

氣象署氣候模式之極端 事件預報能力評估

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前言

第二代氣候模式(CWACFSv2)季節預報系統正式上線作業，本報告將詳細評估極端事件下此CWACFSv2模式的預報能力，同此也加入氣象署第一代氣候模式(TCWB1T1.1)、氣象署二步法氣候模式(CWB2T2)與歐洲中期天氣預報中心(ECMWF)的氣候模式(SEAS5)一同評估。

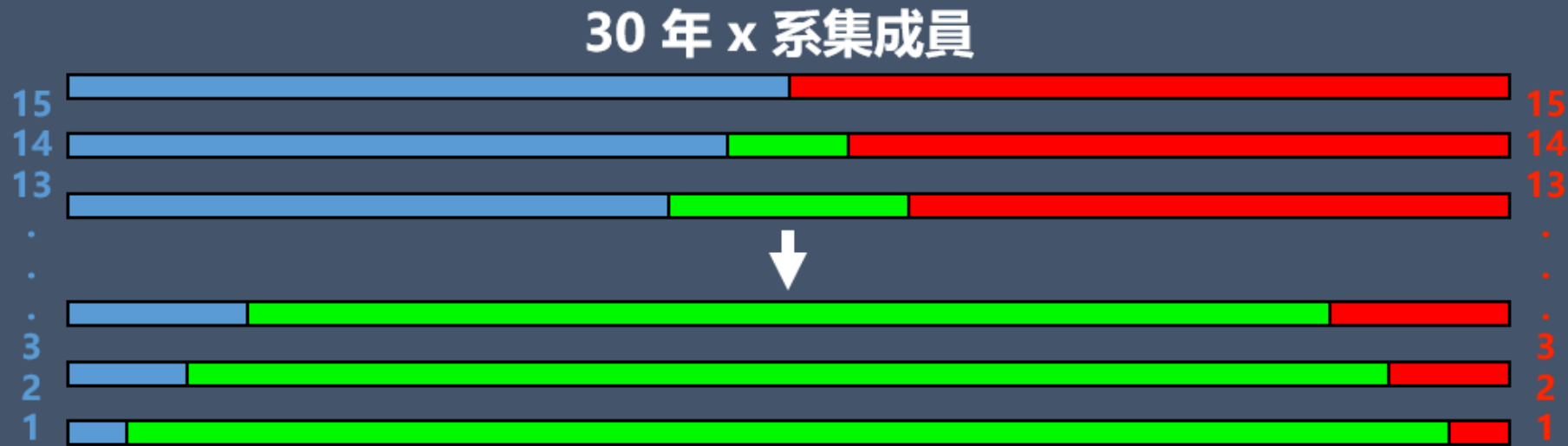


氣候模式簡介

	EC-SEAS5	CWACFSv2 CWARSM	TCWB1T1.1	CWB2T2
Resolution	900 x 451 (0.4°)	720 x 360 (0.5°) 12 km	360 x 180 (1°)	360 x 180 (1°)
Ocean	NEMO	MOM5	MOM3	x
Members	50 (25 for hindcast)	30 (time-lagged)	30 (time-lagged)	30 (time-lagged)
Forecast	6 month (12 month by 2,5,8,11)	9 month	6 month	6 month

校驗方法

- 多種三分類組合 → 不同極端程度的預報技術



- 使用Brier Skill Score 評估不同極端程度三分類的預報技術

預報技術得分

Brier Score (BS)

$$BS = \frac{1}{N} \sum_{i=1}^N (p_i - o_i)^2$$

p_i : 預報事件發生的頻率
 o_i : 觀測到事件發生
 N : 樣本數
BS 介於0和1

氣候場的BS

$$BS_{ref} = \frac{1}{N} \sum_{i=1}^N (p_i - \bar{o})^2$$

\bar{o} : 觀測到事件的平均發生頻率

Brier Skill Score (BSS)

(相對氣候場提升了多少預報技術)

$$BSS = - \frac{BS - BS_{ref}}{BS_{ref}}$$

BSS介於 $-\infty$ 和1之間
BSS = 1: Perfect Score
BSS = 0: 相對氣候場無提升預報技術

NINO34
SST

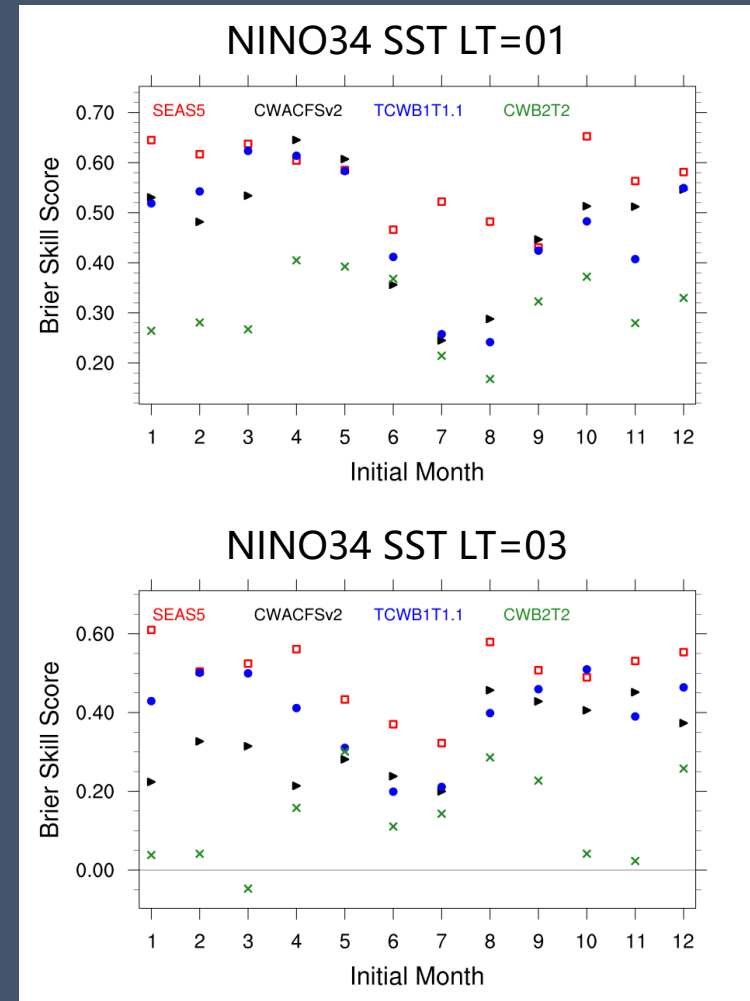
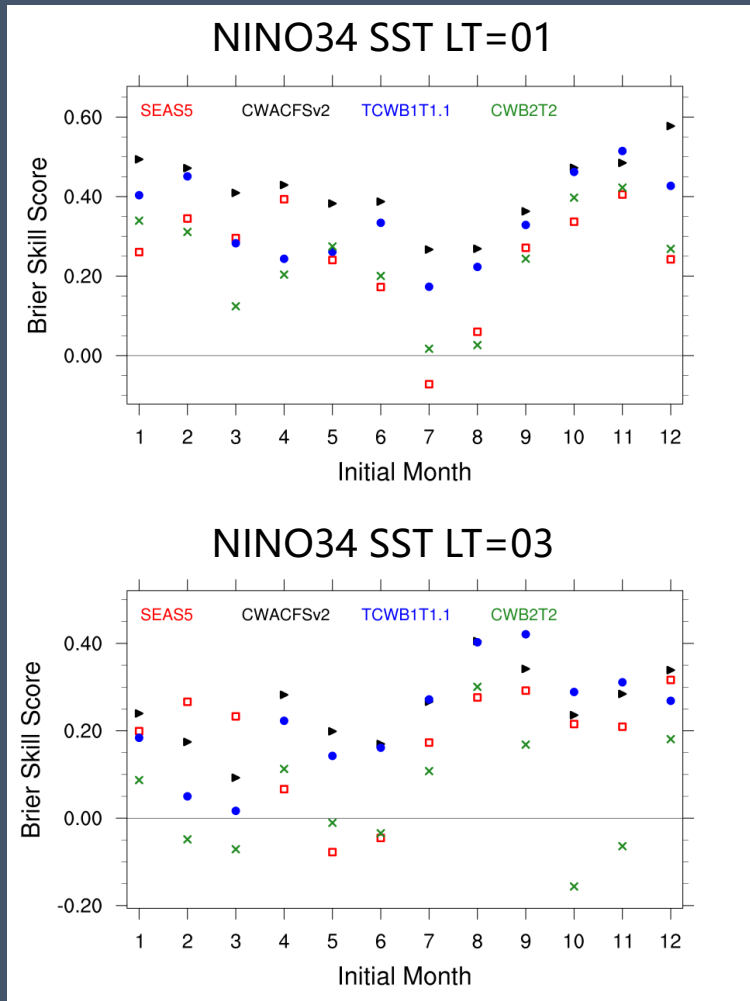
不同初始月份-預報能力

