

評估氣象局第一代海氣耦合模式經 改進後模式預報能力

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Outline

1. CWB Climate Model Introduction

2. Model Bias

3. Anomaly Correlation Skill score

4. Conclusion and Future Work

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

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)

↑↓
Coupler
(MOM3)

TCWB1T1

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CWB Climate Model Information

Atmospheric Model Resolution	T119(1° X 1°) and 40 Level
Ocean Forecast Data (2T):	NCEP-CSFv2 SST (Dynamical Model) CWB-OPGv2 SST (Statistical Model)
Ocean Model Resolution (MOM3) 74°S to 64°N (1T)	Zonal resolution: 1° domain-wide Meridional resolution: 1/3° from 10°S-10°N, increasing gradually to 1° meridional resolution poleward of 30°S and 30°N 40 vertical levels 10 m thickness from surface to 240 m, with 27 levels in the top 400 meters to resolve the mixed layer, Bottom depth is 4500 m with bottom layer thickness of about 511 m
radiation scheme	Fu and Liou. (1993)
Boundary layer parameterization	MRF PBL A first order non-local scheme (Hong and Pan 1996, Troen and Mahrt 1986)
Land Surface Model	Noah 4-layer soil model (Ek et al. 2003)
Cumulus Parameterization	New SAS (Han and Pan 2011)

CWB Climate Model Information

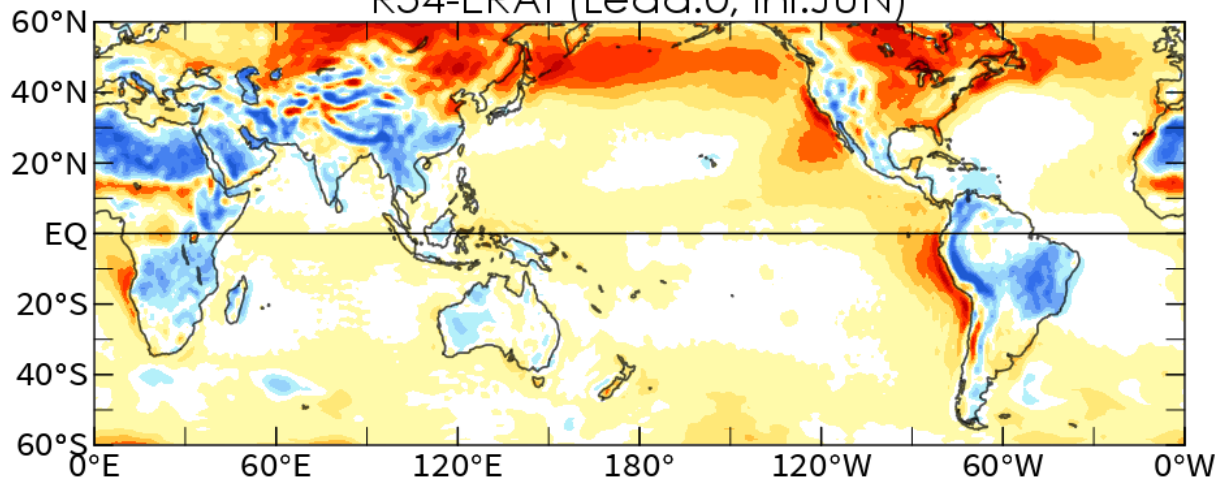
	Model Experiment
Experiment design	Forecast: 2012Jan – present Hindcast: 1982-2011 (30-year integration)
Integration time	280 days (9-month integration for each case)
Atmospheric Model	CWB-GCM (T119L40) ECHAM5 (T42L19)
SST (2T)	OPGSST-v2.0 and NCEP-CFSv2-SST(CFSRR) (OPGSST: 4 statistical models, 2 couple models) (CFSRR: 4 x daily run)
Couple Model (1T)	CWB-GCM (T119L40) – MOM3



TCWB1T1 Climatology Bias

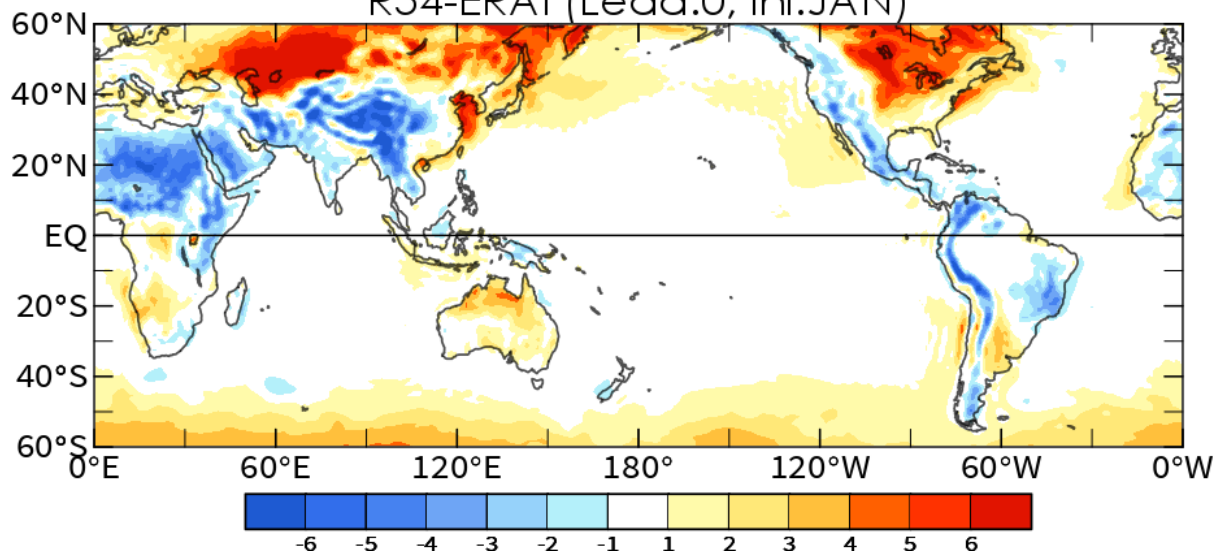
Ini:Jun, Forecast: Jul

1999-2015 Jul t2m Difference
R54-ERAi (Lead:0, ini:JUN)



Ini:Jan, Forecast: Feb

1999-2015 Feb t2m Difference
R54-ERAi (Lead:0, ini:JAN)



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氣候資訊應用組 

TCWB1T1 兩種版本差異

修正方法	R54(作業化版本)	R60(修正後版本)
物理參數化:相對濕度門檻值	達飽和門檻值在從熱帶到高緯越來越高，海陸使用相同門檻值。	達飽和門檻值在從熱帶到高緯越來越高，且會隨天頂角不同而有季節變化。海陸使用不同門檻值。
下邊界		海洋模式內插到大氣模式時，海陸格點的修正
動力架構:處理水平擴散會向參考值趨近	參考值為參考大氣(氣候場)	參考值為前一個time step
初始場		bugfix
氣候場	沒有隨時間更新	隨時間更新氣候場

R54與R60的差異在於物理參數化設定的不同，下邊界海陸格點處理的方法修正，動力架構、初始場和氣候場的改善，詳細的表較說明如下：

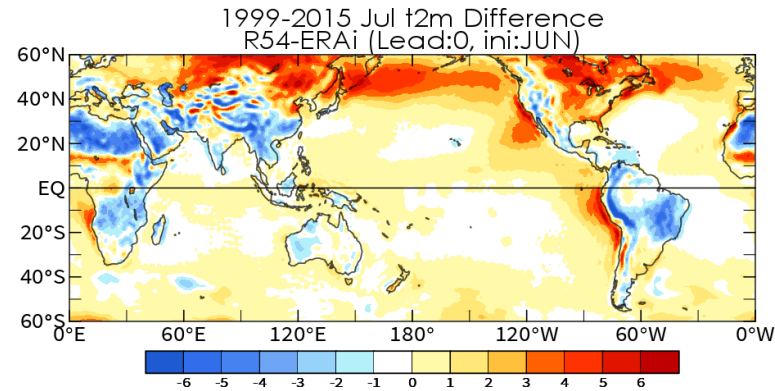
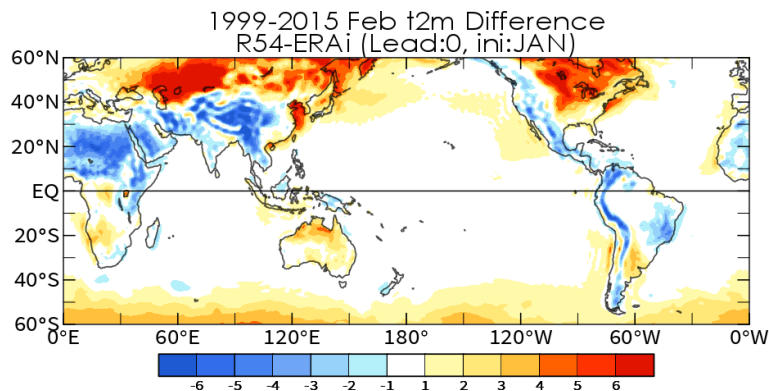
- 物理參數化是相對溼度門檻值設定的不同，除了最大最小值的差異外，還有分布的不同以及海陸差異。
- 下邊界則是海洋模式將海溫插回大氣模式時，兩個模式海點跟陸點差異，造成海溫的誤差，修正處理方法後能減少在海洋大陸區域的海溫誤差。
- 動力部分在處理水平擴散時，會將預報值透過細數調整向參考值接近，若將參考值從參考大氣換成前一個預報時間，會大幅減少預報值與參考值的差異。
- 初始場與氣候場則是針對錯誤的部分進行修正。

