



# 氣象局第二代二步法氣候預報系統 預報能力評估初步結果

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103年天氣分析與預報研討會  
9/16-9/18

# CWB Climate Model Hindcast information

	Model Experiment
<b>Experiment design</b>	30-year integration (1982-2011) 9-month integration for each case
<b>Ensemble member</b>	<b>30 members</b> (days) for ensemble mean
<b>Integration time</b>	<b>280 days</b>
<b>Atmospheric Model</b>	<b>CWB-GCM (T119L40)</b> <b>ECHAM5 (T42L19)</b>
<b>SST</b>	<b>OPGSST-v2.0</b> and <b>NCEP-CFSv2-SST(CFSRR)</b> (OPGSST: 4 statistical models, 2 couple models) (CFSRR: 4 x daily run)
<b>MME</b>	30 members x 4 model = <b>120 members</b> ( <i>MME, CWB-Ens, ECHAM5-Ens</i> <i>MME-CFS, MME-OPG</i> )
<b>Initial Month</b>	<b>May</b> (Jun-Nov) <b>Dec</b> (Jan-Jun)

# Reanalysis Data



<b>Variables</b>	<b>Source and Format</b>
<b>SST</b>	<b><i>ERSSTv3b</i></b> (180 x 89, 2 degree)
<b>T2m, SLP, UV850</b>	<b><i>NCEP-CFSR</i></b> (720 x 361, 0.5 degree )
<b>Precipitation</b>	<b><i>GPCP</i></b> and <b><i>CMAP</i></b> (144 x 72 , 2.5 degree)

# Verification Tools

- Climatology and Standard Deviation
- Temporal Correlation (Anomaly Correlation)
- Temporal Correlation of Area mean with Lead time (Lead 0 – Lead 5)
- Deterministic Skill-Mean Square Skill Score (MSSS)
- Forecast Skill- Gerrity Skill Score (GSS, 3-category)
- Probabilistic Skill– Reliability diagrams , ROC curves (Area of ROC, Brier Skill Score)

*Reference:*

1. *WMO – STANDARDIZED VERIFICATION SYSTEM (SVS) FOR LONG-RANGE FORECASTS (LRF)*
2. *The Centre for Australian Weather and Climate Research (CAWCR ) – Forecast verification*

# Lead Time (month)

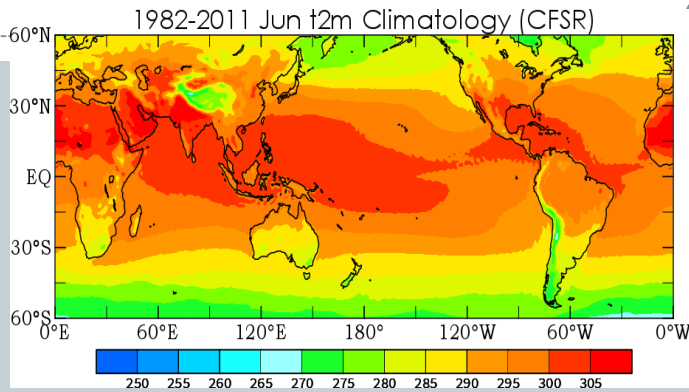


***Lead time***: defined by the number of months of separation between the latest available observed data and the beginning of the forecast target period.

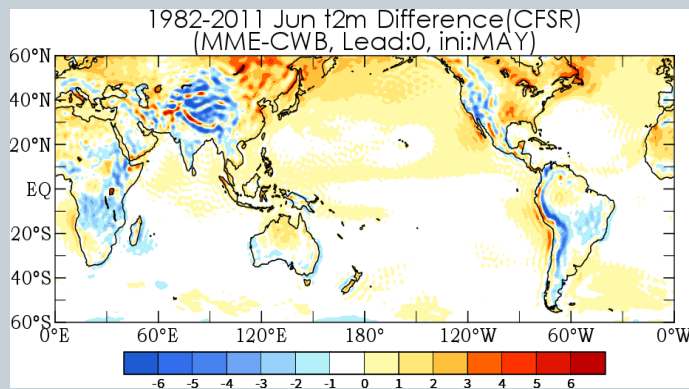
(e.g. Using observed data through December, so January is a lead time of 0 month and February is a lead-1.

# *T2m* Climatology (Lead:0-JUN, ini:MAY)

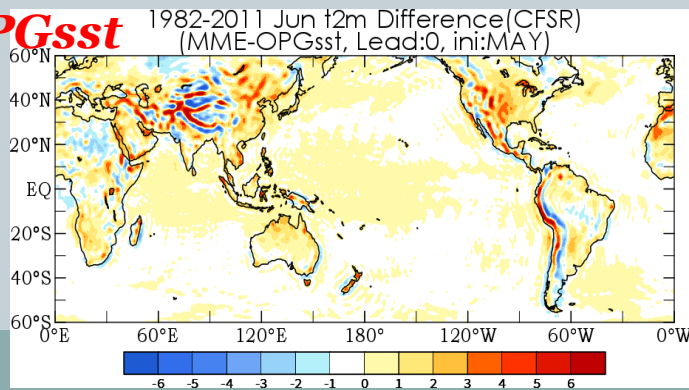
*CFSR*



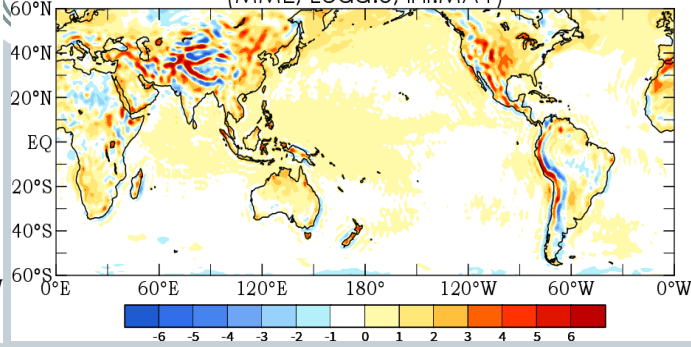
*CWBE*



*MME-OPGsst*

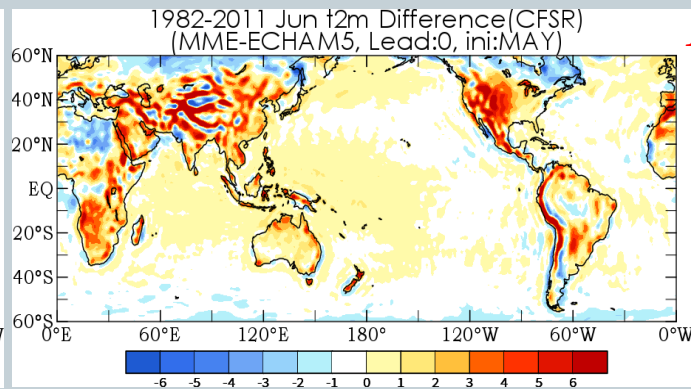


1982-2011 Jun t2m Difference(CFSR)  
(MME, Lead:0, ini:MAY)

