



# 應用DECAYING AVERAGE方法 修正WRF模式在台灣地區地面溫度預報

陳怡儒 洪景山

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# OUTLINE

- Decaying average方法介紹
- 實驗設計
- 校驗分析
- 結論



# DECAYING AVERAGE BIAS CORRECTION

## 1) Bias estimation

- $b(t) = f(t) - a(t_0)$

## 2) Decaying average

- $B(t) = (1-w)^*B(t-1) + w*b(t)$

## 3) Bias correction

- $F(t) = f(t) - B(t)$

$a = f(i, j) \rightarrow$  Ground Truth

$B, b, F, f = f(i, j, fcst)$



# ABOUT DECAYING AVERAGE

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

- $B_1 = (1-w)B_0 + wb_1$

- $B_2 = (1-w)B_1 + wb_2 = (1-w)wb_1 + wb_2$

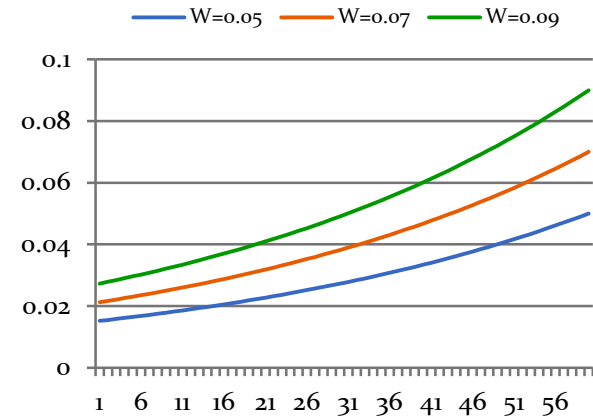
- $B_3 = (1-w)B_2 + wb_3 = (1-w)^2wb_1 + (1-w)wb_2 + wb_3$

- $B_4 = (1-w)B_3 + wb_4 = (1-w)^3wb_1 + (1-w)^2wb_2 + (1-w)wb_3 + wb_4$

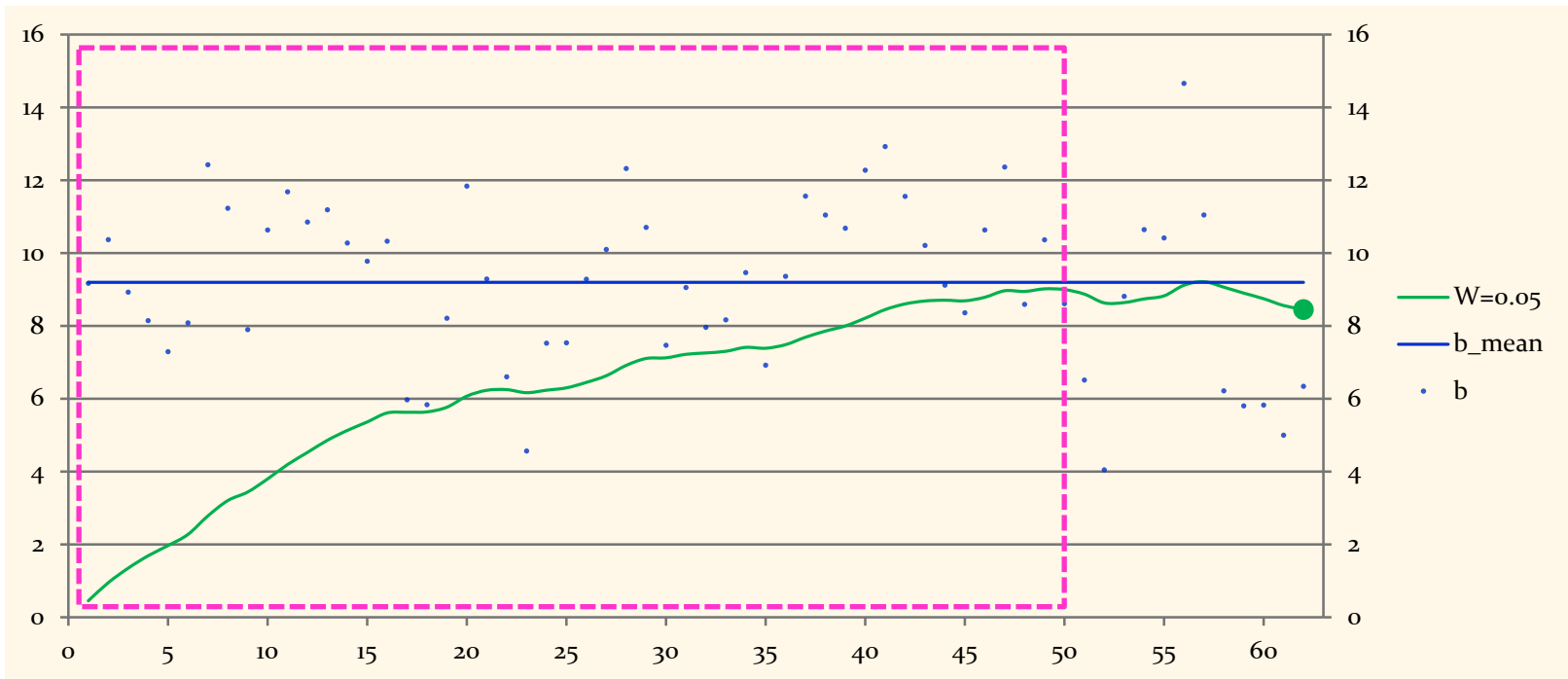
⋮

- $B_{60} = (1-w)^{59}wb_1 + (1-w)^{58}wb_2 + \dots + (1-w)wb_{59} + wb_{60}$

w= 0.05	0.015181	0.015491	.....	0.049	0.05
w=0.07	0.021254	0.021688	.....	0.0686	0.07
w= 0.09	0.027326	0.027884	.....	0.0882	0.09



