


The background features a large, irregular watercolor splash. The top half is a vibrant orange, which transitions into a deep blue at the bottom. The edges of the splash are textured and feathered, with small droplets and speckles of color scattered across the white background.

再乾下去, 會不會
燒起來？



再乾下去, 會不會 燒起來？

颱風跑去了韓國，卻助長北美的野火

Simon 世宇 Wang
Utah State University

上次乾旱來時 (2015)



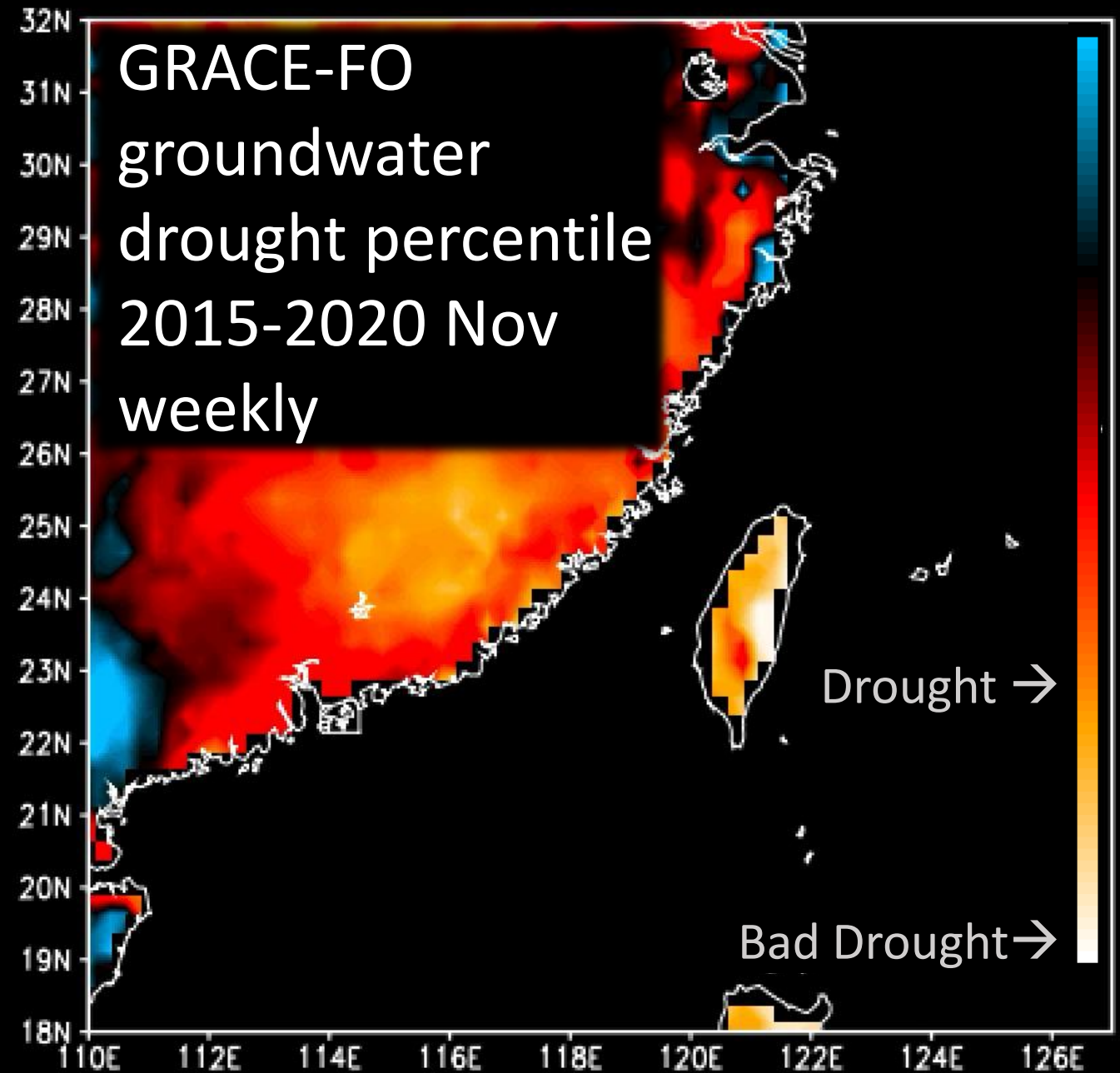
今年是有多乾☀️？

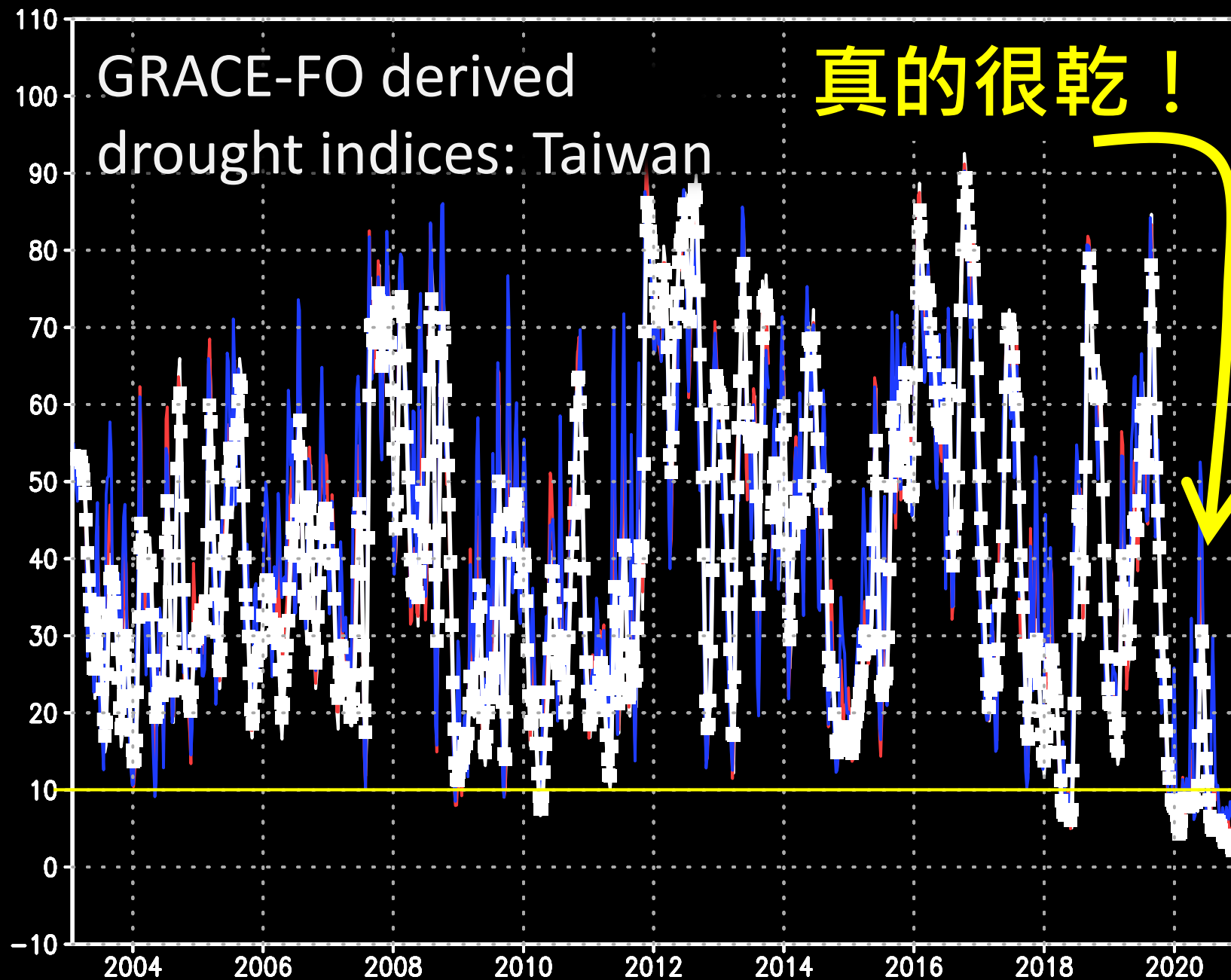
A gravity estimation:

GRACE

Gravity Recovery and Climate Experiment

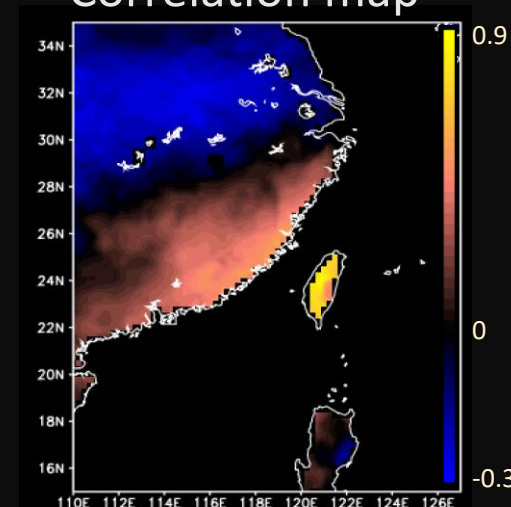
doi:10.1029/2011WR011291



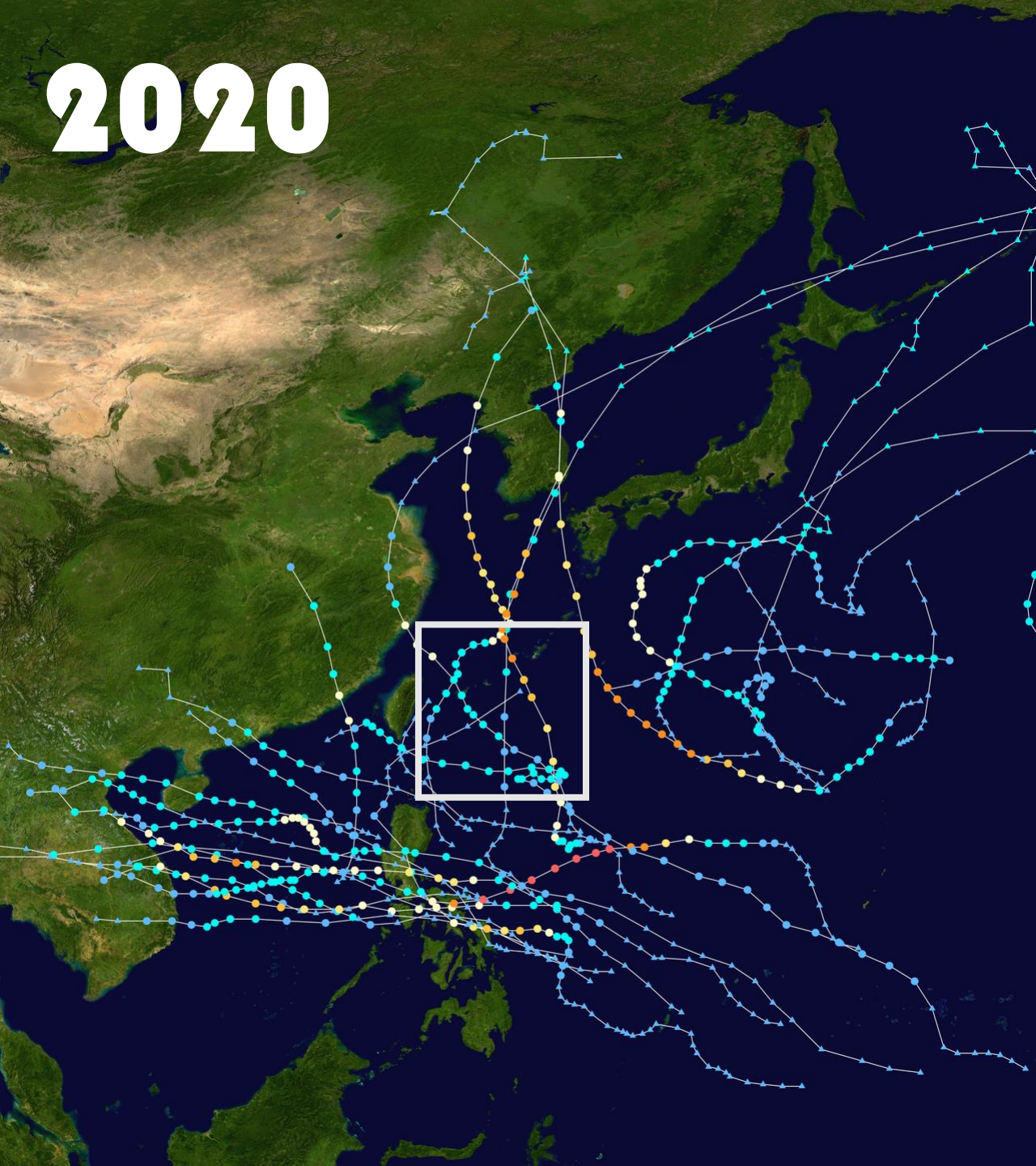


- root zone moisture
- surface soil moisture
- shallow groundwater

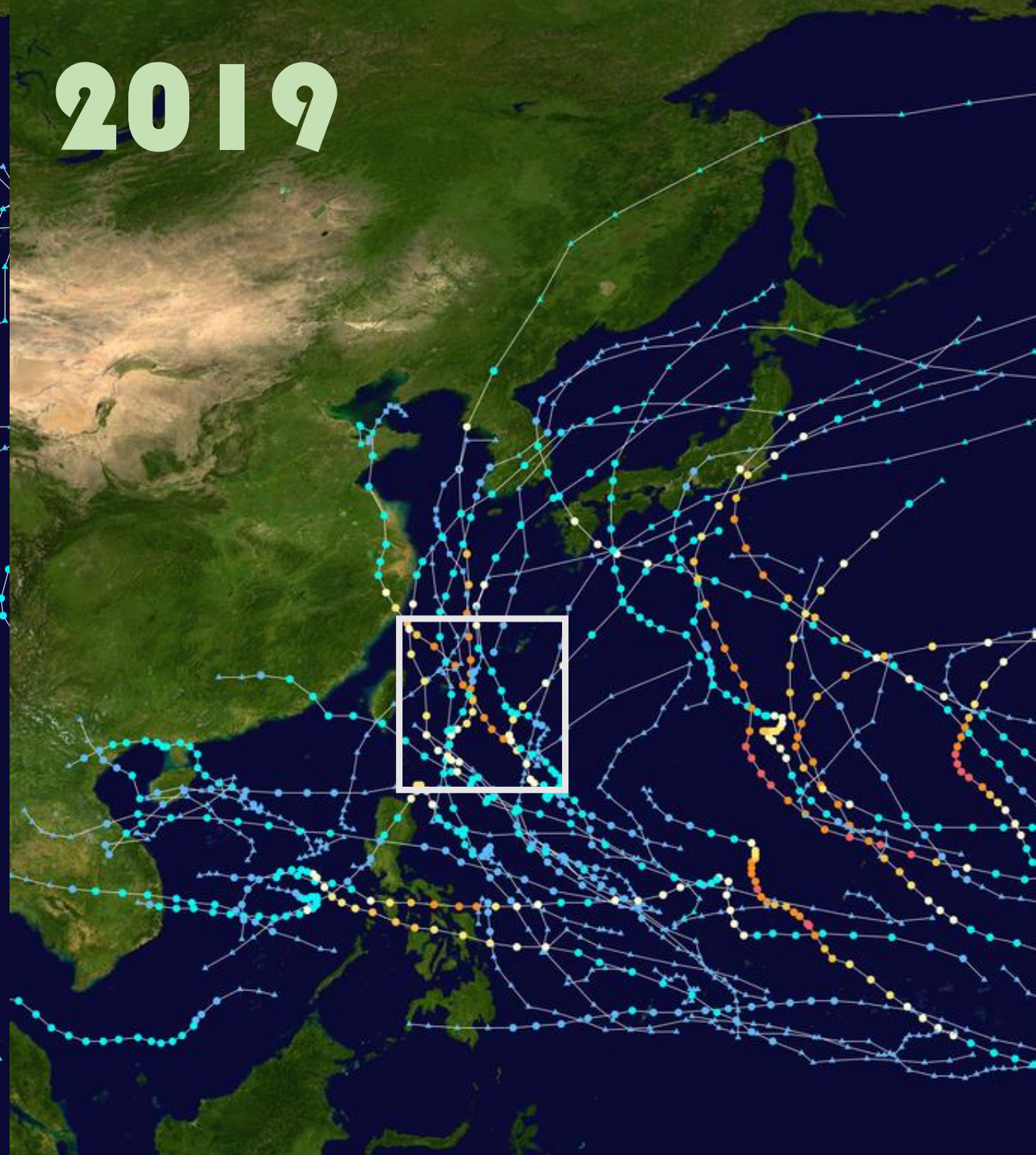
Correlation map



2020



2019



2020-11-30 / 即時回應 氣候變遷

2020年沒有颱風登陸 原因與影響專家意見

議題背景

今（2020）年至11月11日未有颱風次全年都沒有颱風，已時隔56年。根據的紀錄，2020年颱風生成數量為221個颱風發布警報，其中只有1個颱風警報，且全數皆未登陸。據此，新興邀請專家解析今年颱風未登陸的原因。

專家怎麼說？

2020年11月16日

中央氣象局科長 陳孟詩

一般而言，西北太平洋每年平均有2成，每個月都有機會生成颱風，其生成個數最多。然而並不是所有的風來臺灣，颱風的路徑由導引氣流決定。導引氣流就是太平洋高壓（約分布於北太平洋海面）。颱風生成後，當時的太平洋高壓強，颱風就會向西（南海）前進，太平洋高壓太弱，颱風就容易北轉（日韓方向）。

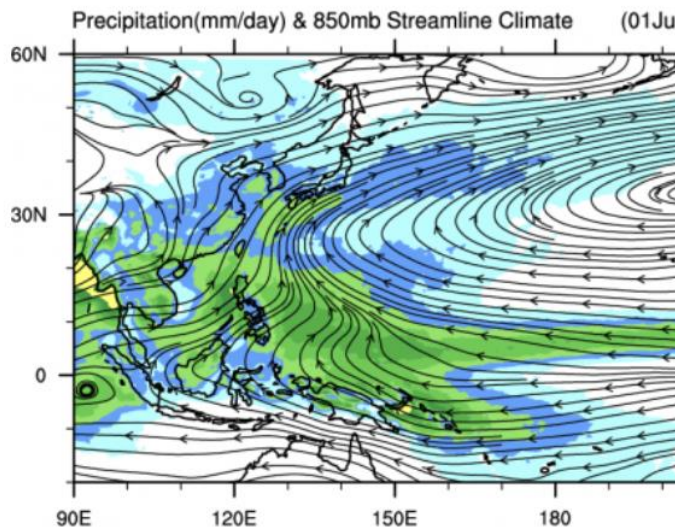


圖 西北太平洋高壓夏季平均

2020年11月22日

中央研究院環境變遷研究中心特聘研究員暨副主任 許晃雄

以颱風數量而言，比起2010年14個颱風與1998年16個颱風，今（2020）年22個不算是颱風極少的年份[6]。但是，若以颱風活躍度來看，到2020年11月18日為止氣旋能量指數僅約長期平均的55% [7、8]。這表示雖然今年颱風數沒有明顯降低，但颱風整體活躍度極低。更特別的是7月無颱，且直到11月初都無侵臺的颱風。

颱風活躍度與路徑，主要受到西北太平洋的副熱帶高壓（簡稱副高）與季風槽[9]（及低壓帶）的相對興衰與位置影響。颱風少（如2010年與1998年）與低活躍度（如2020年）的年份，副高就較強，且往西／南擴張，季風槽則相對弱且往西萎縮。研究發現強副高的現象常是由其他海洋盆地（如北印度洋、熱帶大西洋、副熱帶東北太平洋）的高海溫，

202

indeed appears in the **subtropical** WNP (Figure 10a-d), associated with ...

☆ 99 Related articles

[HTML] A study of climate model responses of the western **Pacific subtropical high** to El Niño diversity

M Chen, TH Chang, CT Lee, [SW Fang](#), [JY Yu](#) - Climate Dynamics, **2020** - Springer

... **high** to El Niño diversity. Download PDF. Download PDF. Published: 19 October **2020** ... The western **Pacific subtropical high** (WPSH) is one of the most influential atmospheric circulation systems ... winds to subsequently induce cold SST anomalies in the **subtropical** central **Pacific** ...

☆ 99

[HTML] Sub-Seasonal Variability of Meridional Activity of Western **Pacific Subtropical High** in Boreal Late Summer

Q Qian, P Liang, L Qi, Y Ding, J He - Frontiers in Earth Science, **2020** - frontiersin.org

... Because the active region of MISO is close to the **subtropics**, it can affect mid-latitude ISO ... Yang and Li (**2020**) revealed that the QBWO of zonal location of the WPSH is closely ... And the westward wave activity over the **subtropical** Atlantic Ocean may have indirect impact on LFO of ...

☆ 99 88

Role of the cold Okhotsk Sea on the climate of the North **Pacific subtropical high** and Baiu precipitation

K Kawasaki, Y Tachibana, T Nakamura... - Journal of ..., **2020** - journals.ametsoc.org

... 11 2nd version 12 Submitted date: 28 September **2020** 13 # JCLI-D-20-0432 14 15 ... moisture flux at the western edge of an intensified North **Pacific subtropical high**. The 29 ... A 49 stationary

[HTML] Comparison on Relationship between Western **Pacific Subtropical High** and Summer Precipitation over Dongting Lake Basin Based on Different Datasets

J Sun, Y Huang, J Han, X Zhang - Asia-Pacific Journal of Atmospheric ..., **2020** - Springer

... Download PDF. Download PDF. Review Paper; Published: 17 August **2020** ... Other studies thought that the West **Pacific subtropical high** in summer was maintained by the combined ... higher in summer and cause the westward extension of the West **Pacific subtropical** through the ...

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The extremely north position of the western **Pacific subtropical high** in summer of 2018: Important role of the convective activities in the western **Pacific**

Y Yuan, H Gao, T Ding - International Journal of Climatology, **2020** - Wiley Online Library

... Advances in Atmospheric Sciences, 6, 21-32. Huang SS and Yu ZH, 1962. On the structure of the **subtropical highs** and some ... Ren RC, Liu YM, Wu G X. 2007. Impact of South Asia **high** on the short-term variation on the **subtropical anticyclone** over western **Pacific** in July 1998 ...

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1485 -

1480 -

1960

1965

1970

1975

2020

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[PDF] The Influence of South **Pacific** Convergence Zone Heating on the South **Pacific Subtropical Anticyclone** and Southern Hemisphere Storm Tracks

[AA Fahad](#), NJ Burls, ET Swenson... - Earth and Space ..., **2020** - researchgate.net

... wave train response in the South **Pacific** Ocean basin occurs over the **subtropical** to mid ... weakened SPCZ heating leads to opposite Rossby wave train response over the SH **subtropics** and ... org/10.1002/essoar.10503610.1 | CC_BY_4.0 | First posted online: Thu, 9 Jul **2020** 04:50 ...

☆ 99 All 2 versions 88

Recent Shift in the State of the Western **Pacific Subtropical High** due to ENSO Change

Z Huang, W Zhang, X Geng, [FF Jin](#) - Journal of Climate, **2020** - journals.ametsoc.org

... Huang, Z., W. Zhang, X. Geng, and F. Jin, **2020**: Recent Shift in the ... The boreal summer western **Pacific subtropical high** (WPSH) exhibits a remarkable decadal shift in its spatial ... Strong **anticyclone** anomalies usually are maintained over the western North **Pacific** (WNP) during ...

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[HTML] Interannual and interdecadal impact of Western North **Pacific Subtropical High** on tropical cyclone activity

Q Wu, X Wang, L Tao - Climate Dynamics, **2020** - Springer

... **Pacific Subtropical High** (WPSH) exhibits a remarkable decadal shift in its spatial ... Strong **anticyclone** anomalies usually are maintained over the western North **Pacific** (WNP) during ...

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... Nature Communications volume 11, Article number: 2802 (**2020**) Cite this article ... and EOF2) derived from intermodel empirical orthogonal function (EOF) analysis on projected changes of the western North **Pacific Subtropical High** (white box) under a **high** emission scenario ...

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Different enhancement of the East Asian summer monsoon under global warming and interglacial epochs simulated by CMIP6 models: Role of the **subtropical high**

C He, W Zhou - Journal of Climate, **2020** - journals.ametsoc.org

... 2004; Miyasaka and Nakamura 2005), and the western portion of this **anticyclone** is called the western North **Pacific subtropical high** (WNP) ... The **elevated** heating over the TP in summer, including both sensible heating and latent heating, drives a cyclonic circulation ... **2020**) ...