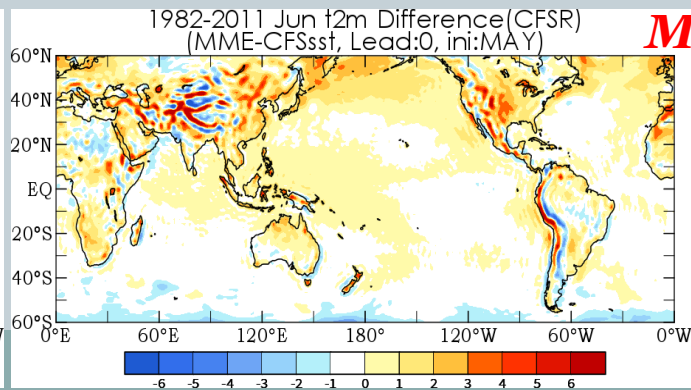


*MME*

*ECHAM5E*

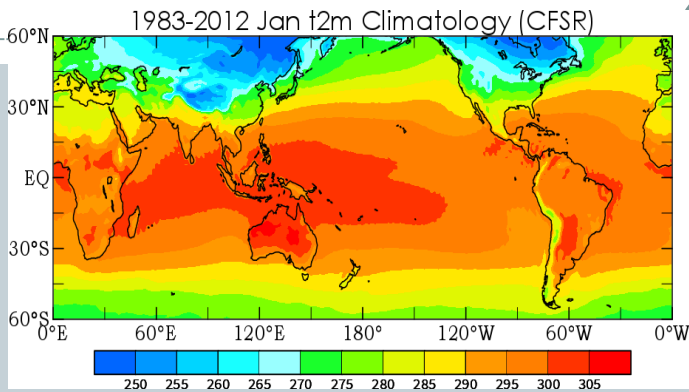


*MME-CFSsst*

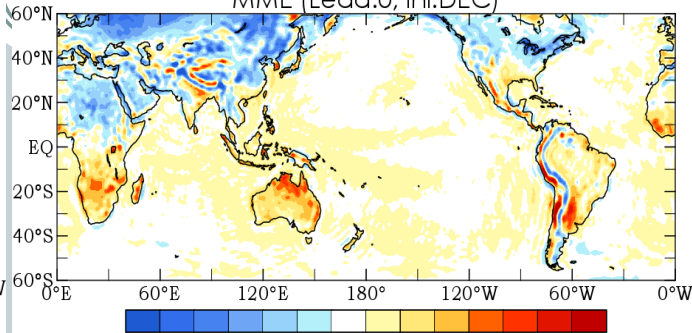


# *T2m* Climatology (Lead:0-JAN, ini:DEC)

**CFSR**

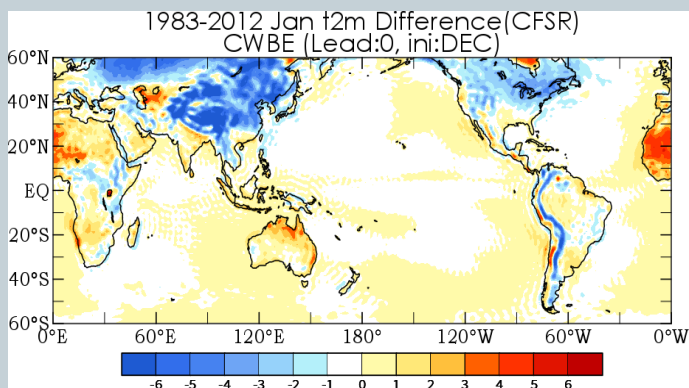


1983-2012 Jan t2m Difference(CFSR)  
MME (Lead:0, ini:DEC)

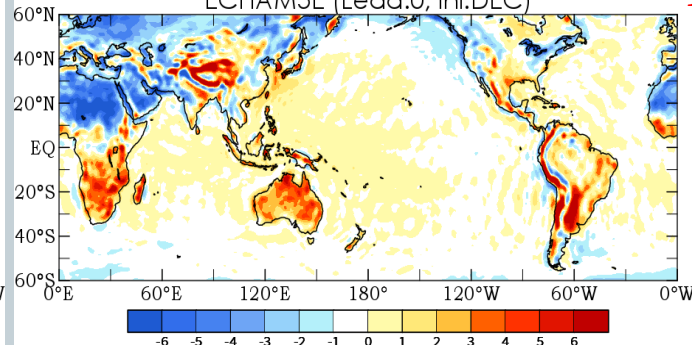


**MME**

**CWBE**

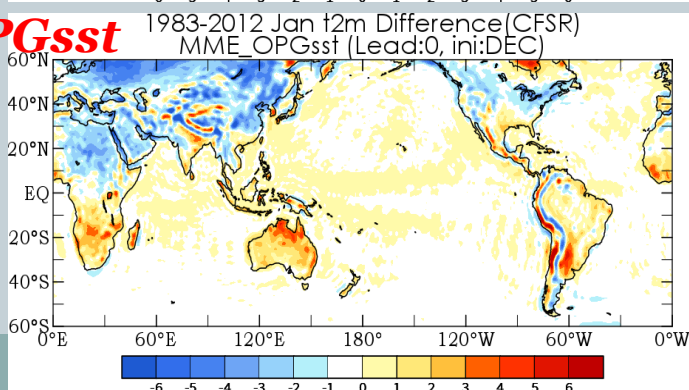


1983-2012 Jan t2m Difference(CFSR)  
ECHAM5E (Lead:0, ini:DEC)

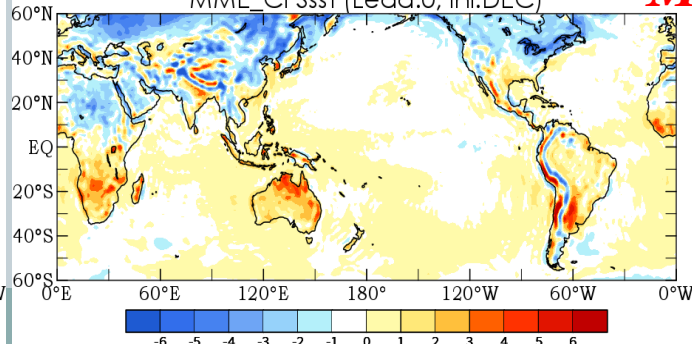


**ECHAM5E**

**MME-OPGsst**



1983-2012 Jan t2m Difference(CFSR)  
MME\_CFSsst (Lead:0, ini:DEC)

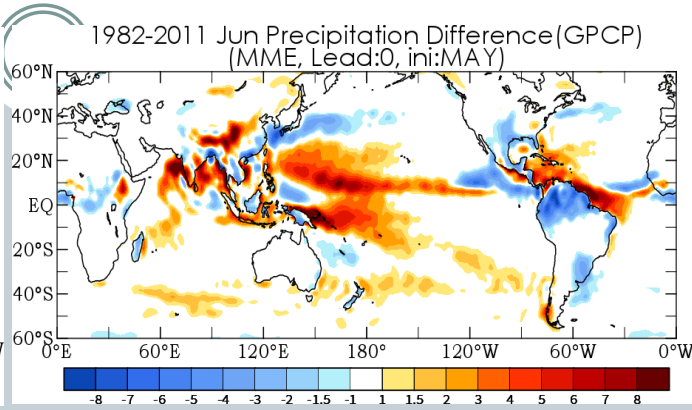
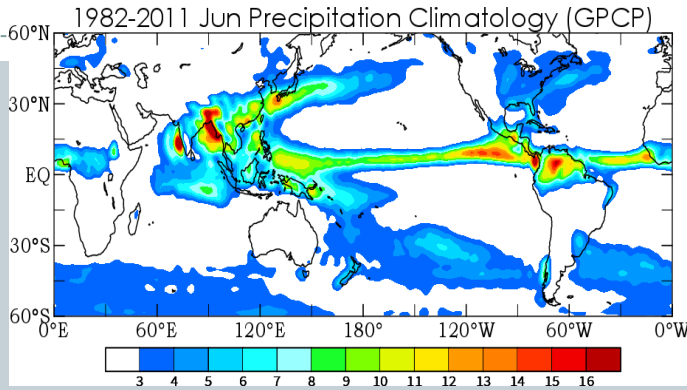


**MME-CFSsst**



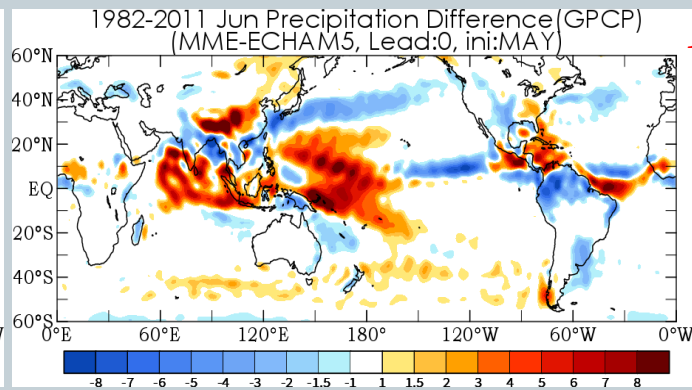
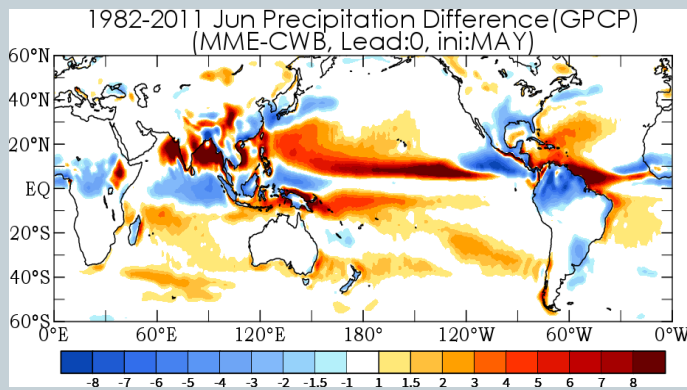
# Precipitation Climatology (Lead:0-JUN, ini:MAY)

**GPCP**



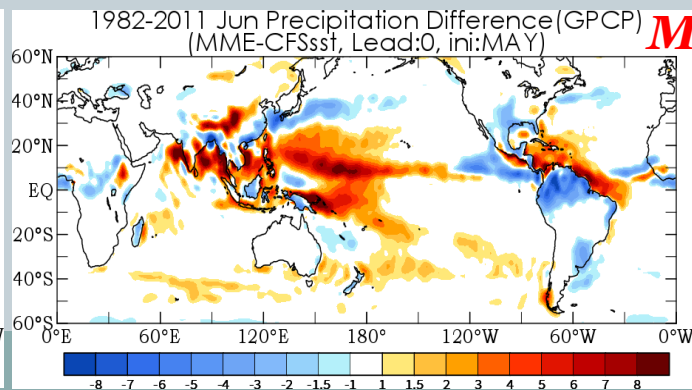
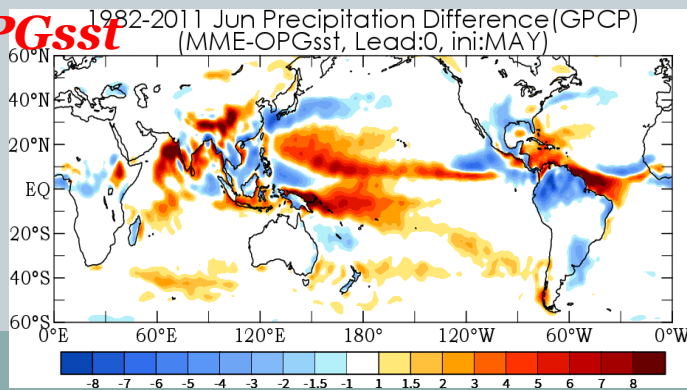
**MME**

