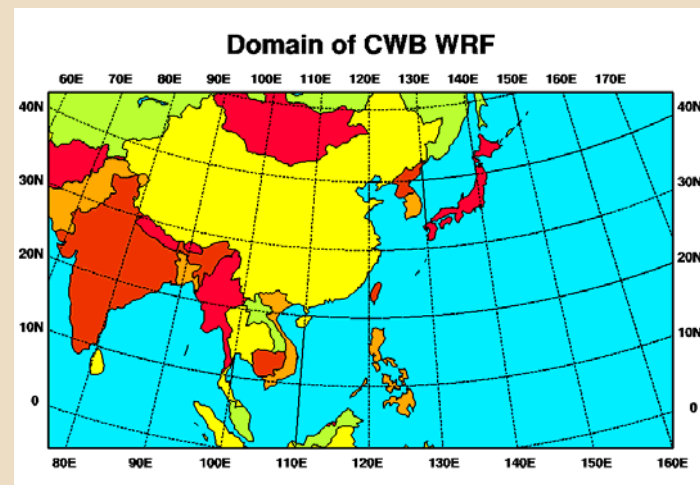
HEEPS



Real Case Studies

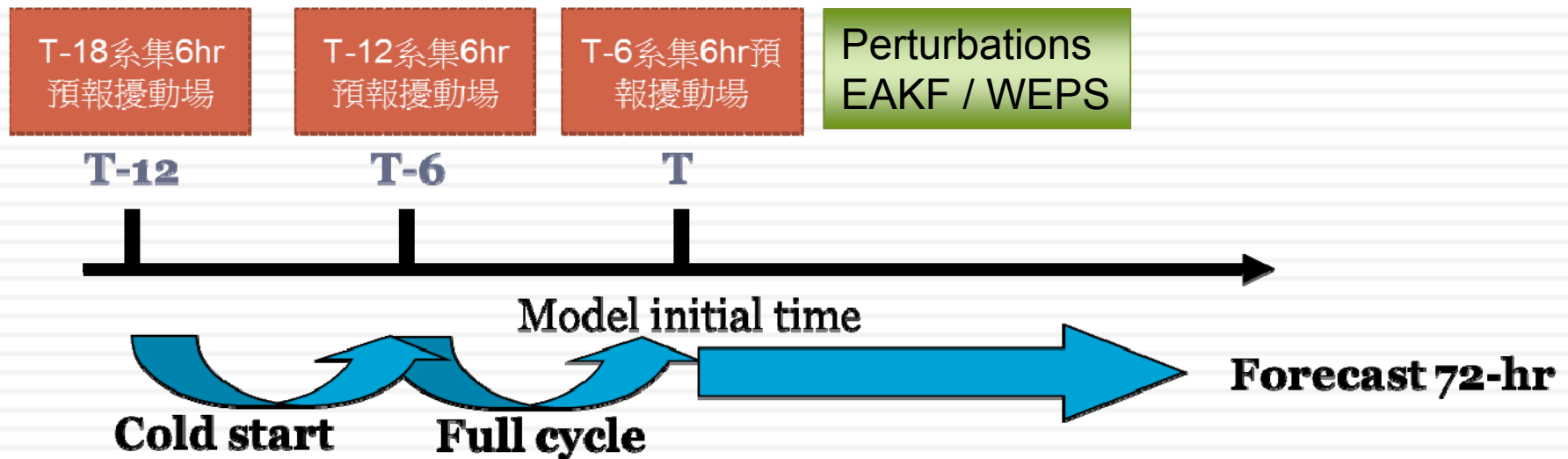
- 3DVAR vs. Hybrid-EAKF
- Hybrid-WEPS vs. Hybrid-EAKF

- Run : Partial Cycling
- Domain : CWB WRF domain 1 (45KM)
- Period :
 - 2012/06/01 00UTC ~ 2012/06/30 12 UTC
- Verification : Against NCEP
- Localization Scale = 200 km
- $\beta_e : \beta_b = 75\% : 25\%$