TCWB1T1 溫度(T2m)模式與觀測場(ERA-Interim)氣候場誤差

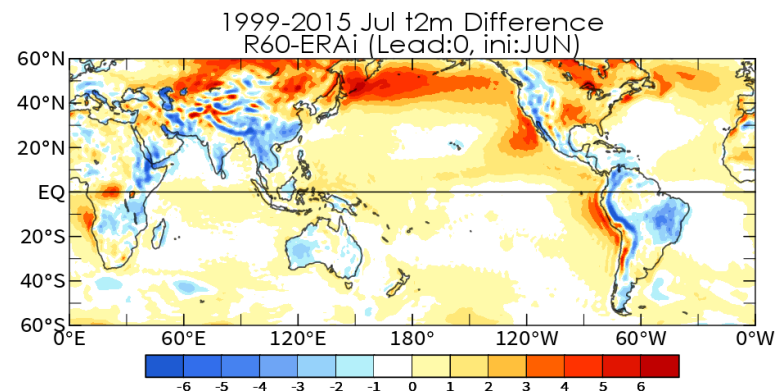
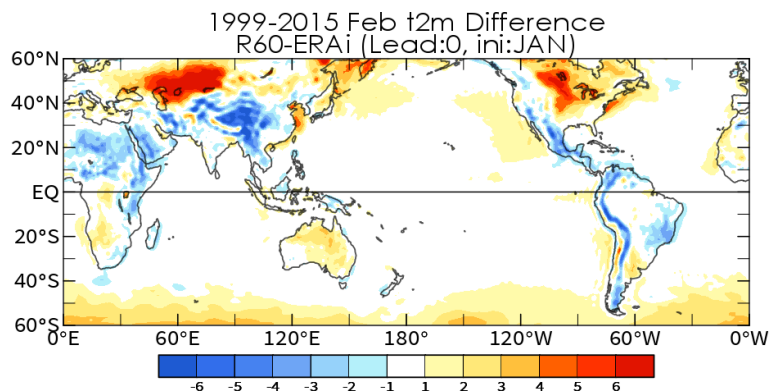
Ini:Jan, Forecast: Feb

Ini:Jun, Forecast: Jul

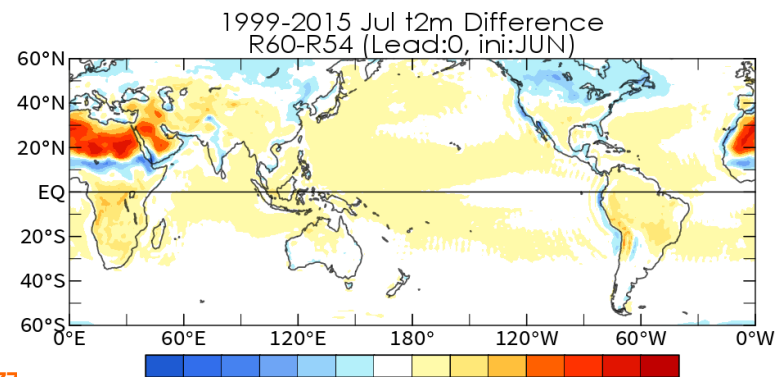
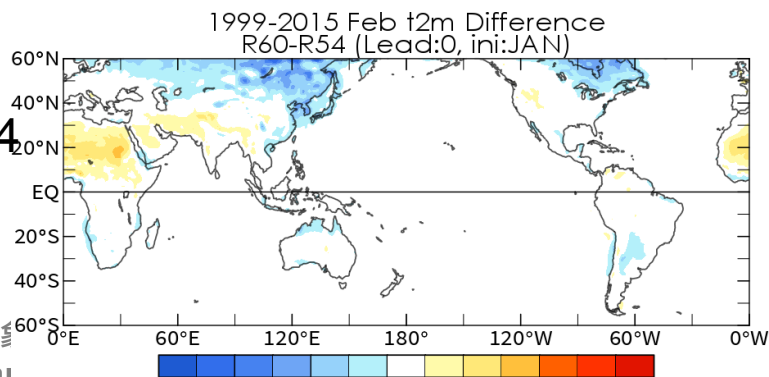
R54



R60



R60-R54



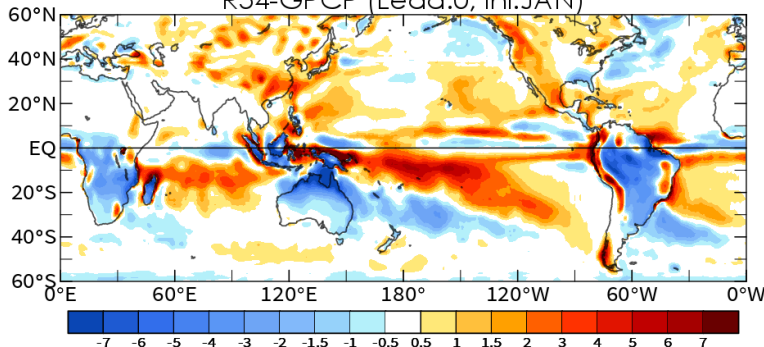
TCWB1T1 雨量(Precipitation)模式與觀測場(GPCP)氣候場誤差

Ini:Jan, Forecast: Feb

Ini:Jun, Forecast: Jul

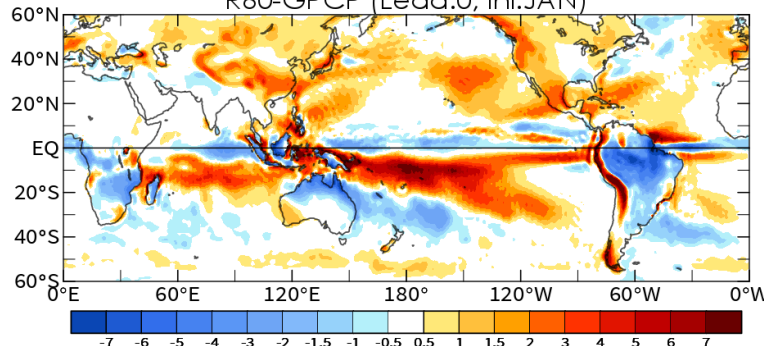
R54

1999-2015 Feb Precipitation Difference
R54-GPCP (Lead:0, ini:JAN)



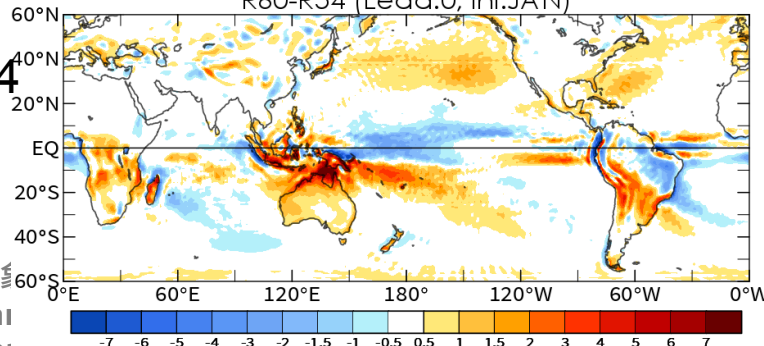
R60

1999-2015 Feb Precipitation Difference
R60-GPCP (Lead:0, ini:JAN)

