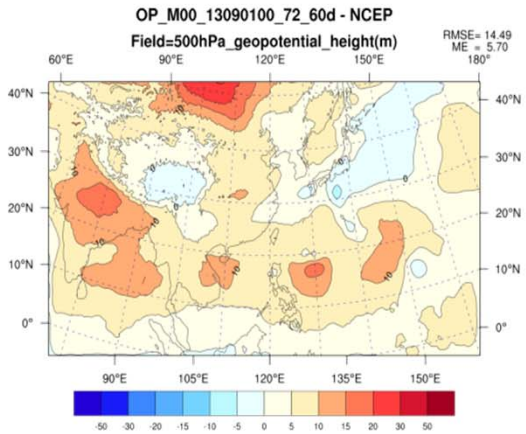
應用Decaying Average方法於修正模式系統性偏差之研究

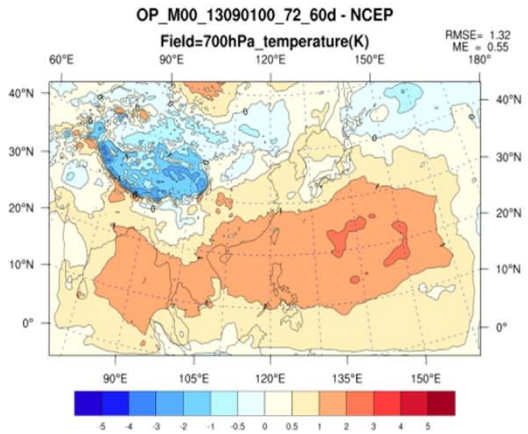
陳怡儒 洪景山 李志昕
中央氣象局氣象資訊中心

OUTLINE

- Decaying average方法介紹
- 實驗設計 & 校驗分析
  - 決定性預報
  - 系集預報
- 結論

WHY ARE WE DOING BIAS CORRECTION ?





- 修正模式預報的**系統性偏差**
- $F = f - \overline{b}$ 扣除模式預報的系統性偏差，
  強化模式預報的準確度。

➢ HOW TO CALCULATE THE MODEL BIAS ?

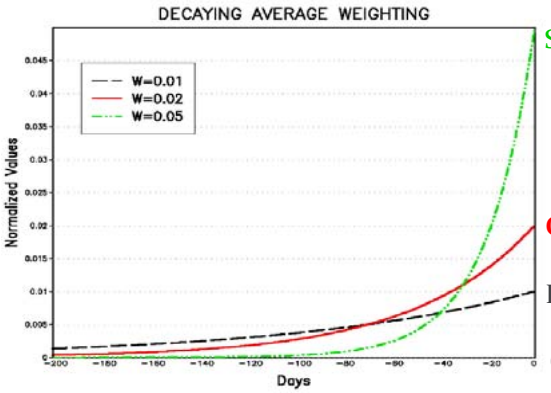
Decaying Average Bias Correction

1) **Bias estimation**
   - $b(t) = f(t) - a(t_o)$
2) **Decaying average**
   - $B(t) = (1-w)*B(t-1) + w*b(t)$
3) **Bias correction**
   - $F(t) = f(t) - B(t)$

→ **a = f (i, j)**

→ **B, b, F, f = f (i, j, fcst)**

About Decaying Average



Short Term Weighting Curve

Operational use by NCEP

Long Term Weighting Curve

(Cui et al., 2012)

