極端氣候變異：北美與台灣

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Outline:

1. 近年來北美與台灣的氣候變異事件介紹

2. 研究成果

- 北美極端氣候變異增強的歸因探討。
  - 發表於英國皇家氣象學會的《大氣科學快報》
    Wang, S.-Y., W.-R. Huang, and J.-H. Yoon (2015), The North American winter 'dipole' and extremes activity: A CMIP5 assessment. *Atmospheric Science Letters*, (in press)

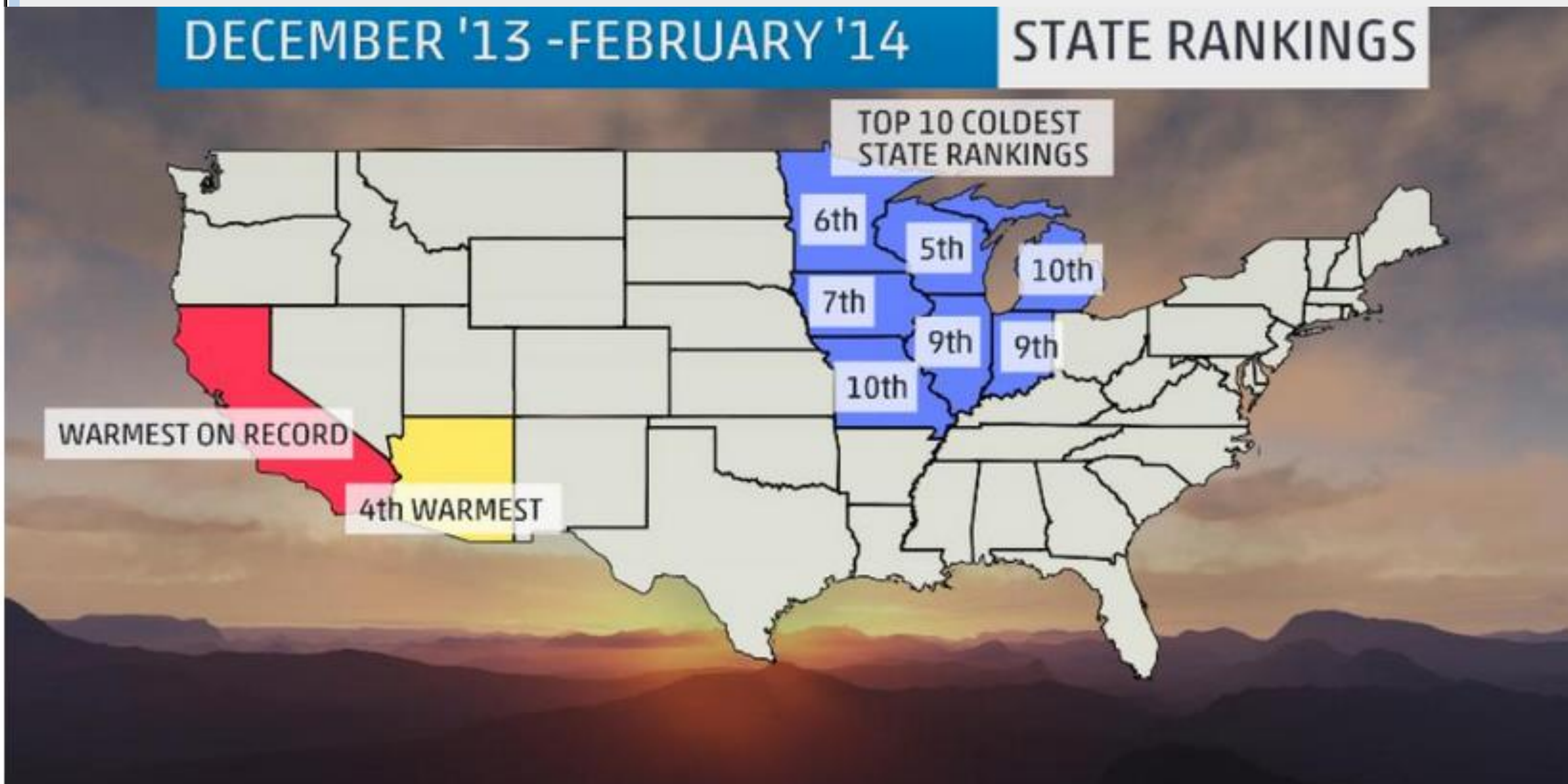
- 台灣梅雨鋒面長期變化的診斷分析。
  - 發表於英國皇家氣象學會的《國際氣候期刊》
    Huang, W. R., and K.-C. Chen (2014), Trends in Pre-Summer Frontal and Diurnal Rainfall Activities during 1982-2012 over Taiwan and Southeast China: Characteristics and Possible Causes. *Int. J. Climatol.*, (in press)

極端氣候事件

2013-14 北美

NOAA: Winter 2013-2014 Among Coldest on Record in Midwest; Driest, Warmest in Southwest