三分類比例 5-20-5



NINO34 偏暖

NINO34 偏冷



SEAS5
CWACFSv2
TCWB1T1.1
CWB2T2

EAWP
T2m

EAWP
Precip

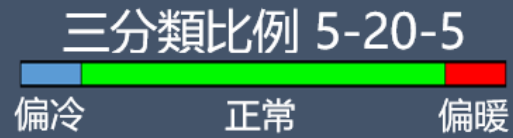
TW
T2m

TW
Precip

個案
分析

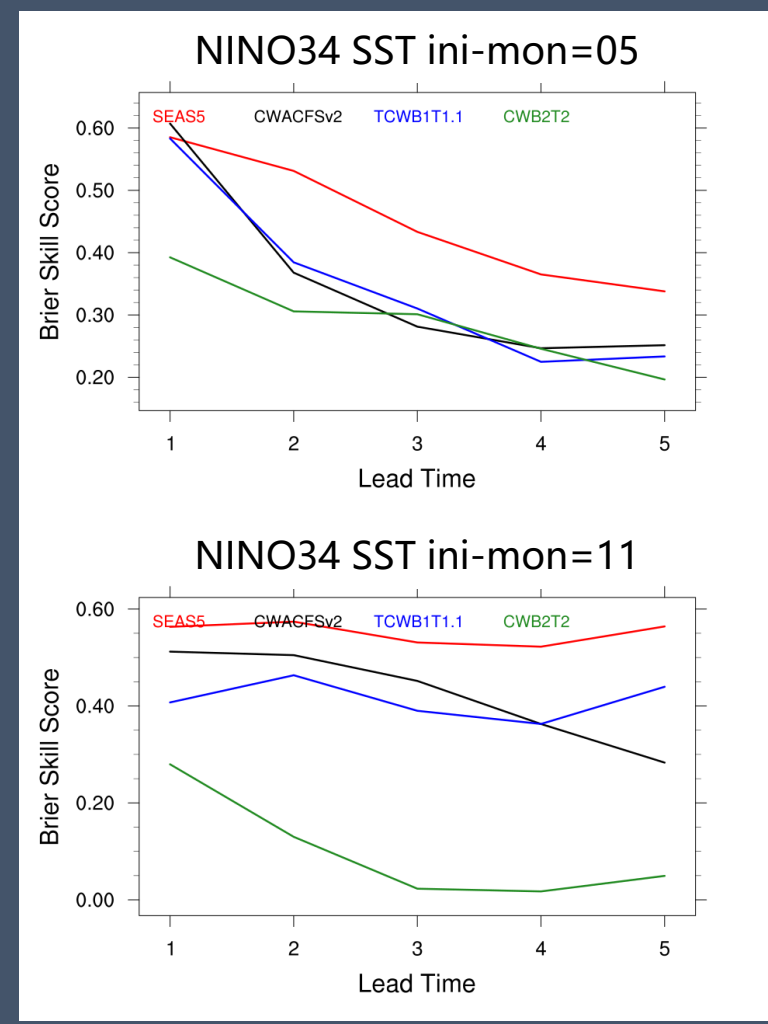
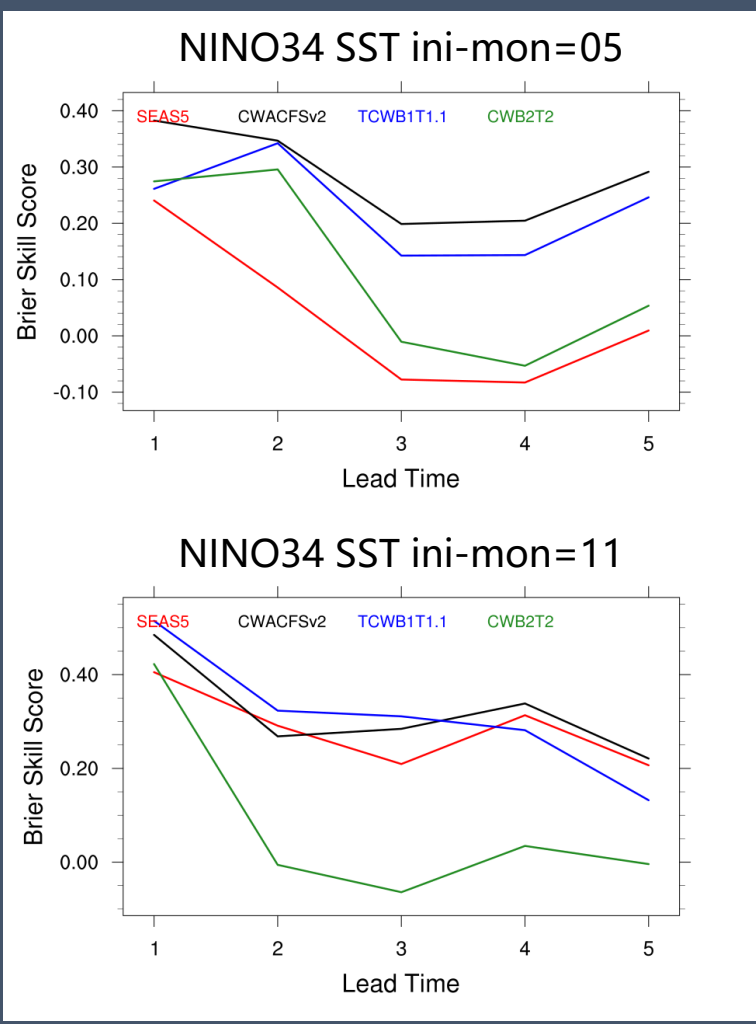
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BSS隨時間變化