**CWBE**



**ECHAM5E**

**MME-OPGsst**

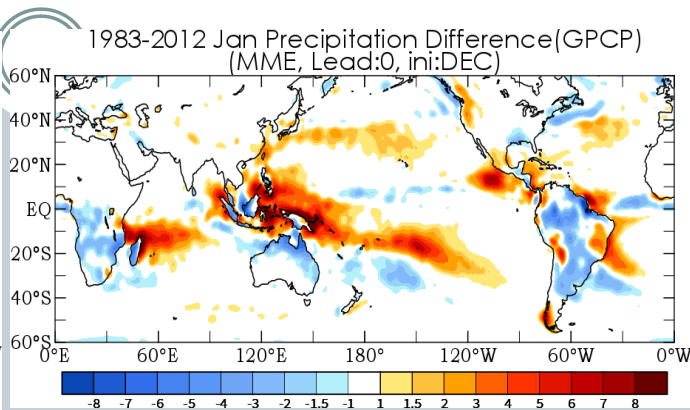
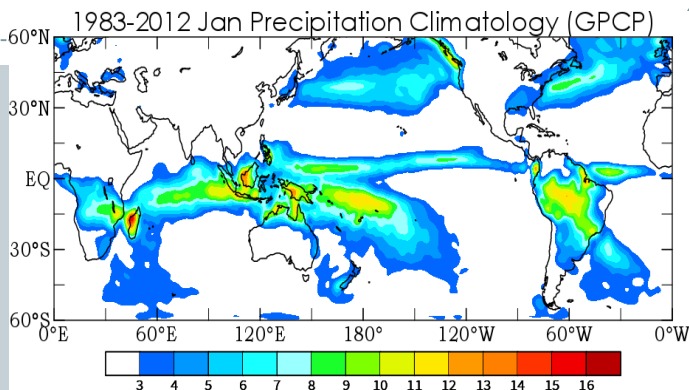


**MME-CFSsst**



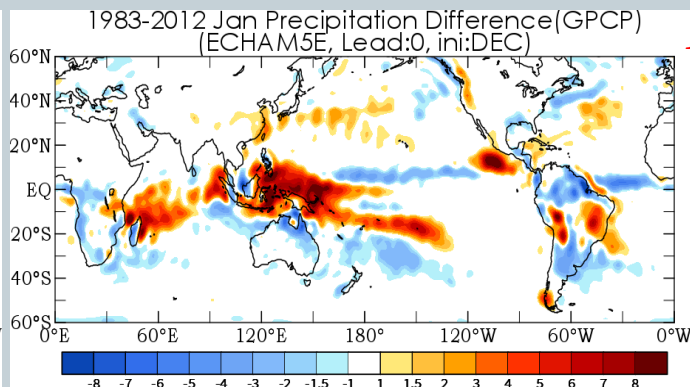
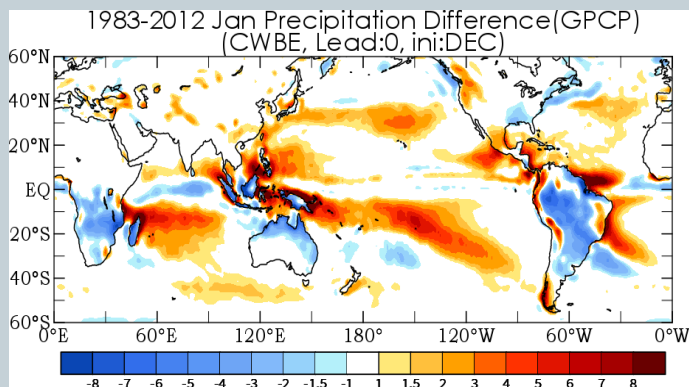
# Precipitation Climatology (Lead:0-JAN, ini:DEC)

**GPCP**



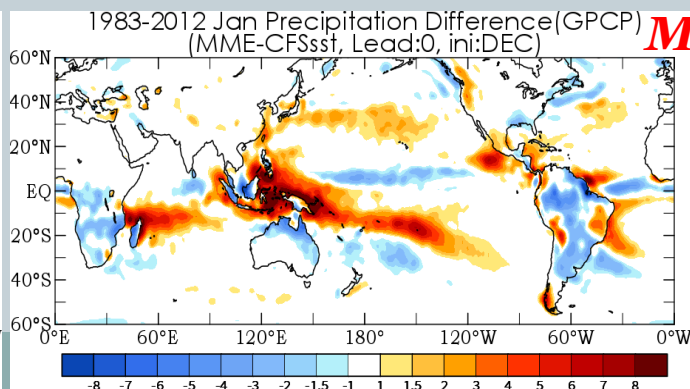
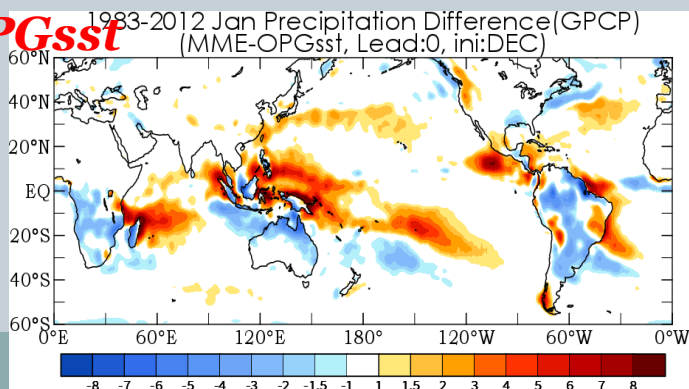
**MME**