- $\mathbf{B = (1-w)B_{t-1} + wb}$

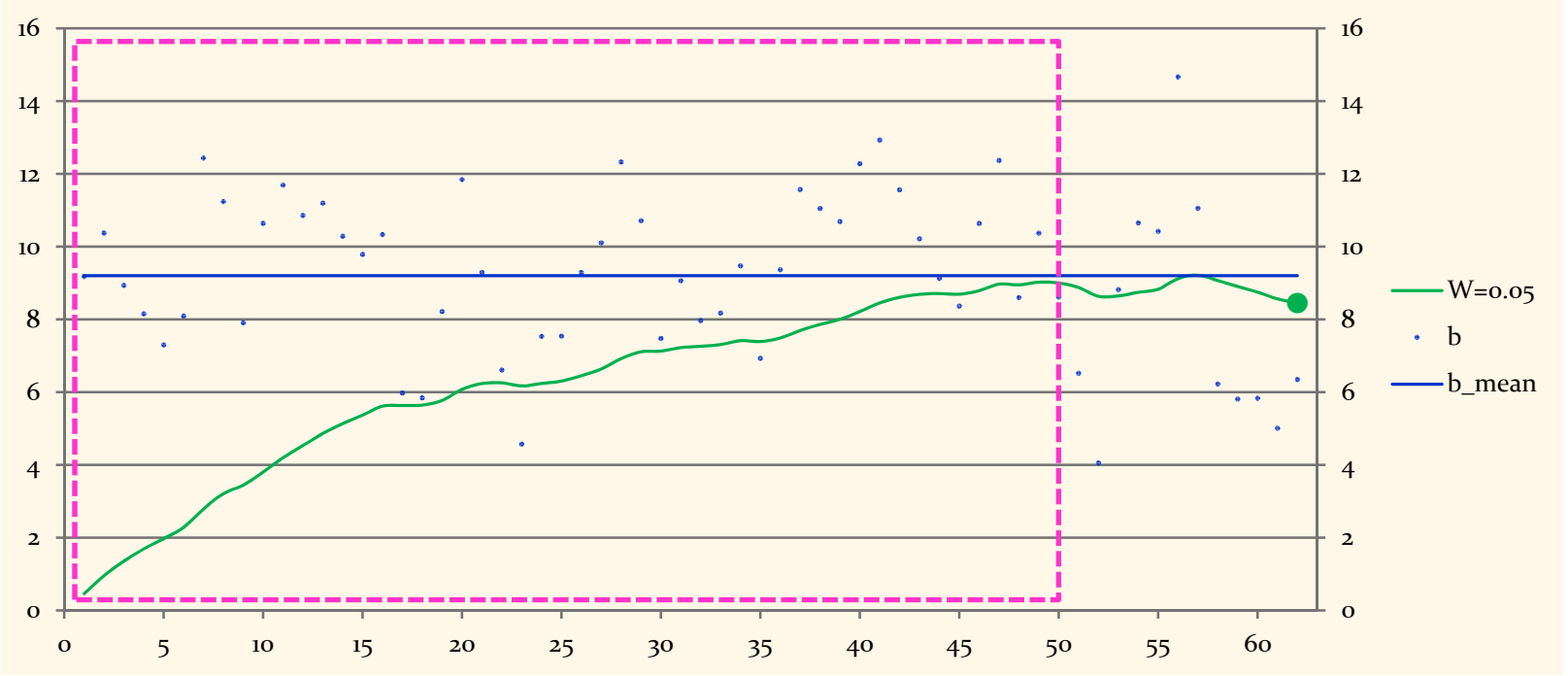
- $B_1 = \cancel{(1-w)B_0} + wb_1$
- $B_2 = (1-w)B_1 + wb_2 = (1-w)\, wb_1 + wb_2$
- $B_3 = (1-w)B_2 + wb_3 = (1-w)^2\, wb_1 + (1-w)\, wb_2 + wb_3$
- $B_4 = (1-w)B_3 + wb_4 = (1-w)^3\, wb_1 + (1-w)^2\, wb_2 + (1-w)\, wb_3 + wb_4$

⋮

- $\mathbf{B_{200} = (1-w)^{199}\, wb_1 + (1-w)^{198}\, wb_2 + \ldots\ldots + (1-w)\, wb_{199} + wb_{200}}$

w= 0.05	0.0000018	0.0000019	.....	0.0475	0.05
w=0.02	0.000359	0.000366	.....	0.0196	0.02
w= 0.01	0.001353	0.001367	.....	0.099	0.01

Mean error vs. Decaying average bias



- 節省硬碟空間&計算資源
- 以權重係數調整decaying average
- 需要一段訓練期

RESULT – (1) 決定性預報

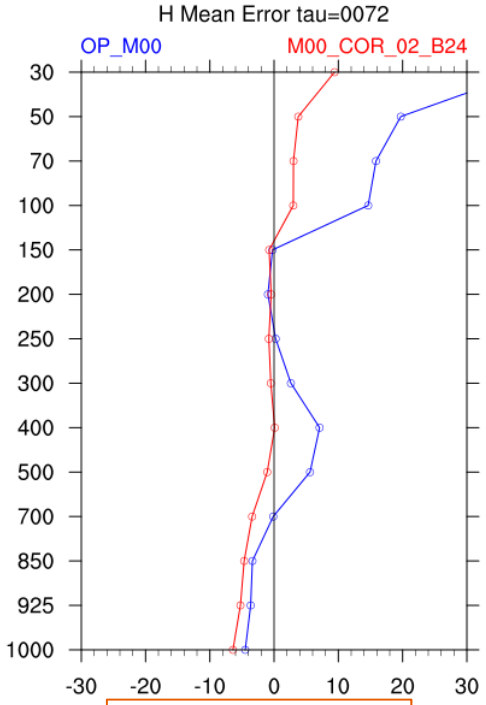
- CWB WRF M00 - domain 1
- Training Data : 2013/07/01 00Z ~ 08/31 12Z
- Verification :
  - Case : 2013/09/01 00Z
  - 15 days average: 2013/09/01 00Z ~ 09/15 18Z （60 case）
- Field : geopotential height --- 500 hPa

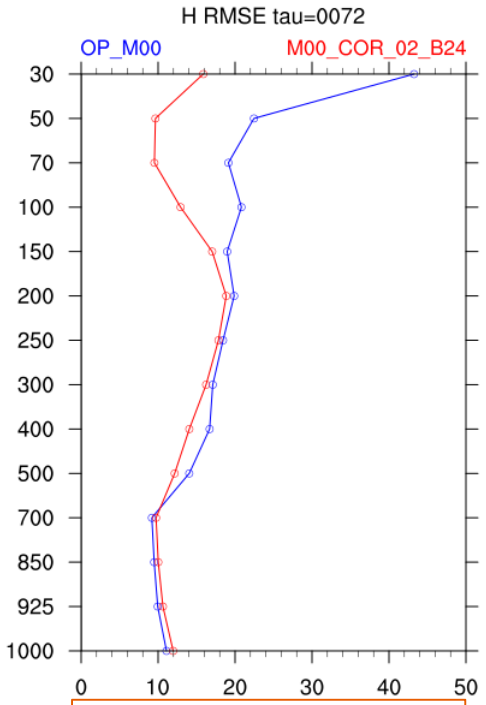
  temperature --- 850 hPa
- **Weighting : 0.01, 0.02, 0.05**