NINO34 偏暖

NINO34 偏冷



SEAS5
CWACFSv2
TCWB1T1.1
CWB2T2

- EAWP T2m
- EAWP Precip
- TW T2m
- TW Precip
- 個案分析

NINO34
SST

五季(target month) BSS隨極端程度變化

NINO34 偏暖

NINO34 偏冷

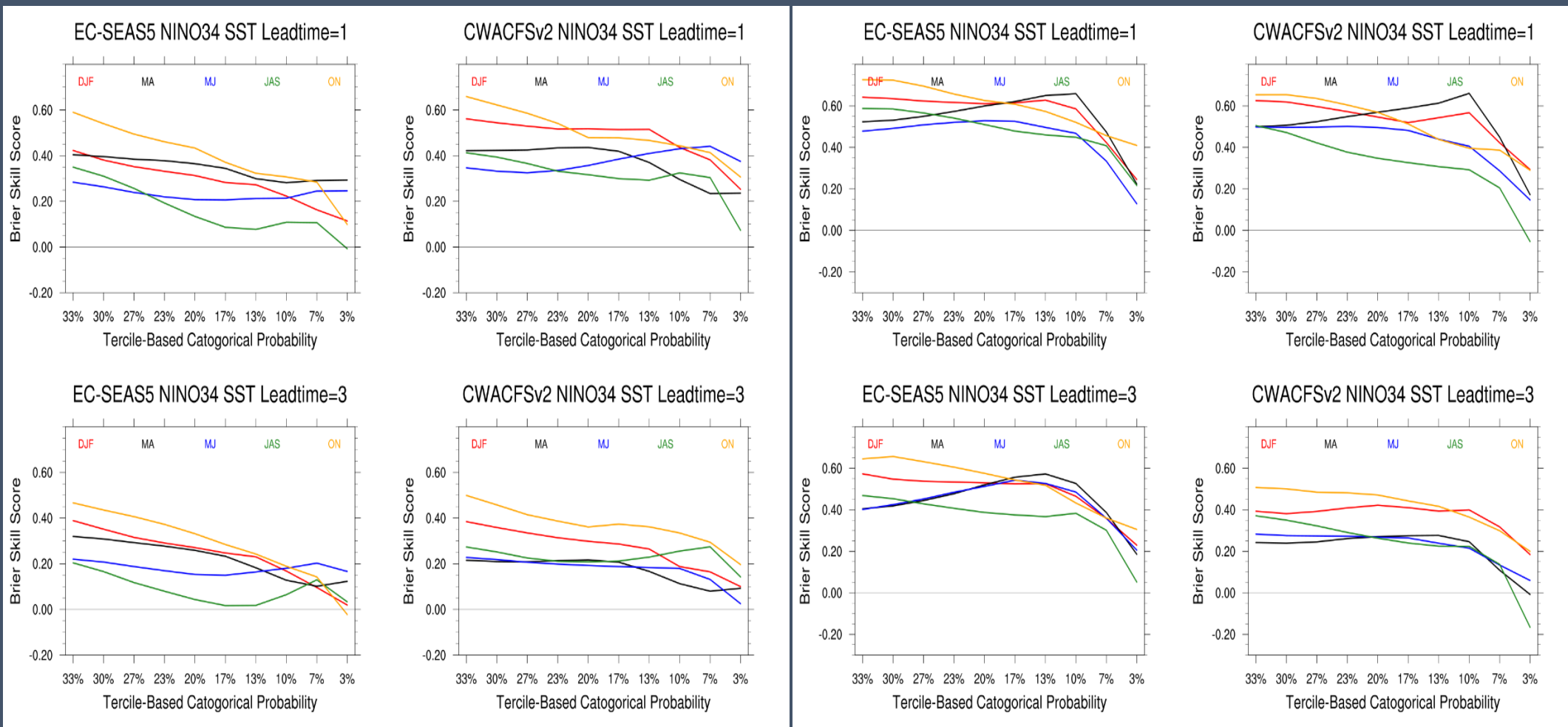
EAWP
T2m

EAWP
Precip

TW
T2m

TW
Precip

個案
分析



DJF MA MJ JAS ON

NINO34
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五季(target month) BSS隨極端程度變化