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The Indo-western **Pacific** Ocean capacitor effect

[Y Kosaka](#), Y Takaya, Y Kamae - Tropical and Extratropical Air ..., **2020** - books.google.com

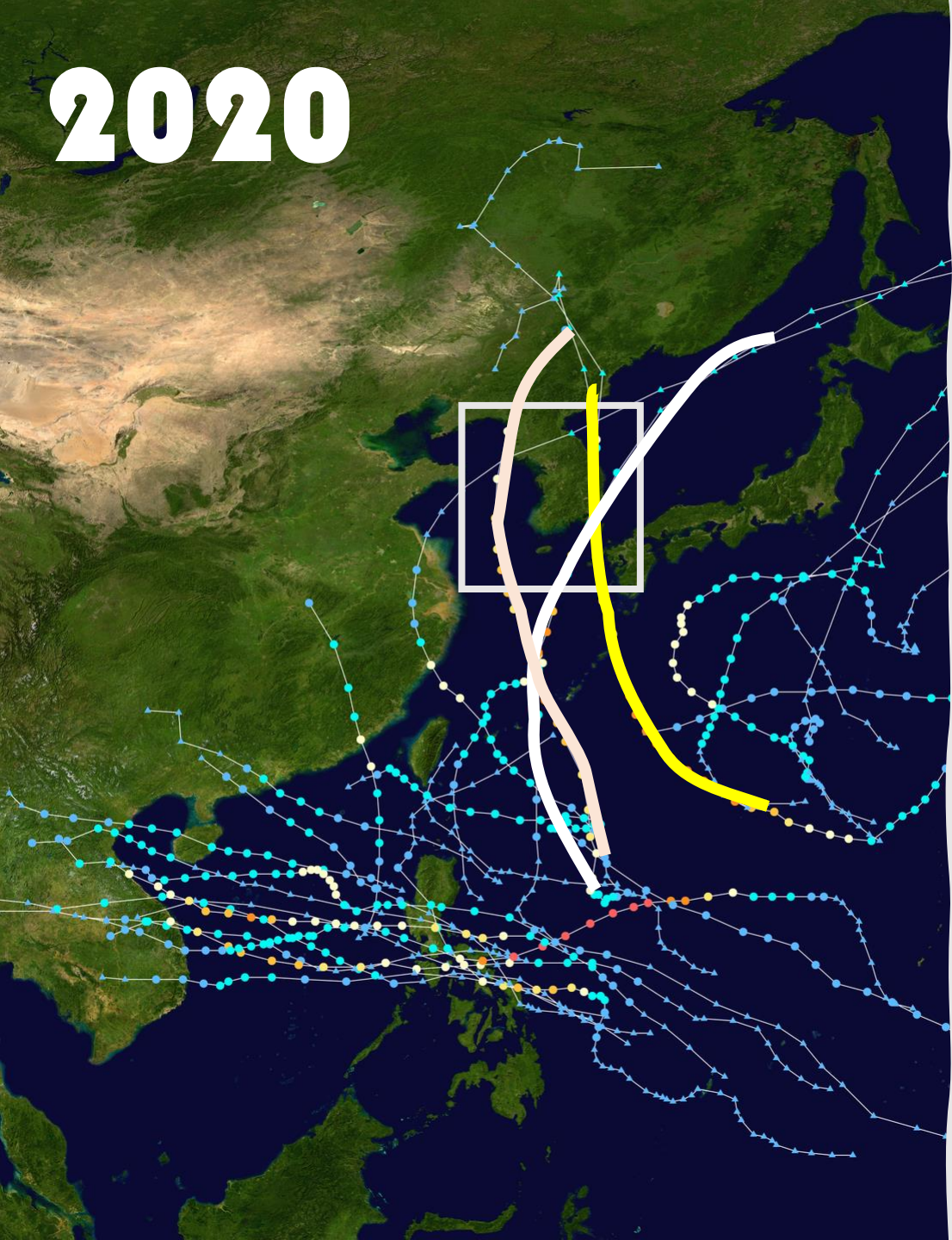
... **Pacific** El Niño (please refer to the review by Marathe and Ashok (**2020**), Chapter 4 ... associated with the **positive** IPOC mode induces westerly anomalies in the **subtropical** WNP, which ... the IPOC mode and successful simulation of TC activity modulations by **high**-resolution AGCM ...

☆ 99 Cited by 3

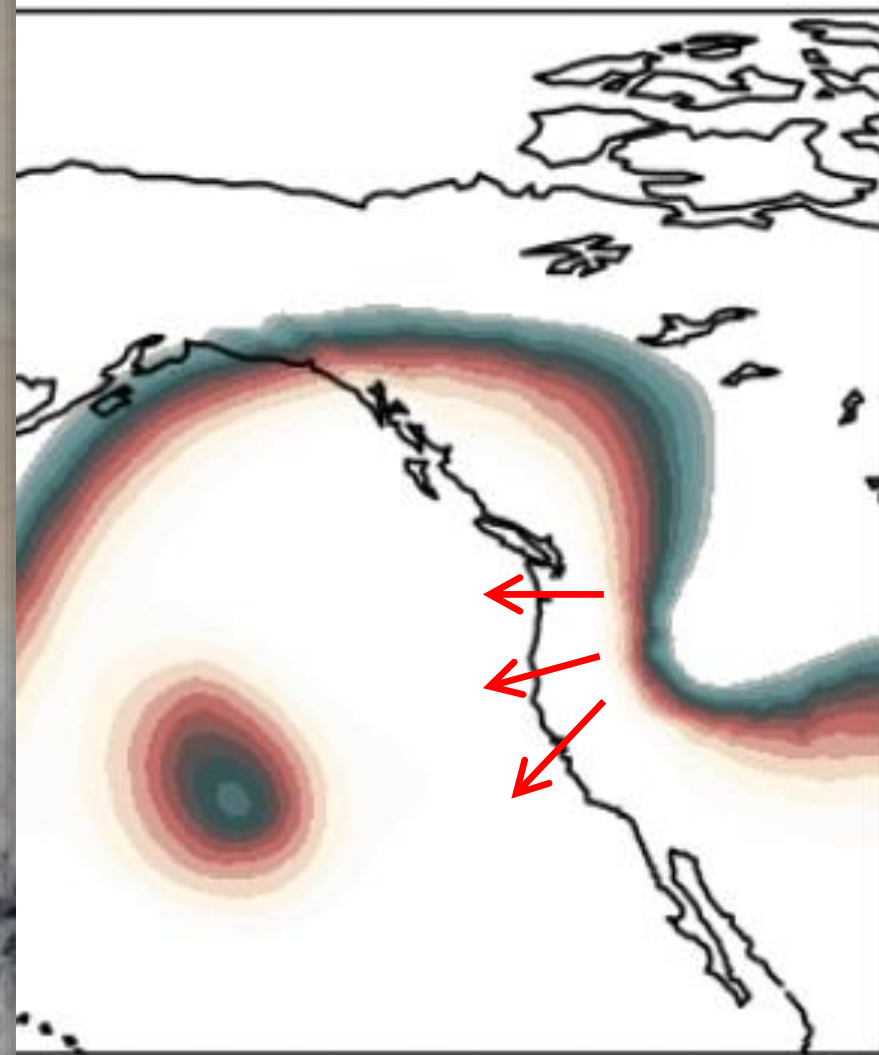
[HTML] The record-breaking northward shift of the western **Pacific subtropical high**

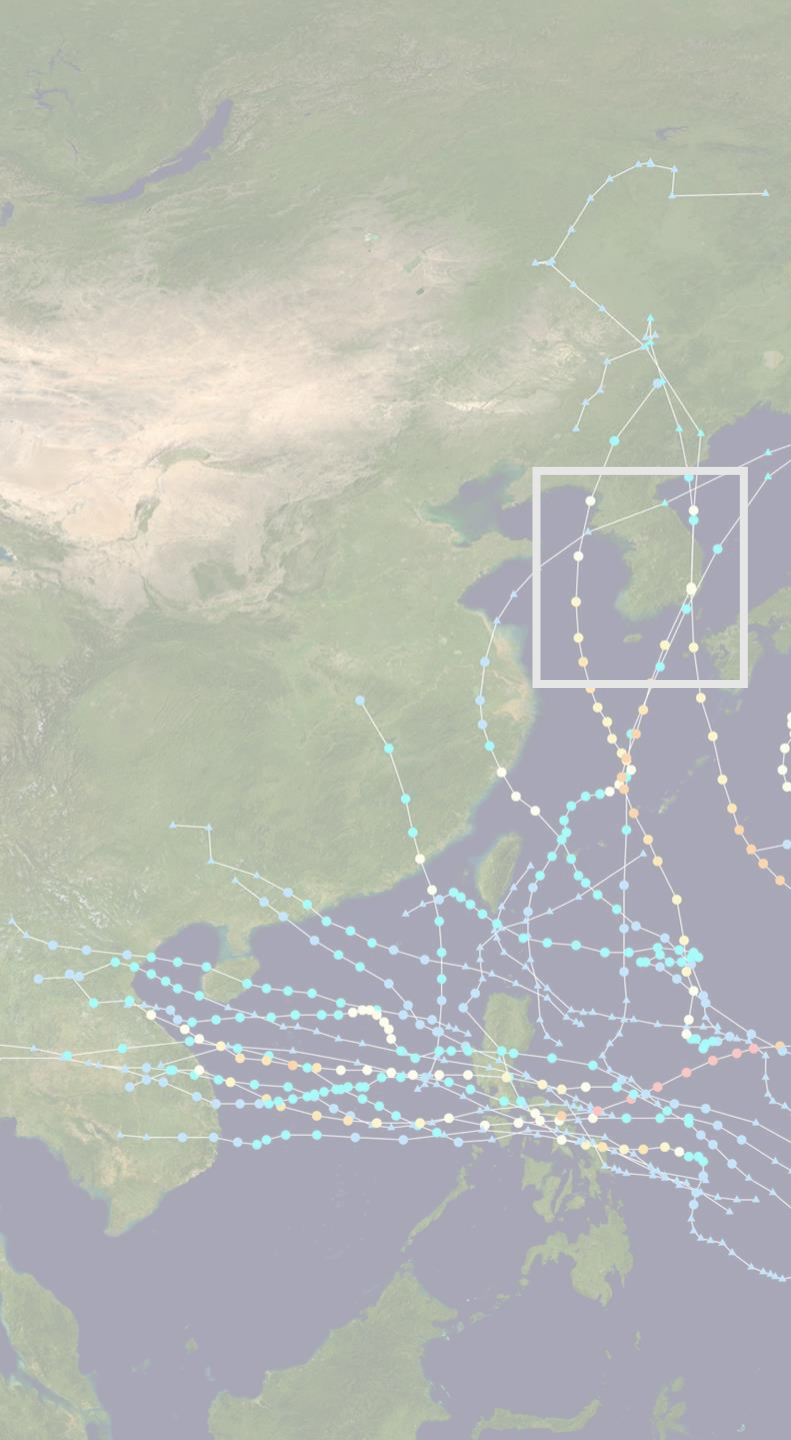
2020

2020

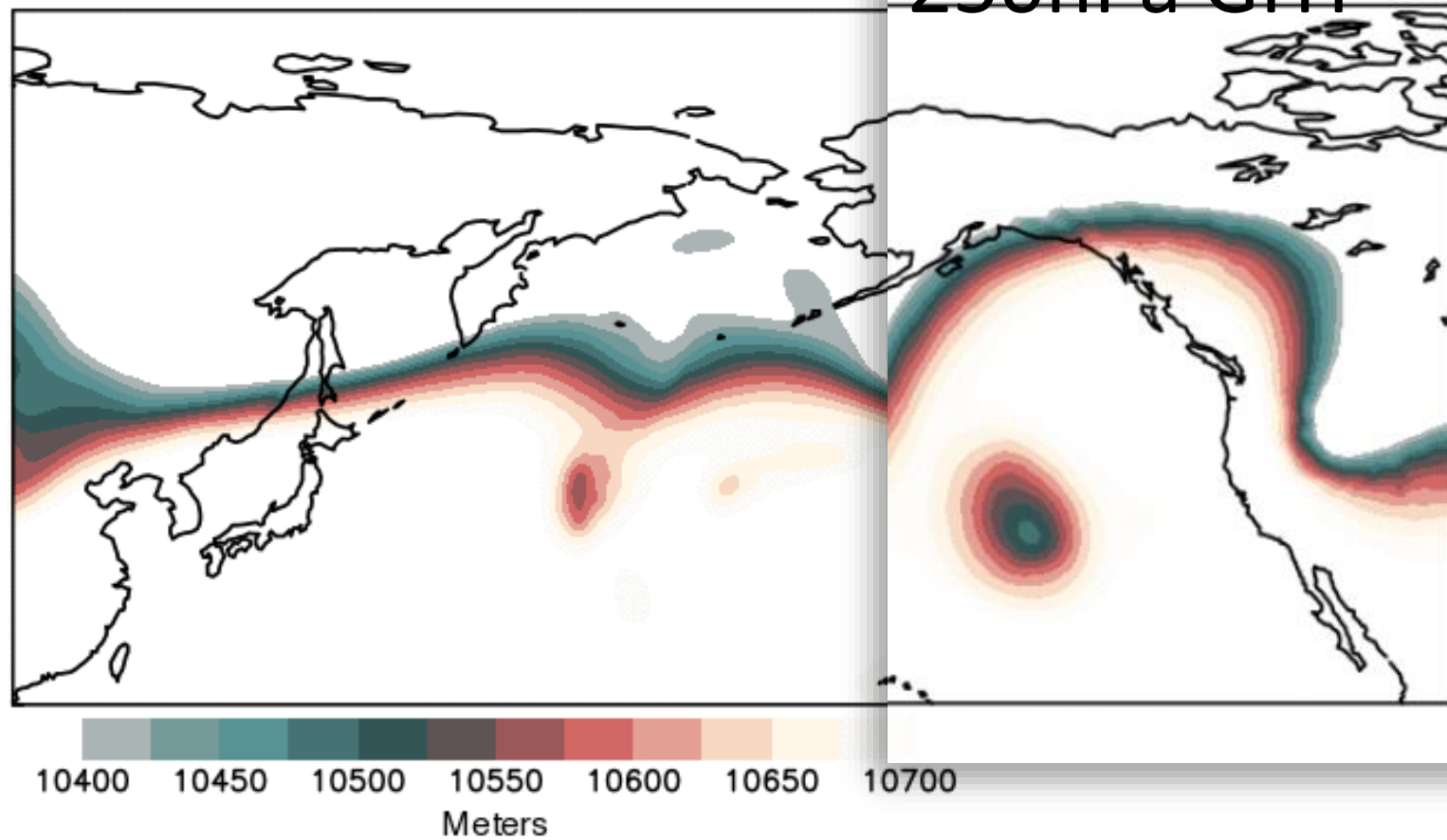


250hPa GHT 2020:9:8:6





ERA5 250hPa Geopotential Height







U.S. National Public Radio



Climate Change's Effect On The Wildfires In The West Coast

September 13, 2020 · 7:53 AM ET
Heard on [Weekend Edition Sunday](#)



4-Minute Listen

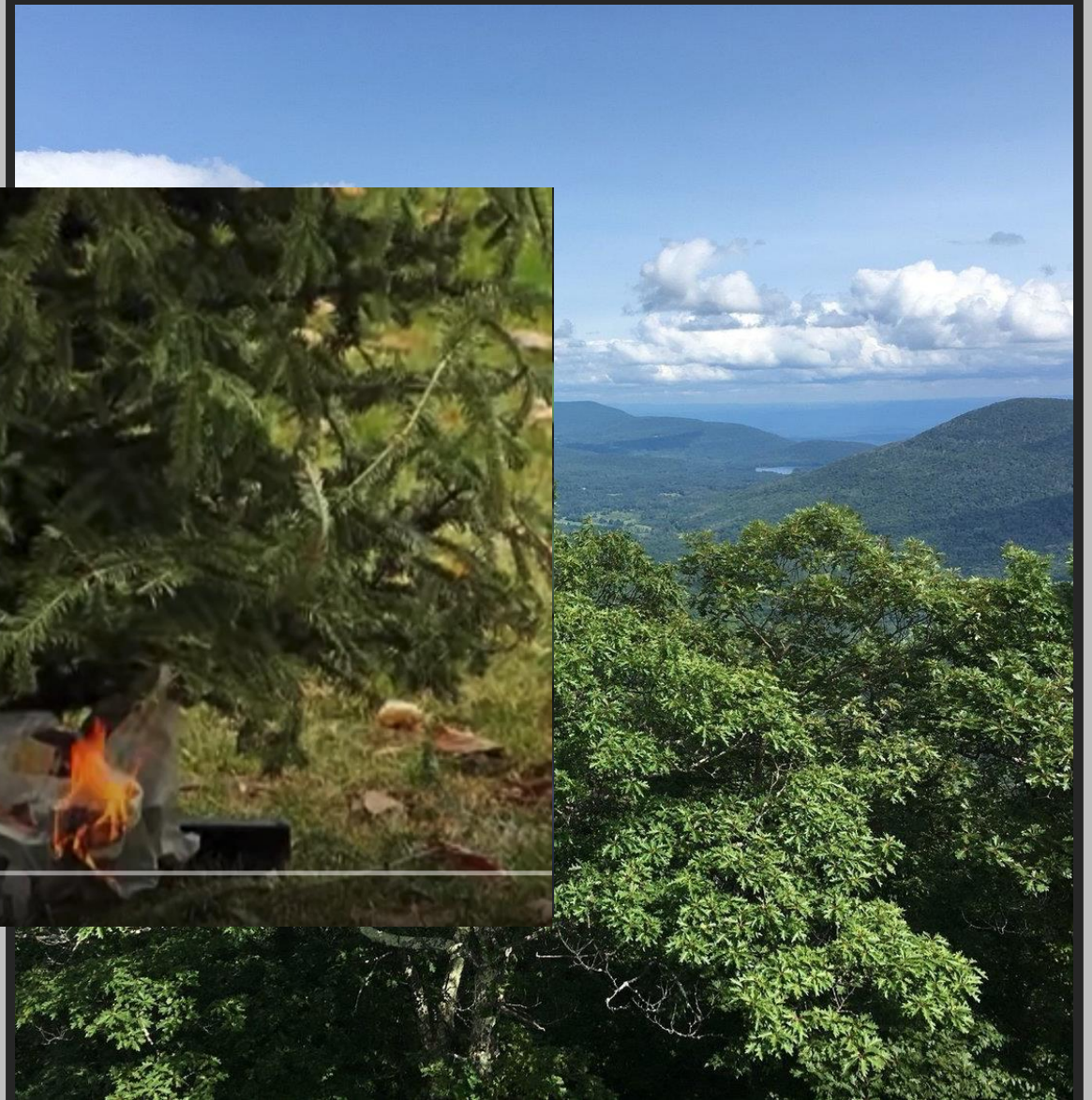


NPR's Lulu Garcia Navarro speaks with Simon Wang of Utah State University about how climate change is intensifying the wildfires on the West Coast.