2013/09/01 00Z
fcst=72

CASE

H

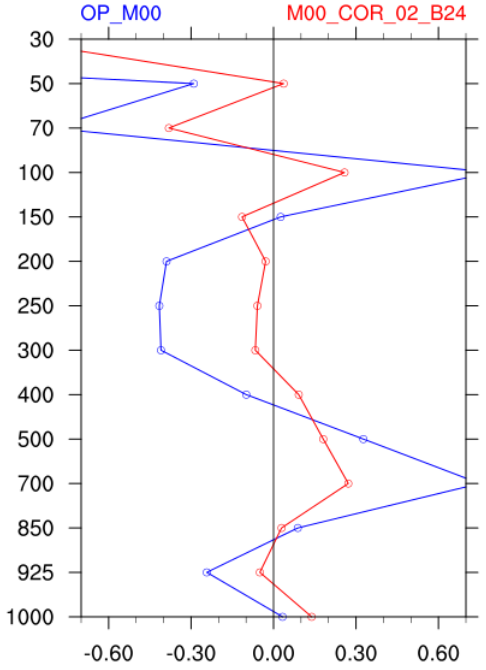


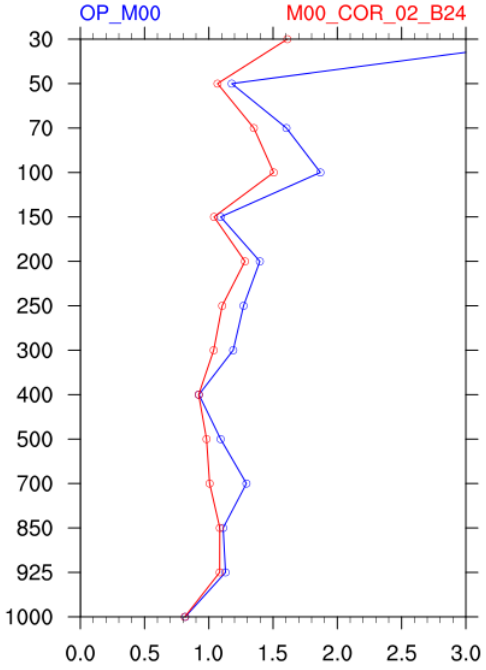


Mean Error

RMSE

T



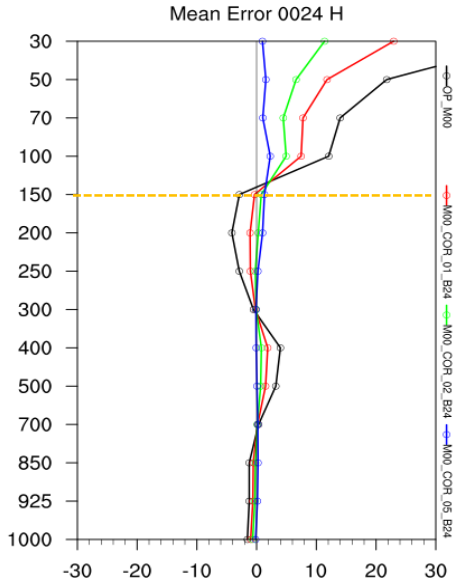


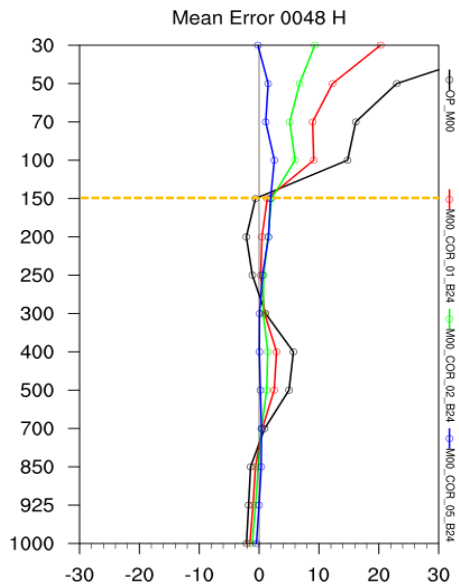
— Moo (OP)
— COR_w02

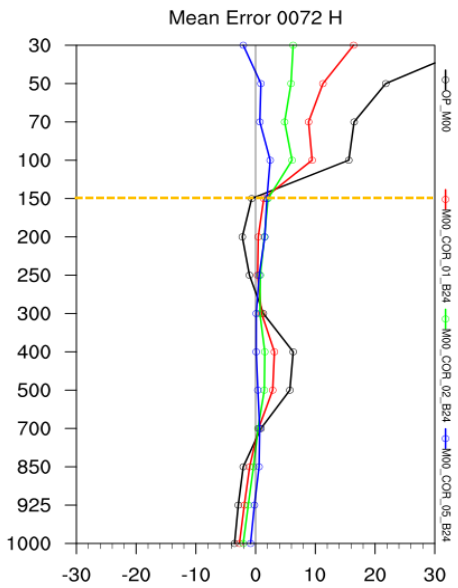
Geopotential height

— Moo — 0.01 — 0.02 — 0.05

15 days average
2013/09/01 00Z ~ 9/15 18Z



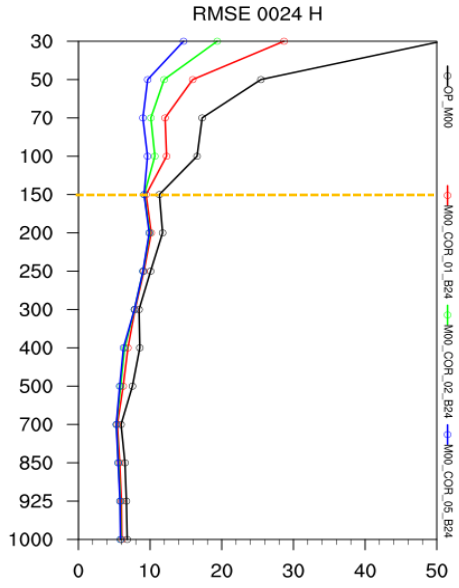