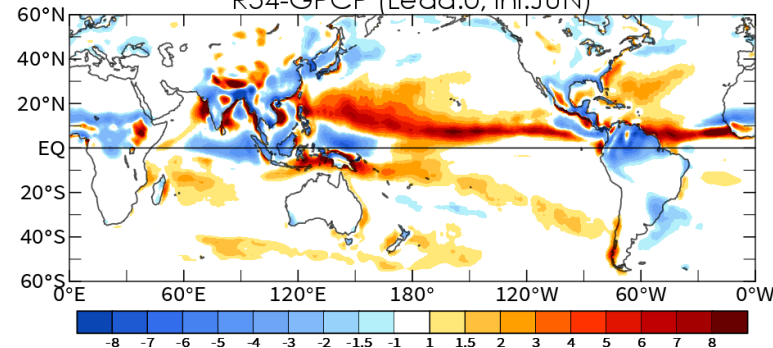


R60-R54

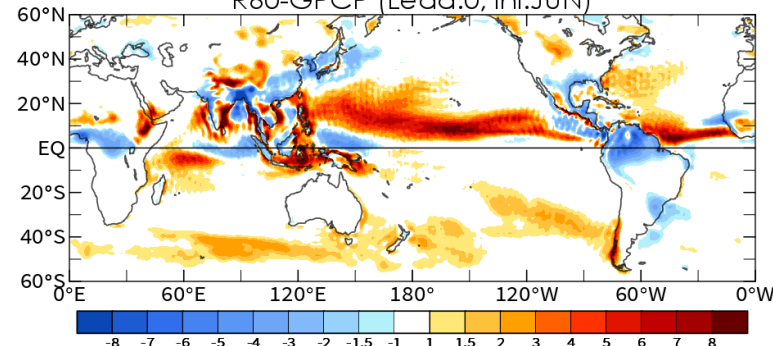
1999-2015 Feb Precipitation Difference
R60-R54 (Lead:0, ini:JAN)



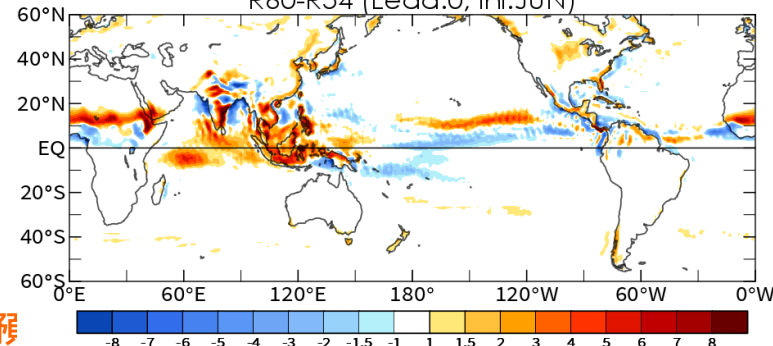
1999-2015 Jul Precipitation Difference
R54-GPCP (Lead:0, ini:JUN)



1999-2015 Jul Precipitation Difference
R60-GPCP (Lead:0, ini:JUN)



1999-2015 Jul Precipitation Difference
R60-R54 (Lead:0, ini:JUN)



祈興預

飛快具可應力組

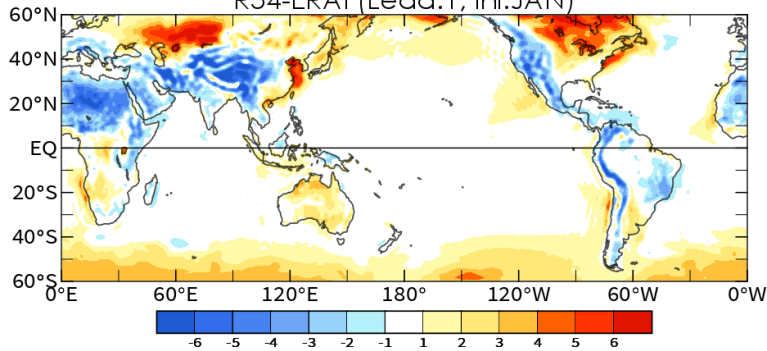
GIA

TCWB1T1 溫度(T2m)隨預報時間增加的氣候場誤差

Ini: Jan, Forecast: Mar, May, Jul

R54

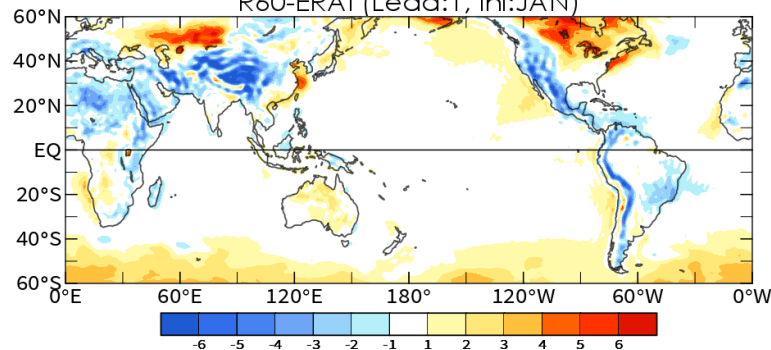
1999-2015 Mar t2m Difference
R54-ERAi (Lead:1, ini:JAN)



For:
Mar

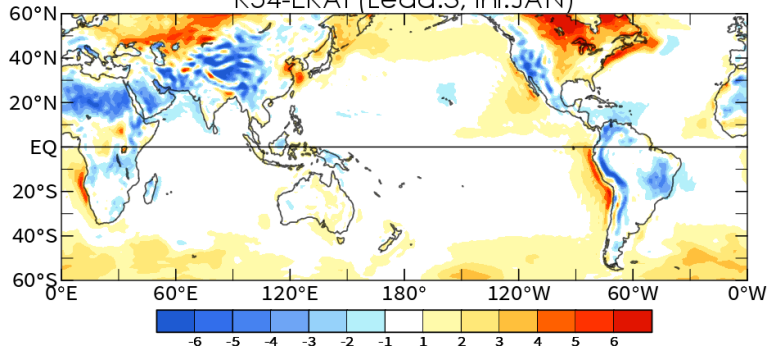
R60

1999-2015 Mar t2m Difference
R60-ERAi (Lead:1, ini:JAN)

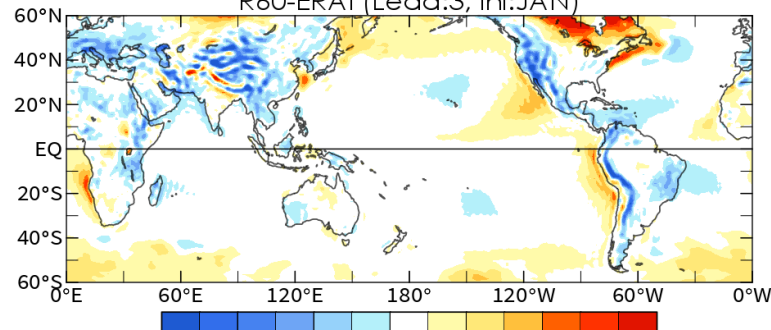


For:
May

1999-2015 May t2m Difference
R54-ERAi (Lead:3, ini:JAN)

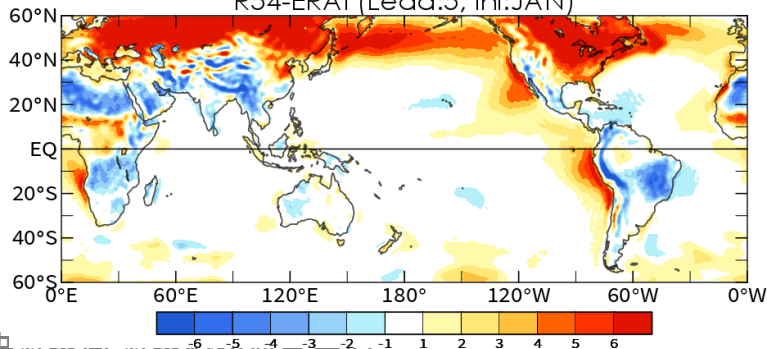


1999-2015 May t2m Difference
R60-ERAi (Lead:3, ini:JAN)

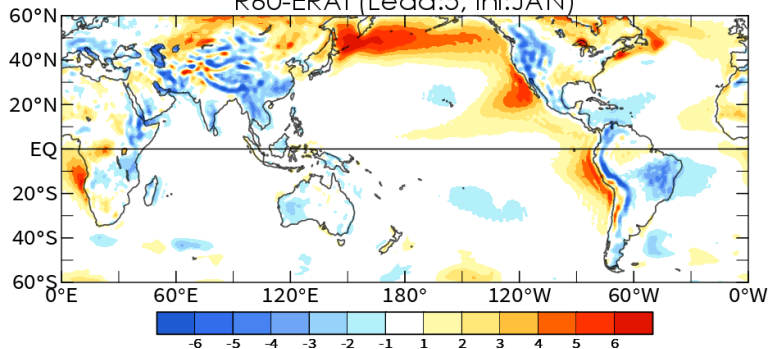


For:
Jul

1999-2015 Jul t2m Difference
R54-ERAi (Lead:5, ini:JAN)



