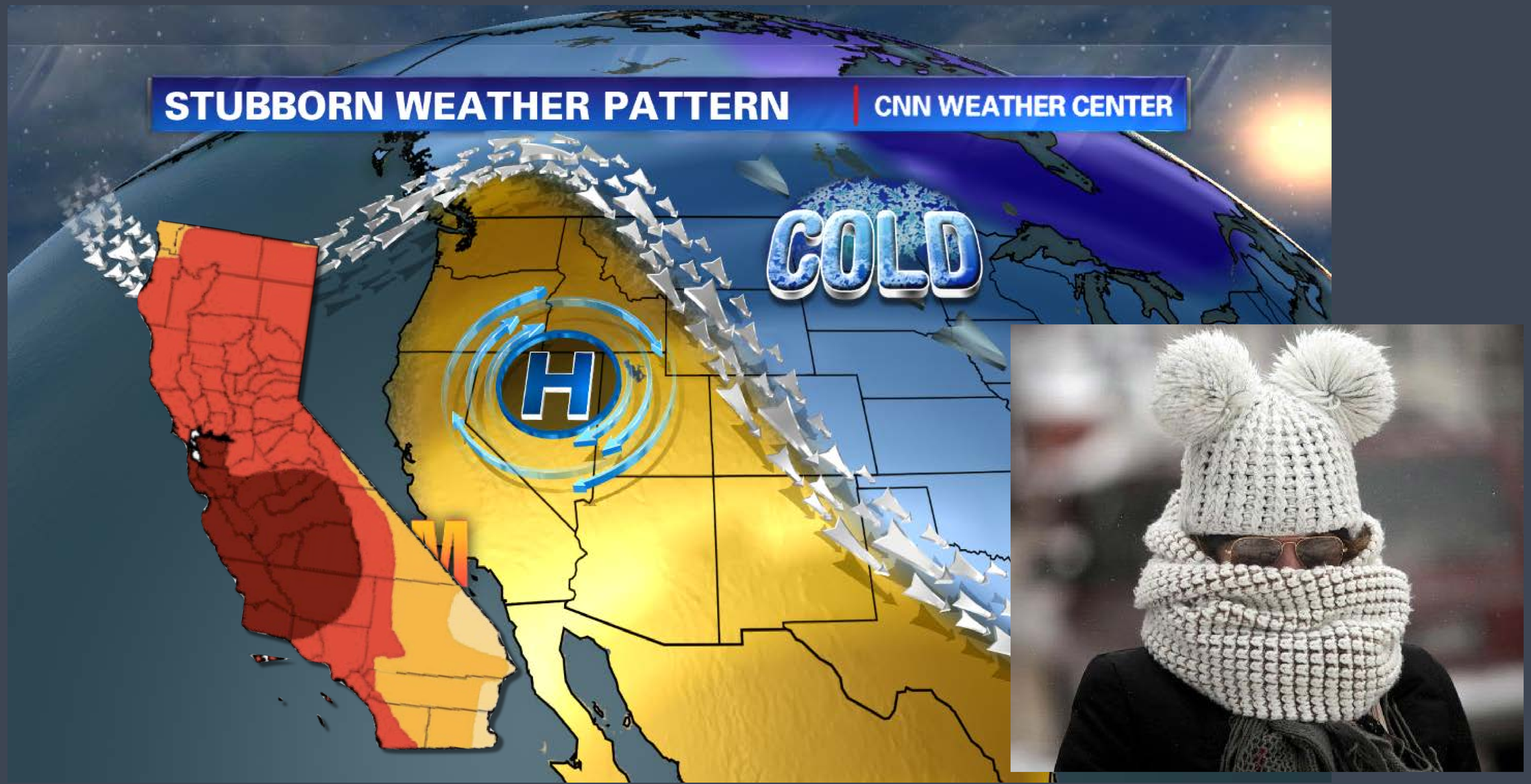
Fire and Ice

California drought and "polar vortex" with the changing climate

S.-Y. Simon Wang, Lawrence Hipps, Robert R Gillies,(Utah State U)
&
J.-H. Yoon (PNNL)