By Jon Erdman | Published Mar 13 2014 05:22 PM EDT | weather.com



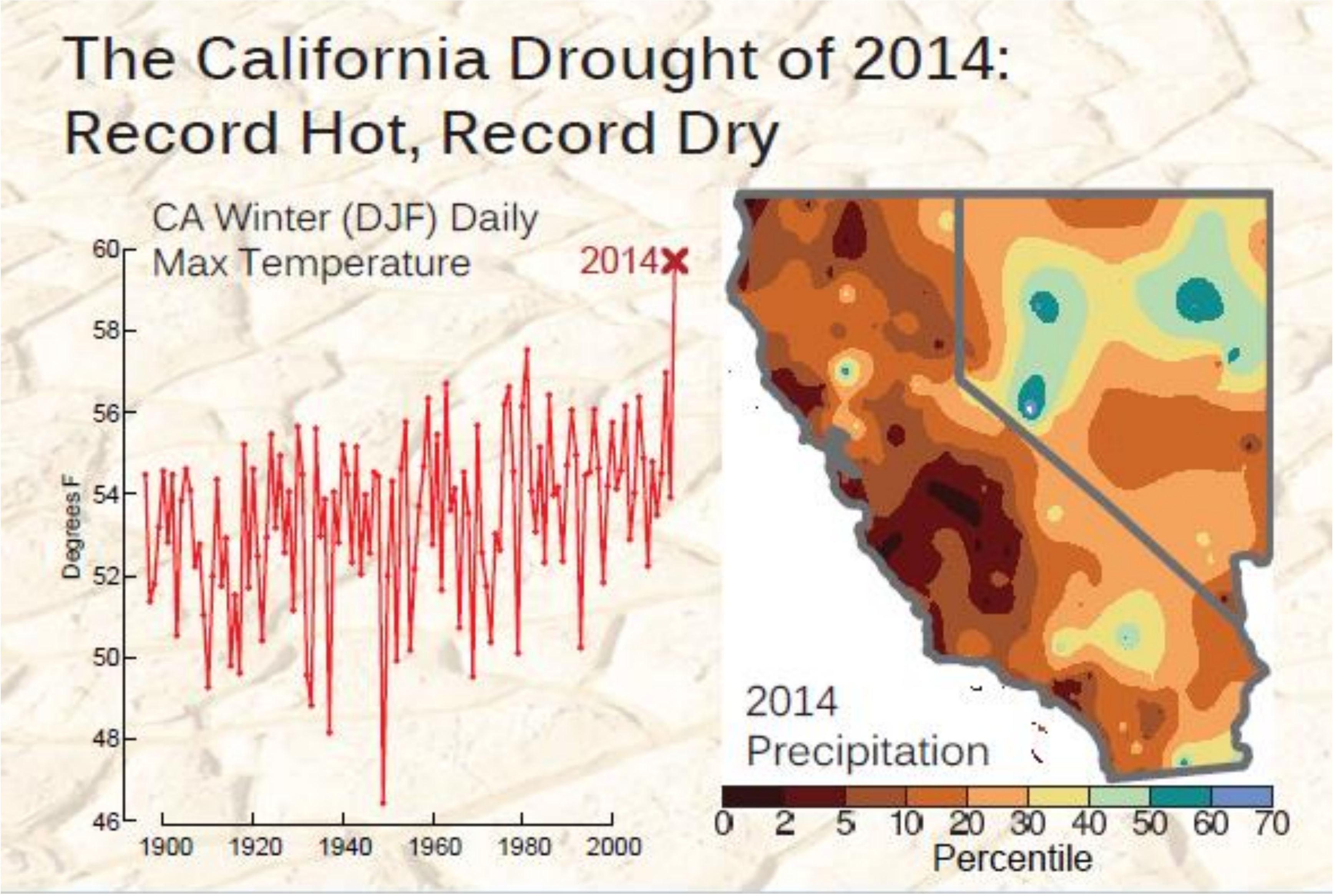
States registering either a top 10 coldest (blue) or top 10 warmest (yellow, red) December-February period in 2013-2014. (NOAA/NCDC)

引用”http://www.weather.com/news/news/winter-ncdc-state-climate-report-2013-2014-20140313

