



MRI-JMA AGCM 與 ECHAM5 模式 推估值之動力降尺度結果比較

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17 Jan. 2013

ECHAM5 & MRI 模式、 動力降尺度簡介

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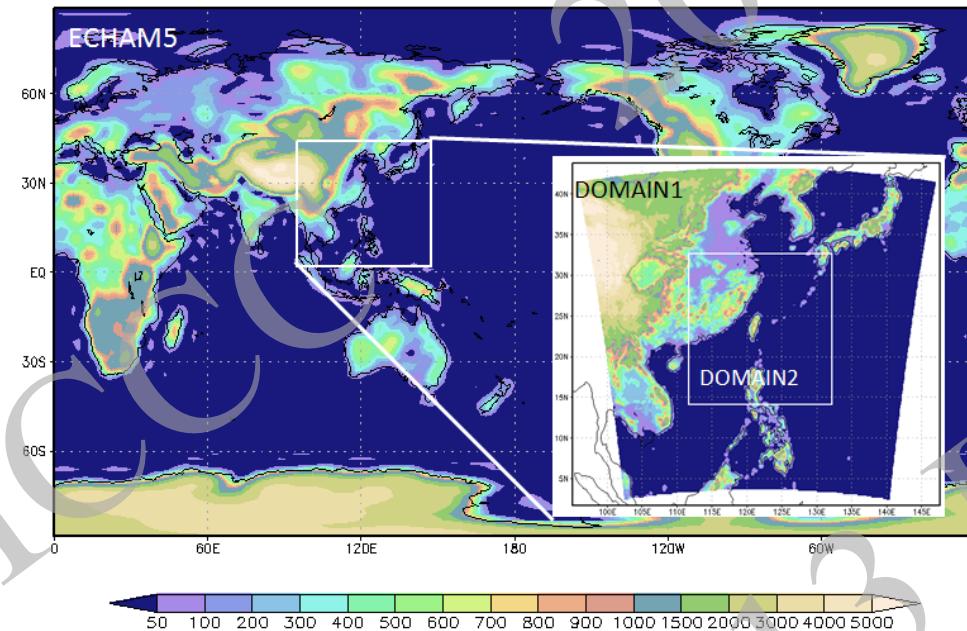


Introduction: dynamical downscaling

- Existing Global climate models (GCMs) typical run at a scale of 200 km which is too coarse for application regional or local
 - Especially for variables that depend on regional topographic, such as precipitation, surface wind and temperature
- Dynamical downscaling with regional climate model is an essential component to fill the gap between GCMs and regional application
- The RCM is **not intended to modify/correct** the large scale circulation of the AOGCM but is intended to add regional detail in response to regional scale forcing (topography, coastlines, and land use/land cover) as it interacts with the larger-scale atmospheric circulations (Hanssen et al.; 2003, Lo et al. 2008; ...)

ECHAM5-WRF dynamical downscaling

- IPCC AR4 中 ECHAM5 的模擬結果作為動力降尺度之基本場，解析度為 T63，資料網格為 192x96，經向網格間距為 1.875° (約 200 公里)，緯向為非等間距網格，垂直分為 17 層，模式最頂層氣壓為 10 hPa
- ECHAM5-WRF



WRF: Domain1 : 301x301 $\Delta x,y=15\text{km}$ FDDA
Domain2 : 382x400 $\Delta x,y=5\text{km}$, vertical 45 levels



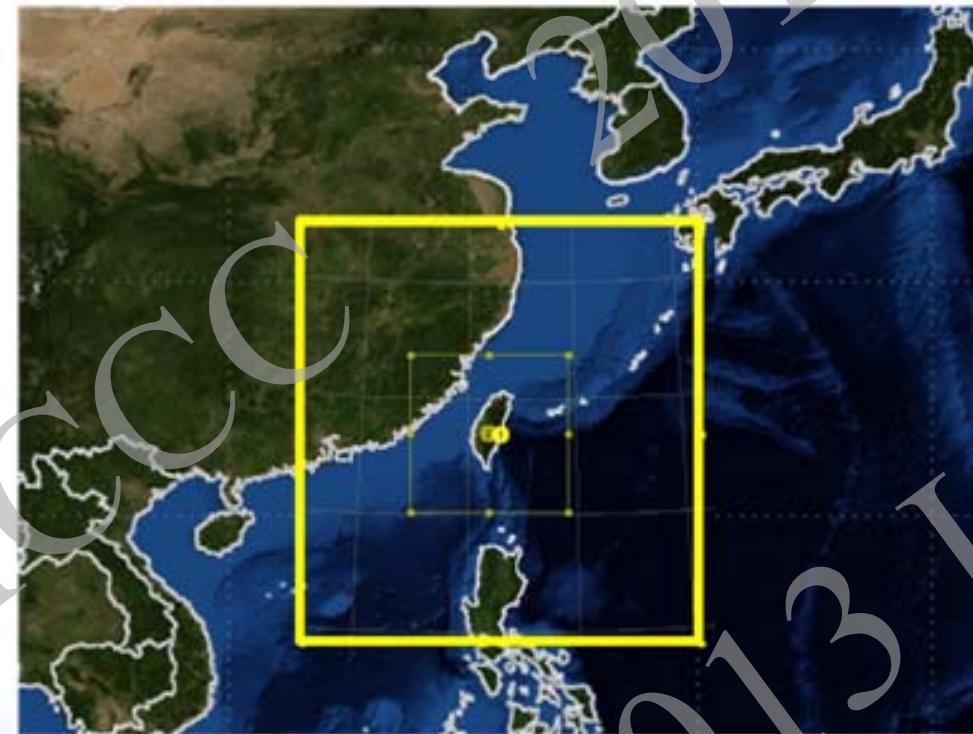
ECHAM5-WRF downscaling

Model Description and Experimental setup

- Study Periods:
1979-2003 (Present), 2015-2039 (Near-future), 2075-2099 (End 21c)
- WRF setup:
Domain1 (15km): FDDA, Cumulus option: Kain-Fritsch scheme
Domain2 (5km): no nudging, no cumulus scheme
Cold start every month and run for one month
- Physical options
Noah Land surface model, Cam LW Scheme
YSU Boundary Scheme, Cam SW scheme
WSM 5-class microphysics, M-O surface layer scheme
- Observation: TCCIP 1 km uniform data
(From Team 1)

MRI downscaling and set up

- MRI-JMA 模式係根據日本氣象廳(Japan Meteorological Agency, JMA)在天氣預報作業上使用的數值模式所發展而成具有TL959極高水平解析度，全球網格數為，網格間距約20公里；垂直方向上有60層，模式最頂層氣壓為0.1 hPa

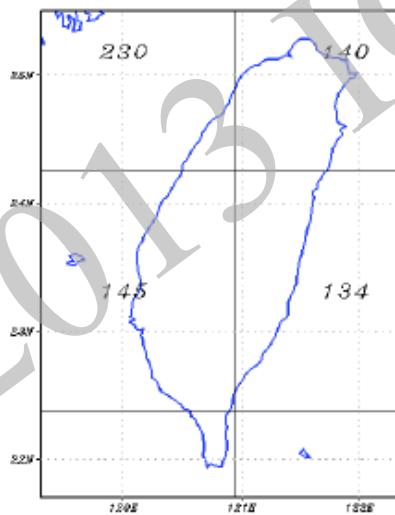


使用一層巢狀網格，水平解析度為5公里，網格點數 380*400 。
垂直解析度為36層

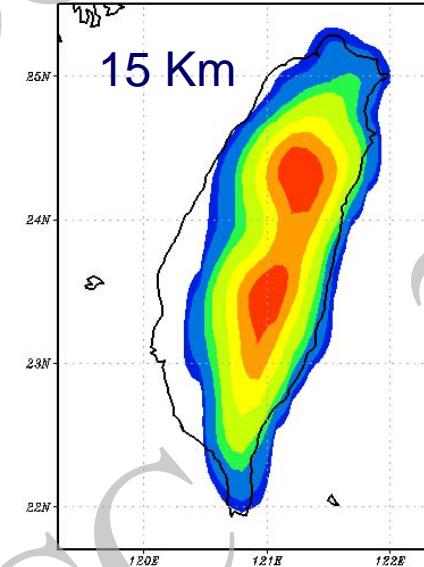


ECHAM5 & WRF Topographic

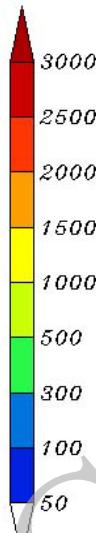
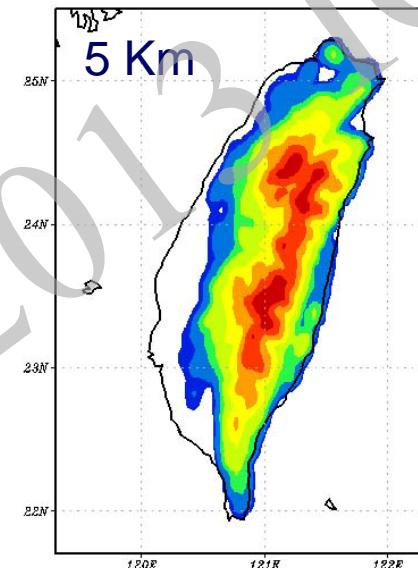
ECHAM5 terrain



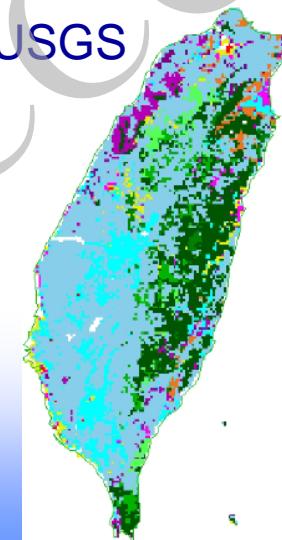
WRF domain1 Terrain Height(



WRF domain2 Terrain Height(m)



USGS



TCCIP



ECHAM5 & MRI

區域環流、高度場比較

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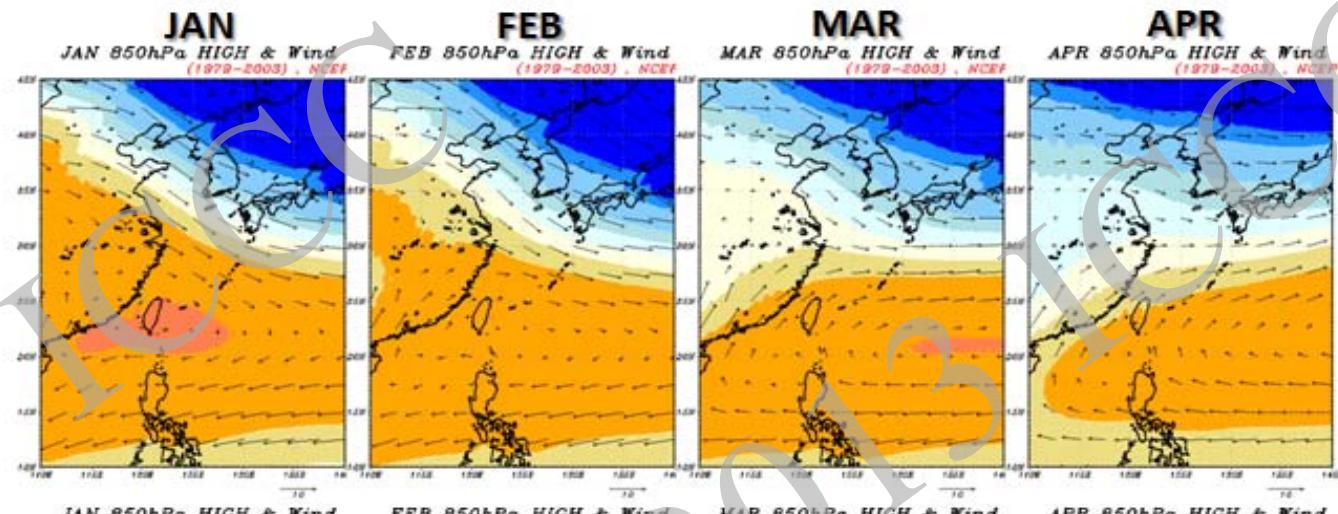
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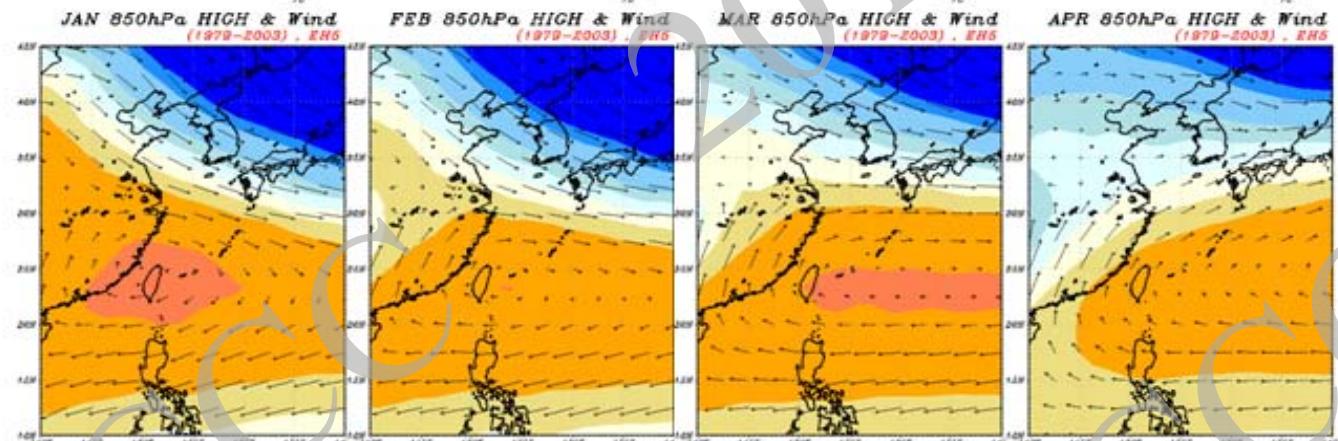
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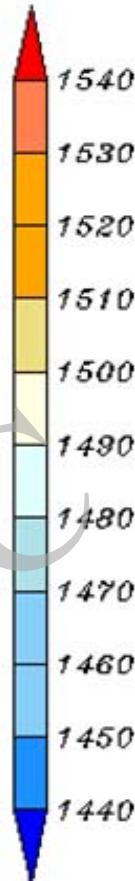
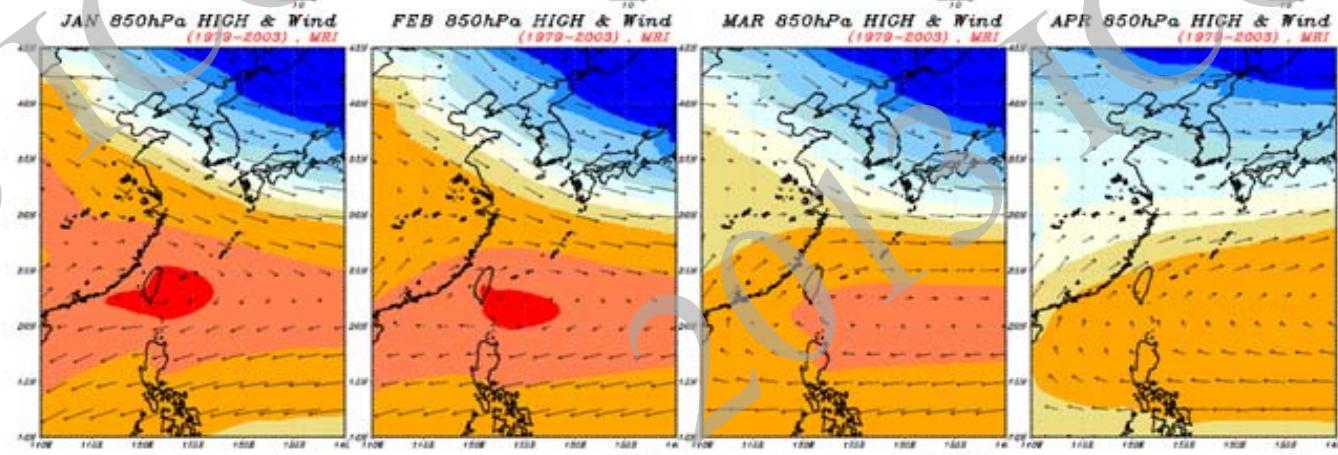
NCEP