**CWBE**



**ECHAM5E**

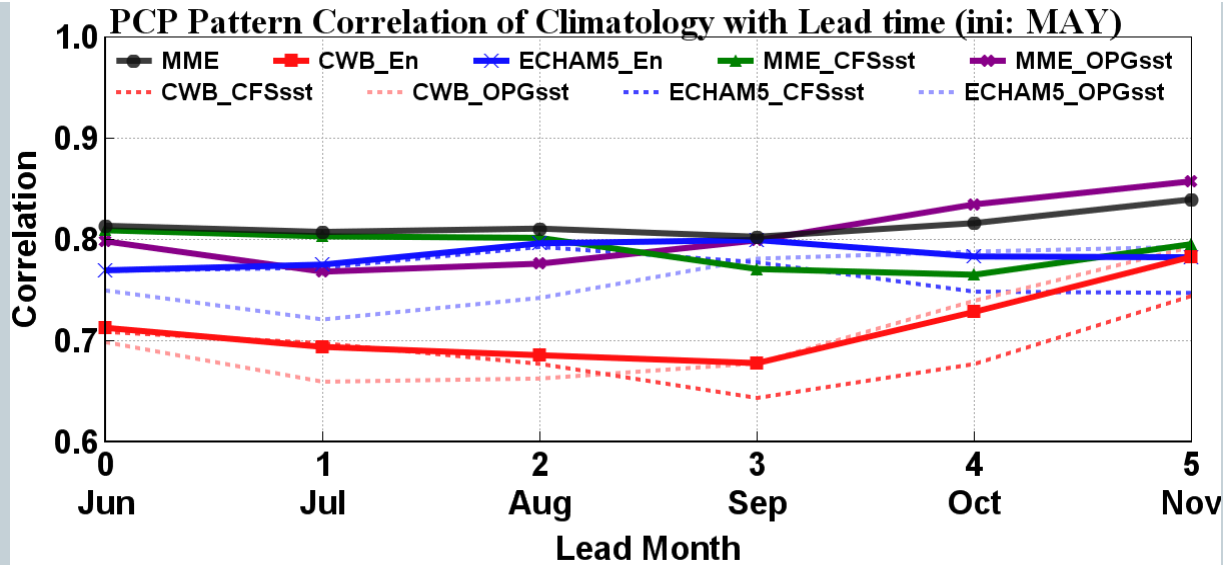
**MME-OPGsst**



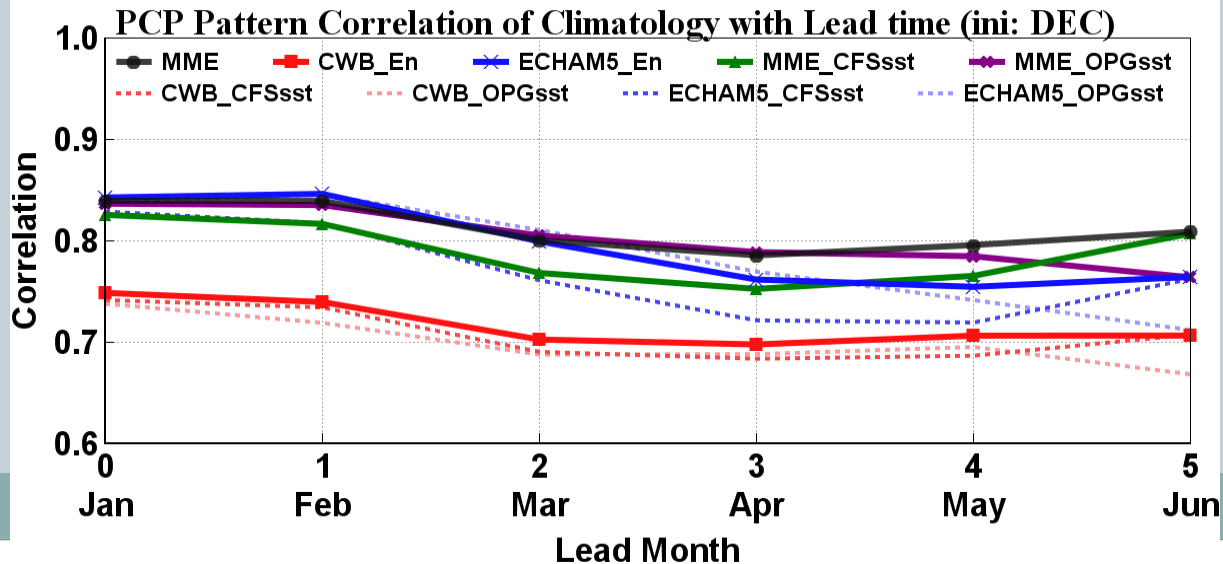
**MME-CFSsst**

# *Pattern Correlation* over Global Domain of Precipitation Climatology between GPCP and others climate model with Lead month

*ini: MAY*



*ini: DEC*



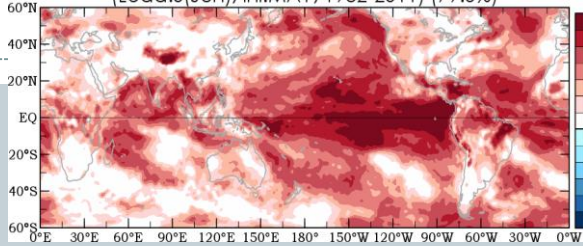


**(Lead:0-Jun, ini:MAY)**

# T2m Anomaly Correlation

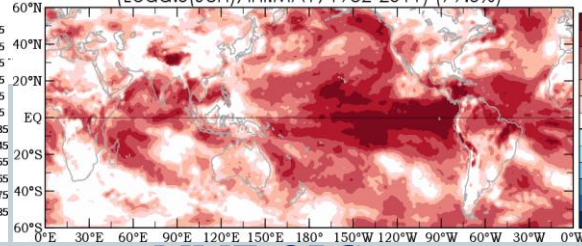
**MME**

T2m Corr between MME & CFSR  
(Lead:0(Jun), ini:MAY, 1982-2011) (79.5%)



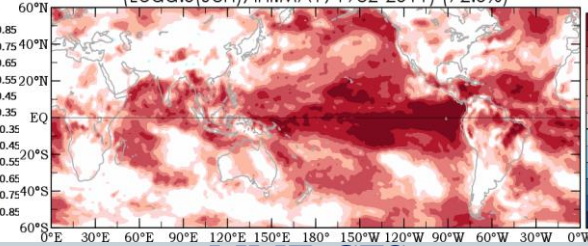
**CWBE**

T2m Corr between CWB\_En & CFSR  
(Lead:0(Jun), ini:MAY, 1982-2011) (79.5%)



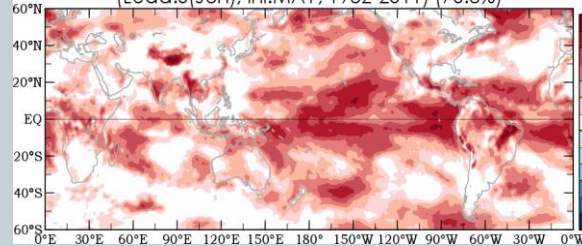
**ECHAM5E**

T2m Corr between ECHAM5\_En & CFSR  
(Lead:0(Jun), ini:MAY, 1982-2011) (72.5%)



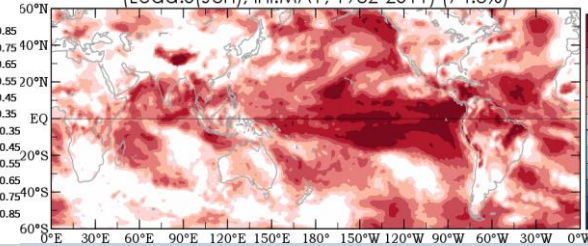
**MME-OPGsst**

T2m Corr between MME\_OPGsst & CFSR  
(Lead:0(Jun), ini:MAY, 1982-2011) (70.3%)



**MME-CFSsst**

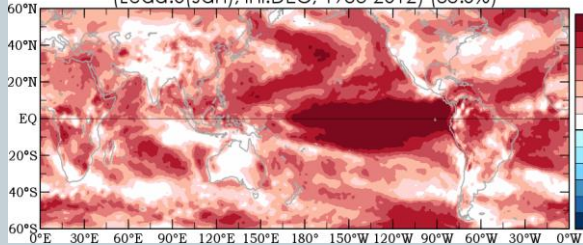
T2m Corr between MME\_CFSsst & CFSR  
(Lead:0(Jun), ini:MAY, 1982-2011) (74.3%)



**(Lead:0-Jan, ini:DEC)**

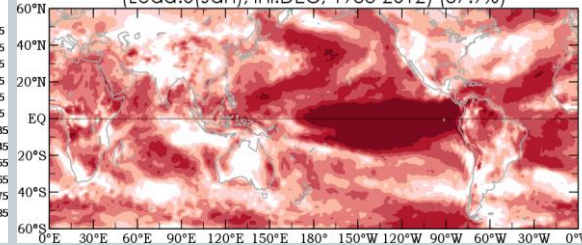
**MME**

T2m Corr between MME & CFSR  
(Lead:0(Jan), ini:DEC, 1983-2012) (88.5%)



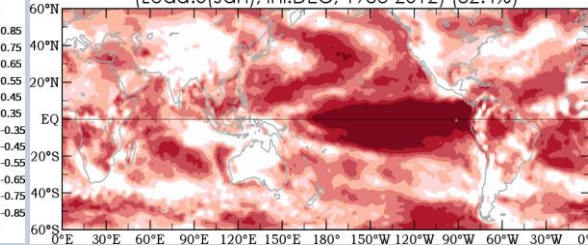
**CWBE**

T2m Corr between CWB\_En & CFSR  
(Lead:0(Jan), ini:DEC, 1983-2012) (87.9%)



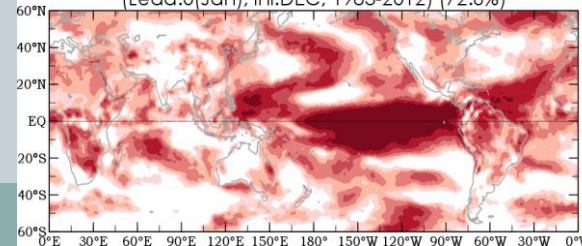
**ECHAM5E**

T2m Corr between ECHAM5\_En & CFSR  
(Lead:0(Jan), ini:DEC, 1983-2012) (82.4%)



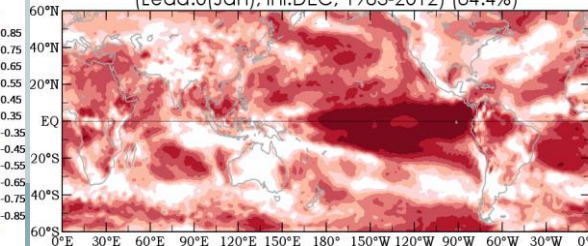
**MME-OPGsst**

T2m Corr between MME\_OPGsst & CFSR  
(Lead:0(Jan), ini:DEC, 1983-2012) (72.6%)



**MME-CFSsst**

T2m Corr between MME\_CFSsst & CFSR  
(Lead:0(Jan), ini:DEC, 1983-2012) (84.4%)



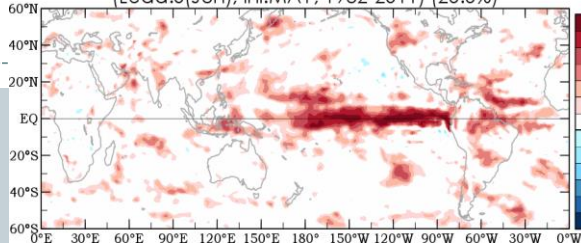


# Precipitation Anomaly Correlation

(Lead:0-Jun, ini:MAY)

