

氣象局全球氣候預報模式之亞洲與西北 太平洋季風模擬技術評估

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➤ 前言:

中央氣象局目前正在加緊發展第二代二步法短期氣候預報系統，預計在2015年發展完成開始作業。全球大氣預報模式方面，現在作業版的氣象局全球預報模式解析度將從T42L18提升至T119L40(水平方向約為150公里,垂直方向40層)。

目前氣象局已分別完成50年(1949-2006)與20年(1991-2010)的AMIP規格之氣候模擬(簡稱AMIP50與AMIP20)，兩者主要差異在於使用不同的海平面溫度資料來當作邊界條件。在進行新模式之預報系統前，需要針對AMIP結果詳細分析，藉此了解此模式的預報能力以及誤差範圍。

➤ 使用資料：

觀測資料：

1949-2010 NCEP Reanalysis I (144 x 73 , 2.5degree)

1979-2010 NCEP Reanalysis II (144 x 73 , 2.5degree)

1979-2010 GPCP (144 x 72, 2.5degree)

1979-2008 CMAP (144x72, 2.5degree)

AMIP 模式資料：

50年(T119L40): 1949-2006 (360 x 180, 1degree)

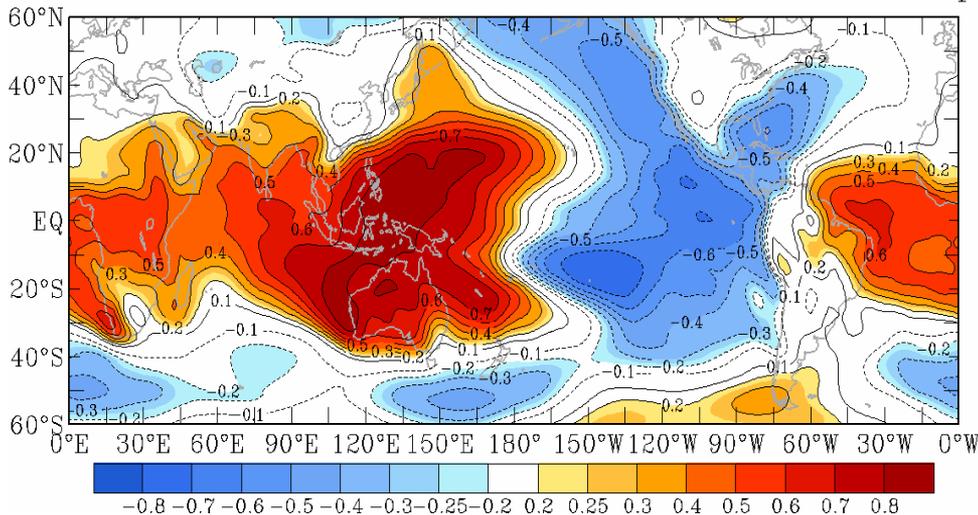
56年(T42L18) : 1950-2005 (128 x 64, 2.8degree)

➤ 模式檢驗

- 海溫指標反應大尺度環流分佈特徵。
- 年、季平均之環流分佈。
- 季風降雨強度、範圍。
- 季風指標。

© 1950-2004 DJF SLP Correlation Between Nino3.4 Index and NCEP-R1, T119, T42

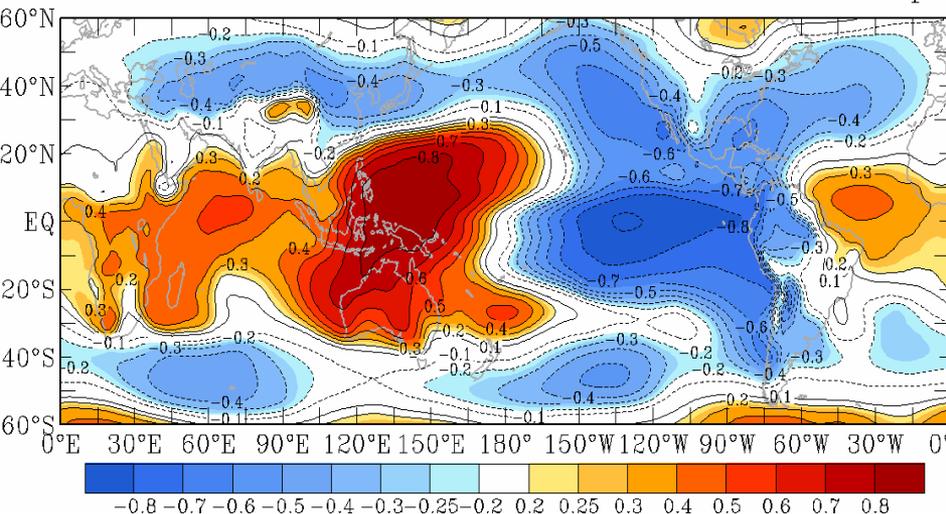
1950-2004 DJF Corr between Nino3.4 & NCEP-R1 slp