Real Case Studies

partial cycling 流程



1206 SCORE (against NCEP)

T

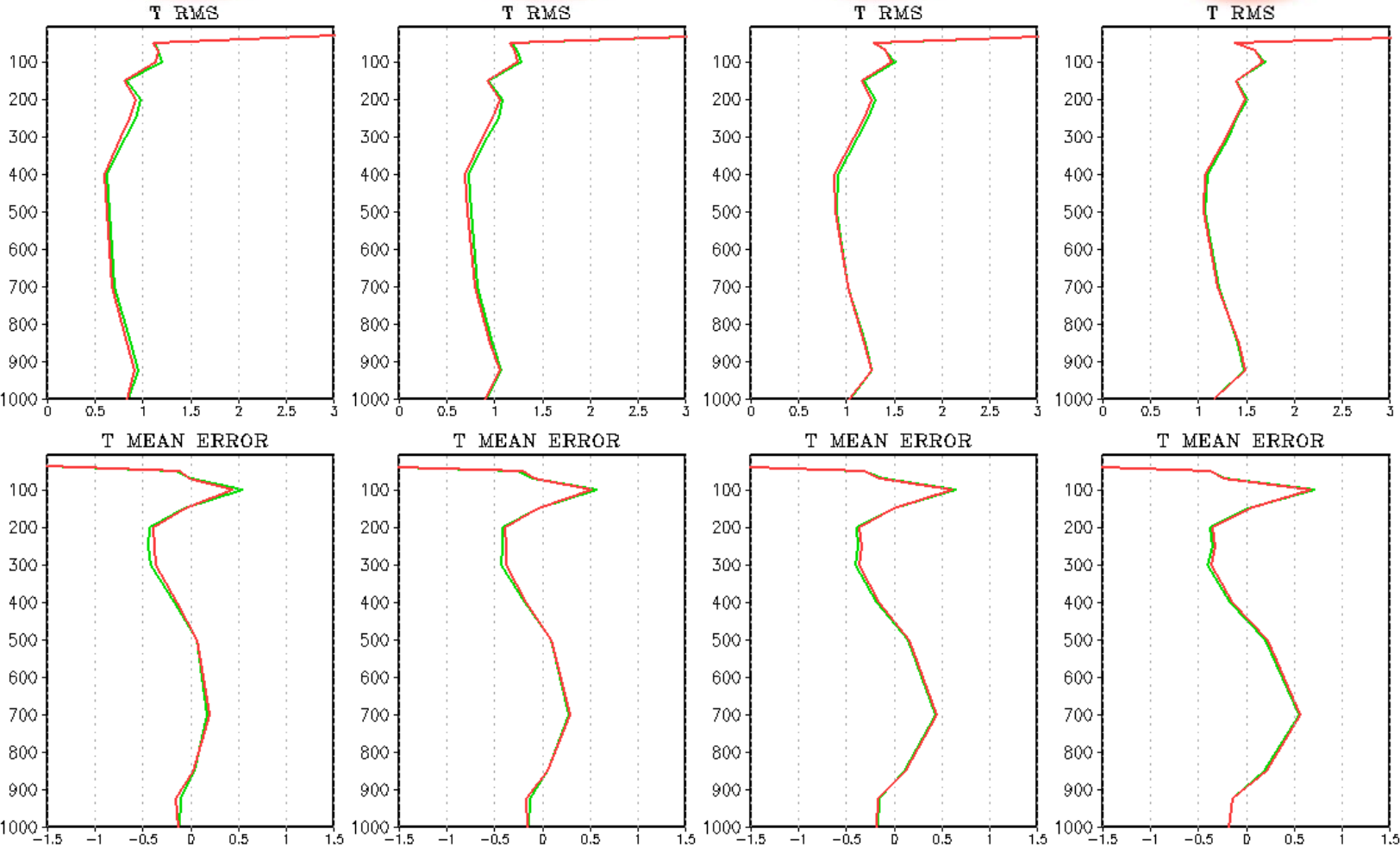
3DVAR HEAKF

12hr

24hr

48hr

72hr



1206 SCORE (against NCEP)

U

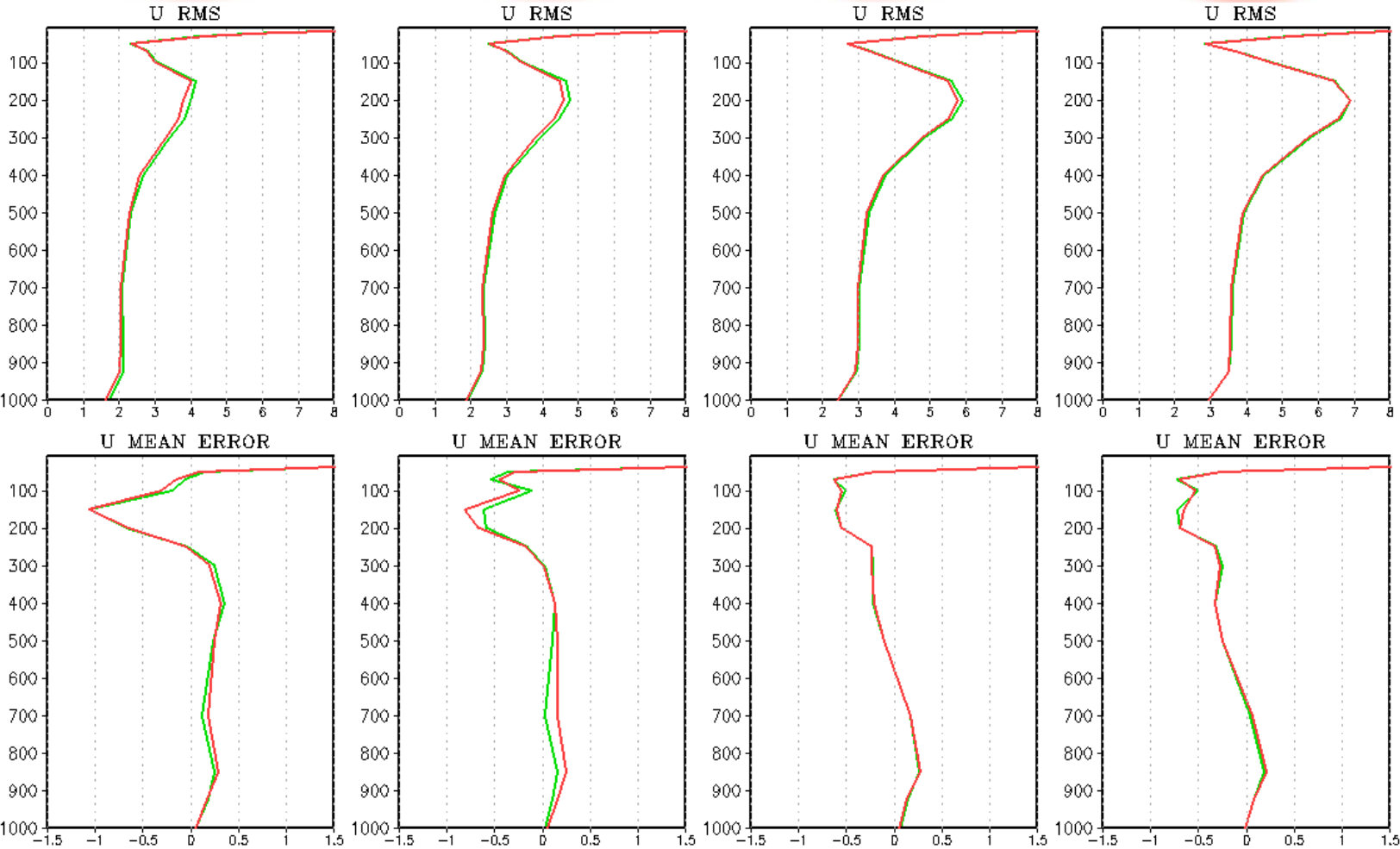
3DVAR **HEAKF**