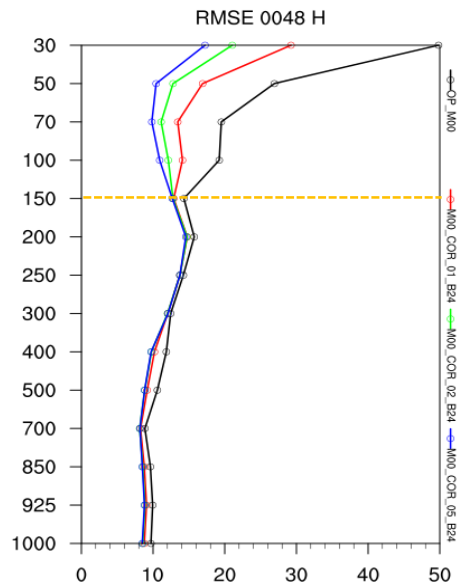


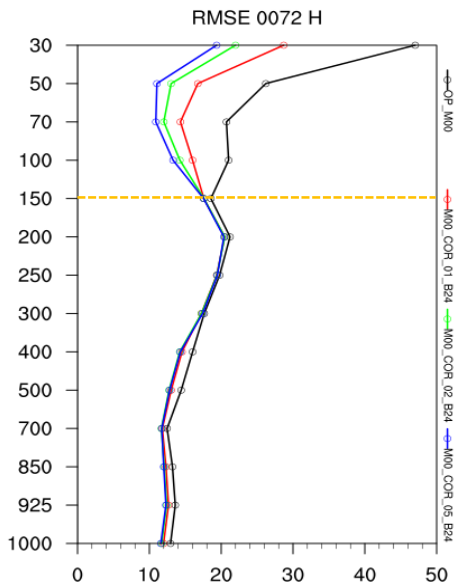
fcst=24 **fcst=48** **fcst=72**

Mean Error

RMSE



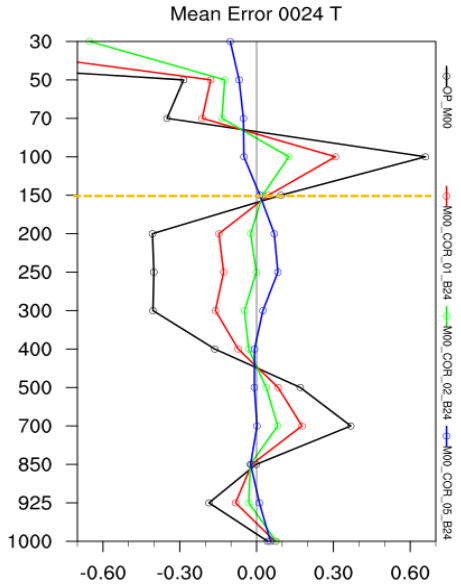


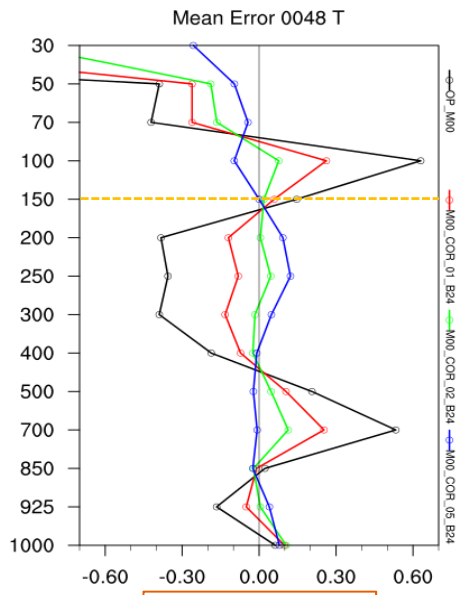


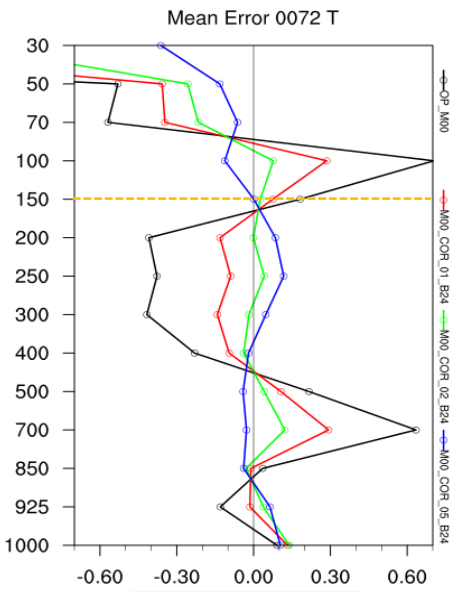
Temperature

— Moo — 0.01 — 0.02 — 0.05

15 days average
2013/09/01 00z ~ 9/15 18z







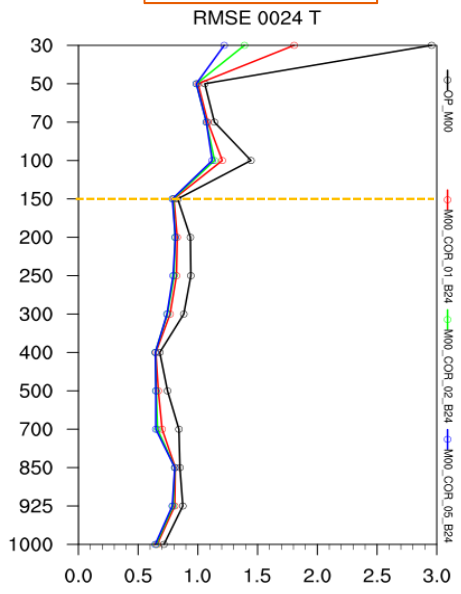
fcst=24