2013-14 美東極度低溫

美國芝加哥湖畔急凍情景。圖片王世宇教授提供

2014 美西旱象



資料引用: https://www.drought.gov/media/images/CNAP-Drought-Newsletter-Aug-2014.pdf

「供五停二」將開跑　你家哪天停水看這裡

2015 台灣旱象

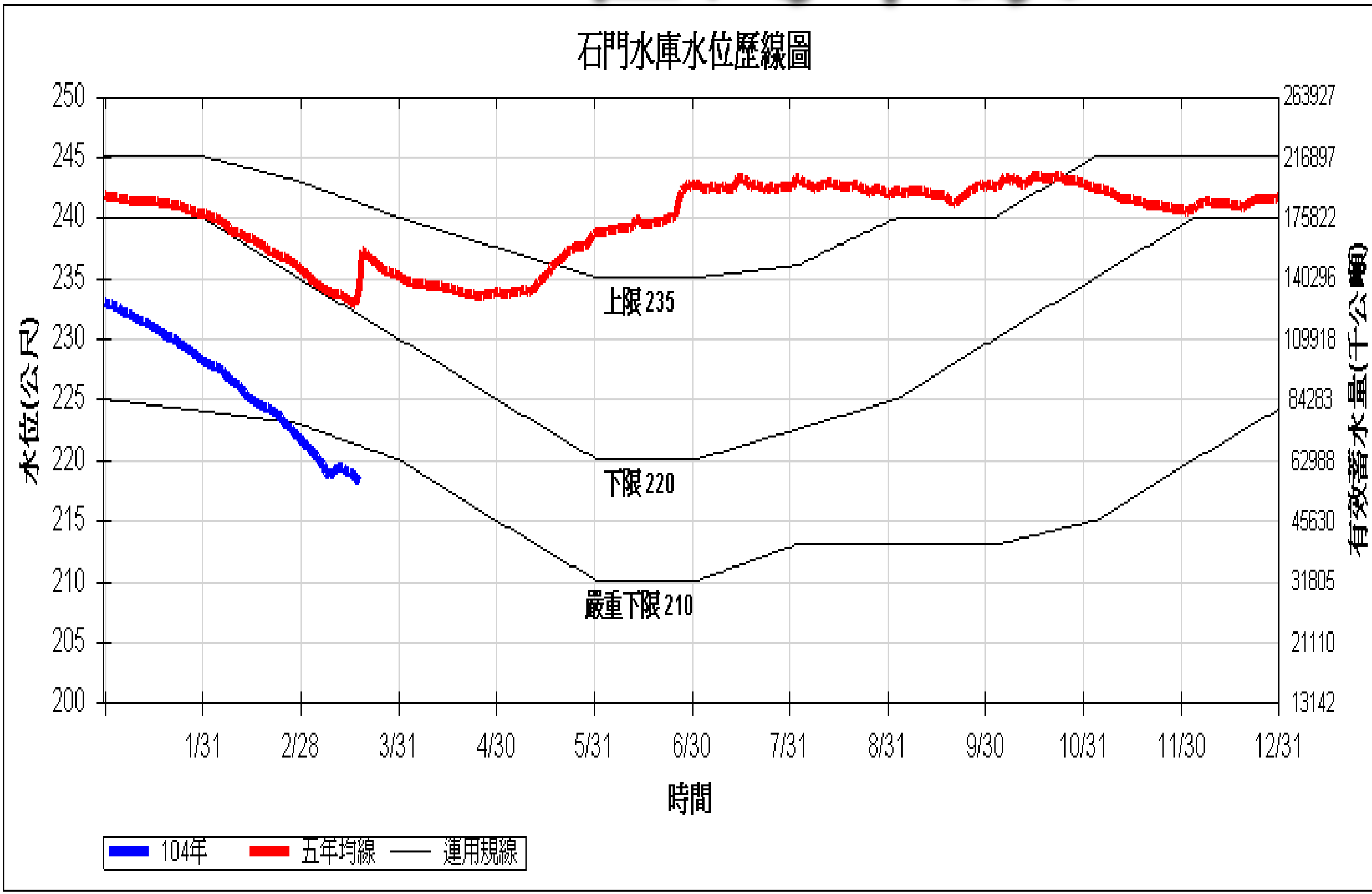
石門水庫集水區因降雨量不足，水位偏低。資料照片

資料引用:
http://www.appledaily.com.tw/realtimenews/article/life/20150320/578318

久旱不雨，致日月潭水位逐漸下降，水位指標的九蛙，目前已「全都露」了，也成了日月潭另類的景點。（記者石振習攝）

資料引用:
http://www.peoplenews.tw/news/0e034934-dd57-49c5-95dd-e17d87d5d1f6

2015 台灣旱象



資料來源:石門水庫管理中心
日期:2015-03-21

可能原因?

發表於
英國皇家氣象學會的《大氣科學快報》

共同合作研究者：
美國猶他州大學王世宇教授（第一作者）
西北太平洋國家實驗室 Jinho Yoon

ATMOSPHERIC SCIENCE LETTERS
Atmos. Sci. Let. (2015)
Published online in Wiley Online Library
(wileyonlinelibrary.com) **DOI:** 10.1002/asl2.565

Royal Meteorological Society

The North American winter 'dipole' and extremes activity: a CMIP5 assessment

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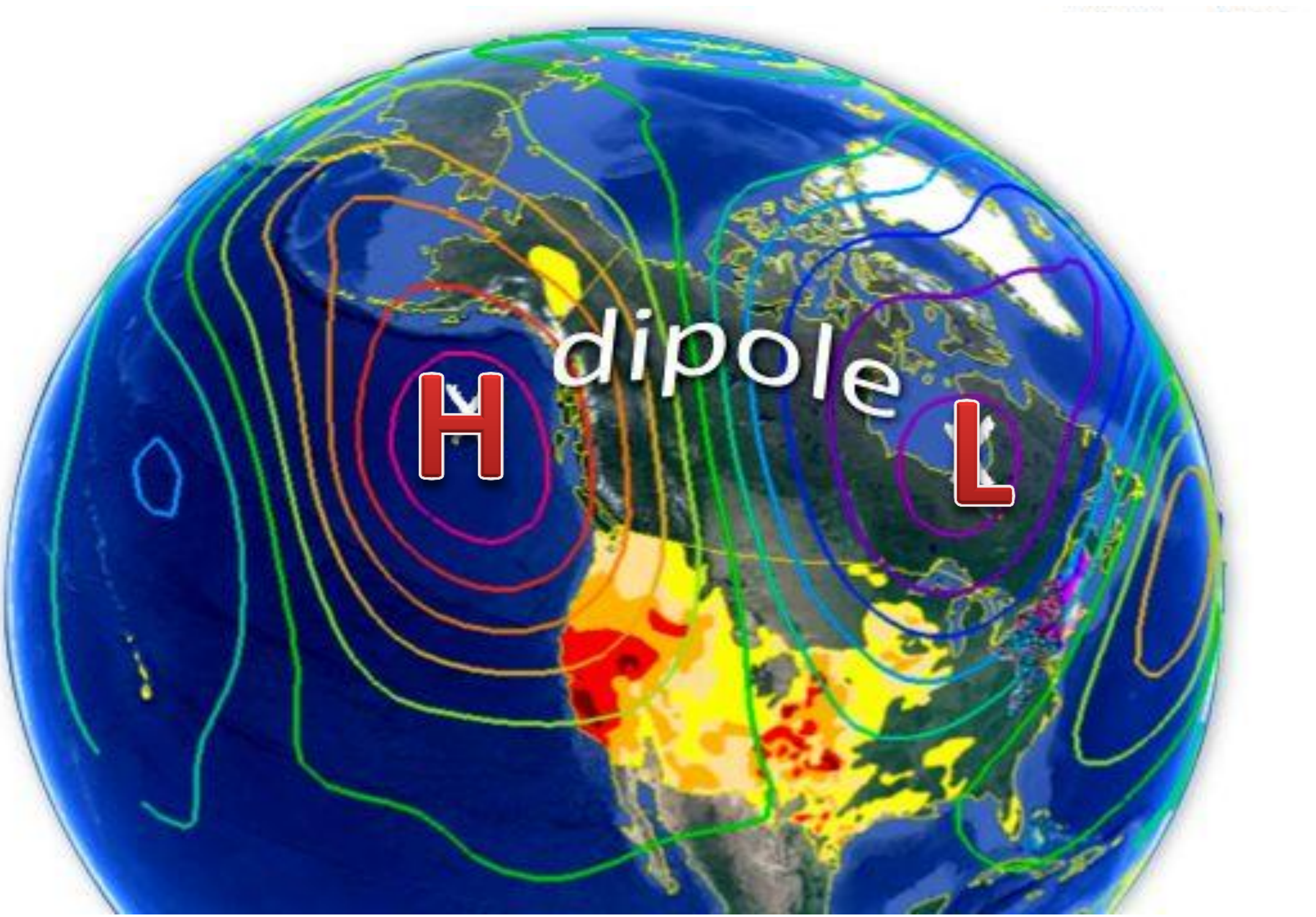
Received: 7 September 2014
Revised: 12 January 2015
Accepted: 14 January 2015

Abstract

The 2013–2014 winter in North America brought intense drought in the West and severe cold in the East. The circulation anomalies were characterized as a dipole: an amplified upper-level ridge over the West Coast and a deepened trough over the central-eastern United States. A previous study using a single model has linked the dipole to the El Niño precursor and found that this link has strengthened in recent years. Here, 17 models from the Coupled Model Intercomparison Project Phase 5 are used to examine the dipole activity. Most models capture the dipole and its association with El Niño precursor and project this association to strengthen.