12hr

24hr

48hr

72hr



1206 SCORE (against NCEP)

T

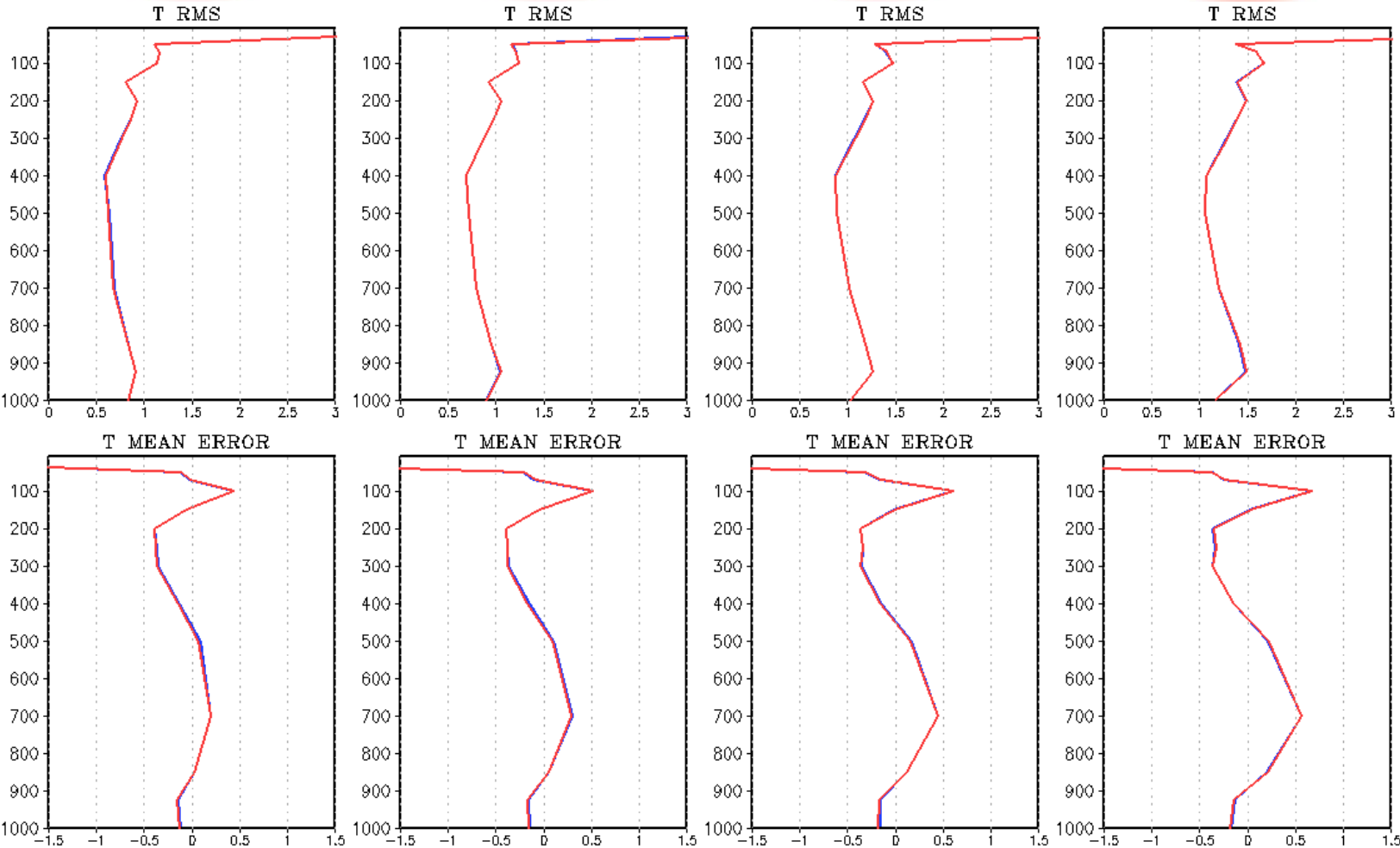
HWEPS **HEAKF**

12hr

24hr

48hr

72hr



1206 SCORE (against NCEP)

U

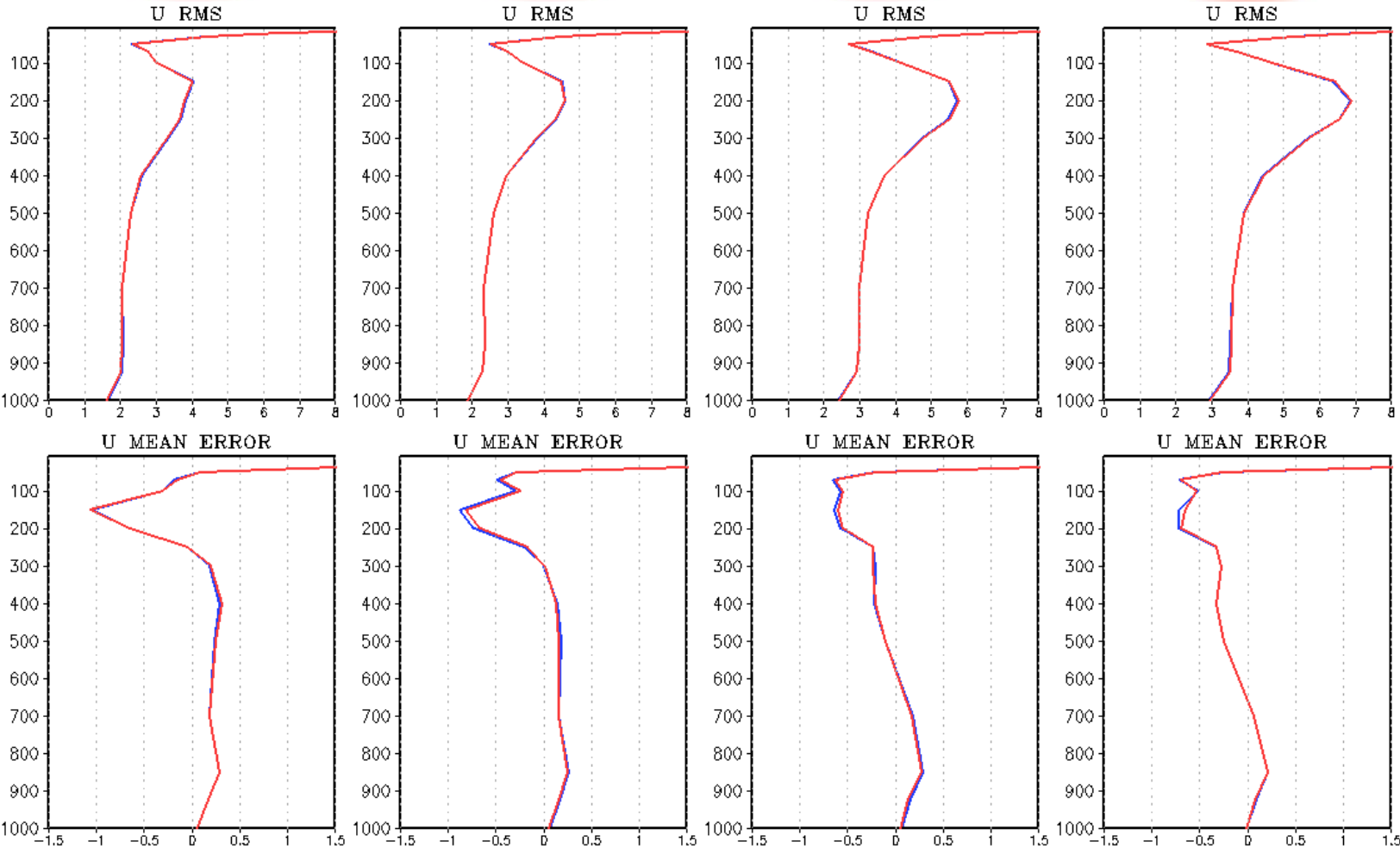
— HWEPS **—** HEAKF

12hr