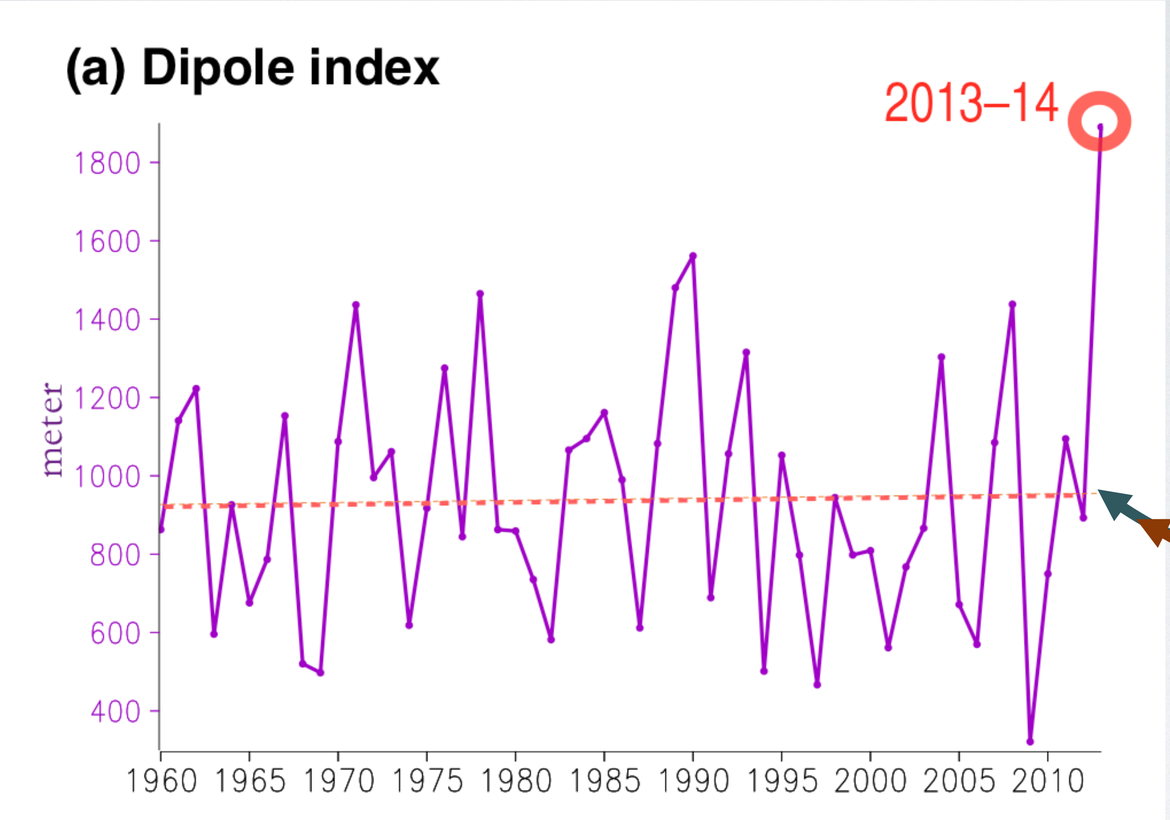
2013-14: A TWO-FACE WINTER



geopotential height @ 250 hPa

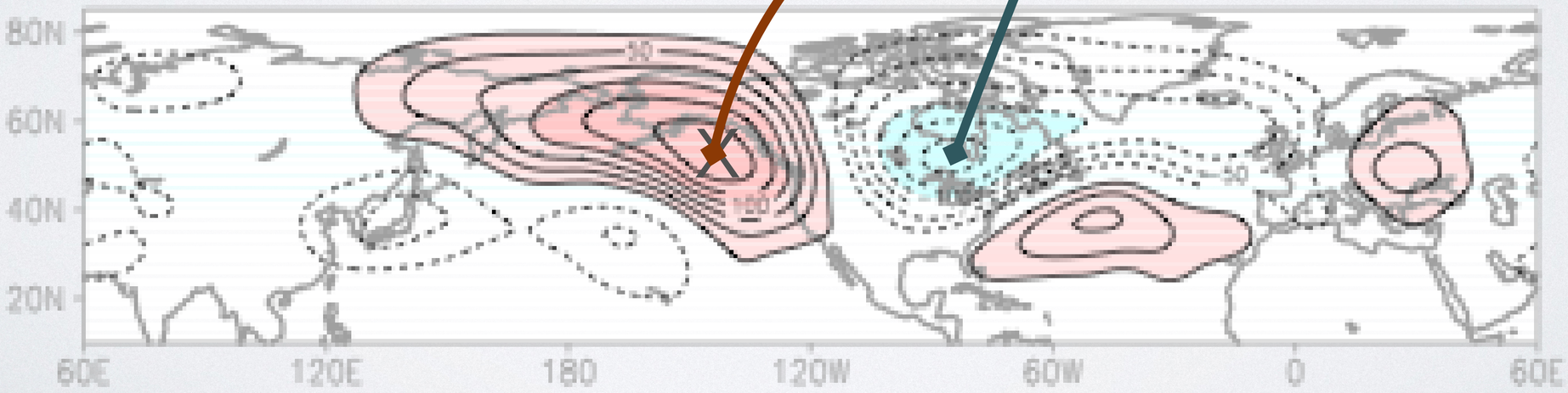
2013-14 winte

anomaly



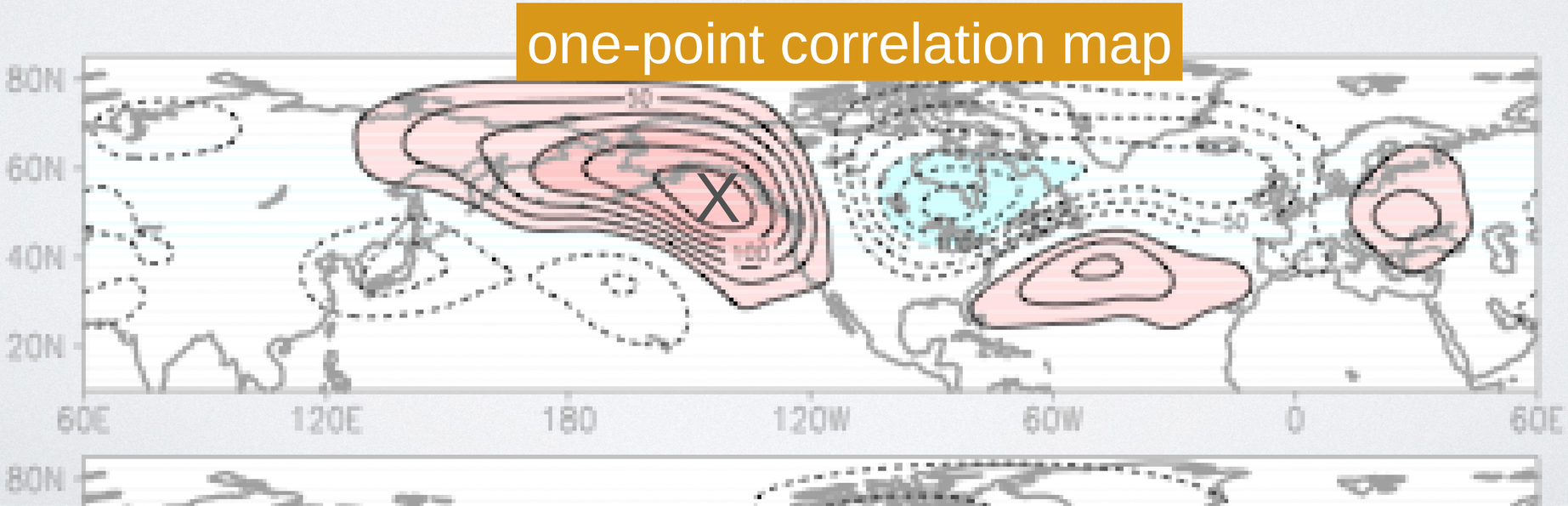
the “dipole”!

anomaly

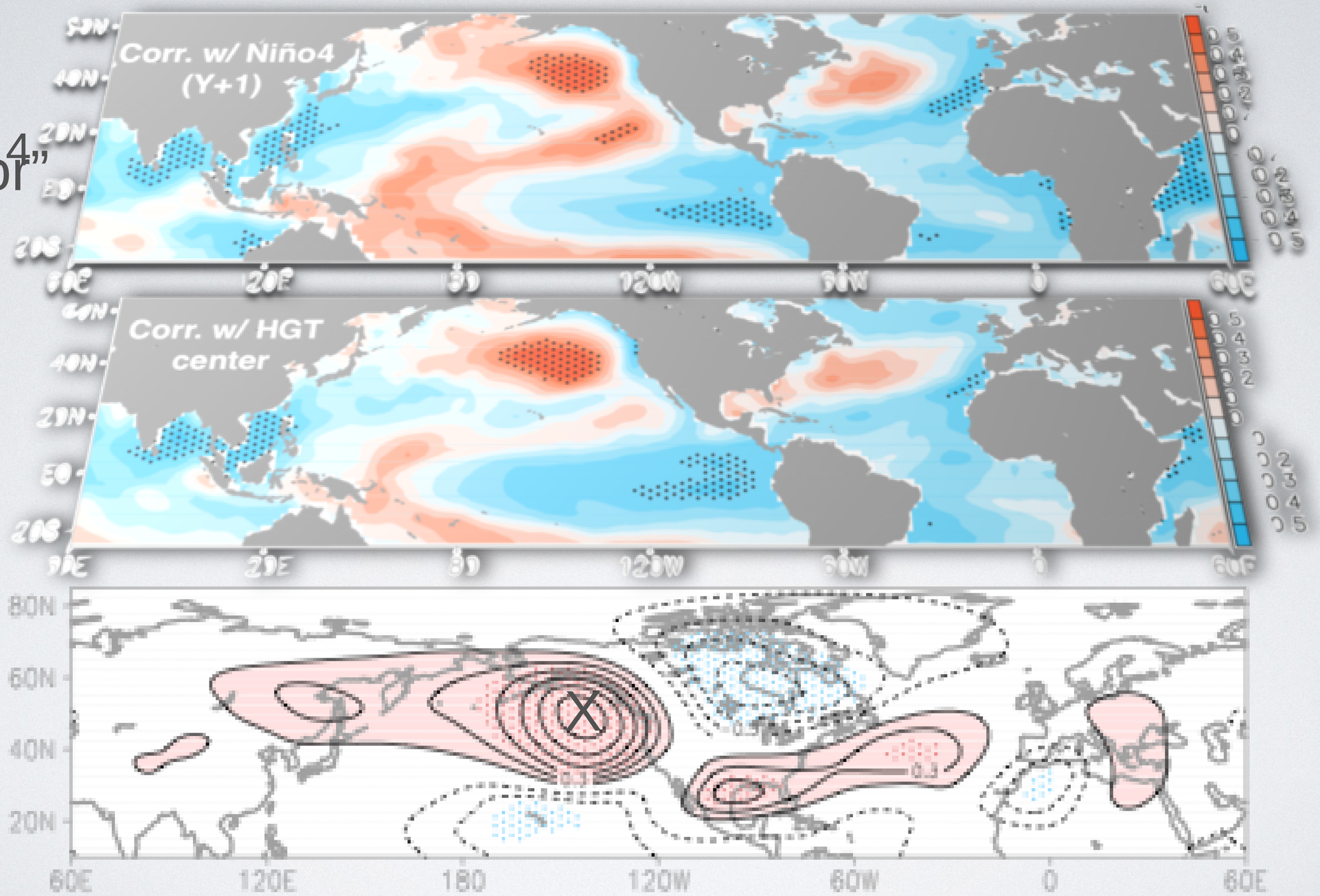


Not an isolated event!