Nino3.4 & NCEP-R1

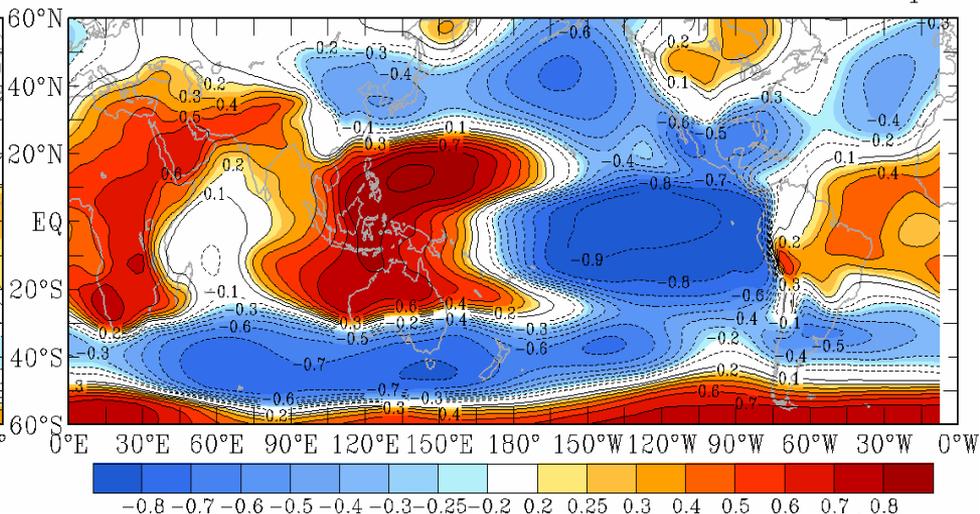
Nino3.4 & AMIP-T42

1950-2004 DJF Corr between Nino3.4 & T119 slp

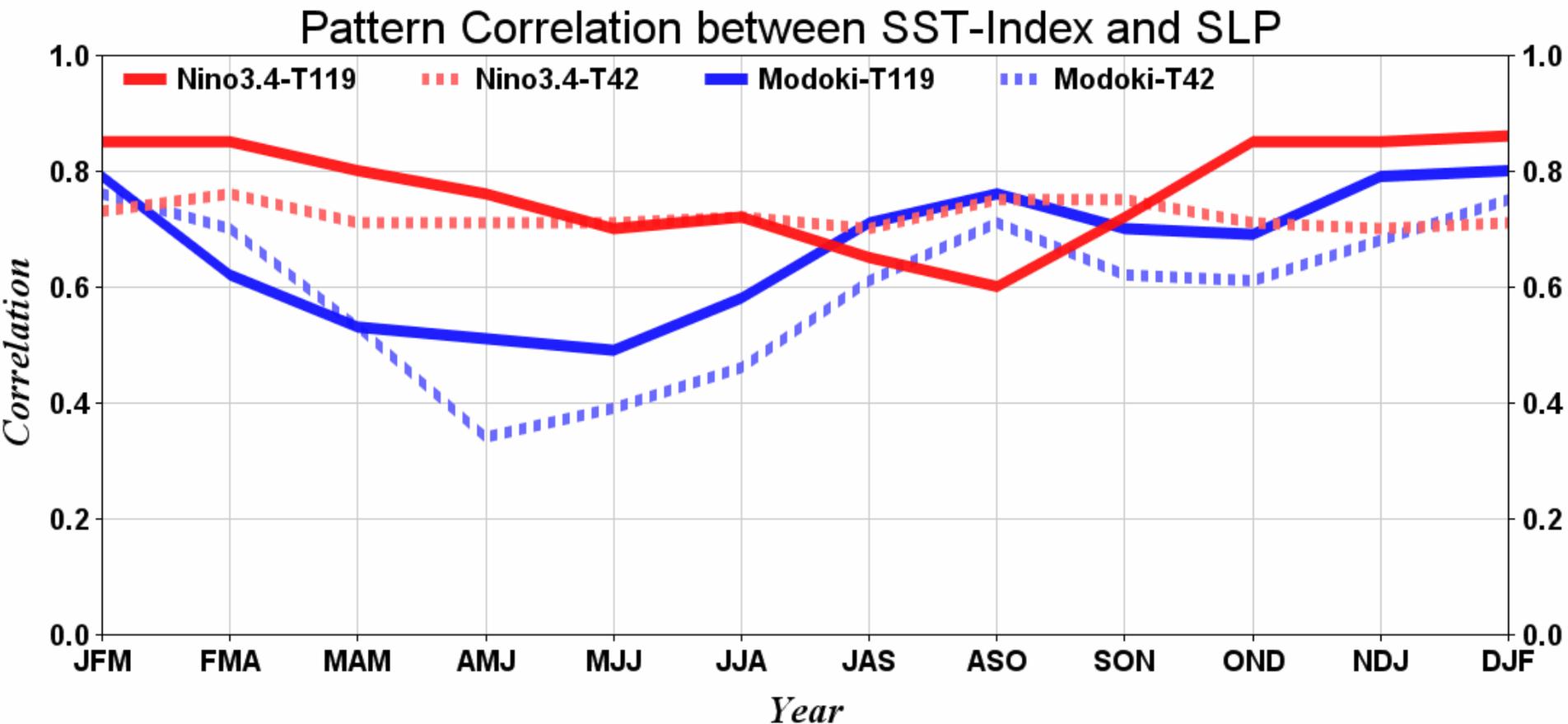


Nino3.4 & AMIP-T119

1950-2004 DJF Corr between Nino3.4 & T42 slp



◎ Pattern Correlation Between Nino3.4, Modoki Index and T119, T42



◎ SLP Pattern Correlation between AMIP-T119 and NCEP-R1

	IOD	NinoWest	Nino4	Nino3.4	Nino3	Nino1+2	Modoki
JFM	0.33	0.73	0.83	0.85	0.84	0.75	0.79
FMA	0.62	0.61	0.82	0.85	0.84	0.75	0.62
MAM	0.34	0.4	0.77	0.8	0.76	0.74	0.53
AMJ	0.26	0.18	0.73	0.76	0.74	0.77	0.51
MJJ	0.42	0.17	0.65	0.7	0.65	0.65	0.49
JJA	0.57	0.36	0.6	0.72	0.66	0.62	0.58
JAS	0.54	0.53	0.54	0.65	0.6	0.49	0.71
ASO	0.45	0.55	0.51	0.6	0.56	0.48	0.76
SON	0.49	0.55	0.68	0.72	0.69	0.6	0.7
OND	0.69	0.54	0.83	0.85	0.84	0.78	0.69
NDJ	0.57	0.64	0.84	0.85	0.85	0.81	0.79
DJF	0.24	0.72	0.85	0.86	0.85	0.8	0.8

● T119能掌握住各海溫指標反應大氣環流特徵，但夏季模擬較差。

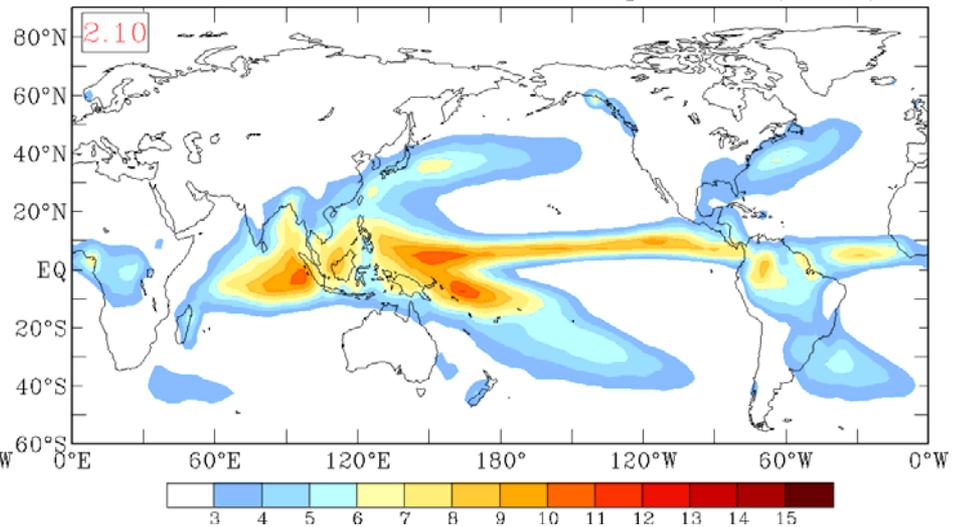
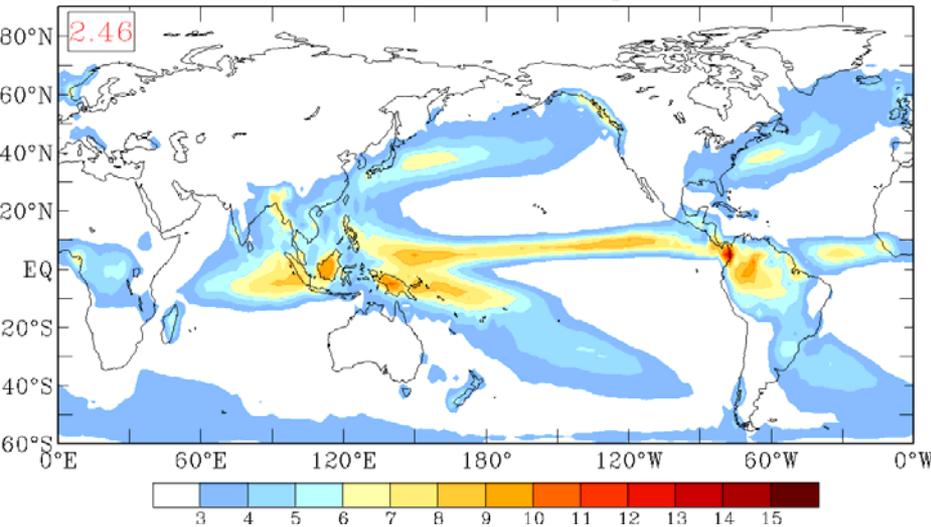
◎ Annual Mean

GPCP (1979-2006)

CMAP(1979-2006)

1979-2006 Annual Mean Precipitation (GPCP)

1979-2006 Annual Mean Precipitation (CMAP)