1999-2015 Jul t2m Difference
R60-ERAi (Lead:5, ini:JAN)



TCWB1T1 雨量隨預報時間增加的氣候場誤差

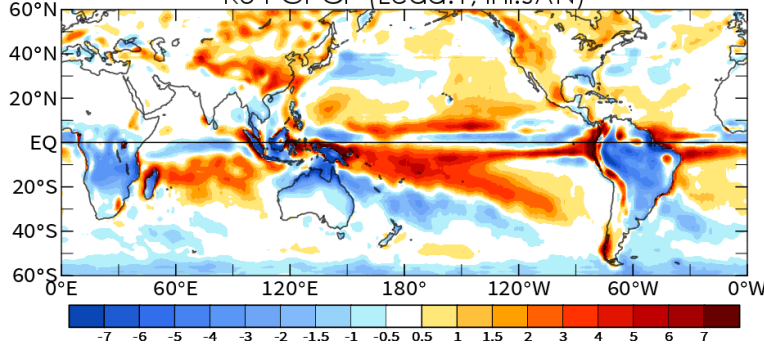
Ini: Jan, Forecast: Mar, May, Jul

R54

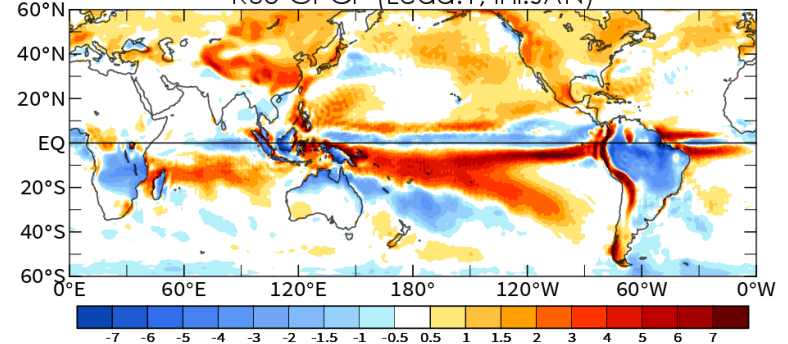
R60

For:
Mar

1999-2015 Mar Precipitation Difference
R54-GPCP (Lead:1, ini:JAN)

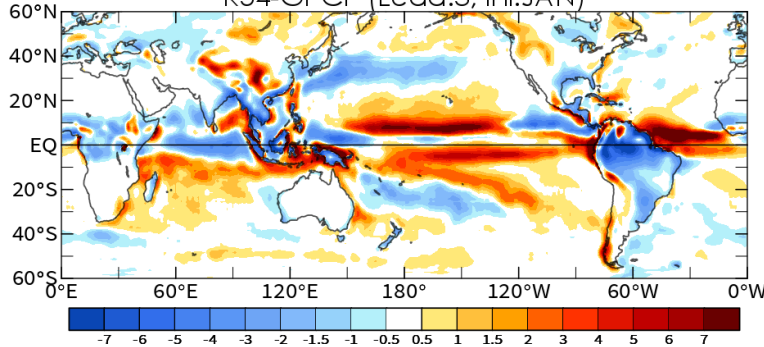


1999-2015 Mar Precipitation Difference
R60-GPCP (Lead:1, ini:JAN)

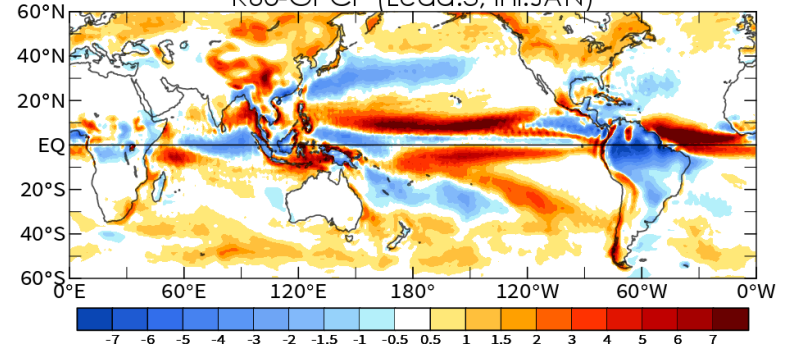


For:
May

1999-2015 May Precipitation Difference
R54-GPCP (Lead:3, ini:JAN)

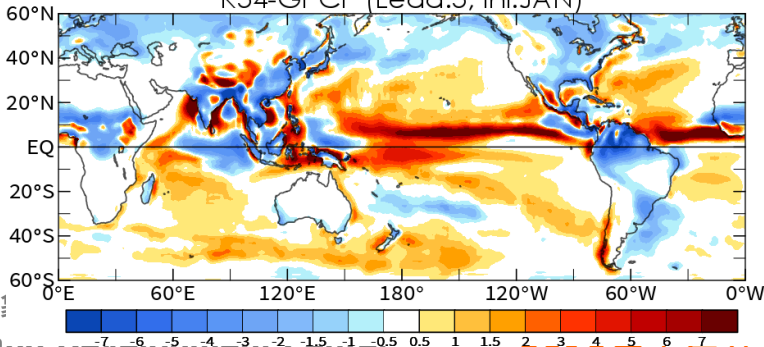


1999-2015 May Precipitation Difference
R60-GPCP (Lead:3, ini:JAN)

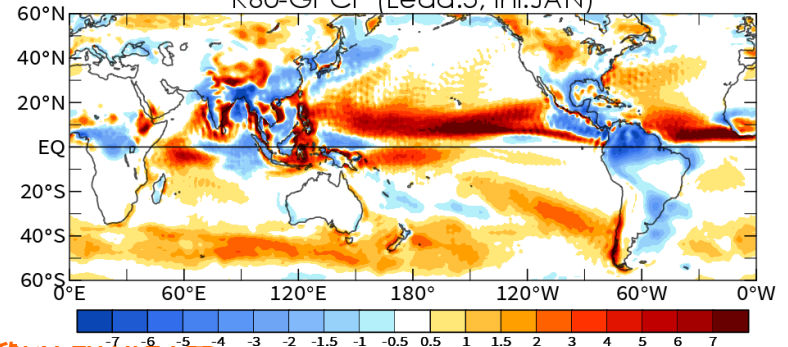


For:
Jul

1999-2015 Jul Precipitation Difference
R54-GPCP (Lead:5, ini:JAN)



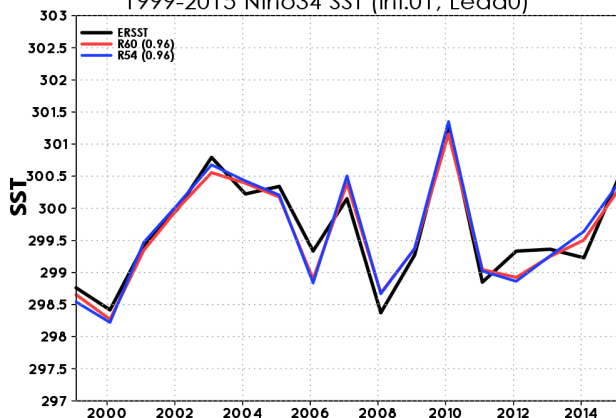
1999-2015 Jul Precipitation Difference
R60-GPCP (Lead:5, ini:JAN)



SST 時間序列變化

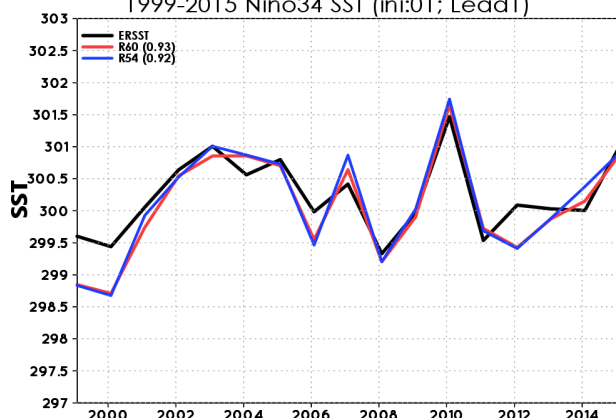
Nino3.4 Lead0

1999-2015 Nino34 SST (ini:01; Lead0)