ECHAM5



MRI



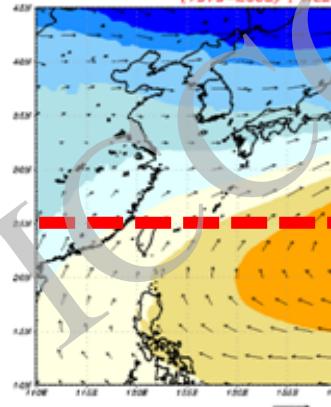


NCEP

2013

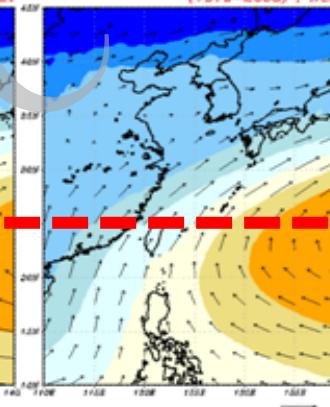
MAY

MAY 850hPa HIGH & Wind
(1979-2003) . NCEP



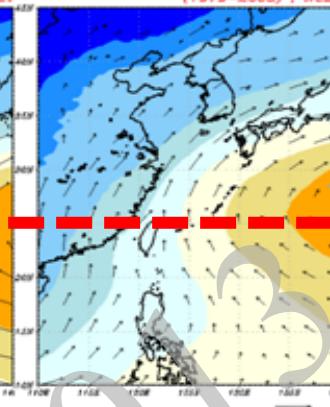
JUN

JUN 850hPa HIGH & Wind
(1979-2003) . NCEP



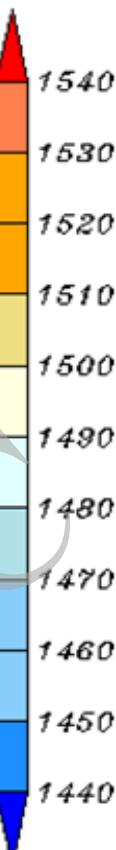
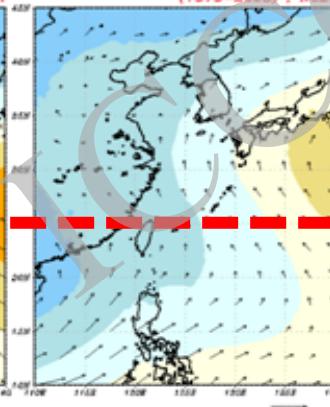
JUL

JUL 850hPa HIGH & Wind
(1979-2003) . NCEP



AUG

AUG 850hPa HIGH & Wind
(1979-2003) . NCEP

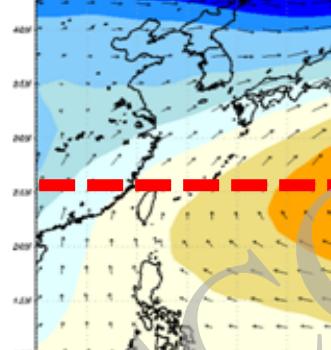


ECHAM5

2013

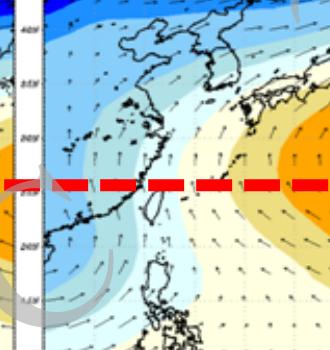
MAY

MAY 850hPa HIGH & Wind
(1979-2003) . ECHAM5



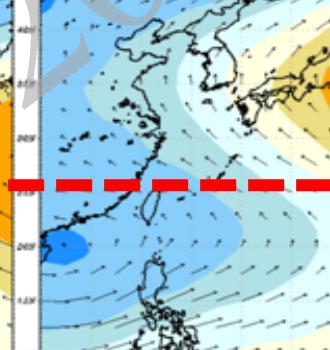
JUN

JUN 850hPa HIGH & Wind
(1979-2003) . ECHAM5



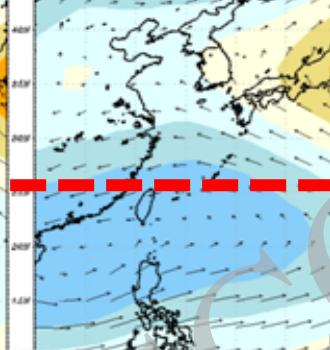
JUL

JUL 850hPa HIGH & Wind
(1979-2003) . ECHAM5



AUG

AUG 850hPa HIGH & Wind
(1979-2003) . ECHAM5

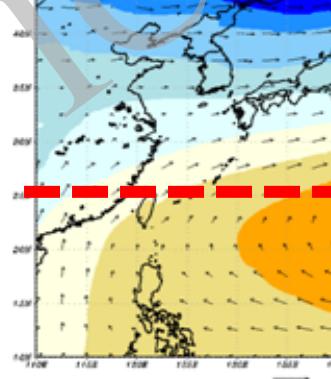


MRI

2013

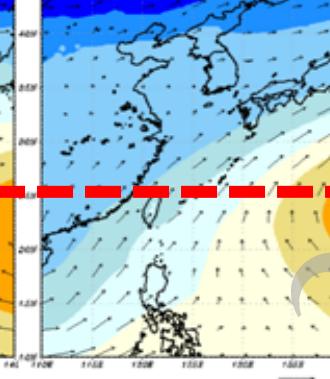
MAY

MAY 850hPa HIGH & Wind
(1979-2003) . MRI



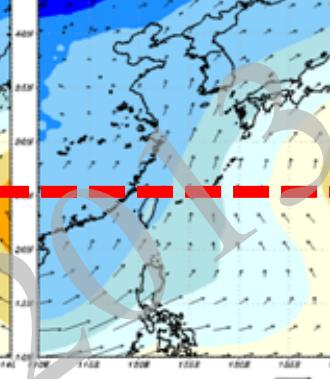
JUN

JUN 850hPa HIGH & Wind
(1979-2003) . MRI



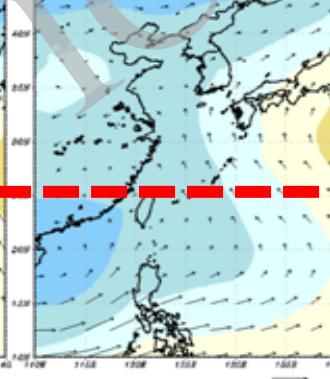
JUL

JUL 850hPa HIGH & Wind
(1979-2003) . MRI

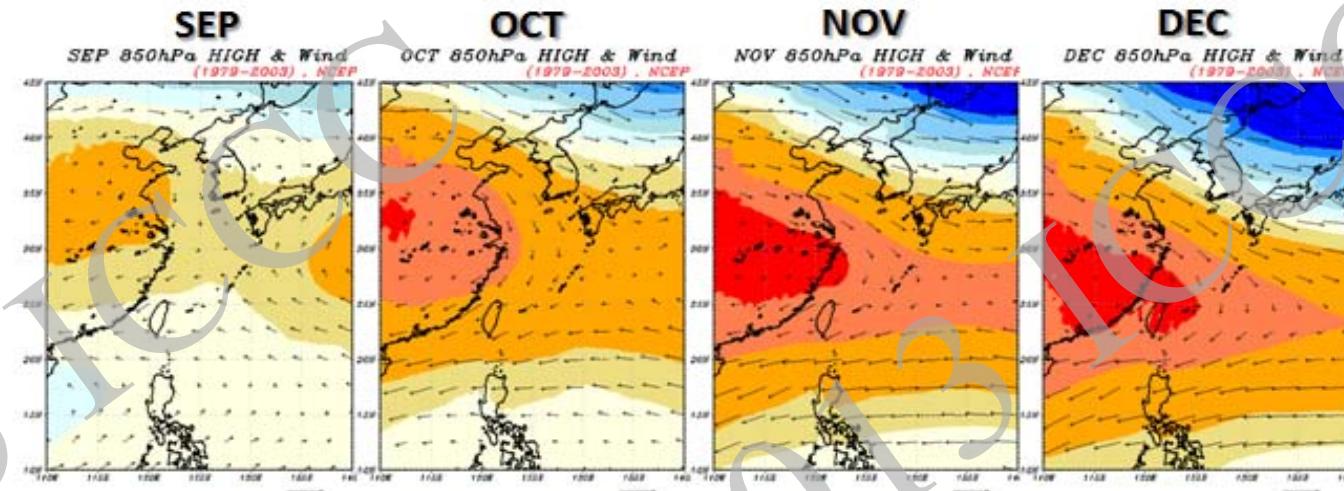


AUG

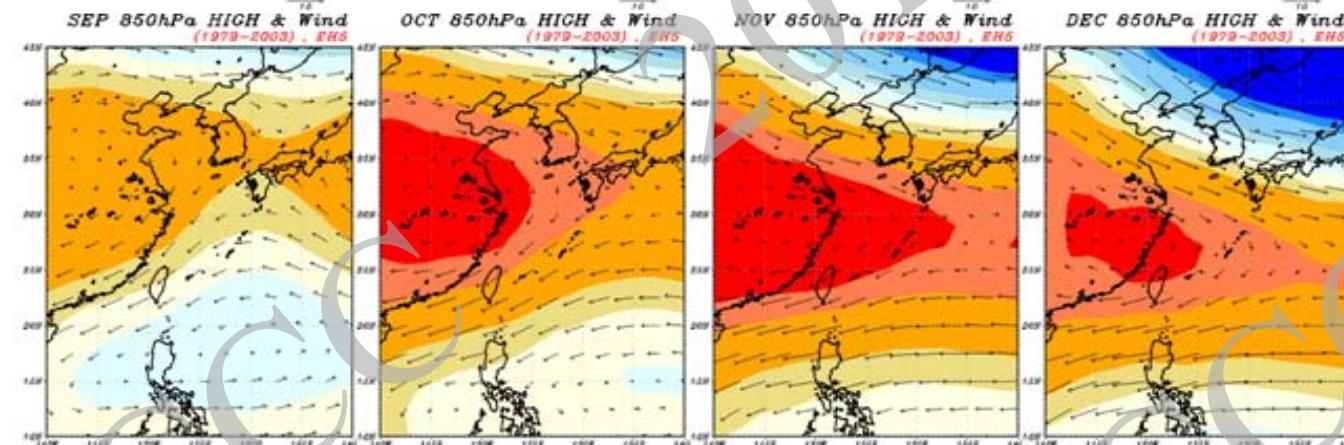
AUG 850hPa HIGH & Wind
(1979-2003) . MRI