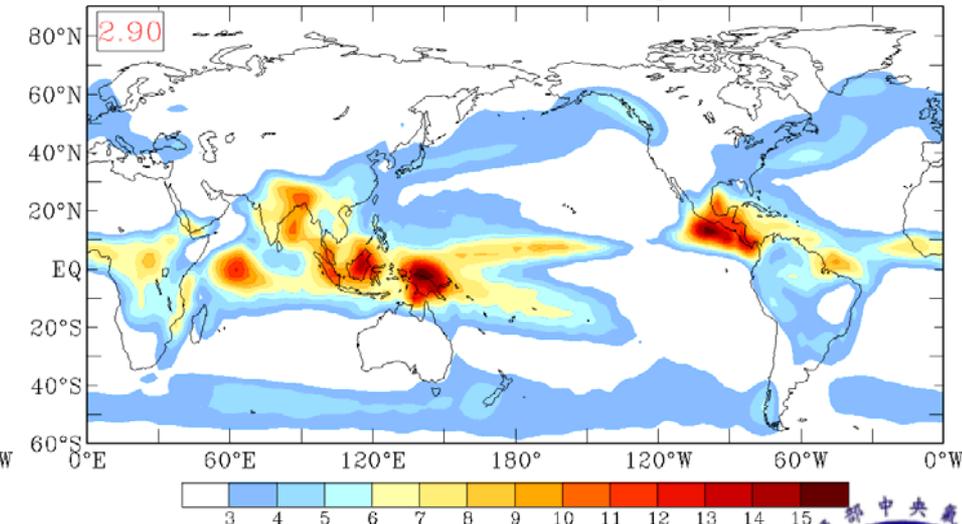
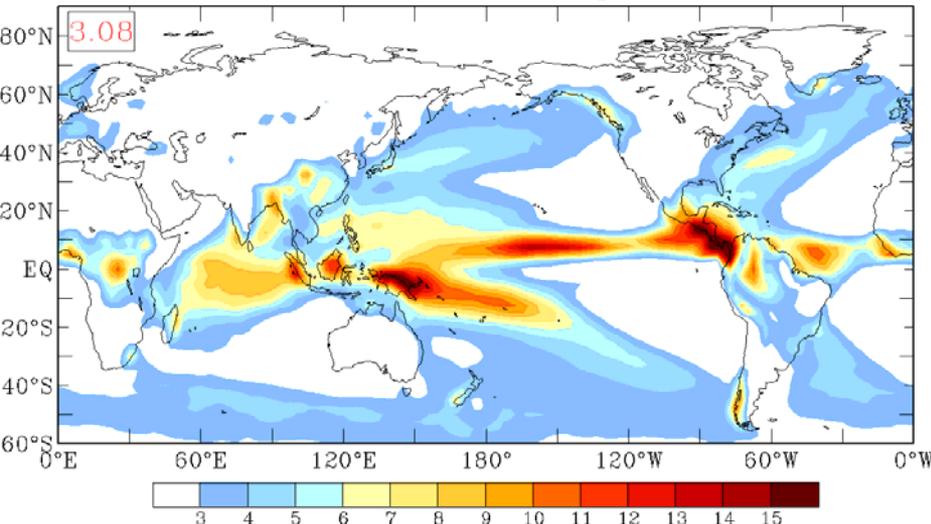


AMIP-T119 (1949-2006) 0.87

AMIP-T42 (1950-2005) 0.76

1949-2006 Annual Mean Precipitation (AMIP50)

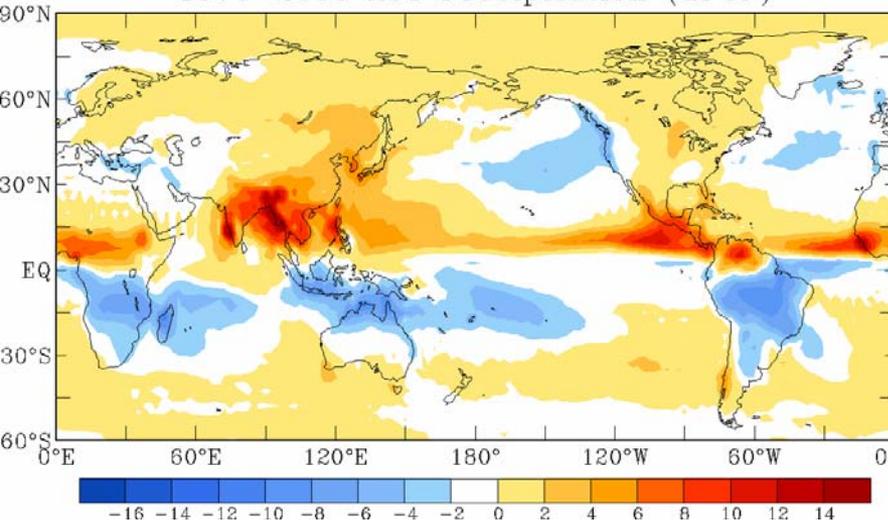
1950-2005 Annual Mean Precipitation (T42)



© AC1 (Apr-May minus Oct-Nov)

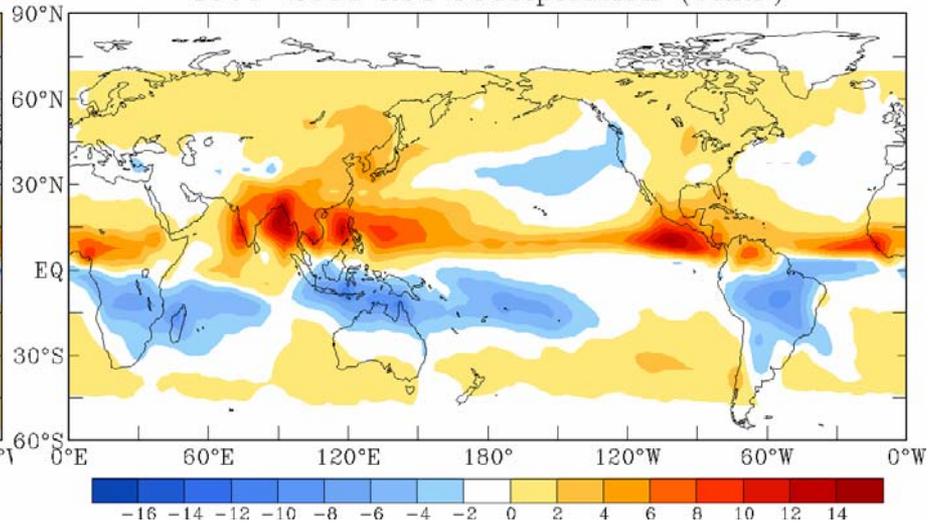
GPCP (1979-2006)

1979-2005 AC1 Precipitation (GPCP)



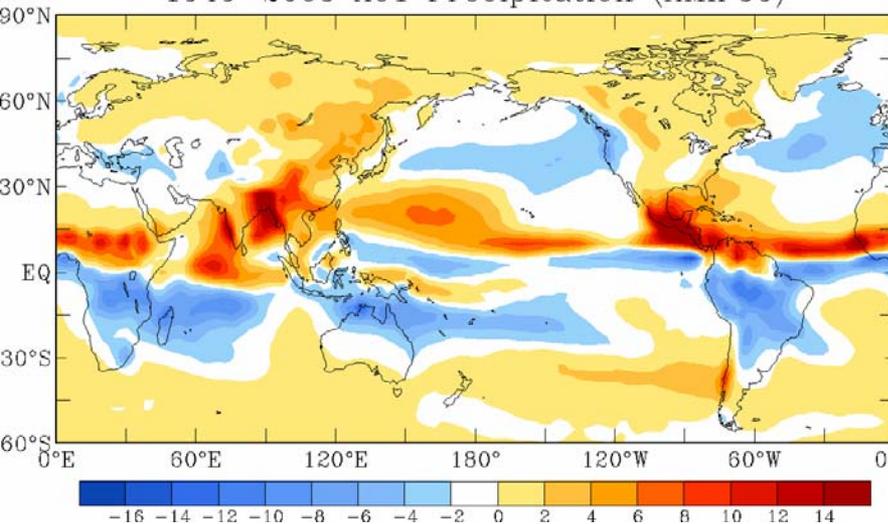
CMAP(1979-2006)

1979-2005 AC1 Precipitation (CMAP)