Keywords: California drought; dipole; west Pacific warming; ENSO precursor

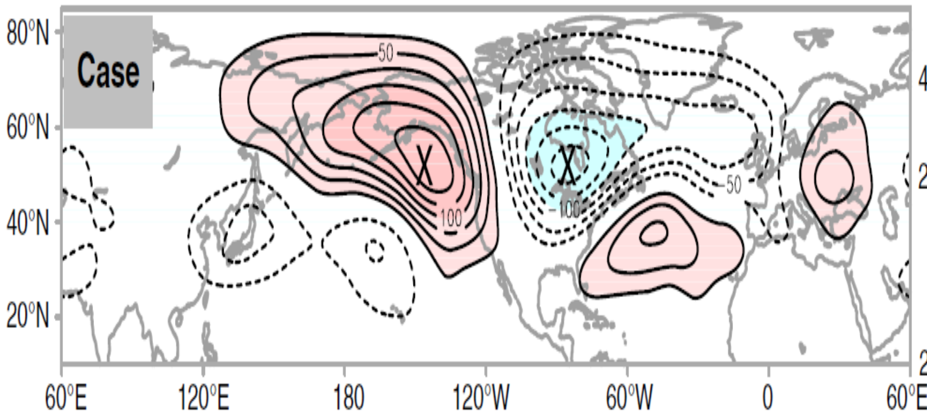
偶極(dipole)結構



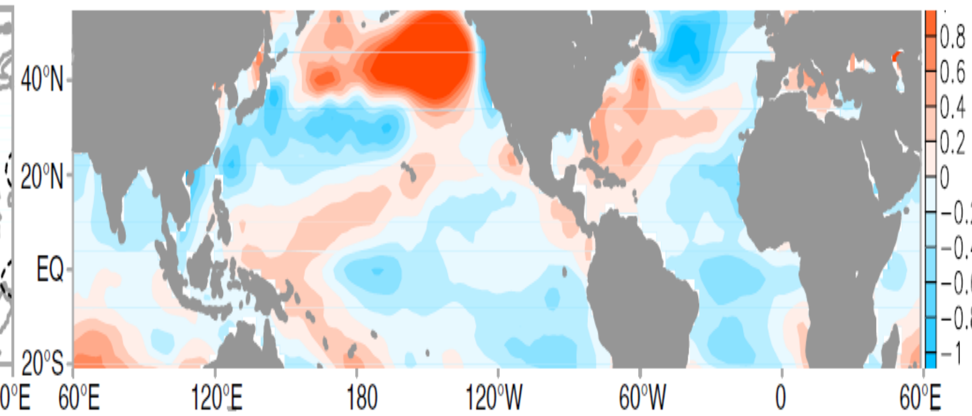
偶極結構。圖片王世宇教授提供

研究假設

2013/14 大氣環流場

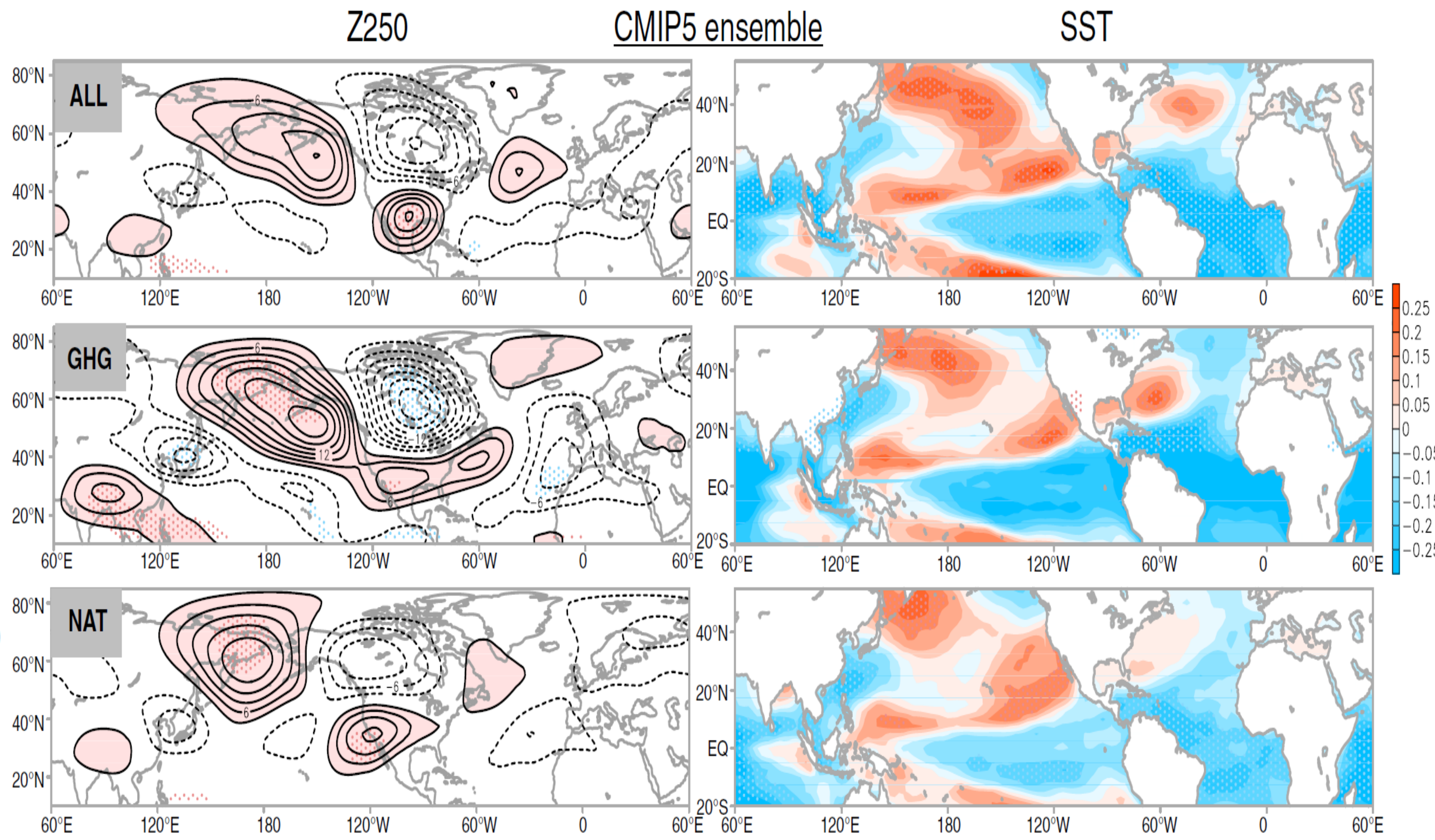


2013/14 冬季海水溫度變異



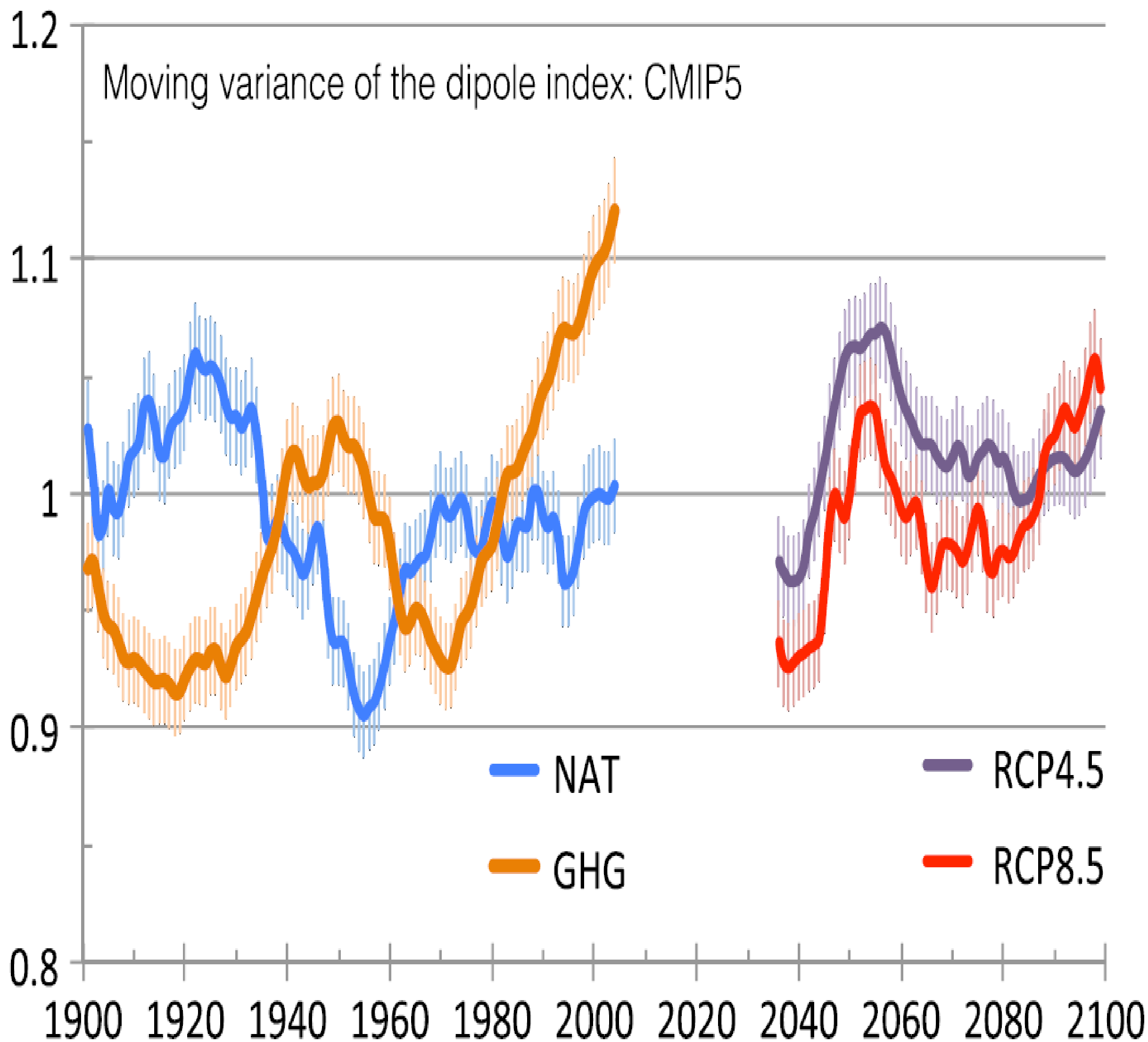
旅美臺灣學者及猶他氣候中心副主任王世宇教授認為，這就像是氣候骨牌的一個複雜遊戲，首先由東亞沿岸海水變冷開始(聖嬰前兆)，最後影響到北美洲的乾旱和嚴寒。

模式驗證「偶極」形成的機制



All: 真實情況　　GHG: 有使用石化燃料的氣體　　Nat: 無使用石化燃料的氣體

模式推估未來「偶極」的強化



共使用17個氣候模式
未來情境:
Rcp8.5 & Rcp4.5

研究發現

- 從1960年代起，類似的氣候極端組合愈來愈明顯，也愈來愈相呼應。
- 以電腦模擬追蹤「加州乾旱形成與有無使用石化燃料的氣體之比較」，當拿掉溫室氣體因素後，這種與日俱增的極端氣候現象便下降了。
- 模式資料顯示，未來當西太平洋隨著全球暖化而增暖，這種北美「偶極」（dipole）將隨之增強。

對台灣的影響?