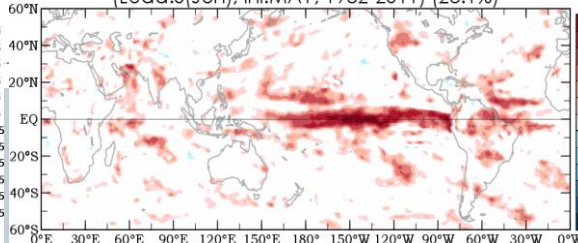
**MME**

Precipitation Corr between MME & GPCP  
(Lead:0(Jun), ini:MAY, 1982-2011) (25.5%)



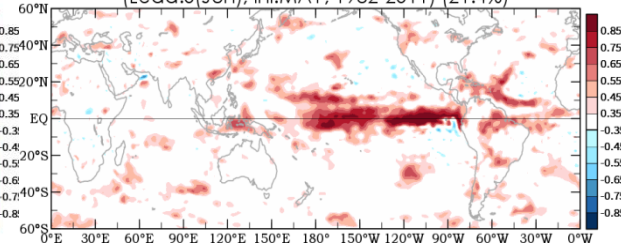
**CWBE**

Precipitation Corr between CWB\_En & GPCP  
(Lead:0(Jun), ini:MAY, 1982-2011) (23.1%)



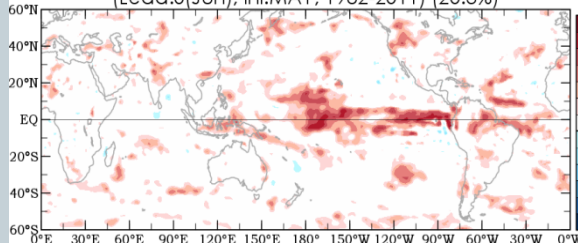
**ECHAM5E**

Precipitation Corr between ECHAM5\_En & GPCP  
(Lead:0(Jun), ini:MAY, 1982-2011) (21.4%)



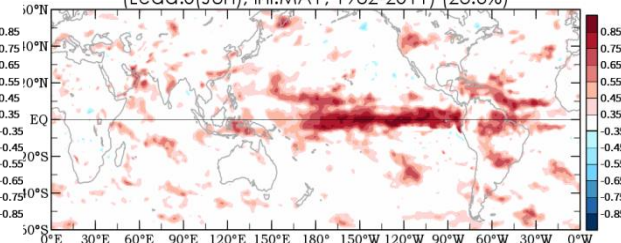
**MME-OPGsst**

Precipitation Corr between MME\_OPGsst & GPCP  
(Lead:0(Jun), ini:MAY, 1982-2011) (20.3%)



**MME-CFSsst**

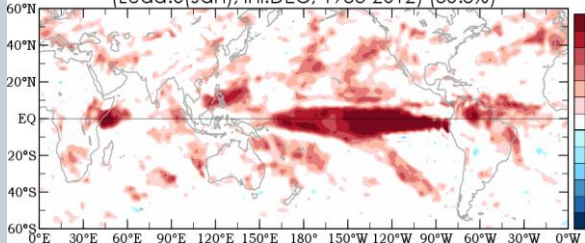
Precipitation Corr between MME\_CFSsst & GPCP  
(Lead:0(Jun), ini:MAY, 1982-2011) (23.6%)



(Lead:0-Jan, ini:DEC)

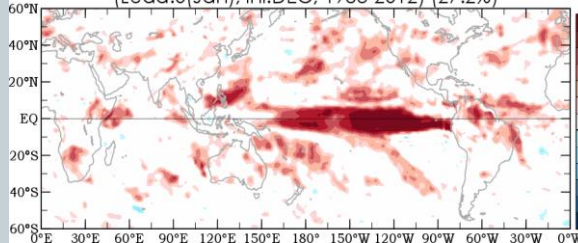
**MME**

Precipitation Corr between MME & GPCP  
(Lead:0(Jan), ini:DEC, 1983-2012) (30.8%)



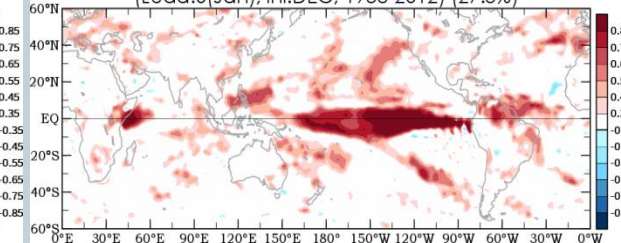
**CWBE**

Precipitation Corr between CWB\_En & GPCP  
(Lead:0(Jan), ini:DEC, 1983-2012) (27.2%)



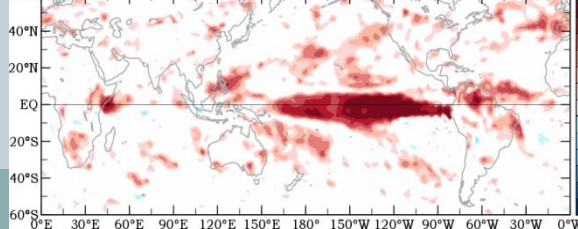
**ECHAM5E**

Precipitation Corr between ECHAM5\_En & GPCP  
(Lead:0(Jan), ini:DEC, 1983-2012) (27.3%)



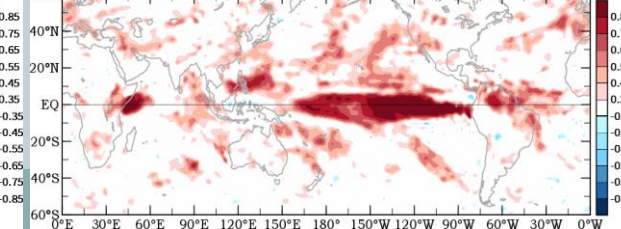
**MME-OPGsst**

Precipitation Corr between MME\_OPGsst & GPCP  
(Lead:0(Jan), ini:DEC, 1983-2012) (24.8%)



**MME-CFSsst**

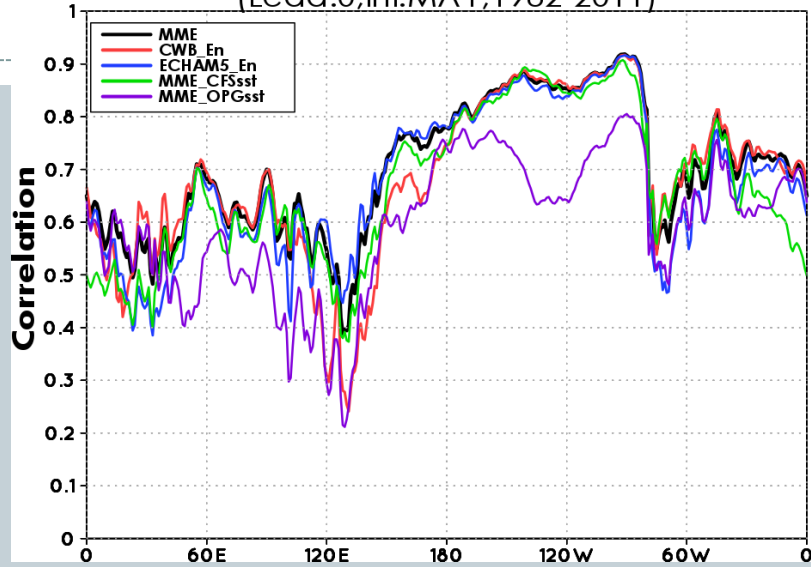
Precipitation Corr between MME\_CFSsst & GPCP  
(Lead:0(Jan), ini:DEC, 1983-2012) (29.3%)



# Latitudinal Mean of Temporal Correlation

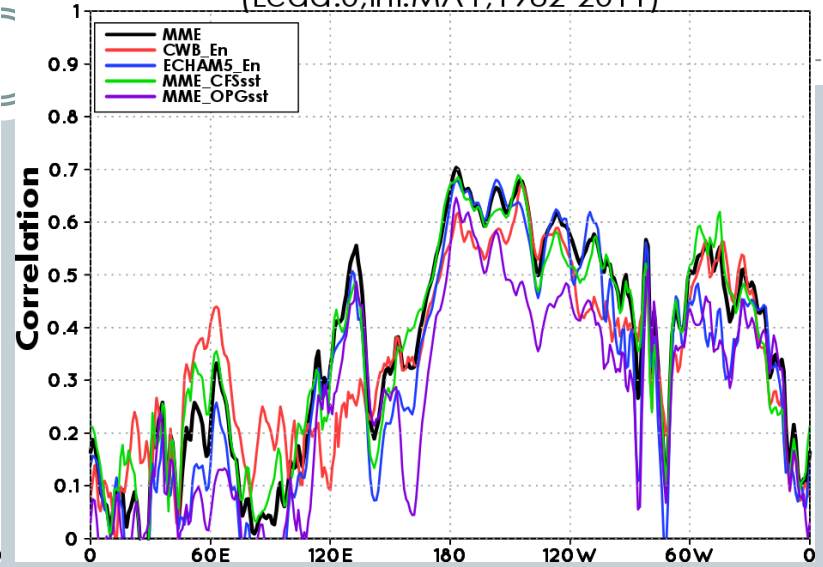
**T2m**

T2m Latitudinal Mean (10S-10N)  
(Lead:0,ini:MAY,1982-2011)