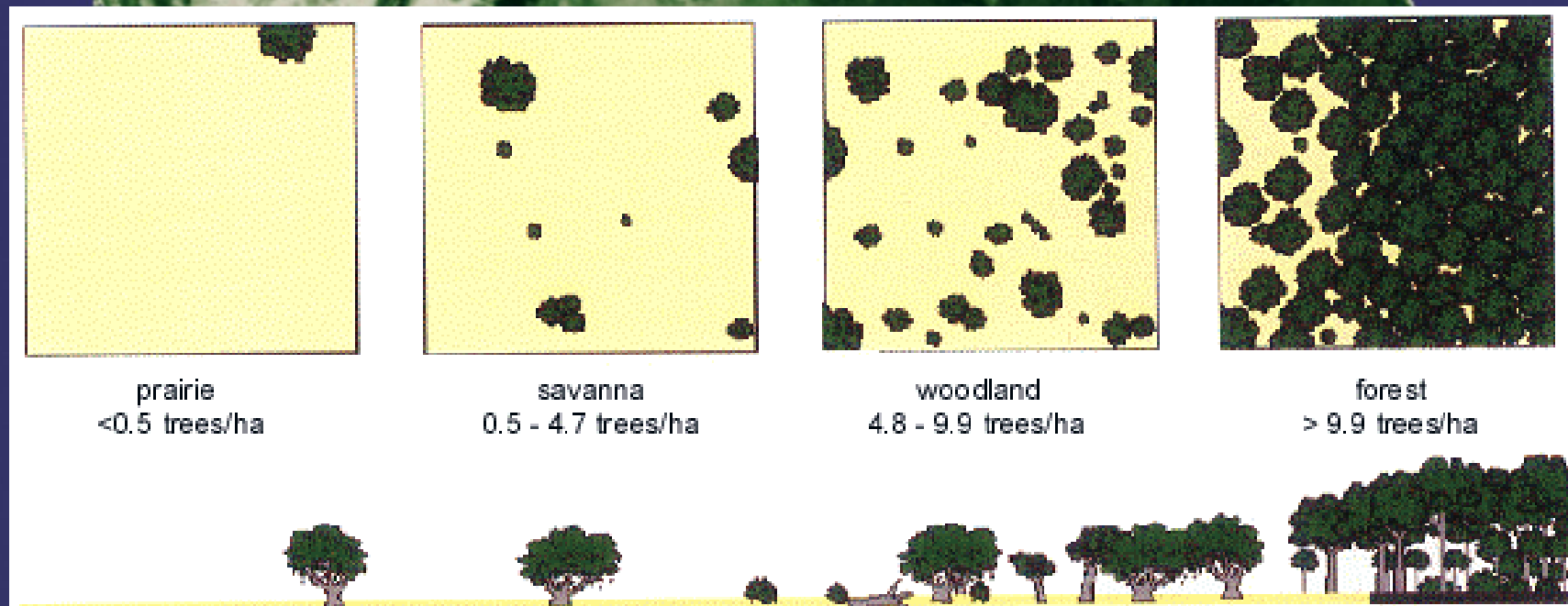


Let's talk about the USA fires

Factor 1: Forest types

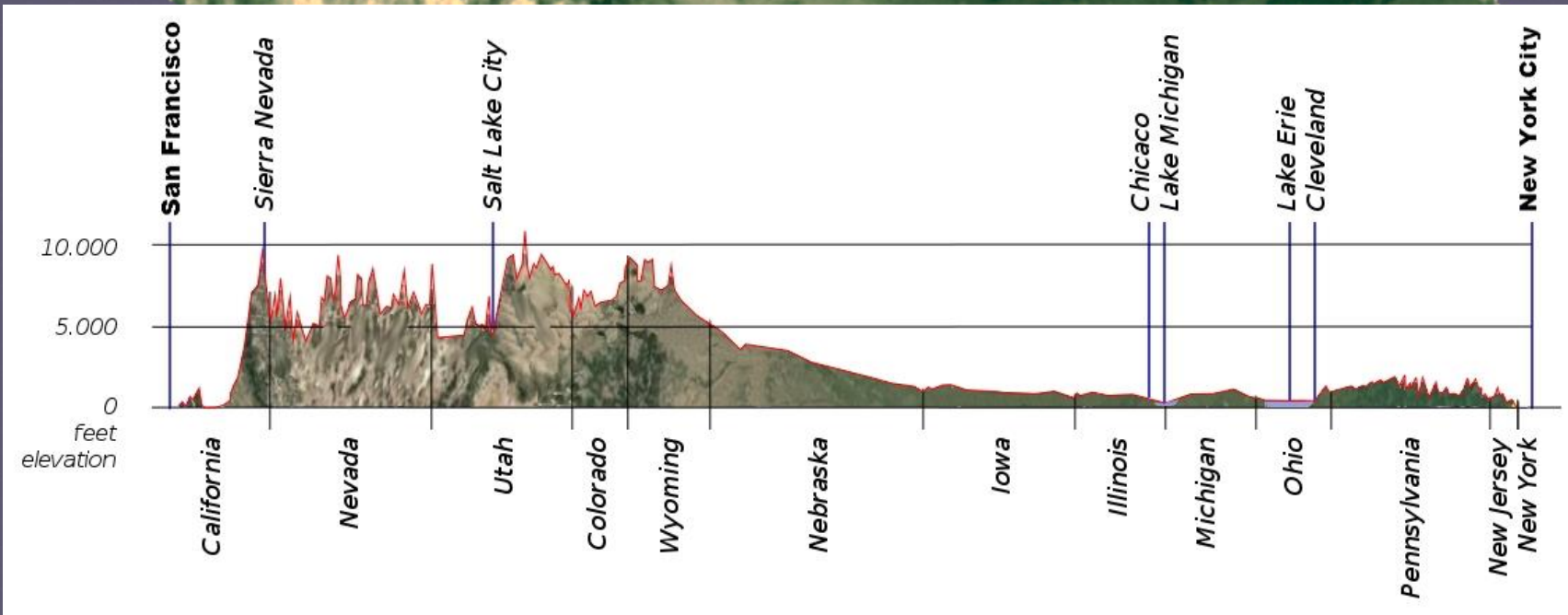


Factor 2: Forest density and gradient



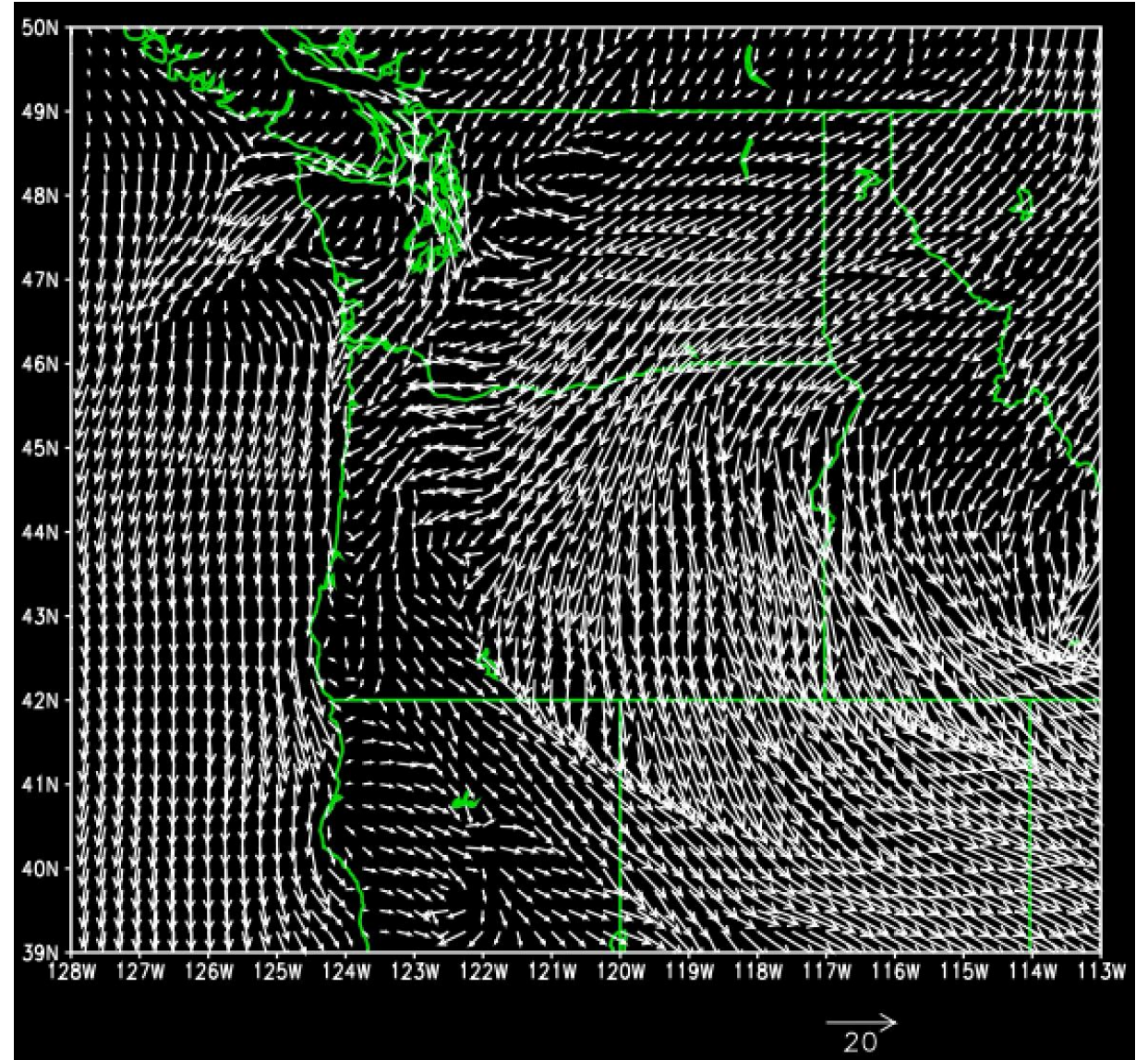
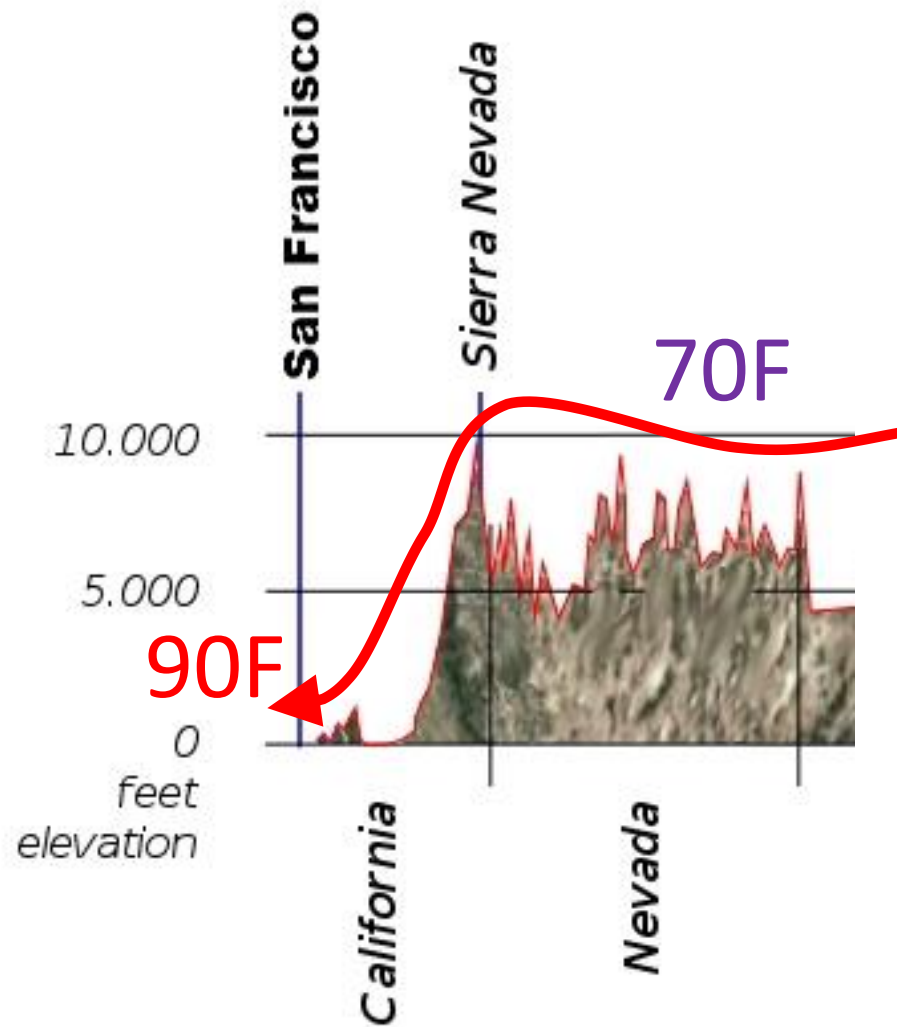
North America NDVI Average July

Factor 3: Terrain and aspect



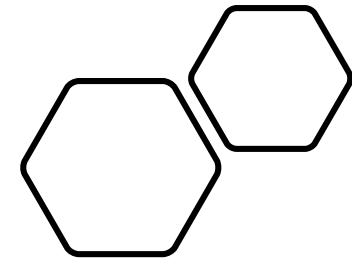
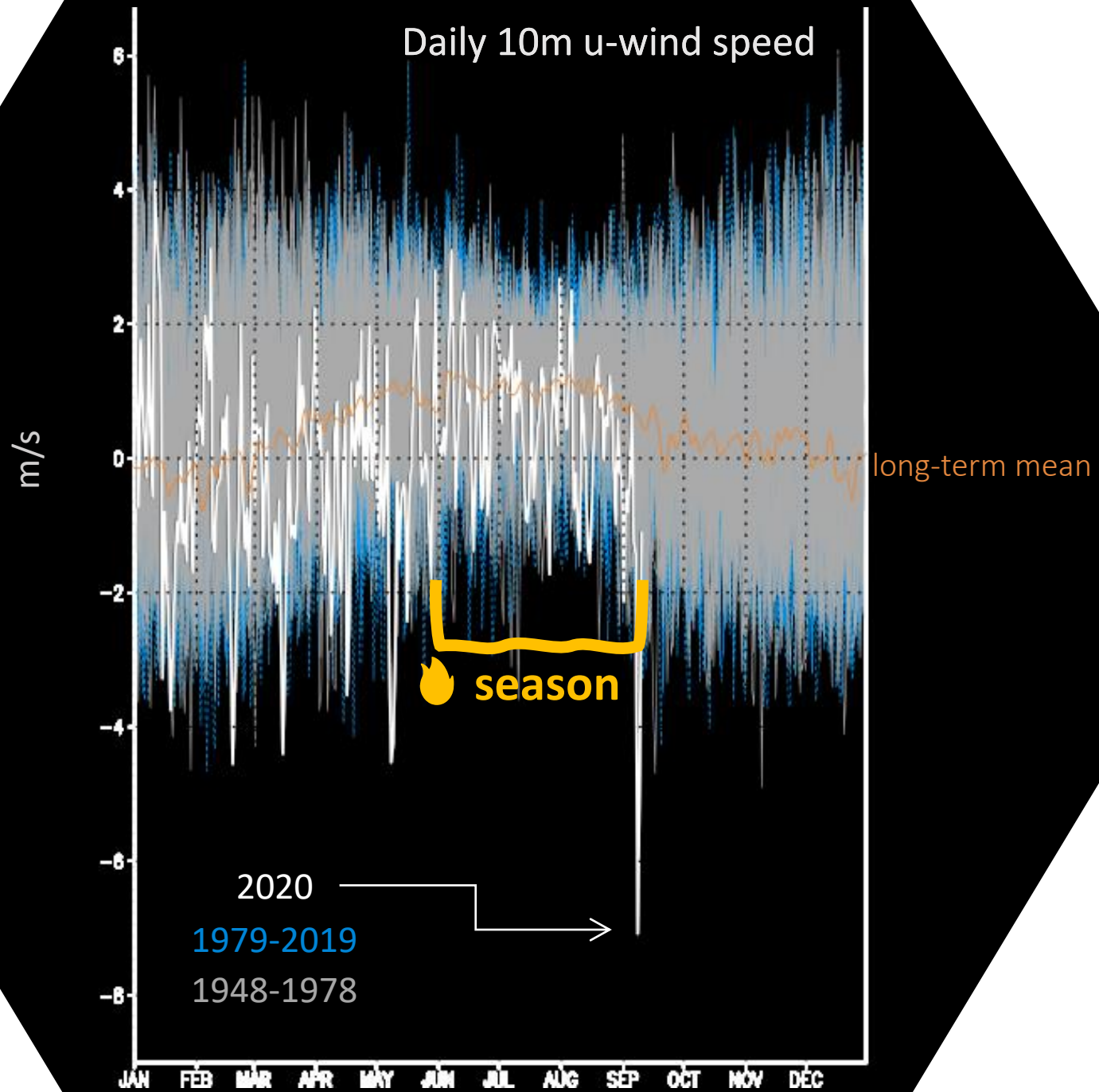
North America NDVI Average July

Factor 4: Weather and climate

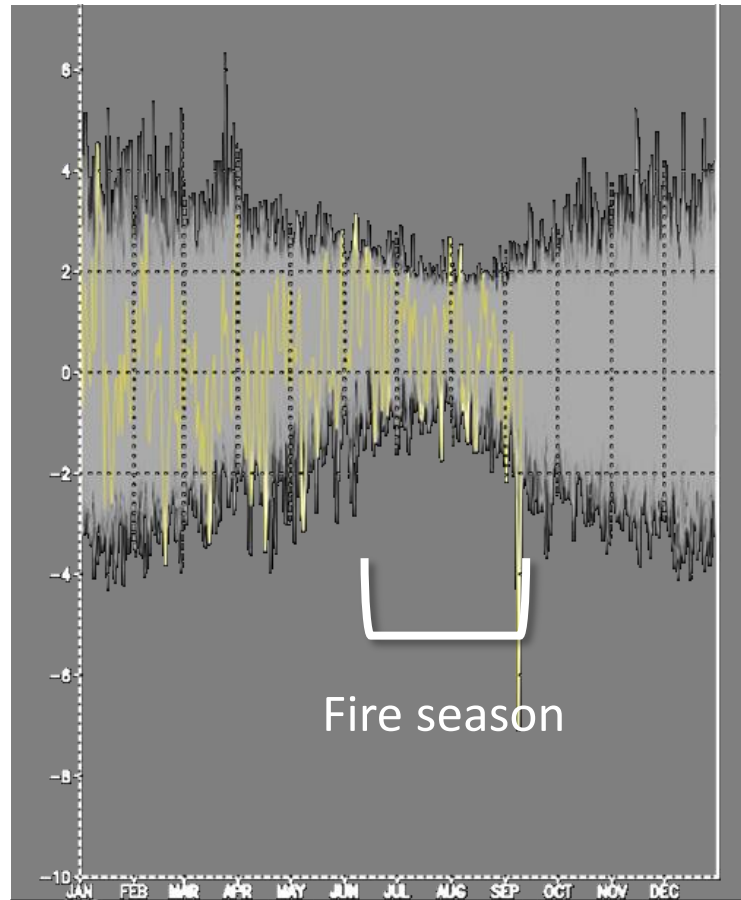




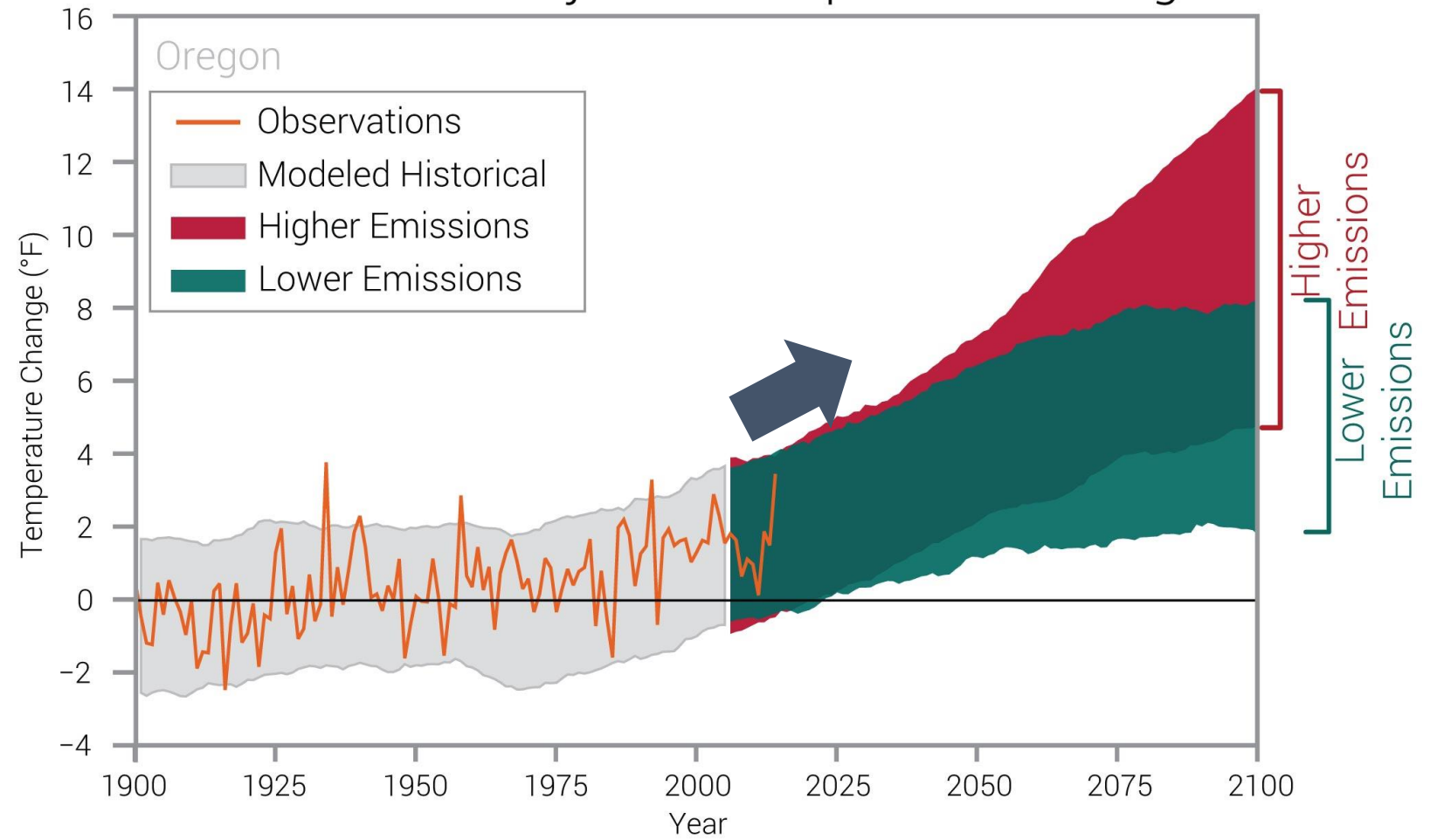
Daily 10m u-wind speed



Wind Change



Observed and Projected Temperature Change



2017 Wildfire Year

| BATS DECEMBER 2015

2. EXTREME FIRE SEASON IN CALIFORNIA: A GLIMPSE INTO THE FUTURE?

JIN-HO YOON, S.-Y. SIMON WANG, ROBERT R. GILLIES, LAWRENCE HIPPS,
BEN KRAVITZ, AND PHILIP J. RASCH

in northern California during 2014 was the second largest in terms of burned areas since
increase in fire risk in California is attributable to human-induced climate change.



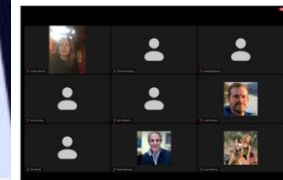
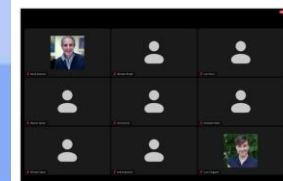
Before



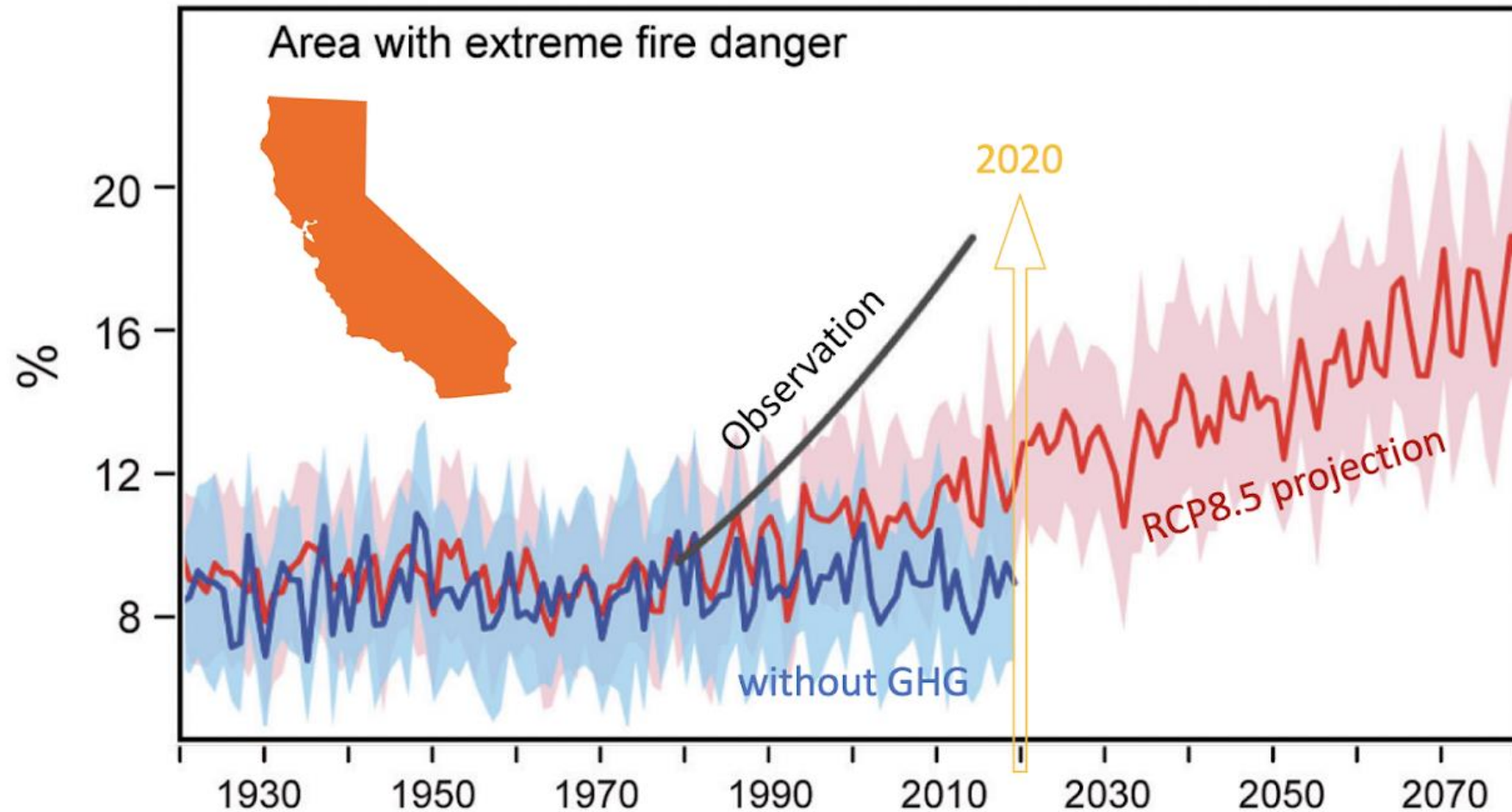
After

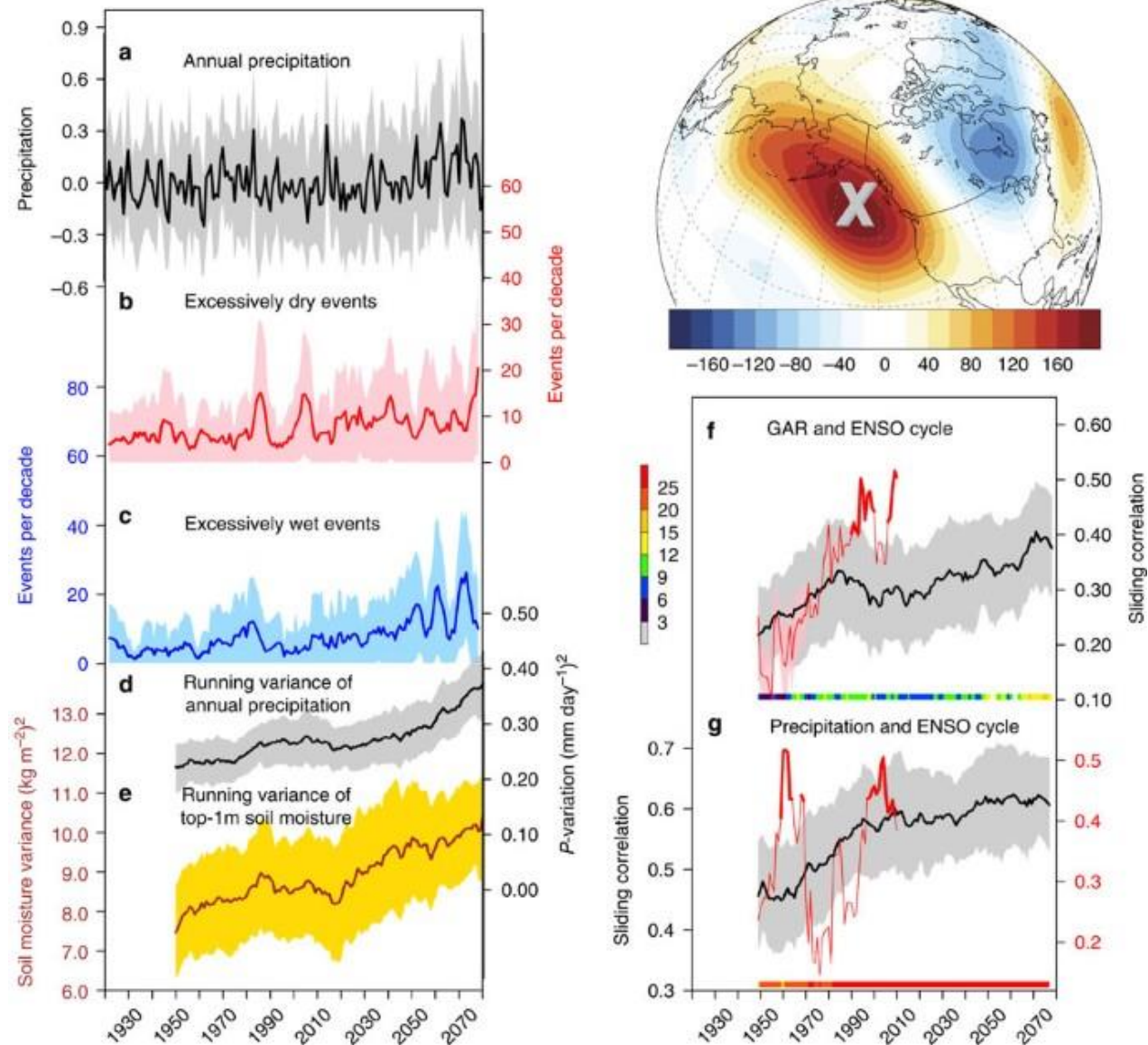
for California: the ever-worsening trend





California: climate models underestimated fire weather trends!