# Mean error vs. Decaying average



- 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



# 實驗設計

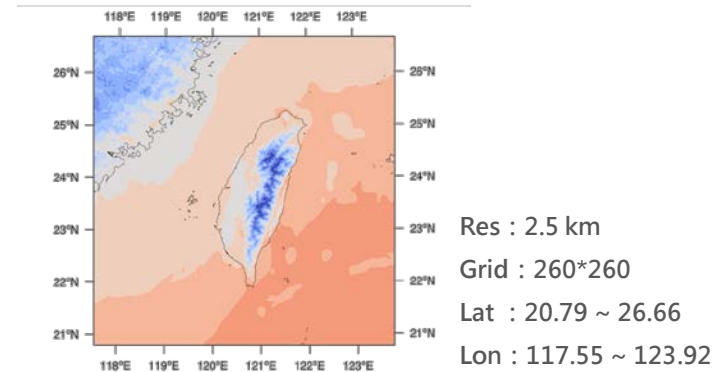
- Field : Temperature @ 2m

- CWB WRF M00 domain 3

  - 水平內插&高度修正 ( 5km → 2.5km ) : OP

- OP → decaying average 偏差修正 : BC

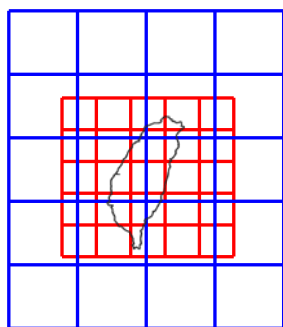
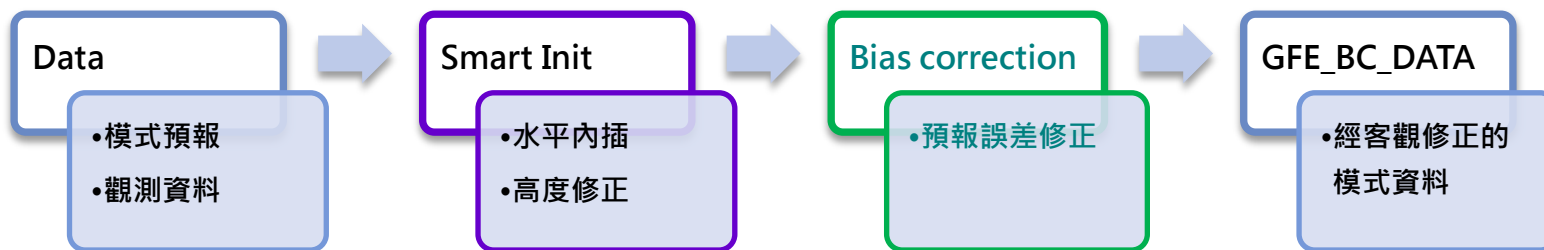
- CWB GFE 修正結果 : GFE



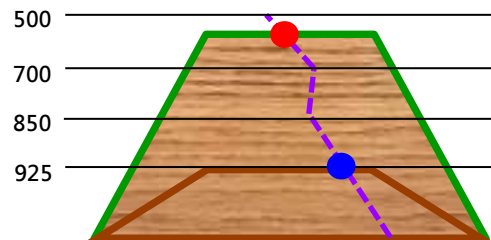
# CWB GFE

## ○ GFE ( graphic forecast editor )

- GFE為美國氣象局發展的圖形化預報編輯系統，中央氣象局引進後，將台灣陸地以2.5公里解析度網格，將數值預報、統計預報和預報員人為修正皆納入電腦計算，得到每個網格未來的天氣變化。



將M00 domain3 5公里解析度格點資料線性內插至解析度為2.5公里的GFE domain中。



參考模式預報兩米溫度，模式地形及各層溫度遞減率，推算到GFE地形，加以計算得到T。

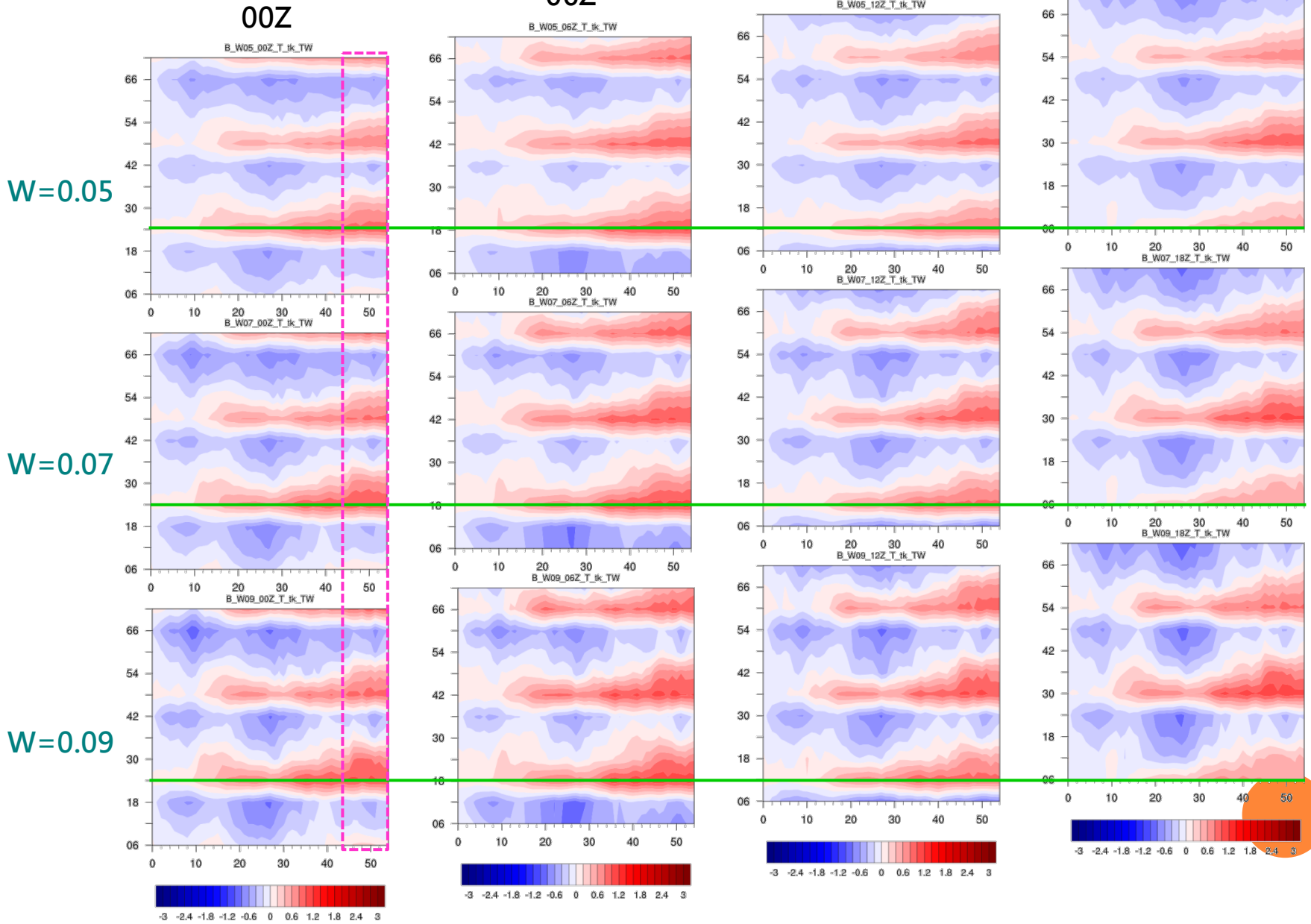
# 結果分析

- 將OP、BC兩組實驗與GFE之地面溫度場進行冬、夏兩季的分析及校驗。
- Field: Temperature @ 2m
- Weighting : 0.05 , 0.07 , 0.09
- Training : 2014/05/04 00 z ~ 06/27 18 z  
2014/11/04 00 z ~ 12/28 18 z
- Verification ( 10 days average / 40 cases ) :
  - 2014/06/18 00 z ~ 06/27 18 z
  - 2014/12/19 00 z ~ 12/28 18 z