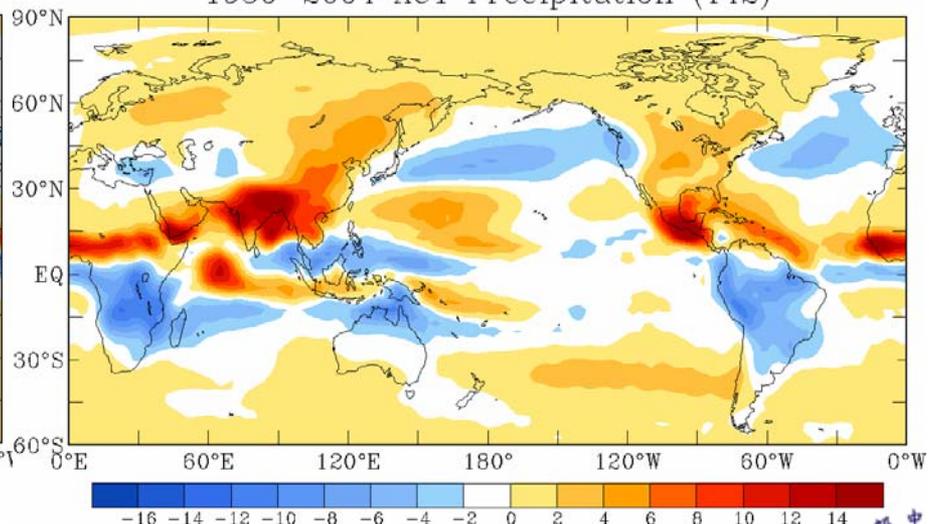
AMIP-T119 (1949-2006) 0.81

1949-2005 AC1 Precipitation (AMIP50)



AMIP-T42 (1950-2005) 0.69

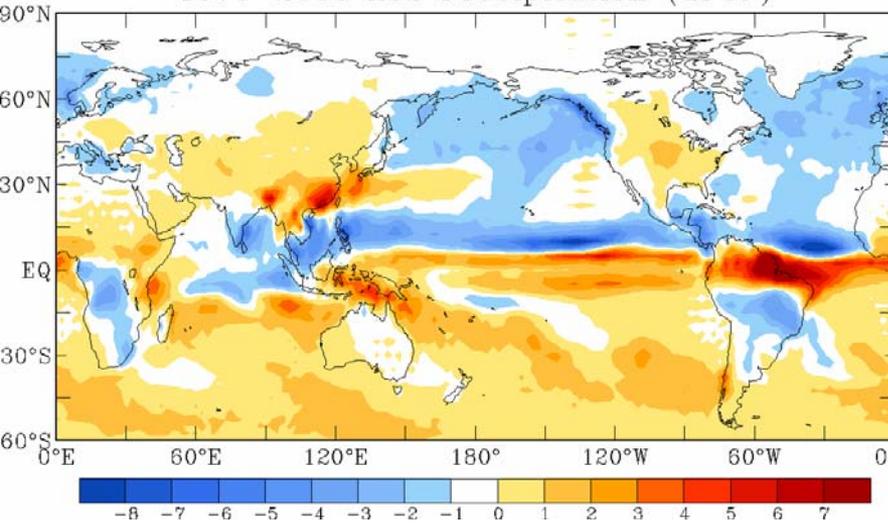
1950-2004 AC1 Precipitation (T42)



© AC2 (Jun-Sep minus Dec-Mar)

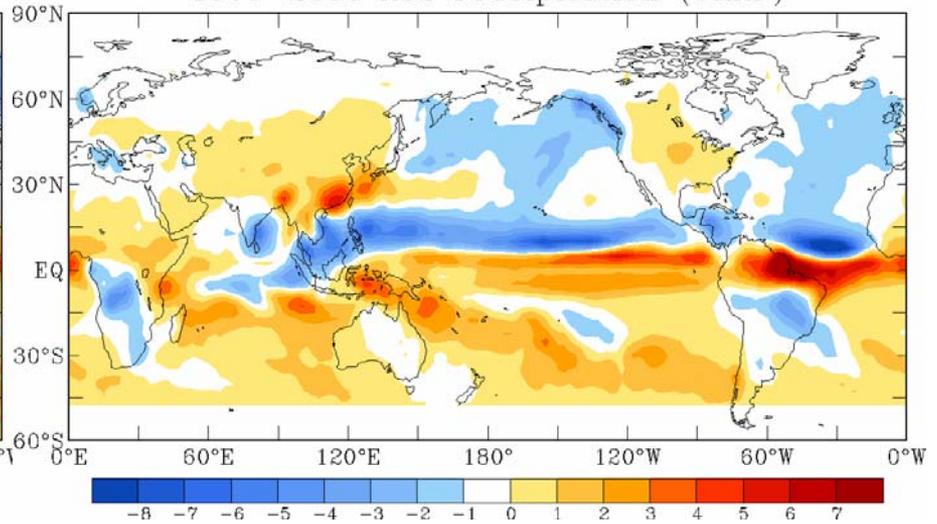
GPCP (1979-2006)

1979-2006 AC2 Precipitation (GPCP)



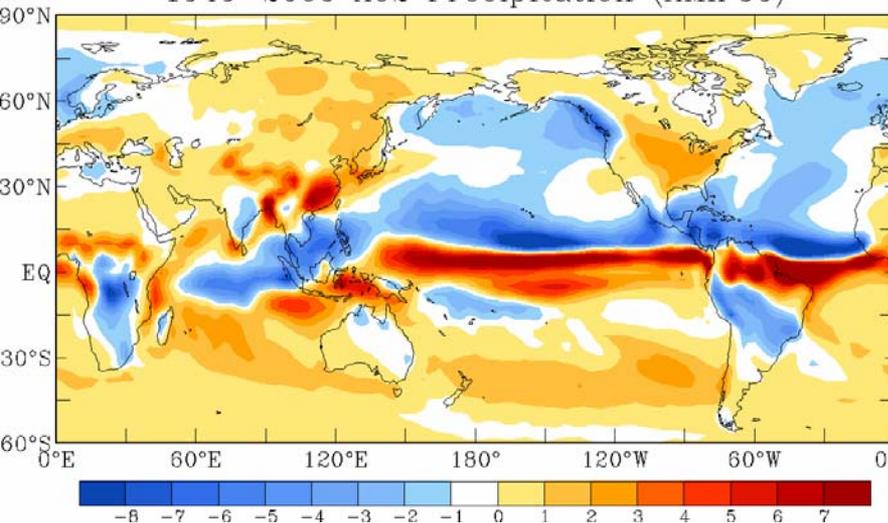
CMAP(1979-2006)

1979-2006 AC2 Precipitation (CMAP)



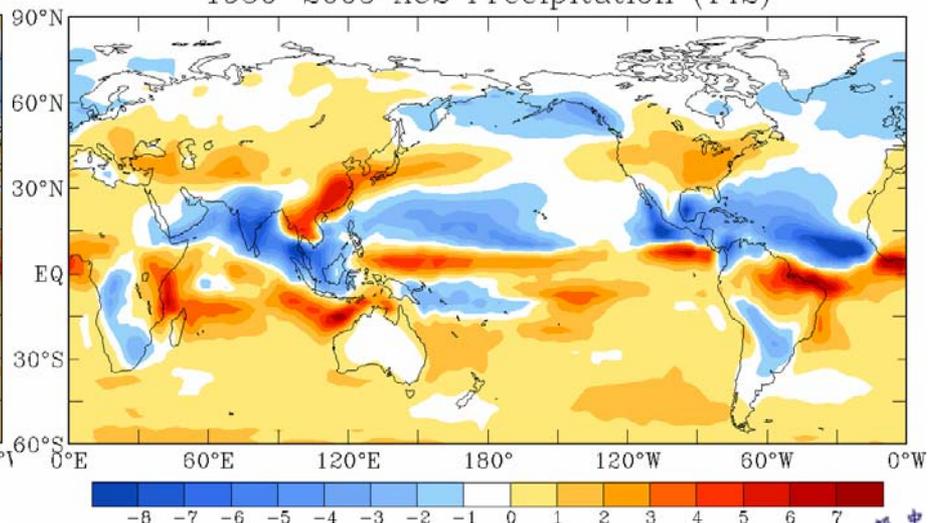
AMIP-T119 (1949-2006) 0.78

1949-2006 AC2 Precipitation (AMIP50)