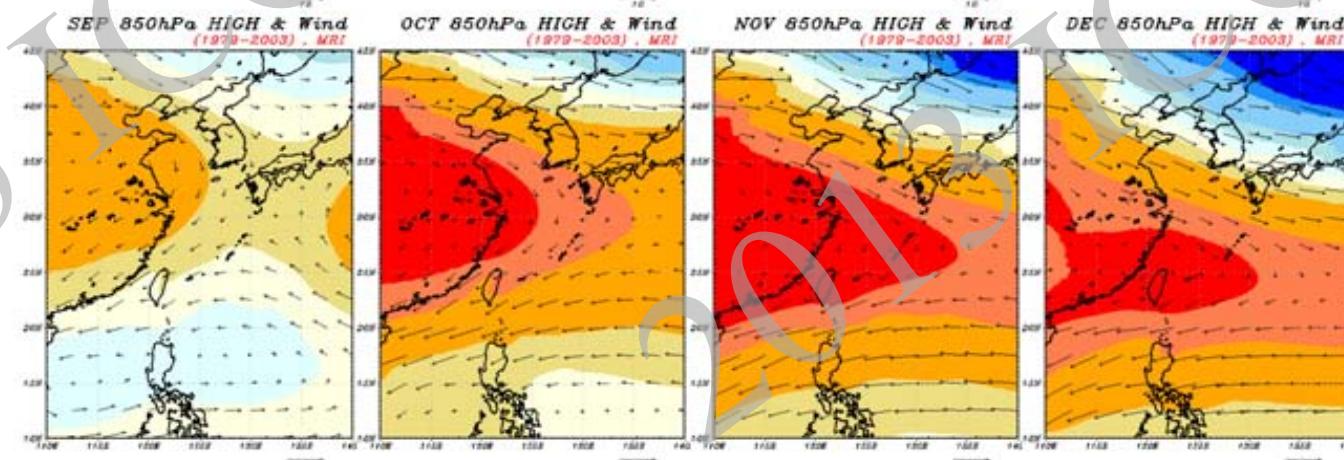
NCEP



ECHAM5



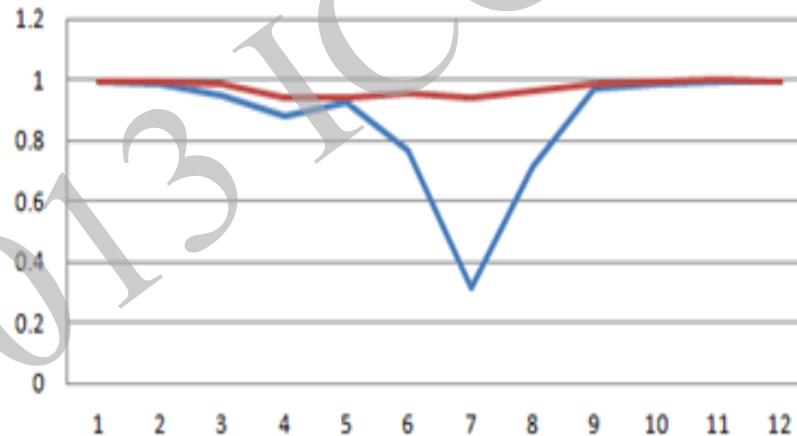
MRI



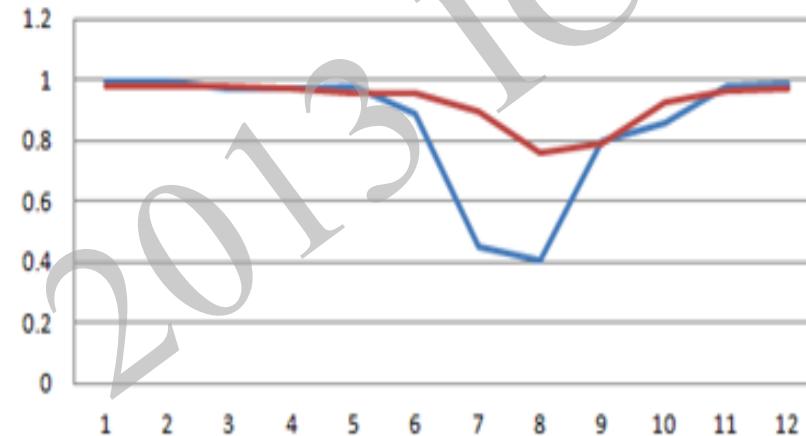


NCEP& MRI、ECHAM5 相關係數比較

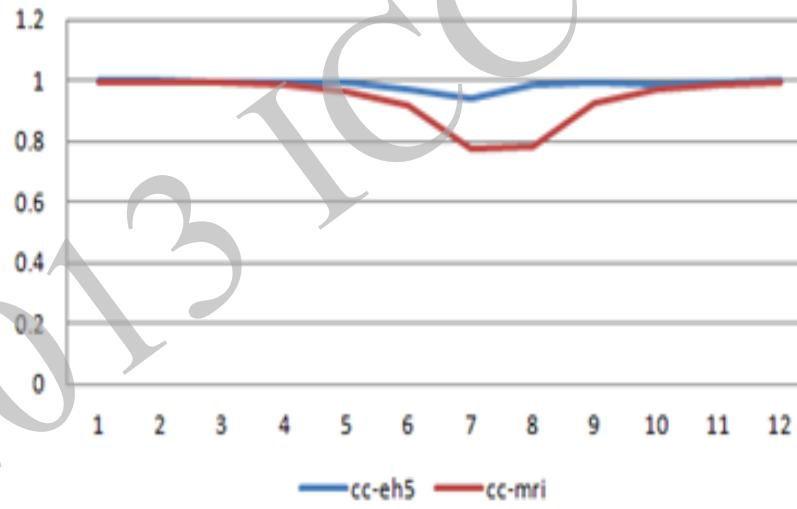
1000hPa CC



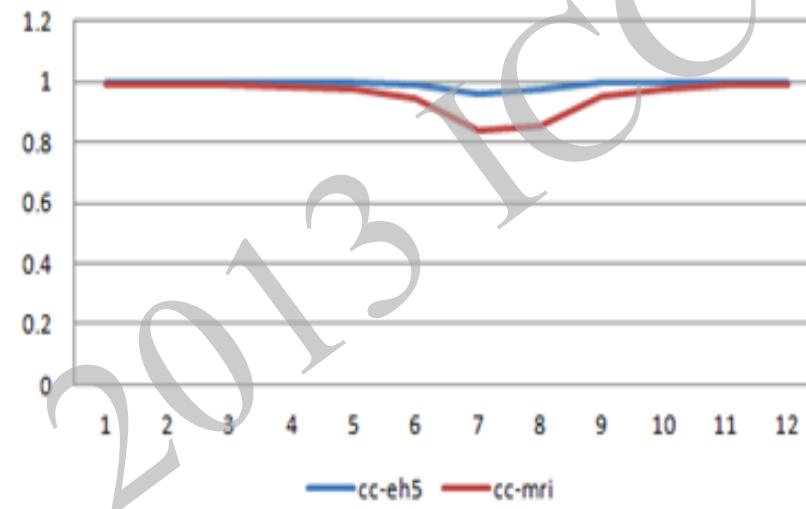
850hPa CC



500hPa CC



200hPa CC



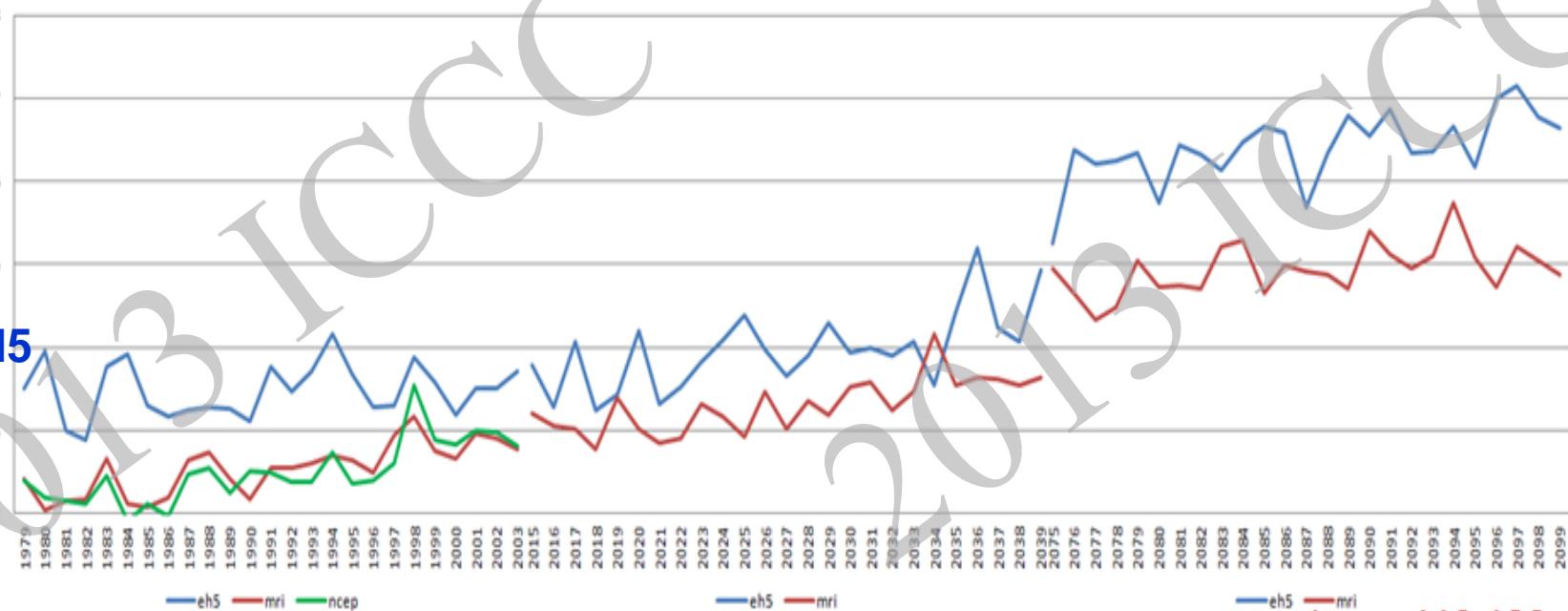
1979-2003 EH5 & MRI T2MEAN

2015-2039 EH5 & MRI T2MEAN

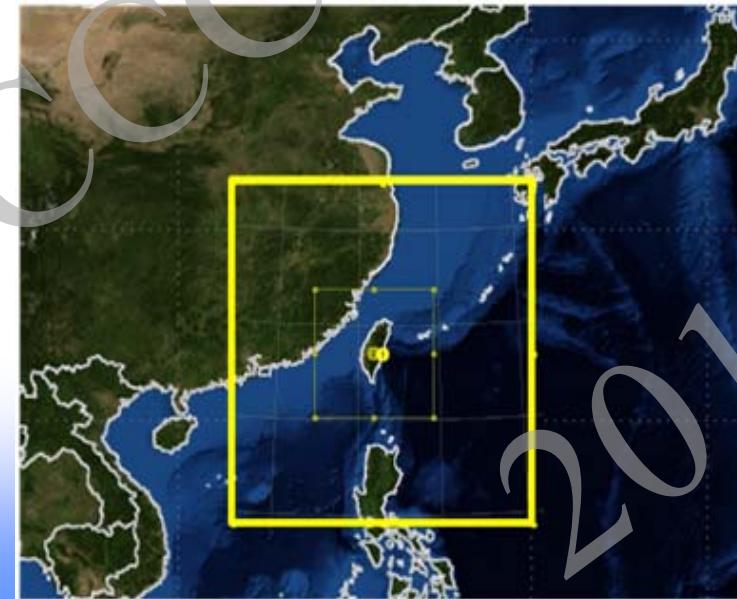
2075-2099 EH5 & MRI T2MEAN

ECHAM5

MRI



ECHAM5:~200 Km
MRI:20 Km



Lon : 112-130
Lat : 15-32

動力降尺度 氣溫推估比較

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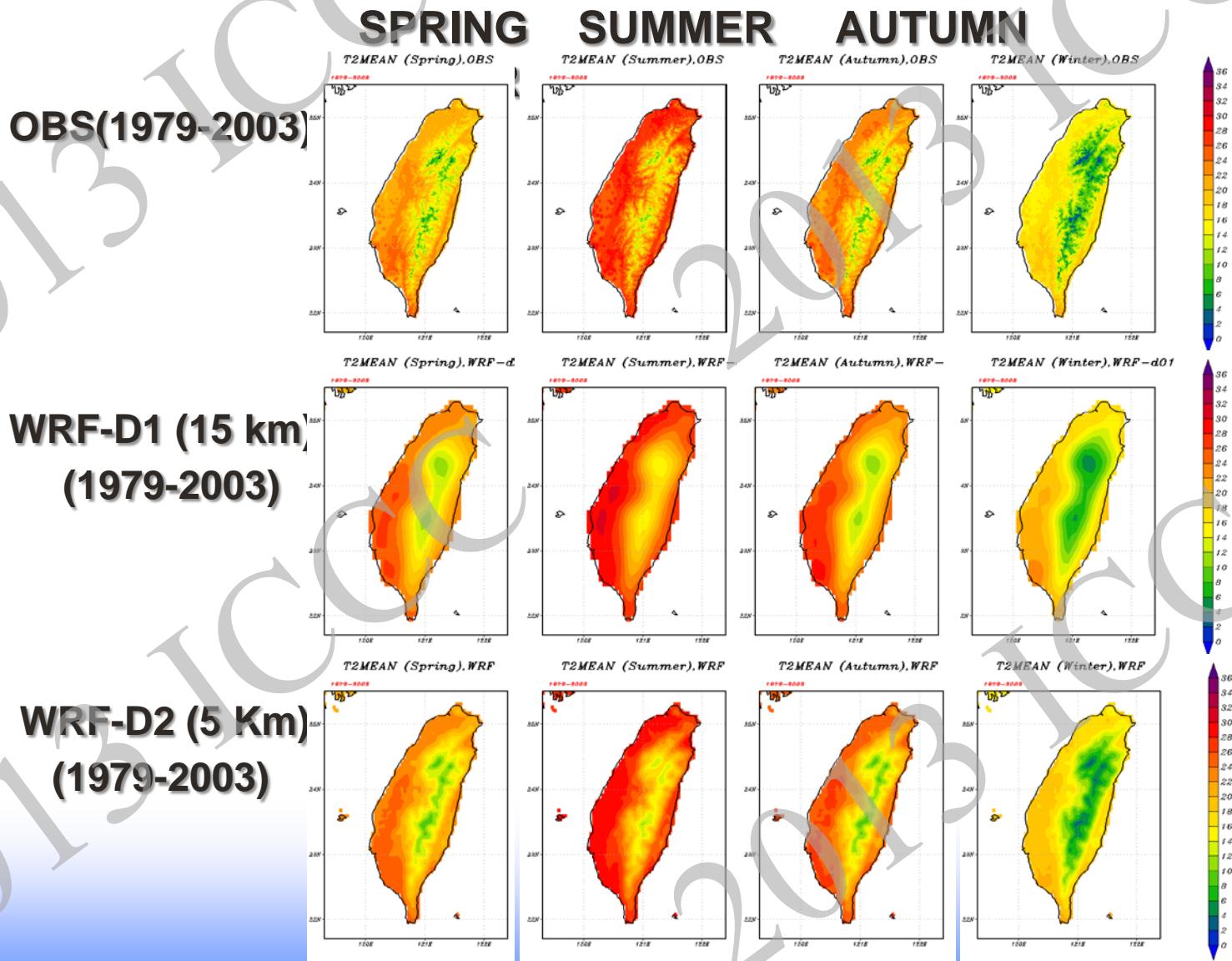
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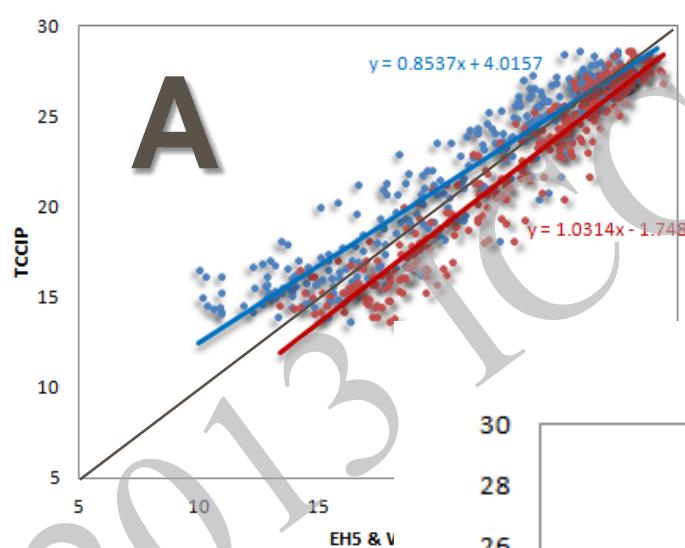
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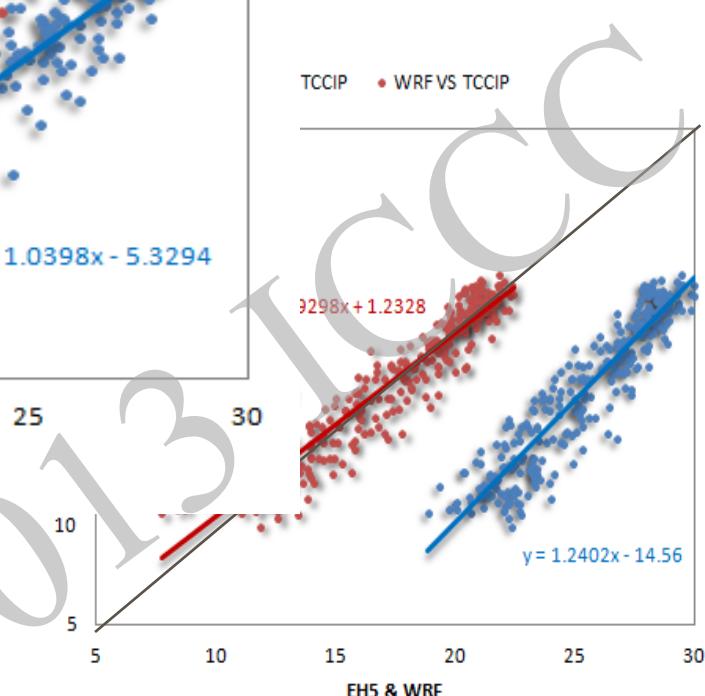
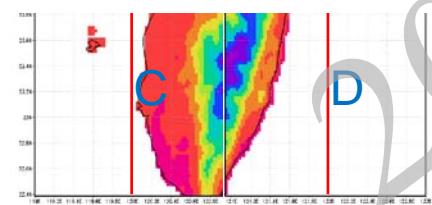
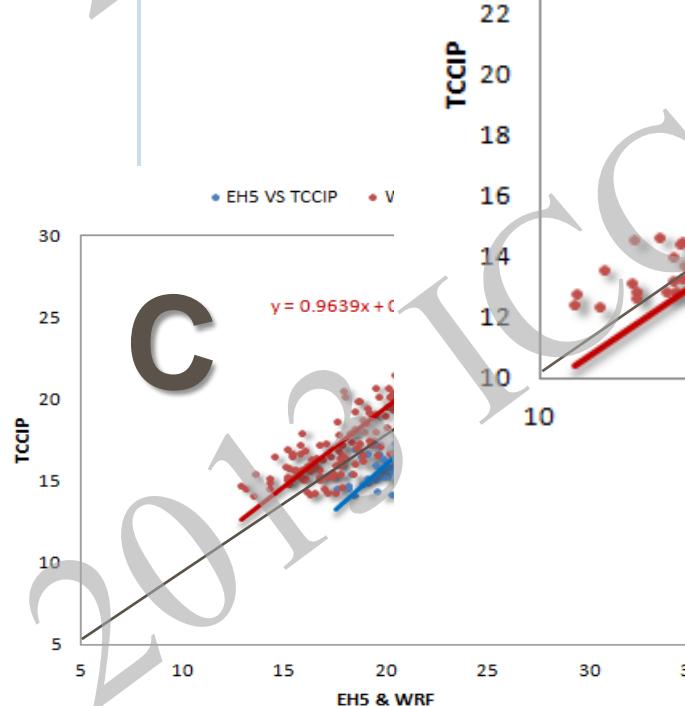
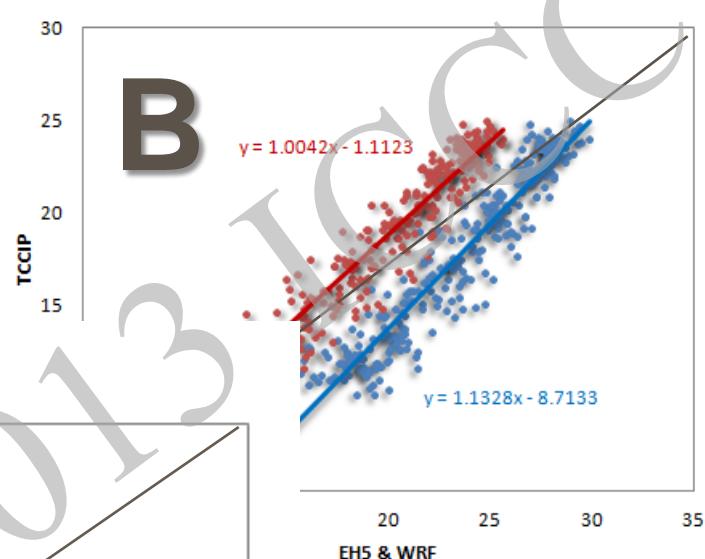
ECHAM5 dynamical downscaling : Temperature evaluation