24hr

48hr

72hr

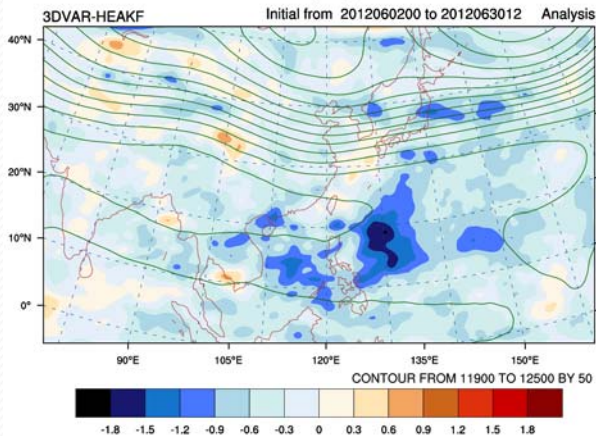


分析時之平均差異分布圖

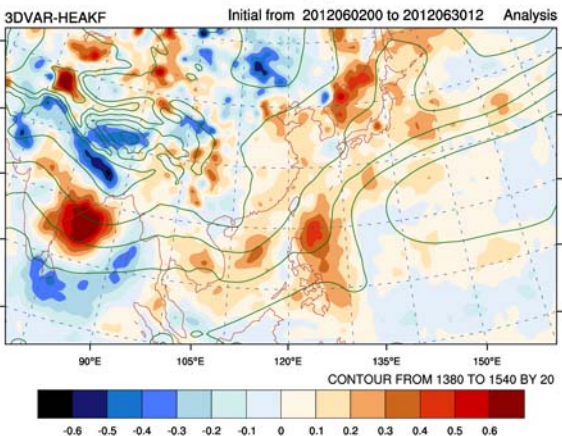
3DVAR

HEAKF

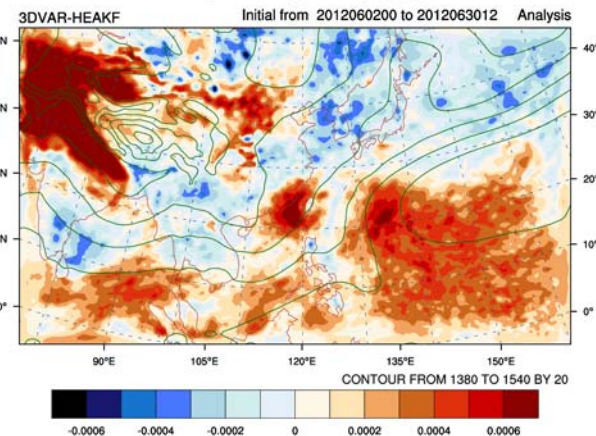
Mean U wind (m/s) at 200hPa



Mean Temperature(K) at 850hPa