geopotential height @ 250 hPa

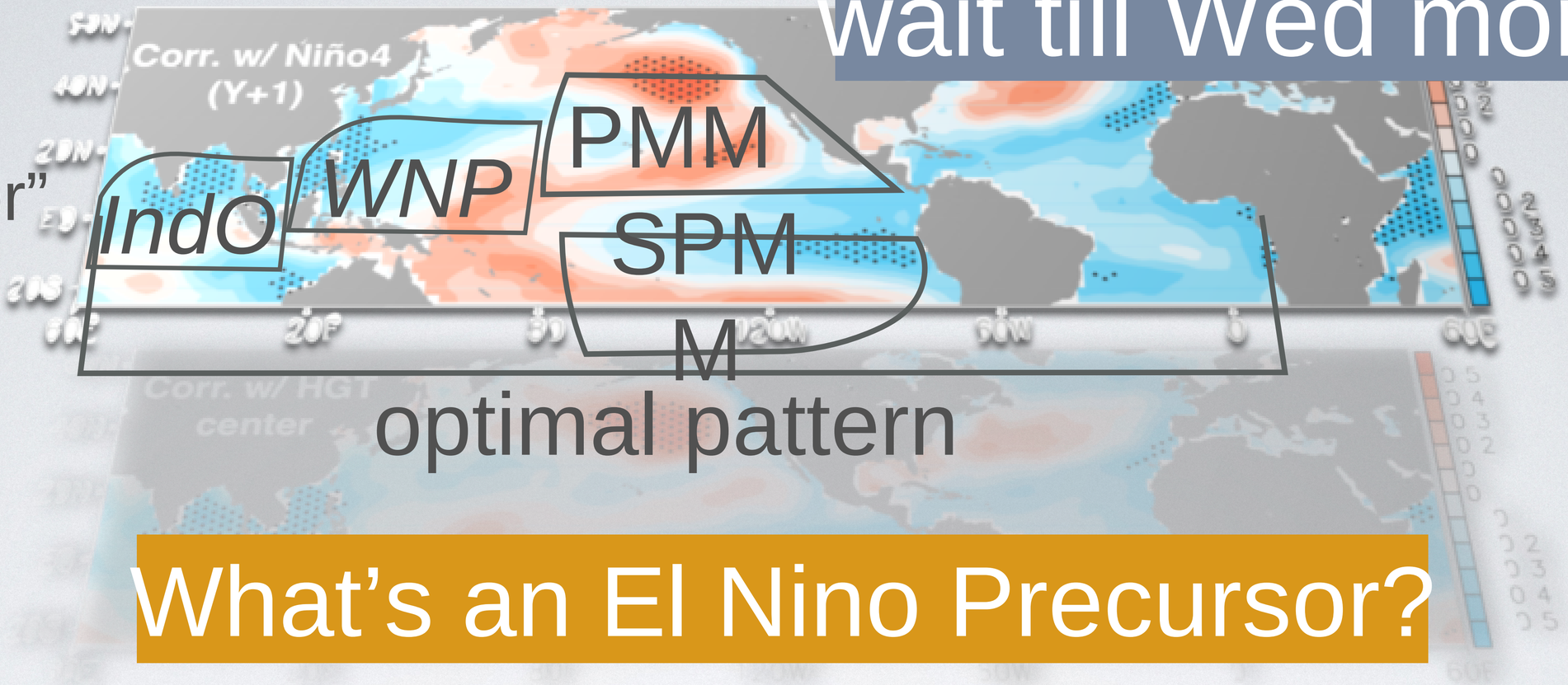


El Nino 2013-14 “Precursor”



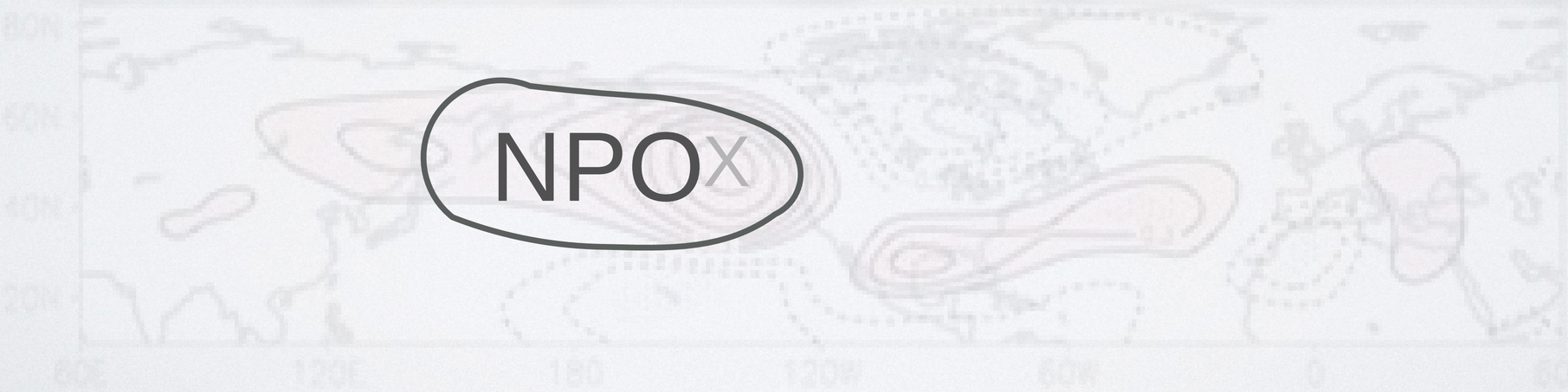
wait till Wed morning.

El Nino
“Precursor”



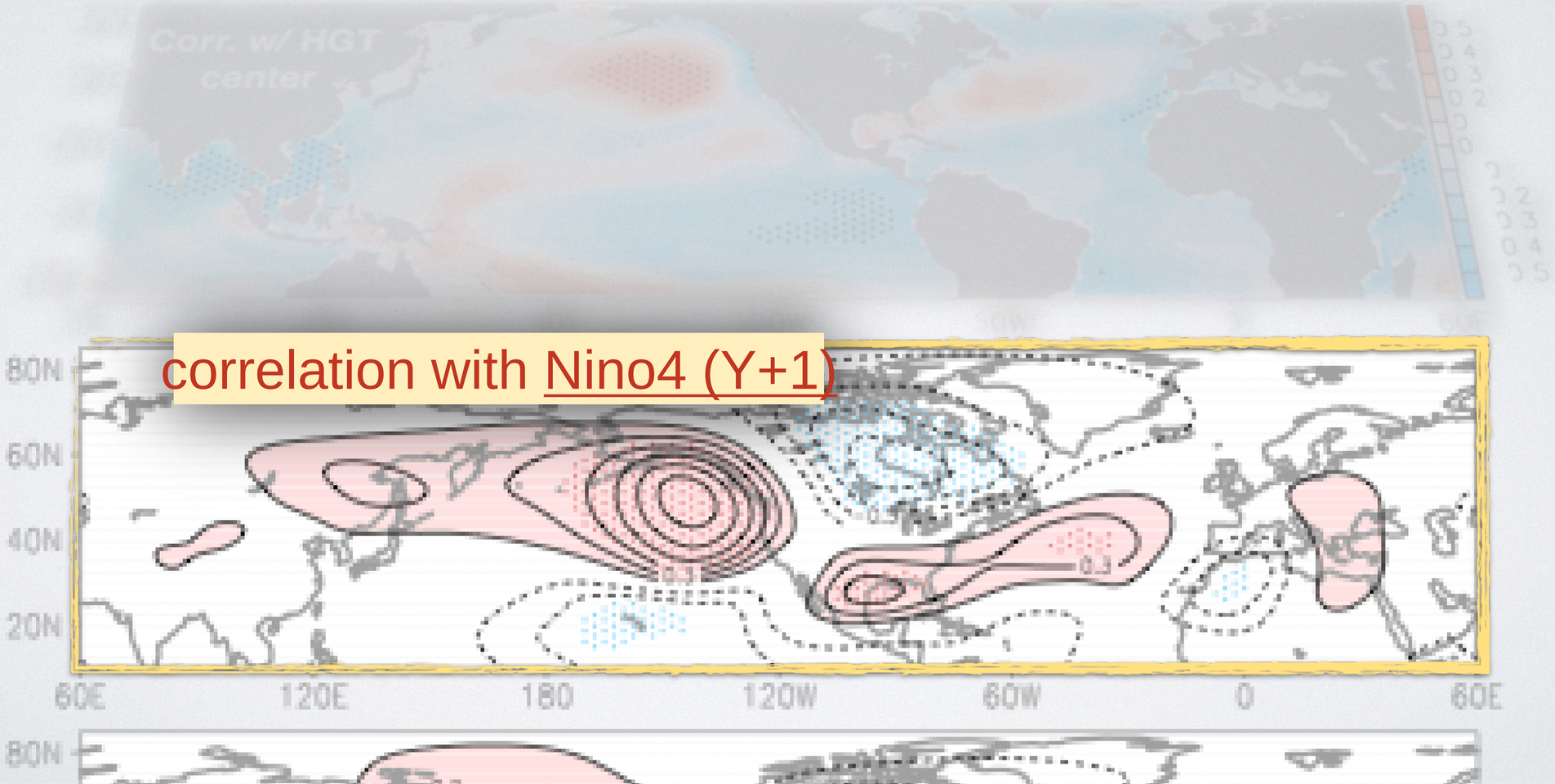
optimal pattern

What’s an El Nino Precursor?