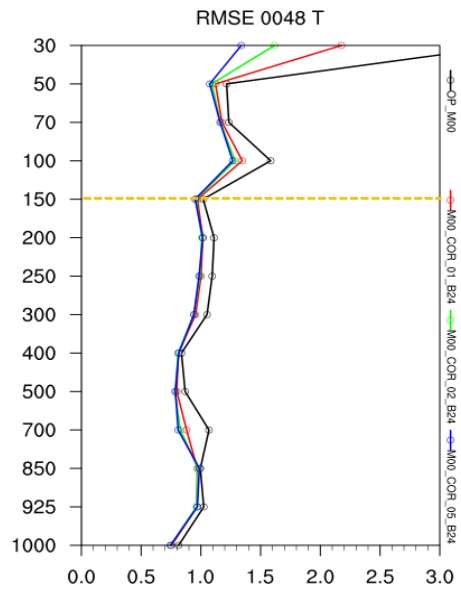
fcst=48

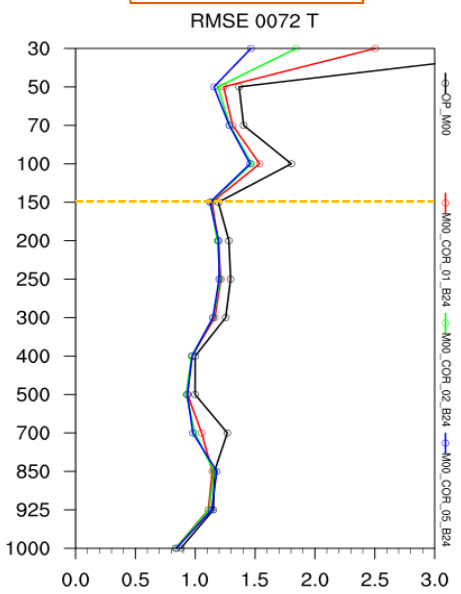
fcst=72

Mean Error

RMSE





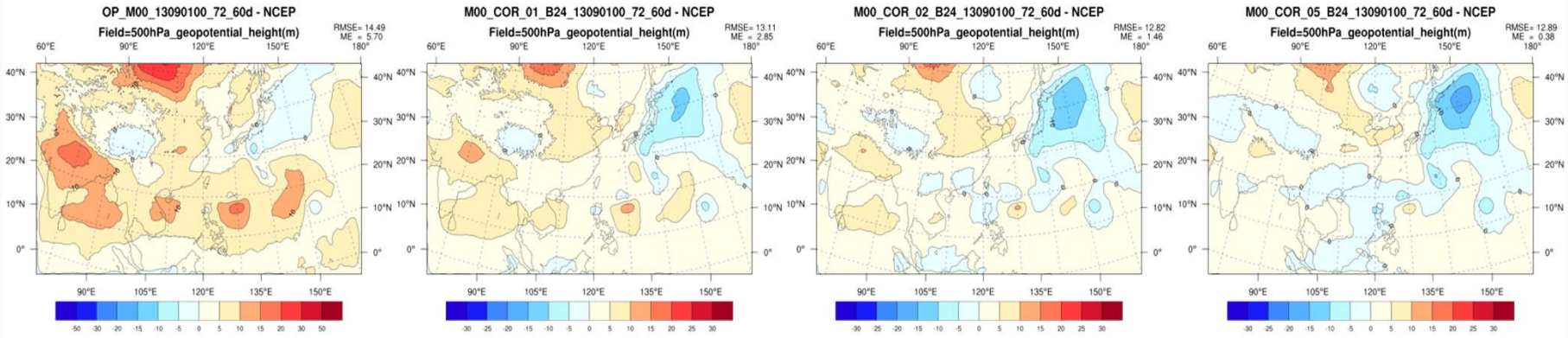


500 hPa Geopotential height

15 days average
2013/09/01 00z ~ 9/15 18z

M00	w = 0.01	w = 0.02	w = 0.05

RMSE	14.49	13.11	12.82	12.89
ME	5.7	2.85	1.46	0.38

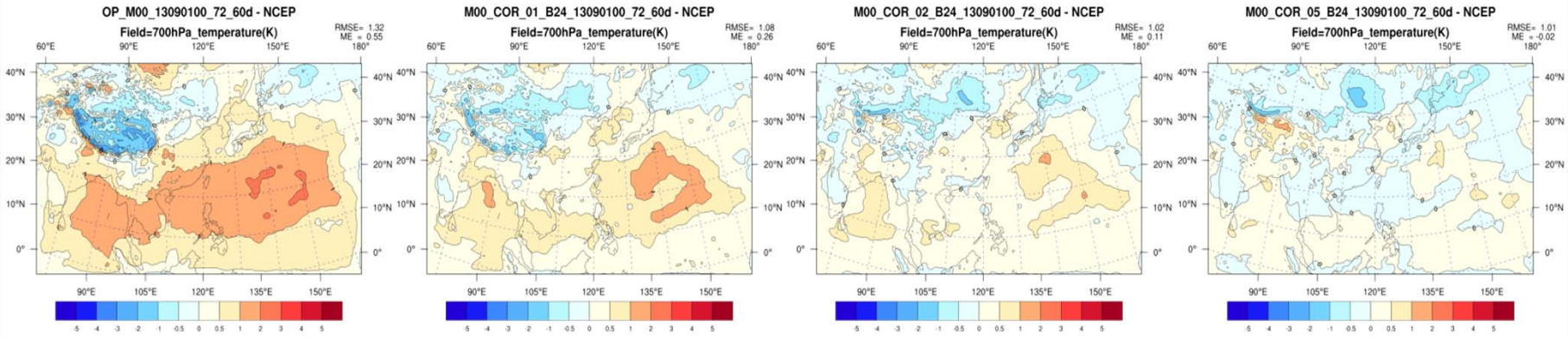


700 hPa Tempreature

15 days average
2013/09/01 00z ~ 9/15 18z