EAWP
T2m

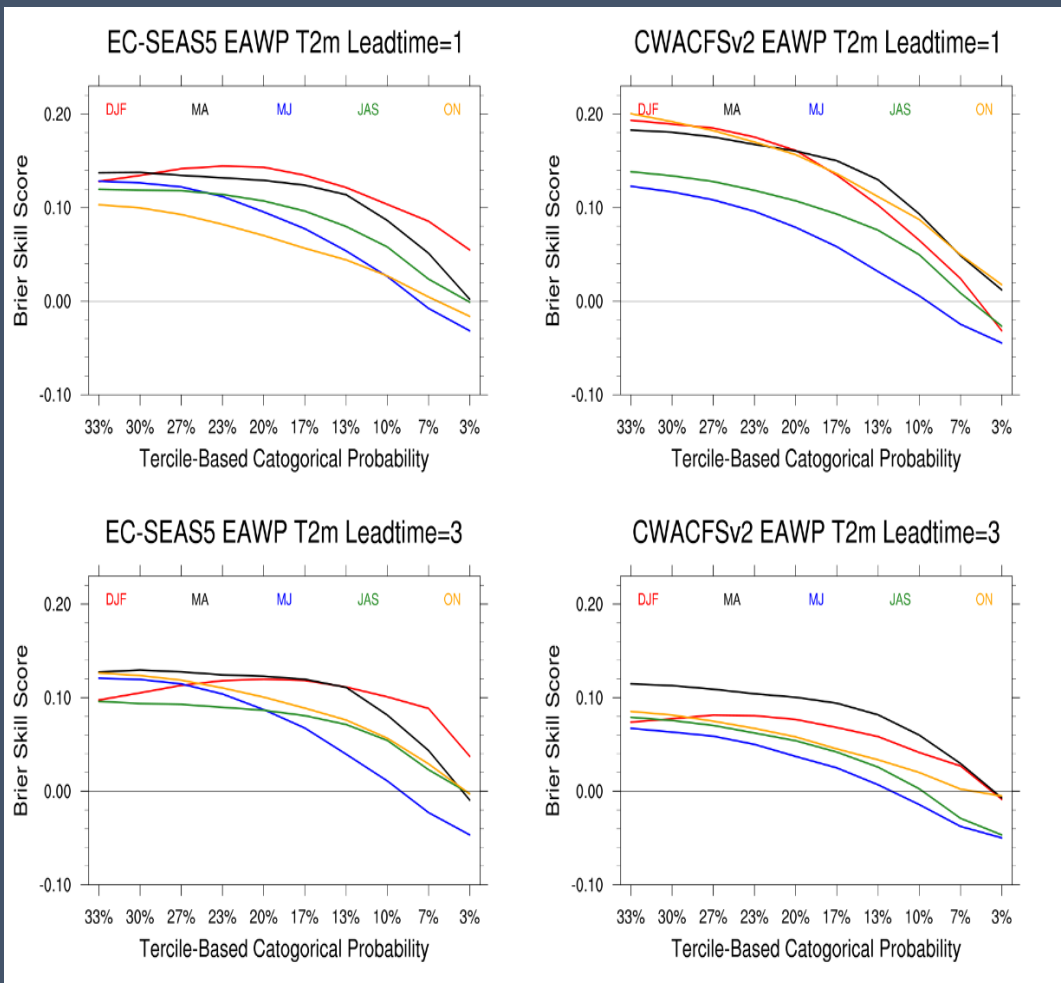
EAWP
Precip

TW
T2m

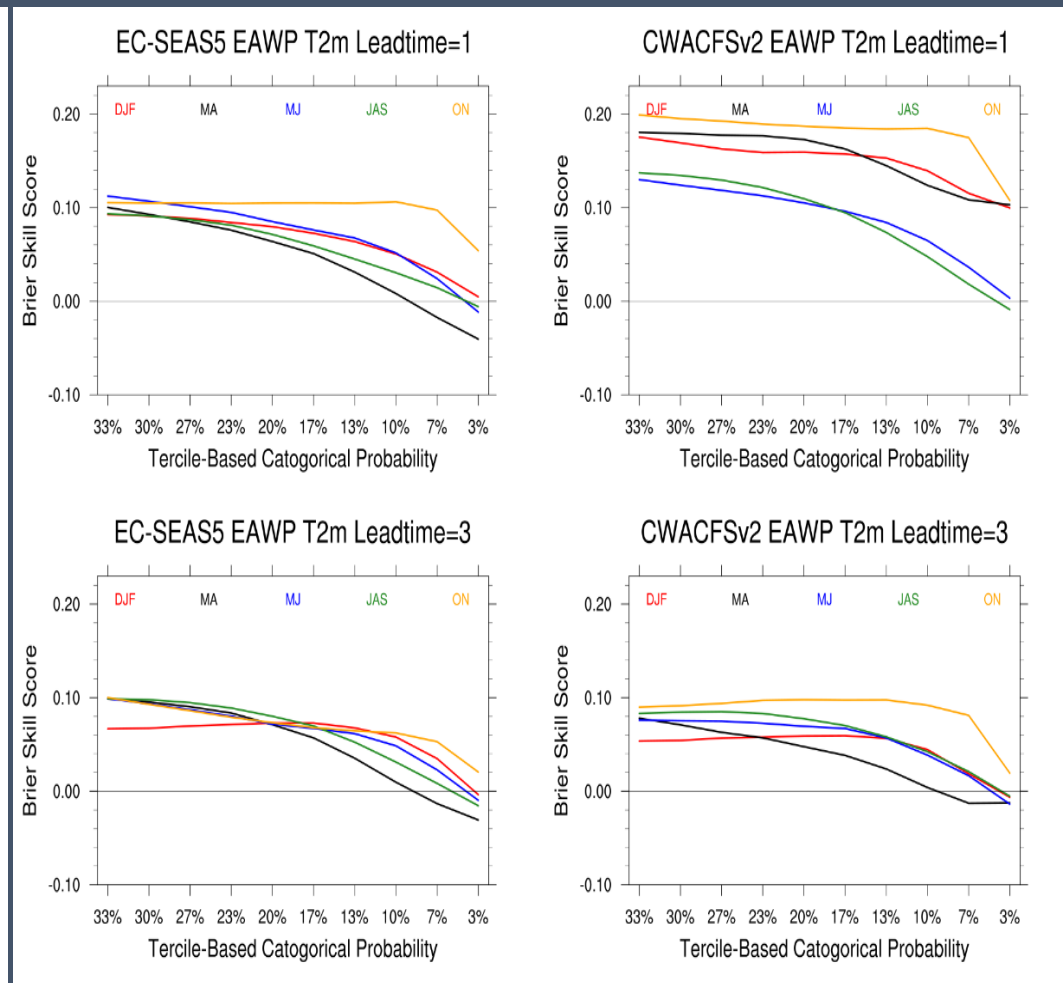
TW
Precip

個案
分析

EAWP 偏暖



EAWP 偏冷



DJF MA MJ JAS ON

NINO34
SST

五季(target month) BSS隨極端程度變化

EAWP
T2m

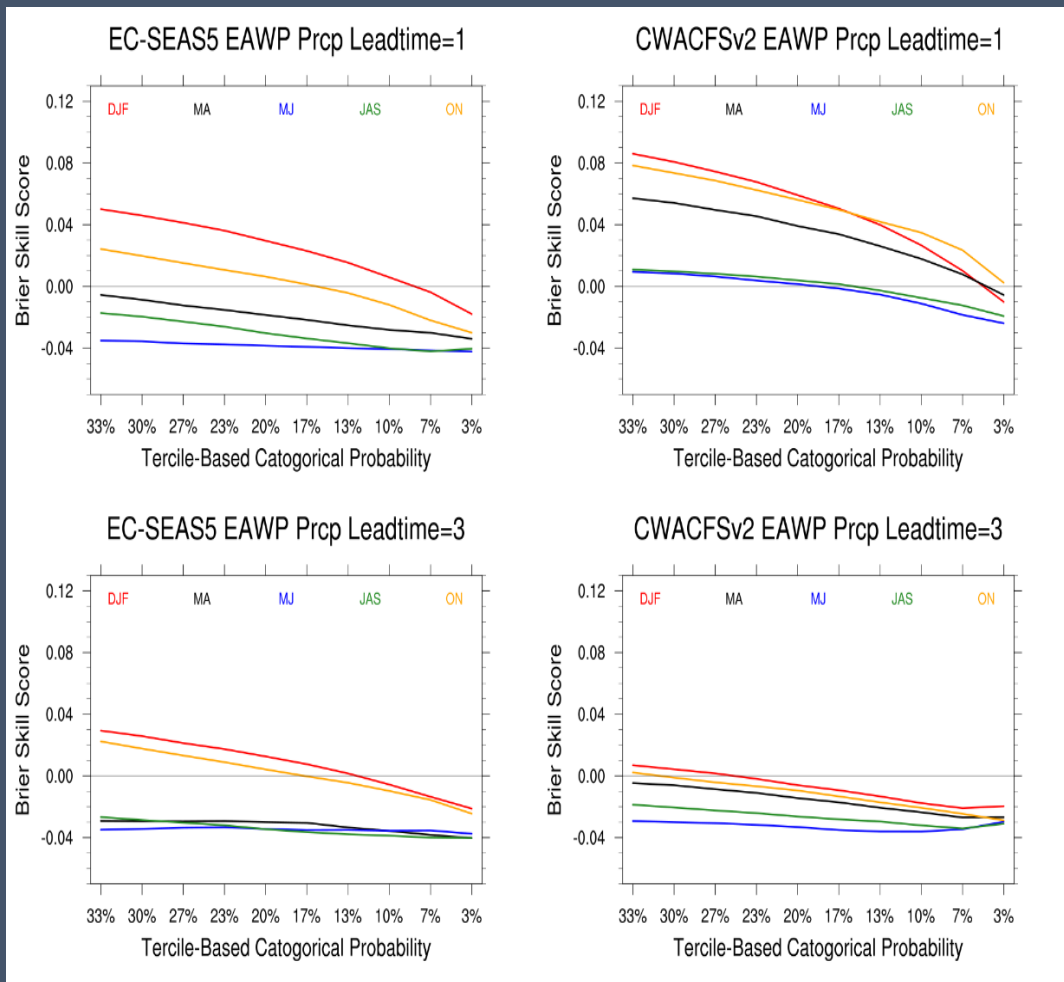
EAWP
Precip