ARTICLE

Received 13 Oct 2014 | Accepted 17 Sep 2015 | Published 21 Oct 2015

DOI: 10.1038/ncomms9657

OPEN

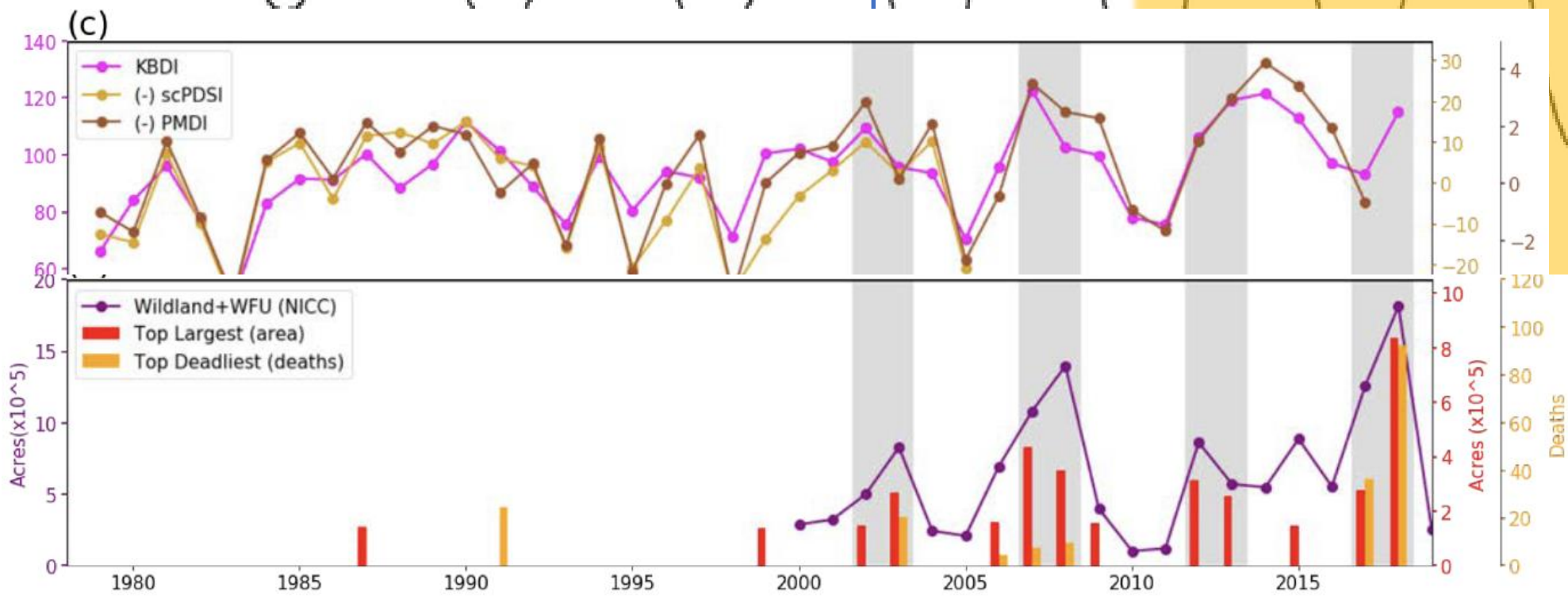
Increasing water cycle extremes in California and in relation to ENSO cycle under global warming

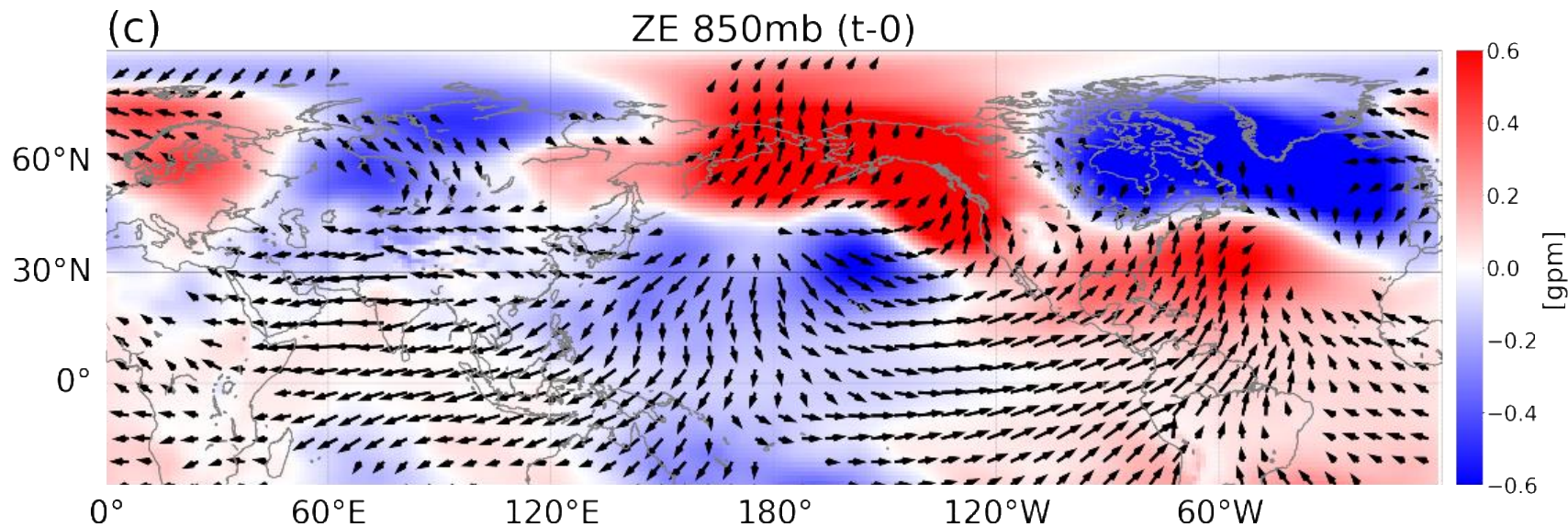
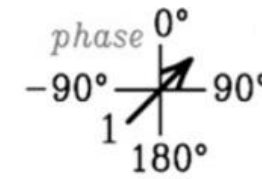
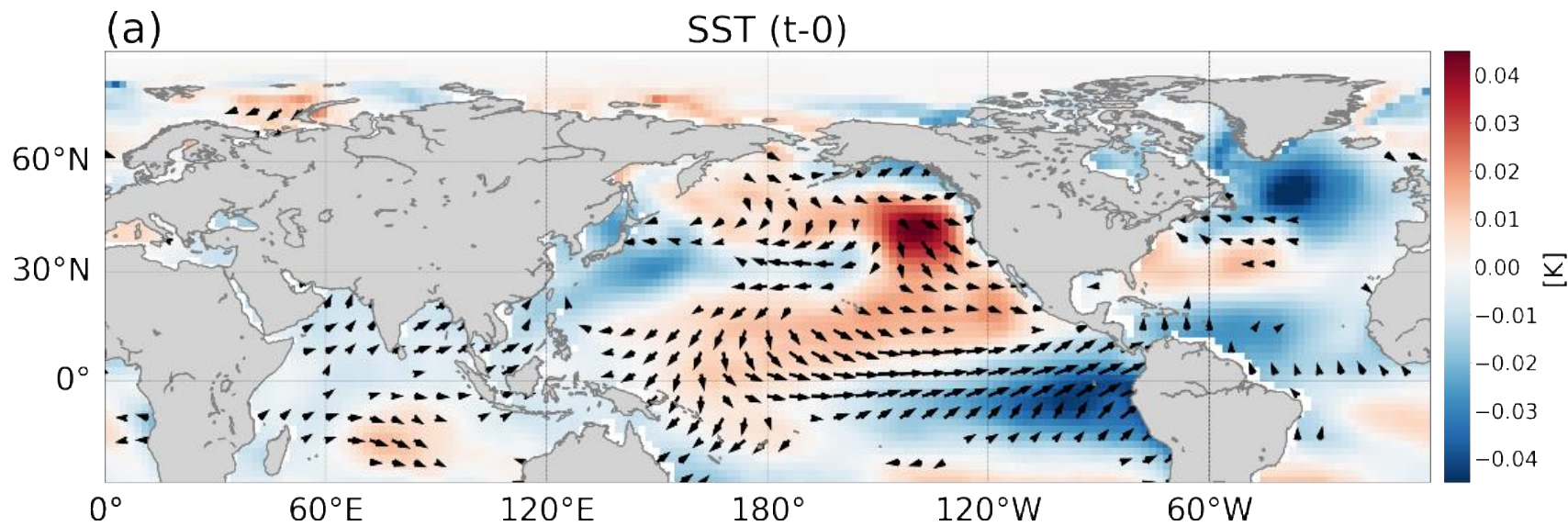
Precipitation variation

El Nino

La Nina precursor

Warming climate





Regression & MTM-SVD spectral coherence based on VHI in California. Regression (shading) and maximum coherence (vector, amplitude is for length and phase is for direction) between VHI in California and SST anomalies.,
c. geopotential height 850mb (zonal mean is removed). Only significant coherences ($p < 0.01$, vectors) are shown. Linear trend is removed and 12 months moving average is applied in advance.

(Son et al., 2020 submitted)



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Climate news, stories, images, & video
(ClimateWatch Magazine)

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How the
System

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How might El Niño affect wildfires in California?

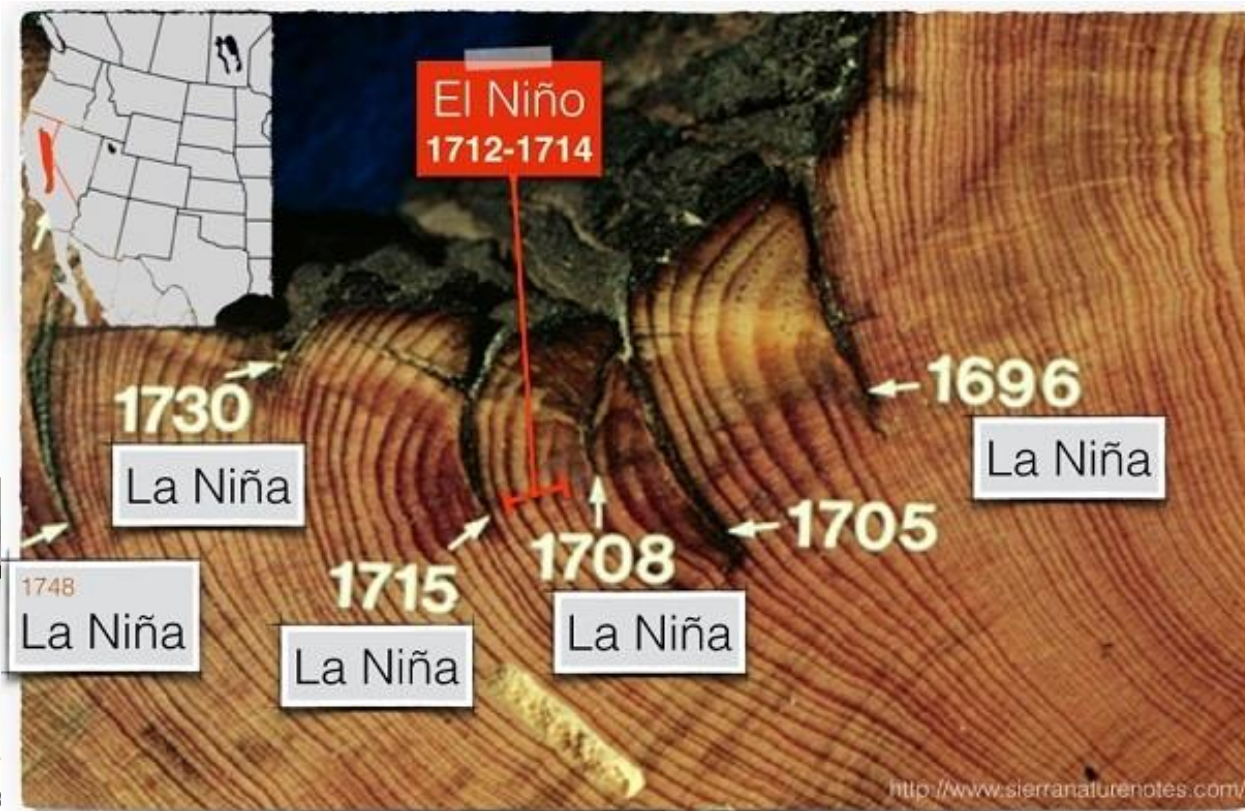
Author: S.-Y. Simon Wang

August 27, 2014



Print

This is a guest post from Simon Wang, Utah Climate Center/Dept. Plants, Soils & Climate, Utah State University





Robert Gehrke: A changing climate demands a holistic response to preventing wildfires — not a partisan one

September 17, 2020

We hear the same thing every time the forests burn. And even if we accept that more could be done to manage the forests, it ignores a critical piece of the puzzle.

“There is no denying that the fire season has prolonged and is almost year-round in some parts of the West,” Simon Wang, a professor of climate dynamics at Utah State University, told me Wednesday. “Climate change is making this so-called fire weather occur more frequently, to last long, and each week it prolongs it stretches the forest [making it] easier to burn.”

Over wildfire causes out science vs.

Michael Hiltzik | BUSINESS COLUMNIST

September 15, 2020 | 6 AM

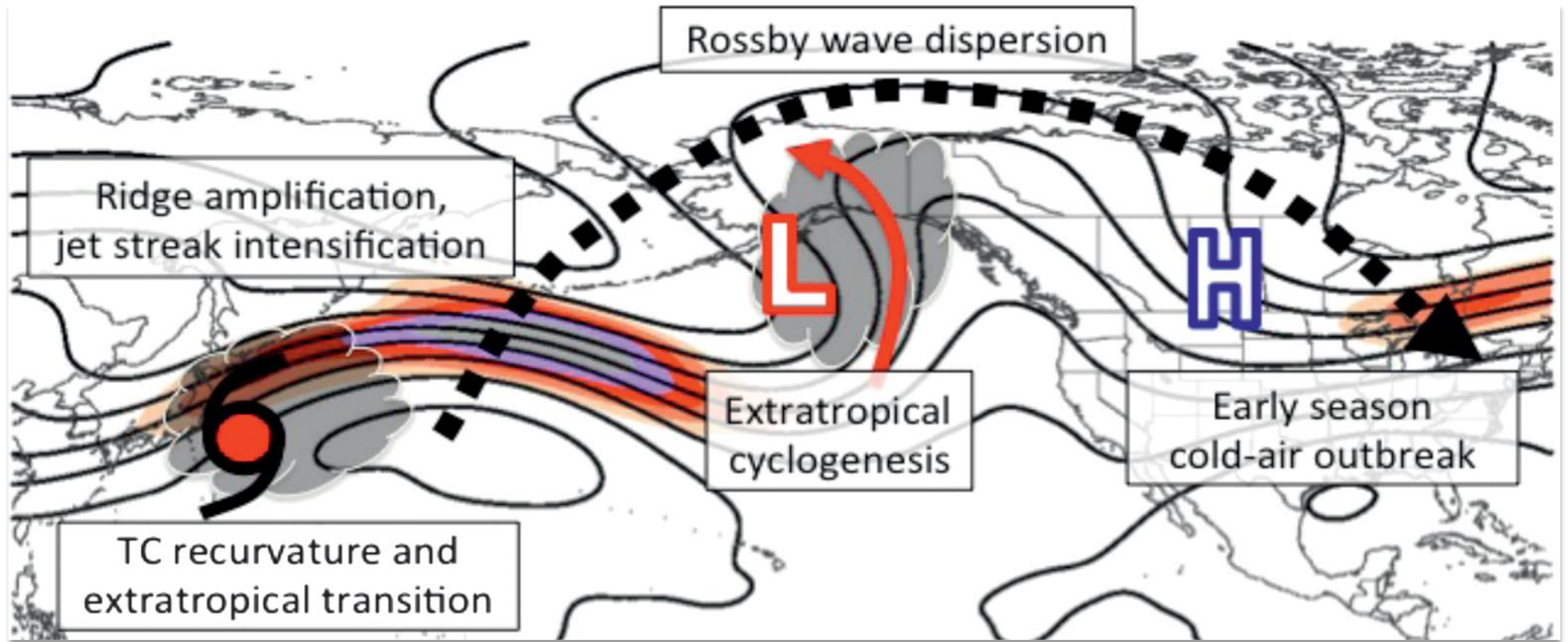
management, that’s only one side of the fire dynamics at Utah State University.

It’s not just ignition triggers such as lightning, but “every time we have a trigger, that’s a trigger, and those conditions under climate change make large

the ability to manage forests on its own is limited. About 97% of forest land within the state is managed by the federal government, and only 3% by the state.



December 2020



Archambault et al. 2013

12 days!

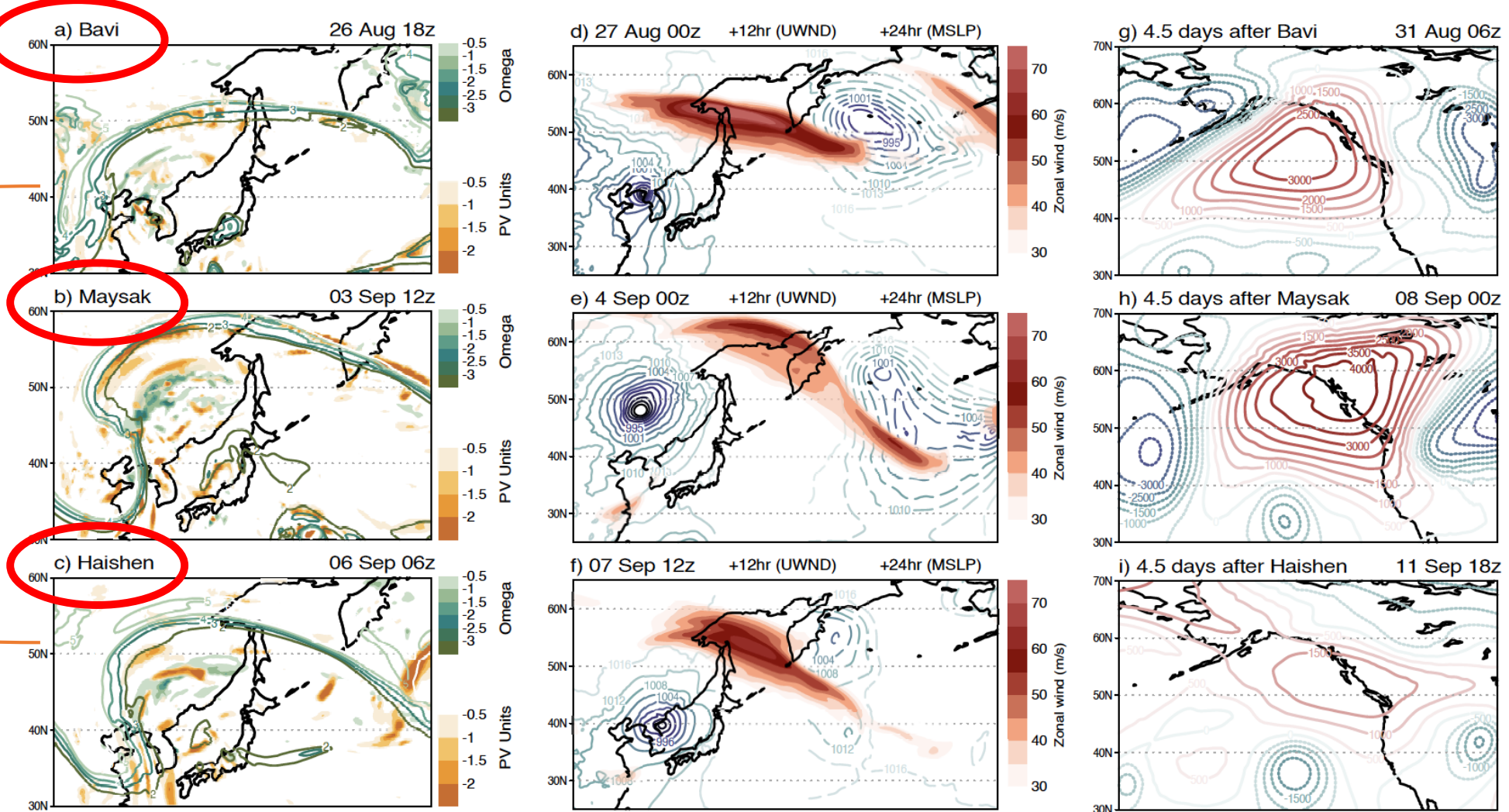


Figure 2. (a-c) Potential vorticity units (green contours), potential vorticity advection (orange shading) and omega (green shading) for typhoon Bavi, Maysak and Haishen. (d-f) Typhoon mean sea level pressure (MSLP), zonal wind at 250hPa 12 hours after the displayed MSLP, and downstream MSLP 24 hours after the typhoon's MSLP time step. (g-i) HGT₂₅₀ four and a half days after the Typhoon time step in panels a-c.