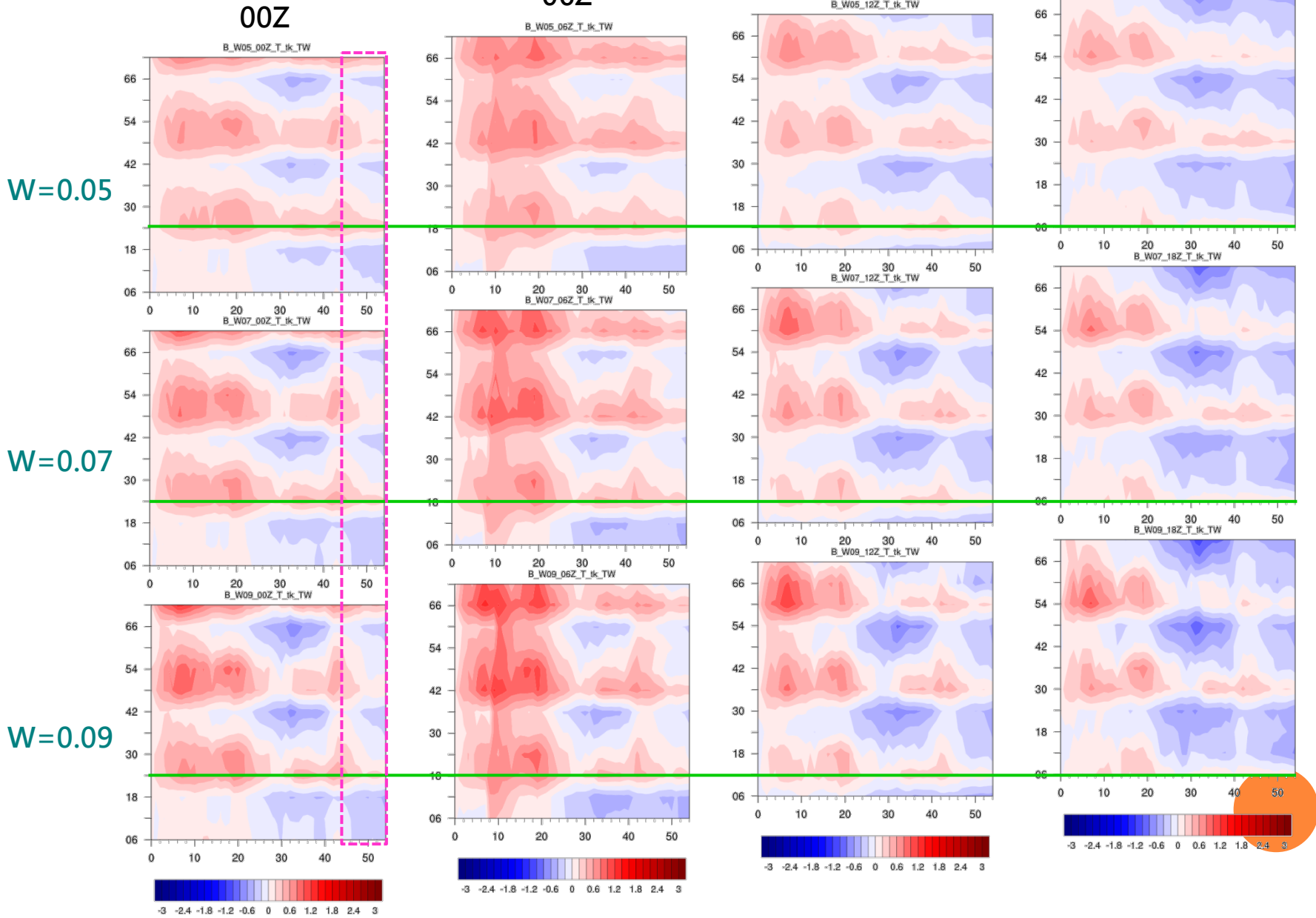




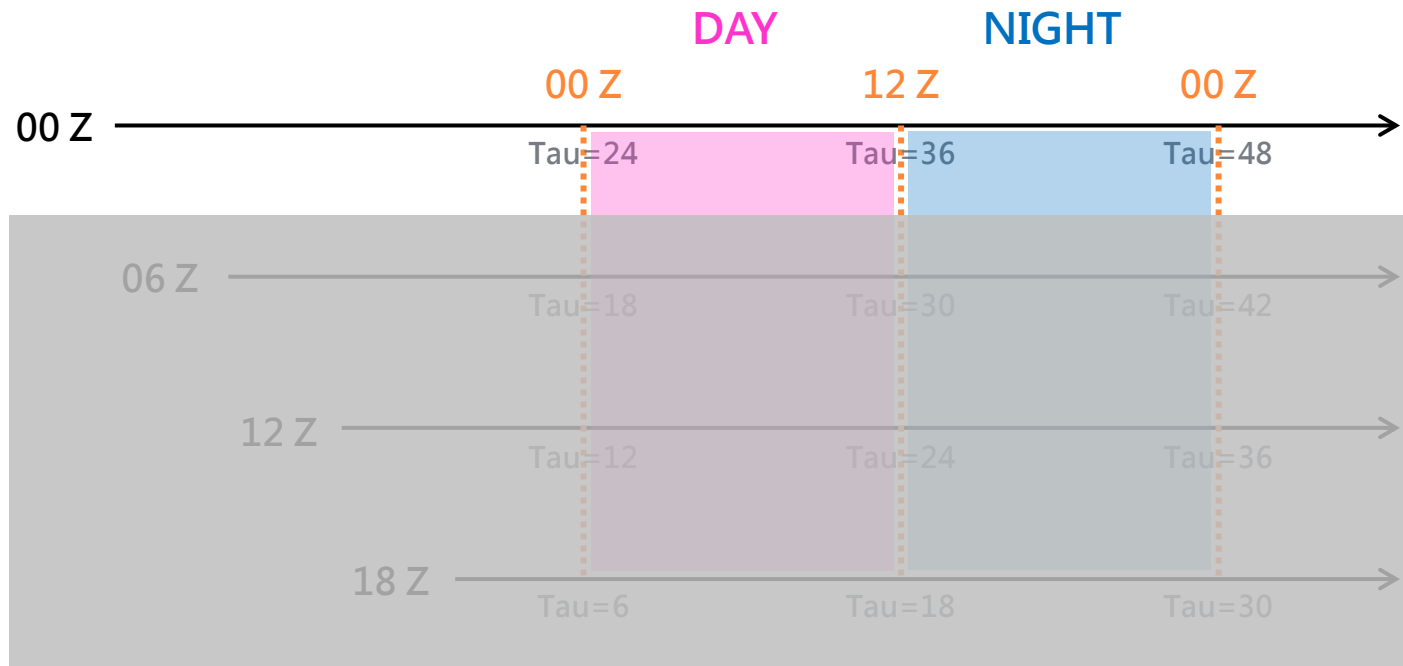
# B - WINTER



# B - SUMMER



# 校驗資料選取



不同初始時間，取對應到相同valid time的預報時間，並區分白天及夜晚做分析及校驗。

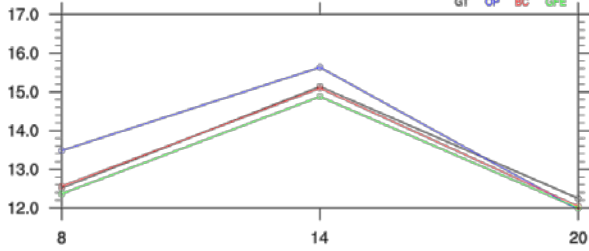


# WINTER

- Initial time : 00 Z

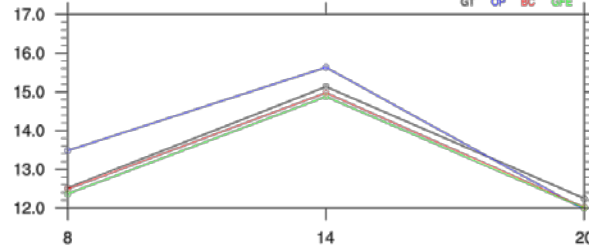
W=0.05

temp\_00Z\_W05\_TW



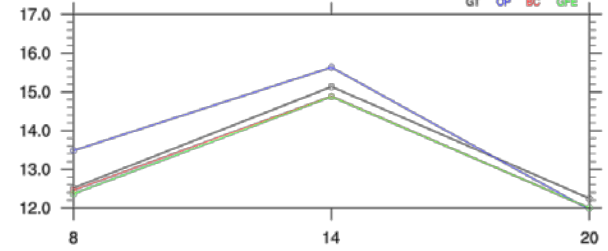
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temp\_00Z\_W07\_TW



W=0.09

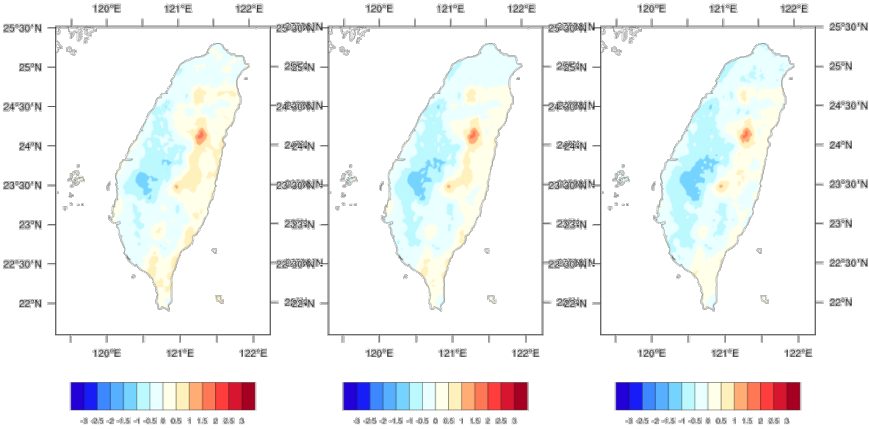
temp\_00Z\_W09\_TW



2Ddiff\_temp\_00Z\_W05\_BC-GT

2Ddiff\_temp\_00Z\_W07\_BC-GT

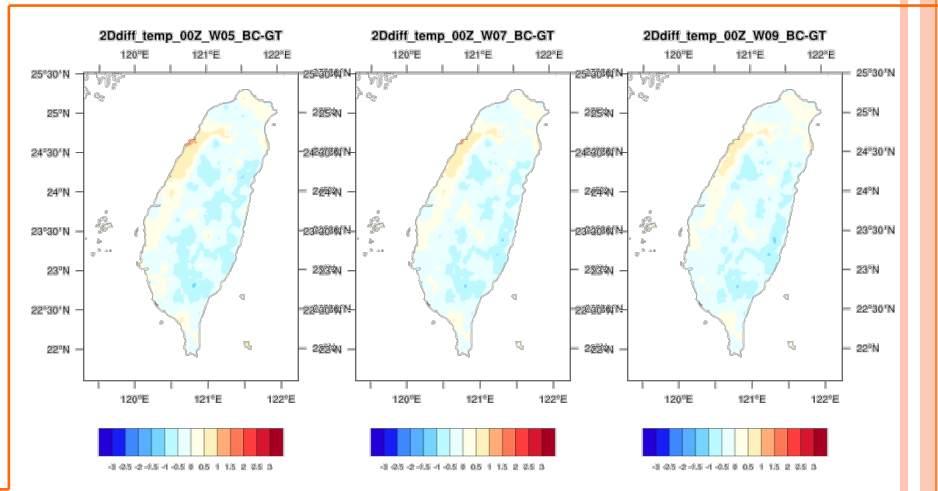
2Ddiff\_temp\_00Z\_W09\_BC-GT