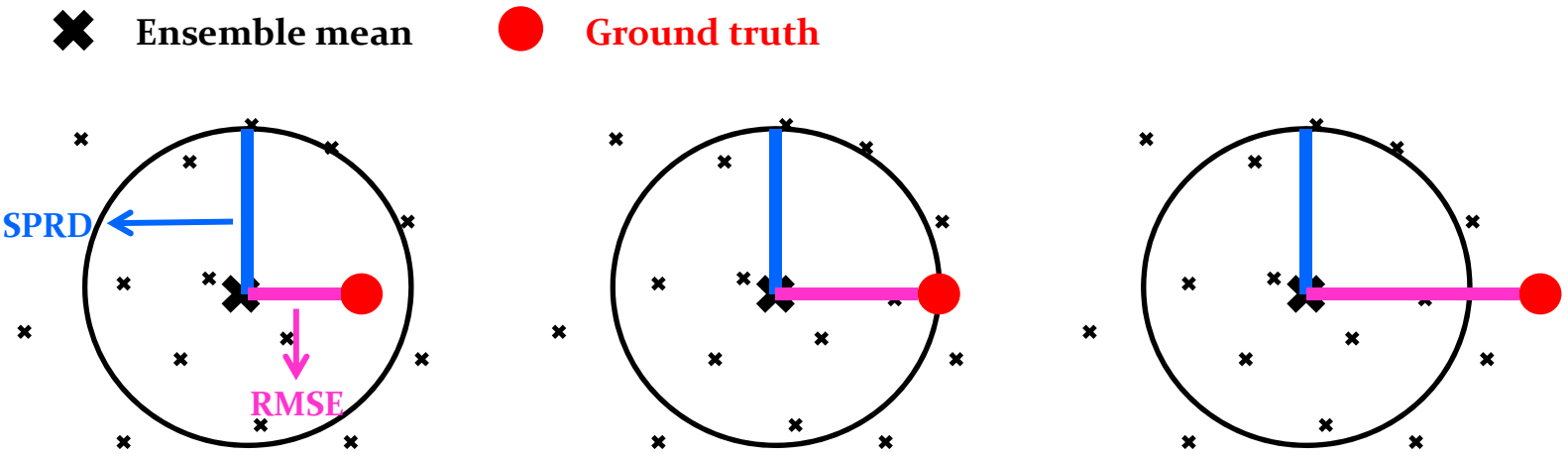
M00	w = 0.01	w = 0.02	w = 0.05

RMSE	1.32	1.08	1.02	1.01
ME	0.55	0.26	0.11	0.02



系集預報

- 評估系集預報系統的**準確度**
- 評估系集預報系統的**離散度**



SPRD > RMSE　　SPRD = RMSE　　SPRD < RMSE

RESULT – (2) 系集預報

- CWB WRF EPS - domain 1
- Training Data : 2013/07/01 00z ~ 08/31 12z
- Verification :
  - 15 days average : 2013/09/01 00z ~ 09/15 12z (30 case)
- Field : 500 hPa geopotential height