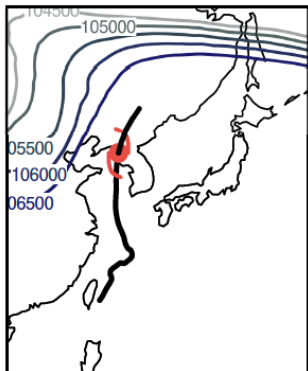
1st typhoon

2nd typhoon

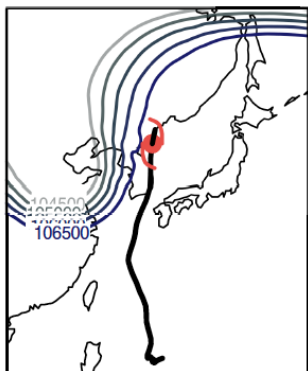
3rd typhoon

a) Typhoon tracks

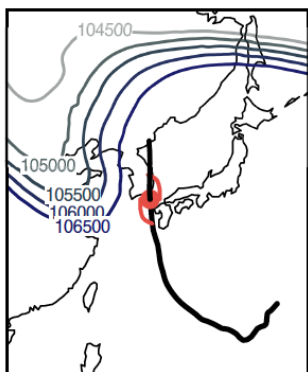
Bavi: 21 Aug 18z - 27 Aug 12z



Maysak: 28 Aug 00z - 03 Sep 03z

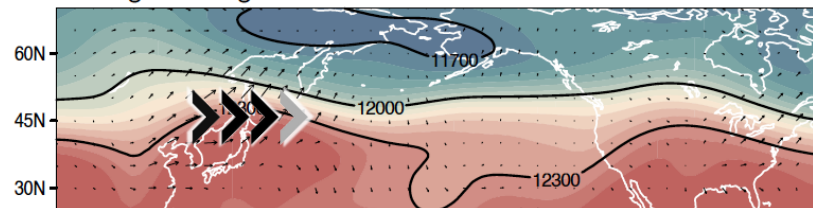


Haishen: 31 Aug 06z - 07 Sep 09z

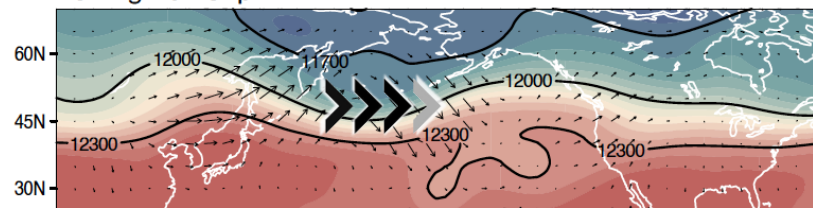


b) Wave activity flux

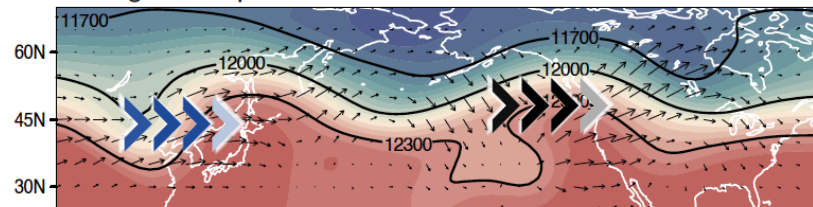
25 Aug - 30 Aug



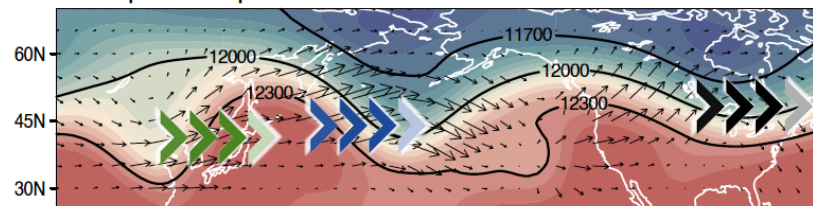
28 Aug - 02 Sep



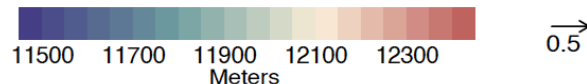
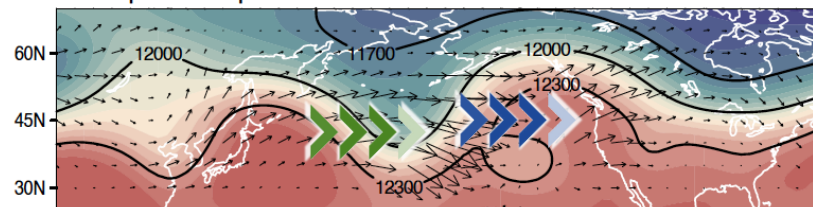
31 Aug - 05 Sep



03 Sep - 08 Sep



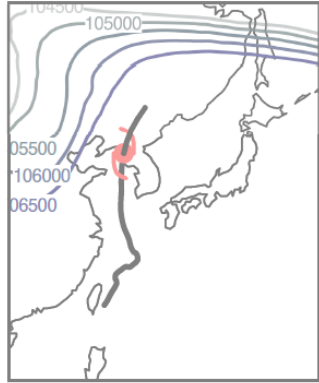
06 Sep - 11 Sep



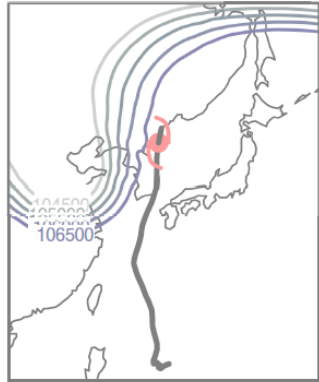
5-day mean
of evolution

a) Typhoon tracks

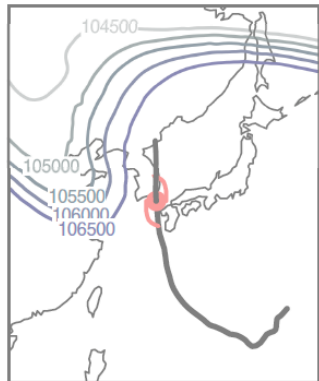
Bavi: 21 Aug 18z - 27 Aug 12z



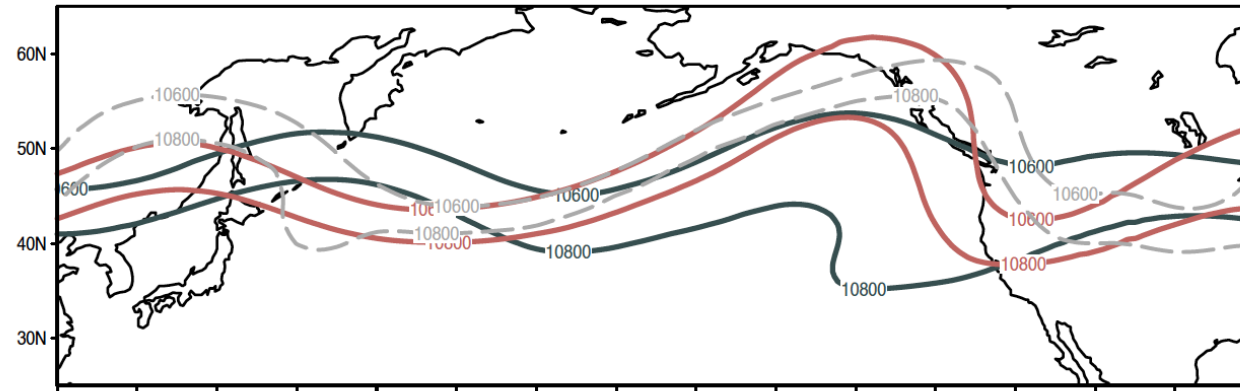
Maysak: 28 Aug 00z - 03 Sep 03z



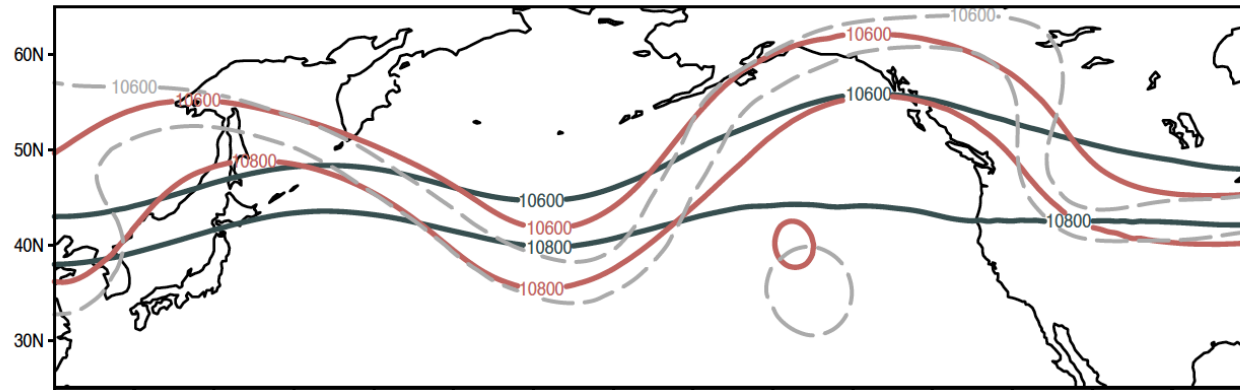
Haishen: 31 Aug 06z - 07 Sep 09z



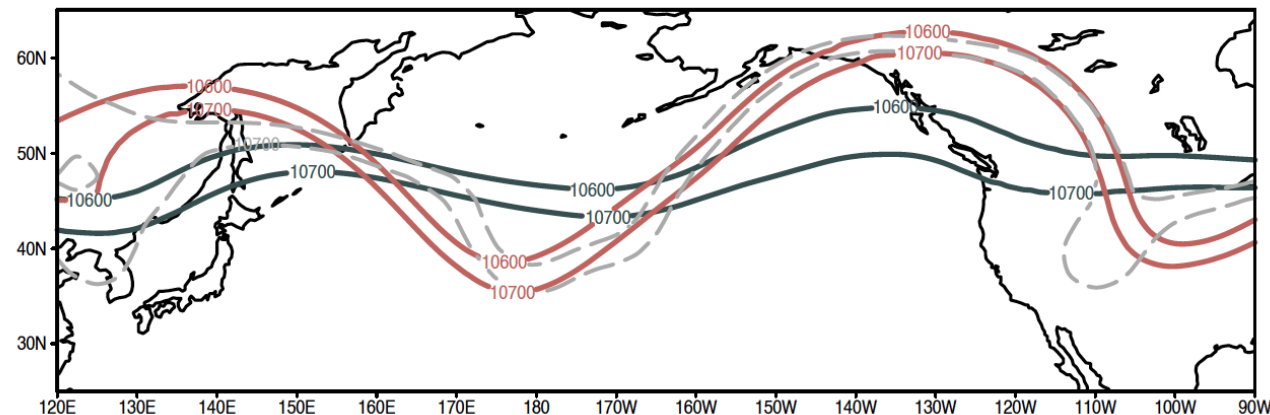
a) Typhoon Bavi upper level response: 31 Aug 12z



b) Typhoon Maysak upper level response: 08 Sep 00z



c) Typhoon Haishen upper level response: 09 Sep 00z



— With typhoon

— Without typhoon

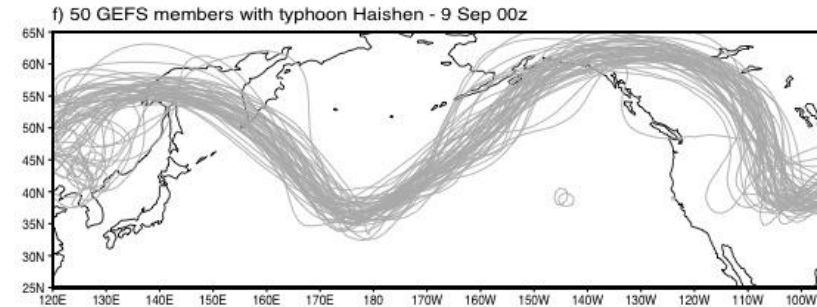
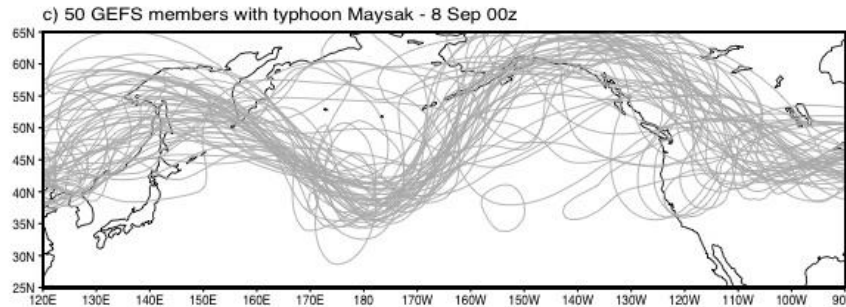
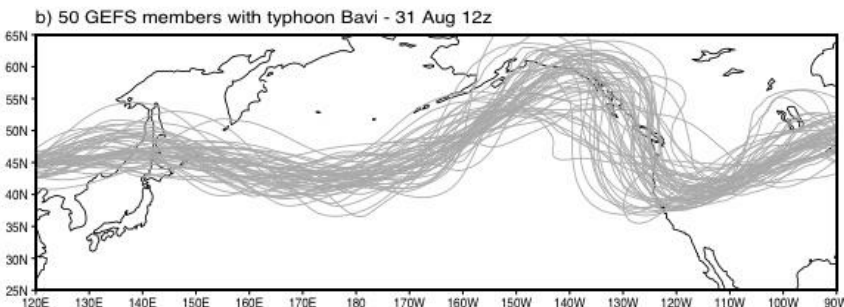
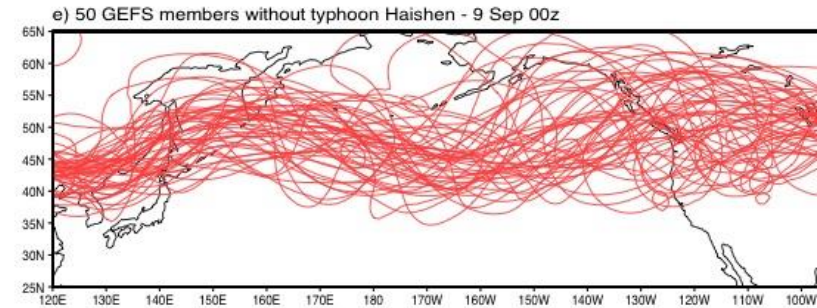
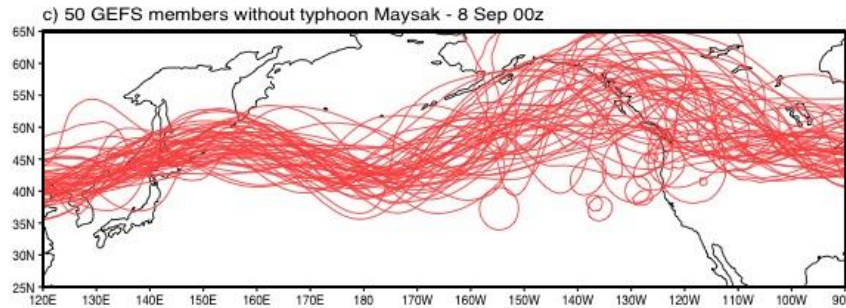
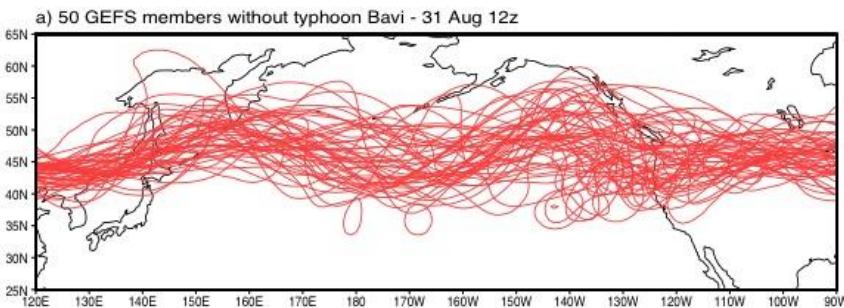
- - - Observation

GEFS forecast

forecast data
evaluated consists
of 4 time steps x
17 days x 21
members, which
results in 1,428
possible members
for the analysis

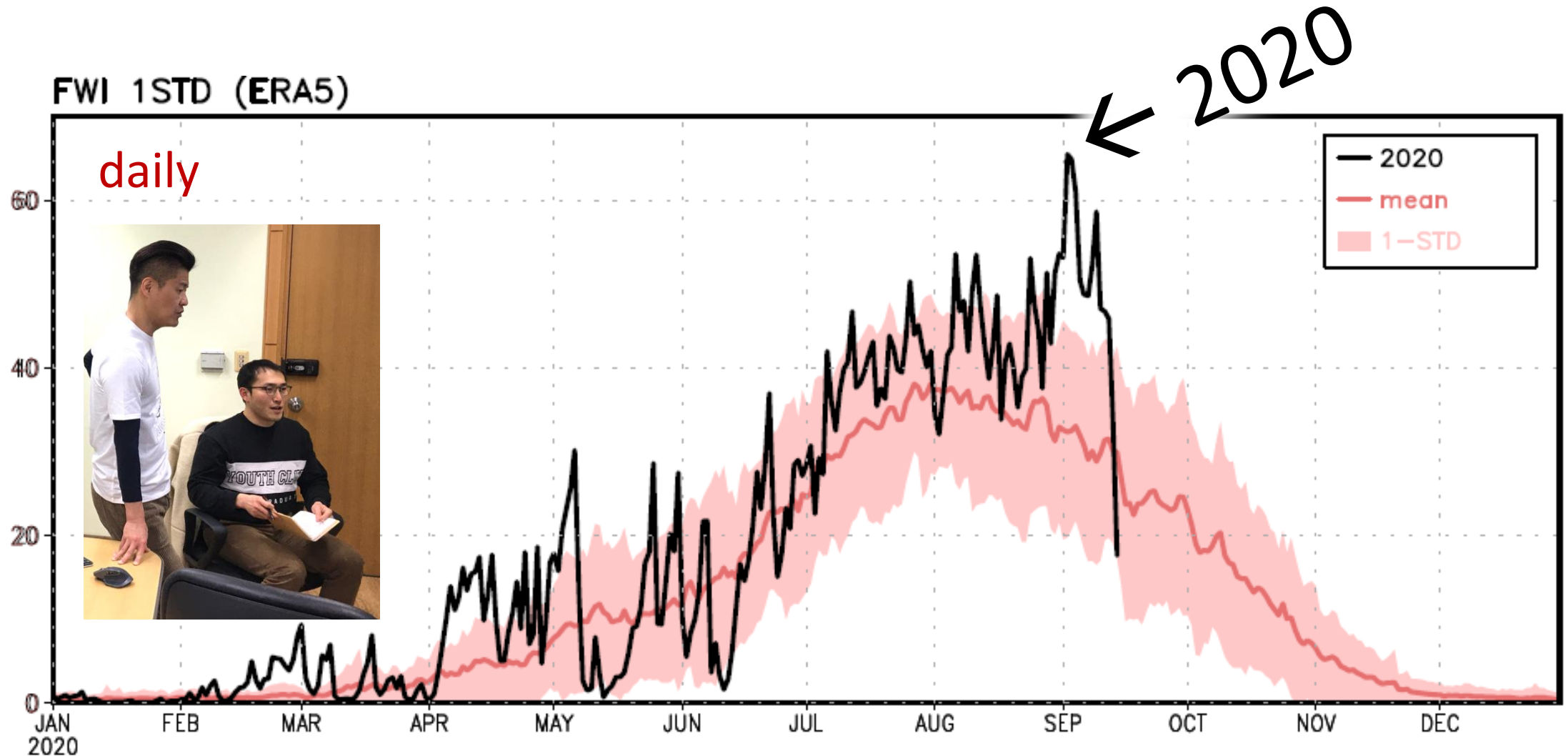
GEFS forecast

Without typhoon

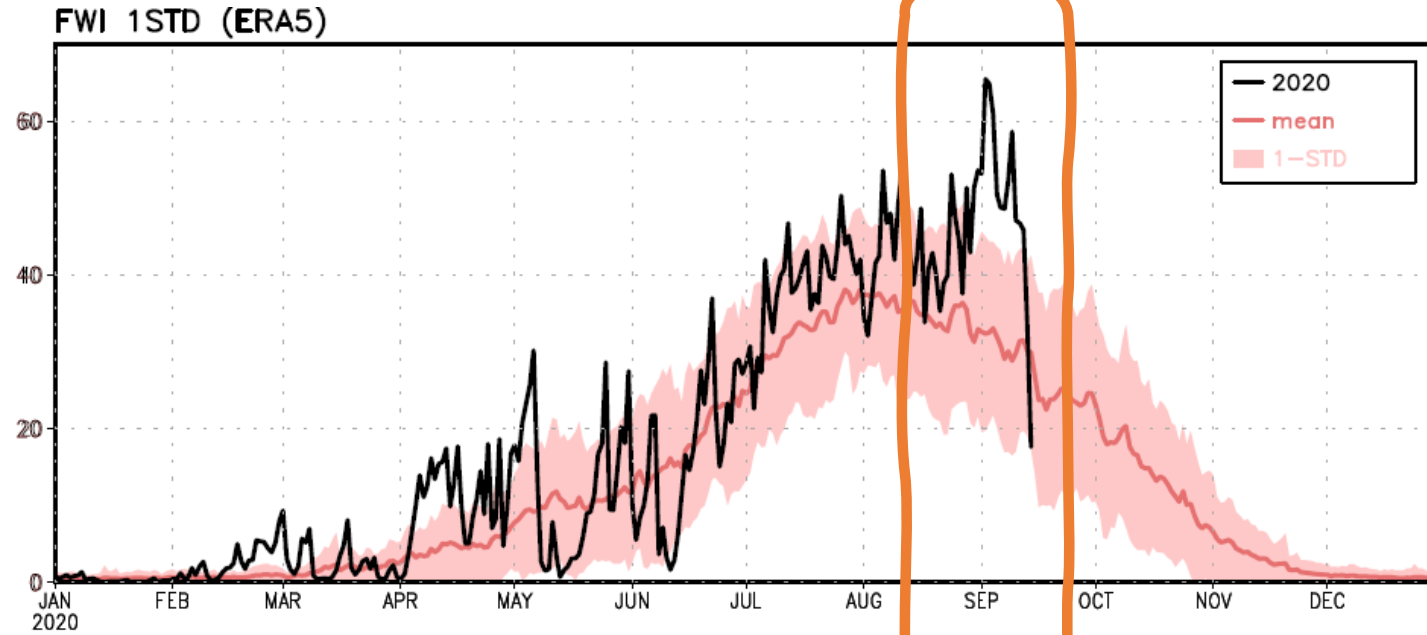


With typhoon

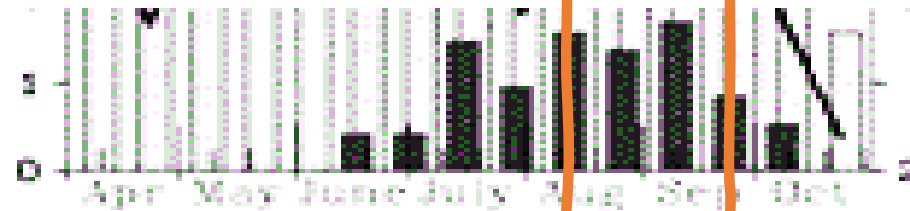
ERA5's Fire Weather Index: Oregon



End of fire season

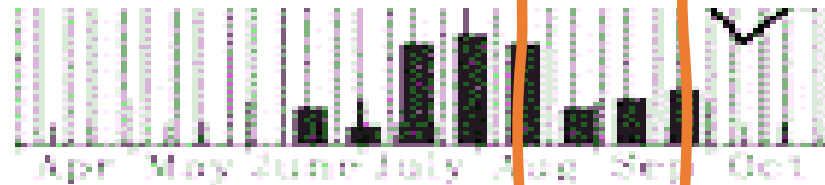


Typhoon count: **Japan**



1979-2002

Korea



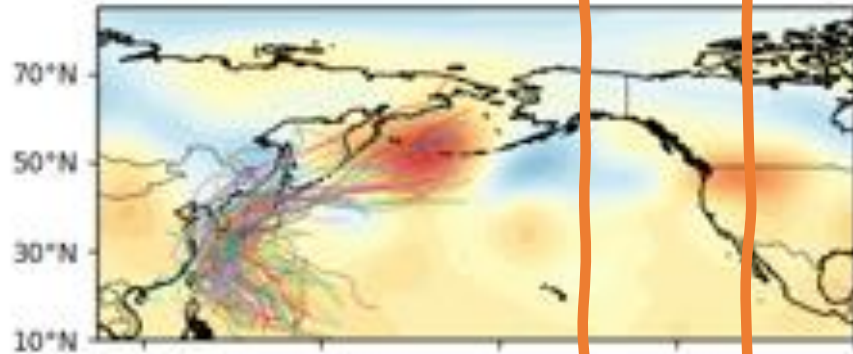
Downstream response from TC pressure?

