

氣象局氣候模式在季內尺度下的預報 能力評估

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CWB Seasonal Forecast System

- a multi model ensemble 2-tiered(TCWB2T2) and 1-tiered(TCWB1T1) forecast system

TCWB2T2

- OPGv2/CWB-SST
- CFSv2/NCEP-SST

CDAS/NCEP IC

TCWB2T2 Retire in 2021

Atmospheric Model
CWB-GFS(T119L40)
ECHAM5(T42L19)

Ensemble

2 Atmos * 2 Ocean * 30 members
(120members)

hindcast skill
evaluation

Forecast Product

- Temperature
- Precipitation
- Monsoon Index
 - ENSO
- Probability Forecast

Statistical Downscaling

- Taiwan Station Temperature
- Taiwan Station Precipitation
- 3 category forecast

CDAS/NCEP IC
OISST

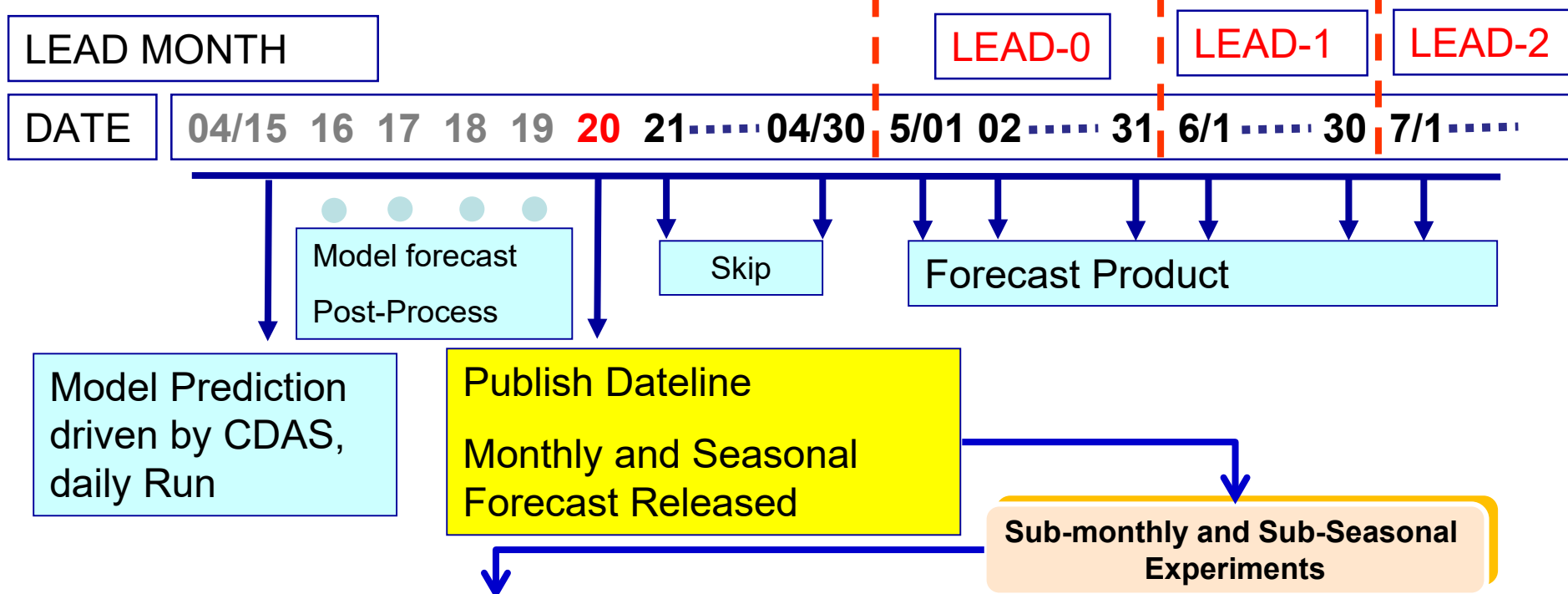
Atmospheric Model
CWB-GFS(T119L40)
(30 members)

↑↓
Coupler
(MOM3)

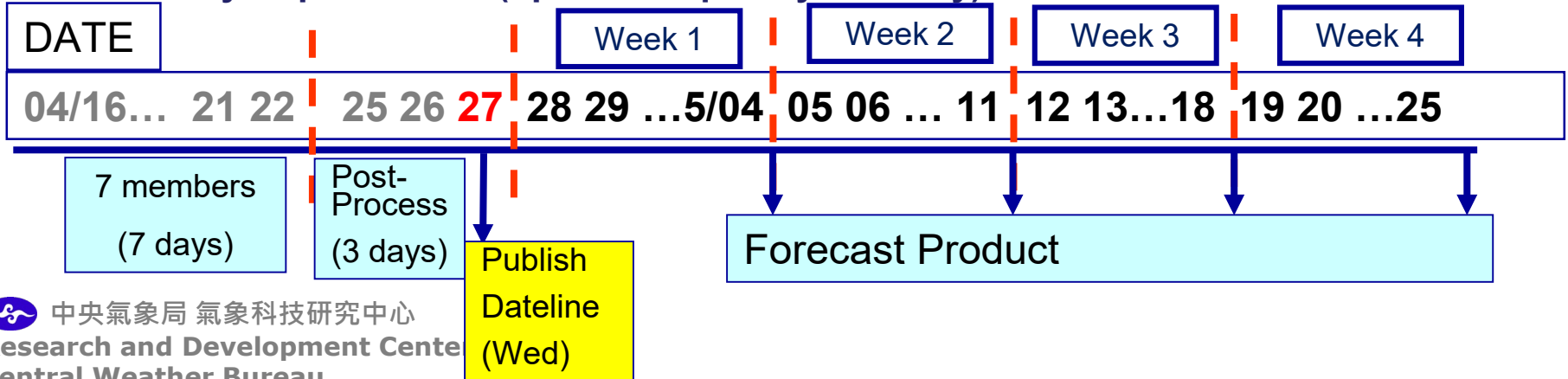
TCWB1T1

TCWB1T1.1 Operational Forecast Schedule

Monthly and Seasonal Experiments: (update frequency : 1 Month)

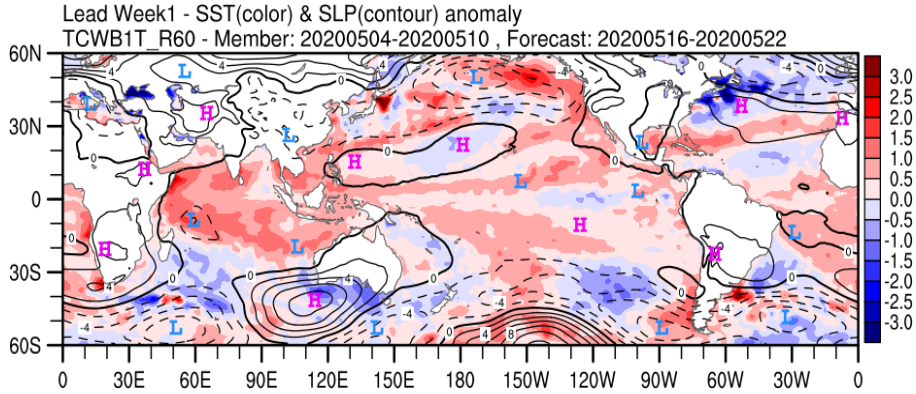


Sub-monthly Experiments: (update frequency : weekly)