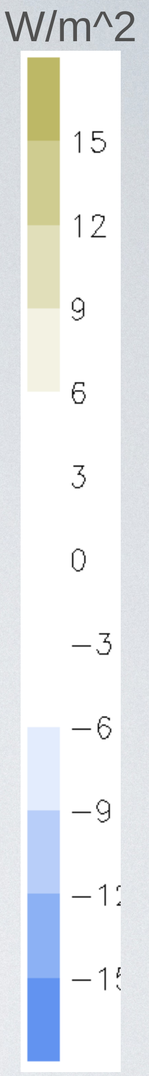
NPO X

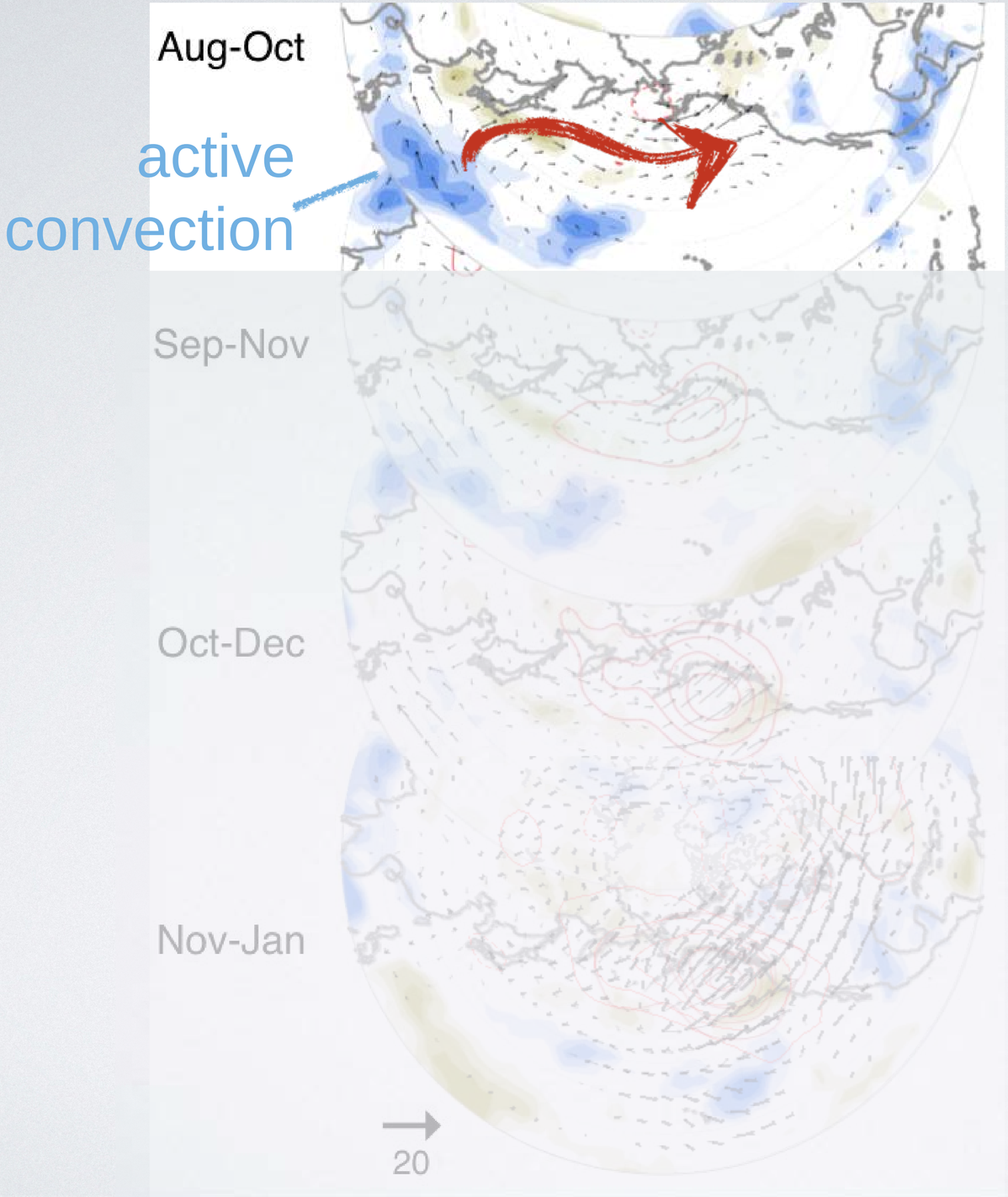
ENSO precursor Nino#(Y+1)