Downstream response to central pressure

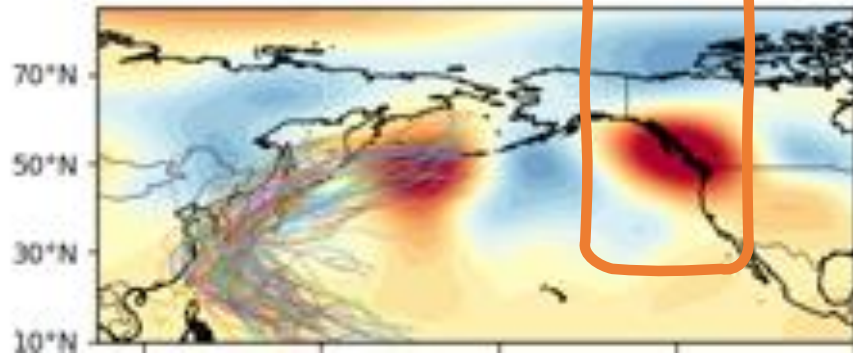
970 < TC < 990 hPa : n=78



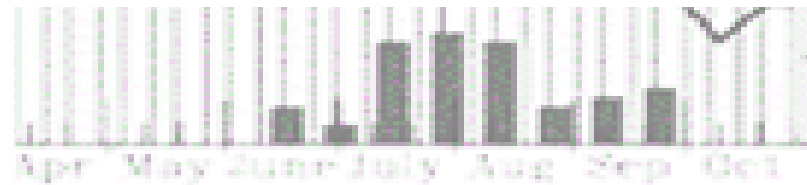
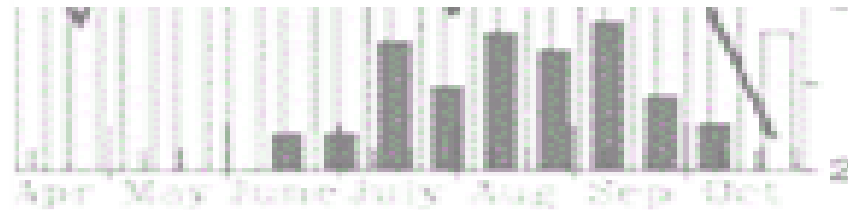
950 < TC < 970 hPa : n=71



920 < TC < 950 hPa : n=78

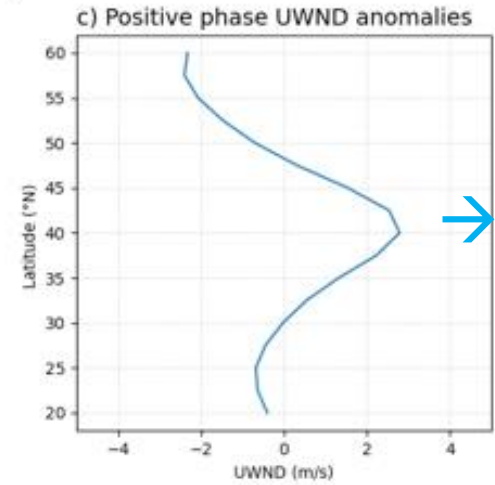
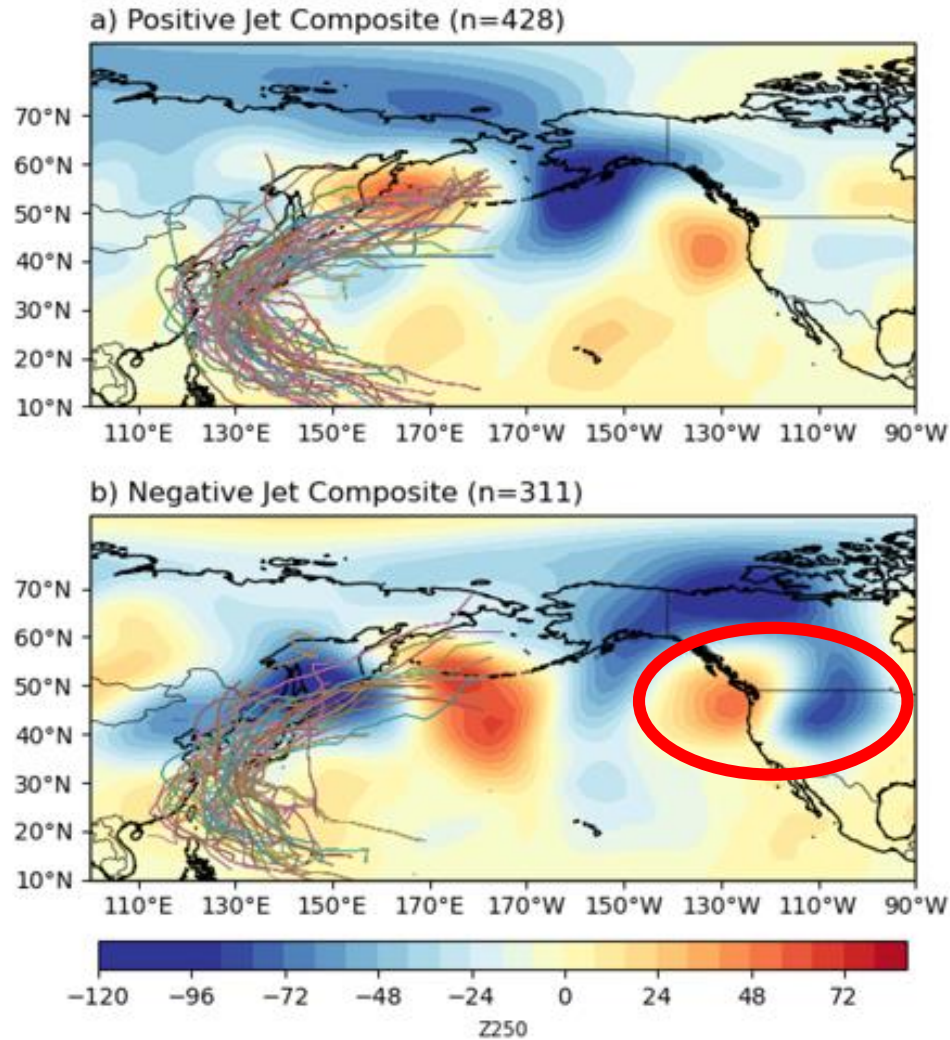


Stronger typhoon, stronger ridge
(worse fire weather)

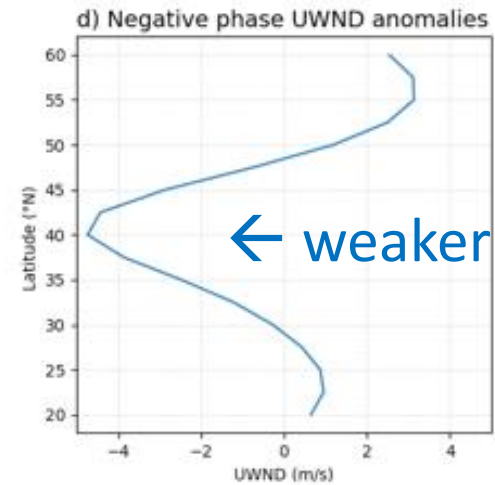


Jet stream influence

250 hPa composites from zonal jet index
HGT 250 (+96hrs) - HGT 250 (0hrs)



→ stronger jet →

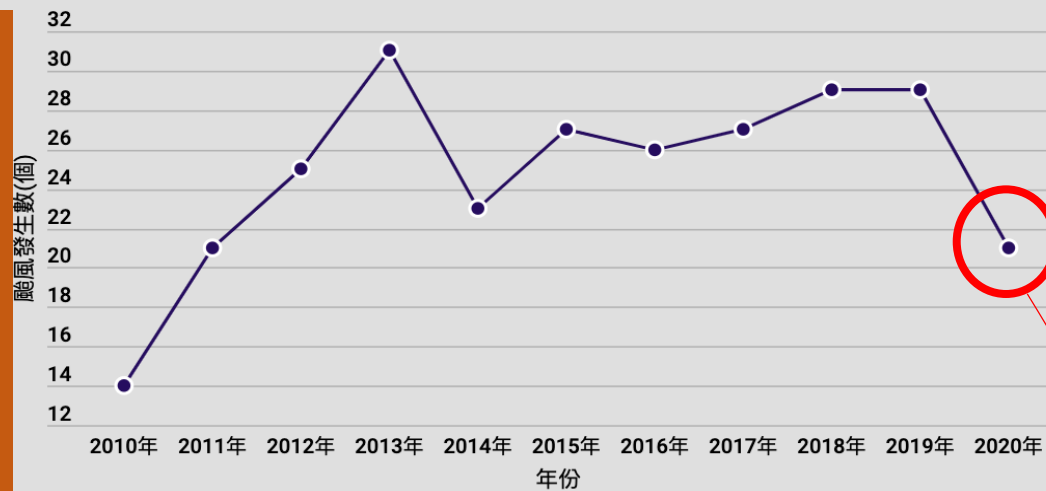


← weaker jet ←

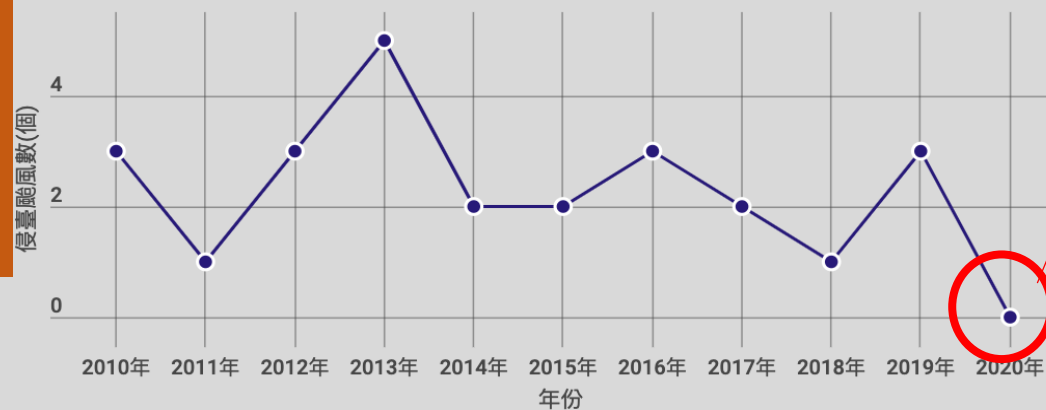
2020

旱象

近10年北太平洋西部海域每年颱風生成數 (表一)



近10年北太平洋西部海域侵台颱風數量 (表三)



2020

旱象肆虐下，
台灣也會野火
氾濫嗎？



每年41起森林火災 林務局祭獎金鼓勵通報

最新更新：2019/09/28 16:52



| 乾燥季節易火災 通報林火拿獎金

2019/09/27

 行政院農業委員會林務局

更新時間：2019/10/25 09:10



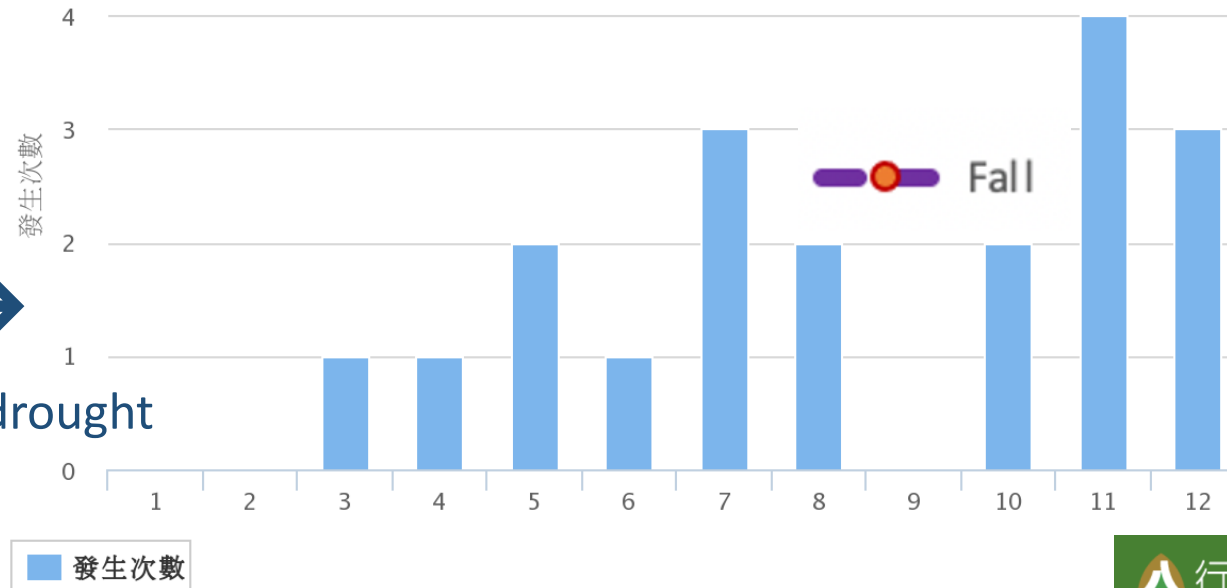
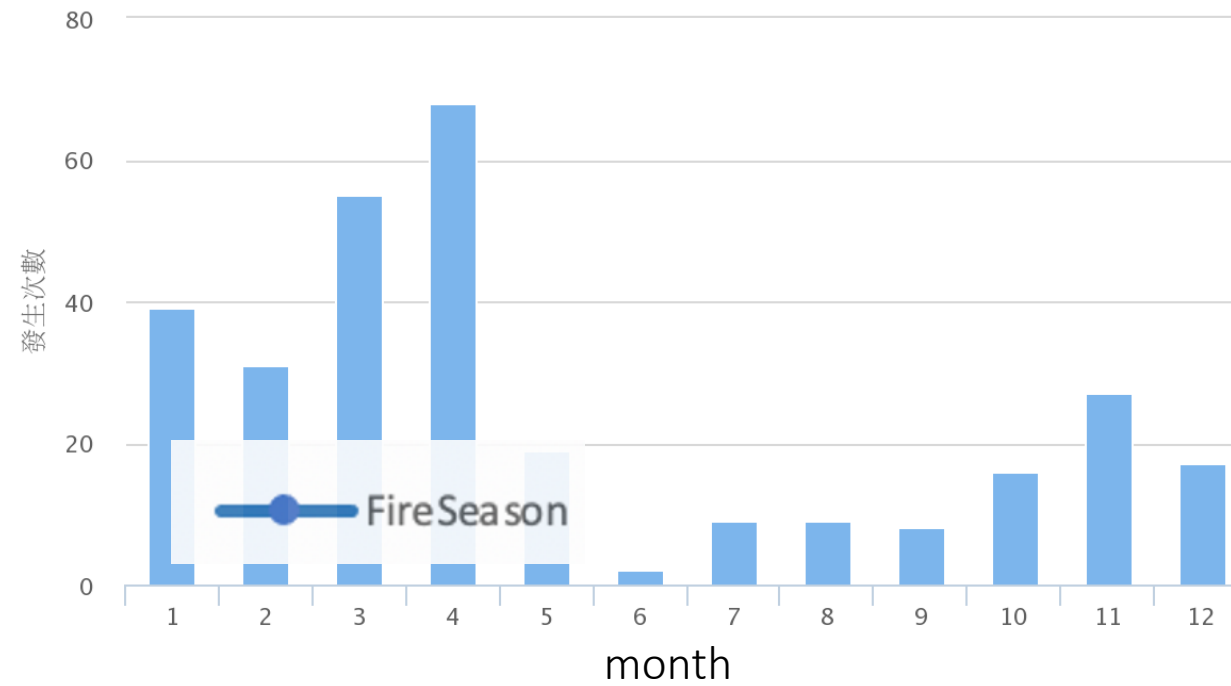
空勤總隊出動吊掛水袋，協助灌灑，以免梨山森林火災災情擴大。（東勢林管處提供）

2020/06/26 19:05

臺灣多數的森林火災來自人為，包含紮營野炊、打獵留下的餘火沒有徹底熄滅，7、8月偶爾有雷擊引火，但雨季讓火災不容易發展

各月份森林火災發生次數

統計時間:全部

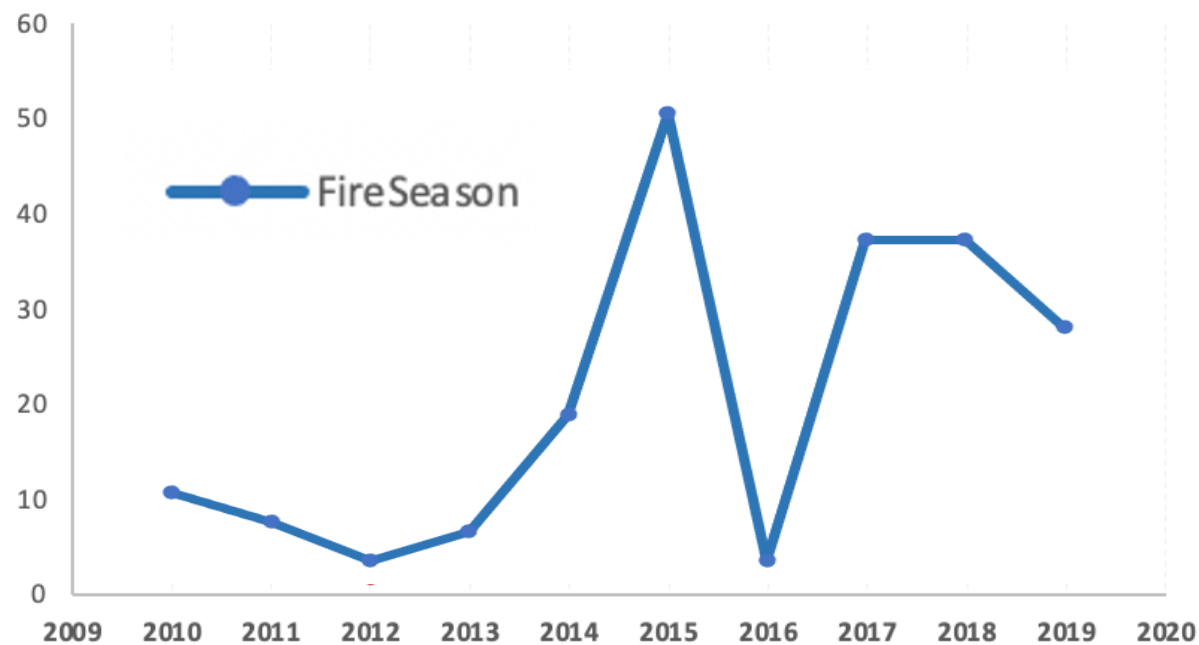


2016 →

following a big drought

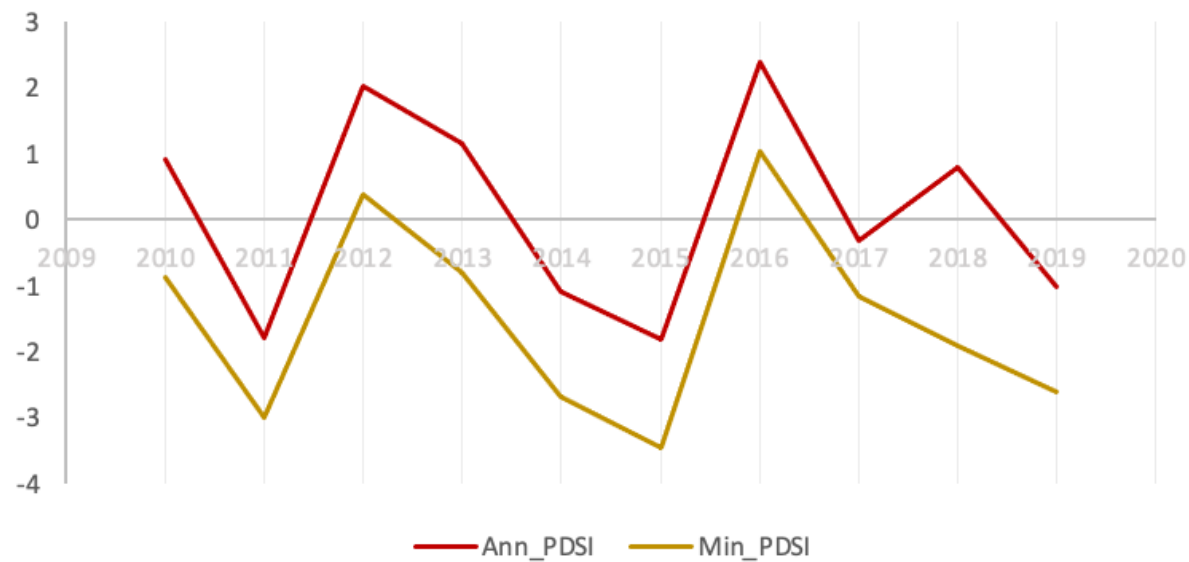


Fire occurrence



← 火災次數

Drought severity

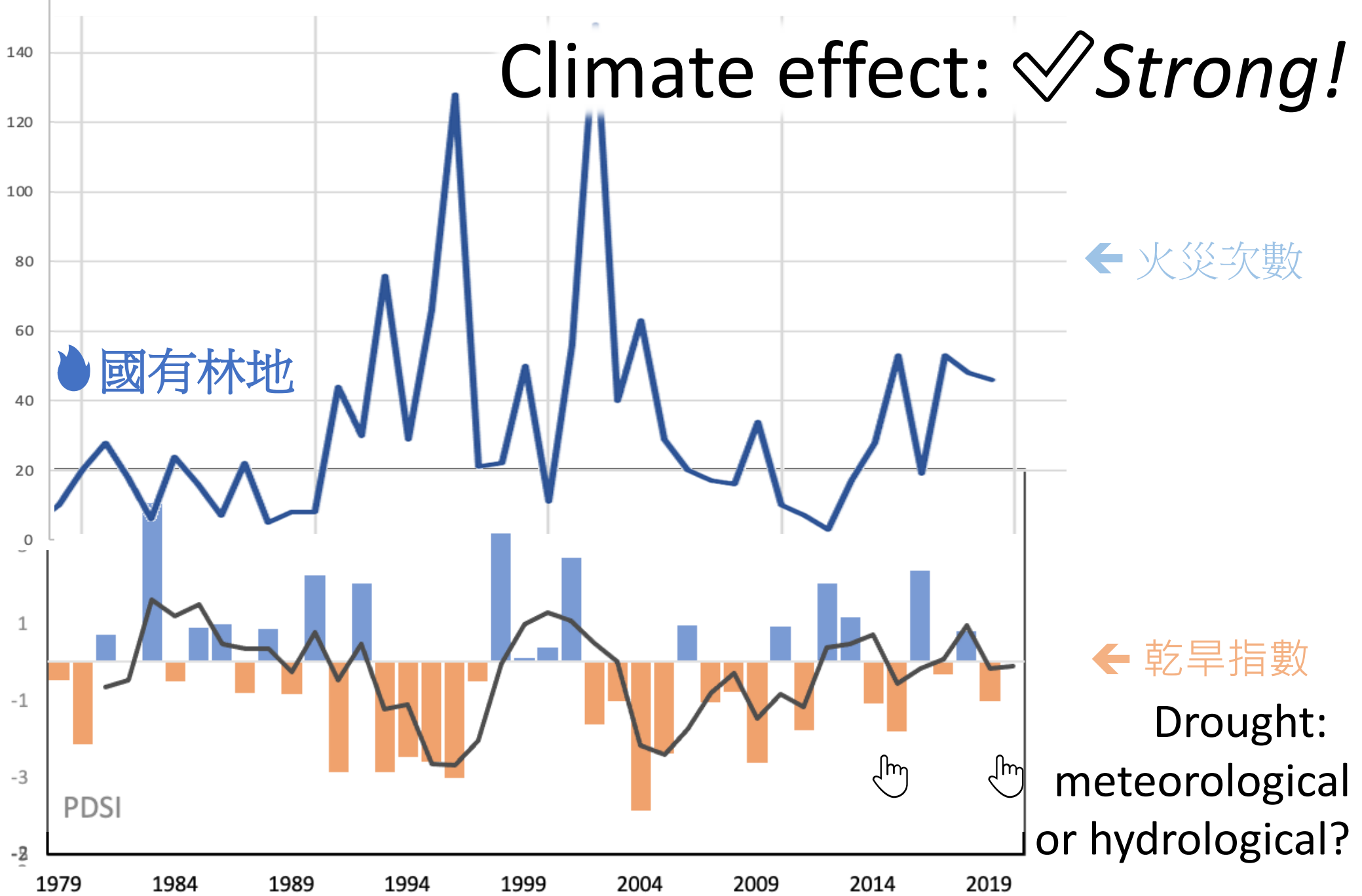


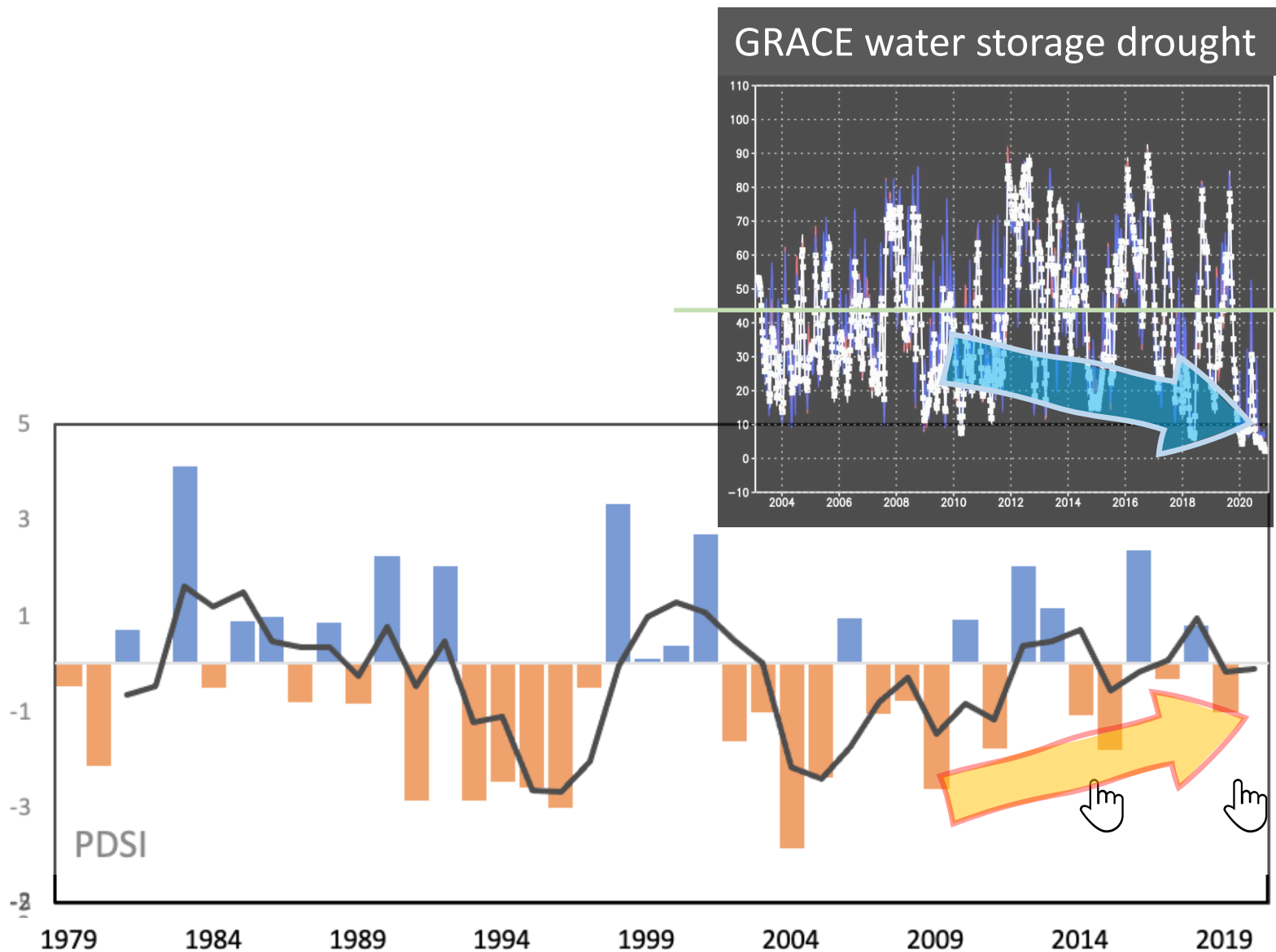
← 乾旱指數

↖ 2002 梨山大火！



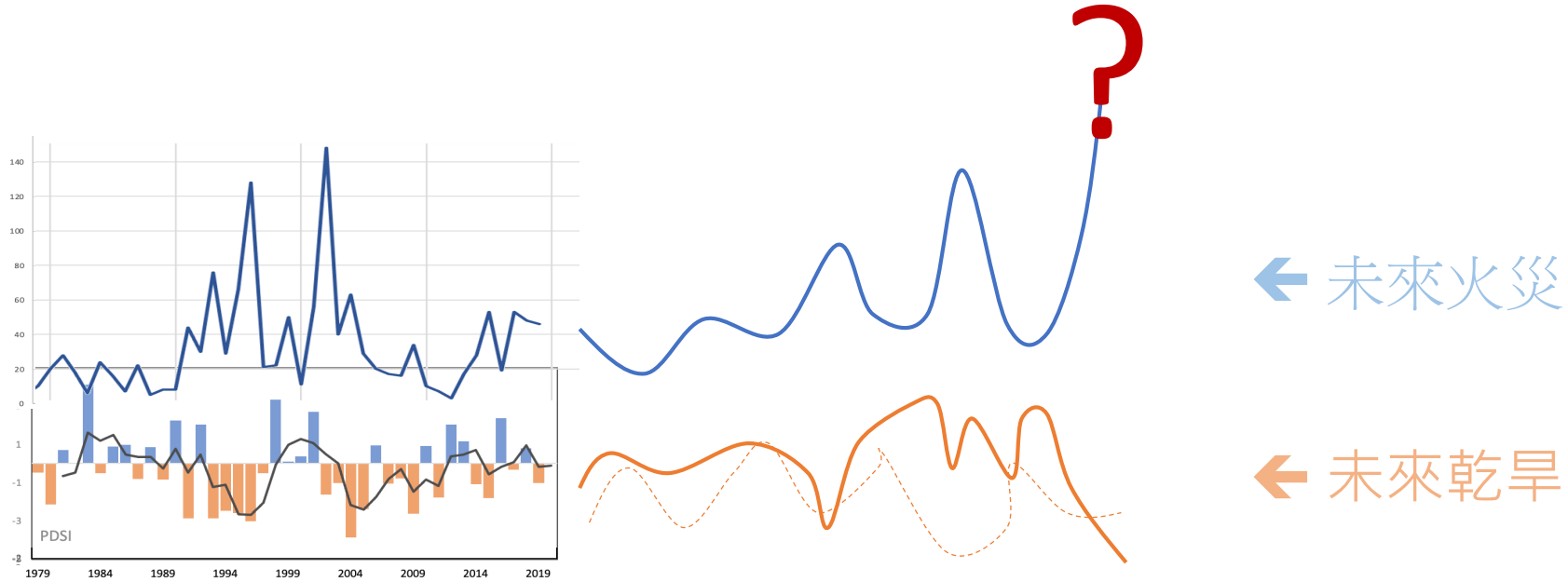
Climate effect: ✓ *Strong!*





← 乾旱指數

Drought:
meteorological
or hydrological?