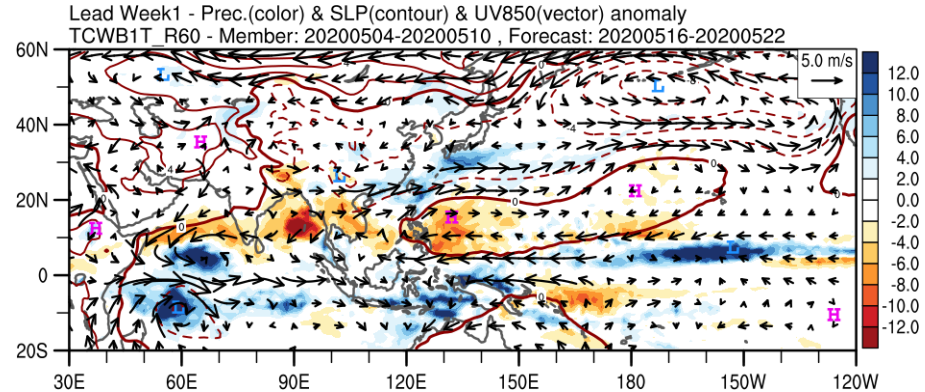


Weekly Forecast Product

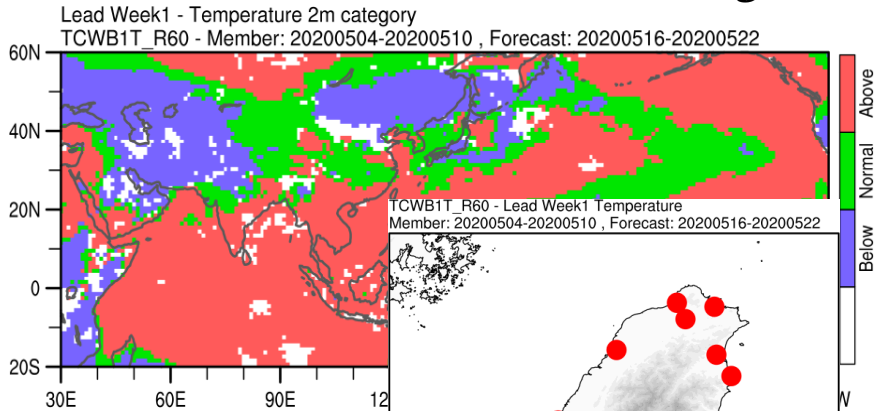
SST Anomaly



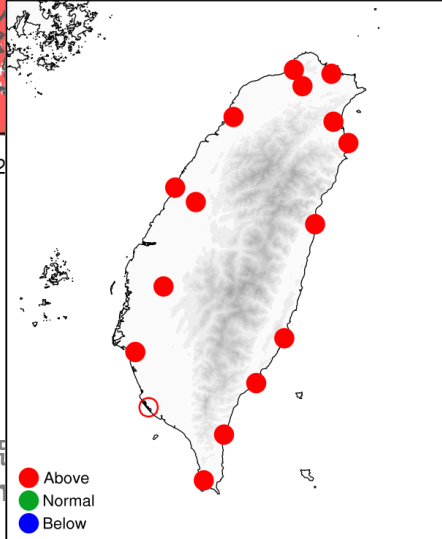
Precipitation Anomaly



T2M Probability

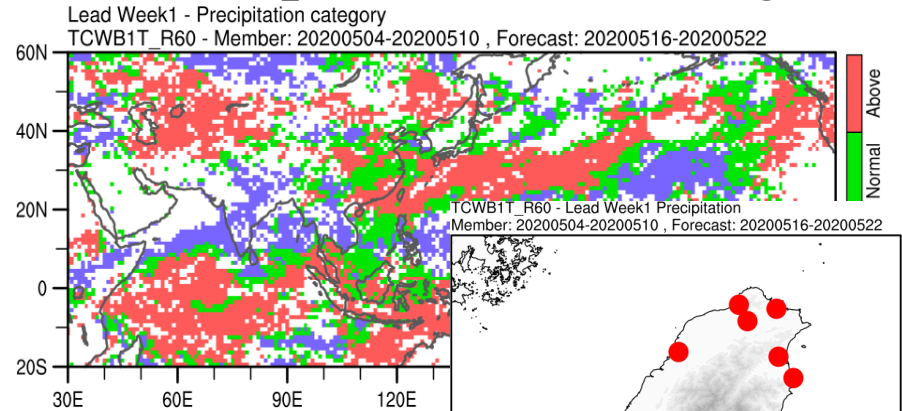


TCWB1T_R60 - Lead Week1 Temperature
 Member: 20200504-20200510, Forecast: 20200516-20200522

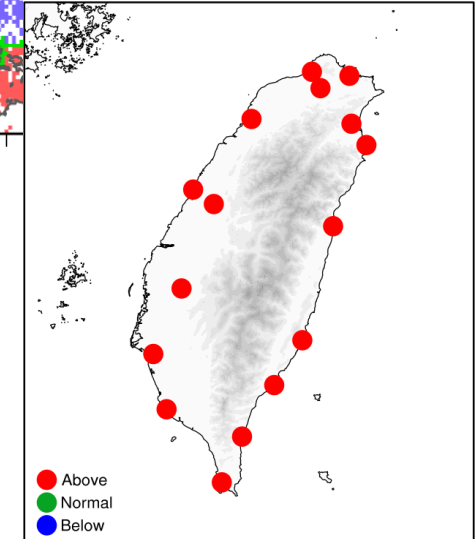


- Above
- Normal
- Below

Precipitation Probability



TCWB1T_R60 - Lead Week1 Precipitation
 Member: 20200504-20200510, Forecast: 20200516-20200522



- Above
- Normal
- Below

Verification Metrics in CWB

- Used these metrics to evaluate overall forecast skill.
- CWB probability forecast product has skill mask by skill score and the skill score is RPSS based on hindcast. (hindcast period : 1982-2011)

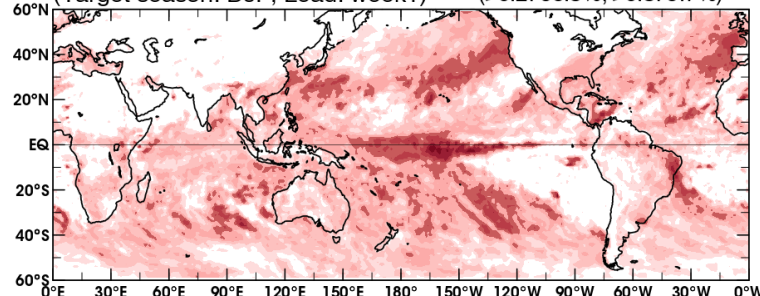
Standardized Verification System (SVS) for Long-Range Forecasts (LRF)
長期預報標準校驗系統

Mean climatology 平均氣候場	Rain, Temperature 雨量、溫度	Mean 平均值
Mean variance 平均變異量	Rain, Temperature 雨量、溫度	Mean, Variance 平均值、變異度
Mean bias 平均偏差	Rain, Temperature 雨量、溫度	Mean, Difference 平均值、差異量
Pattern correlation coefficient (PCC) 空間形態相關係數	Rain, Temperature 雨量、溫度	PCC of Mean climatology 平均氣候場空間形態相關係數
Anomaly correlation coefficient (ACC) 距平相關係數圖	Rain, Temperature 雨量、溫度	Temporal correlation of anomaly maps 距平的時間相關係數圖
Root mean square errors (RMSE) 均方根誤差	Rain, Temperature 雨量、溫度	RMSE of Mean bias 平均偏差值的均方根誤差
Heidke skill score (HSS) HSS技術得分	Rain, Temperature 雨量、溫度	HSS (Tercile categories) 評量三分類機率預報技術HSS得分
Gerrity skill score (GSS) GSS技術得分	Rain, Temperature 雨量、溫度	GSS (Tercile categories) 評量三分類機率預報技術GSS得分
Ranked probability skill score (RPSS) RPSS技術得分	Rain, Temperature 雨量、溫度	RPSS (Full probability, PDF) 評量機率預報技術RPSS得分
Relative/Receiver Operating Characteristic score (ROC Score) ROC技術得分	Rain, Temperature 雨量、溫度	ROC Score (Full probability / 10 Bins) 評量機率預報技術ROC得分

TCWB1T.1

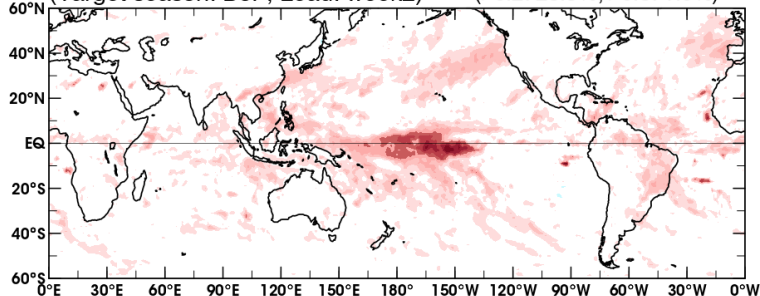
Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: DJF, Lead: week1) (>0.2: 66.8%; >0.5: 9.7%)

Target:
DJF
Lead
Week1



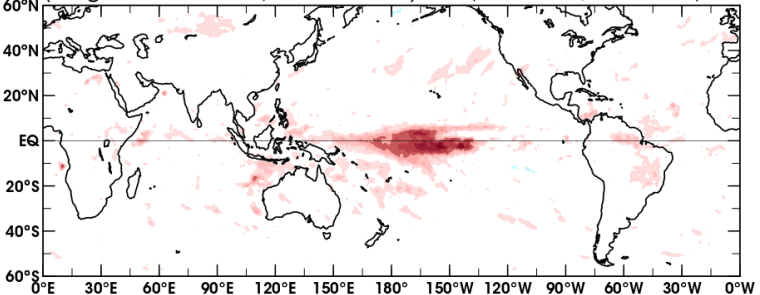
Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: DJF, Lead: week2) (>0.2: 23.3%; >0.5: 1.0%)

Lead
Week2



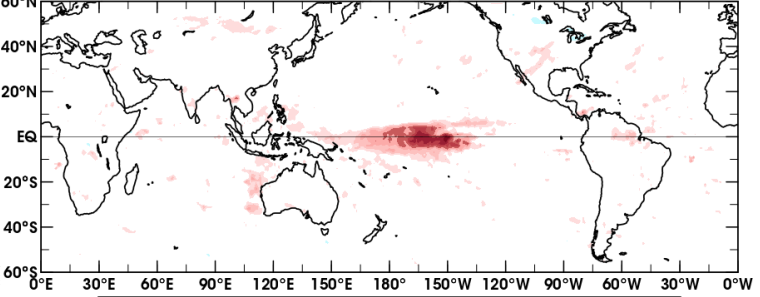
Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: DJF, Lead: week3) (>0.2: 9.2%; >0.5: 0.9%)