• EH5 VS TCCIP • WRF VS TCCIP

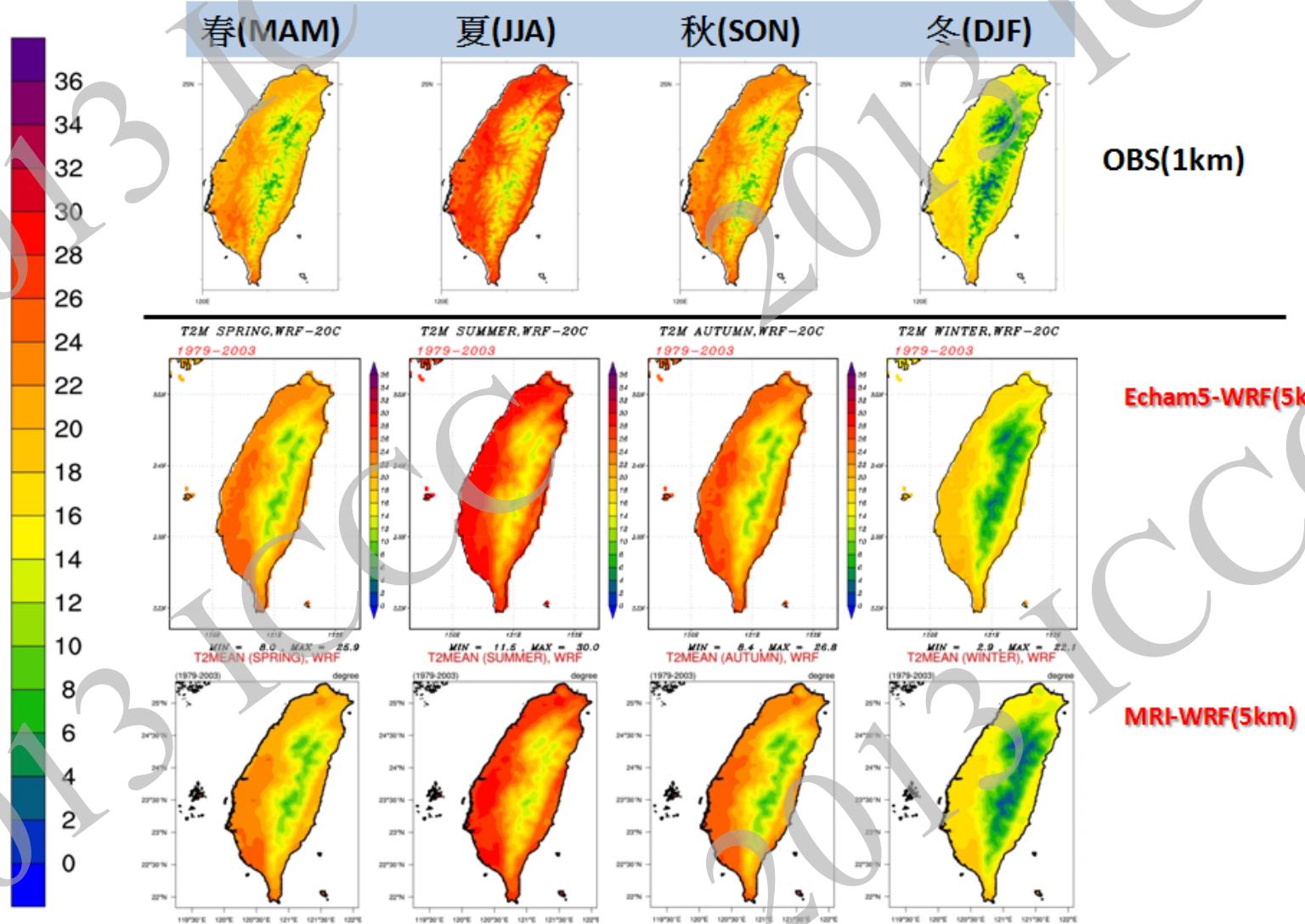


• EH5 VS TCCIP • WRF VS TCCIP



Present (1979-2003)

Tmean (1979-2003)



Temperature difference (Near Future –Present)

Change of Tmean , Near Future

Spring

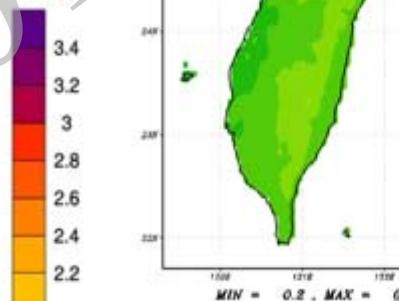
Summer

Autumn

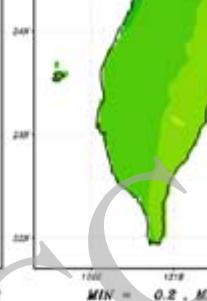
Winter

T2MEAN Change SPRING, WRF
Near future - Present

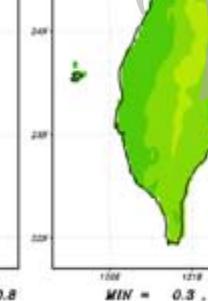
(°C)



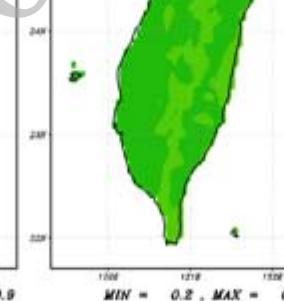
T2MEAN Change SUMMER, WRF
Near future - Present



T2MEAN Change AUTUMN, WRF
Near future - Present

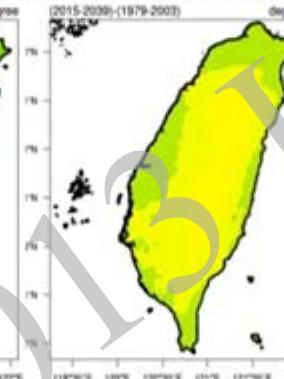
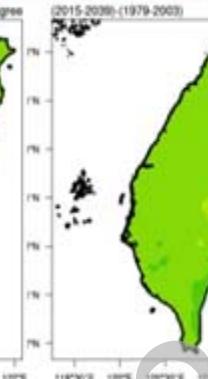
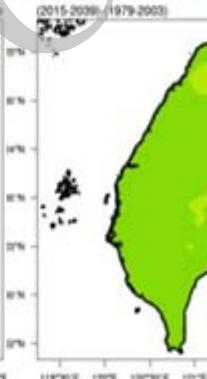
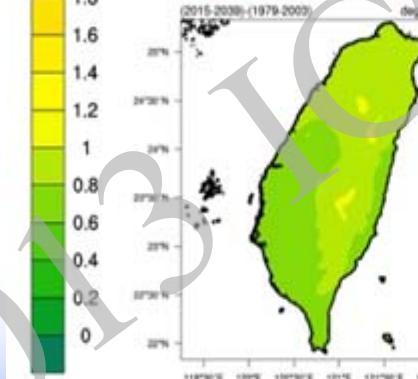


T2MEAN Change WINTER, WRF
Near future - Present



Echam5-WRF

T2MEAN Change (SPRING), WRF T2MEAN Change (SUMMER), WRF T2MEAN Change (AUTUMN), WRF T2MEAN Change (WINTER), WRF

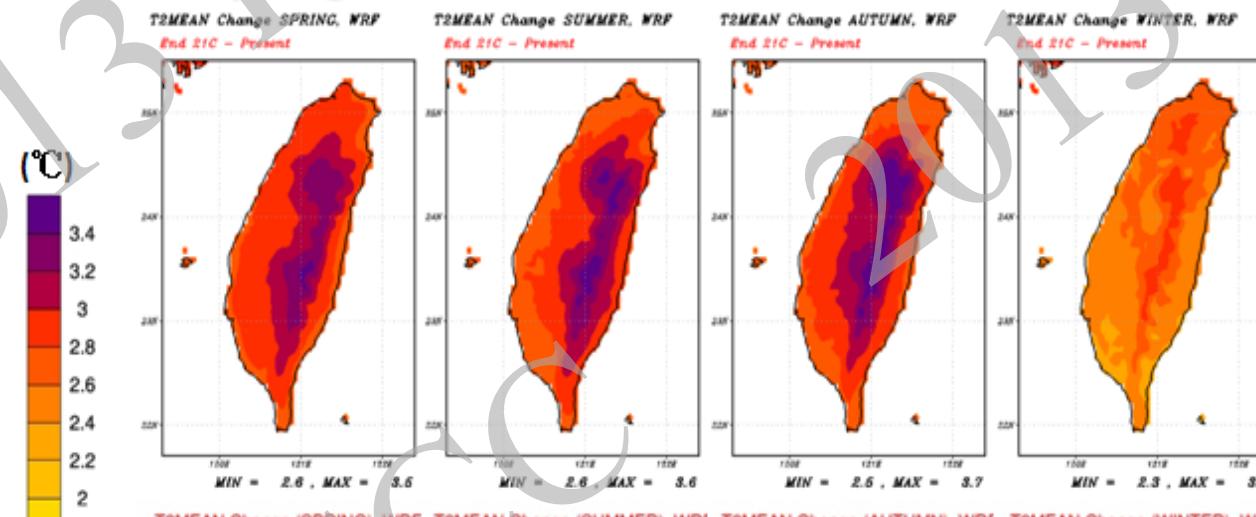


MRI-WRF

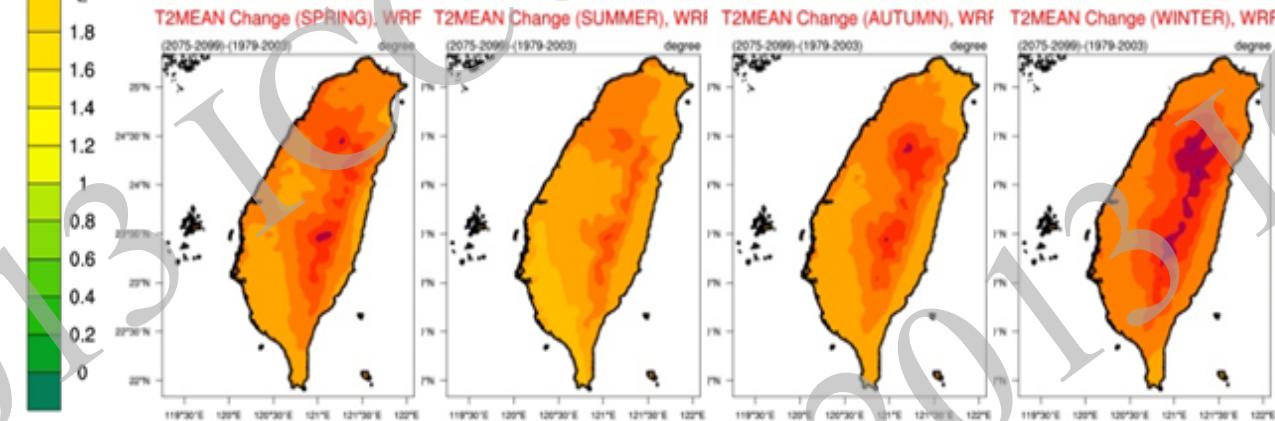
Temperature Difference (End of Century-Present)