Wave flux (250 hPa) OLR

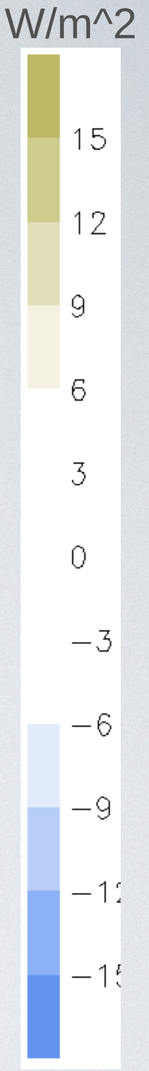
NDJ 2013-14



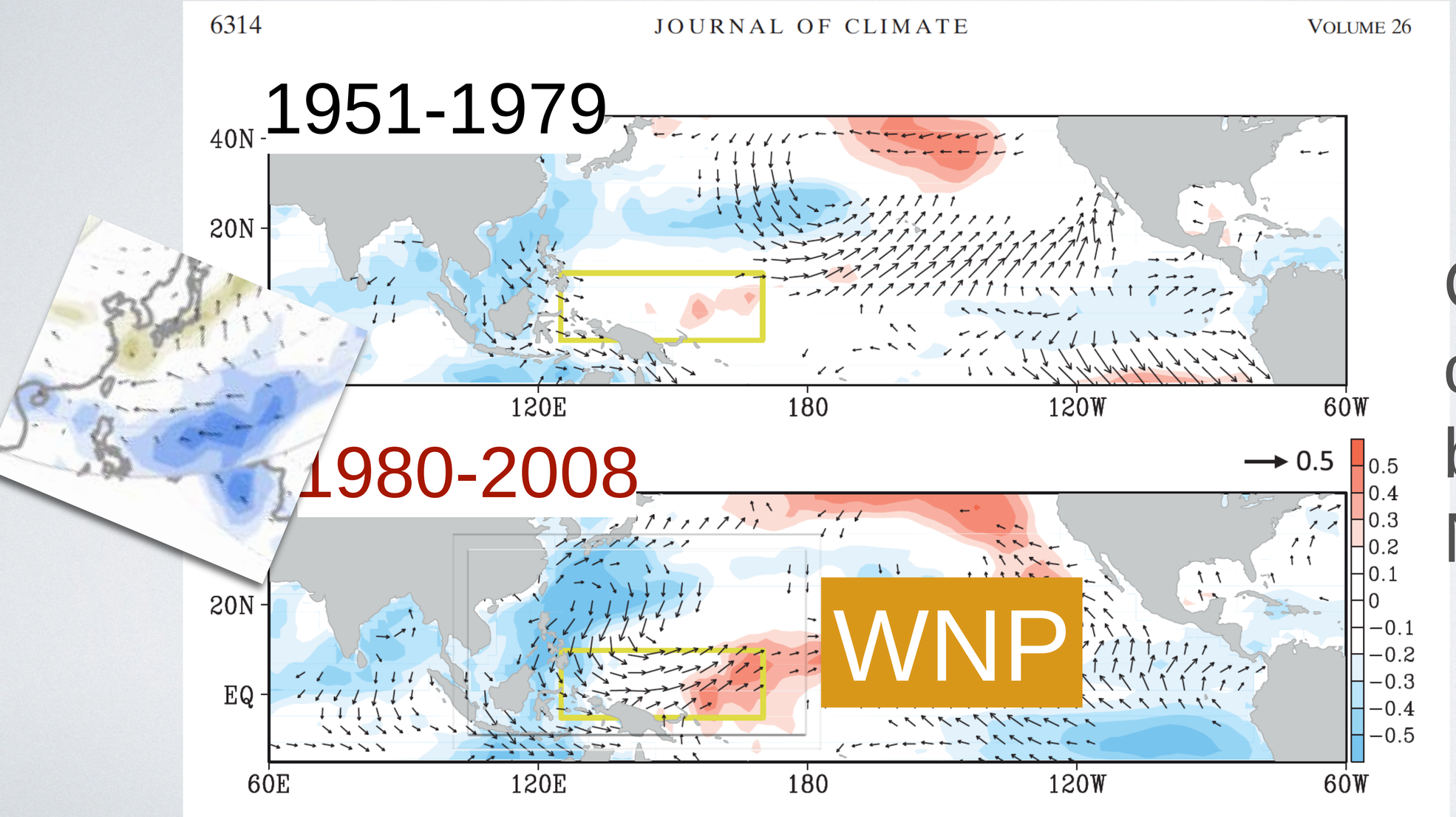


Wave flux (850 hPa) OLR

evolution



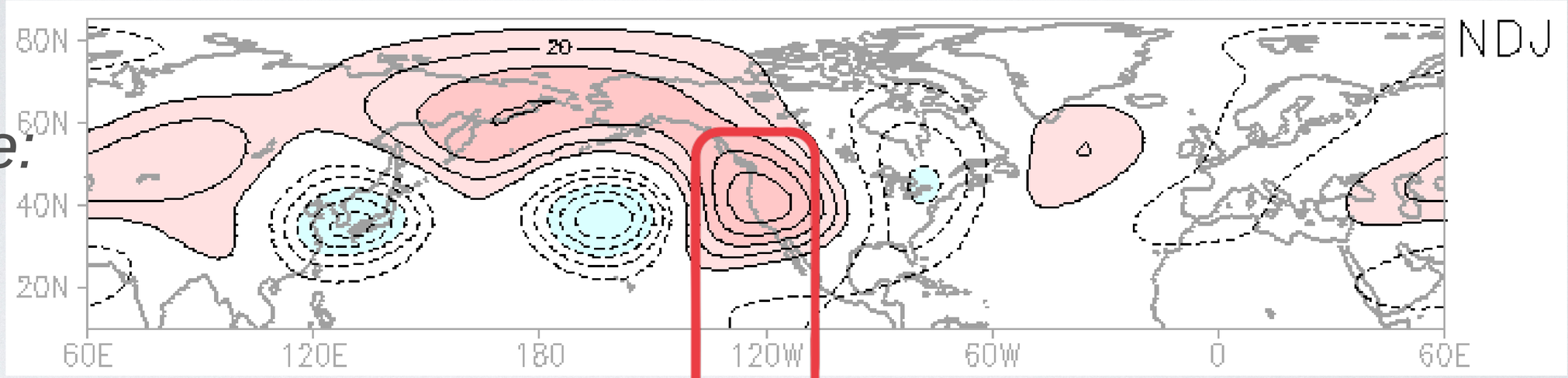
ENSO Precursor - has it changed?

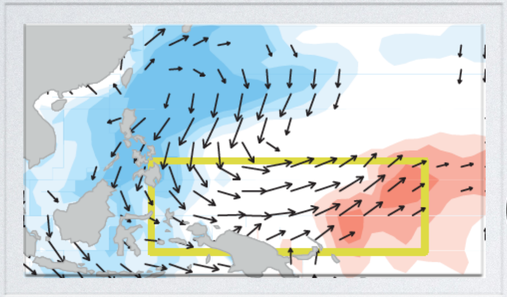


Composite for one year before an El Nino

CESM large ensemble (x30)

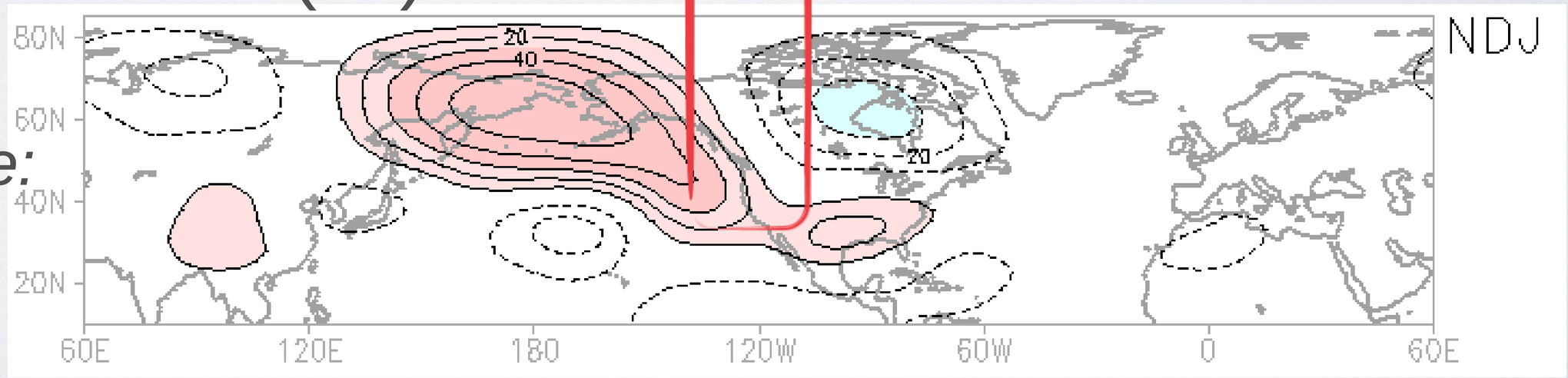
WNP composite:

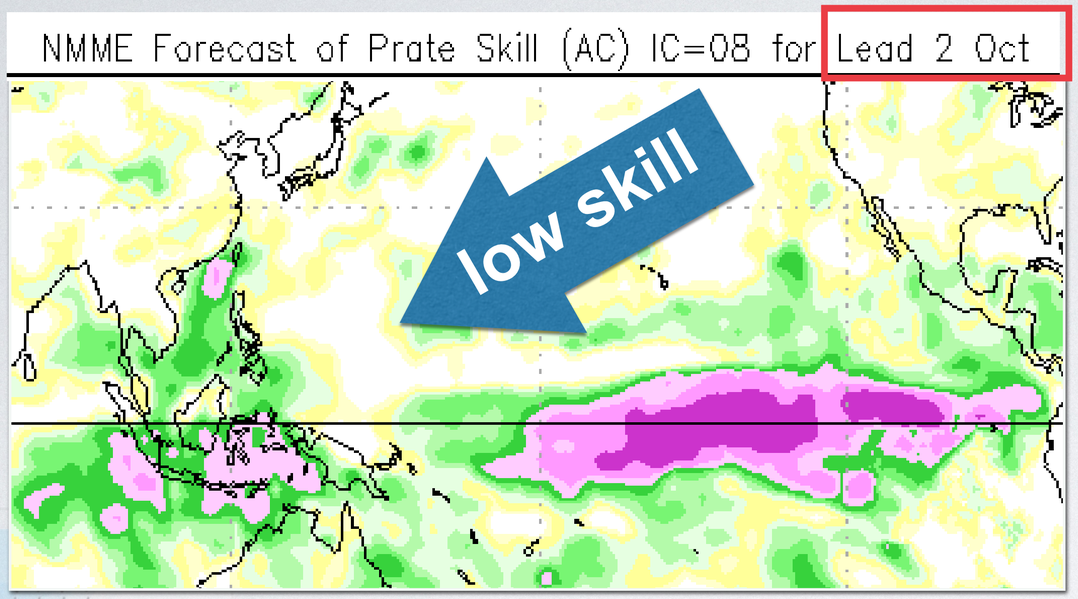


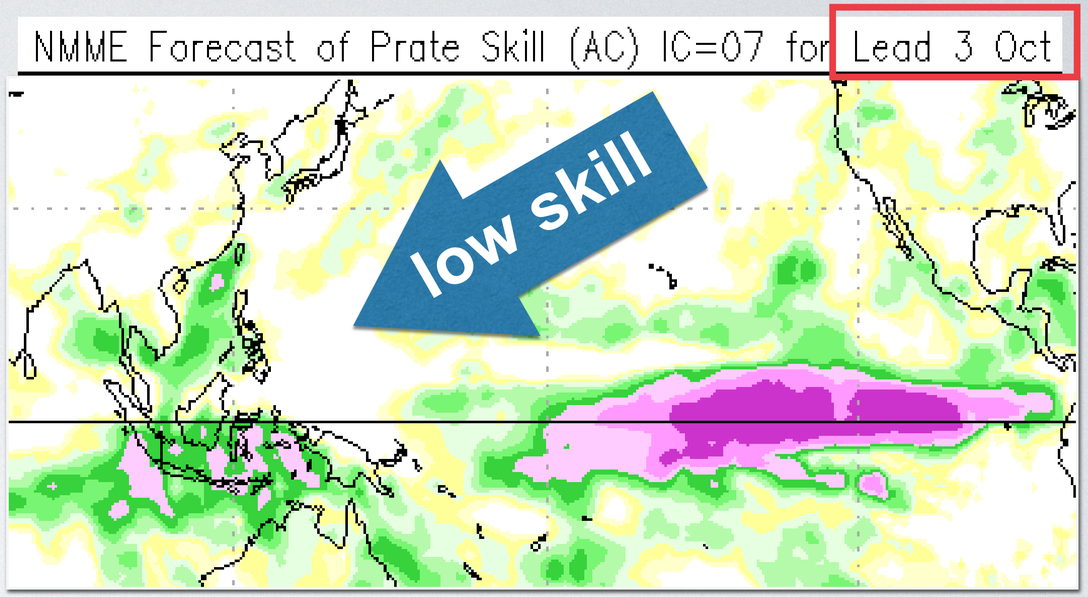


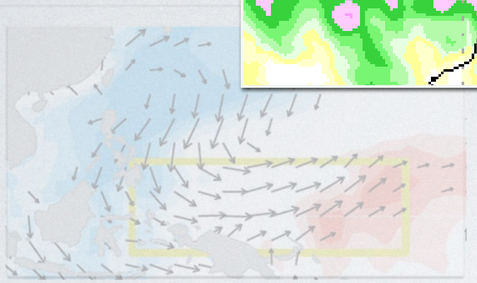
CCSM4 (x6)