Lead
Week3



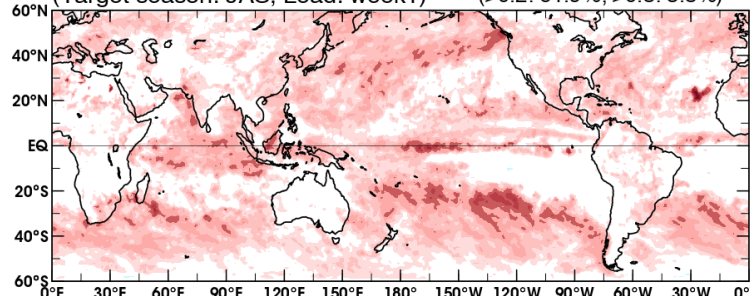
Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: DJF, Lead: week4) (>0.2: 5.8%; >0.5: 0.6%)

Lead
Week4

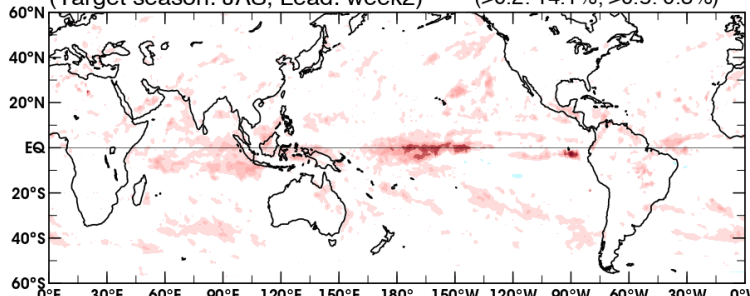


Target:
JAS

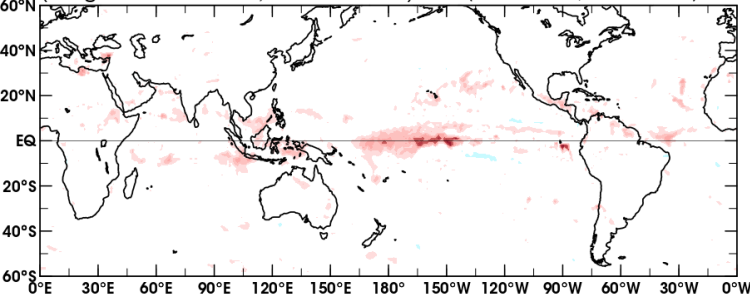
Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: JAS, Lead: week1) (>0.2: 61.9%; >0.5: 3.8%)



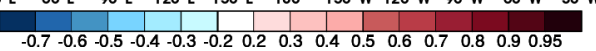
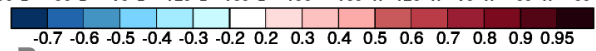
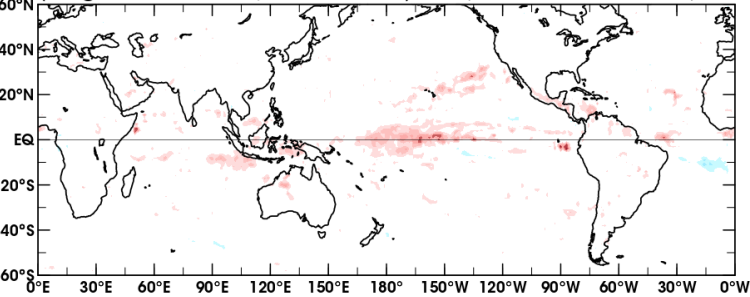
Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: JAS, Lead: week2) (>0.2: 14.1%; >0.5: 0.3%)



Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: JAS, Lead: week3) (>0.2: 6.1%; >0.5: 0.2%)



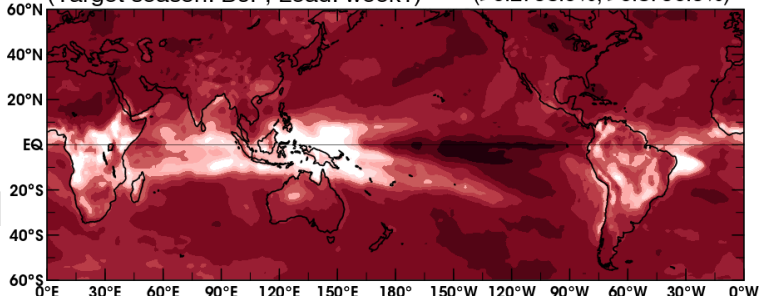
Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: JAS, Lead: week4) (>0.2: 5.0%; >0.5: 0.1%)



TCWB1T1.1

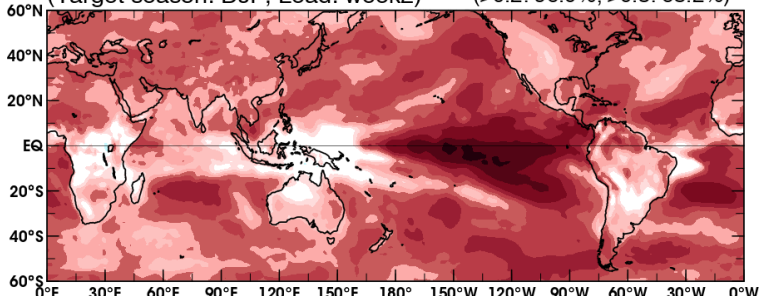
T2M Corr between TCWB1T & OBS(ERAi)
(Target season: DJF, Lead: week1) (>0.2: 98.0%; >0.5: 90.9%)

Target:
DJF
Lead
Week1



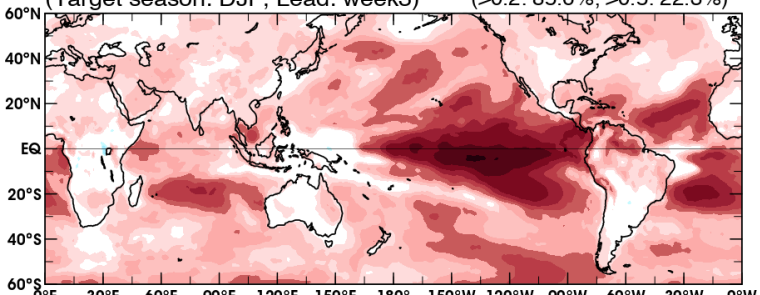
T2M Corr between TCWB1T & OBS(ERAi)
(Target season: DJF, Lead: week2) (>0.2: 96.0%; >0.5: 65.2%)

Lead
Week2



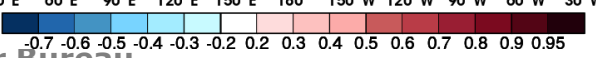
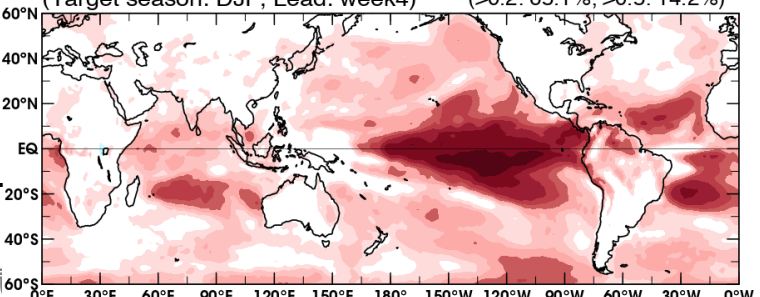
T2M Corr between TCWB1T & OBS(ERAi)
(Target season: DJF, Lead: week3) (>0.2: 85.6%; >0.5: 22.3%)

Lead
Week3



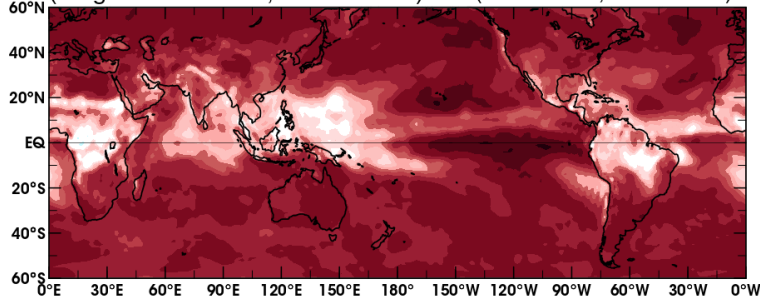
T2M Corr between TCWB1T & OBS(ERAi)
(Target season: DJF, Lead: week4) (>0.2: 65.1%; >0.5: 14.2%)