Change of Tmean , End of Century

Spring Summer Autumn Winter



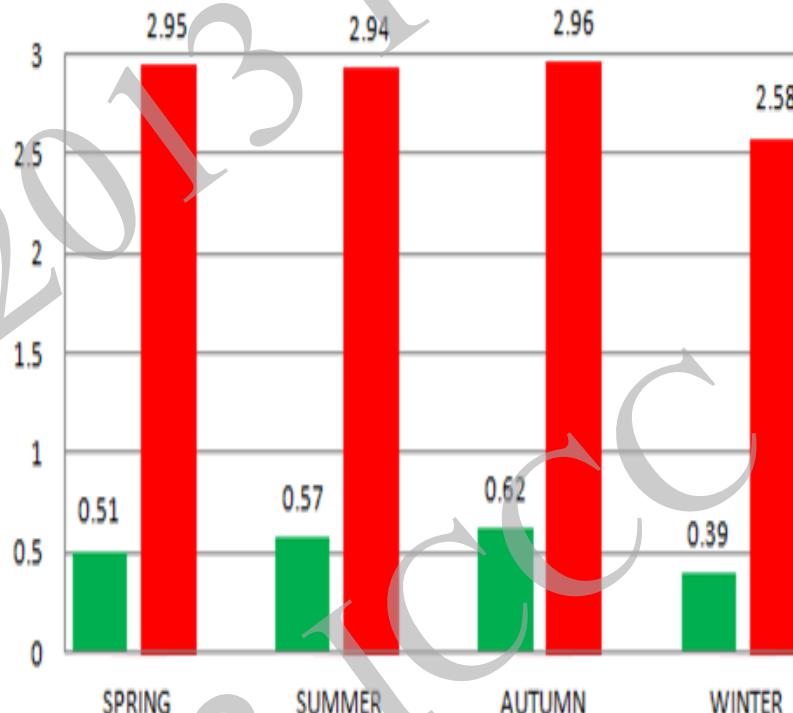
Echam5-WRF



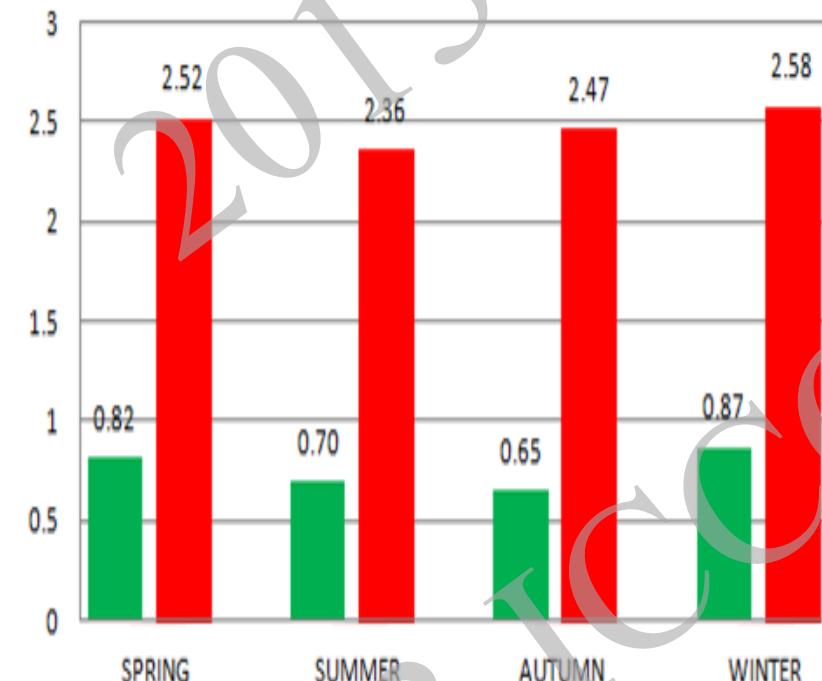
MRI-WRF

Temperature Difference Summary

台灣地區平均溫度改變ECHAM5-WRF



台灣地區平均溫度改變MRI-WRF



動力降尺度 降雨推估比較

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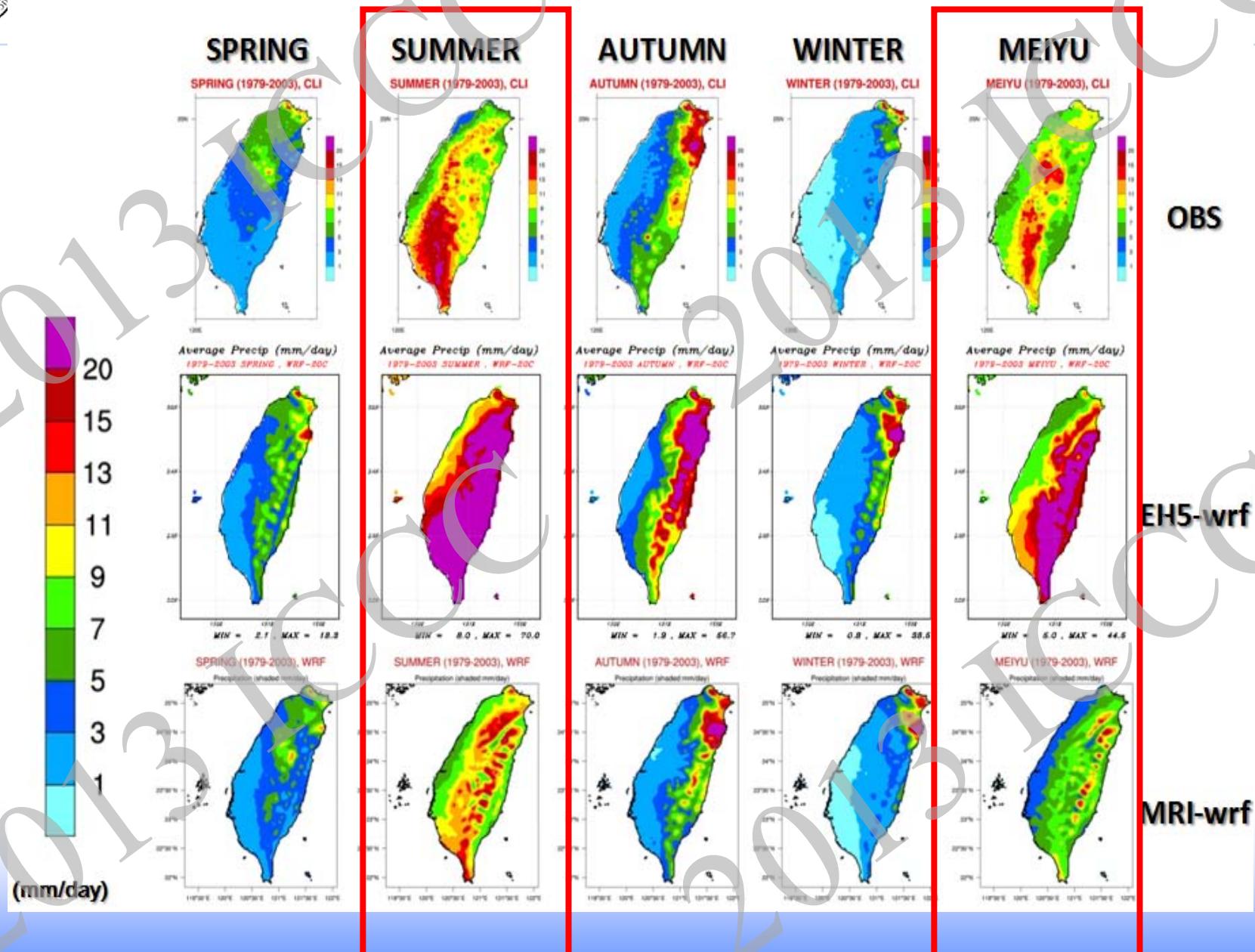
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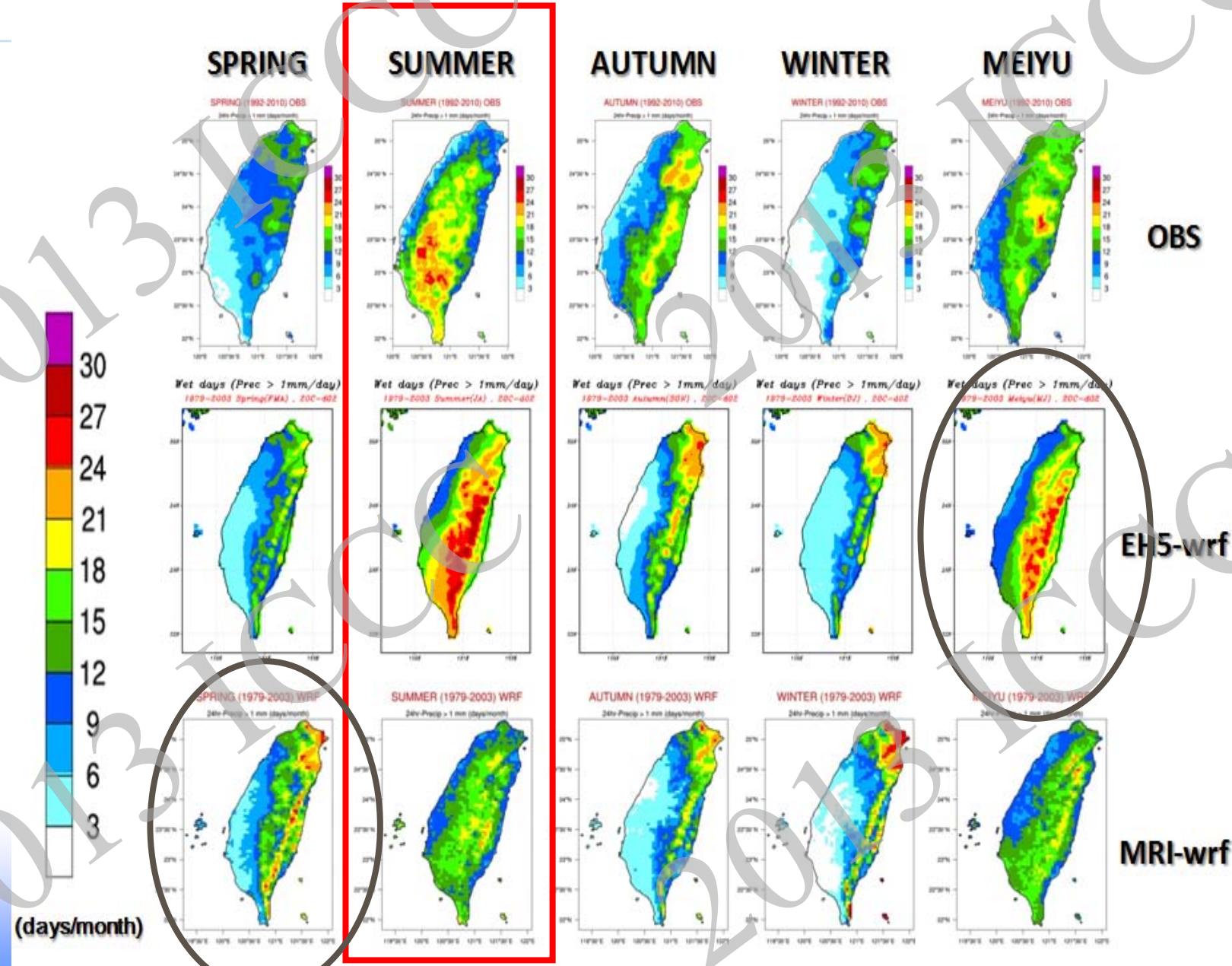


Seasonal Mean Precipitation

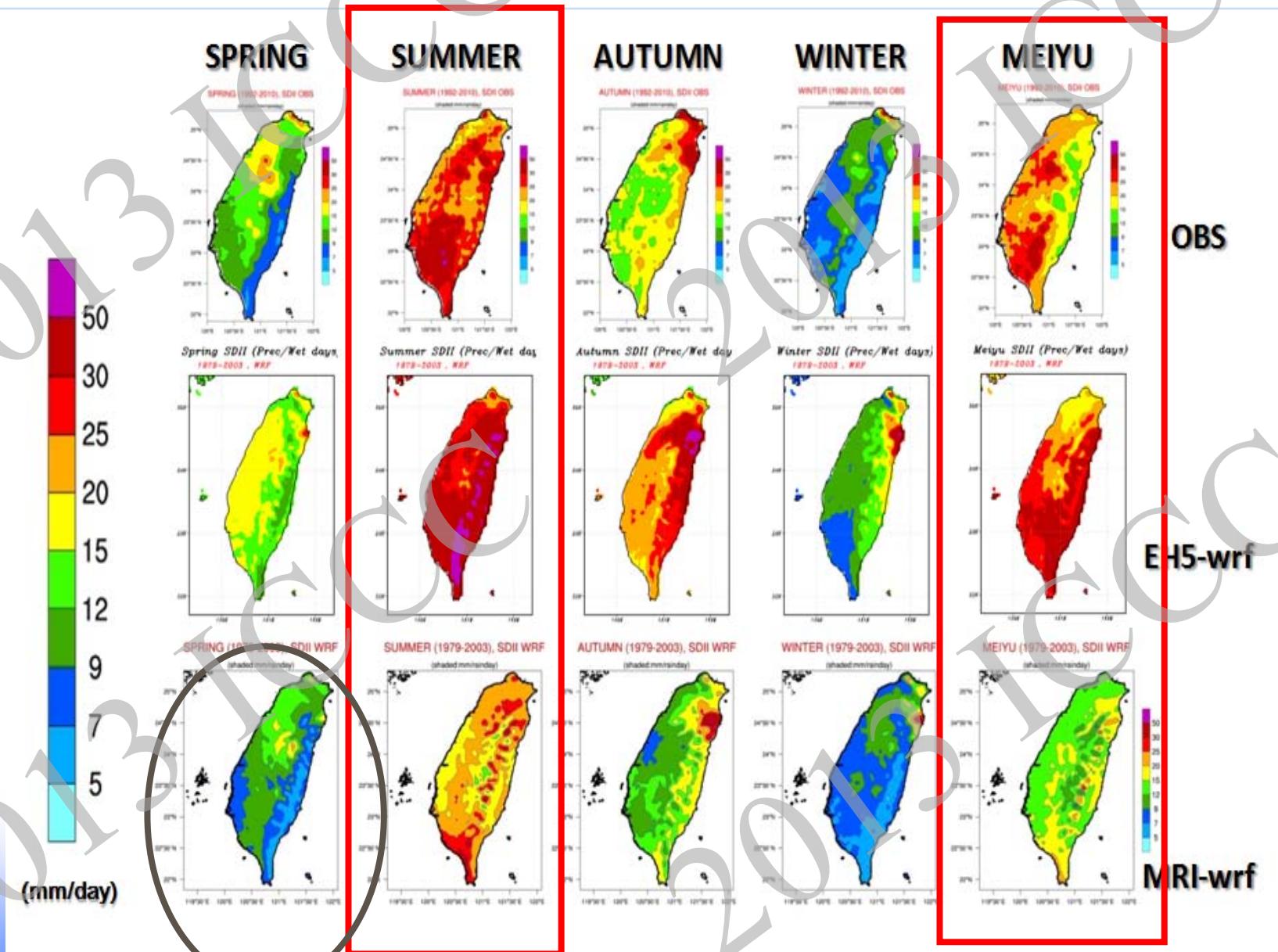
(1979-2003)



Wet Day (Daily Precipitation > 1mm) --- Present (1979-2003)

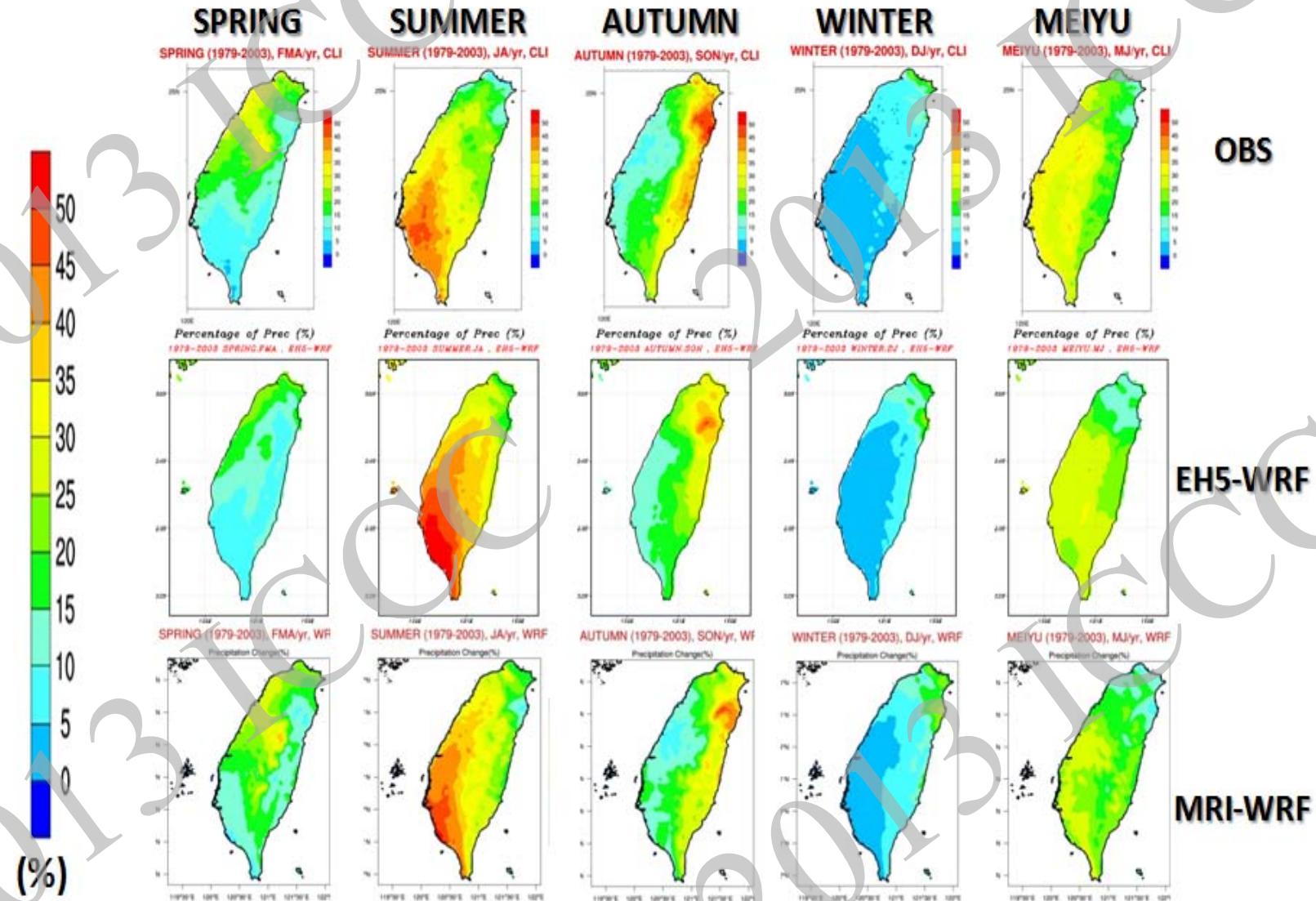


SDII (*Simple Day Intensity Index*) (1979-2003)



Percentage of Precipitation (%)

(1979-2003)