TW
T2m

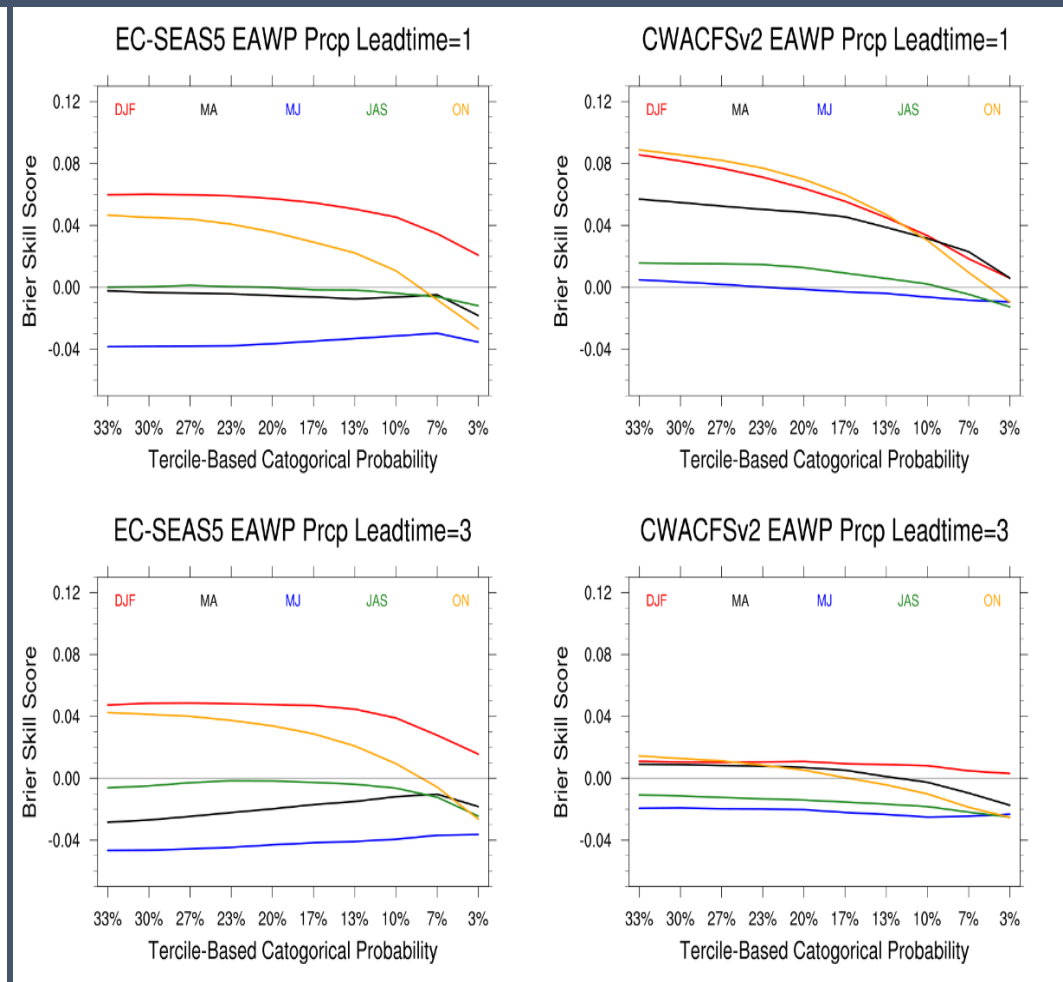
TW
Precip

個案
分析

EAWP 偏濕



EAWP 偏乾



DJF MA MJ JAS ON

NINO34
SST

EAWP
T2m

EAWP
Precip

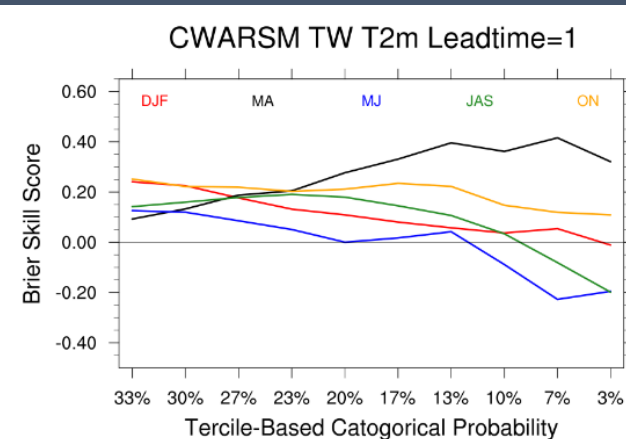
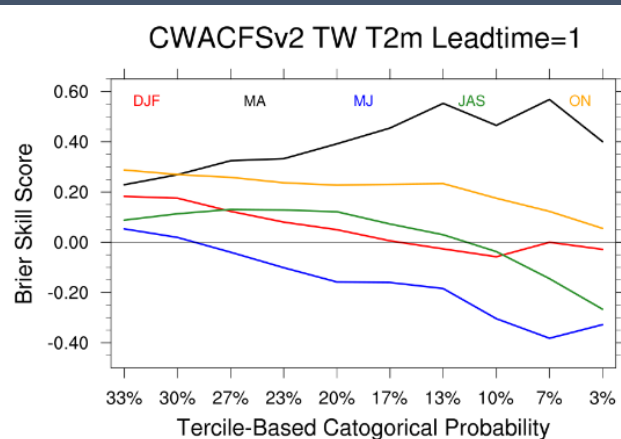
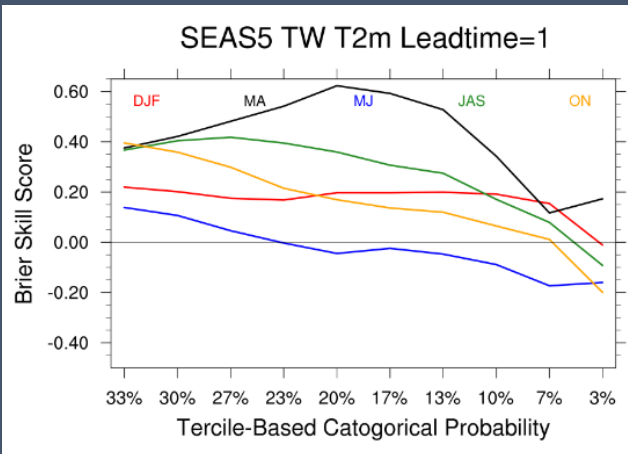
TW
T2m