Lead
Week4

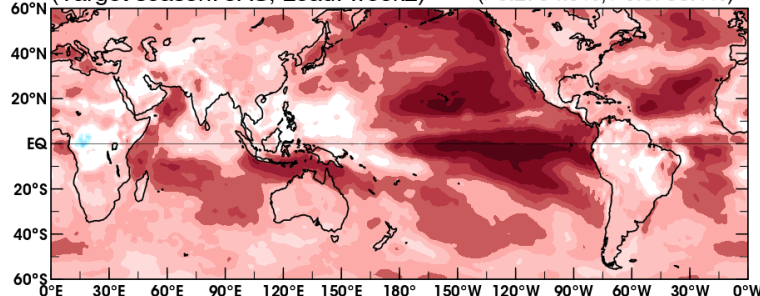


Target:
JAS

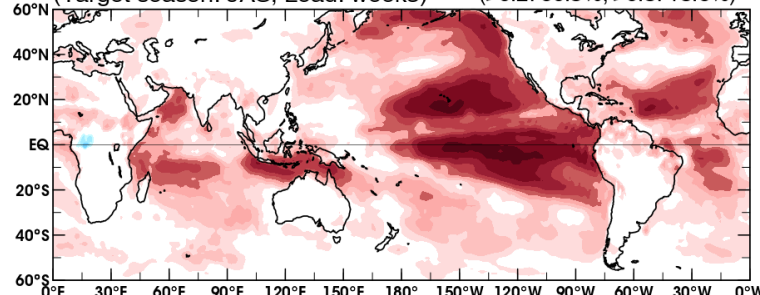
T2M Corr between TCWB1T & OBS(ERAi)
(Target season: JAS, Lead: week1) (>0.2: 98.1%; >0.5: 86.4%)



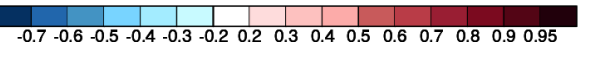
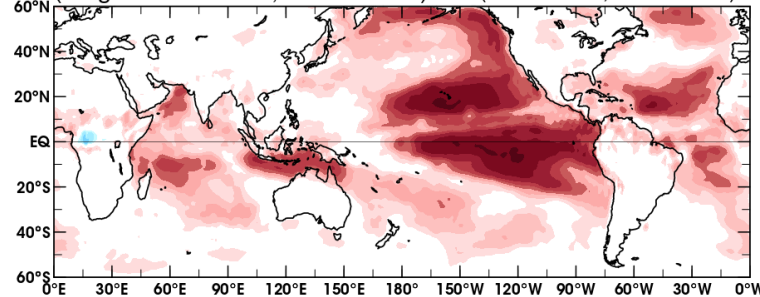
T2M Corr between TCWB1T & OBS(ERAi)
(Target season: JAS, Lead: week2) (>0.2: 94.9%; >0.5: 35.1%)



T2M Corr between TCWB1T & OBS(ERAi)
(Target season: JAS, Lead: week3) (>0.2: 60.5%; >0.5: 18.6%)

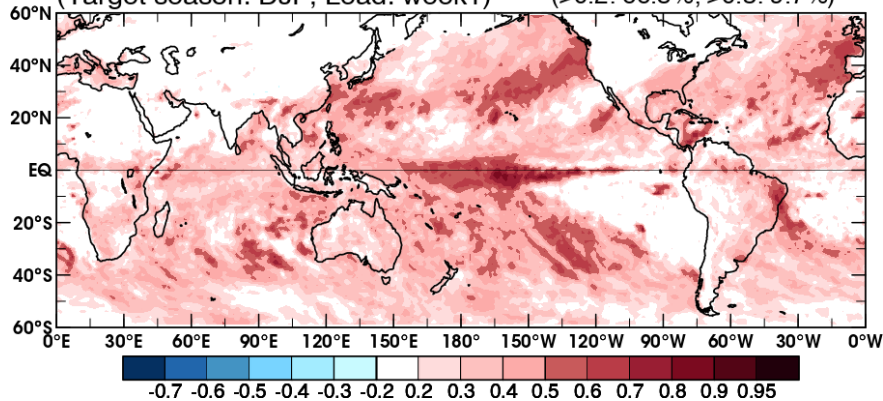


T2M Corr between TCWB1T & OBS(ERAi)
(Target season: JAS, Lead: week4) (>0.2: 50.1%; >0.5: 15.6%)

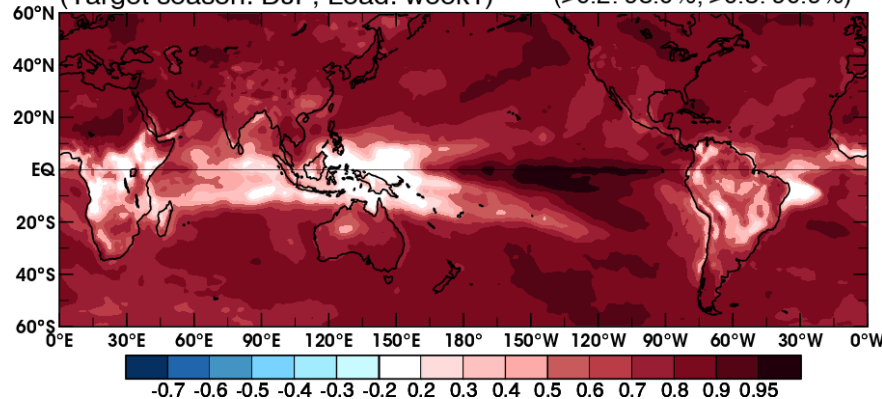


TCWB1T.1

Precipitation Corr between TCWB1T & OBS(CMORPH)
(Target season: DJF, Lead: week1) (>0.2: 66.8%; >0.5: 9.7%)

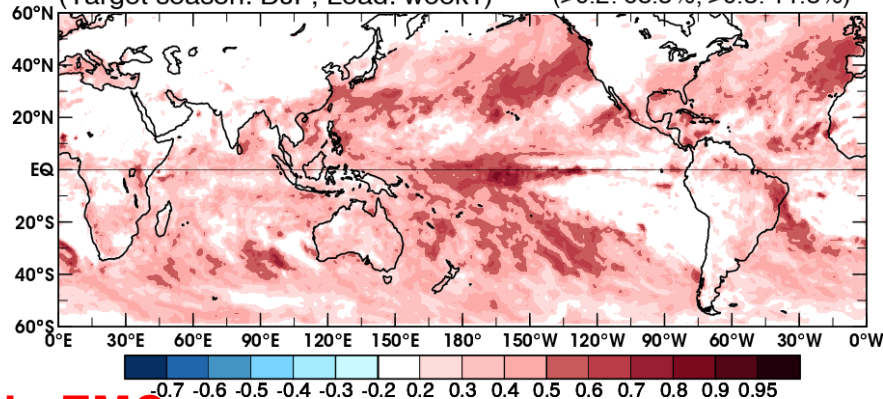


T2M Corr between TCWB1T & OBS(ERAi)
(Target season: DJF, Lead: week1) (>0.2: 98.0%; >0.5: 90.9%)

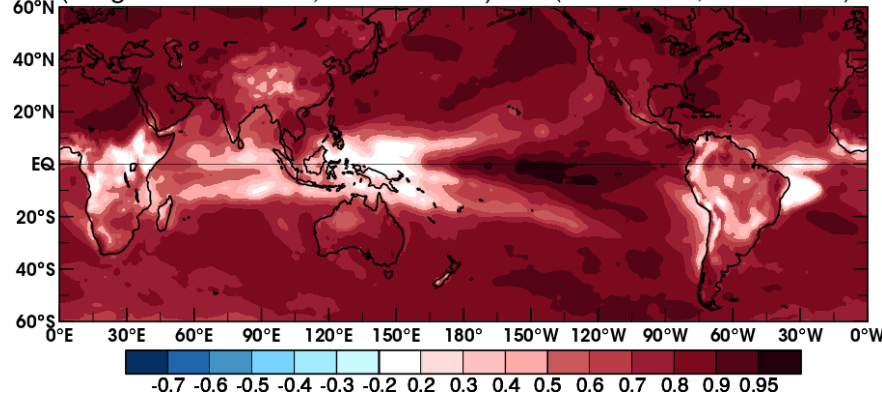


TCWB2T2

Precipitation Corr between TCWB2T & OBS(CMORPH)
(Target season: DJF, Lead: week1) (>0.2: 68.3%; >0.5: 11.5%)

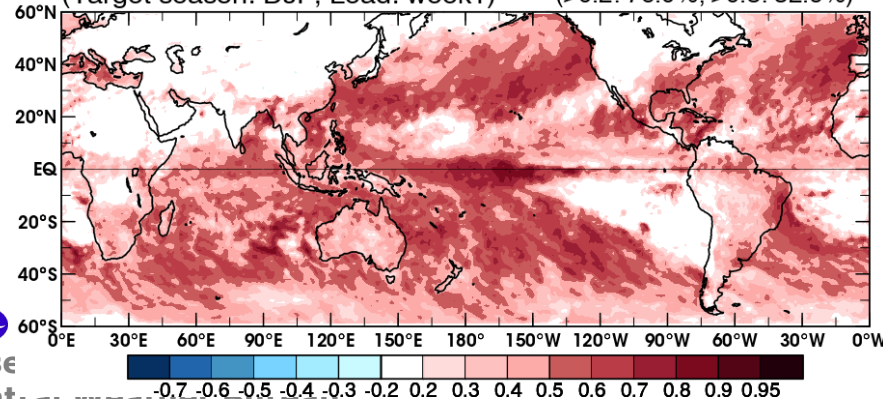


T2M Corr between TCWB2T & OBS(ERAi)
(Target season: DJF, Lead: week1) (>0.2: 98.4%; >0.5: 91.1%)