AMIP-T42 (1950-2005) 0.64

1950-2005 AC2 Precipitation (T42)

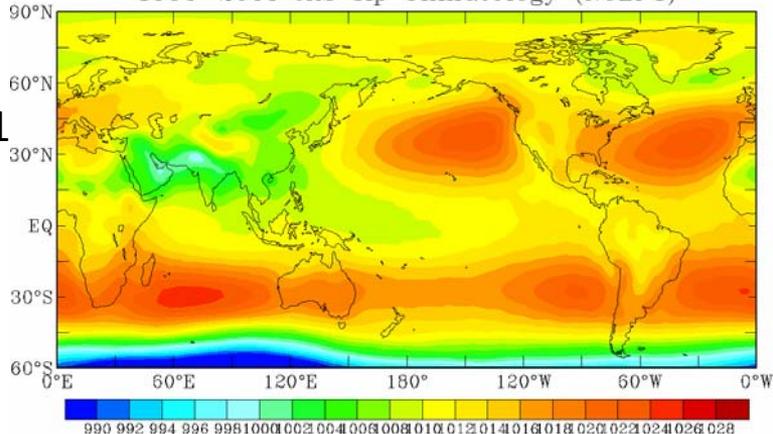


➤ 小結

- T119能正掌握住各海溫指標反應大氣環流特徵，而且形態相關係數明顯比T42高。
- 年降雨分析中，T119能夠正確表現降雨隨不同季節的分佈特性，並且大幅度改善T42在海面上降水誤差，尤其是ITCZ降雨帶。
- T119之高解度模式能夠突顯出局部地區的降水分佈特徵。

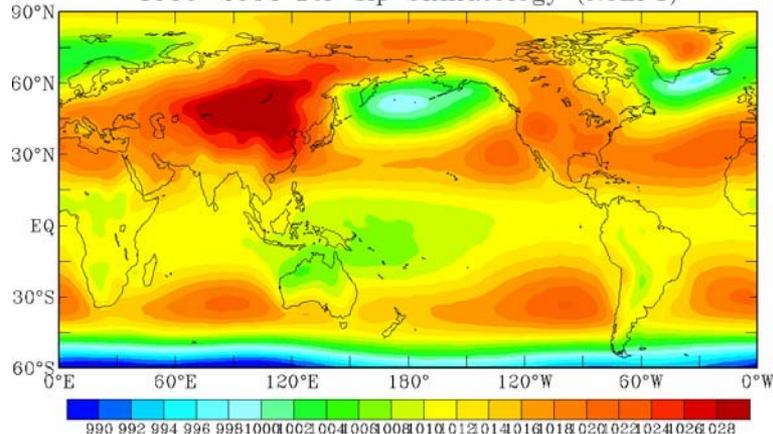
JAS SLP - Climatology

1950-2005 JAS slp Climatology (NCEP1)



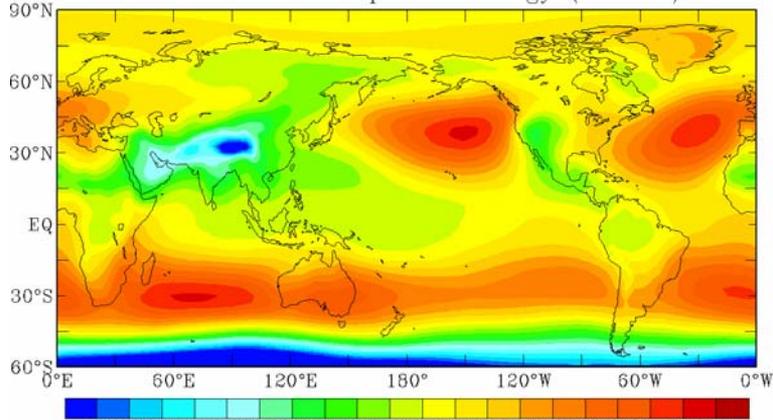
DJF SLP - Climatology

1950-2004 DJF slp Climatology (NCEP1)

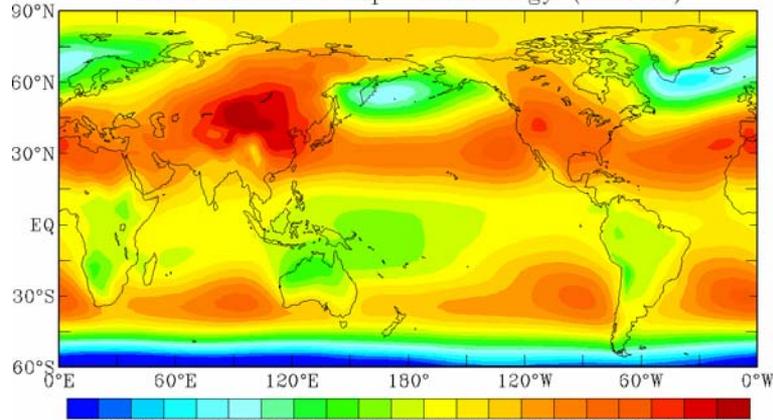


NCEP-R1

1950-2005 JAS slp Climatology (AMIP50)

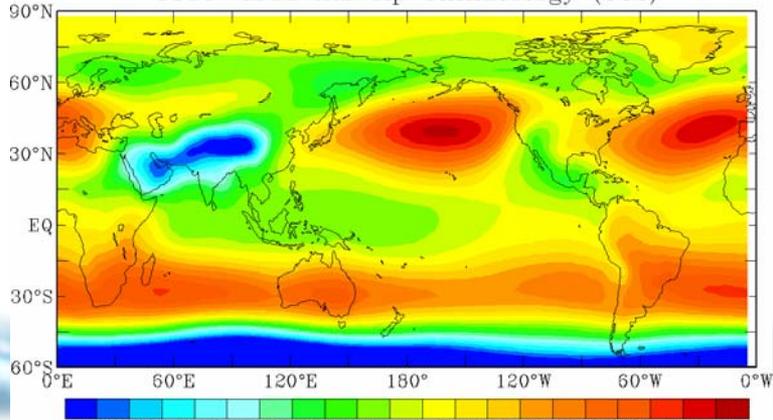


1950-2004 DJF slp Climatology (AMIP50)

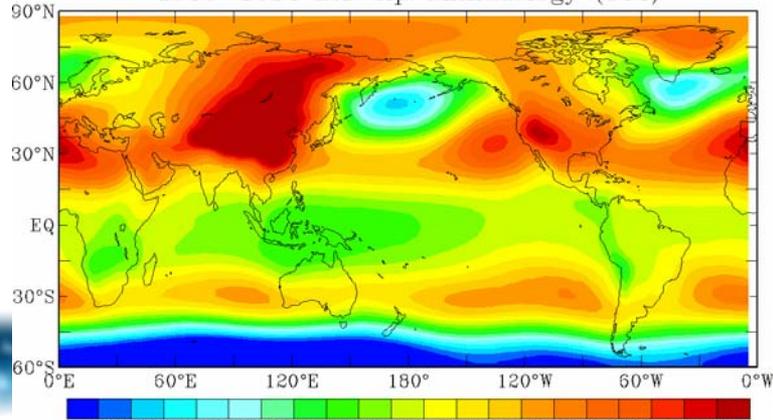


AMIP-T119

1950-2005 JAS slp Climatology (T42)



1950-2004 DJF slp Climatology (T42)