WNP composite:



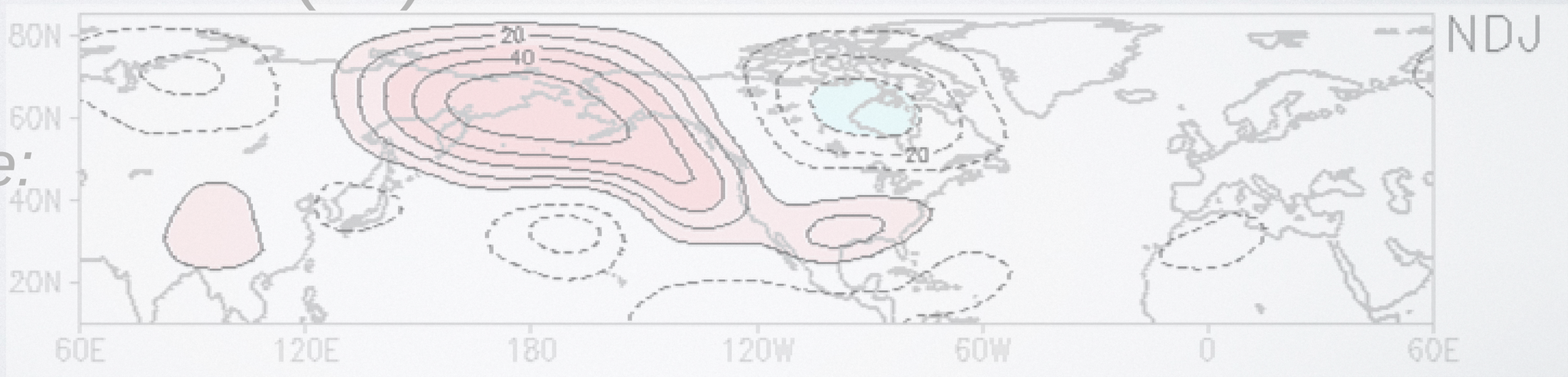




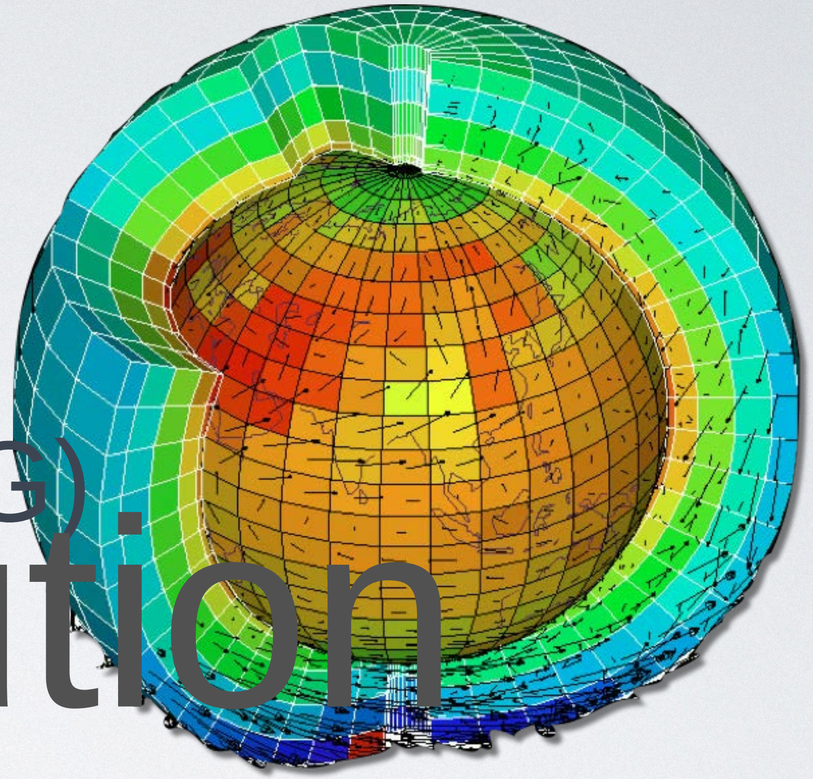


CCSM4 (x6)

WNP composite:



NCAR UCAR | CESM COMMUNITY EARTH SYSTEM MODEL



Attribution

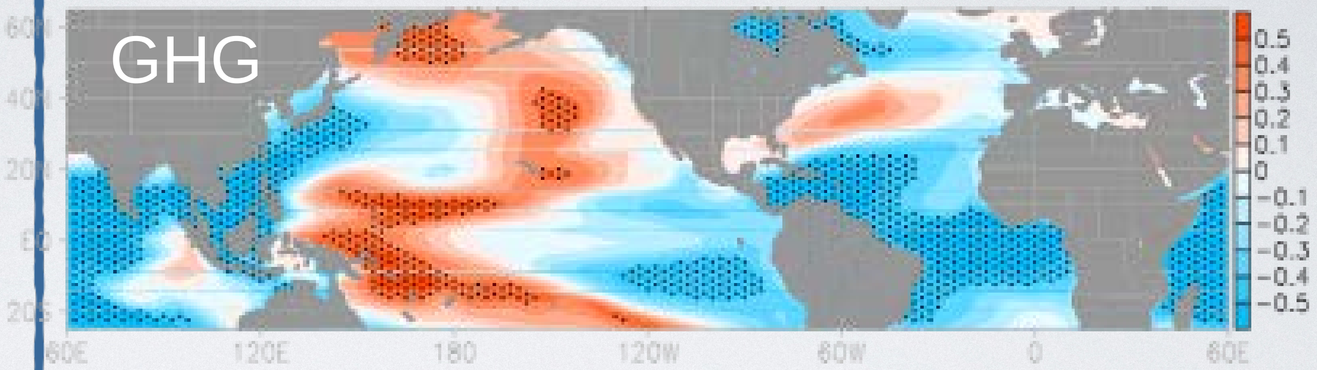
- greenhouse gas (GHG)
- natural forcing (NAT)

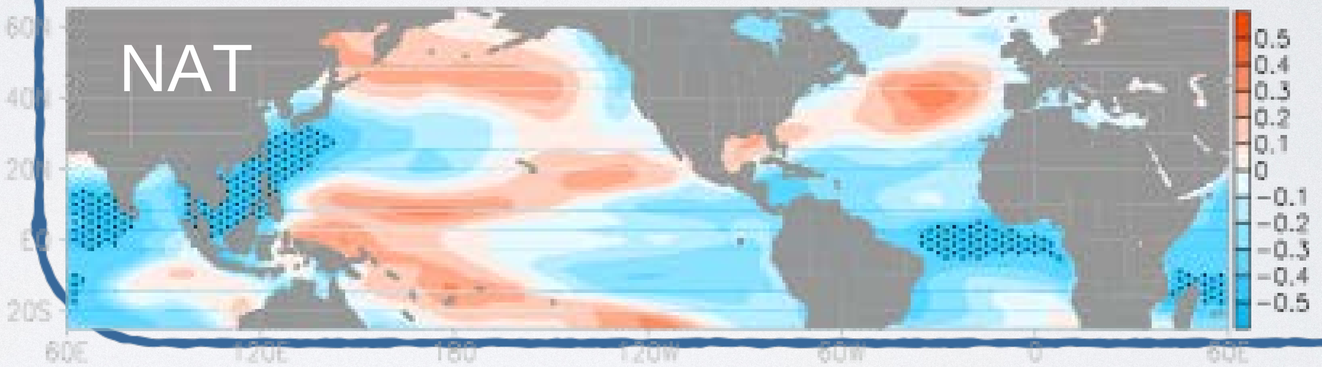
NCAR UCAR | CESM COMMUNITY EARTH SYSTEM MODEL