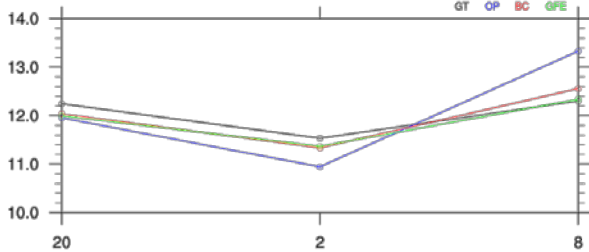
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2Ddiff\_temp\_00Z\_W07\_BC-GT

2Ddiff\_temp\_00Z\_W09\_BC-GT

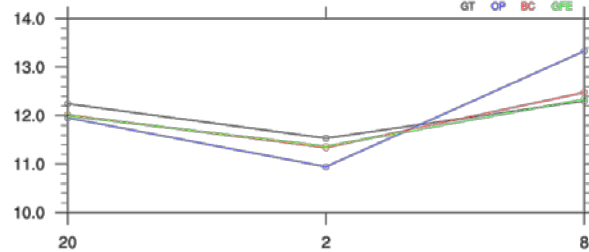


temp\_00Z\_W05\_TW



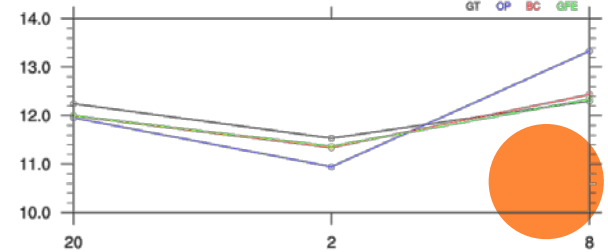
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temp\_00Z\_W07\_TW



W=0.07

temp\_00Z\_W09\_TW



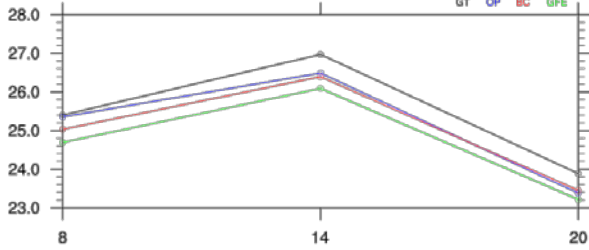
W=0.09

# SUMMER

- Initial time : 00 Z

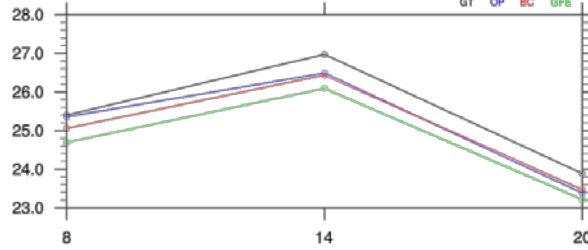
W=0.05

temp\_00Z\_W05\_TW



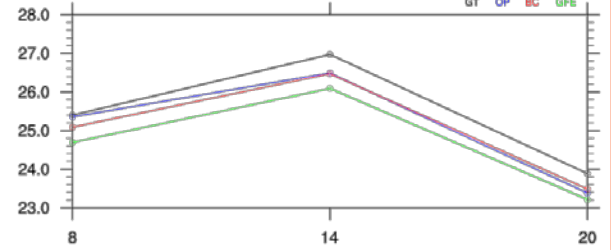
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temp\_00Z\_W07\_TW