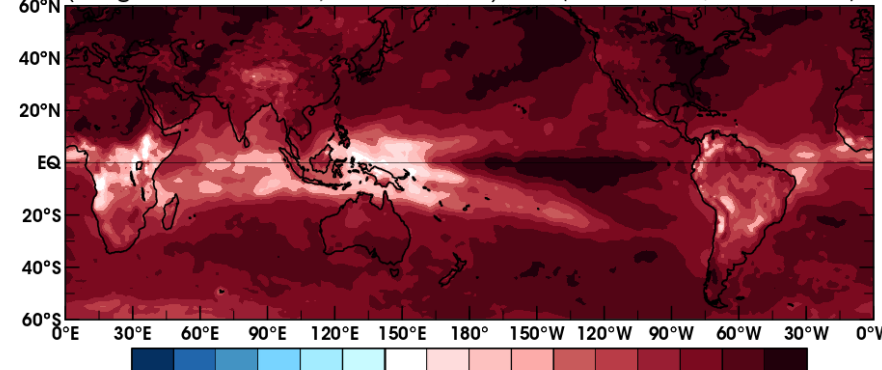


SubxEMC

Precipitation Corr between EMC & OBS(CMORPH)
(Target season: DJF, Lead: week1) (>0.2: 76.0%; >0.5: 32.9%)

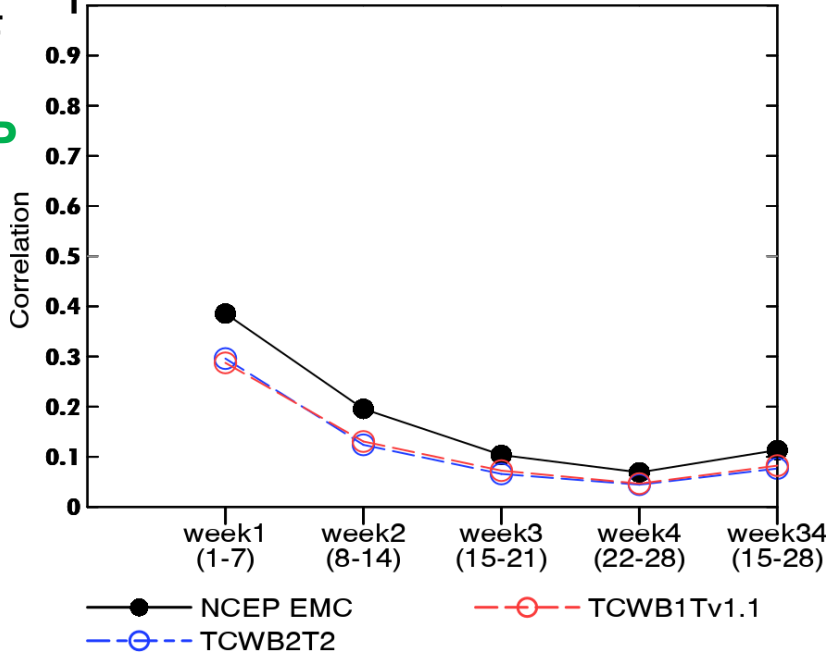


T2M Corr between EMC & OBS(ERAi)
(Target season: DJF, Lead: week1) (>0.2: 99.8%; >0.5: 95.5%)



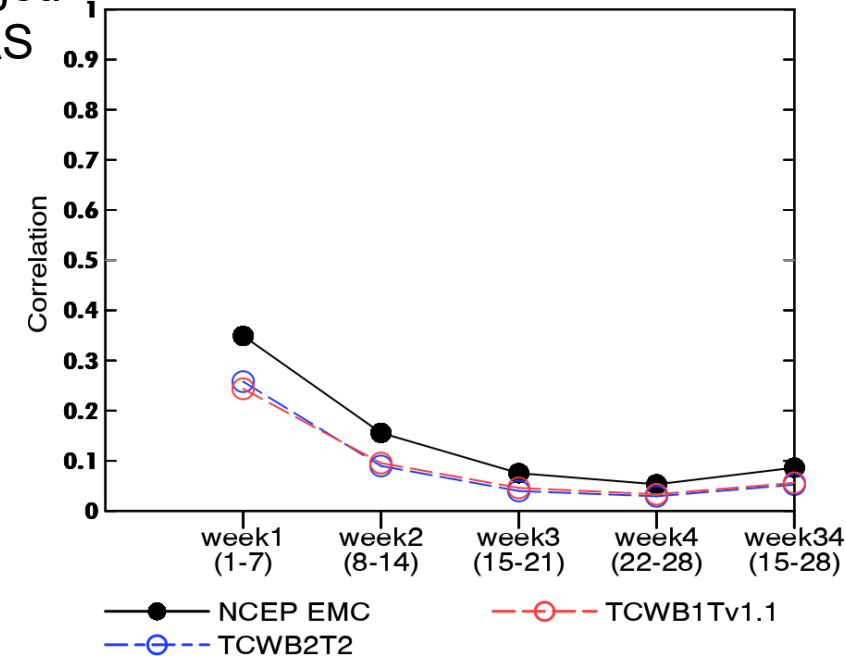
Target:
DJF
PRCP

pr Anomaly Correlation over GFA (Target: DJF)



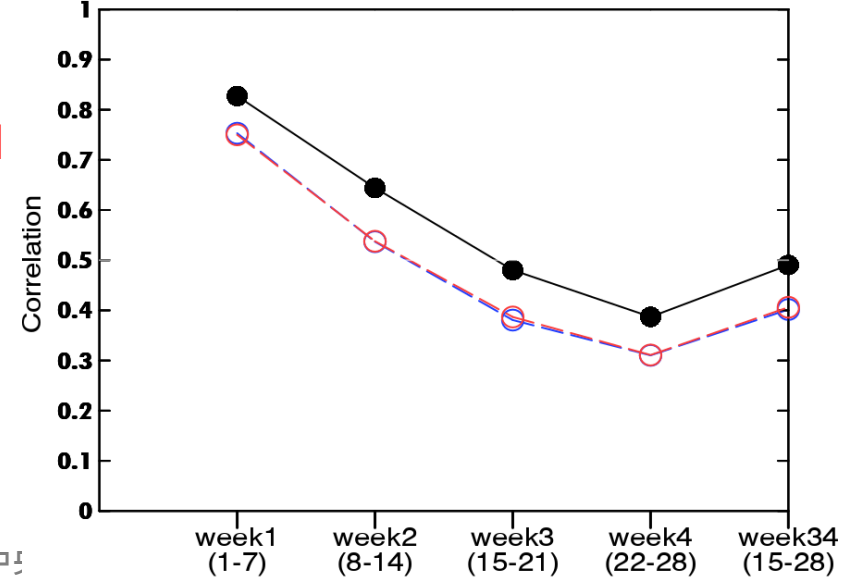
Target:
JAS

pr Anomaly Correlation over GFA (Target: JAS)

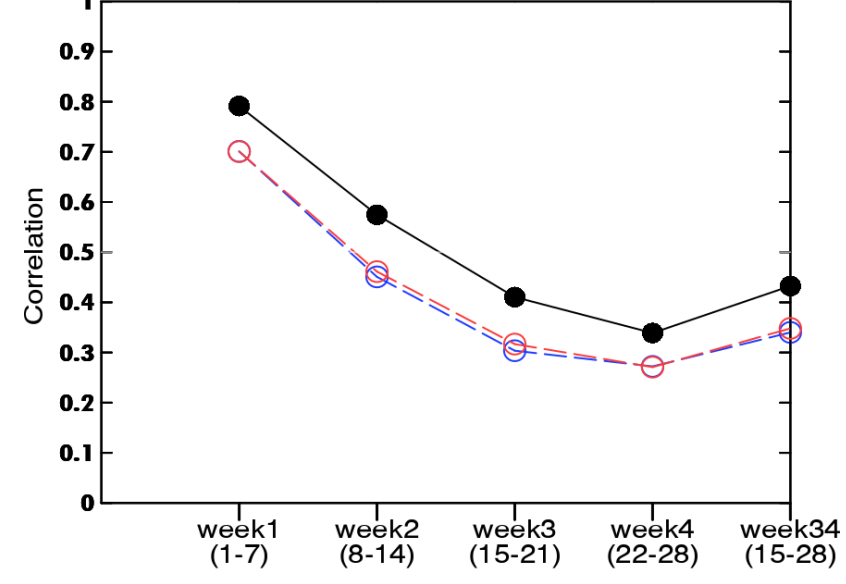


T2M

t2m Anomaly Correlation over GFA (Target: DJF)