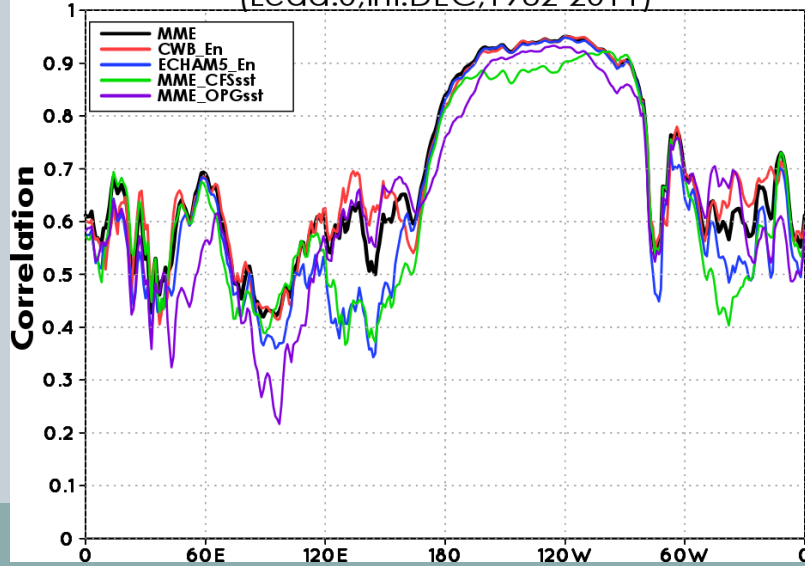


**Precipitaion**

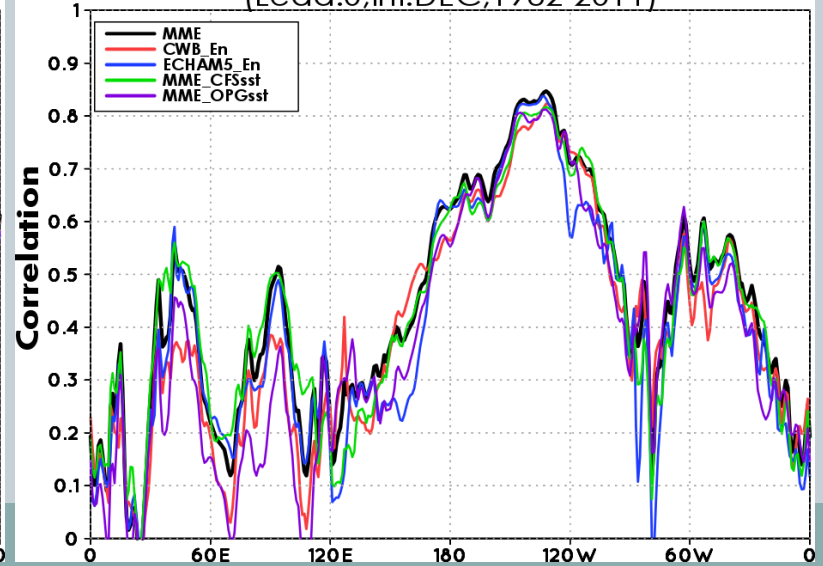
PCP Latitudinal Mean (10S-10N)  
(Lead:0,ini:MAY,1982-2011)



T2m Latitudinal Mean (10S-10N)  
(Lead:0,ini:DEC,1982-2011)



PCP Latitudinal Mean (10S-10N)  
(Lead:0,ini:DEC,1982-2011)



**MAY**

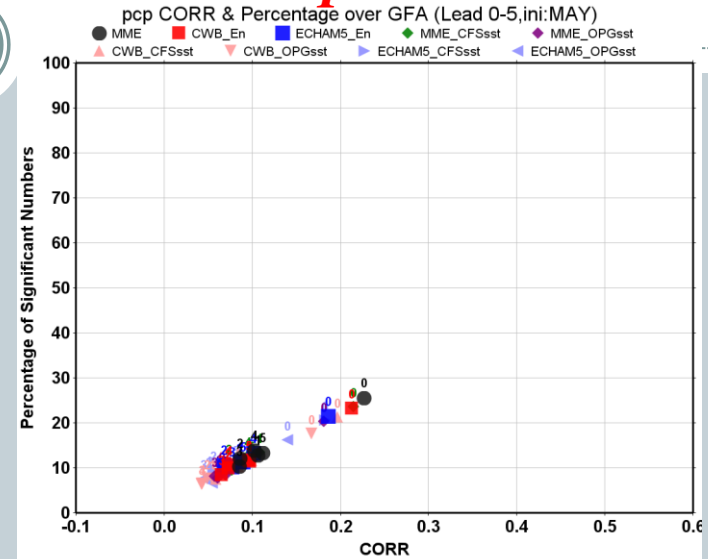
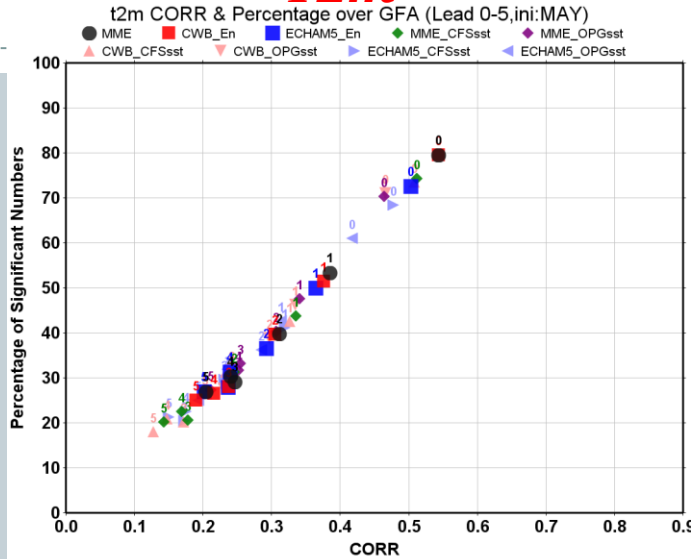
**DEC**

# Anomaly Correlation & percentage of grid-points with 95% significant in Lead 0-5 month

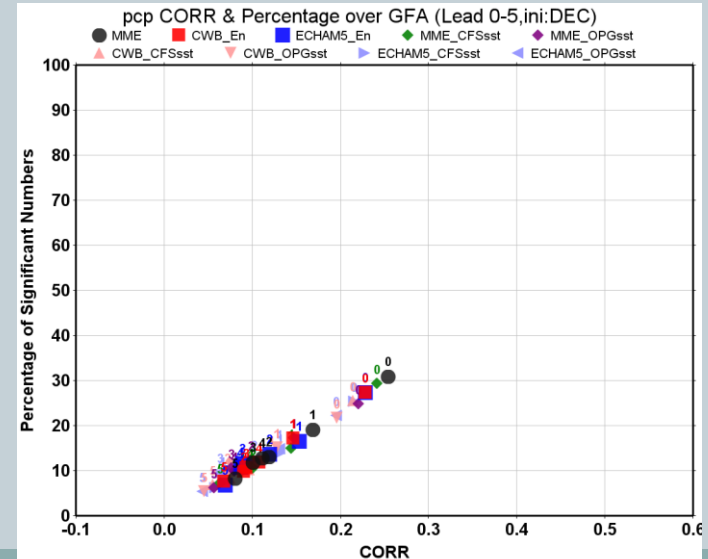
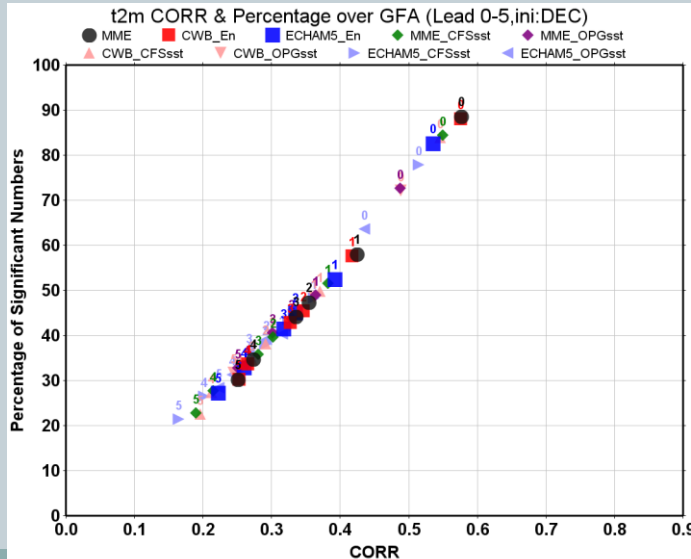
**T2m**