W=0.09

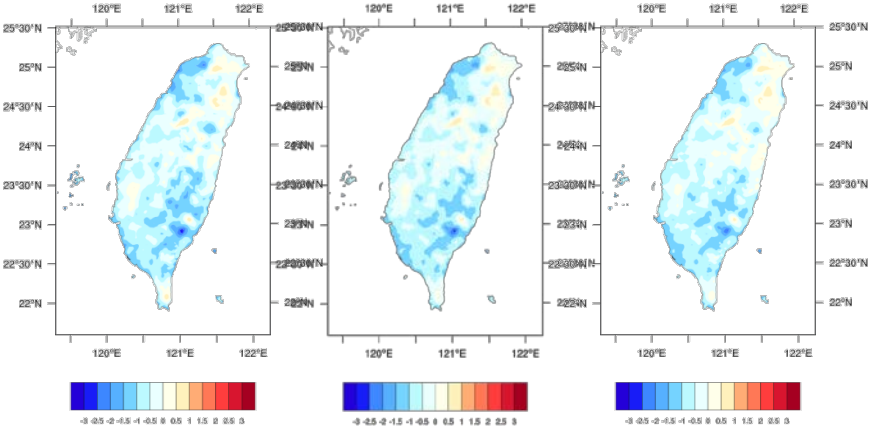
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2Ddiff\_temp\_00Z\_W05\_BC-GT

2Ddiff\_temp\_00Z\_W07\_BC-GT

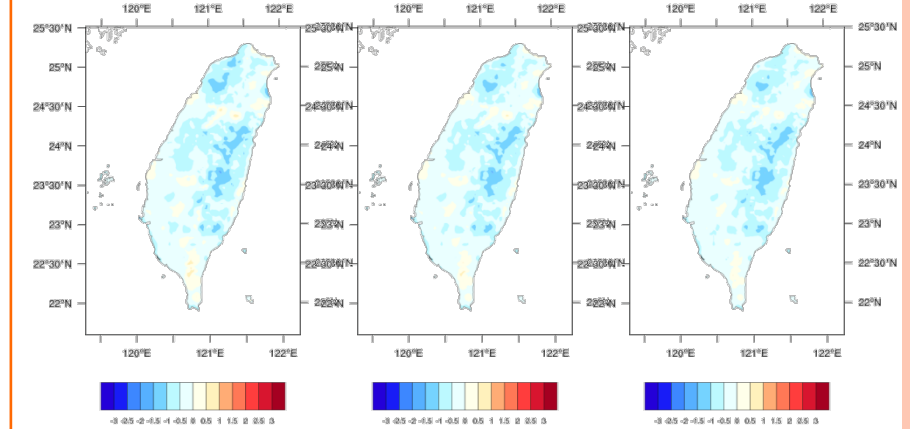
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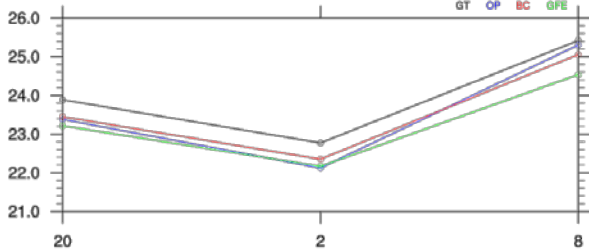
2Ddiff\_temp\_00Z\_W05\_BC-GT

2Ddiff\_temp\_00Z\_W07\_BC-GT

2Ddiff\_temp\_00Z\_W09\_BC-GT

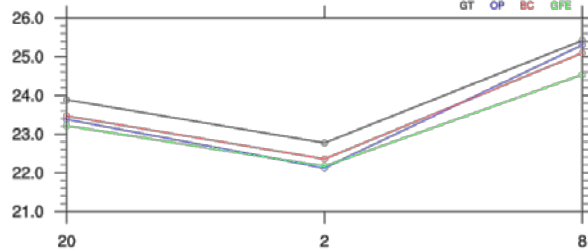


temp\_00Z\_W05\_TW



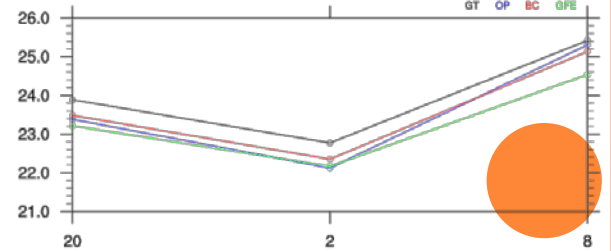
W=0.05

temp\_00Z\_W07\_TW



W=0.07

temp\_00Z\_W09\_TW

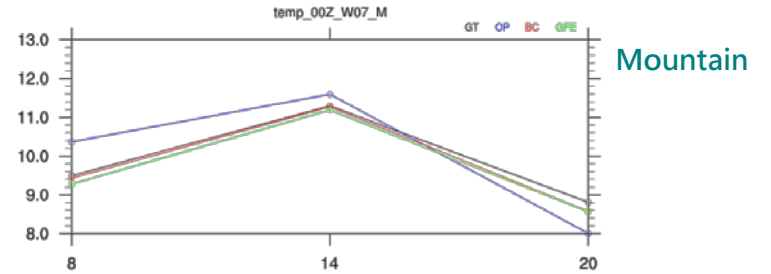
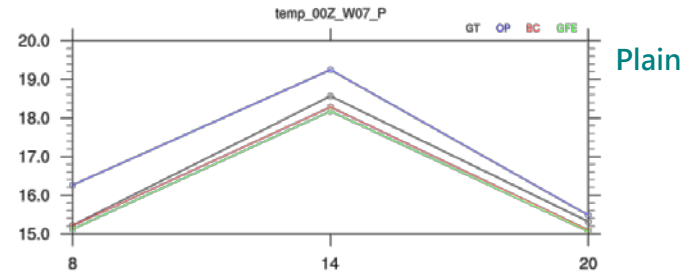
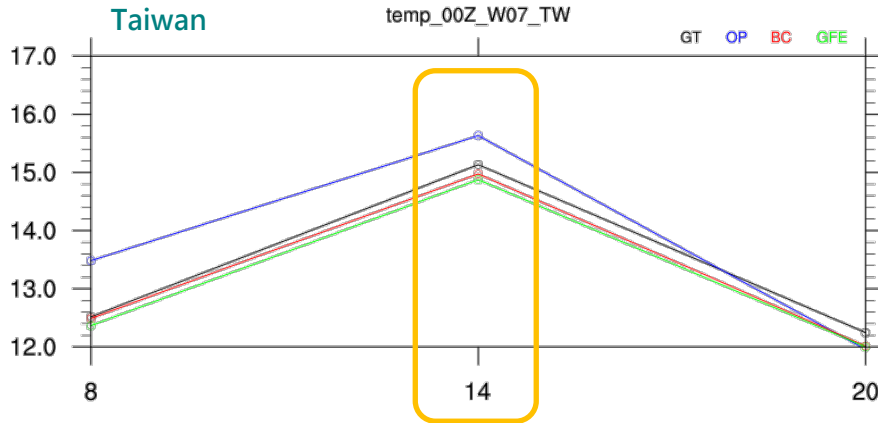