  700 hPa temperature
- Weighting : 0.02

B --- Each member

--- ensemble mean

RESULT – (2) 系集預報

B --- Each member

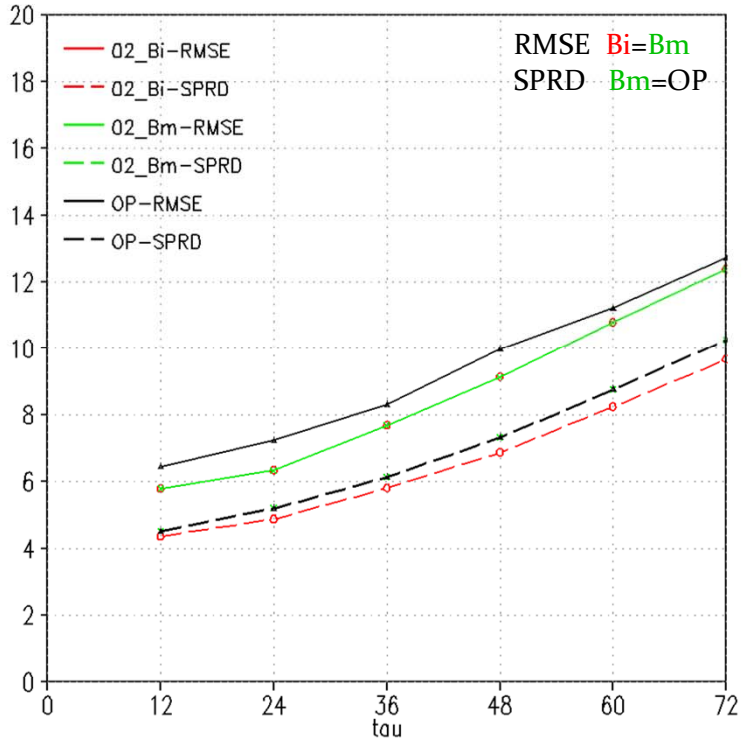
--- ensemble mean

- 系集成員的預報場減去自己的系統性偏差（Bi）
- 系集成員的預報場減去系集平均的系統性偏差（Bm）

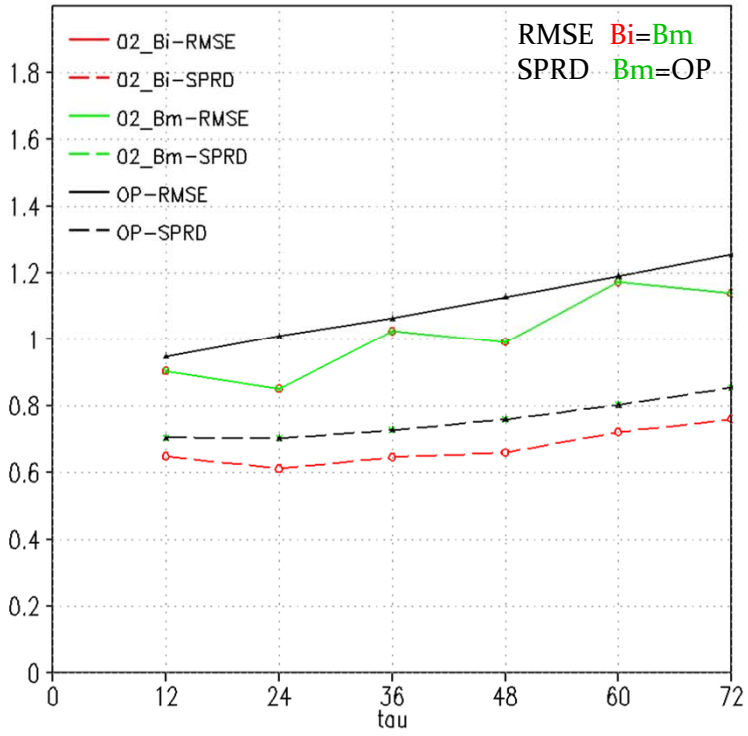
RMSE & SPRD

15 days average
2013/09/01 00Z ~ 9/15 12Z
W=0.02

500 hPa H



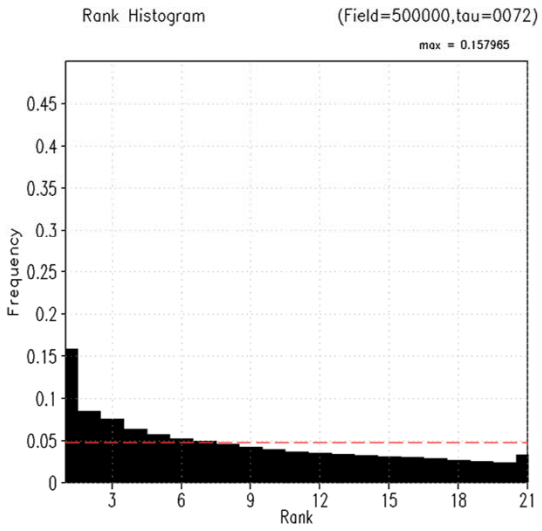
850hPa T

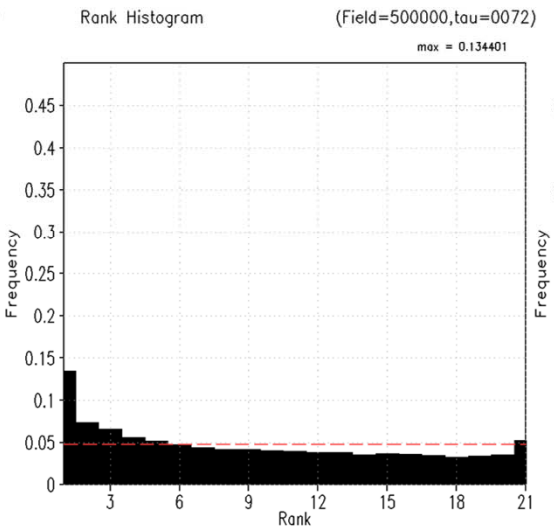


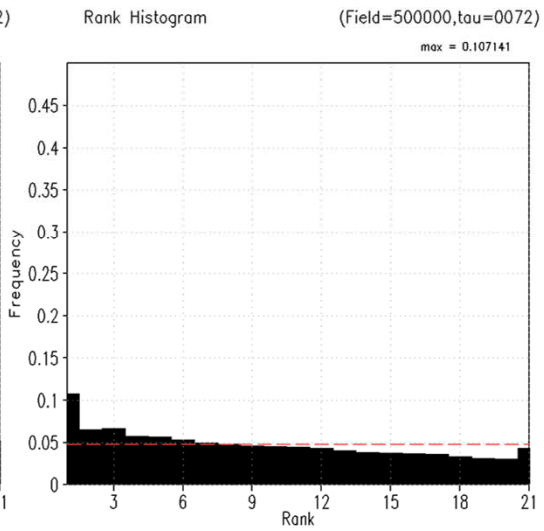
— WEPS (OP) — COR_Bi — COR_Bm

Rank Histogram

15 days average
2013/09/01 00Z ~ 9/15 12Z
fcst=72