Mean Water Vapor mixing ratio (kg/kg) at 850hPa

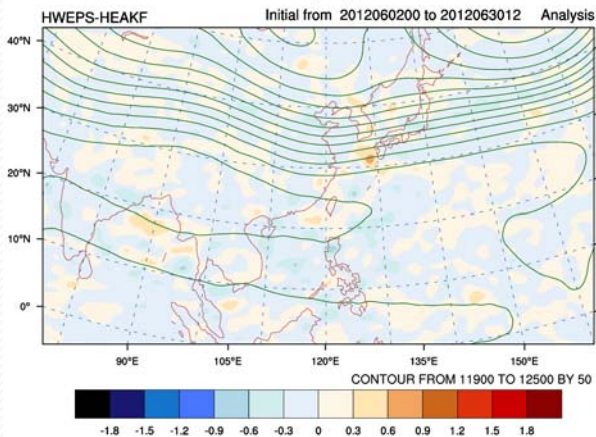


U @ 200mb

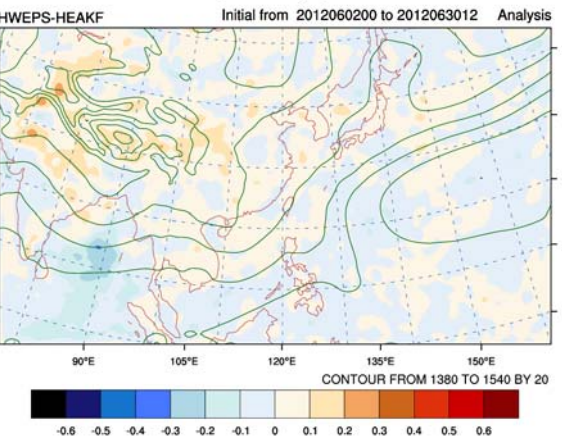
T @ 850mb

Qv @ 850mb

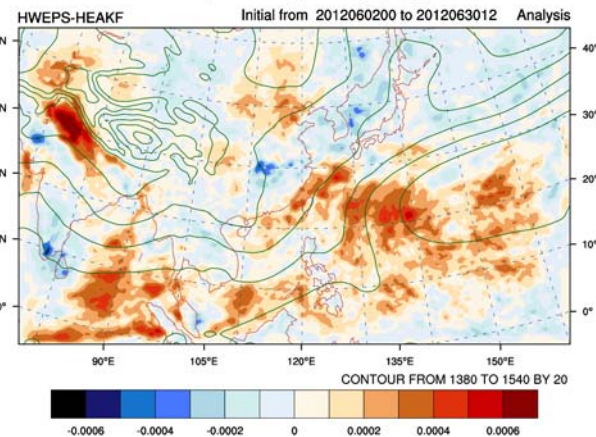
Mean U wind (m/s) at 200hPa