W=0.09



# DAY - WINTER

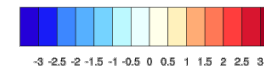
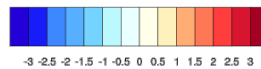
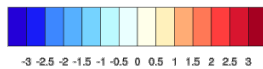
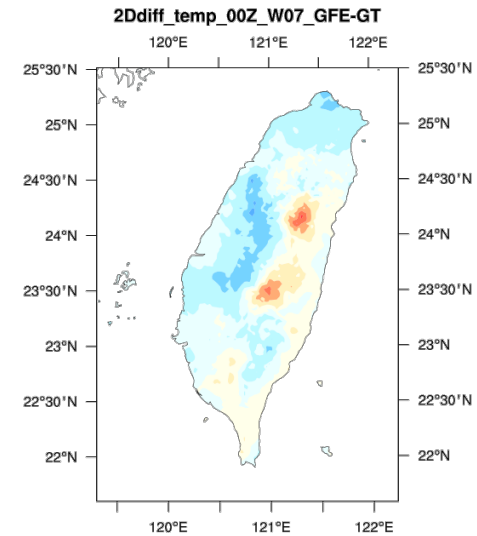
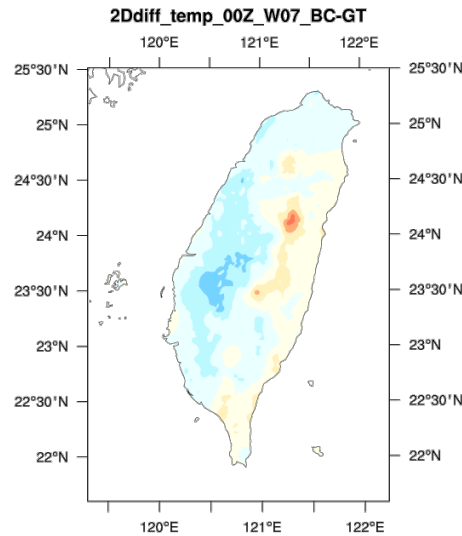
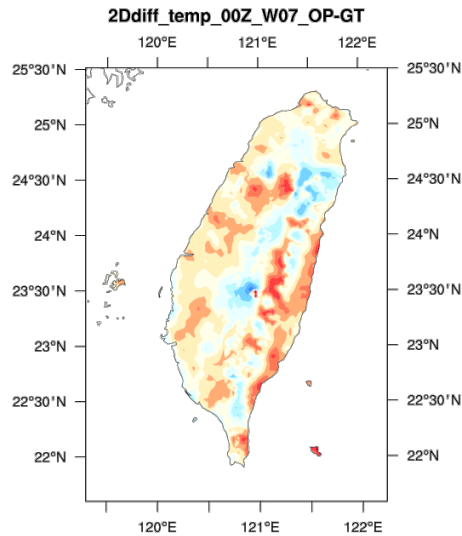
- Initial time : 00 Z
- $W = 0.07$



OP-GT

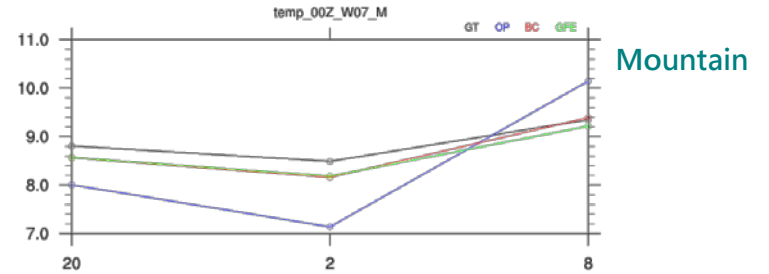
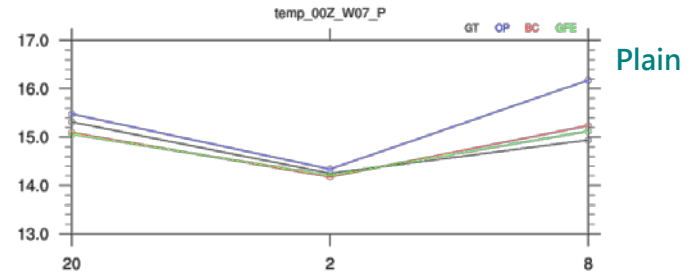
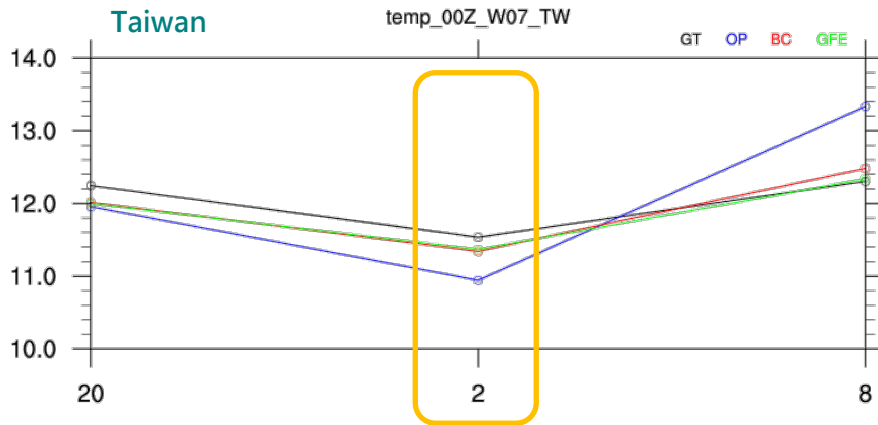
BC-GT