TW
Precip

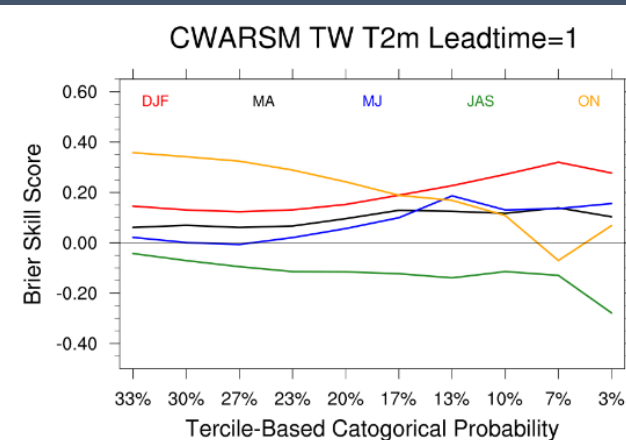
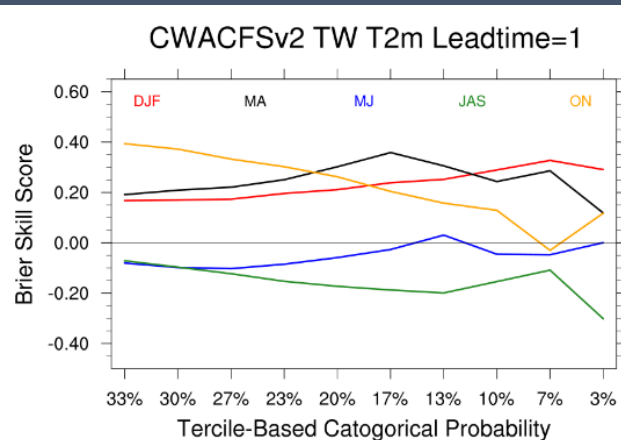
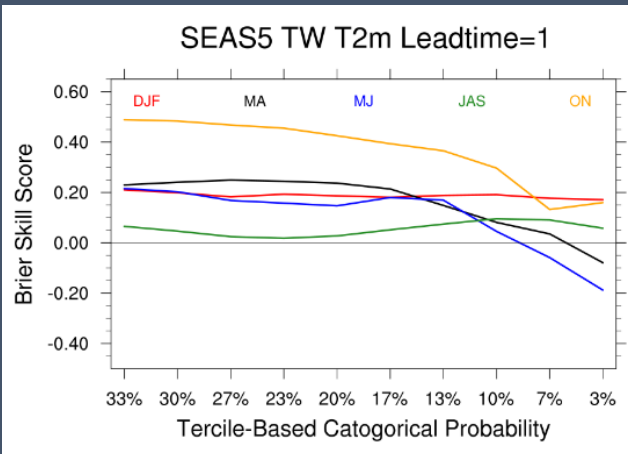
個案
分析

五季(target month) BSS隨極端程度變化

TW
偏暖



TW
冷極



DJF MA MJ JAS ON

五季(target month) BSS隨極端程度變化

NINO34
SST

EAWP
T2m

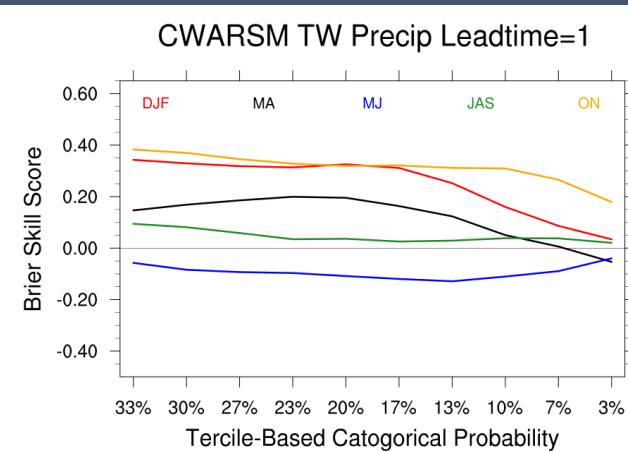
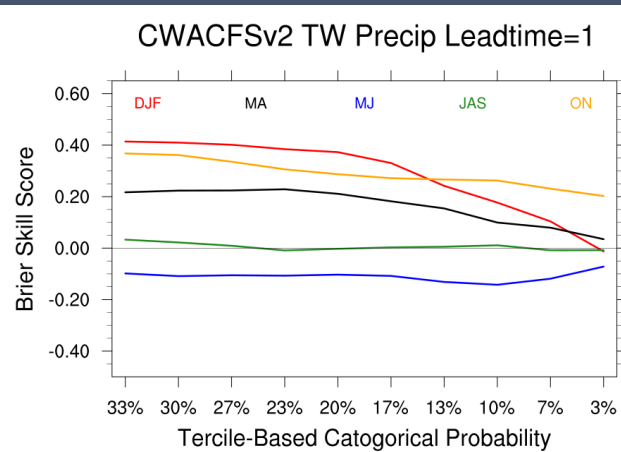
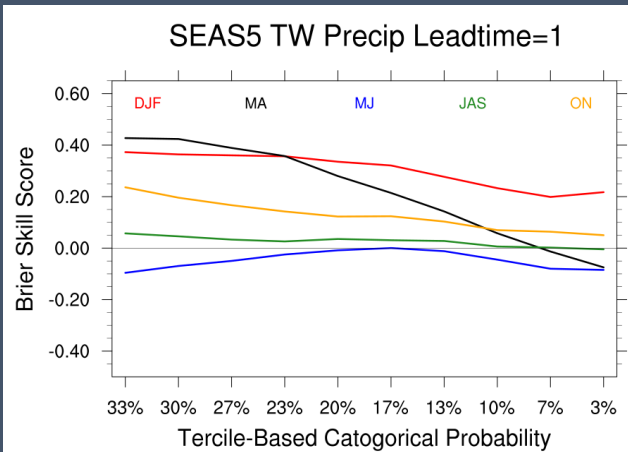
EAWP
Precip

TW
T2m

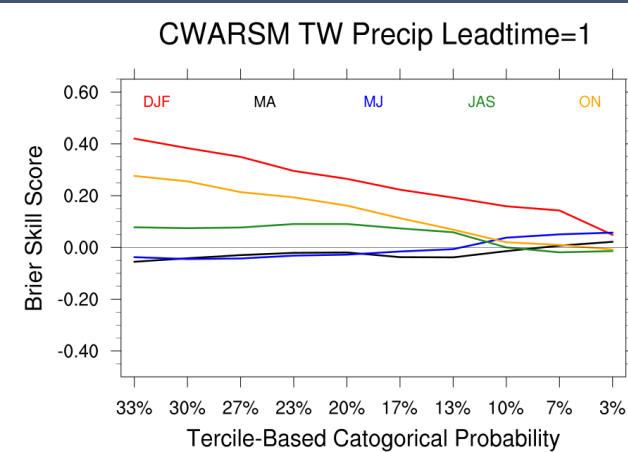
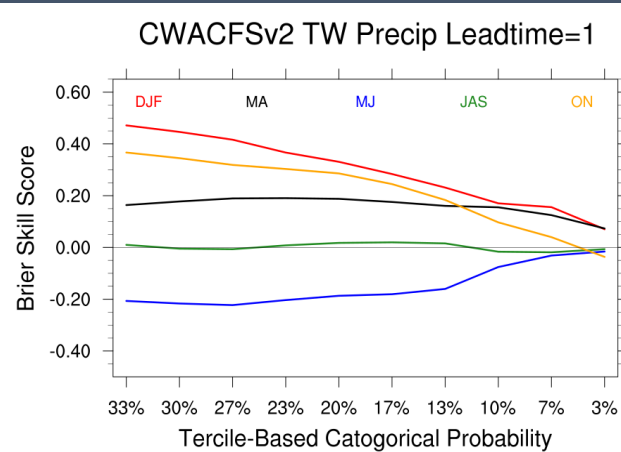
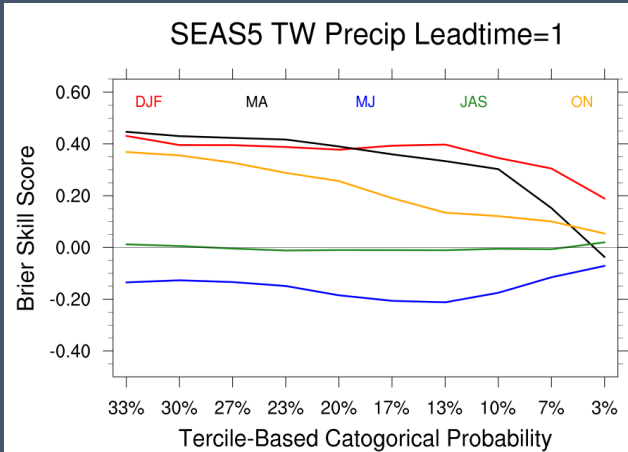
TW
Precip