1 yr before

El Niño

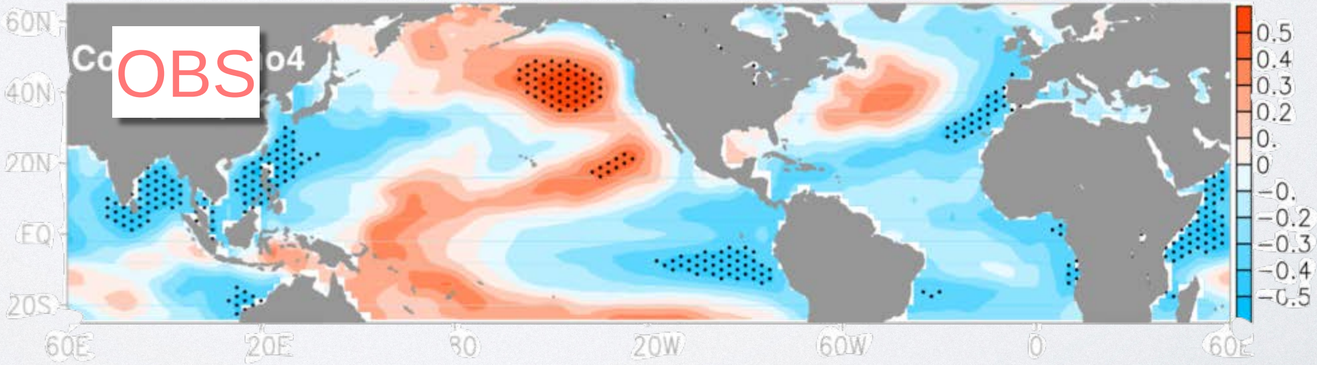
(simulated)





1 yr before

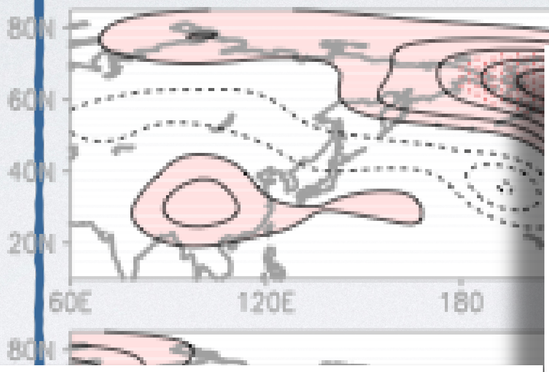
El Niño



NCAR UCAR | CESM COMMUNITY EARTH SYSTEM MODEL

Z250 anomalies

GHG

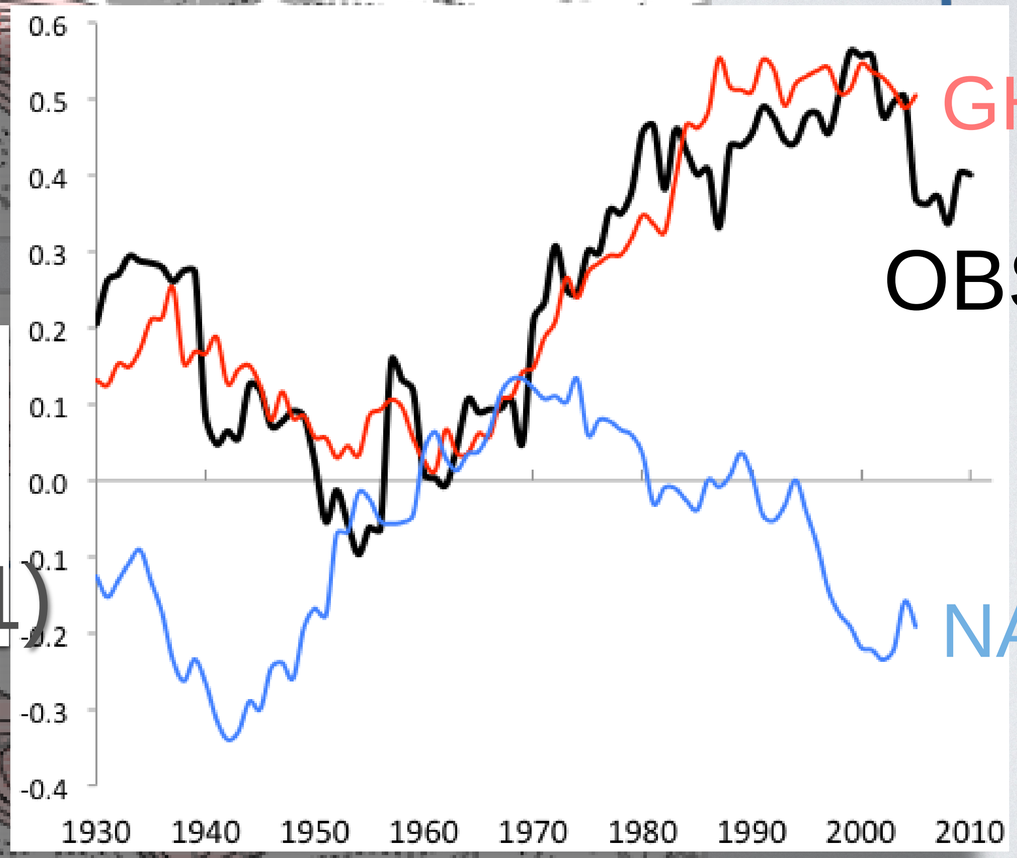


1 yr before

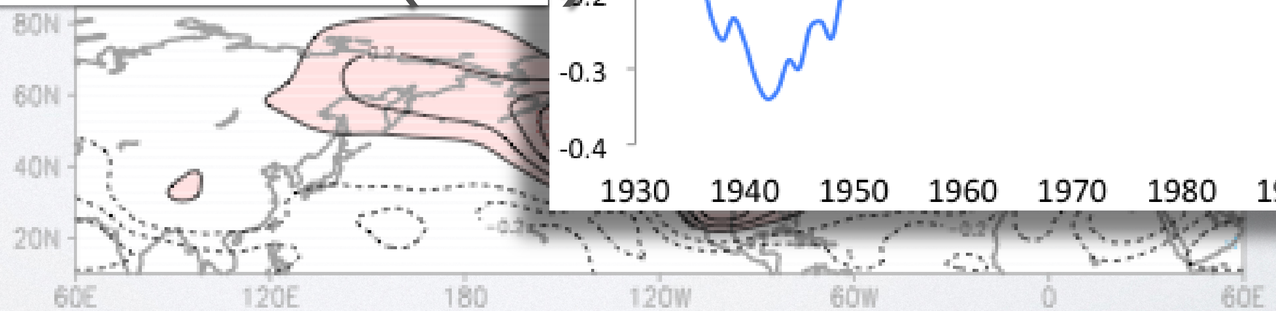
El Niño

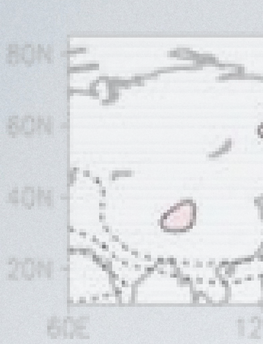
Sliding correlation:

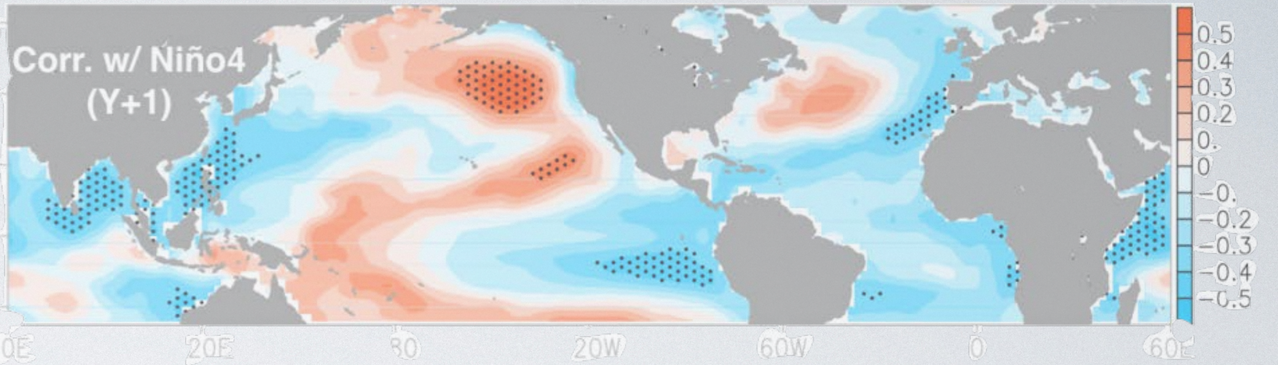
dipole vs. Nino4(Y-1)