**Precipitation**

**MAY**



**DEC**



● MME    ● CWB\_En    ● ECHAM5\_En    ● MME\_CFSsst    ● MME\_OPGsst  
 ▲ CWB\_CFSsst    ▼ CWB\_OPGsst    ▲ ECHAM5\_CFSsst    ▼ ECHAM5\_OPGsst



# Monsoon Index



## *Summer Monsoon Index- WPSH, WPSM*

**WPSH** =  $H_{850}(15^{\circ}\text{N}-25^{\circ}\text{N}, 115^{\circ}\text{E}-150^{\circ}\text{E})$

**WNPM** =  $u_{850}(5^{\circ}\text{N}-15^{\circ}\text{N}, 110^{\circ}\text{E}-130^{\circ}\text{E}) - u_{850}(20^{\circ}\text{N}-30^{\circ}\text{N}, 110^{\circ}\text{E}-140^{\circ}\text{E})$

## *Winter Monsoon Index- EAWM-JL, EAWM-LY*

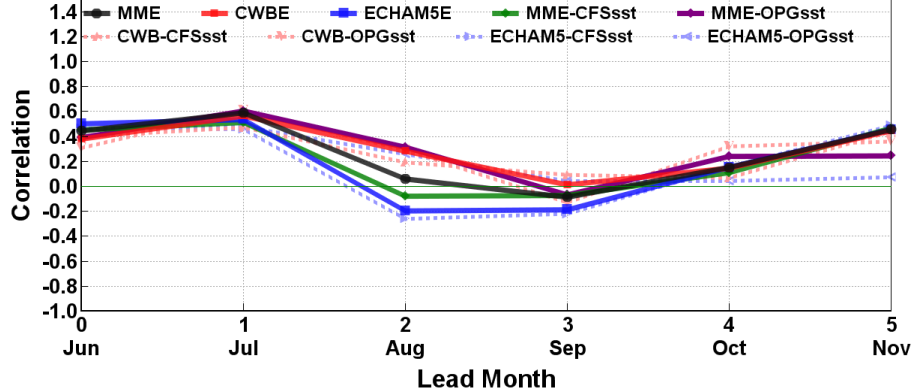
**EAWM-JL** =  $u_{300}(27.5^{\circ}\text{N}-37.5^{\circ}\text{N}, 110^{\circ}\text{E}-170^{\circ}\text{E}) - u_{300}(50^{\circ}\text{N}-60^{\circ}\text{N}, 80^{\circ}\text{E}-140^{\circ}\text{E})$

$$\mathbf{EAWM-LY} = \left\{ \left[ U_{200}(30^{\circ} - 35^{\circ}\text{N} / 90^{\circ} - 160^{\circ}\text{E}) - U_{200}(50^{\circ} - 60^{\circ}\text{N} / 70^{\circ} - 170^{\circ}\text{E}) \right] + \left[ U_{200}(30^{\circ} - 35^{\circ}\text{N} / 90^{\circ} - 160^{\circ}\text{E}) - U_{200}(5^{\circ}\text{S} - 10^{\circ}\text{N} / 90^{\circ} - 160^{\circ}\text{E}) \right] \right\} / 2$$

# Summer and Winter Monsoon Index

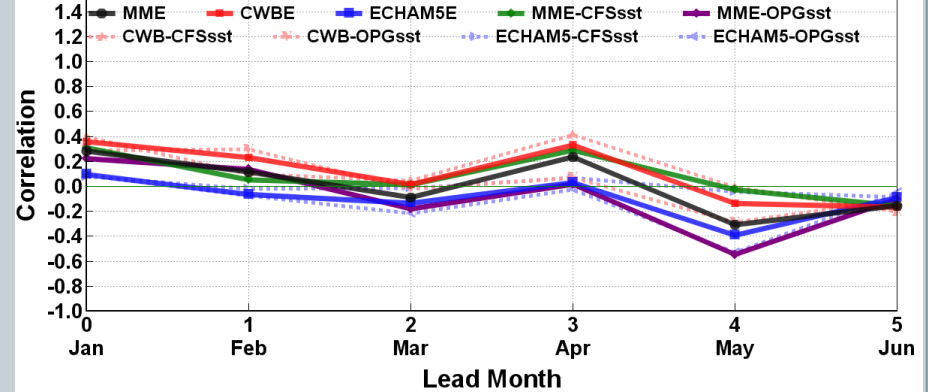
## WPSH

WPSH Index Correlation of initiated from MAY



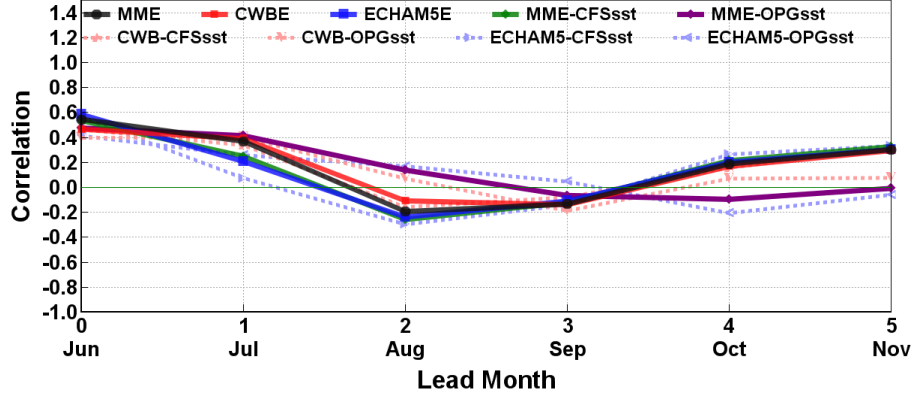
## EAWM-JL

JL Index Correlation of initiated from DEC



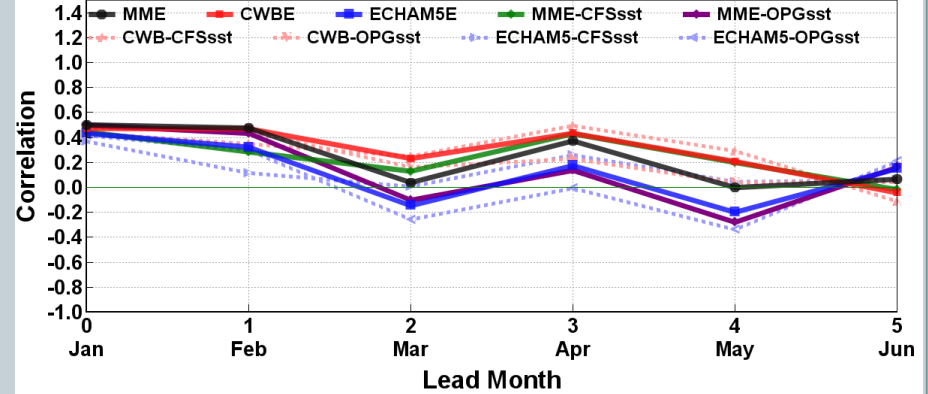
## WNPM

WNPM Index Correlation of initiated from MAY



## EAWM-LY

LY Index Correlation of initiated from DEC



# Precipitation Over Monsoon regions

印度夏季季風區(ISM)

$65^{\circ}\text{E}-105^{\circ}\text{E}$ ,  $5^{\circ}\text{N}-27.5^{\circ}\text{N}$

東亞夏季季風區(EASM)