發表於
英國皇家氣象學會的《國際氣候期刊》

共同合作研究者：師大地科陳冠杰

INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. (2014)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/joc.4159

RMetS
Royal Meteorological Society

Trends in pre-summer frontal and diurnal rainfall activities during 1982–2012 over Taiwan and Southeast China: characteristics and possible causes

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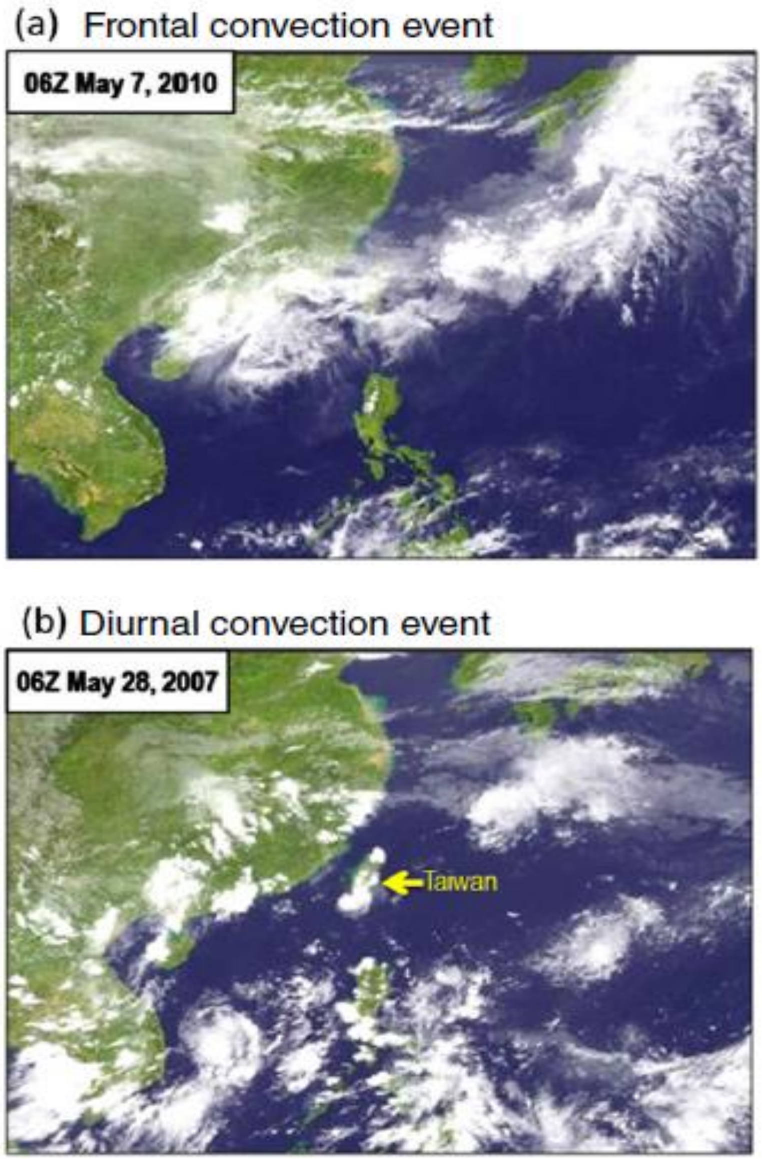
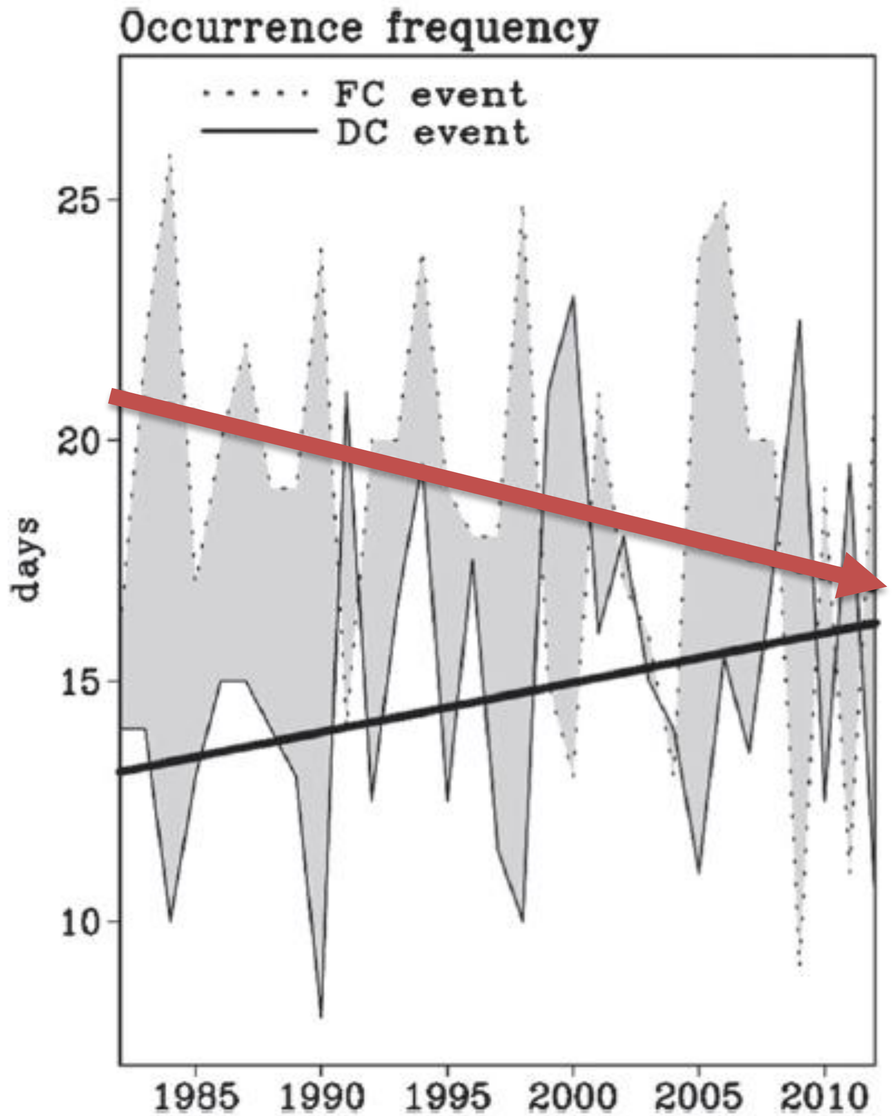
ABSTRACT: Frontal convection (FC) and diurnal convection (DC) are the two most frequently observed weather systems affecting the pre-summer (May and June, MJ) rainfall formation over Taiwan and Southeast China. Focusing on the time period of 1982–2012 MJ months, this study found that the occurrence frequency of FC has declined, but the occurrence frequency of DC has significantly increased over Taiwan and Southeast China. Diagnoses of the atmospheric thermodynamic conditions over the East Asian–Western North Pacific (EAWNP) region indicate that the area favourable for the FC formation (i.e. the area with a locally enhanced meridional temperature gradient) has shifted northward from 20°–30°N to north of 30°N during the recent three decades; this shift has led to a decline in FC numbers over Taiwan and Southeast China. Analyses also indicate that the recent increase in DC activities over Taiwan and Southeast China after 1982 occurred in association with an observed strengthening of the daytime land–sea thermal contrast coupled with an intensification of the afternoon sea-breeze over the EAWNP region and a locally enhanced moisture flux convergence over Taiwan and Southeast China. Possible causes for the observed changes in the atmospheric thermodynamic conditions over the EAWNP region are also discussed.