Precipitation Change Rate (%) WRF

(Near future – Present)/Present

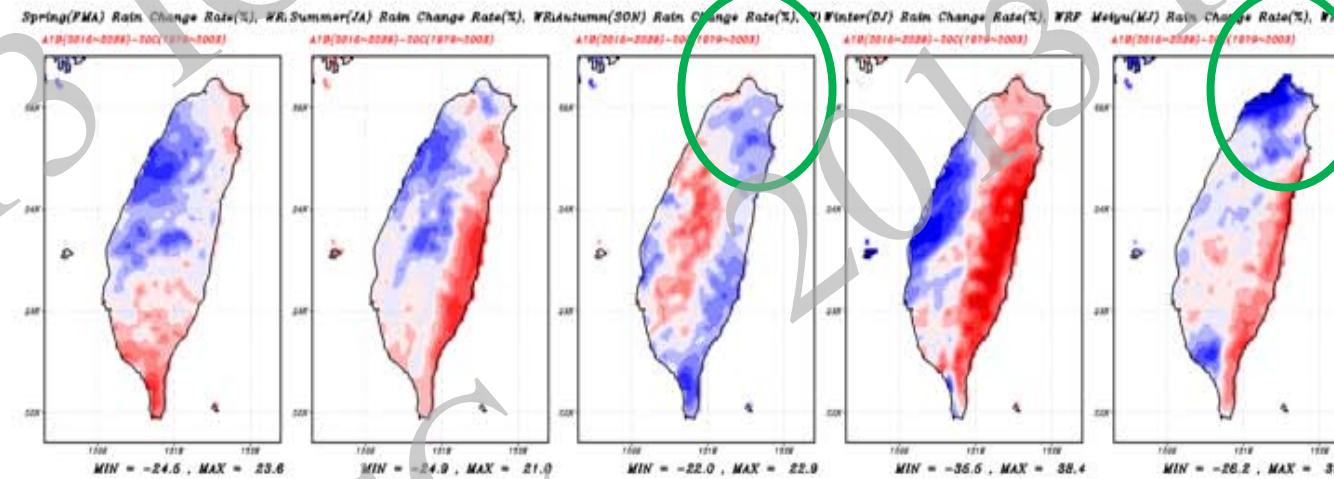
Spring

Summer

Autumn

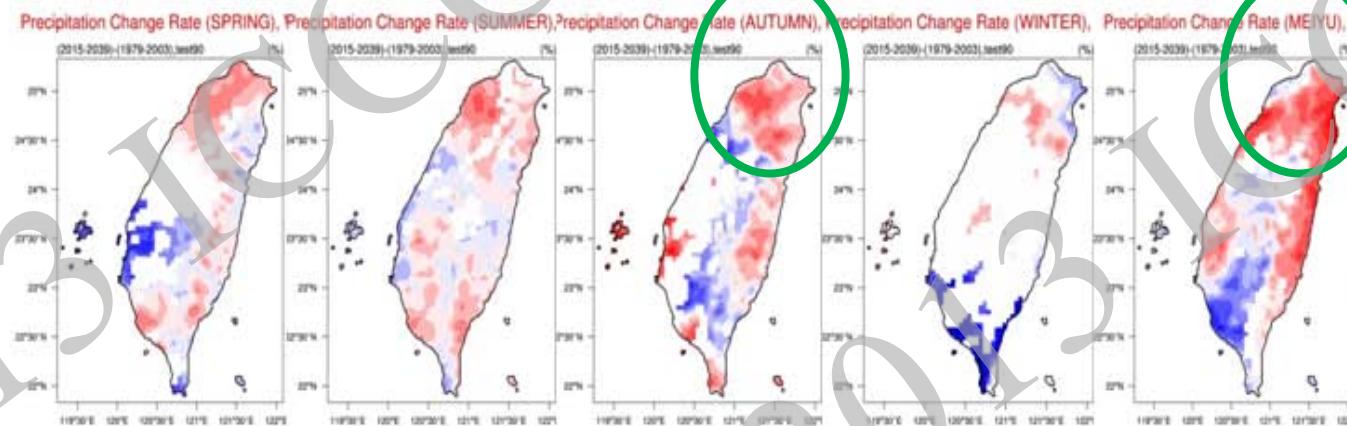
Winter

Meiyu



Echam5-WRF

(%)

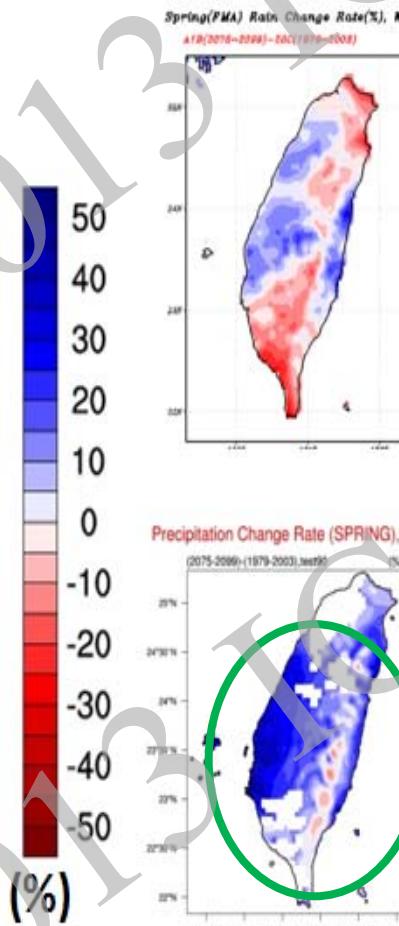


MRI-WRF

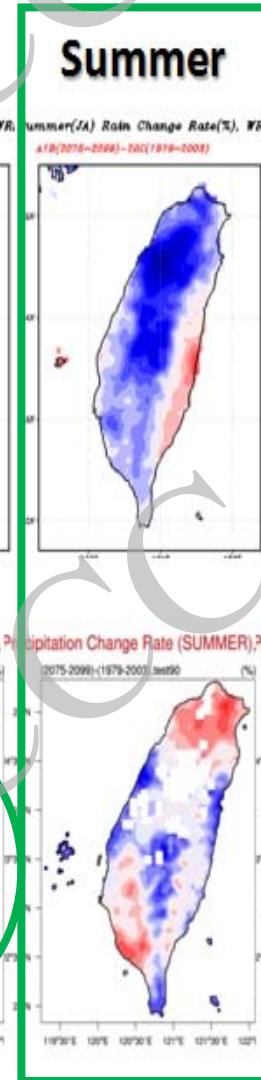
Precipitation Change Rate (%) WRF

(End 21C- Present)/ Present

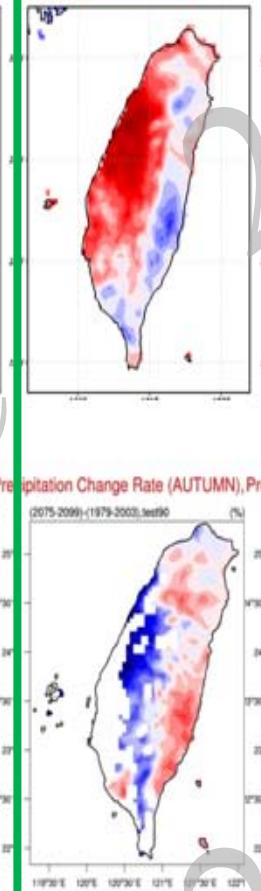
Spring



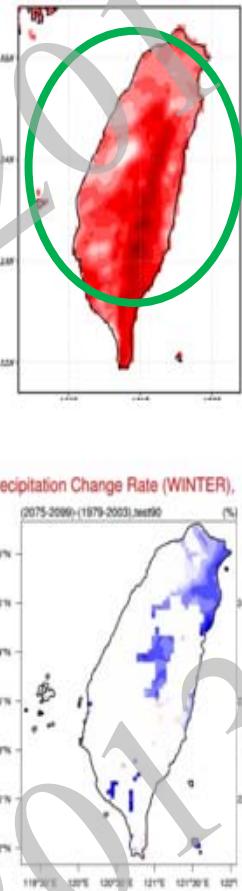
Summer



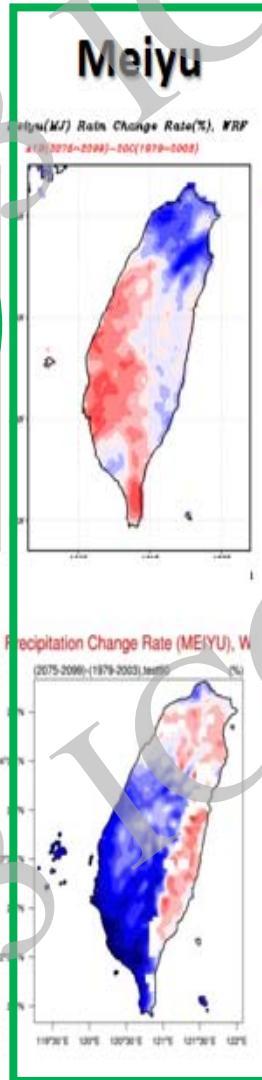
Autumn



Winter



Meiyu

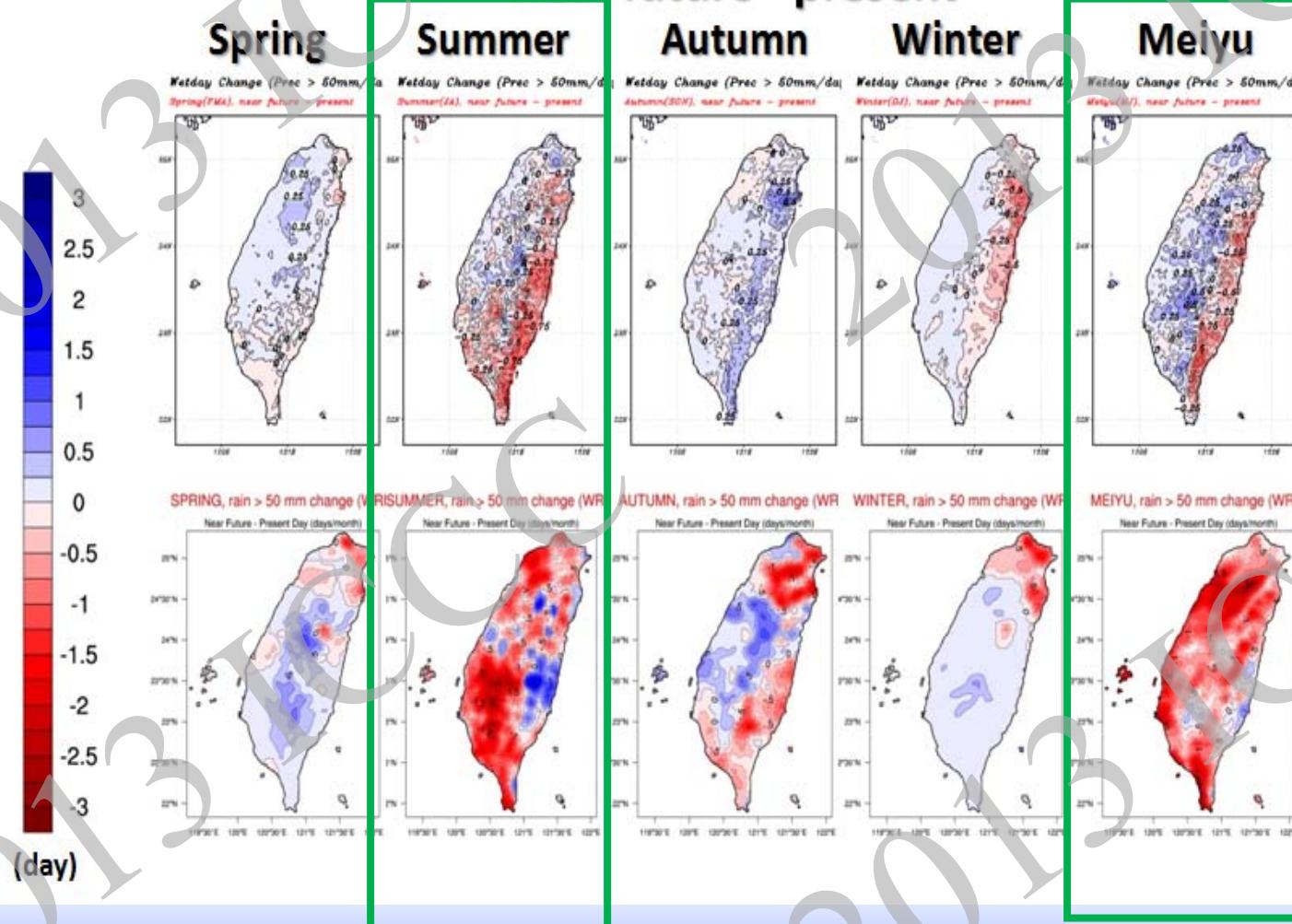


Echam5-WRF

Precipitation Change Rate (SPRING), Precipitation Change Rate (SUMMER), Precipitation Change Rate (AUTUMN), Precipitation Change Rate (WINTER), Precipitation Change Rate (MEIYU), WRF