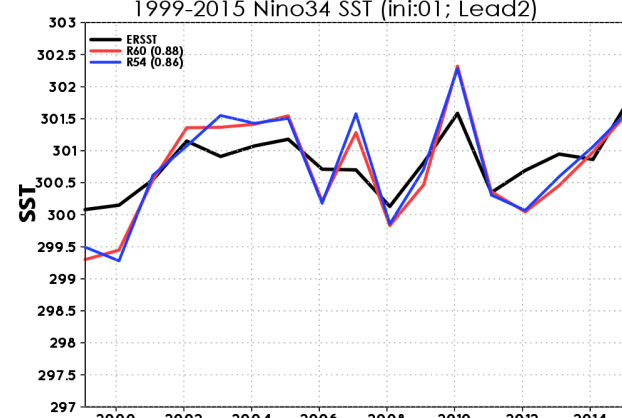
Nino3.4 Lead1

1999-2015 Nino34 SST (ini:01; Lead1)



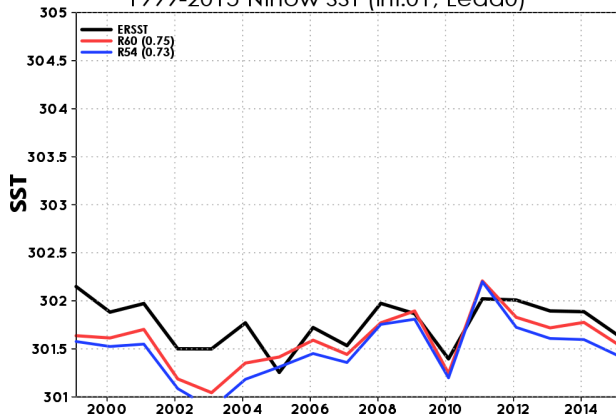
Nino3.4 Lead2

1999-2015 Nino34 SST (ini:01; Lead2)



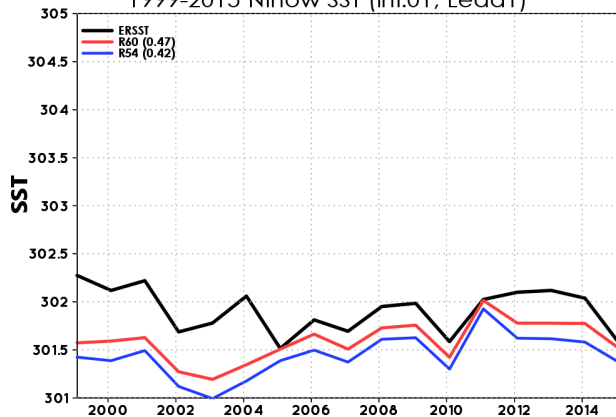
NinoW Lead0

1999-2015 Ninow SST (ini:01; Lead0)



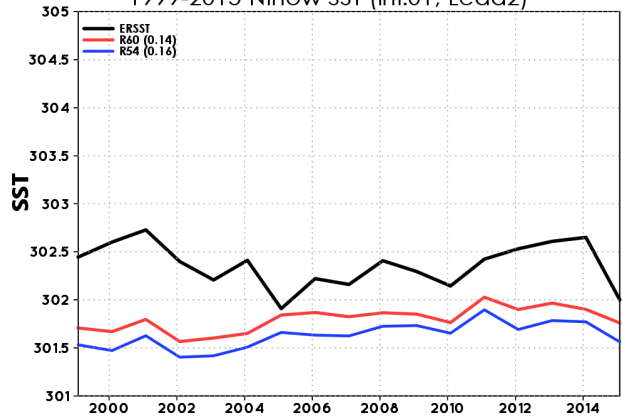
NinoW Lead1

1999-2015 Ninow SST (ini:01; Lead1)



NinoW Lead2

1999-2015 Ninow SST (ini:01; Lead2)



NinoW (130E-150E,0-15N)



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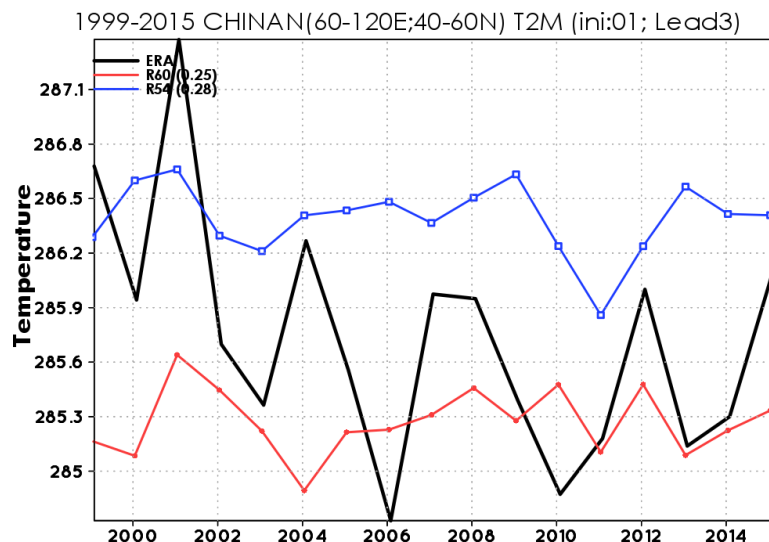
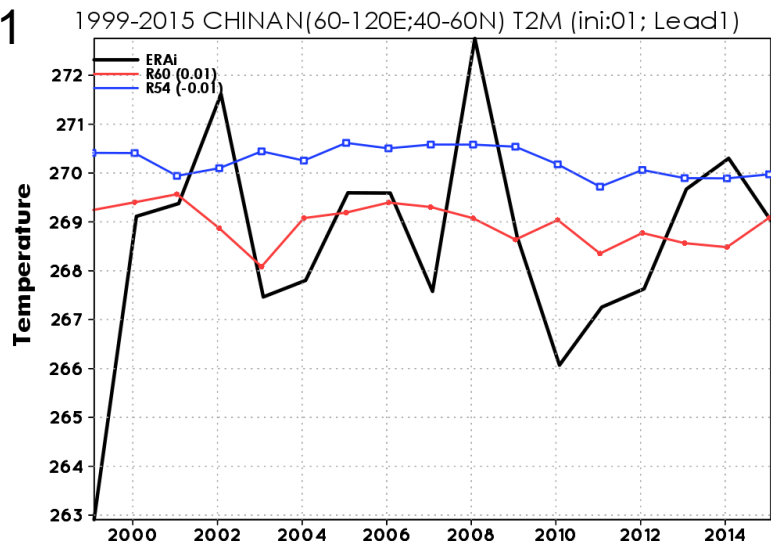
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氣候資訊應用組 CIA