Future research: 

Assessing future drought-fire risk in Taiwan

真燒起來了？

UDN 聯合新聞網



新聞
WS HD

石門水庫燃燒燄劑 人工增雨盼為台"解

人工增雨放炮圖為目前降雨環境，今日熱帶雲系自南海向臺灣附近伸展，中南部降雨機會增加，降雨區有機會涵蓋曾文集水區上游一帶，今上午 ...

2 weeks ago

Effect of cloud seeding: How to quantify it?



人工增雨大多在春季實施 可增加10%降雨量

(球員兼裁判？)

Cloud seeding to enhance precipitation and weather modification research current Status

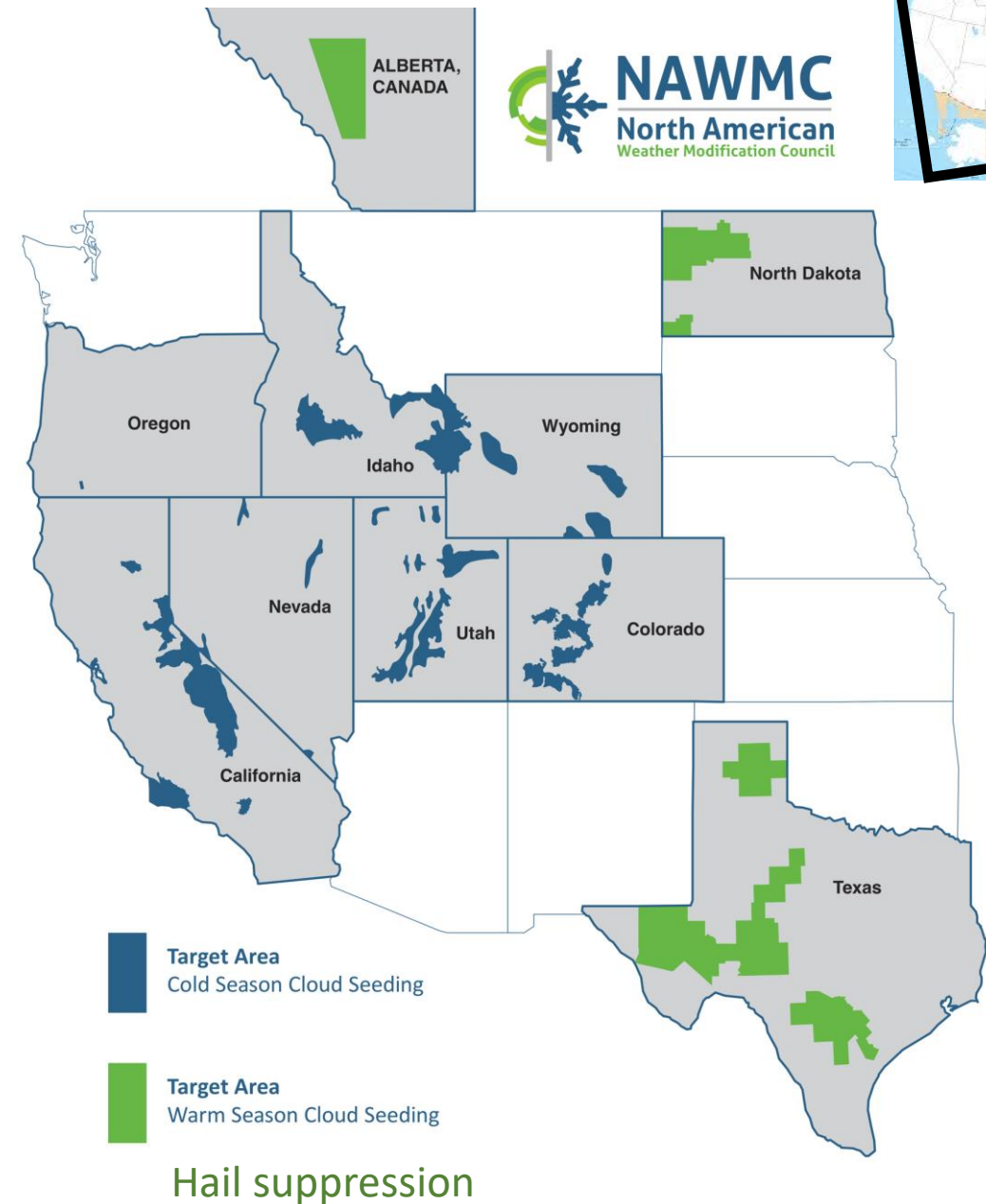


Binod Pokharel
*Utah State University,
Logan, Utah, USA*

Current Cloud Seeding Program In USA

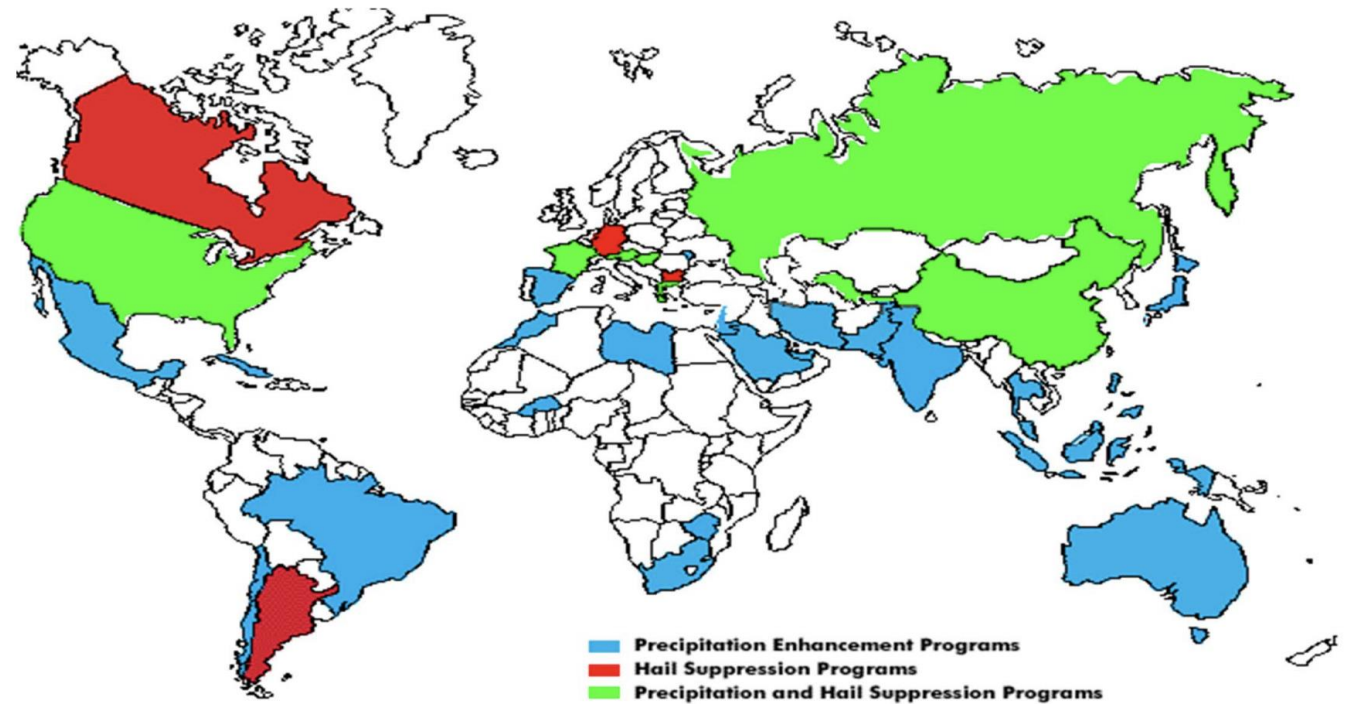
Hygroscopic Seeding

Glaciogenic Seeding

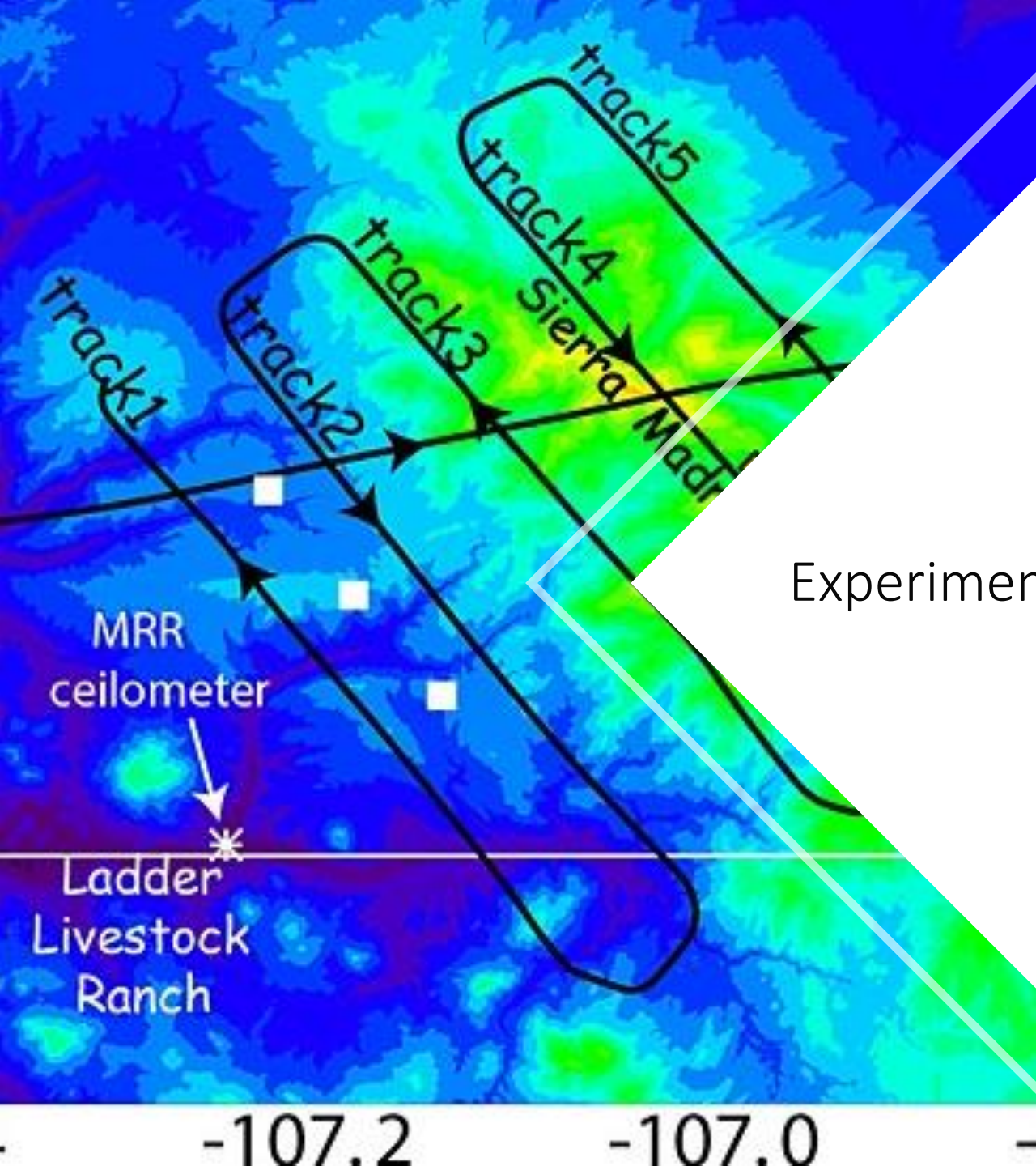


Around the
Globe?

Weather Modification Around the World 56 Countries with active cloud seeding programs



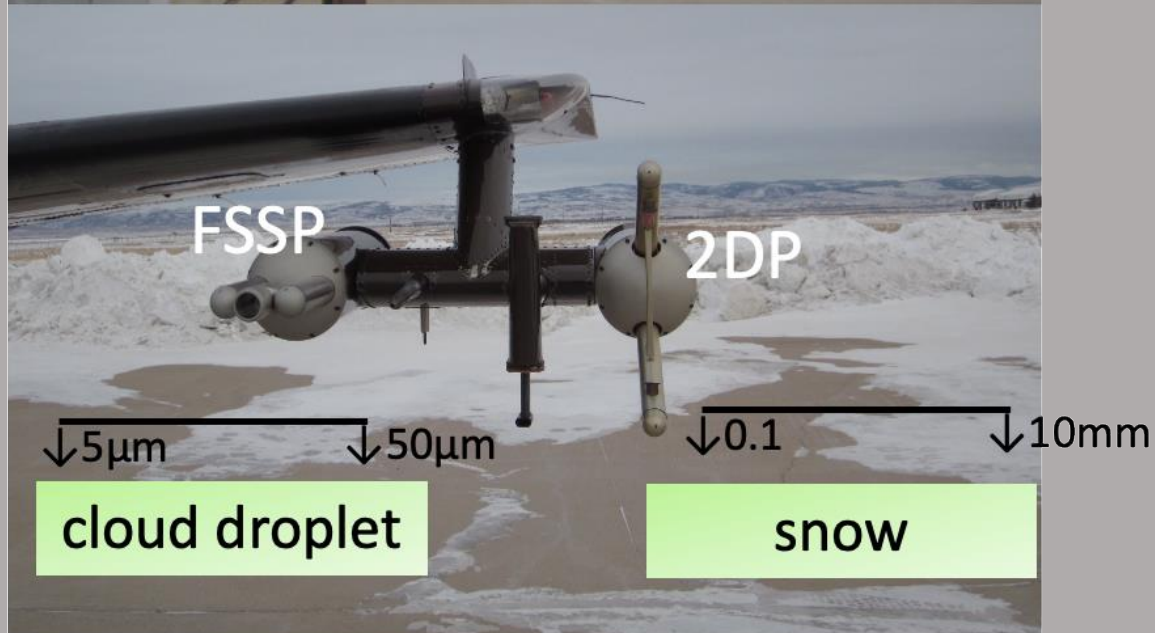
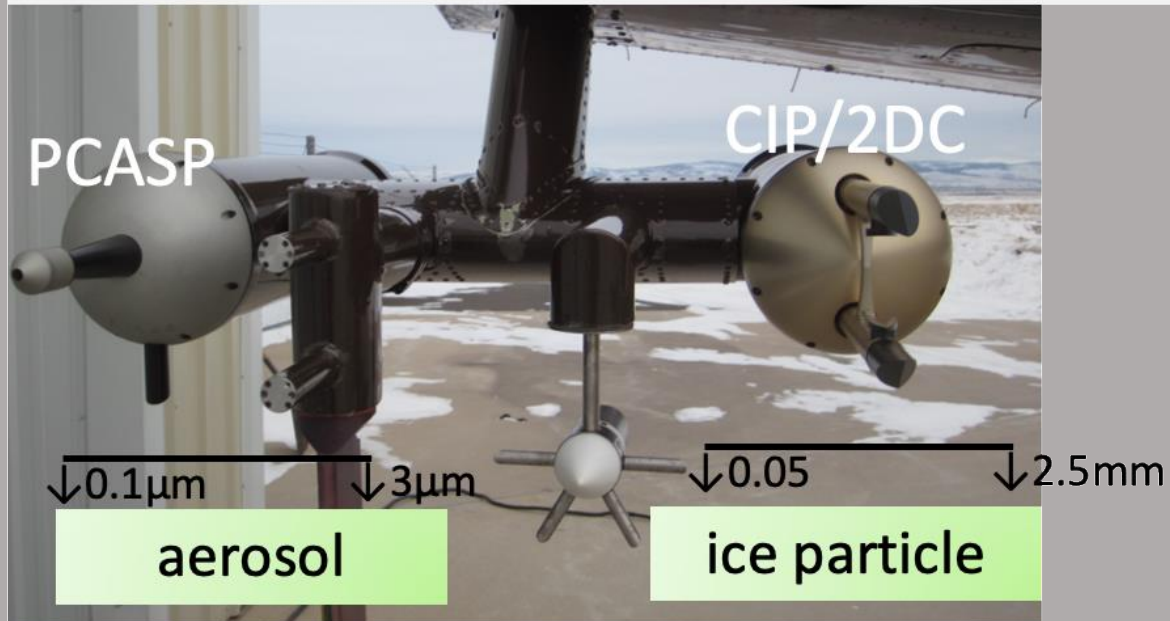
(WMO, 2016)



Experimental Design



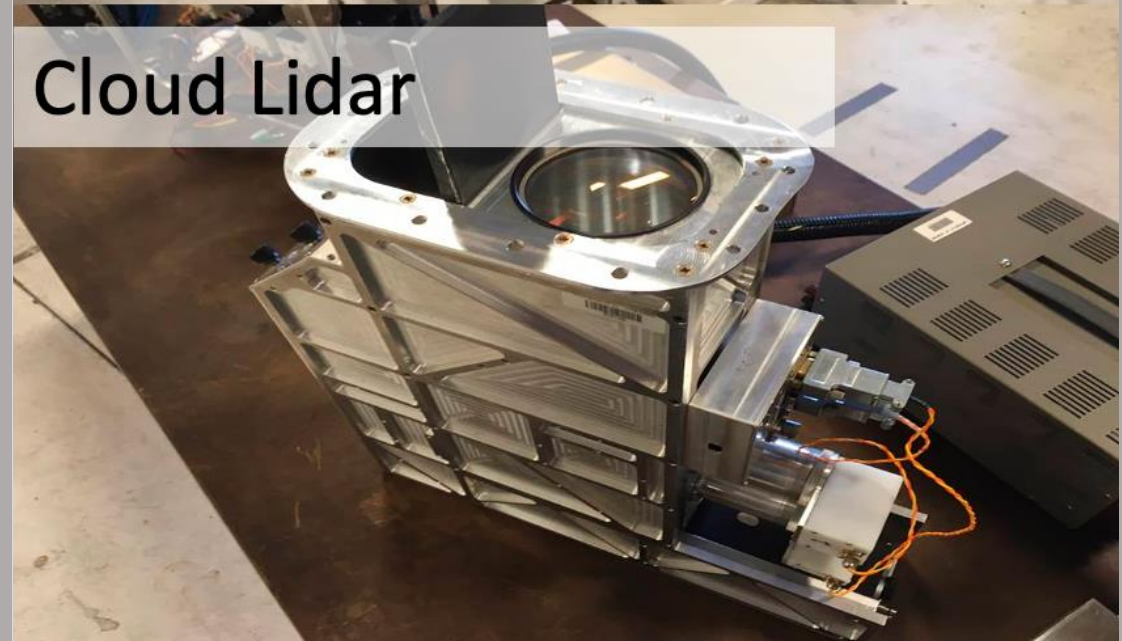
Airborne instruments



Cloud Radar



Cloud Lidar



Ground-based instruments



Micro-rain-radar (MRR)