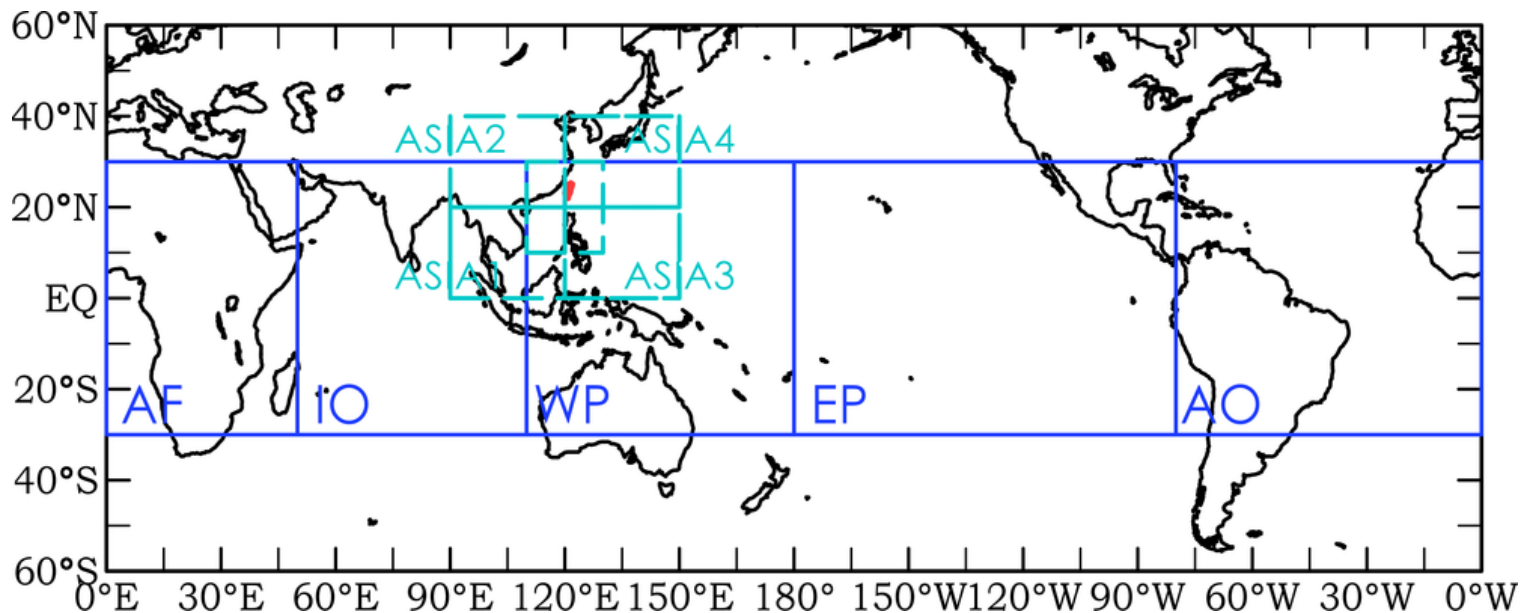


t2m Anomaly Correlation over GFA (Target: JAS)



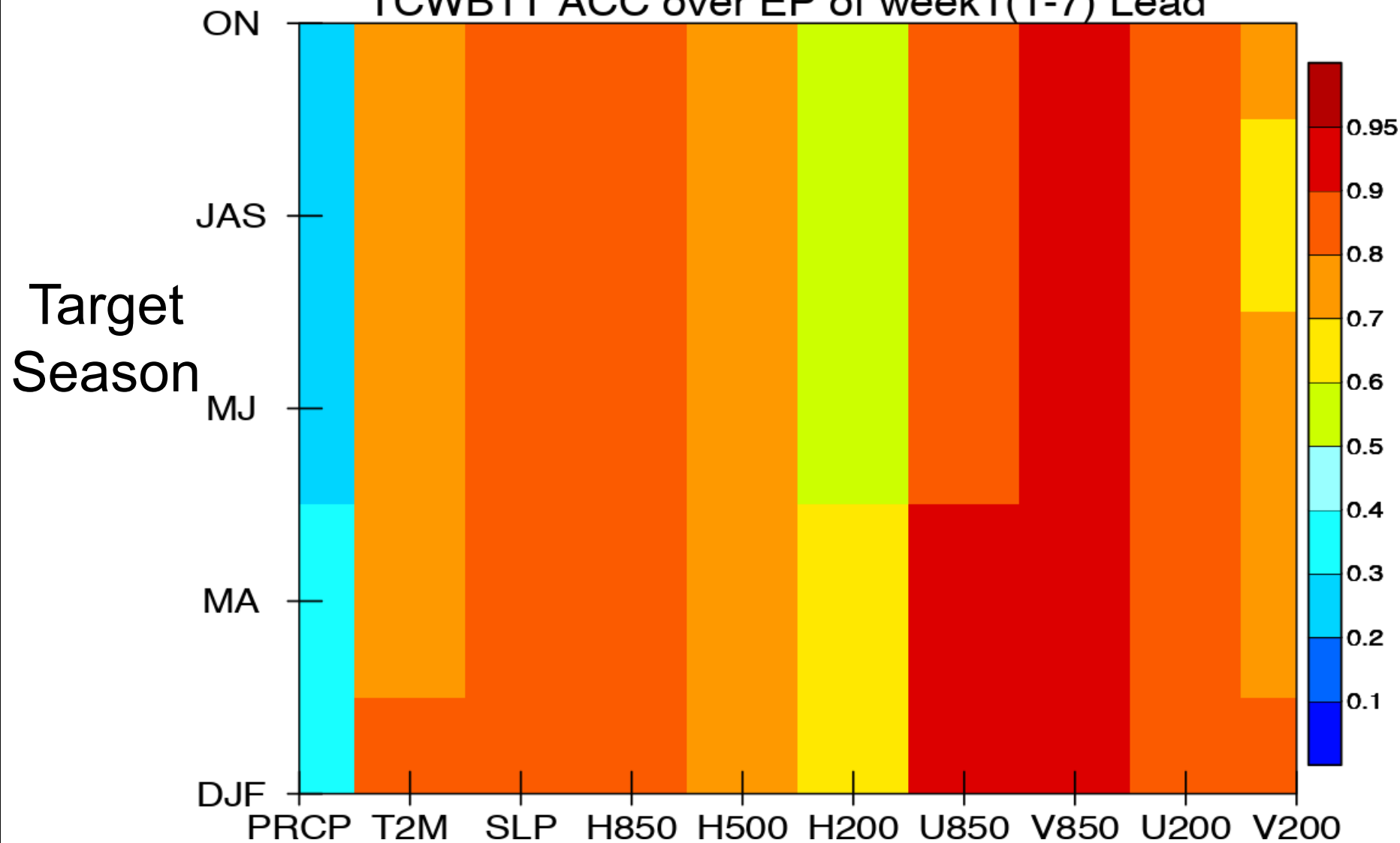
The skill of 5 Area(AF,IO,WP,EP,AO)

- AF(0-50°E), IO(50°E-110°E), WP(110°E-180°E), EP(180°W-80°W), AO(80°W-0) domain with 30°S-30°N
- Asia Regions and Taiwan Area.
Asia1(90-120E,0-20N), Asia2(90-120E,20-40N),
Asia3(120-150E,0-20N),Asia4(120-150E,20-40N)
Taiwan(110-130E,10-30N), Taiwan-s(117.5-125E,20-27.5N)