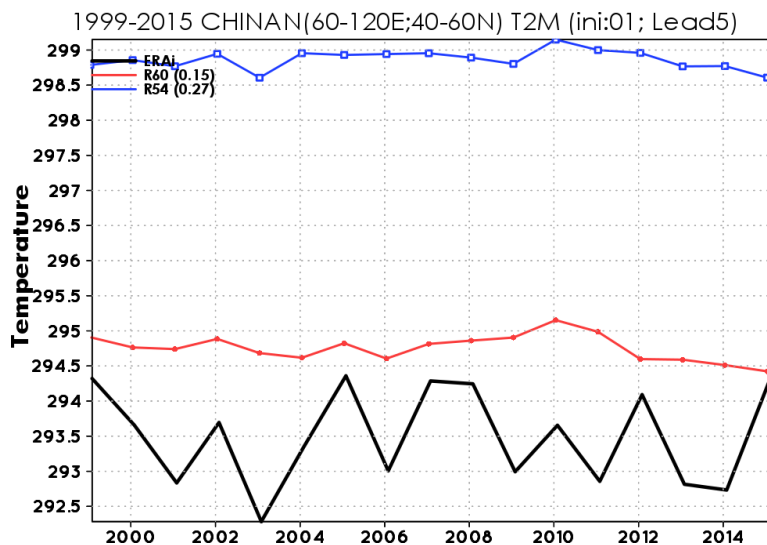
大陸地區(60-120E, 40-60N) T2M 時間序列變化

Lead3

Lead1



Lead5

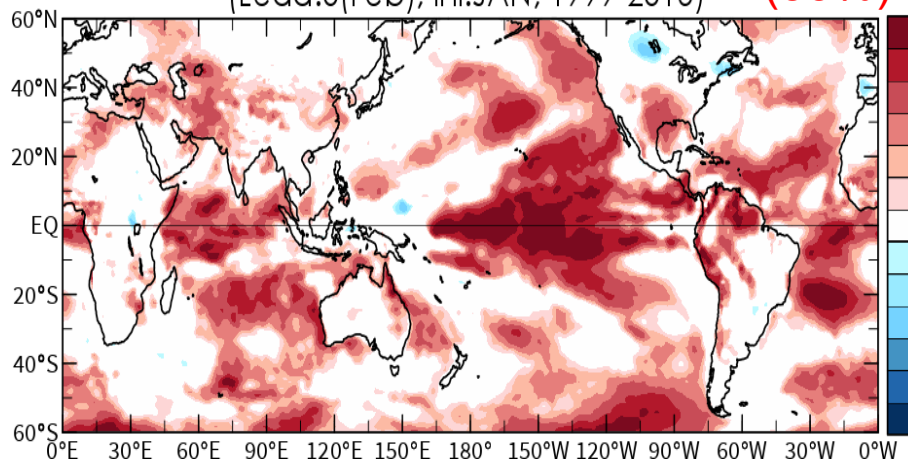


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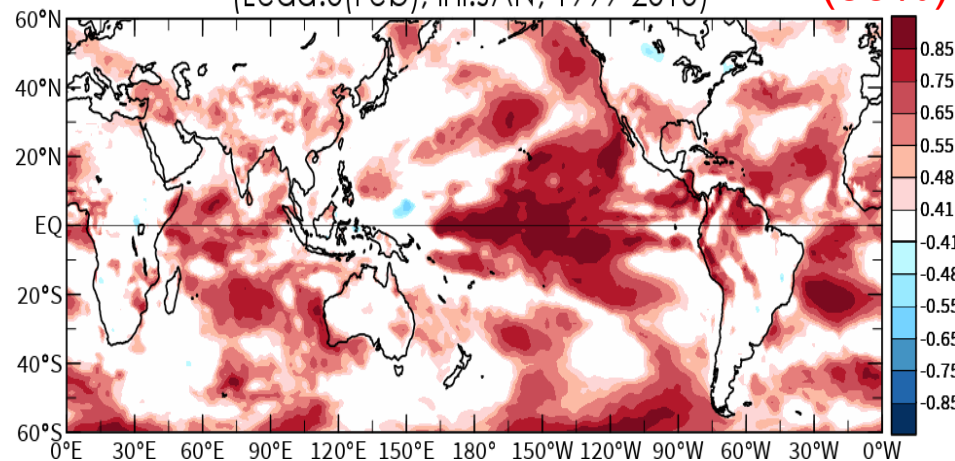
組 CIA

T2M Anomaly Correlation

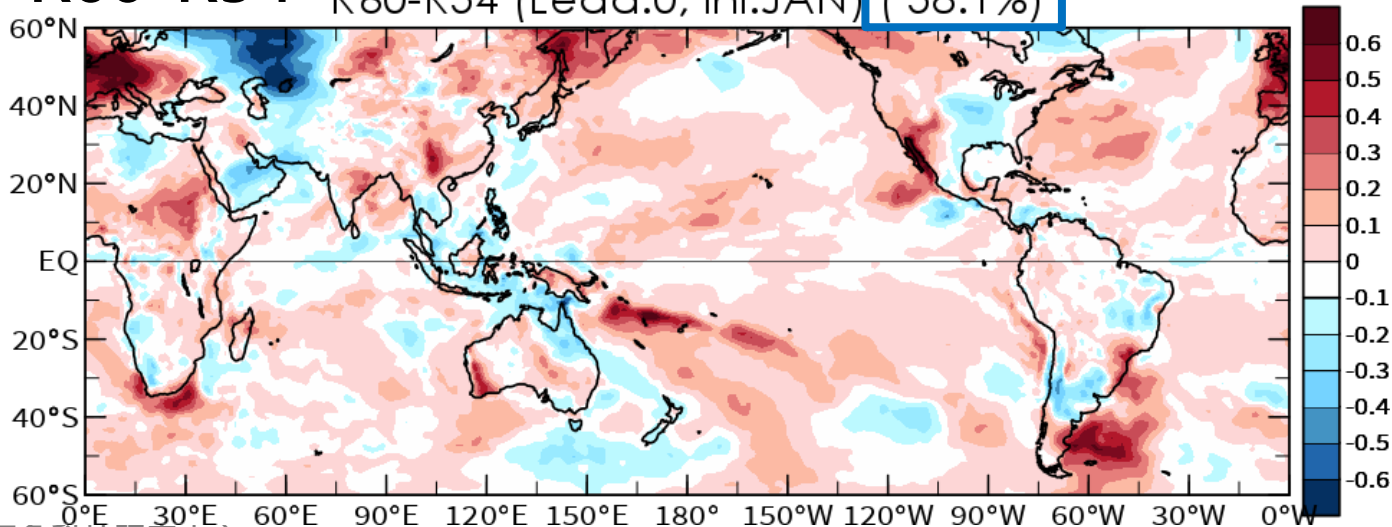
R54 T2m Corr between TCWB1T1-R54 & ERAi
(Lead:0(Feb), ini:JAN, 1999-2015) **(53%)**



R60 T2m Corr between TCWB1T1-R60 & ERAi
(Lead:0(Feb), ini:JAN, 1999-2015) **(55%)**



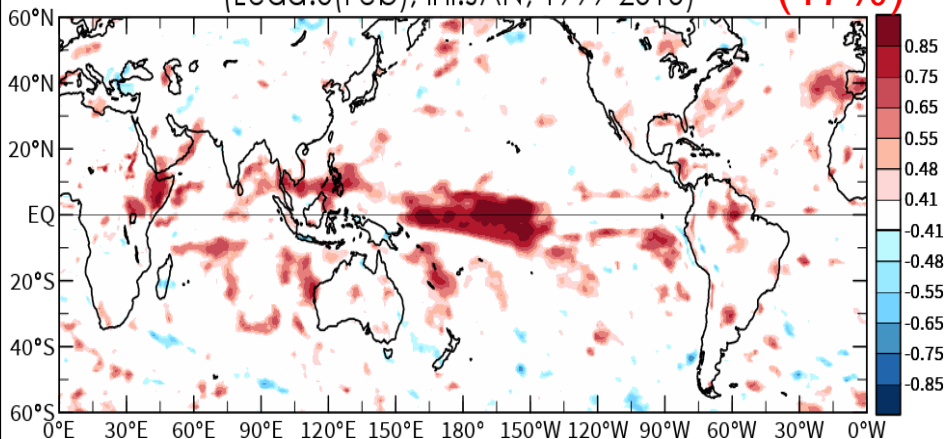
R60-R54 T2M Correlation Difference
R60-R54 (Lead:0, ini:JAN) **(58.1%)**



Precipitation Anomaly Correlation

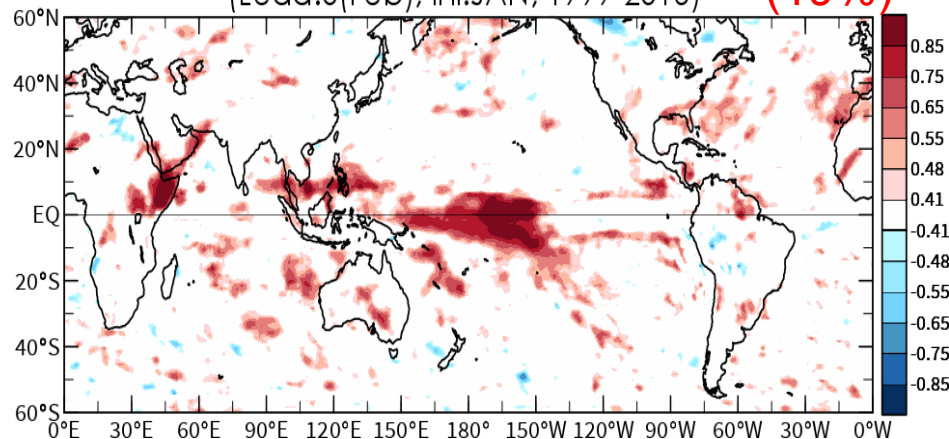
R54

Precipitation Corr between TCWB1T1-R54 & GPCP
(Lead:0(Feb), ini:JAN, 1999-2015) **(17%)**