GFE-GT



# NIGHT - WINTER

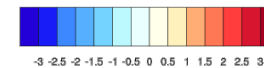
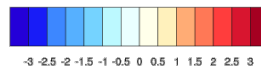
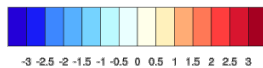
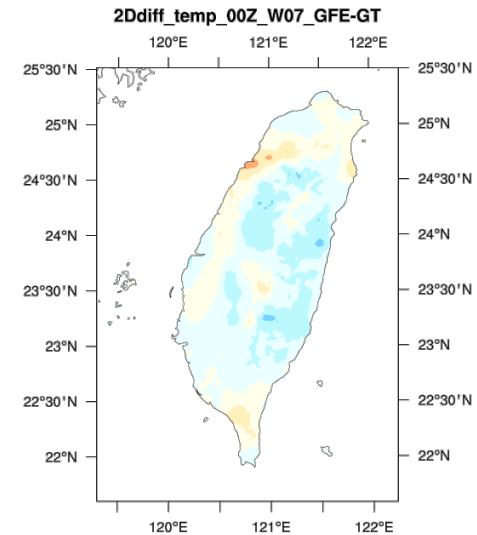
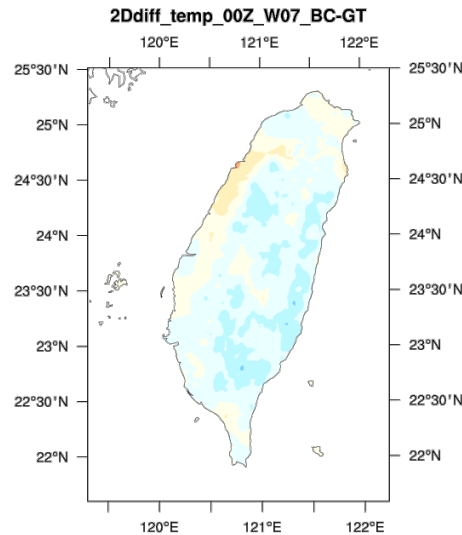
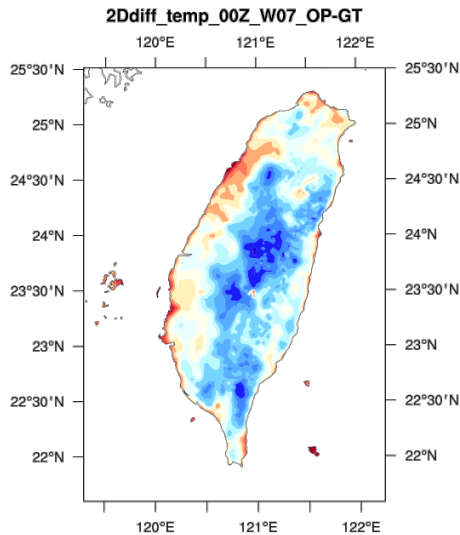
- Initial time : 00 Z
- $W = 0.07$



OP-GT

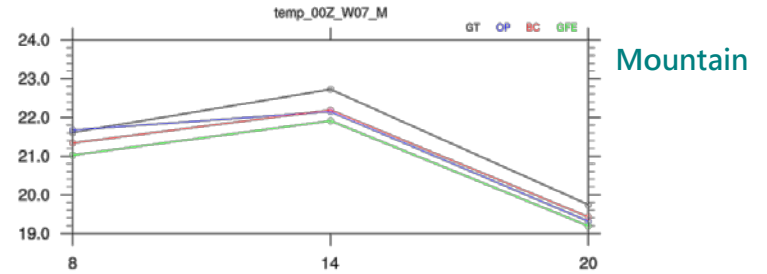
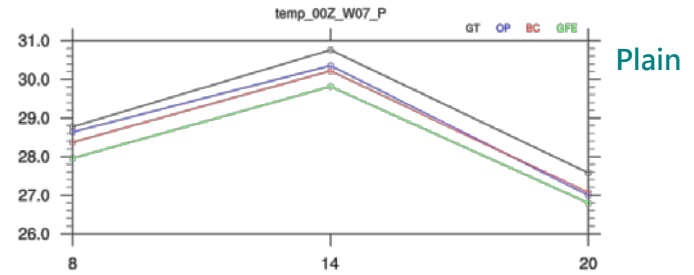
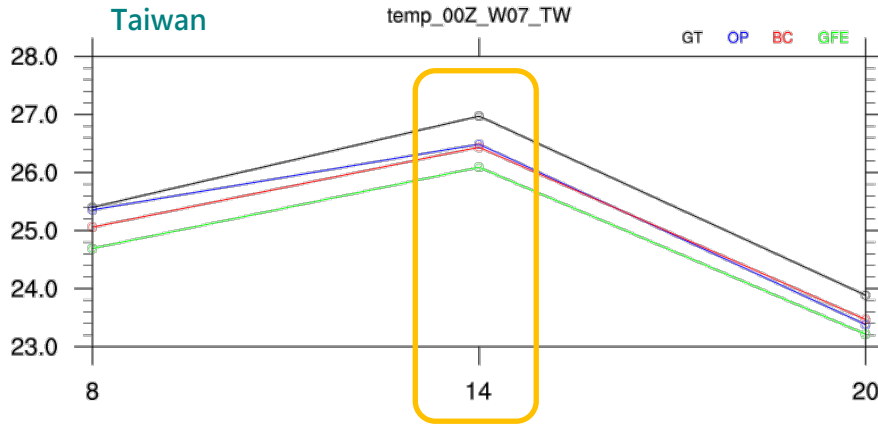
BC-GT

GFE-GT



# DAY - SUMMER

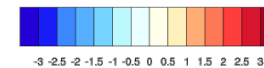
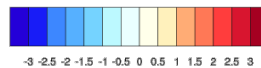
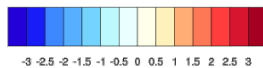
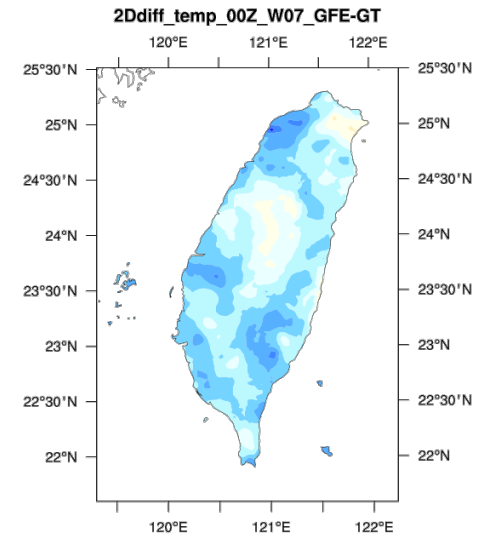
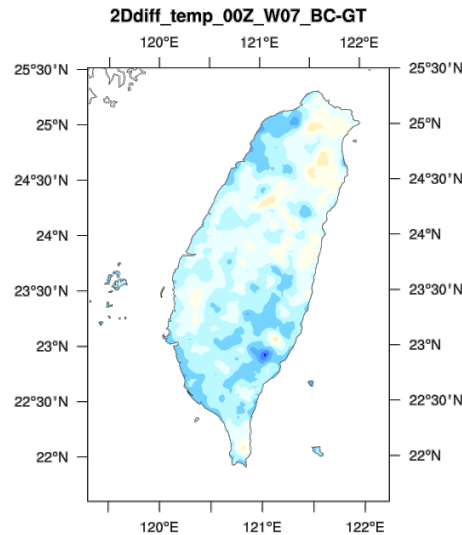
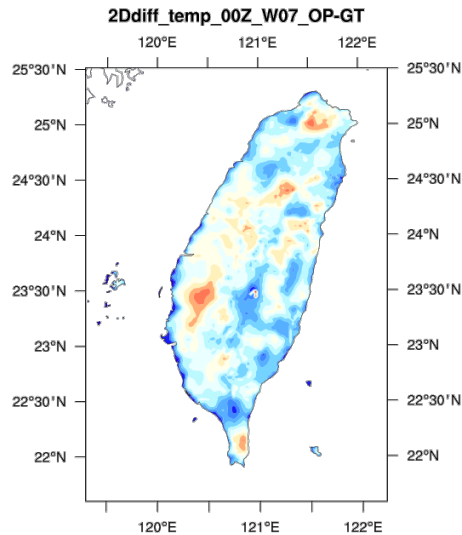
- Initial time : 00 Z
- $W = 0.07$