TCWB1T1.1 Skill of EP region

TCWB1T ACC over EP of week1(1-7) Lead



EP Region

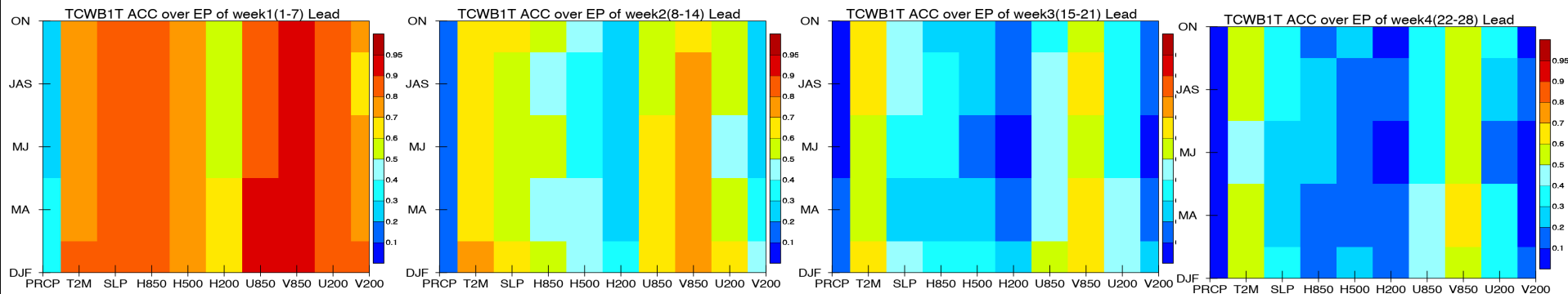
Lead-WK1

Lead-WK2

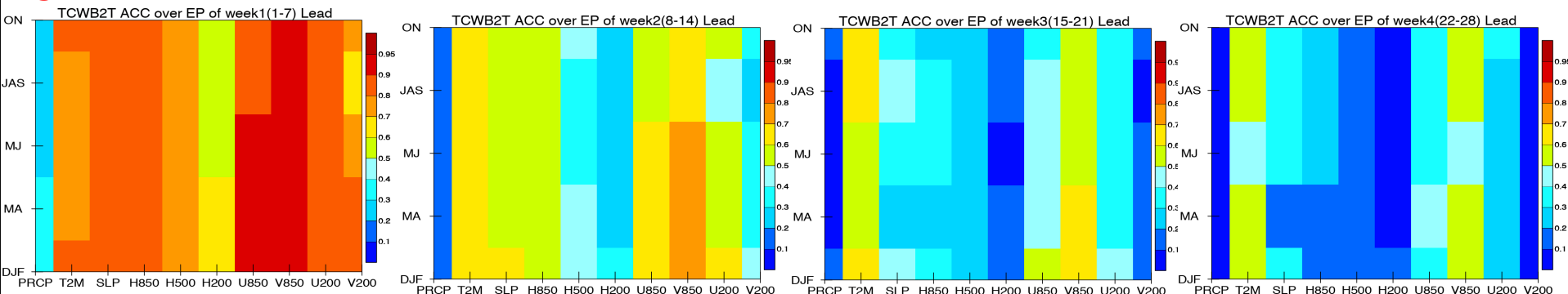
Lead-WK3

Lead-WK4

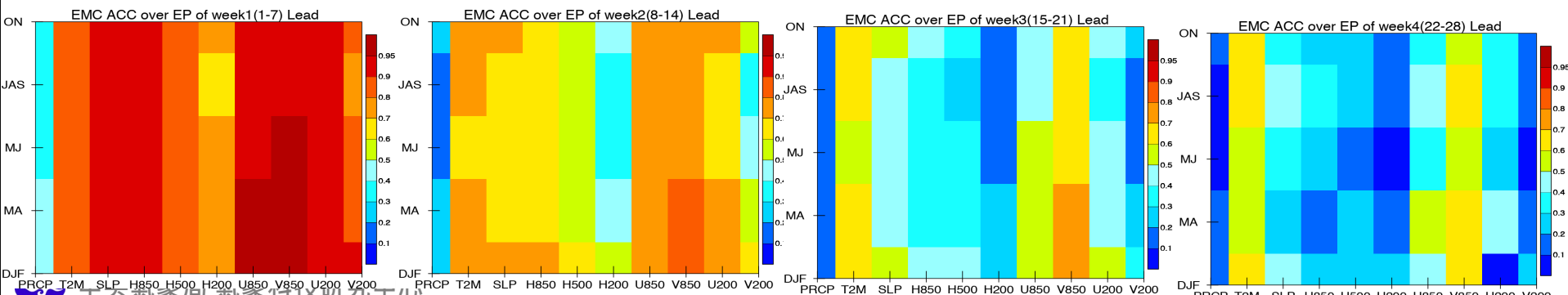
TCWB1T1.1



TCWB2T2



EMC

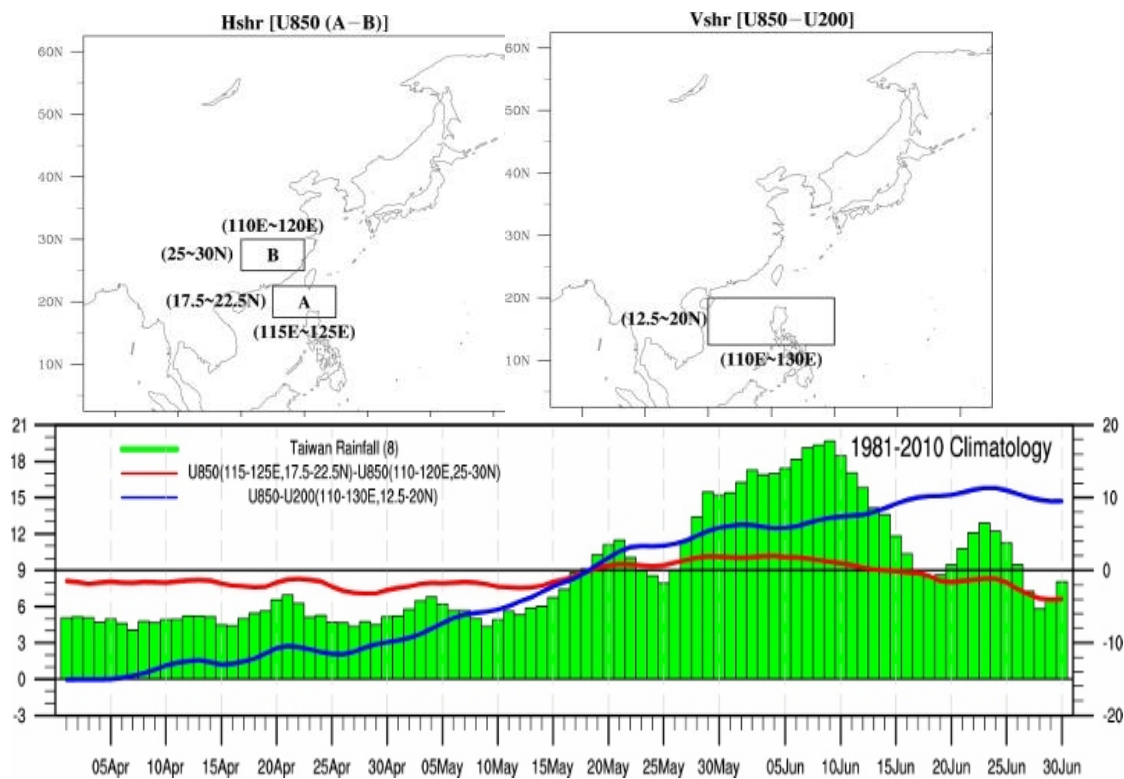


臺灣地區-梅雨季降雨指標

同時考慮大尺度環流的轉變和局地環境的不穩定條件，以一組指標代表臺灣梅雨期的開始，以及梅雨期間降雨的情形。

Hshear— 低層水平風切，為臺灣附近低層水平風切的轉變。 $U850[(115E-125E, 17.5N-22.5N) - (110E-120E, 25N-30N)]$

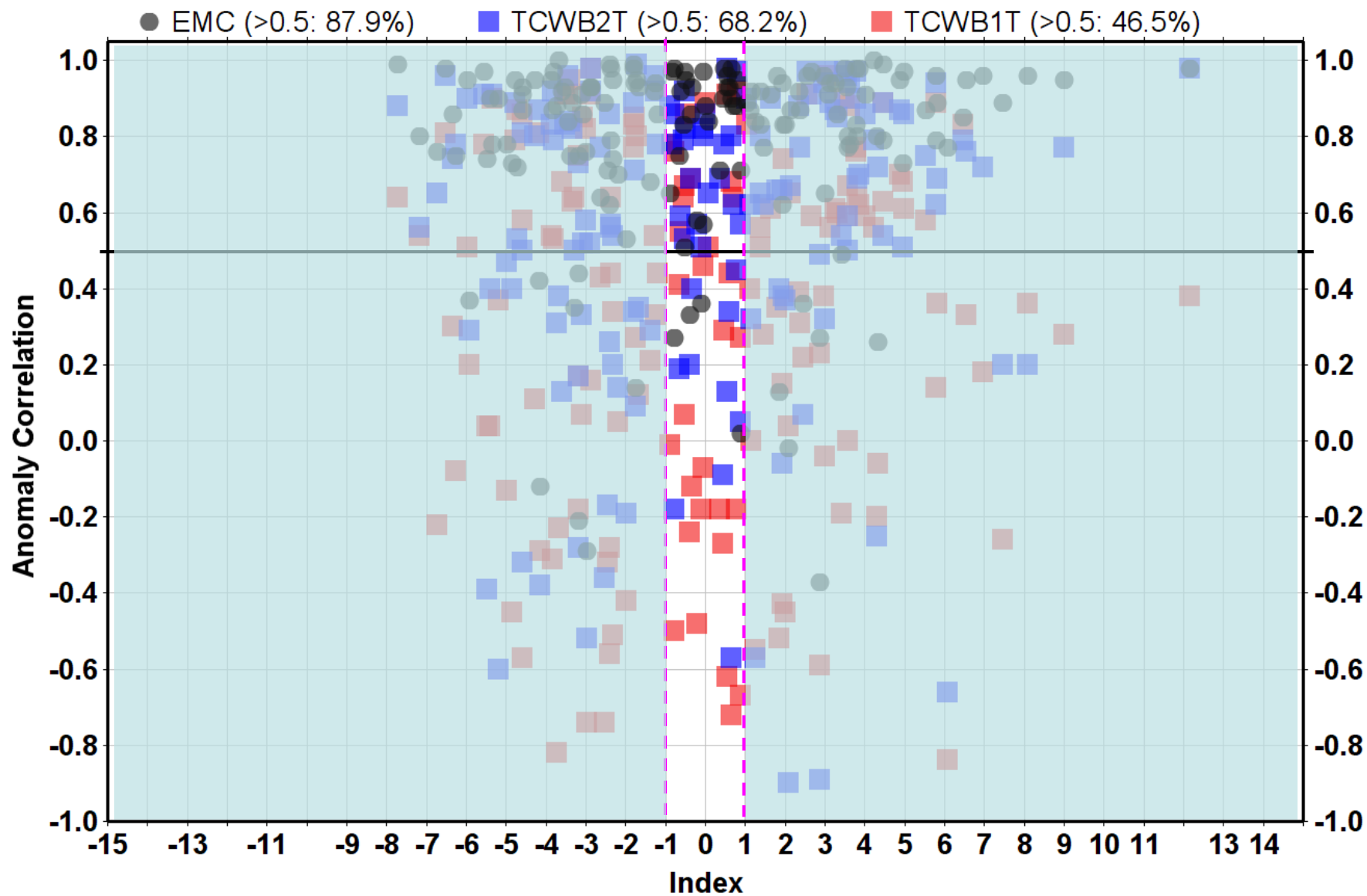
Vshear— 垂直風切，大尺度環流的變化，顯示季風建立的時間。 $U850(110E-130E, 12.5N-20N) - U200(110E-130E, 12.5N-20N)$