W=0.02

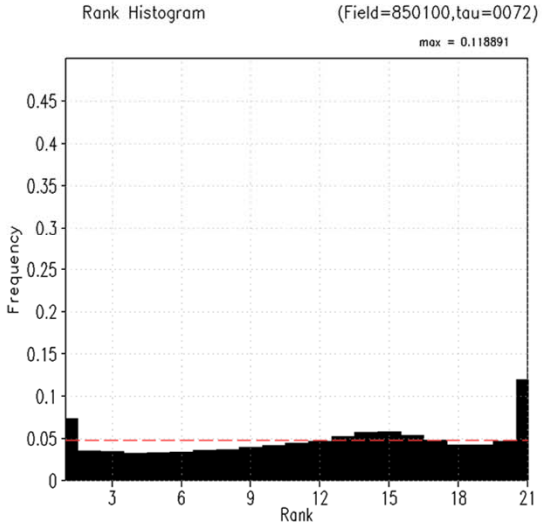


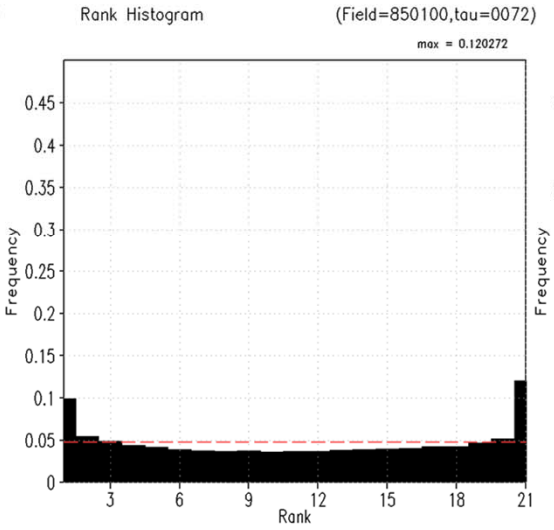


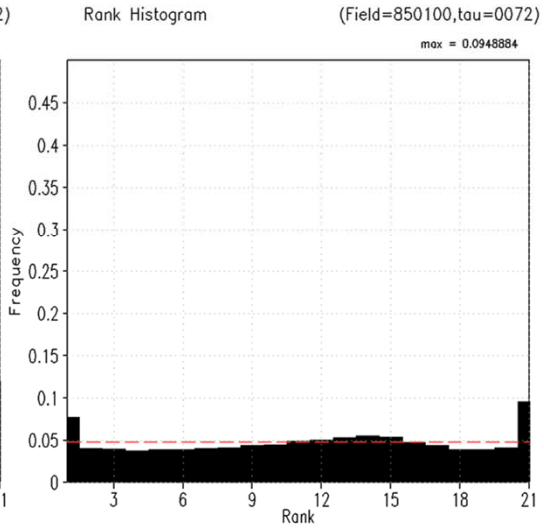


WEPS | **COR_Bi** | **COR_Bm**

500hPa H







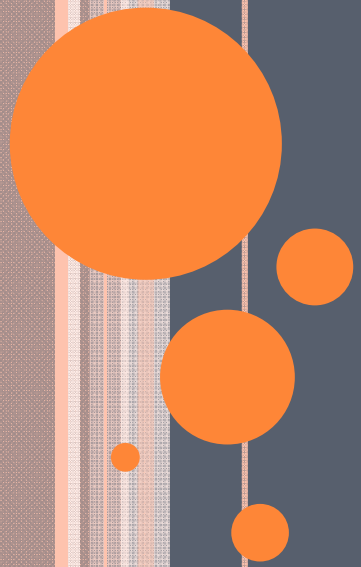
850hPa T

SUMMARY

- **本研究以decaying average方法，在綜觀尺度下，針對中央氣象局區域模式進行系統性偏差修正，分析結果顯示：**
  - **決定性預報**

    溫度及高度場在不同垂直分層下，RMSE及Mean Error皆有改善，對500 hPa高度場預報過高及700 hPa溫度場暖偏差的情形皆有明顯的修正。
  - **系集預報**

    可降低500 hPa高度場及850 hPa溫度場的RMSE，兩組實驗在不影響系集離散度表現下，修正系集平均的系統性偏差方法較為理想。
- **由各組實驗結果顯示：使用decaying average方法確實可修正模式的系統性偏差。**



The End

Thanks for your attention