KEY WORDS Mei-Yu season rainfall; frontal activity; diurnal activity; long-term variations.

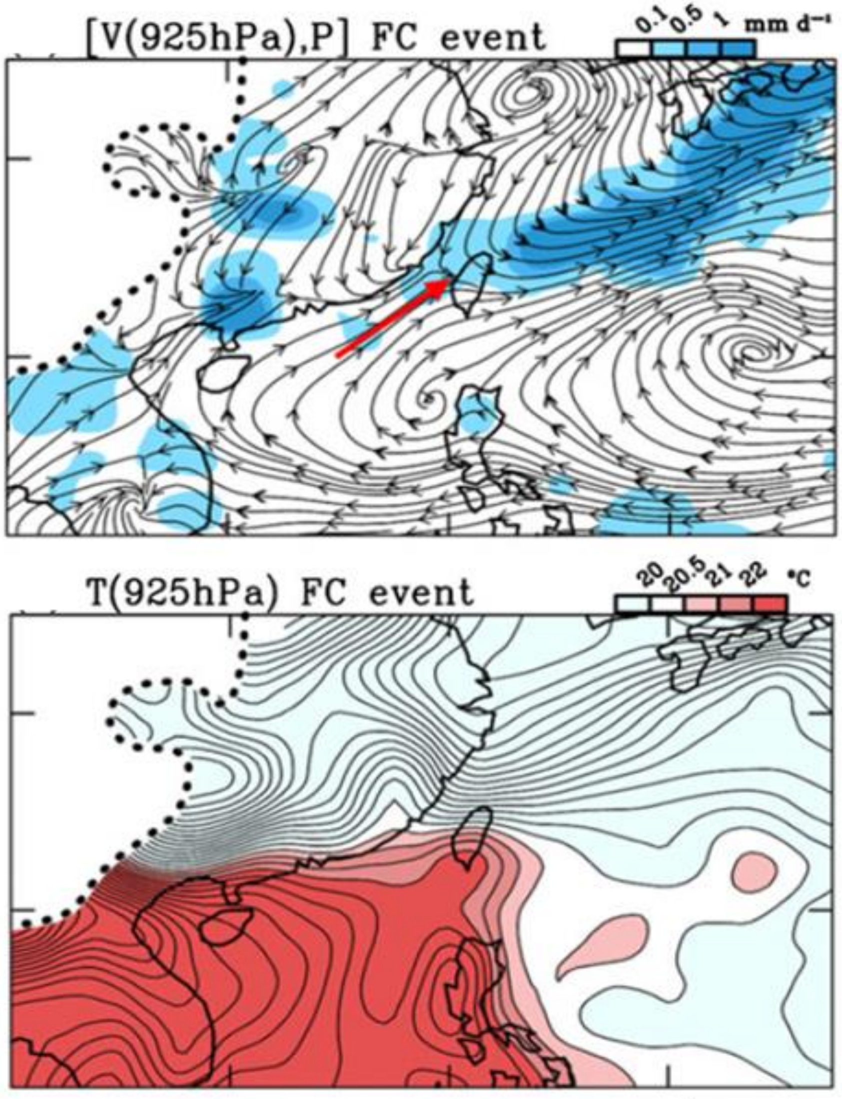
Received 17 May 2014; Revised 11 August 2014; Accepted 13 August 2014