AMIP-T42



◎ Table of Pattern Correlation

	T119-PCP	T119-T2m	T119-SLP	T119-u850	T42-PCP	T42-T2m	T42-SLP	T42-u850
JFM	0.87	1	0.95	0.96	0.8	0.99	0.89	0.85
FMA	0.86	1	0.96	0.97	0.78	0.99	0.91	0.88
MAM	0.85	1	0.96	0.97	0.76	0.99	0.93	0.91
AMJ	0.85	0.99	0.96	0.97	0.76	0.98	0.95	0.93
MJJ	0.83	0.99	0.95	0.97	0.74	0.98	0.94	0.93
JJA	0.81	0.99	0.94	0.96	0.69	0.98	0.92	0.92
JAS	0.8	0.99	0.94	0.96	0.64	0.98	0.93	0.91
ASO	0.81	0.99	0.95	0.96	0.64	0.99	0.93	0.91
SON	0.85	0.99	0.97	0.97	0.69	0.99	0.94	0.91
OND	0.87	1	0.97	0.97	0.74	0.99	0.92	0.9
NDJ	0.88	1	0.96	0.97	0.78	0.99	0.9	0.89
DJF	0.88	1	0.96	0.96	0.81	0.99	0.87	0.86

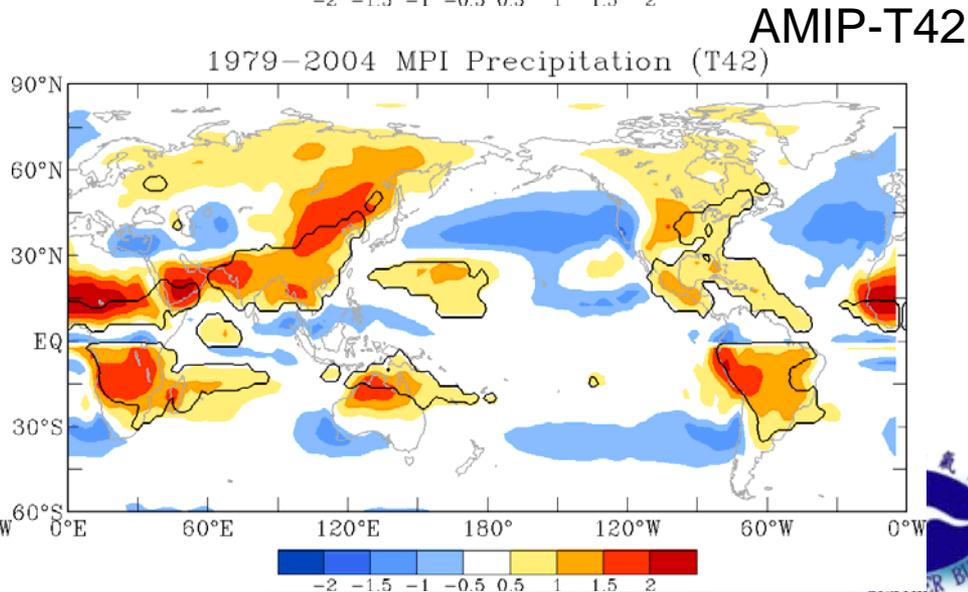
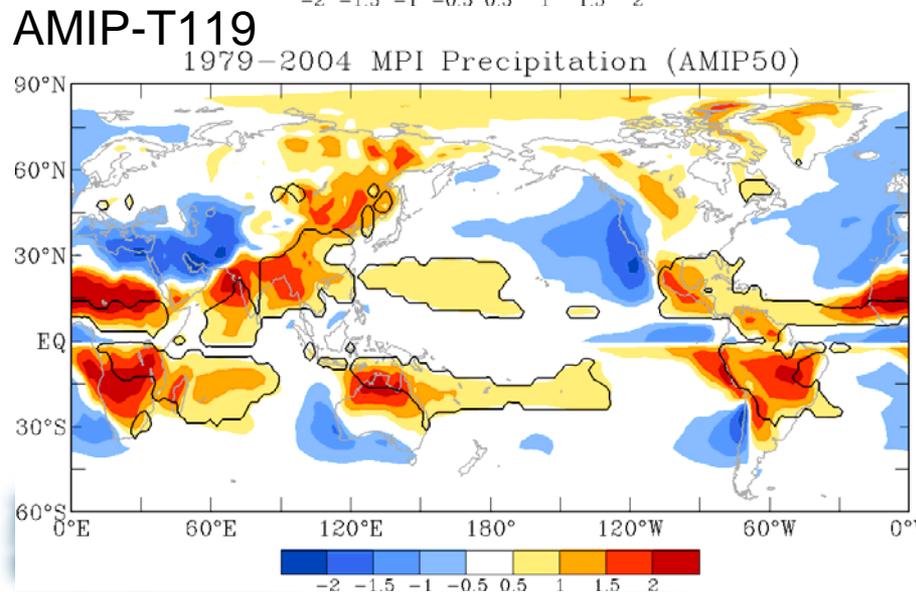
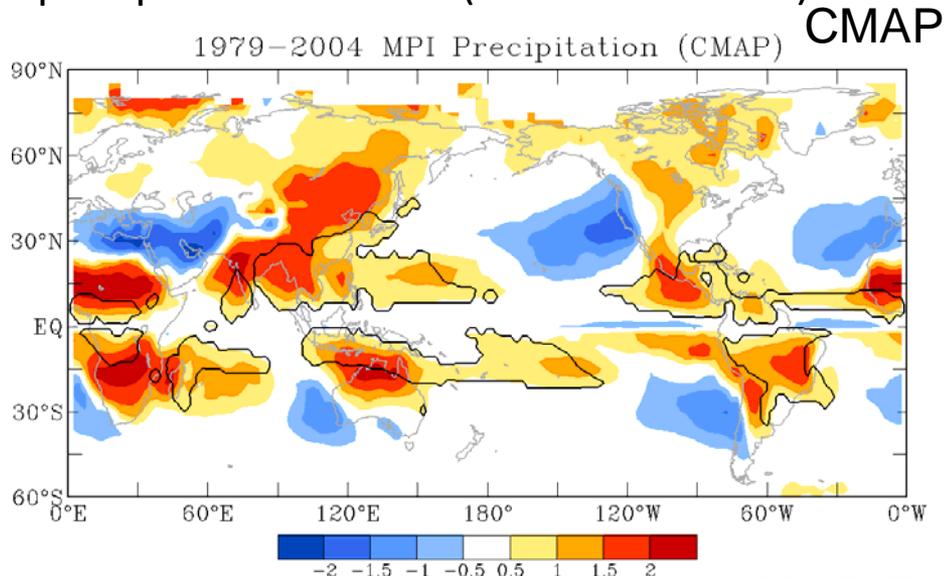
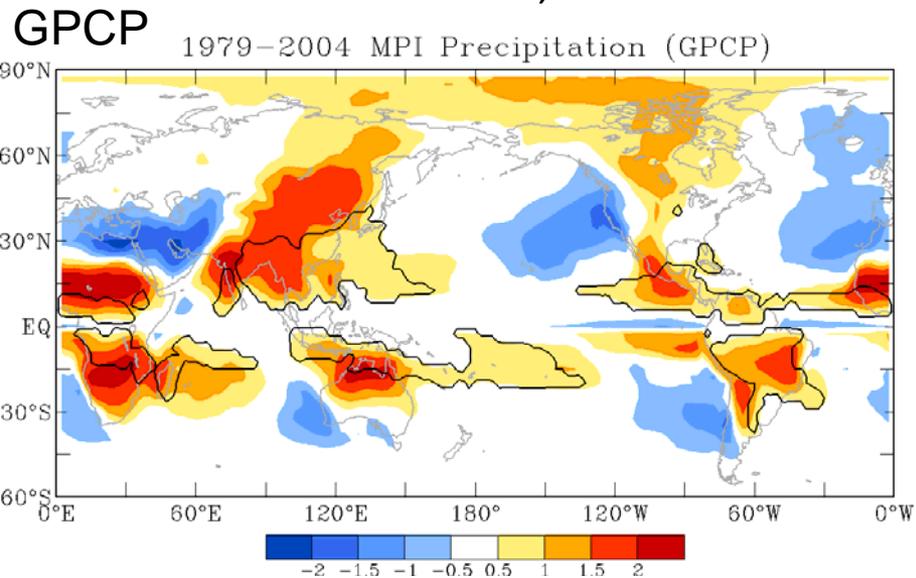
- 形態相關係數除了降雨場外，其它變數場均有達0.95以上的高相關，T119又比T42有更高的相關係數值。

季風降雨強度、範圍 - Monsoon Precipitation Index (MPI)

MPI = Annual Range of precipitation / Annual Mean of precipitation

AR = MJJAS(NDJFM) minus NDJFM(MJJAS) in NH (SH).