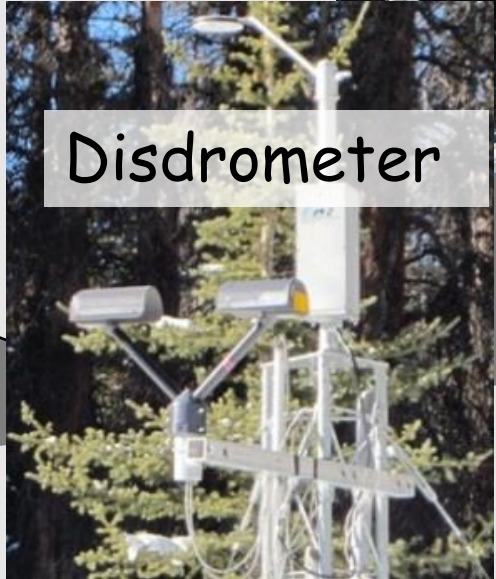
Doppler-on-wheel (DOW) radar



radiosonde



radiometer

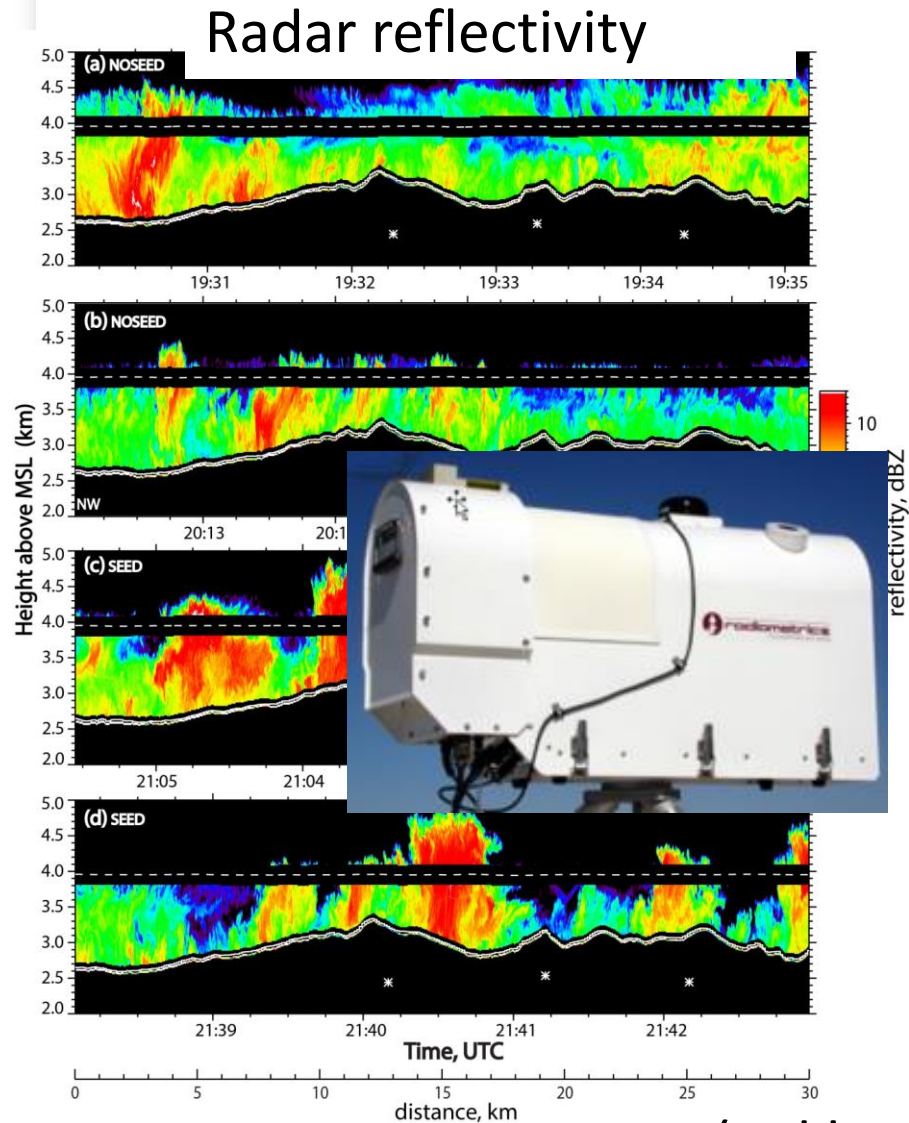


Disdrometer

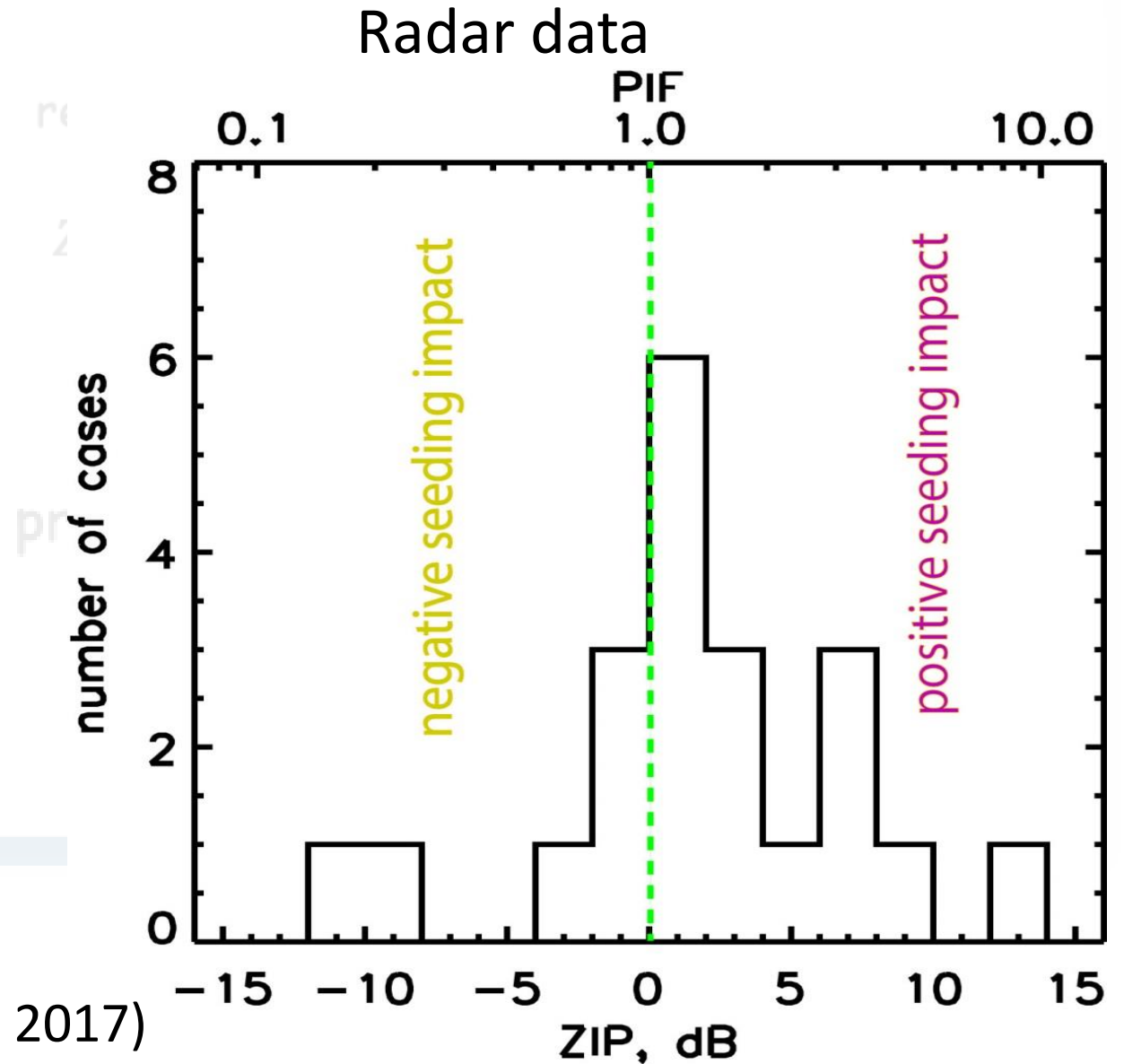


Snow gauges

Detecting Seeding Impact



(Pokharel et al., 2017)

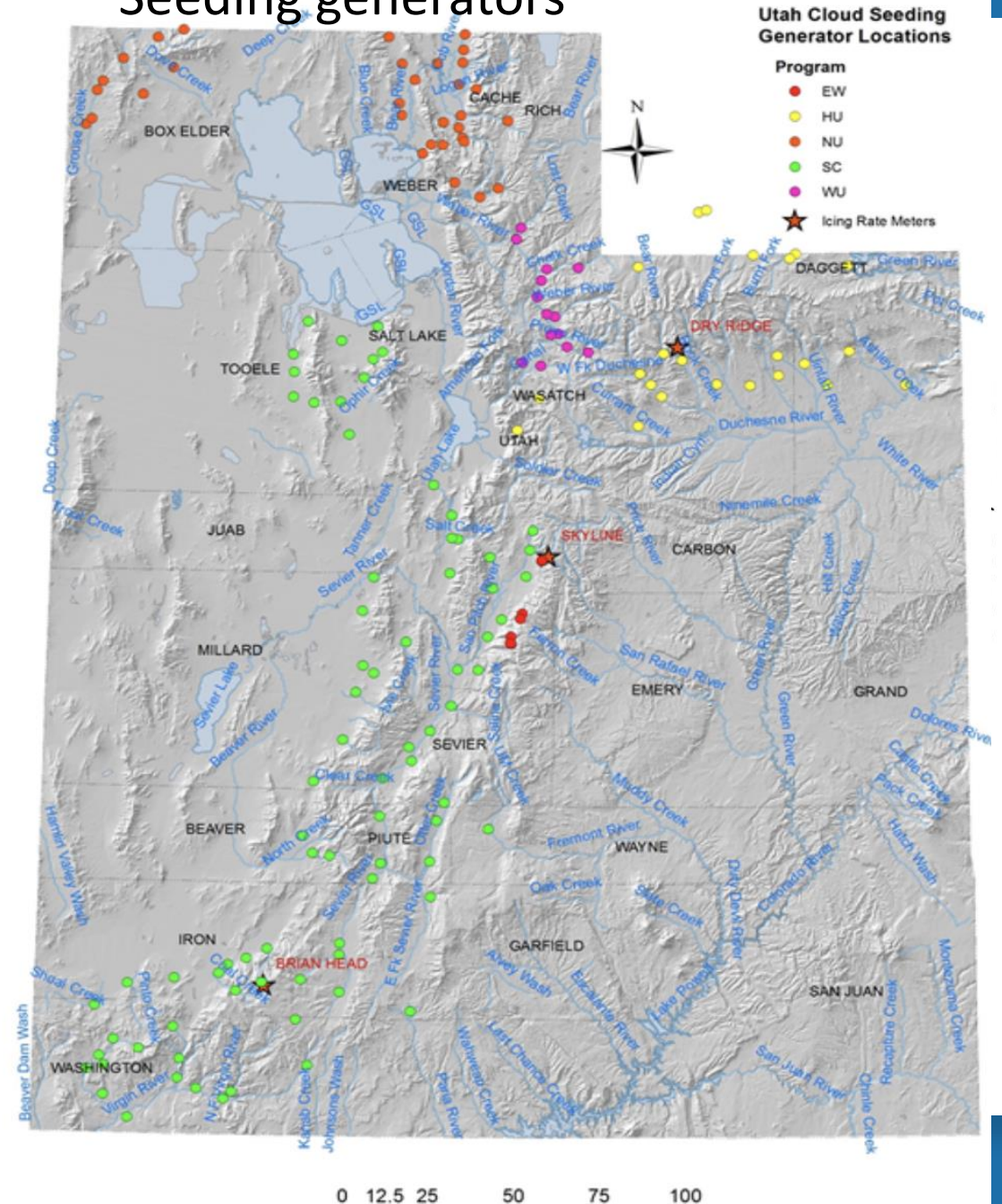


Cloud Seeding in Utah

Research-for-Operation:

- How often does the suitable condition exist?
- How will that change in future?

Seeding generators

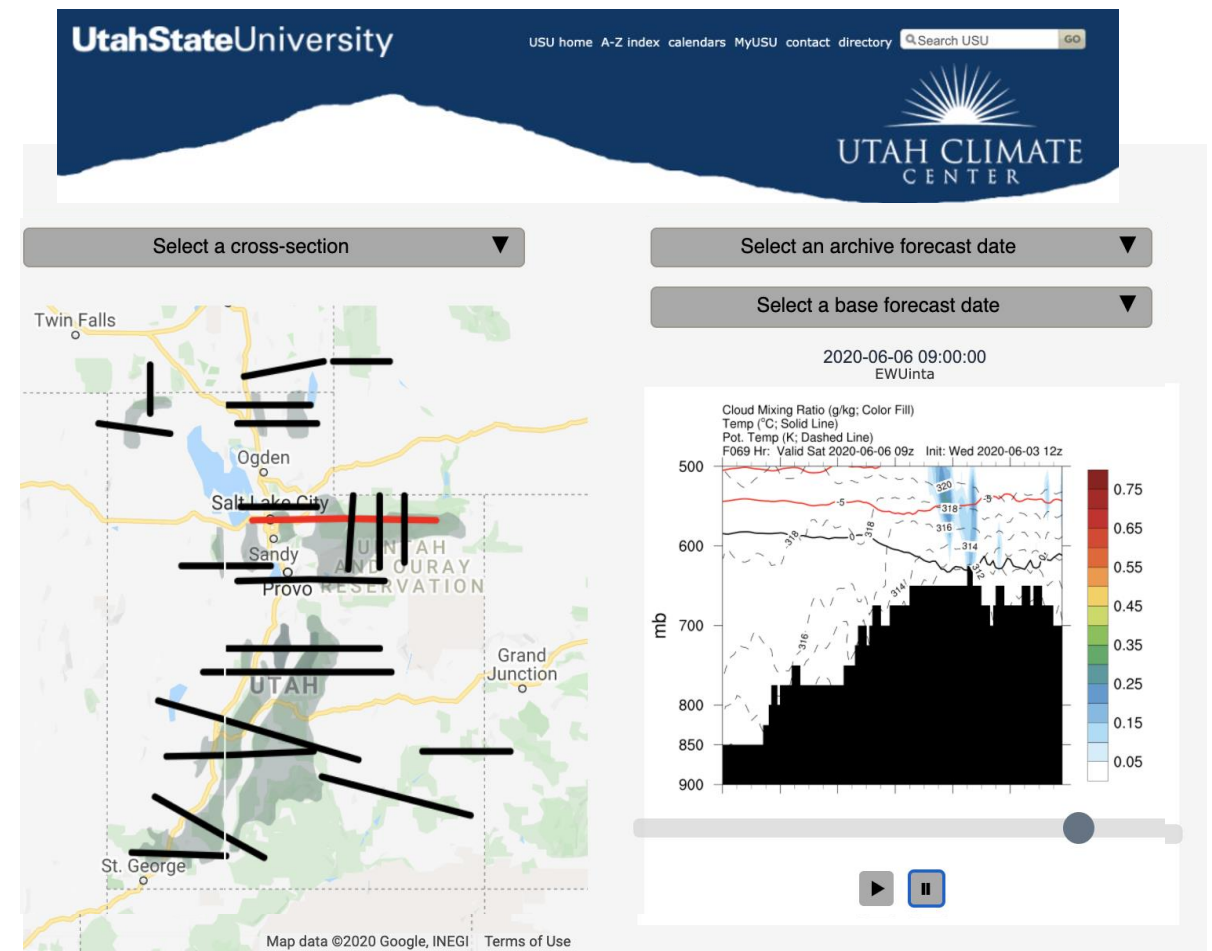




WRF Modeling: Research-to-Operation

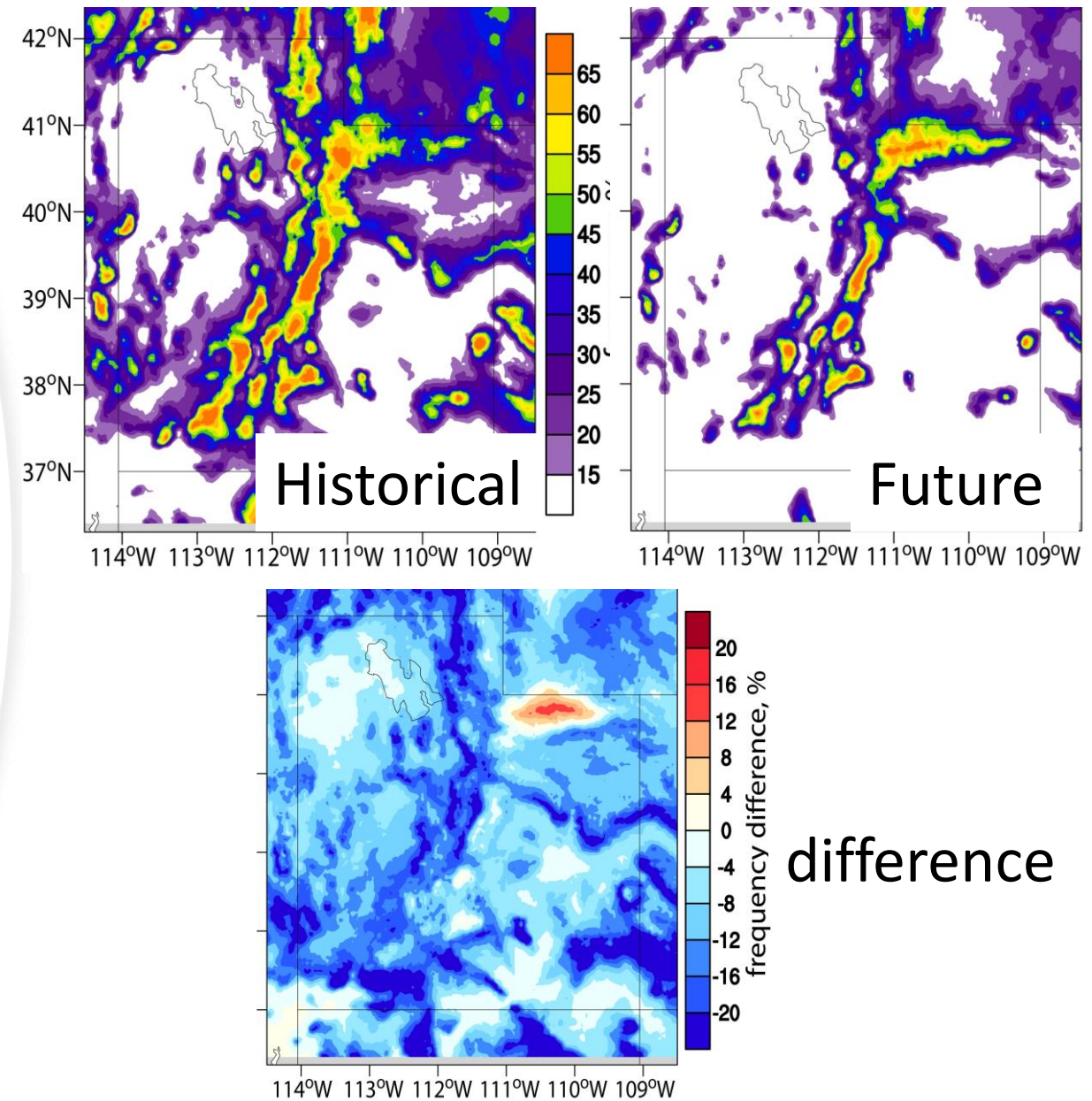


Guidance for cloud seeding operation



Fraction of Seedable Cloud: Change in Future

- High resolution (4-km) regional climate model data
- Future scenario under RCP8.5 by the end of 21st century



要評估，就得正確地評估

多日未雨偏乾 連兩日人工增雨成效待評估

水利署

水情

人工增雨

時間：2020-02-15 17:33

新聞引據：採訪

撰稿編輯：謝佳興

讚 0

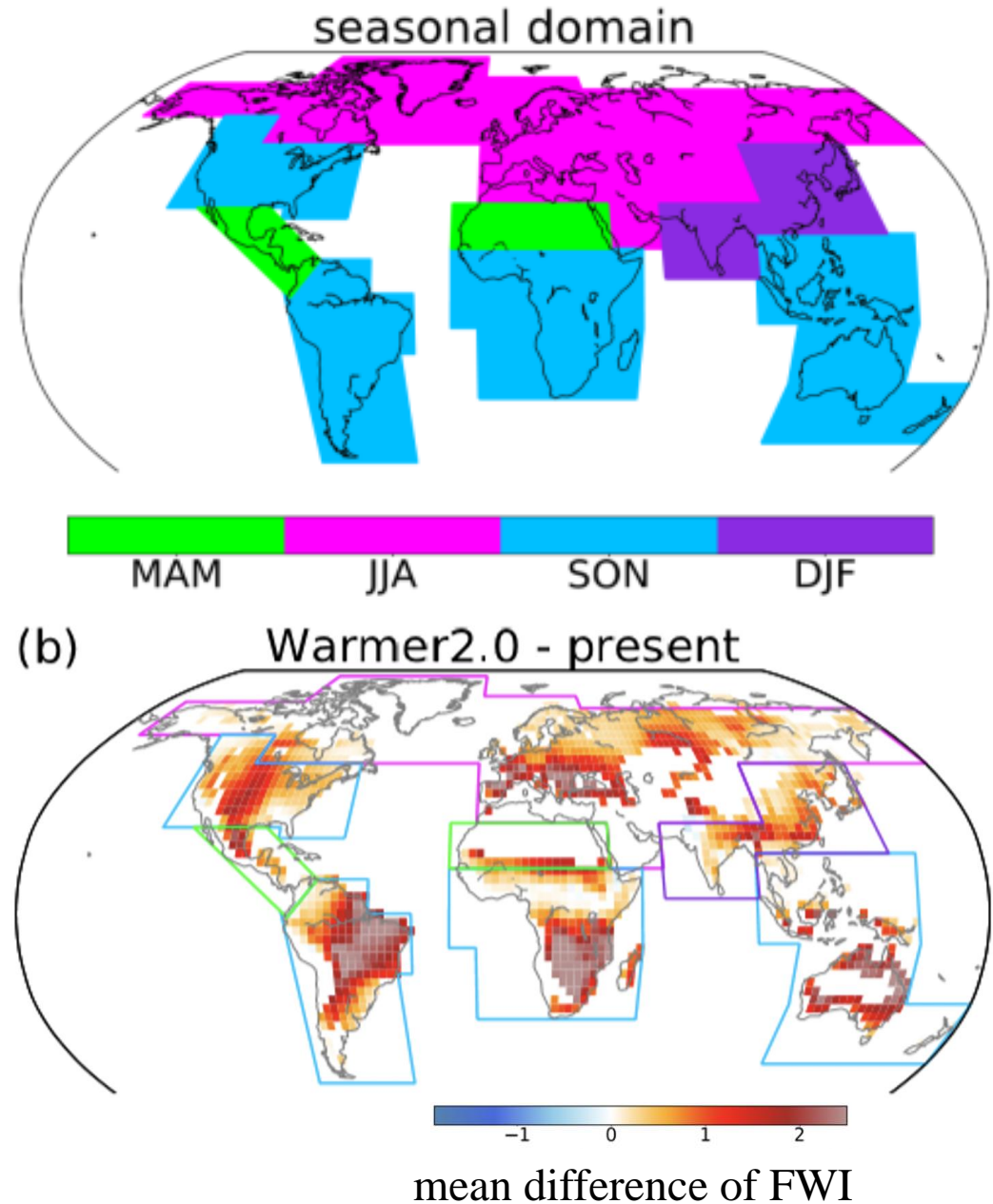
再乾下去, 會不會 燒起來？

颱風跑去了韓國，卻助長北美的野火

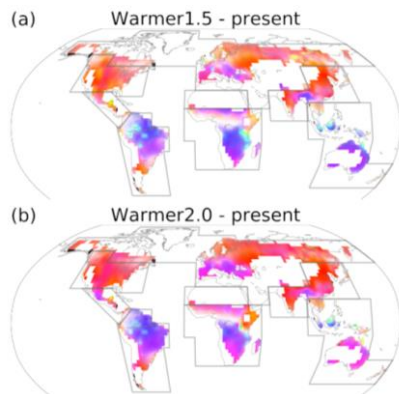
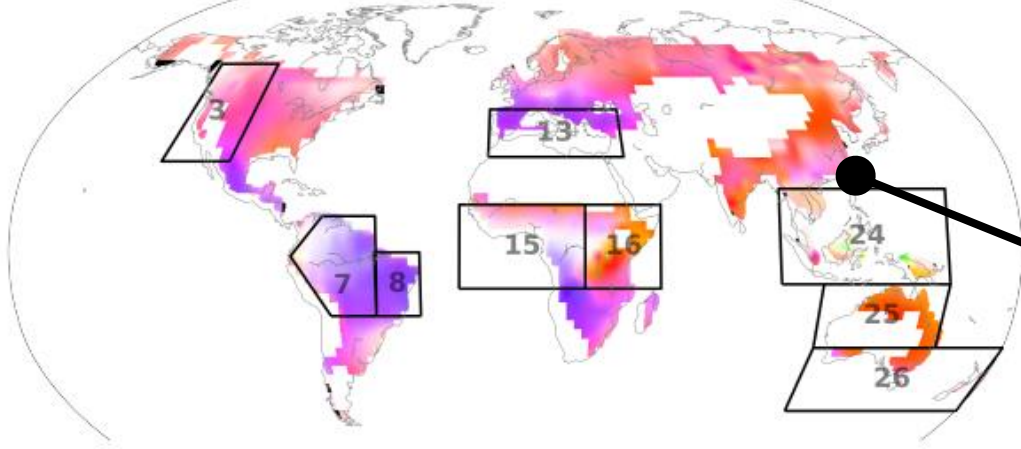
Simon 世宇 Wang
Utah State University

Changes in climate-driven wildfire risk under 1.5° and 2.0° warming projections

submitted to *ERL*



(c) Warmer2.0 - Warmer1.5

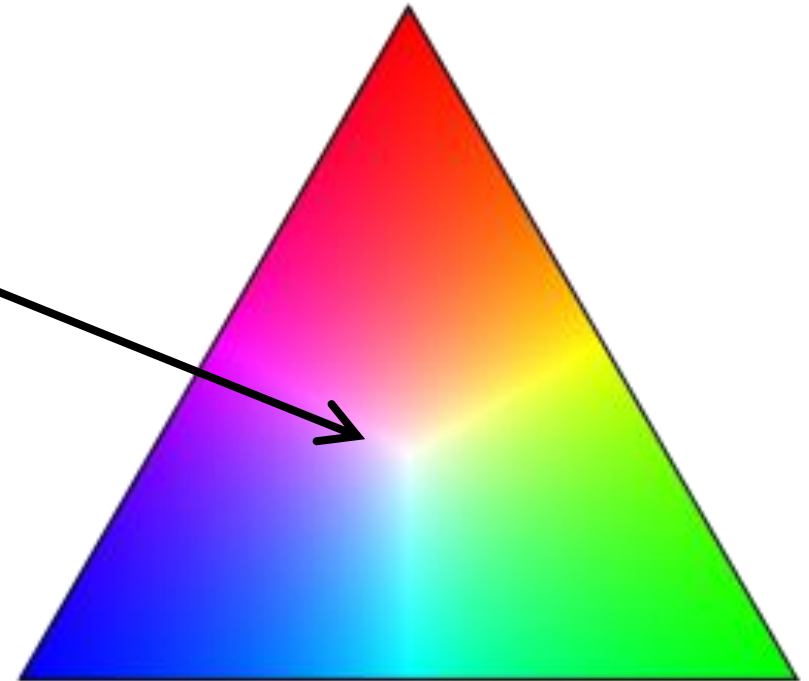


Sensitivity
comparison
between
climate
components

TMAX

RHUM
& RAIN

WIND



Changes in
climate-driven
wildfire risk
under 1.5° and
2.0° warming
projections

submitted to *ERL*

The 0.5°C difference may significantly increase fire risk in parts of the world, including Taiwan, while warming-driven increase in fire risk may already happen in Australia and western US.