個案
分析

TW
偏濕



TW
偏乾



DJF MA MJ JAS ON

NINO34
SST

EAWP
T2m

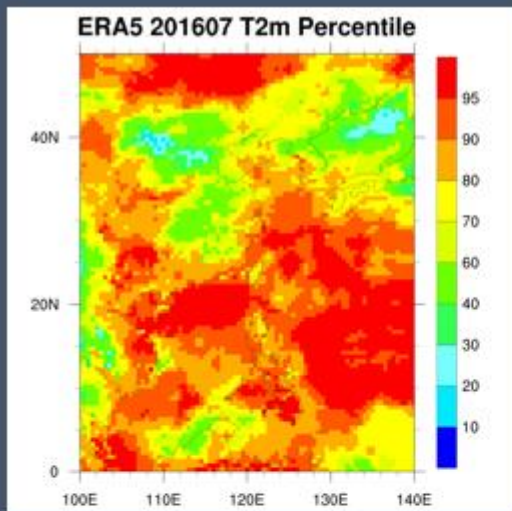
EAWP
Precip

TW
T2m

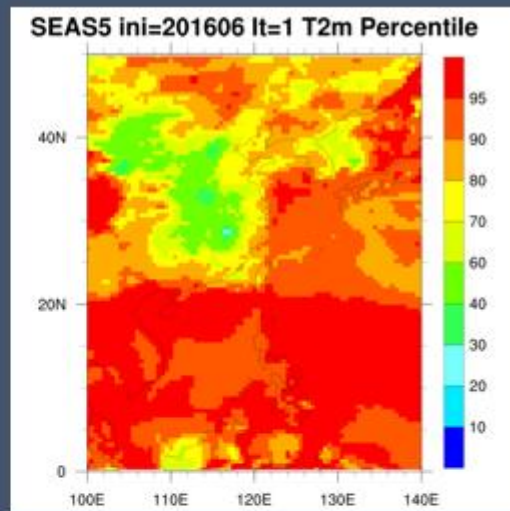
TW
Precip

個案
分析

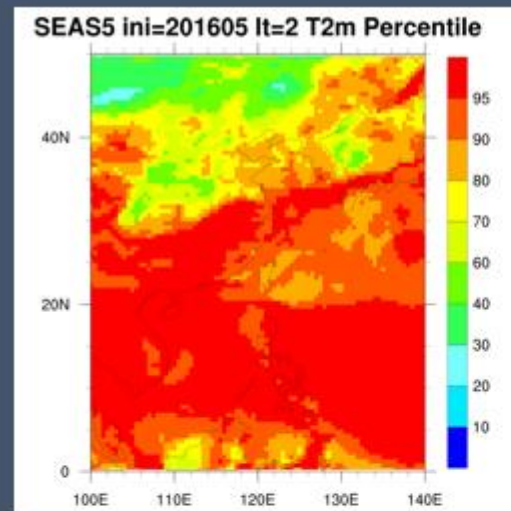
ERA5



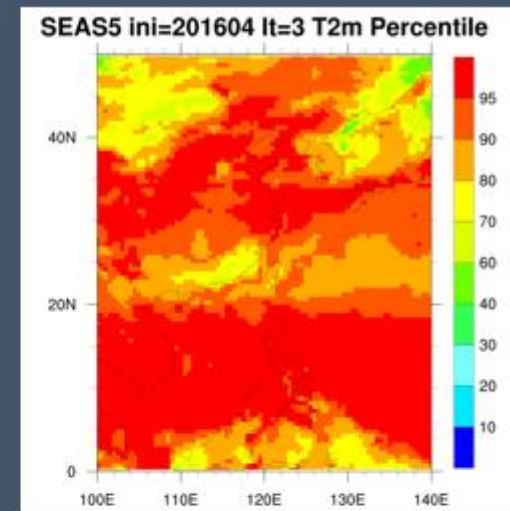
Lead time = 1



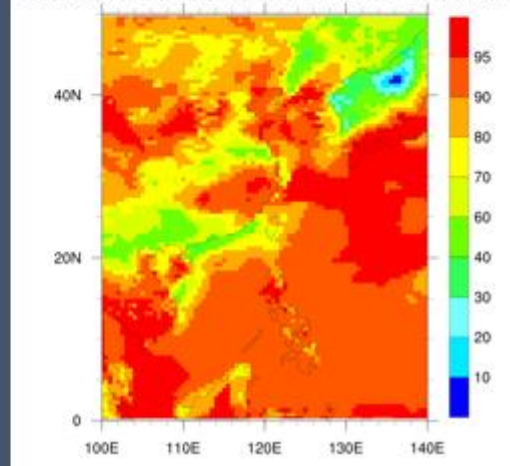
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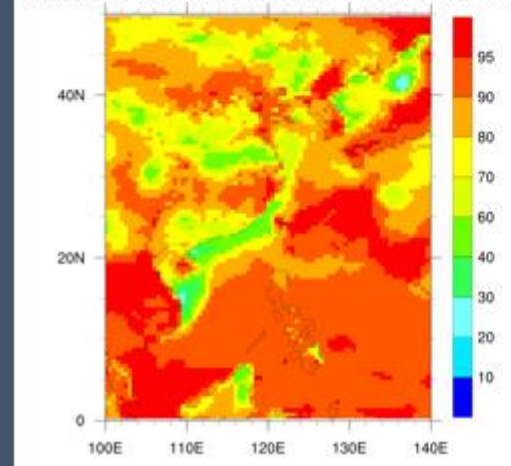
Lead time = 3