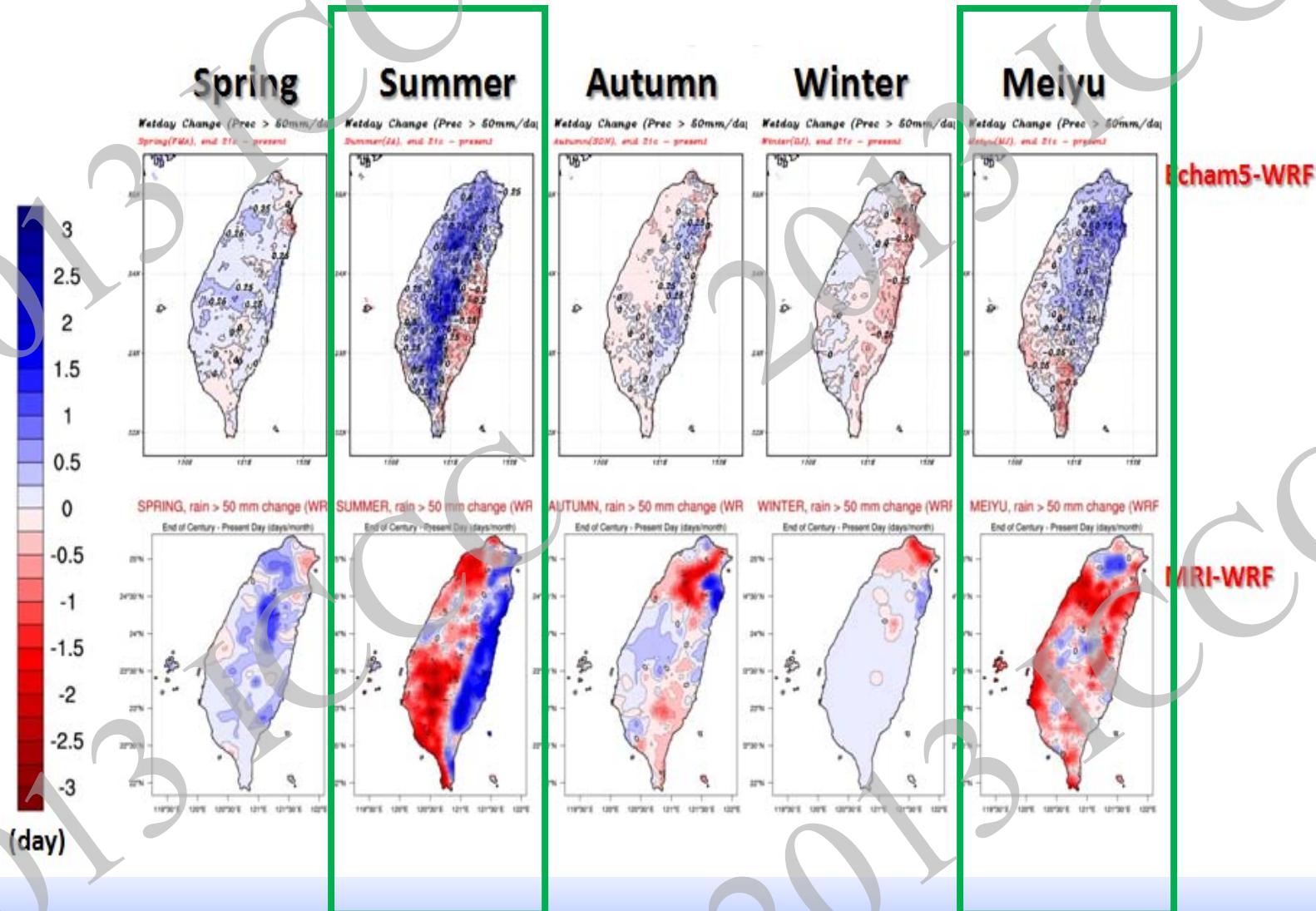
MRI-WRF

Extremely Day Change (Daily Precipitation > 50mm), WRF Near future - present



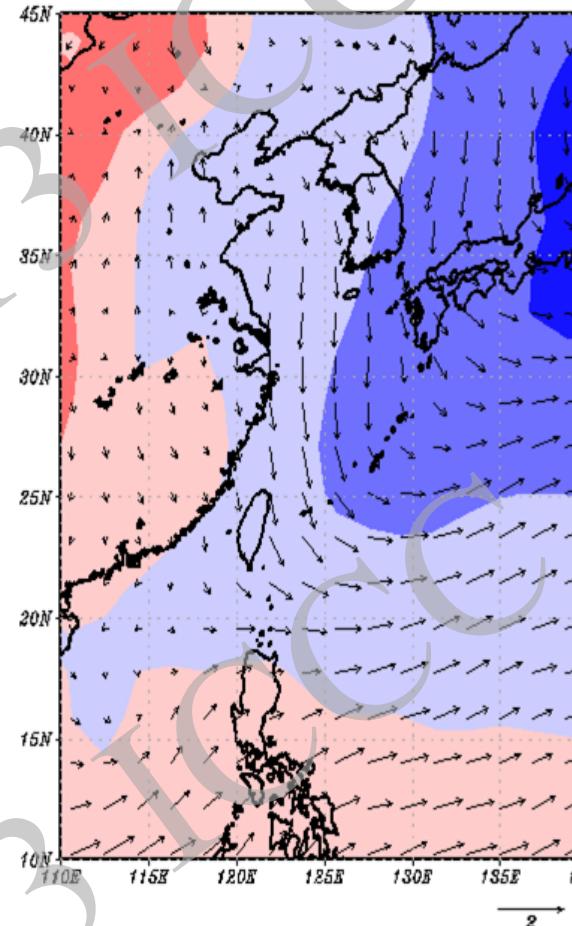


Extremely Day Change (Daily Precipitation > 50mm) , WRF End of century - present



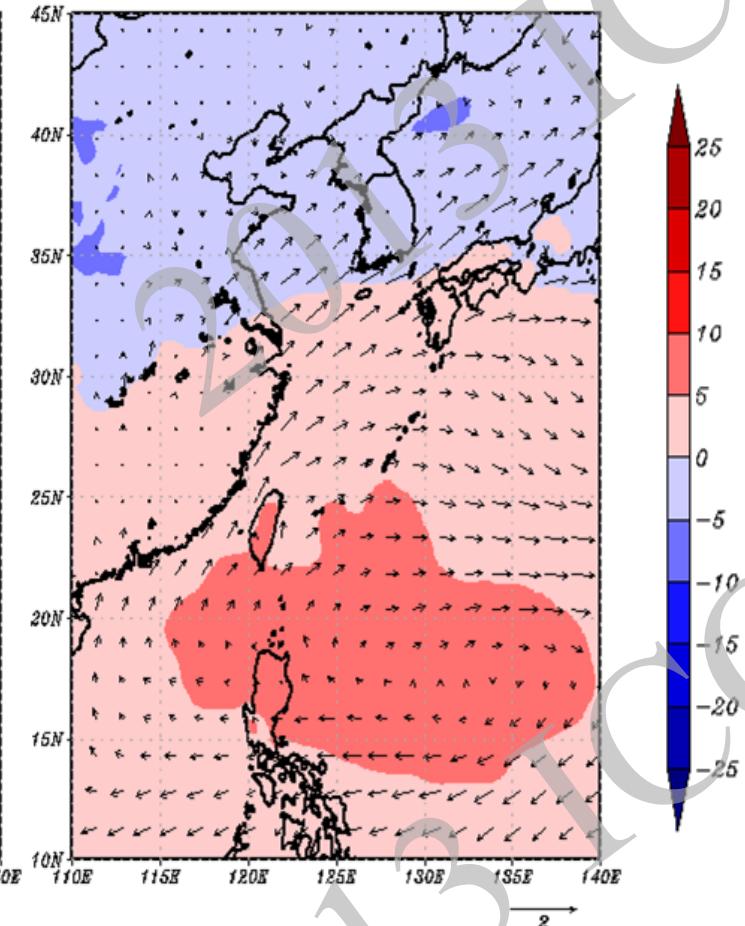
ECHAM5

1000hPa Height & Wind
End of century-Present SUMMER



MRI

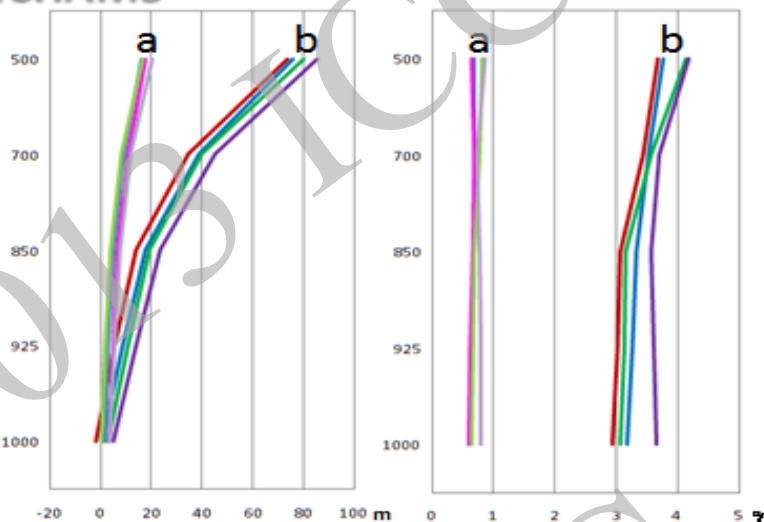
1000hPa Height & Wind
(2076-2099) SUMMER,E-P



1000hPa ECHAM5與MRI高度場與風場變化(世紀末時期減現在時期)，左邊為ECHAM5，右邊為MRI。冷色系表示世紀末時期低估，暖色系表示世紀末時期高估。

ECHAM5

Lon : 110-140 Lat : 10-45

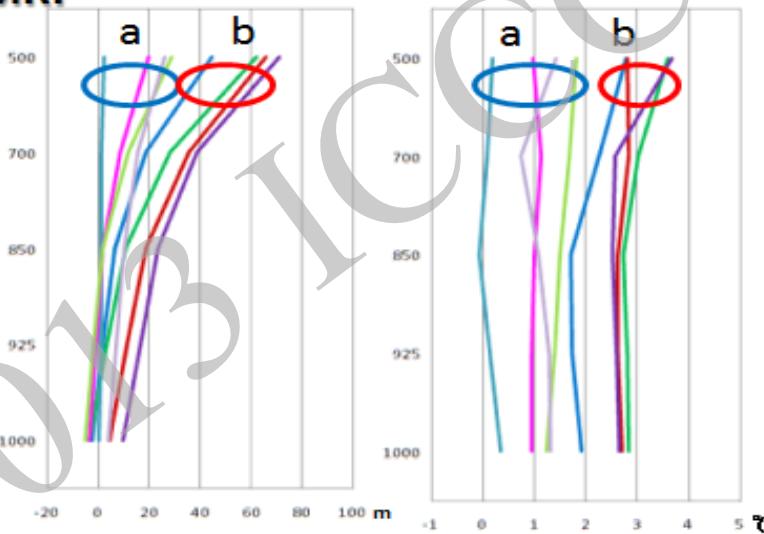


- SPRING(E-P)
- SUMMER(E-P)
- AUTUMN(E-P)
- WINTER(E-P)
- SPRING(N-P)
- SUMMER(N-P)
- AUTUMN(N-P)
- WINTER(N-P)

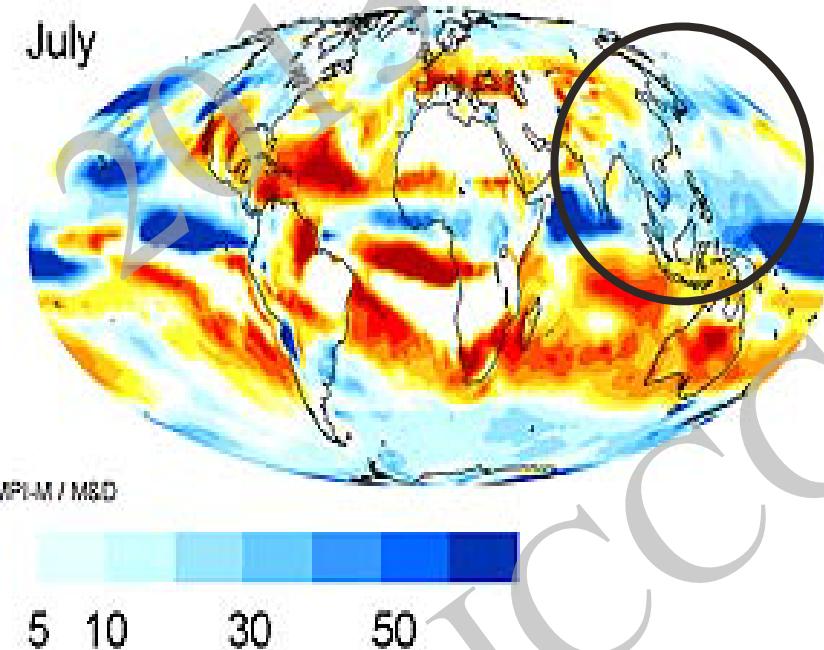
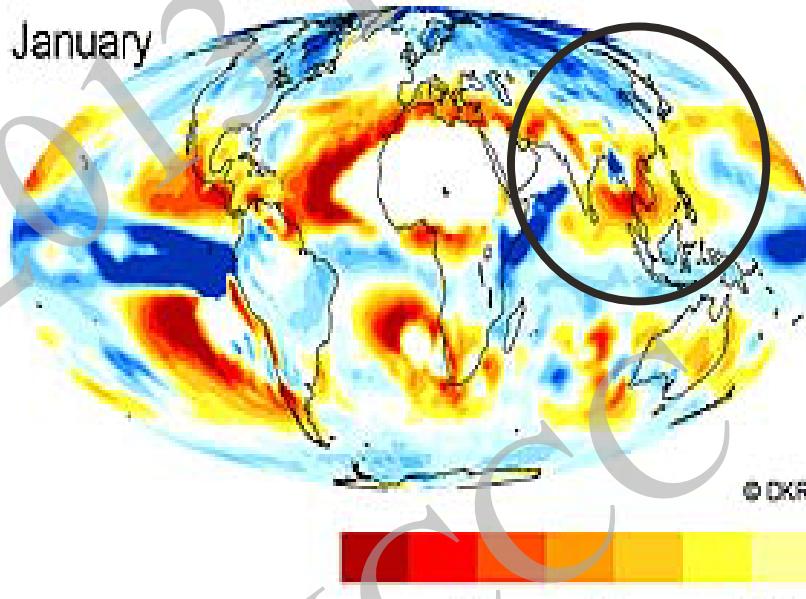
MRI