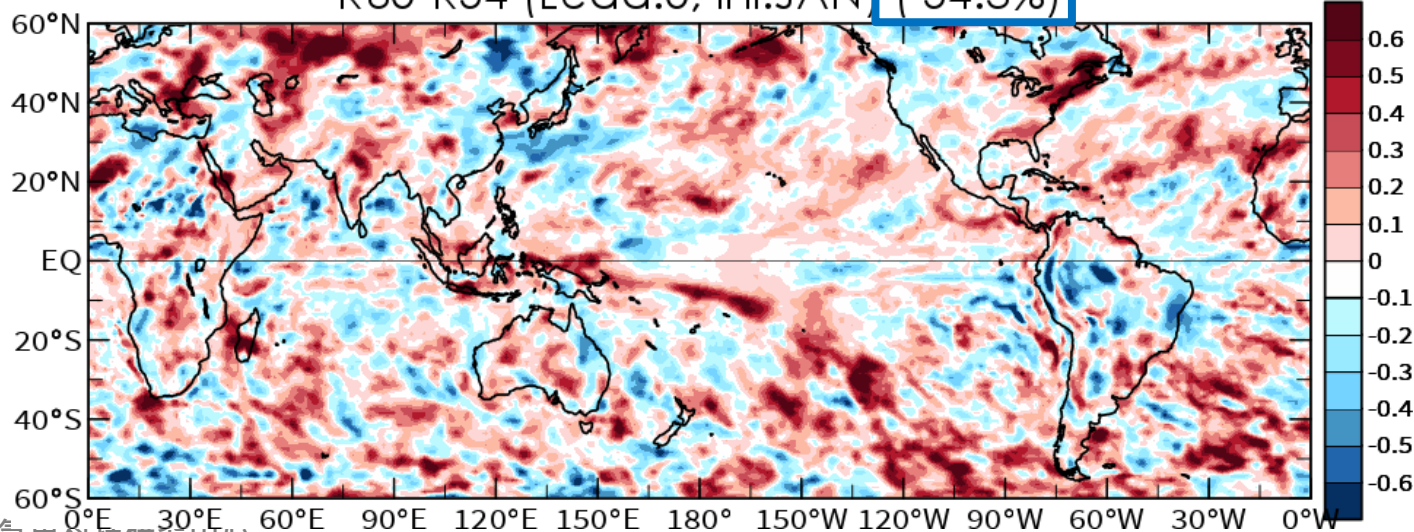
R60

Precipitation Corr between TCWB1T1-R60 & GPCP
(Lead:0(Feb), ini:JAN, 1999-2015) **(19%)**



R60-R54

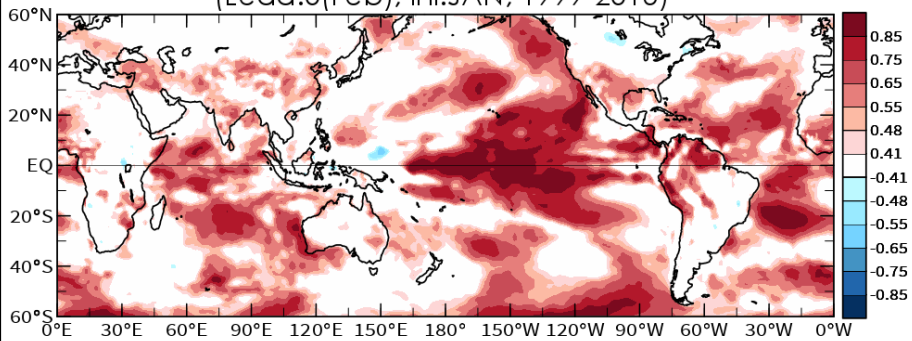
Precipitation Correlation Difference
R60-R54 (Lead:0, ini:JAN) **(54.3%)**



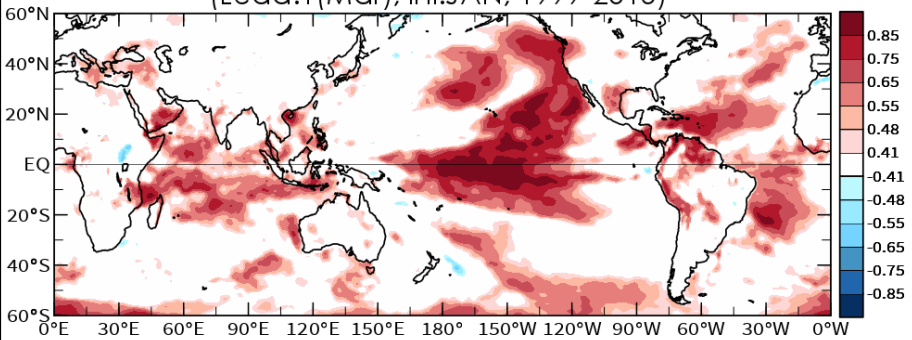
R60 T2M Anomaly Correlation (Lead0,1,2)

R60

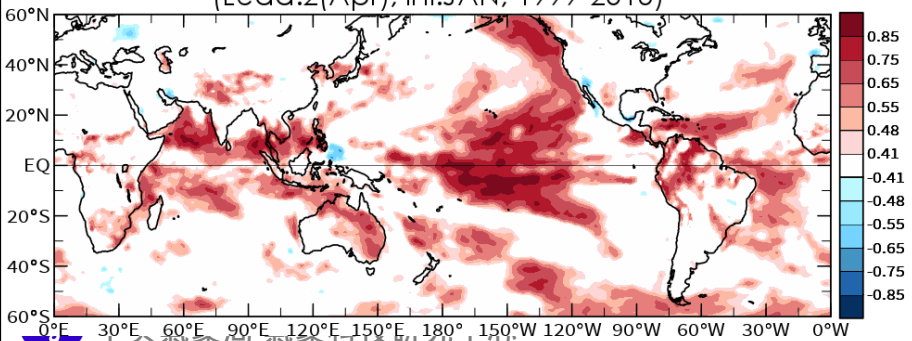
T2m Corr between TCWB1T1-R60 & ERAi
(Lead:0(Feb), ini:JAN, 1999-2015)



T2m Corr between TCWB1T1-R60 & ERAi
(Lead:1 (Mar), ini:JAN, 1999-2015)

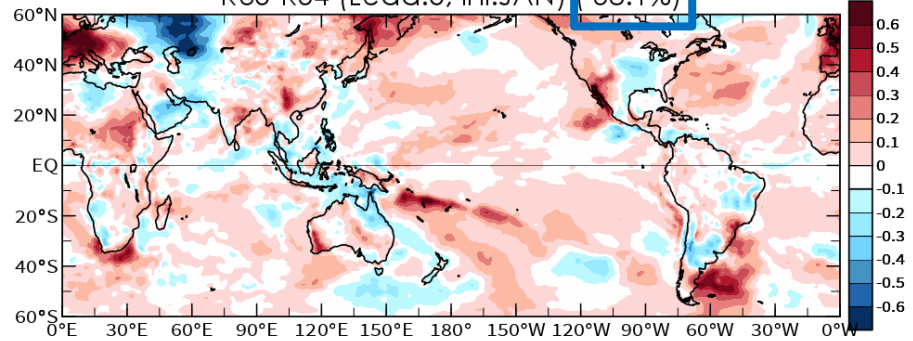


T2m Corr between TCWB1T1-R60 & ERAi
(Lead:2 (Apr), ini:JAN, 1999-2015)

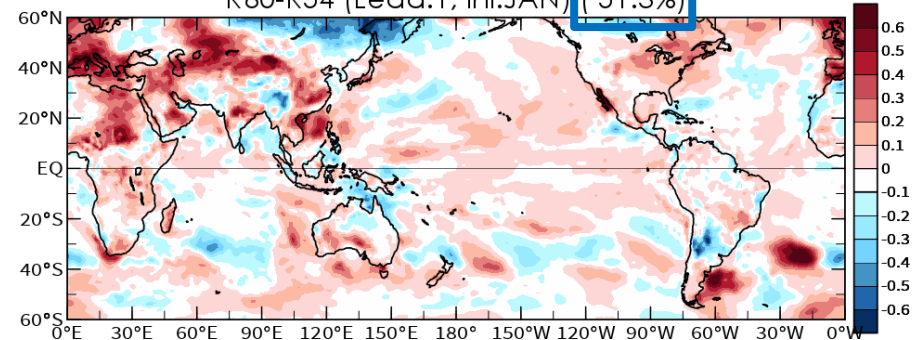


R60-R54

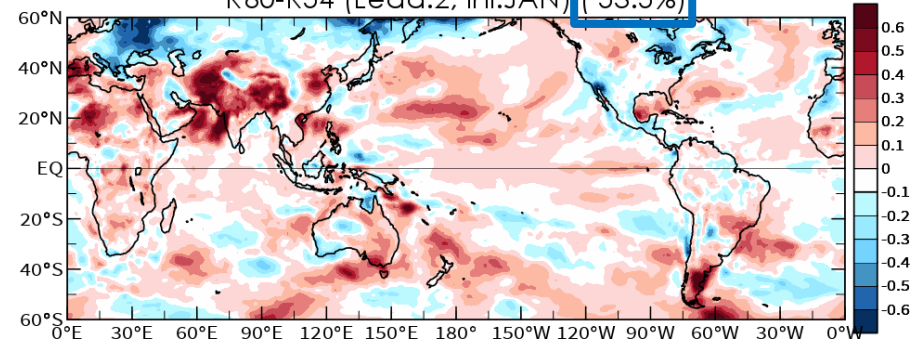
T2m Correlation Difference
R60-R54 (Lead:0, ini:JAN) (58.1%)