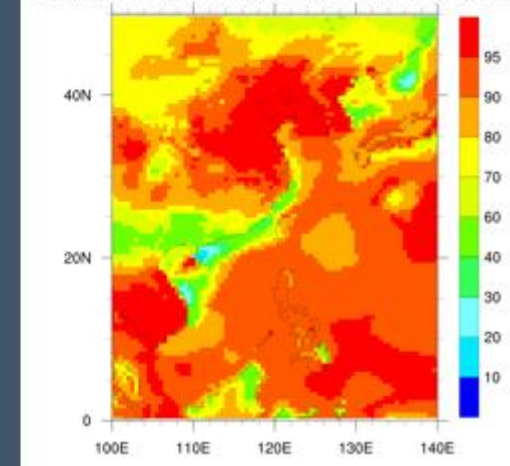
CWACFSv2 ini=201606 It=1 T2m Percentile



CWACFSv2 ini=201605 It=2 T2m Percentile



CWACFSv2 ini=201604 It=3 T2m Percentile



NINO34
SST

EAWP
T2m

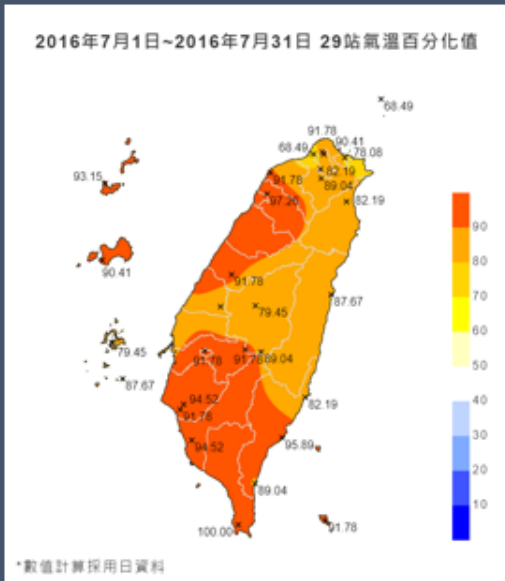
EAWP
Precip

TW
T2m

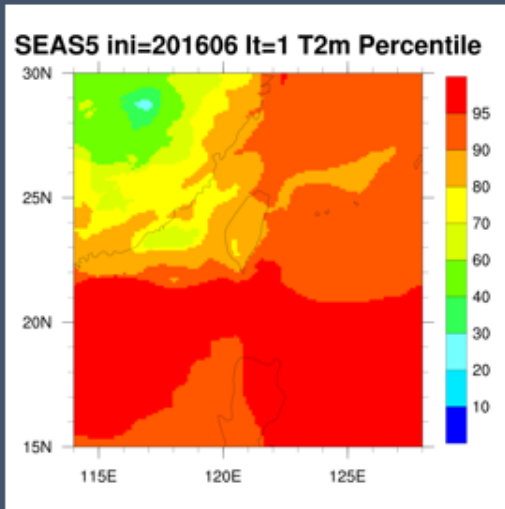
TW
Precip

個案
分析

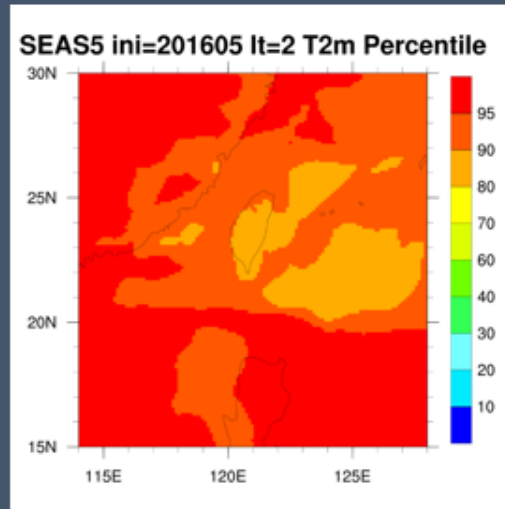
測站



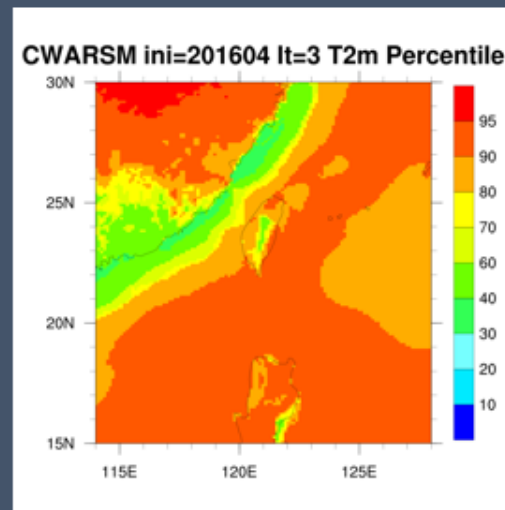
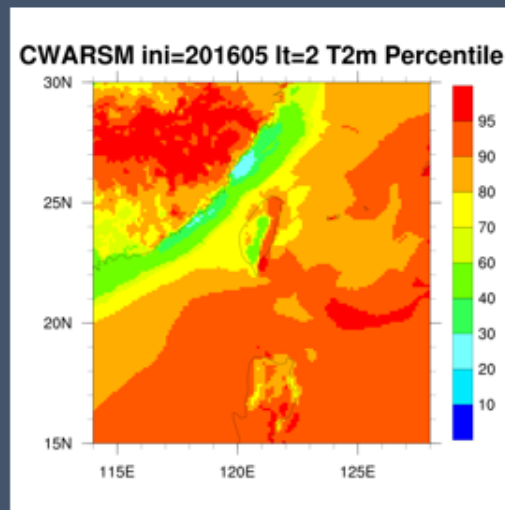
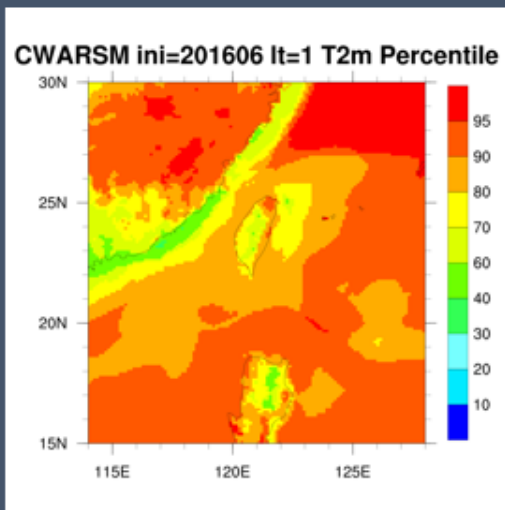
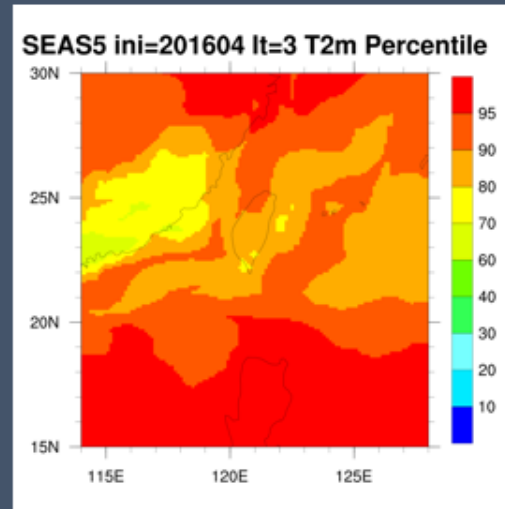
Lead time = 1



Lead time = 2



Lead time = 3



結論

- 海溫: CWACFSv2在預報偏暖方面技術得分比較高，但預報海溫偏冷時SEAS5技術得分比較高
- 東亞: CWACFSv2在第一個預報時間預報技術得分比較高，但是預報技術得分隨預報時間增加降低速度比SEAS5快
- 臺灣: CWARSM在特定季節略有提高CWACFSv2預報得分，但綜合來看SEAS5預報技術得分比較高
- 個案分析: 東亞方面SEAS5表現出和ERA5較相似的溫度分布，CWARSM則可以表現出細微的特徵

謝謝大家