Mean Temperature(K) at 850hPa



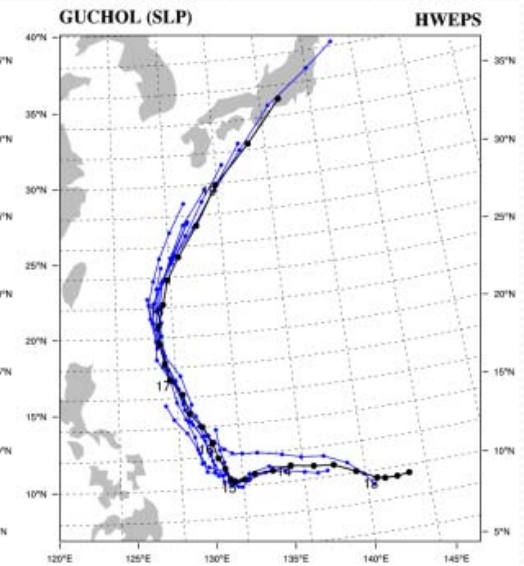
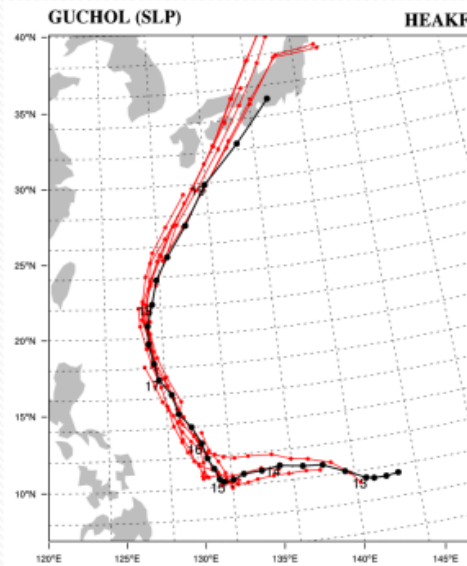
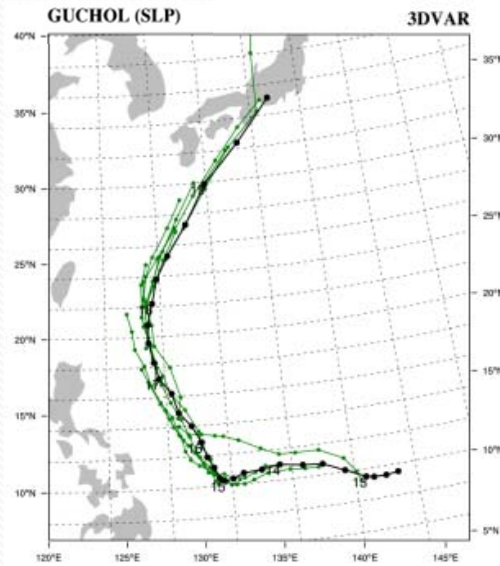
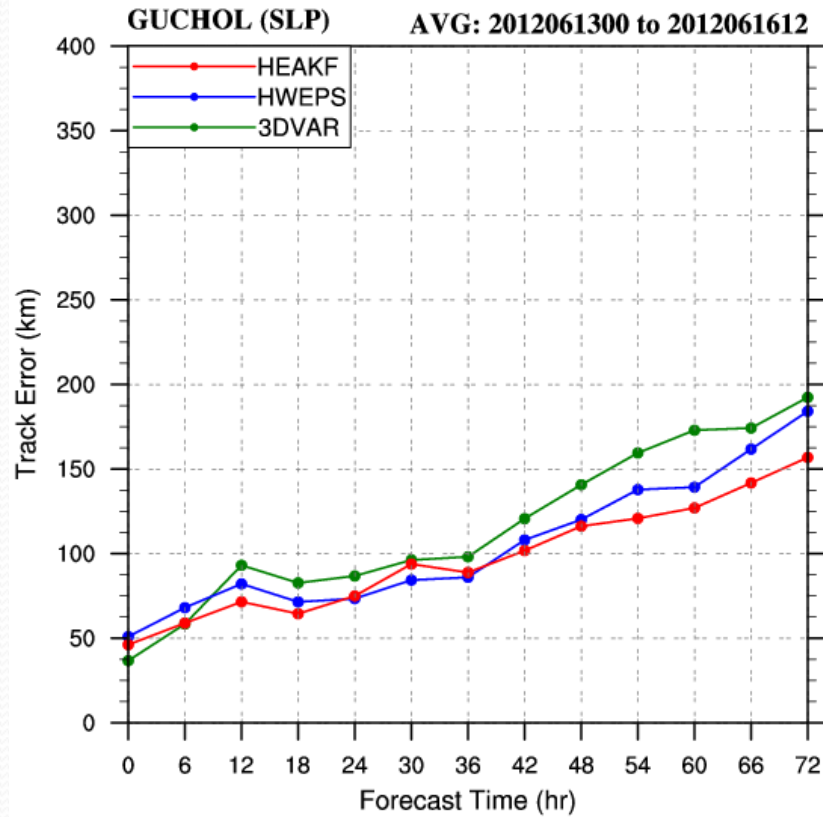
Mean Water Vapor mixing ratio (kg/kg) at 850hPa