OP-GT

BC-GT

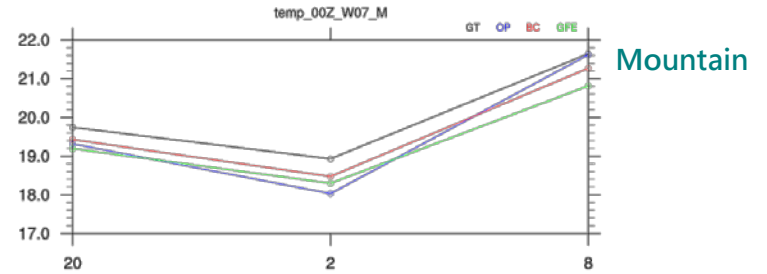
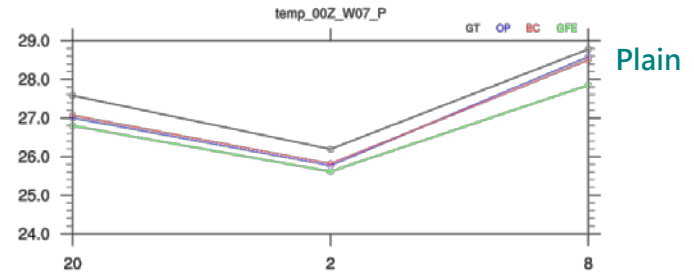
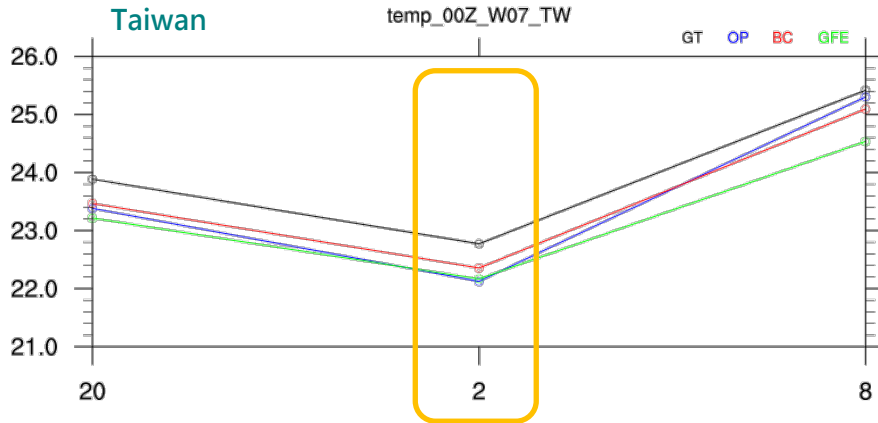
GFE-GT





# NIGHT - SUMMER

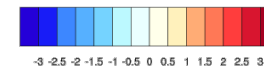
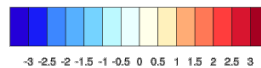
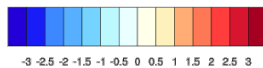
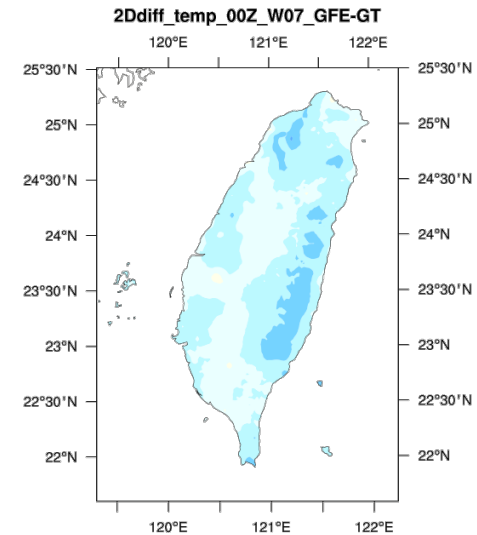
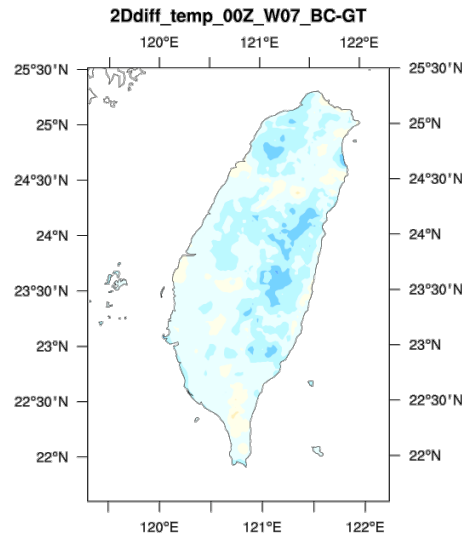
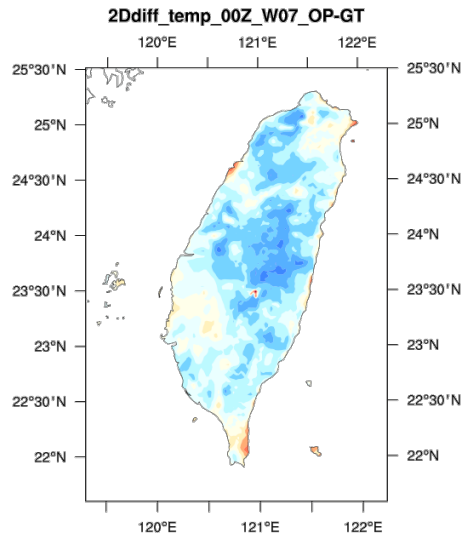
- Initial time : 00 Z
- $W = 0.07$



OP-GT

BC-GT

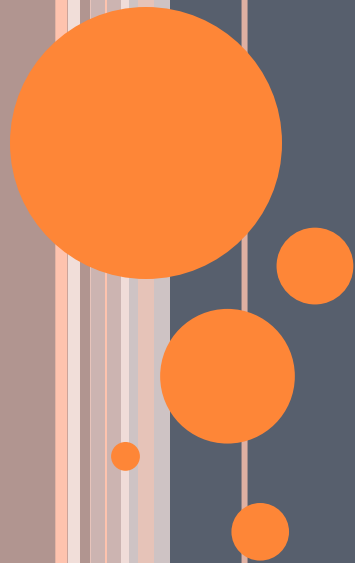
GFE-GT



# SUMMARY

- 本研究以decaying average方法，針對中央氣象局區域模式之台灣地區地面溫度預報進行系統性偏差修正，分析結果顯示：
  - 夏季台灣地區地面溫度預報經過decaying average方法修正後，不論平地或山區皆可改善預報過冷的趨勢，其誤差比GFE的分析結果還小。
  - 冬季地面溫度預報白天的暖偏差及山區夜間冷偏差情形，經修正後也有非常顯著的改善，誤差也比GFE來得小。
- Decaying average為一個簡單且快速的數學方法，期望能應用此法提升模式對台灣地區的地面預報能力。





**THE END**

Thanks for your attention