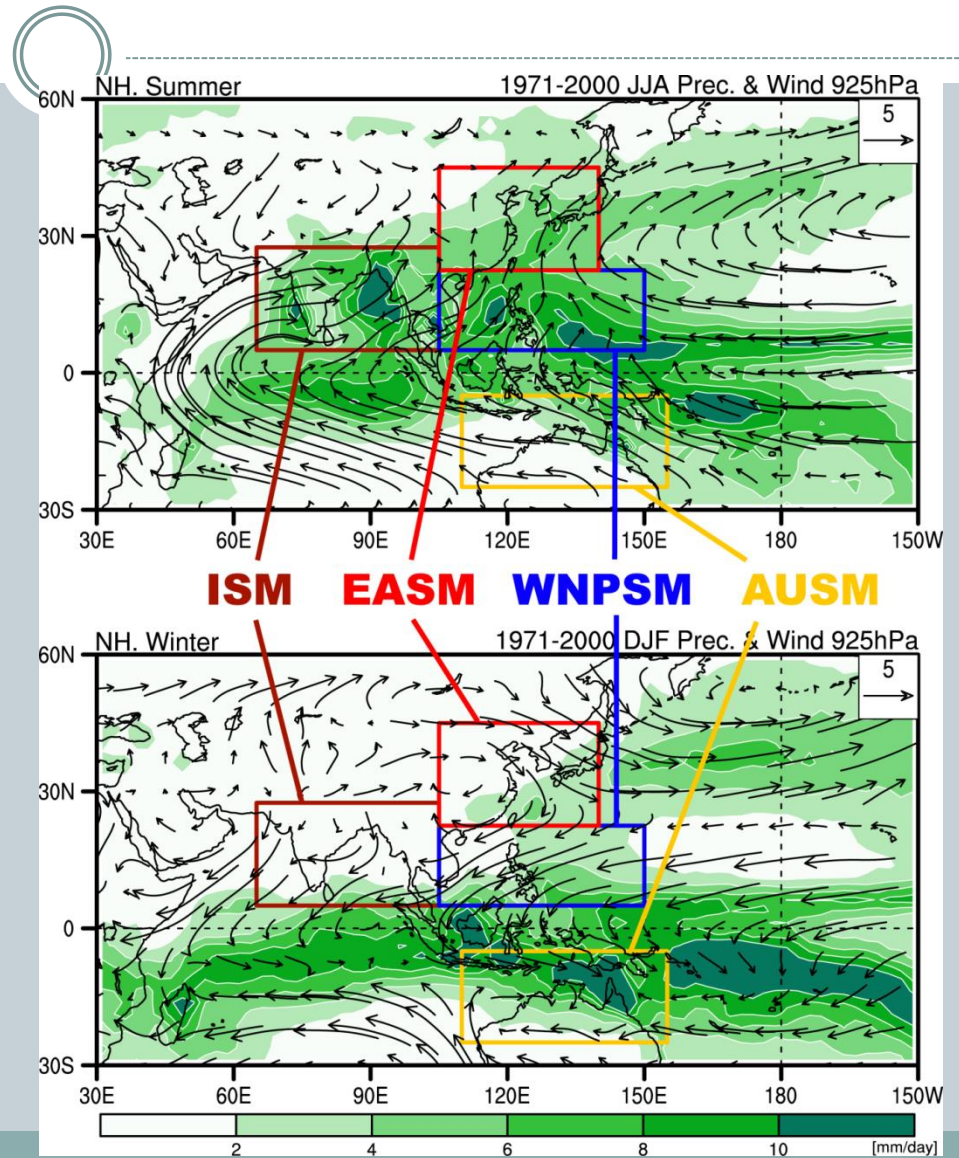
$105^{\circ}\text{E}-140^{\circ}\text{E}$ ,  $22.5^{\circ}\text{N}-45^{\circ}\text{N}$

西北太平洋夏季季風區(WNPSM)

$105^{\circ}\text{E}-150^{\circ}\text{E}$ ,  $5^{\circ}\text{N}-22.5^{\circ}\text{N}$

澳洲季風區(AUSM)

$110^{\circ}\text{E}-155^{\circ}\text{E}$ ,  $5^{\circ}\text{S}-25^{\circ}\text{S}$

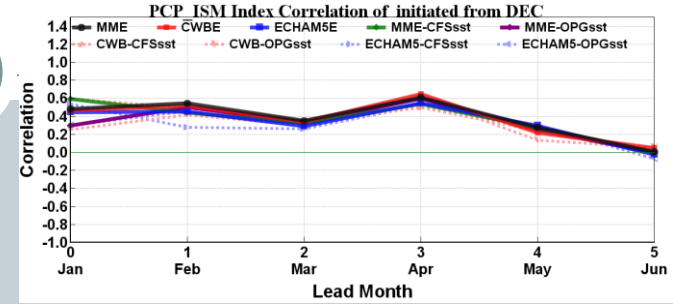
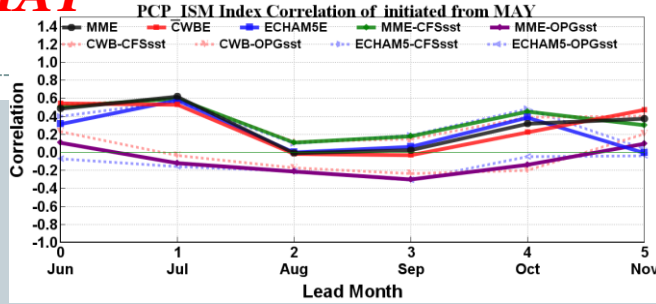


# Precipitation over Monsoon Regions

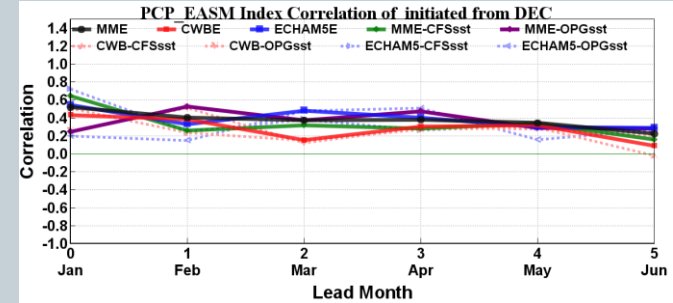
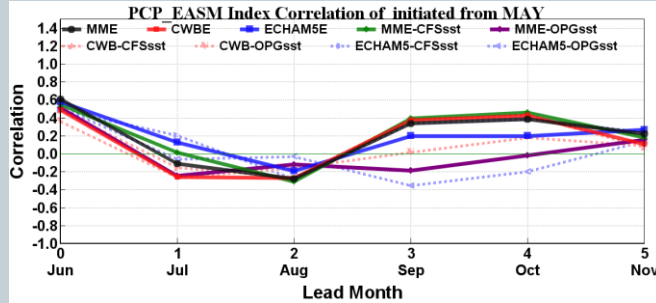
**MAY**

**DEC**

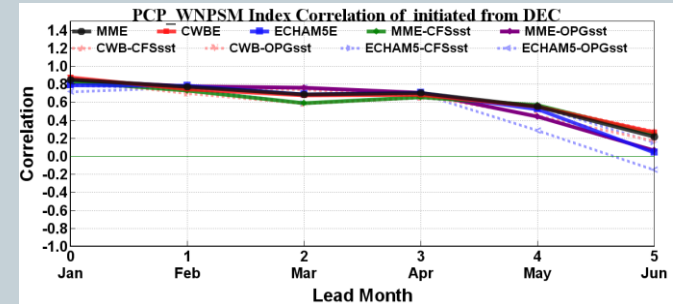
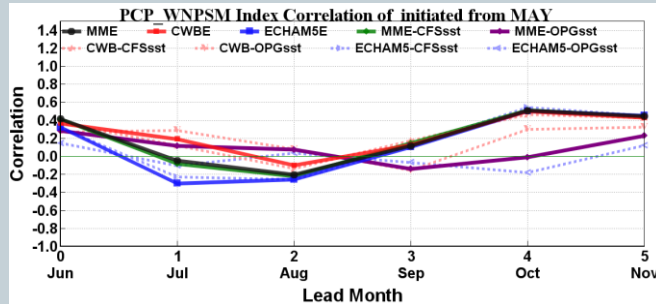
**ISM**



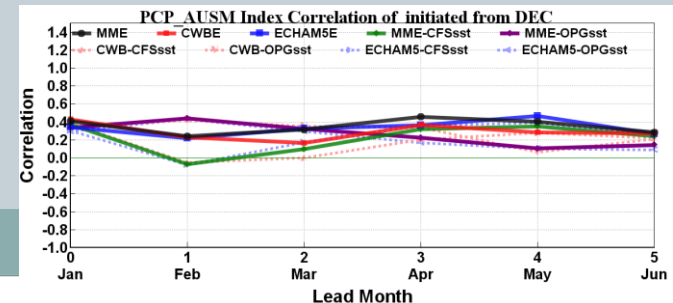
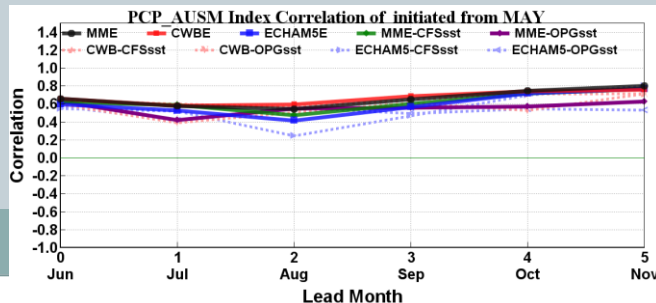
**EASM**



**WNPSM**



**AUSM**



# Summary



- 氣象局新一代高解析度模式模擬夏季及冬季的氣候分佈都和觀測場相似，但雨量則是海洋模擬偏多，陸地模擬偏少。
- 多模式系集平均(MME)的結果都比各個系集平均，無論氣候平均場、距平相關係數或是預報技術都是最高的技術得分。
- 溫度場的預報技術得分明顯比雨量高出許多，得分最高區域集中在中、東太平洋地區。
- 夏季、冬季季風指標都顯示此氣候模式具有領先兩個月的預報技術，但在雨量預報則只有領先一個月是具有預報技術。

# Future Work



- 計算1-12月份的各個預報技術指標。
- 將月份轉換成季節後，評估是否會提高技術得分。
- 利用合成方法來分析模式預報能力。
- 未來預報技術得分標準，將採用Anomaly Correlation、Gerrity Skill Score 以及 Rank Probability Skill Score。





***Any Question ?***