HWEPS

HEAKF

Typhoon Track Errors



總結

- **Hybrid-EAKF vs. 3DVAR :**
 - 使用Hybrid資料同化方法之模式預報準確度優於3DVAR，此優勢可持續至48小時預報；
 - 由兩者實驗之差值分布得知，Hybrid資料同化在熱帶洋面和東太平洋環流區之貢獻最大。
- **Hybrid-HEAKF vs. Hybrid-WEPS :**
 - 在得分預報表現顯示，兩者實驗之模式預報結果差異小。
 - 不過在颱風路徑預報結果中，HEAKF實驗有較佳的颱風路徑預報表現。
- **未來展望 :**
 - 將探討在高解析度的模式環境設定下，Hybrid資料同化方法對模式預報的影響。
 - 並瞭解高解析度模式設定運用於Hybrid系統可能面臨問題與如何進行同化策略調整，期望能更發揮出Hybrid資料同化系統之優勢。



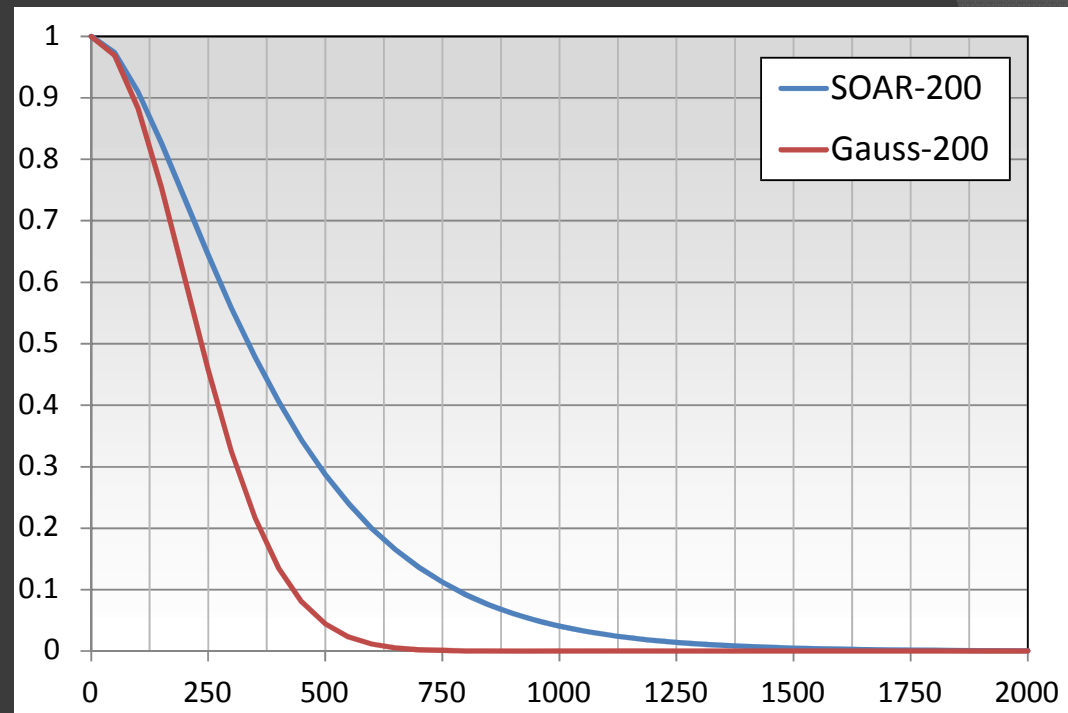
**The End
Thanks**

Horizontal Localization

- Horizontal localization correlation function is realized by **recursive filter (RF)**.