Height

Tmp



A1B: Mean Precipitation Change [%] for 2071-2100 compared with 1961-1990



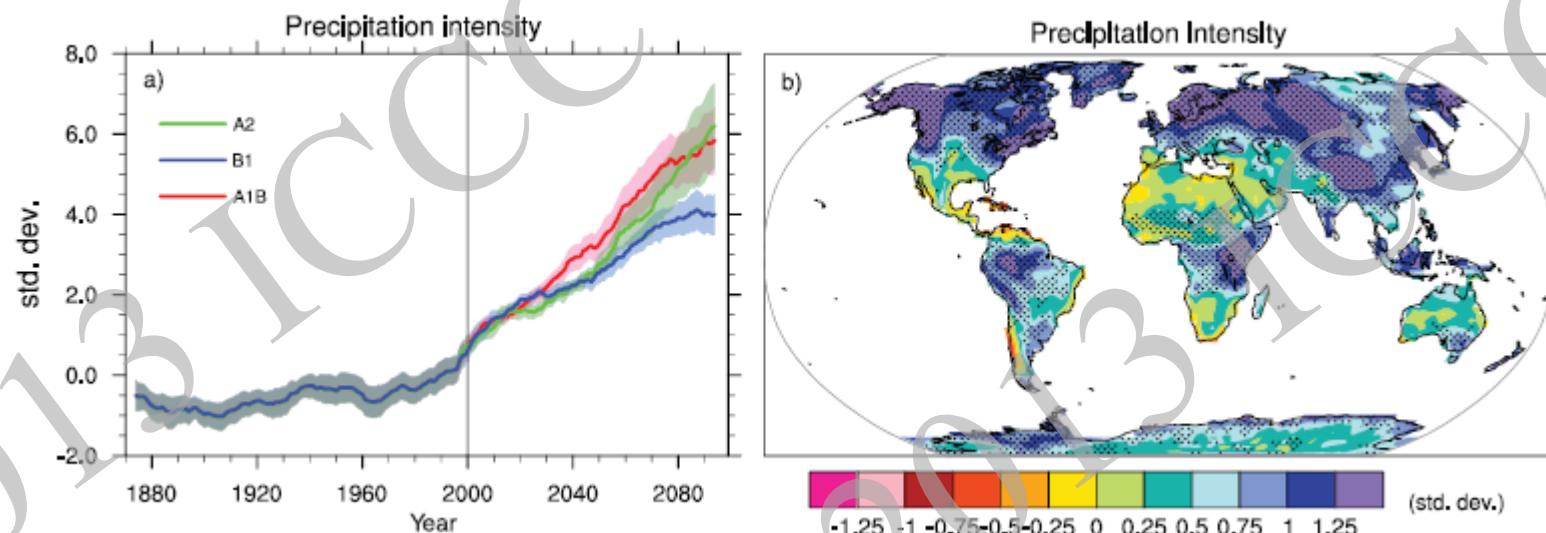
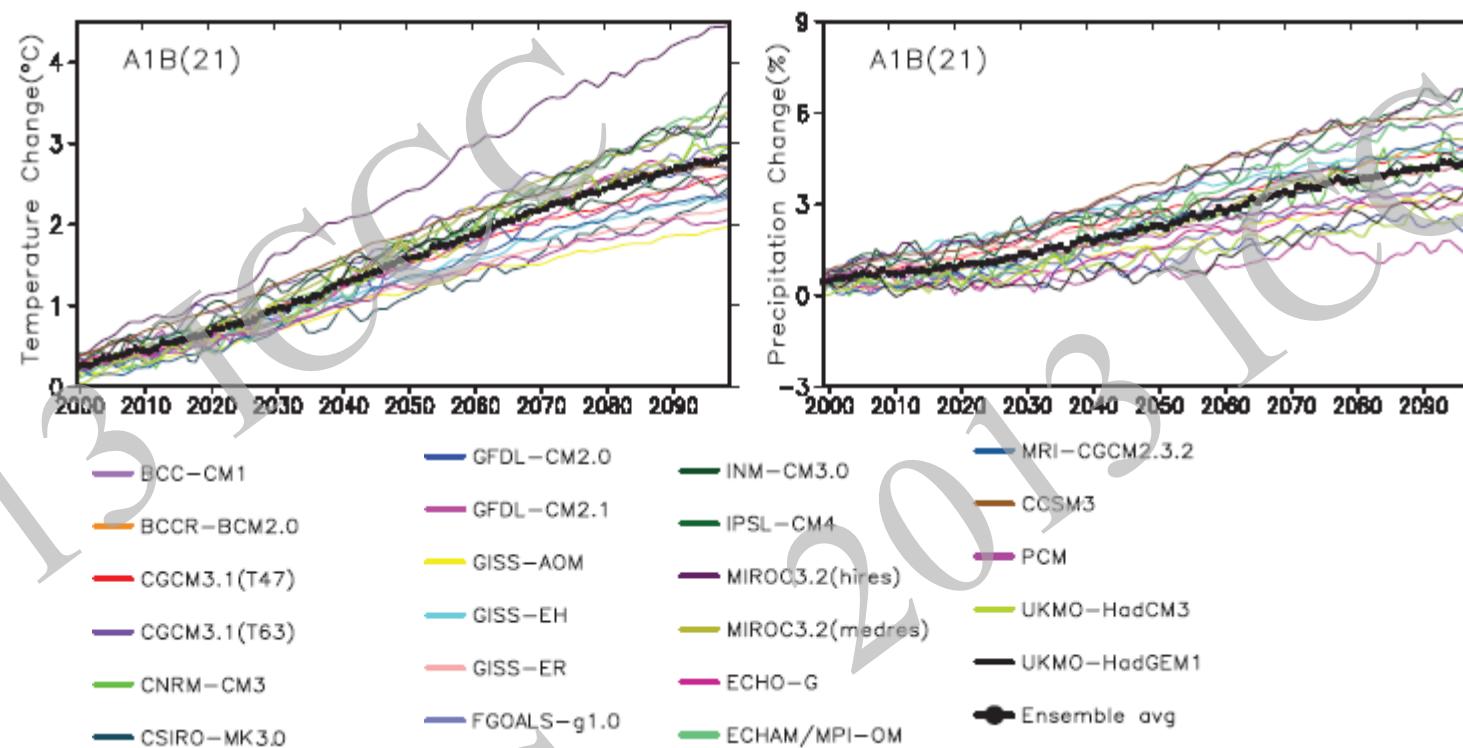
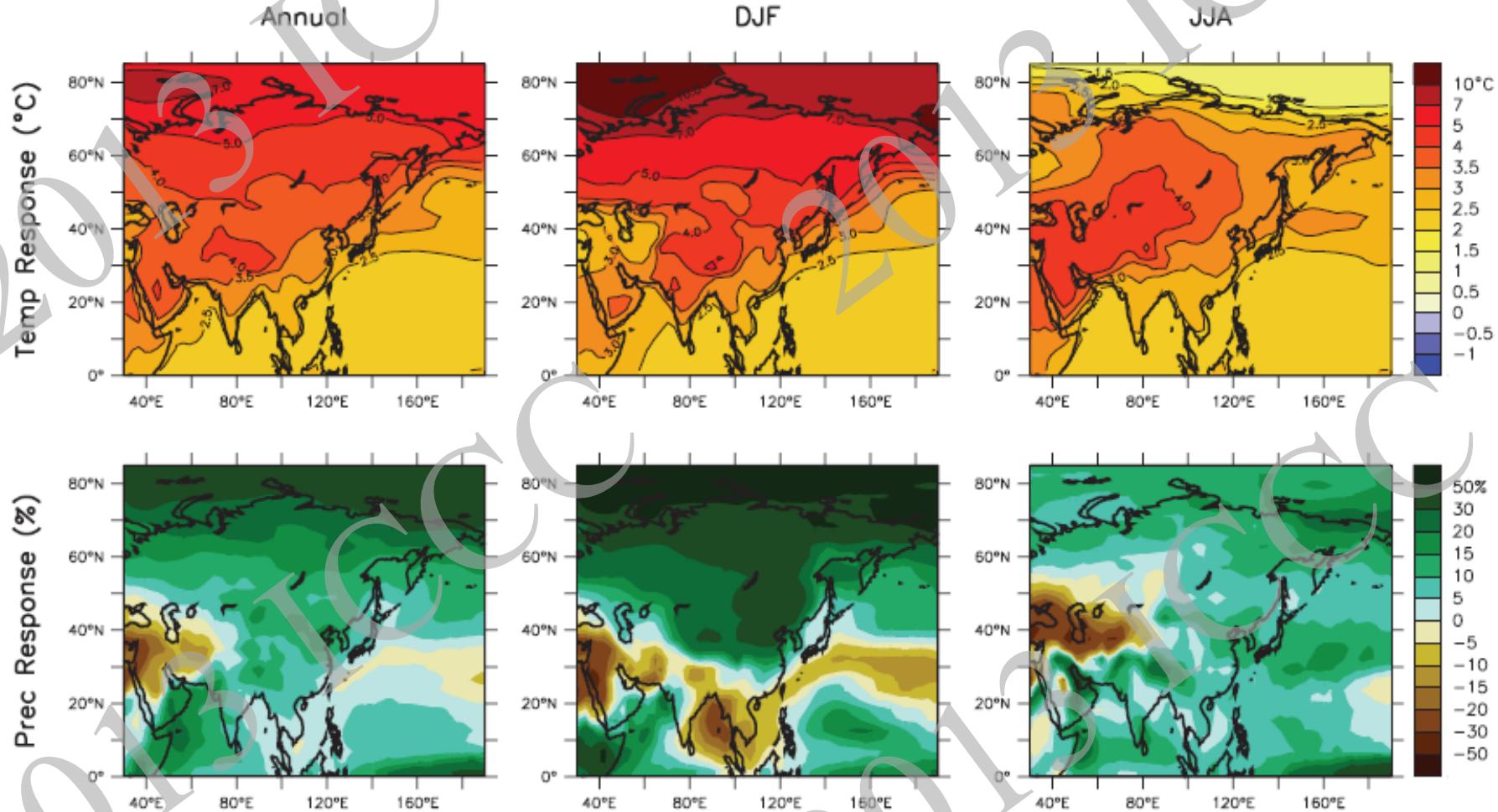


Figure 10.18. Changes in extremes based on multi-model simulations from nine global coupled climate models, adapted from Tebaldi et al. (2006). (a) Globally averaged changes in precipitation intensity (defined as the annual total precipitation divided by the number of wet days) for a low (SRES B1), middle (SRES A1B) and high (SRES A2) scenario. (b) Changes in spatial patterns of simulated precipitation intensity between two 20-year means (2080–2099 minus 1980–1999) for the A1B scenario. (c) Globally aver-



Summary

- 高度場與NCEP reanalysis 資料比較(未降尺度):
 - 以850 hPa 高度場為例, MRI 在夏季偏弱, 冬季偏強的趨勢,
 - 以氣流型態而言, 主要差異在夏季(6, 7, 8月), MRI與NCEP 較為接近, ECHAM5 太平洋高壓脊則較為北偏(5-10 度)
- ECHAM5 及MRI 動力降尺度, 確可改善台灣區域尺度之模擬推估結果
- 溫度:平均而言, 台灣區域
 - 近未來ECHAM5 推估增溫0.52 度, MRI 增溫0.76 度
 - 世紀末, ECHAM5 推估增溫2.82 度, MRI 增溫2.48 度
- 雨量:
 - 整體而言, ECHAM5 推估降雨量有高估的現象, 而MRI 雨量在夏季及梅雨季則為低估
 - 兩模式降雨推估**並不一致**, 以極端降雨為例, ECHAM5推估極端降雨日數之變化, 在世紀末, 夏季, 台灣西半部是增加; 梅雨季北部降雨日數為增加, 相反的, 在MRI 却與上述相反



Temperature and precipitation changes over Asia from the MMD-A1B simulations.



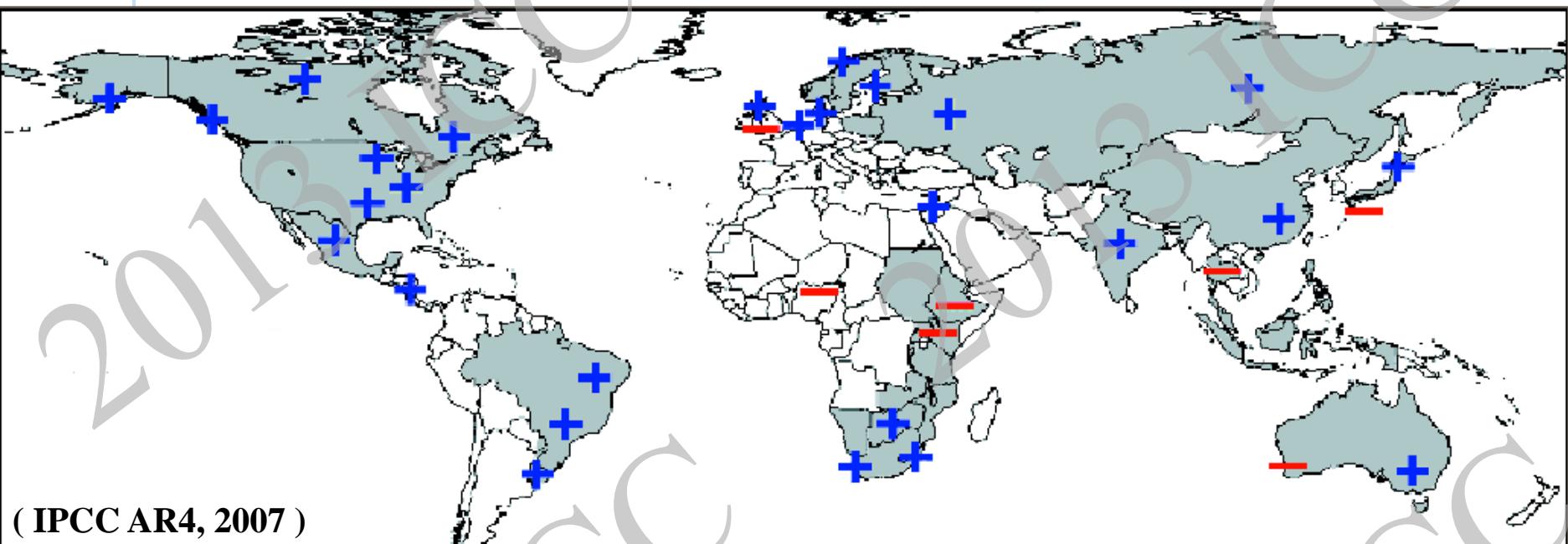
2013 ICCC

2013 ICCC

2013 ICCC

2013 ICCC

2013 ICCC



Changes in **heavy precipitation frequencies** are always greater than changes in precipitation total and in some regions, an increase in heavy and/or very heavy precipitation occurred while no change or even a decrease in precipitation totals was observed



大雨日	春季	夏季	秋季	冬季	梅雨季	近未來	春季	夏季	秋季	冬季	梅雨季
北部	↑	↑	↑	↑	↑		↑	↓	↓	↓	↓
中部	↑	↑	↑	↑	↑		↑	↓	↑	↑	↓
南部	↓	↓	↑	↑	↑		↑	↓	↓	↑	↓
東部	↑	↓	↑	↓	↓		↑	↑	↓	↑	↓
世紀末											
北部	↑	↑	↓	↑	↑		↑	↓	↓	↓	↑
中部	↑	↑	↓	↑	↑		↑	↓	↑	↑	↑
南部	↑	↑	↓	↑	↓		↑	↓	↑	↑	↓
東部	↑	↓	↑	↓	↑		↑	↑	↑	↑	↓

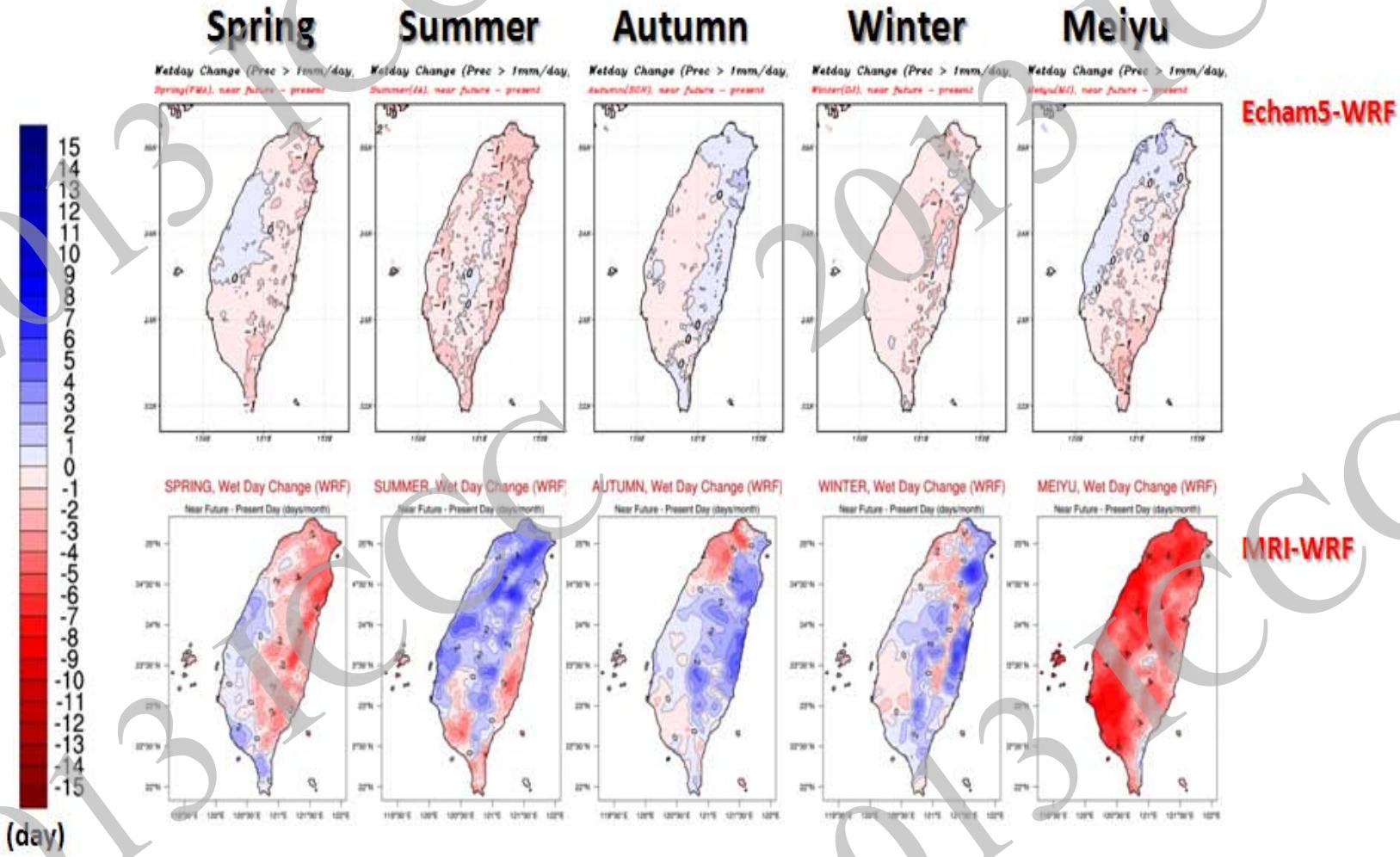
大雨日分佈的情況



日溫差變化	ECHAM5-WRF				近未來	MRI-WRF			
	春季	夏季	秋季	冬季		春季	夏季	秋季	冬季
北部	↓	↓	↓	↑		↑	↑	↑	↑
中部	↓	↓	↑	↓		↑	—	↑	↓
南部	↑	↑	↓	↑		↑	↓	↑	↓
東部	↑	↑	↓	↑		↑	↓	↑	↓
					世紀末				
北部	↑	↓	↓	↑		↑	↑	↓	↓
中部	↑	↓	↓	↑		↓	↓	↓	↓
南部	↑	↓	↓	↑		↓	↓	↓	↓
東部	↑	↓	↓	↑		↓	↓	↓	↓

為 ECHAM5-WRF 與 MRI-WRF 在近未來及世紀末日
溫差變化分佈表

Wet Day Change (Daily Precipitation > 1mm) , WRF Near future - present



Wet Day Change (Daily Precipitation > 1mm), WRF End of century - present