Shaded= MPI, Contour= monsoon precipitation domain (MPI>0.5&PCP>2)



➤ 季風指標

● 風場指標:

1. Western North Pacific-East Asian Monsoons index (WNPM)

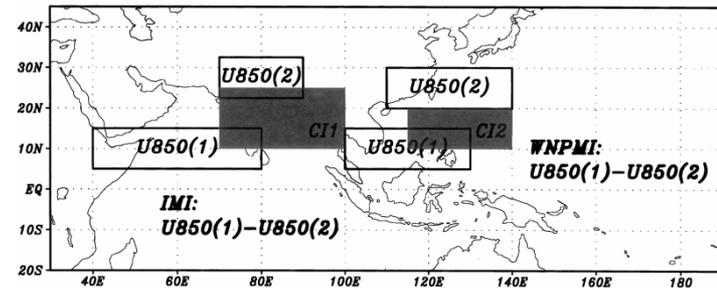
$U850(5^{\circ}-15^{\circ}N, 100-130^{\circ}E) - U850(20-30^{\circ}N, 110-140^{\circ}E)$

(Wang et al., 2001)

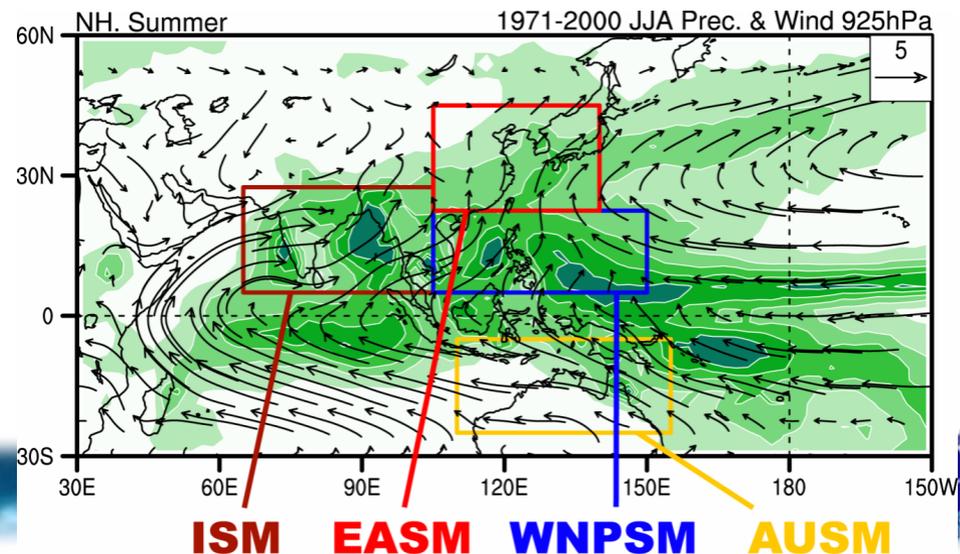
2. Webster-Yang monsoon index (WYI)

($U850-U200$ averaged over $0-20^{\circ}N, 40^{\circ}E-110^{\circ}E$)

(Webster, P.J., and S.Yang, 1992)