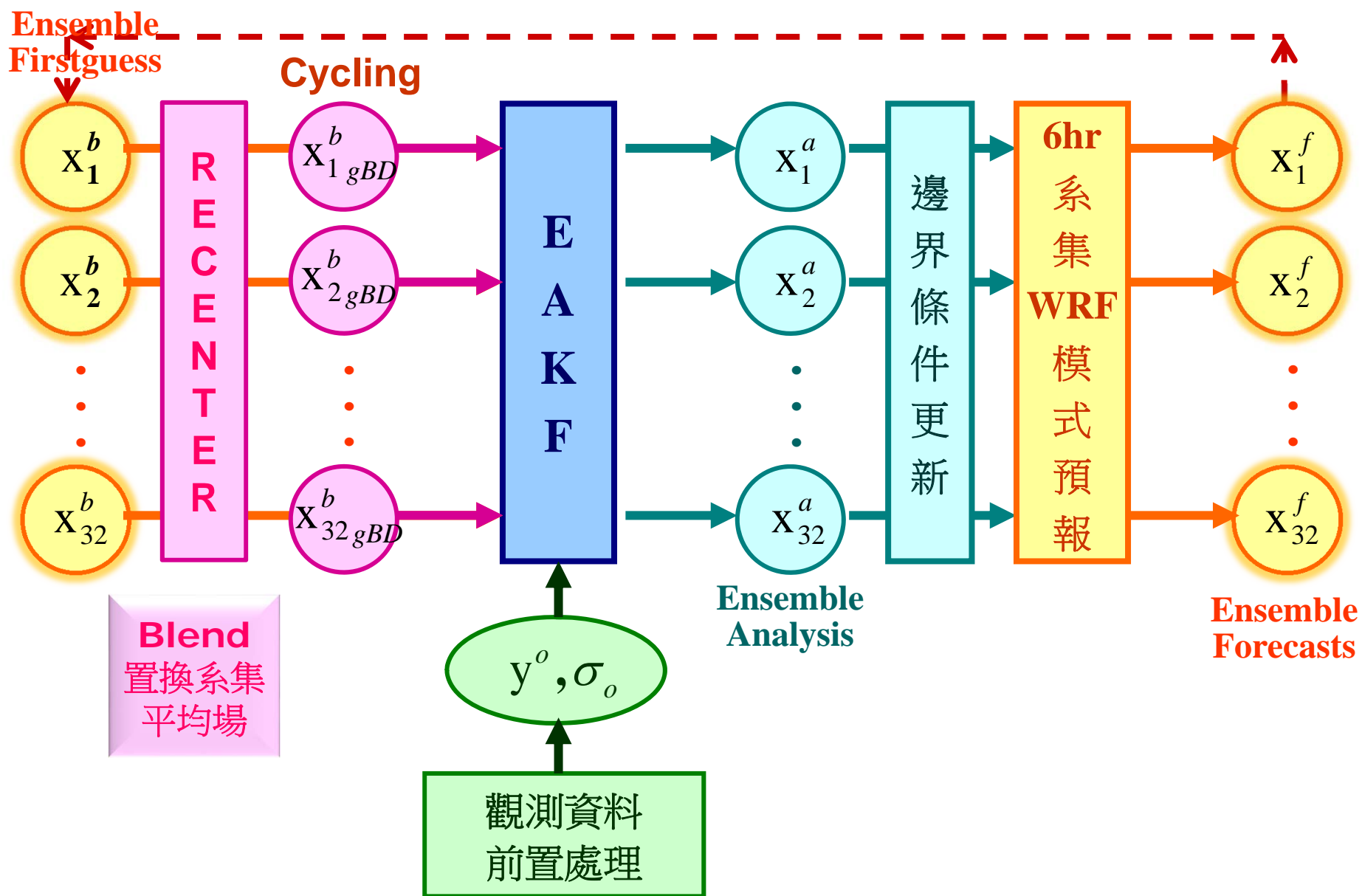
- 2 passes of RF leads to second-order auto-regressive (SOAR) function.

- ∞ passes of RF tends to produce Gaussian correlation function.



- WRFDA default setting is 6 passes of RF.**

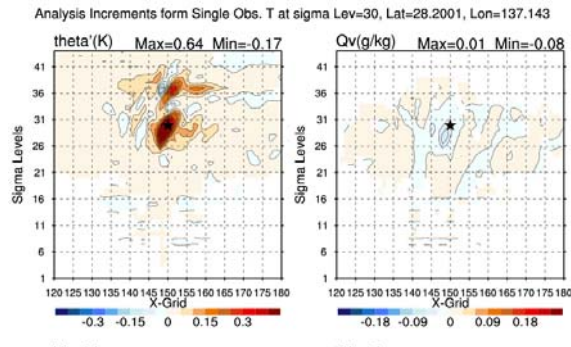
EAKF with Background Blending 簡略流程圖示



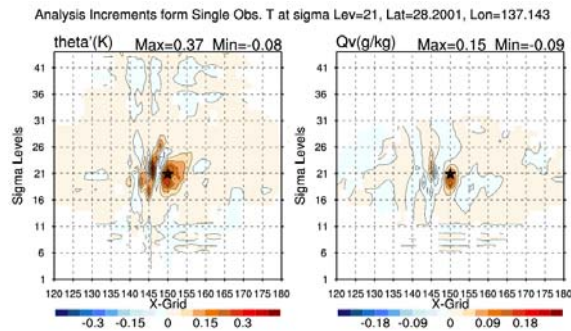
Vertical Localization

CTL

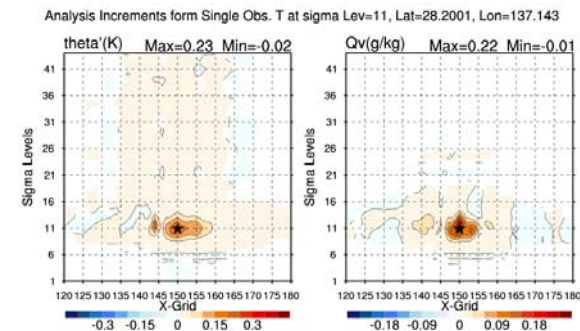
Lev-30



Lev-21



Lev-11



NEW