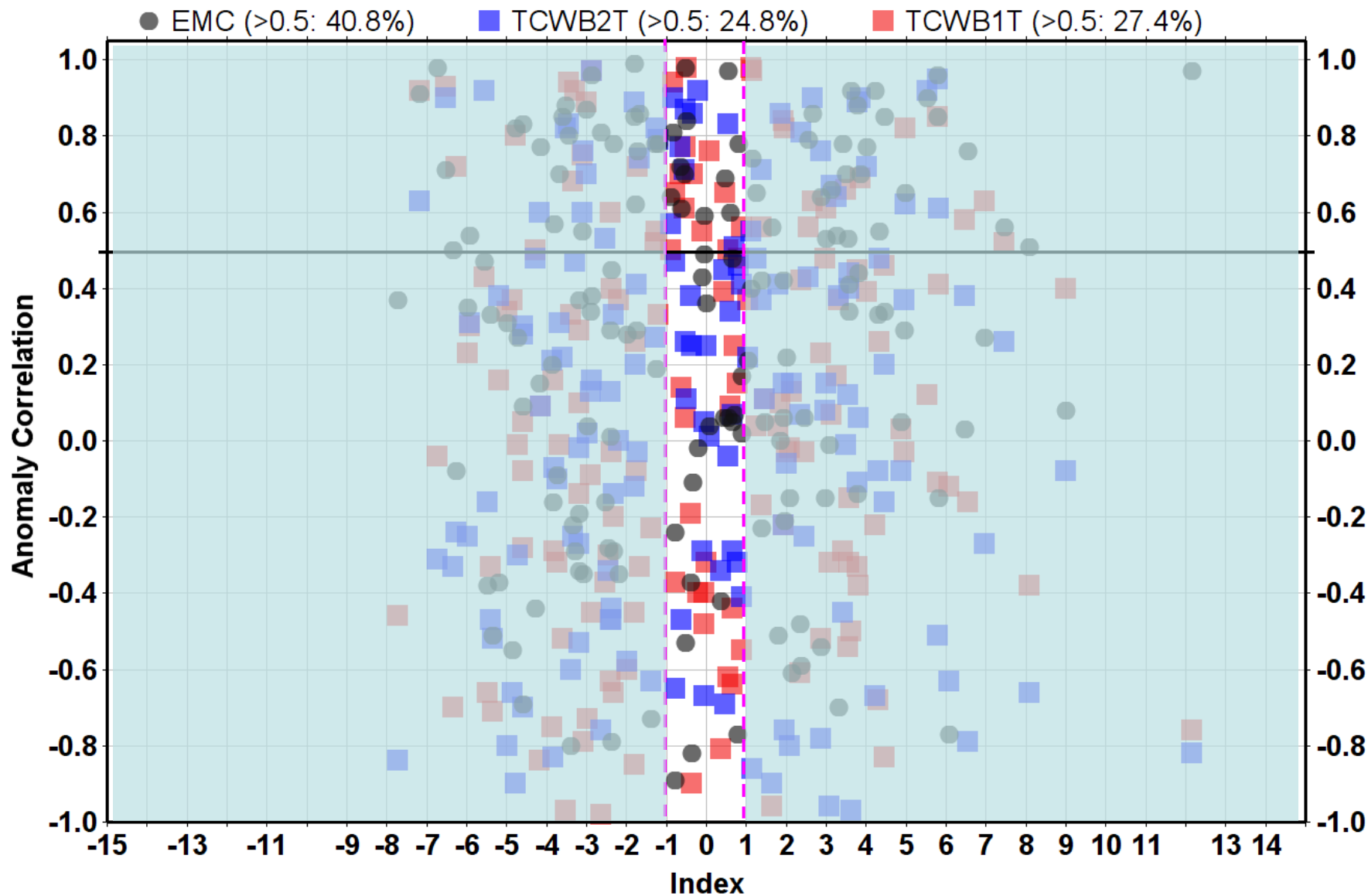
Vshear (- → +) & Hshear (反氣旋(-) → 氣旋(+))
→ 風切渦度↑ → 環境不穩定↑
→ 臺灣豪大雨發生機會↑

※將Vshear和Hshear兩指標結合，可以良好地反應臺灣梅雨期雨量變化。

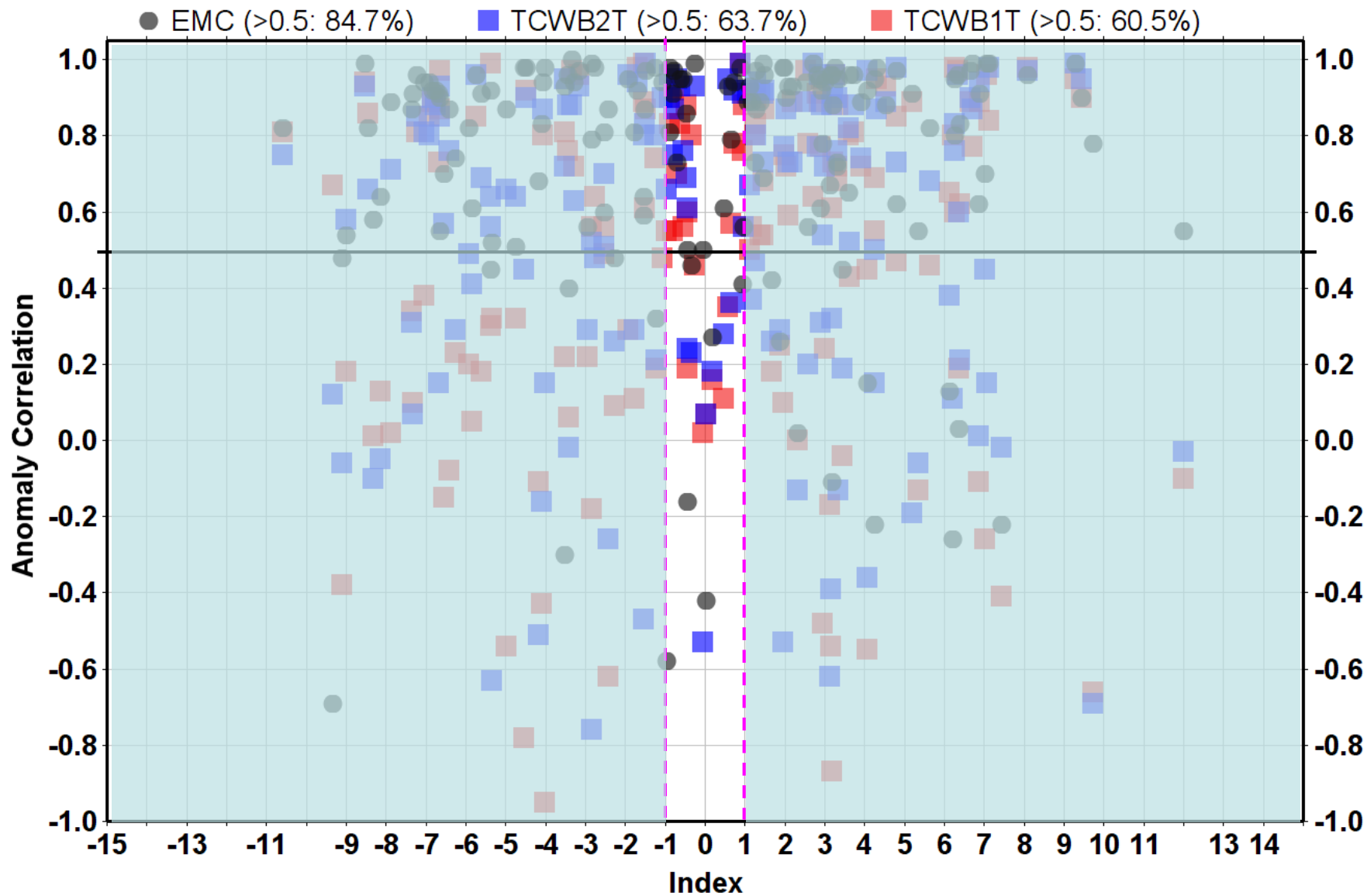
Model ACC and Hshear Index (Lead: week1)



Model ACC and Hshear Index (Lead: week2)



Model ACC and Vshear Index (Lead: week1)



Conclusion

- 溫度在季內尺度比降水有更高的技術得分，冬季比夏季有較好的預報能力
- 溫度在前四周都具有預報技術，但雨量具無預報技術(距平相關係數 >0.5)，環流場在領先第一周都具有預報技術，而領先2-4周具只剩下低層風場(U850, V850)有預報能力。
- 氣象局第一代海氣偶合模式(TCWB1T1.1)的預報與美國氣象局環境預測中心(NCEP_EMG)的全球模式(GEFS)預報能力表現當一致。



謝謝聆聽 敬請指教

Thank you for your listening.