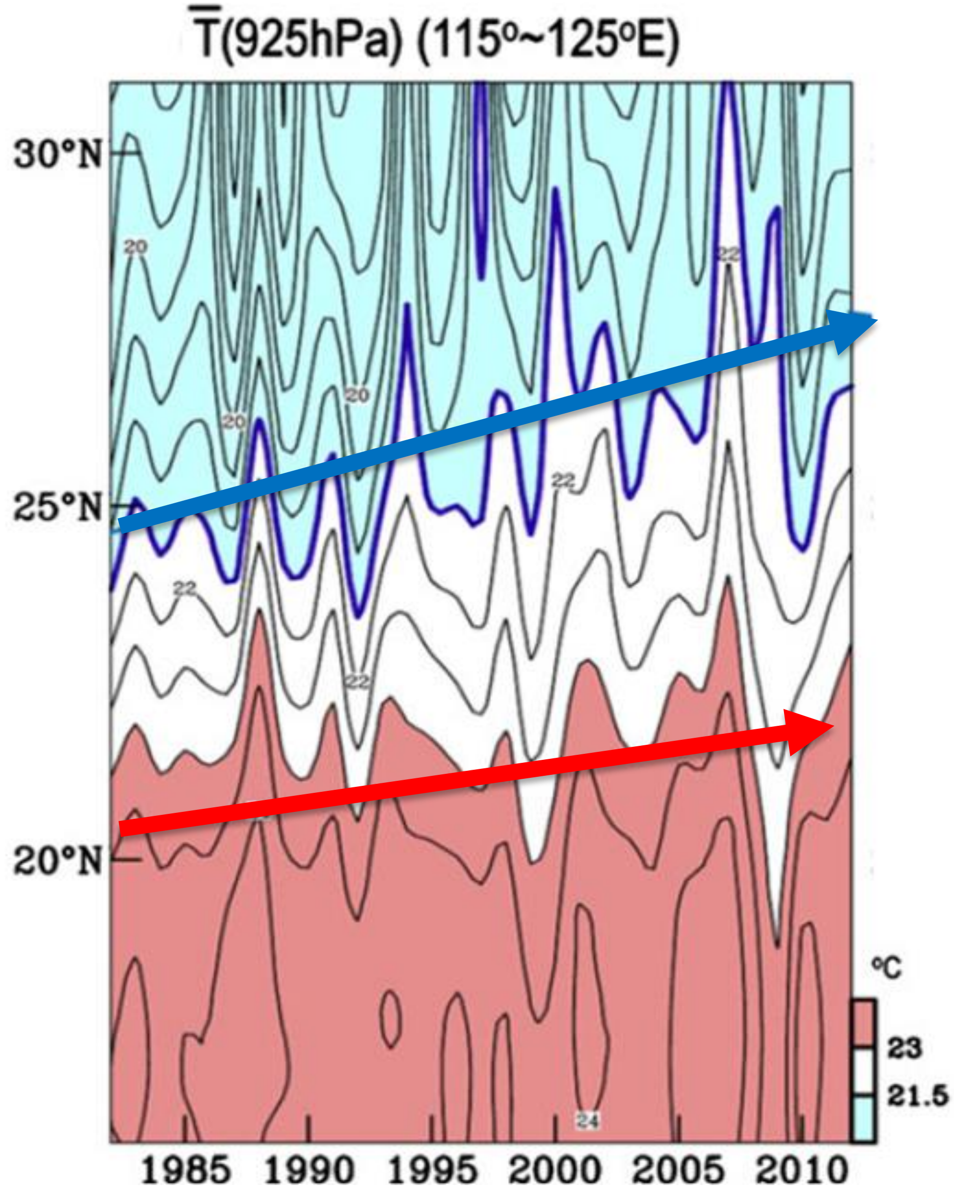
近20~30年，5-6月氣候變化





溫度變遷導致鋒面活躍處改變





研究發現

- 受到溫度變化的影響(如西太平洋海溫增暖)，從1990左右起，梅雨季的開始有延後的傾向，並在降雨方面有強度增加但是頻率減少的現象。

- 長期來說，這現象對水庫蓄水並無幫助。因為短暫的強降水易流失又會累積淤泥。

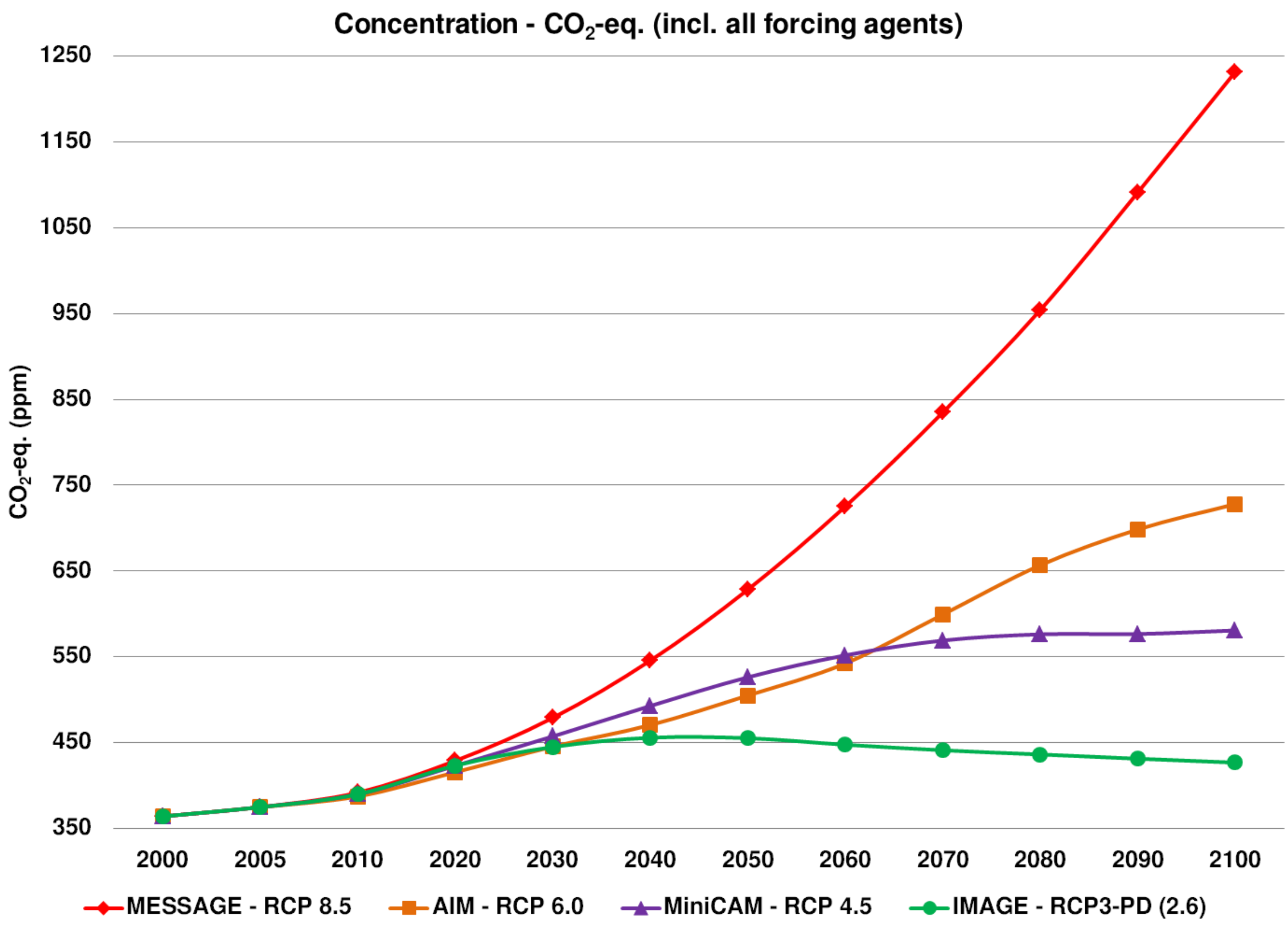
建議

儘管學術界對臺灣梅雨變化趨勢尚未獲得一致的答案，但極端氣候頻頻發威，產生更多潛在危機。

若不正視全球暖化問題並積極研究暖化對地區性氣候的效應，極端氣候將會是我們這個世代無可逃避的重大挑戰，也會使臺灣環境面臨比世界各地更嚴峻的威脅。

Thanks for listening

Question?


Concentration - CO2-eq. (incl. all forcing agents)
CO2-eq. (ppm)
1250
1150
1050
950
850
750
650
550
450
350
2000
2005
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
MESSAGE - RCP 8.5
AIM - RCP 6.0
MiniCAM - RCP 4.5
IMAGE - RCP3-PD (2.6)