T2m Correlation Difference
R60-R54 (Lead:1, ini:JAN) (51.3%)



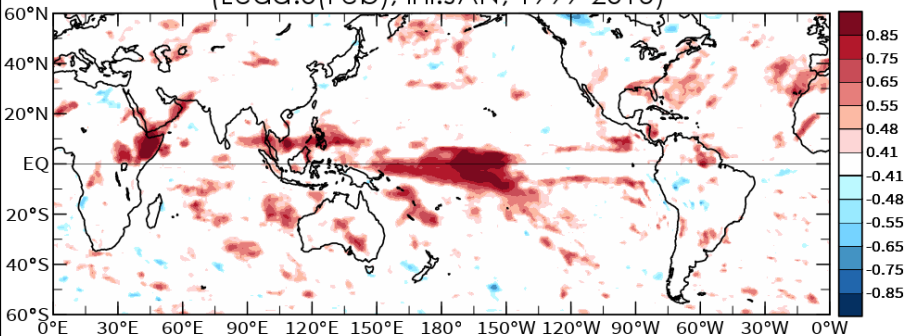
T2m Correlation Difference
R60-R54 (Lead:2, ini:JAN) (53.5%)



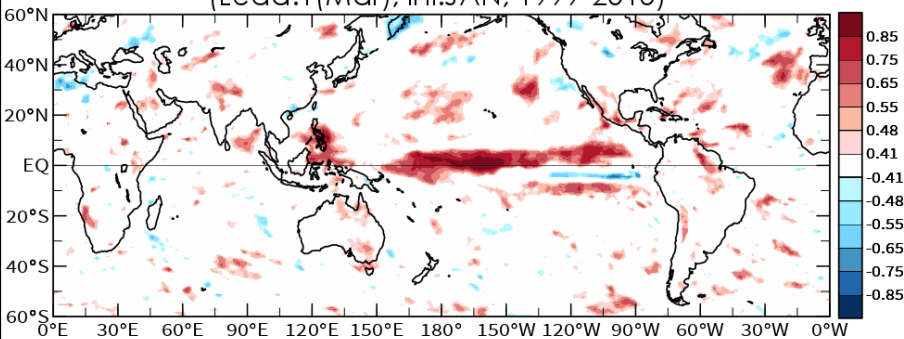
R60 Precipitation Anomaly Correlation (Lead0,1,2)

R60

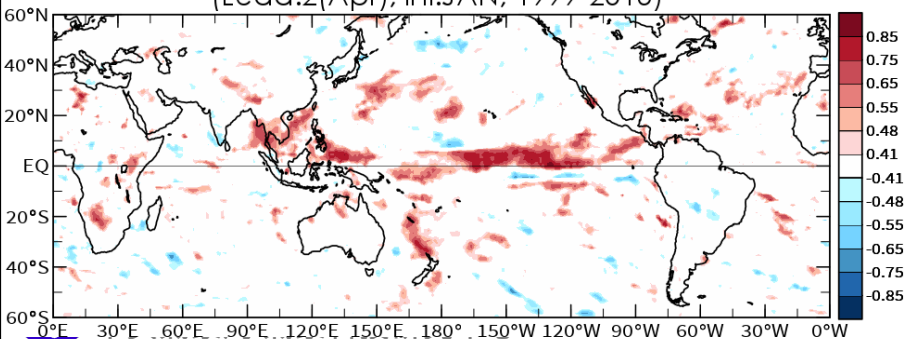
Precipitation Corr between TCWB1T1-R60 & GPCP
(Lead:0(Feb), ini:JAN, 1999-2015)



Precipitation Corr between TCWB1T1-R60 & GPCP
(Lead:1(Mar), ini:JAN, 1999-2015)

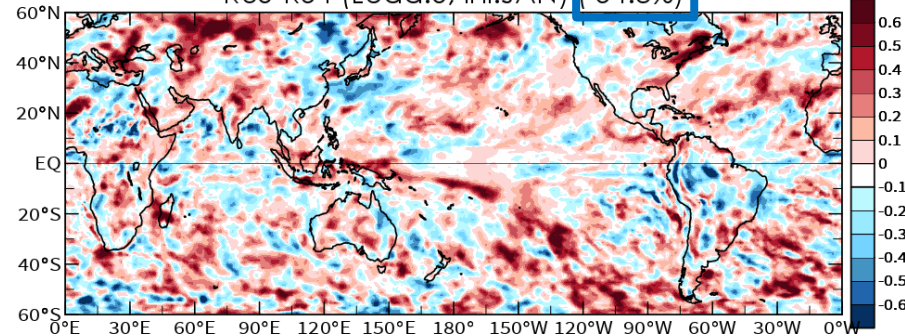


Precipitation Corr between TCWB1T1-R60 & GPCP
(Lead:2(Apr), ini:JAN, 1999-2015)

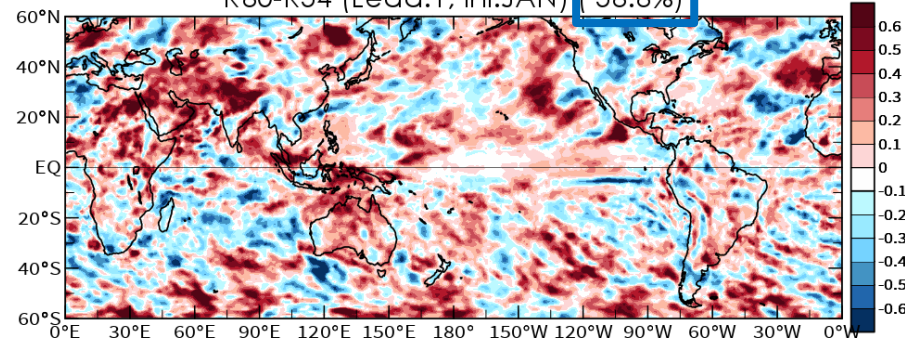


R60-R54

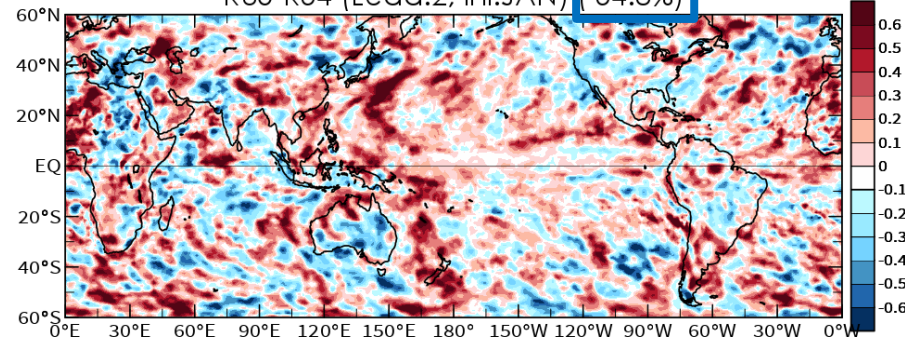
Precipitation Correlation Difference
R60-R54 (Lead:0, ini:JAN) (54.3%)



Precipitation Correlation Difference
R60-R54 (Lead:1, ini:JAN) (56.6%)



Precipitation Correlation Difference
R60-R54 (Lead:2, ini:JAN) (54.8%)



Conclusion

- R60修正了物理參數化設定，下邊界海陸格點處理方法，模式動力架構、初始場和氣候場的改善。此版本大幅度改善R54模式預報T2M有隨預報時間增長而有明顯偏暖誤差存在，尤其是中國大陸地區特別明顯。
- 在預報技術得分中，R60的距平相關技術得分略高於R54，主要高相關區域集中於赤道太平洋區域。
- 未來將更進一步分析各季節模式預報環流場的技術得分以及各季風指標的掌握程度。