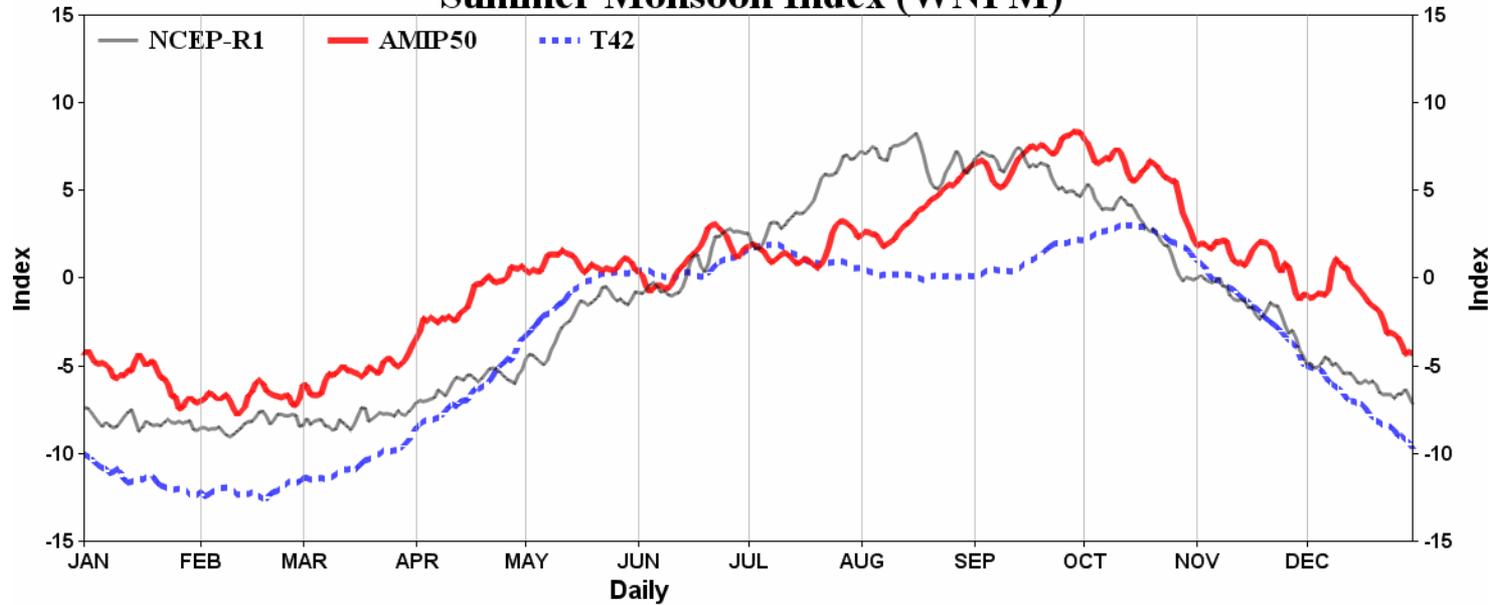


● 雨量指標: 不同區域內的降雨量

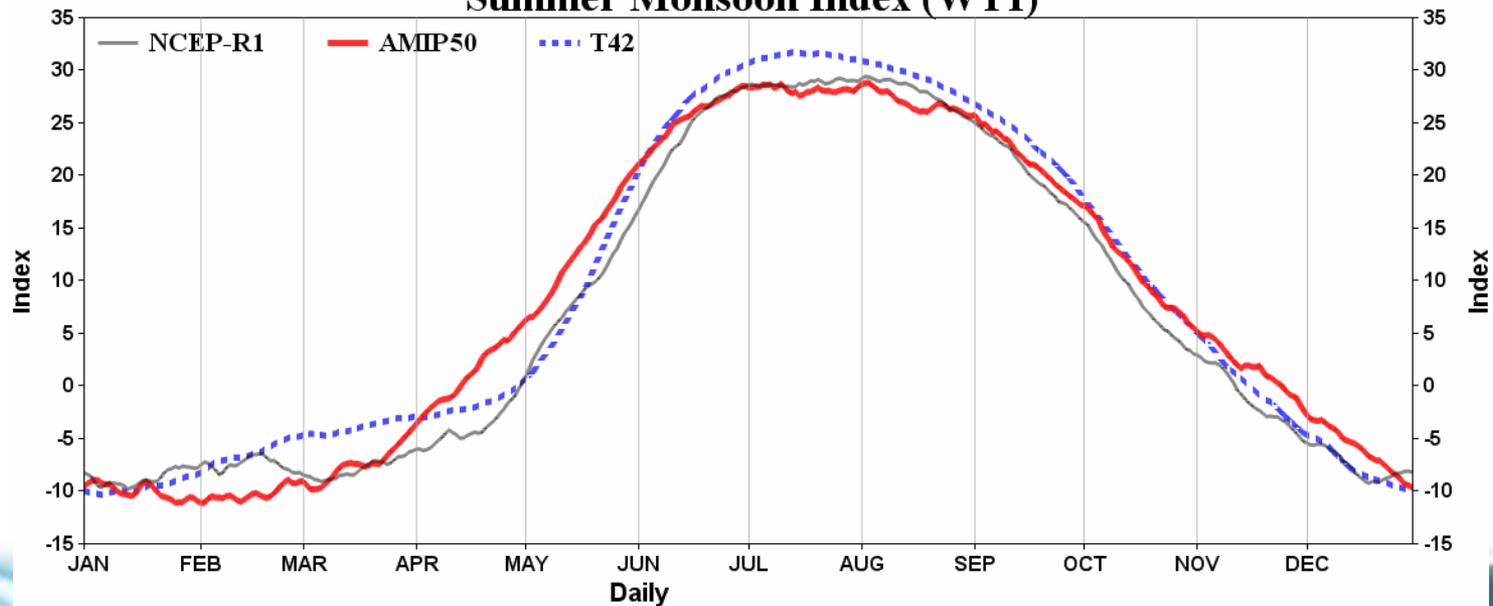


© Monsoon Index (Daily Climatology)

Summer Monsoon Index (WNPM)



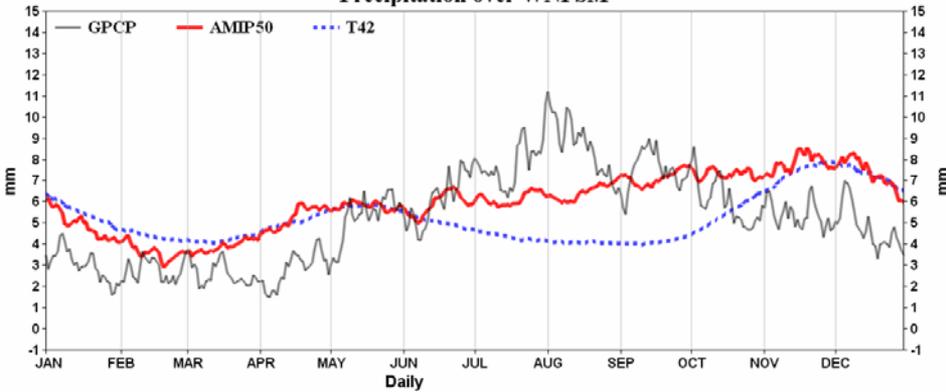
Summer Monsoon Index (WYI)



© Precipitation over Domain

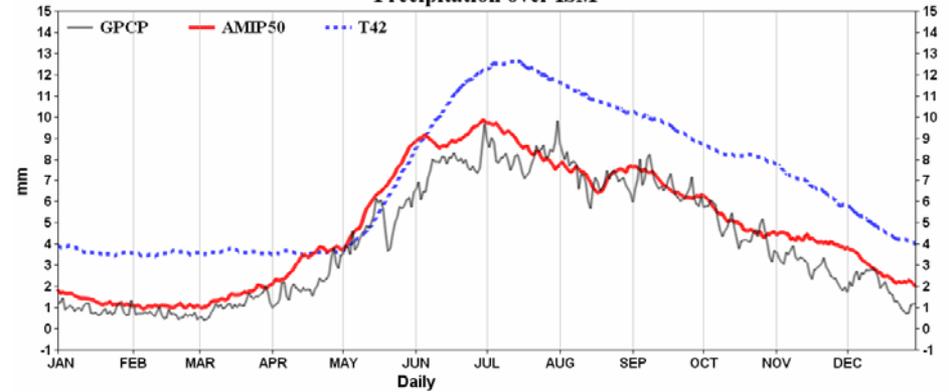
WNPSM

Precipitation over WNPSM



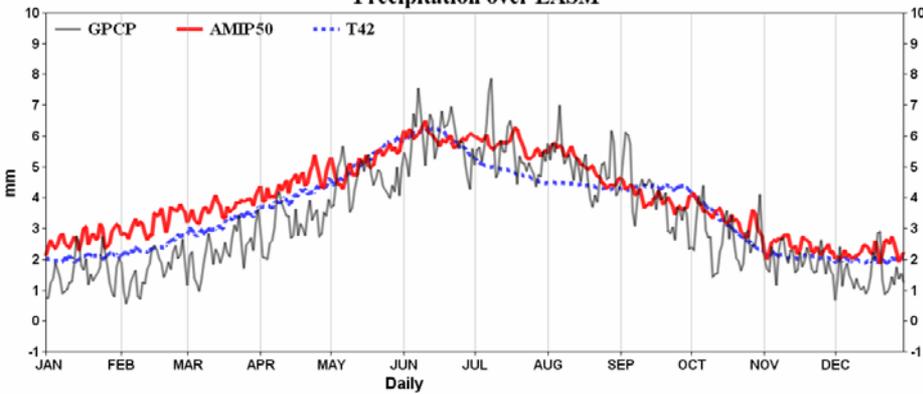
ISM

Precipitation over ISM



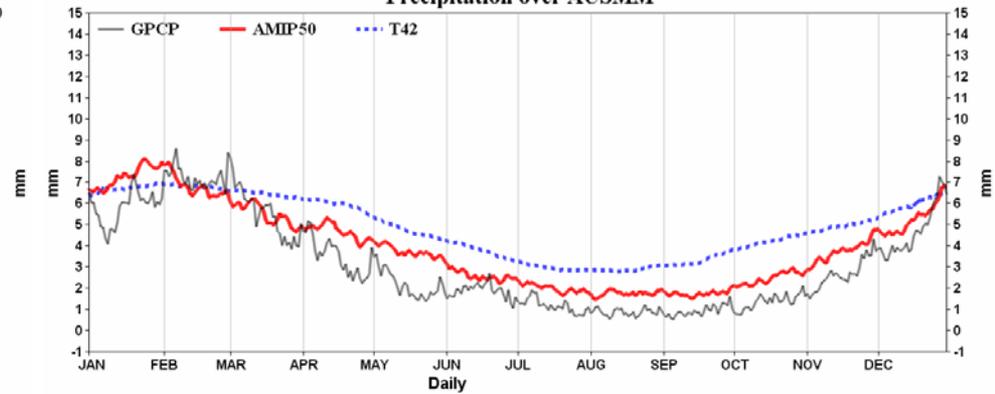
EASM

Precipitation over EASM



AUSM

Precipitation over AUSM



➤ 結論:

1. 新一代高解析之氣候預報模式(T119)與作業化模式(T42)之AMIP結果比較，此T119模式不論在環流場、雨量等氣候場模擬均比T42更接近於觀測場，尤其是ITCZ的降雨氣候場，此外也突顯出局部性的降雨分佈特性。
2. T119之大氣環流氣候場模擬和NCEP重分析資料相似，形態相關係數可達0.9以上，但夏季模擬太平洋副熱帶高壓強度偏強，且位置偏北。另外雨量氣候場在印度洋和赤道西太平洋地區模擬偏強。
3. 年循環(Annual Cycle)分析方面，發現T119模擬的各種季風指標之年循環均與觀測相近，並且明顯優於T42低解析度模式，但在西北太平洋季風指標的表現則明顯劣於其它地區的季風指標。