OBS

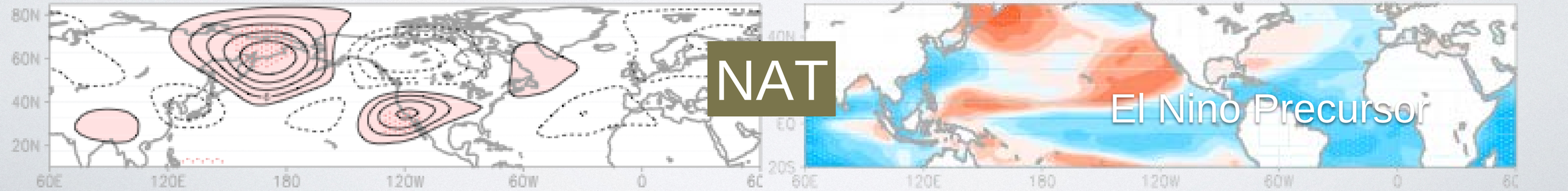






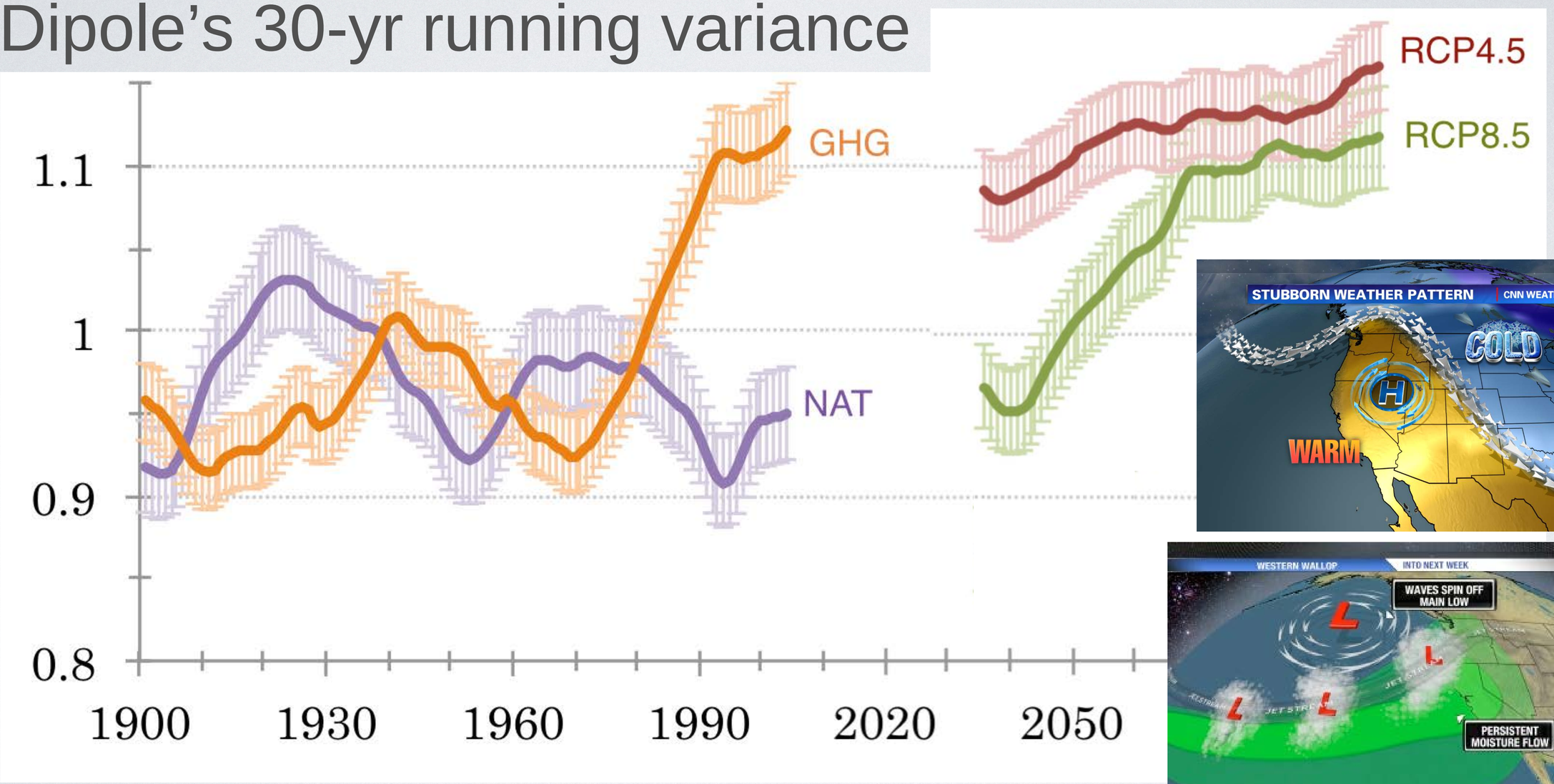
CMIP5 Coupled Model Intercomparison Project

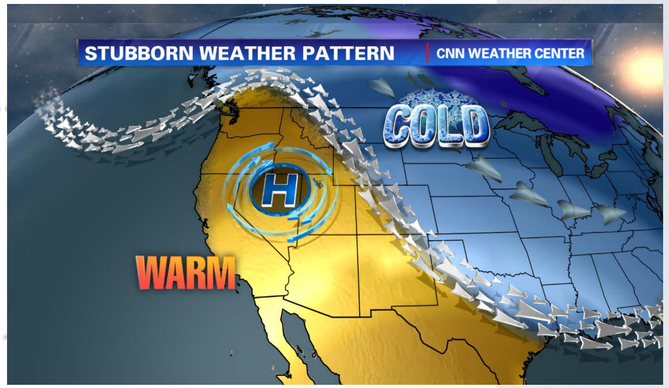
18 models

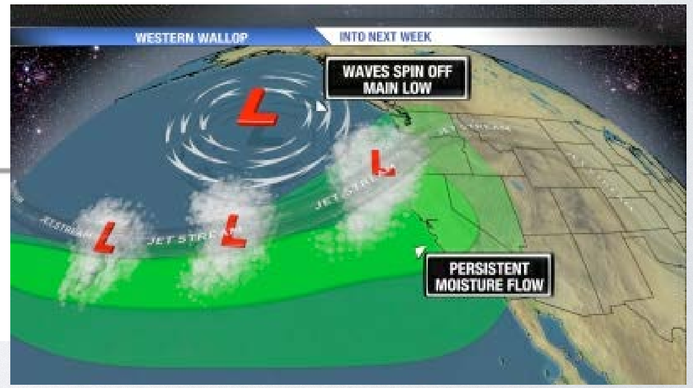


CMIP5 projection

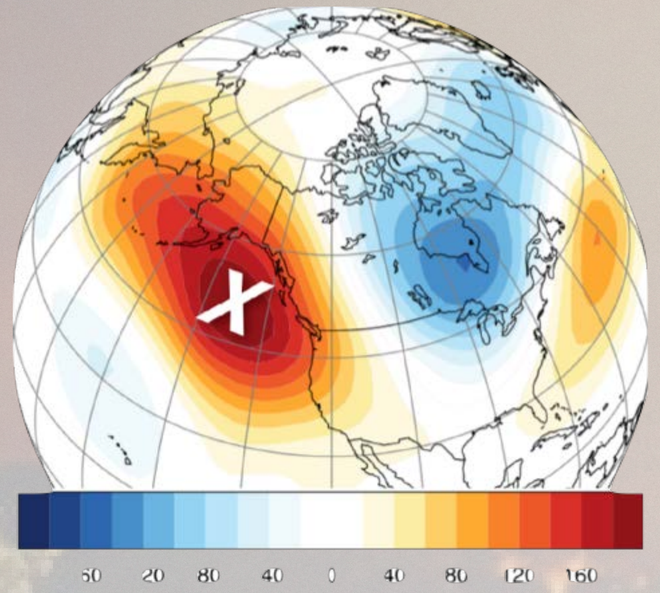
Dipole's 30-yr running variance



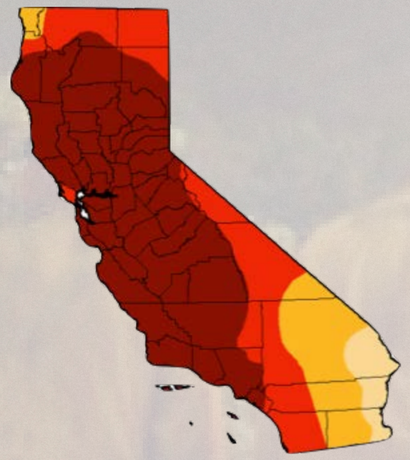


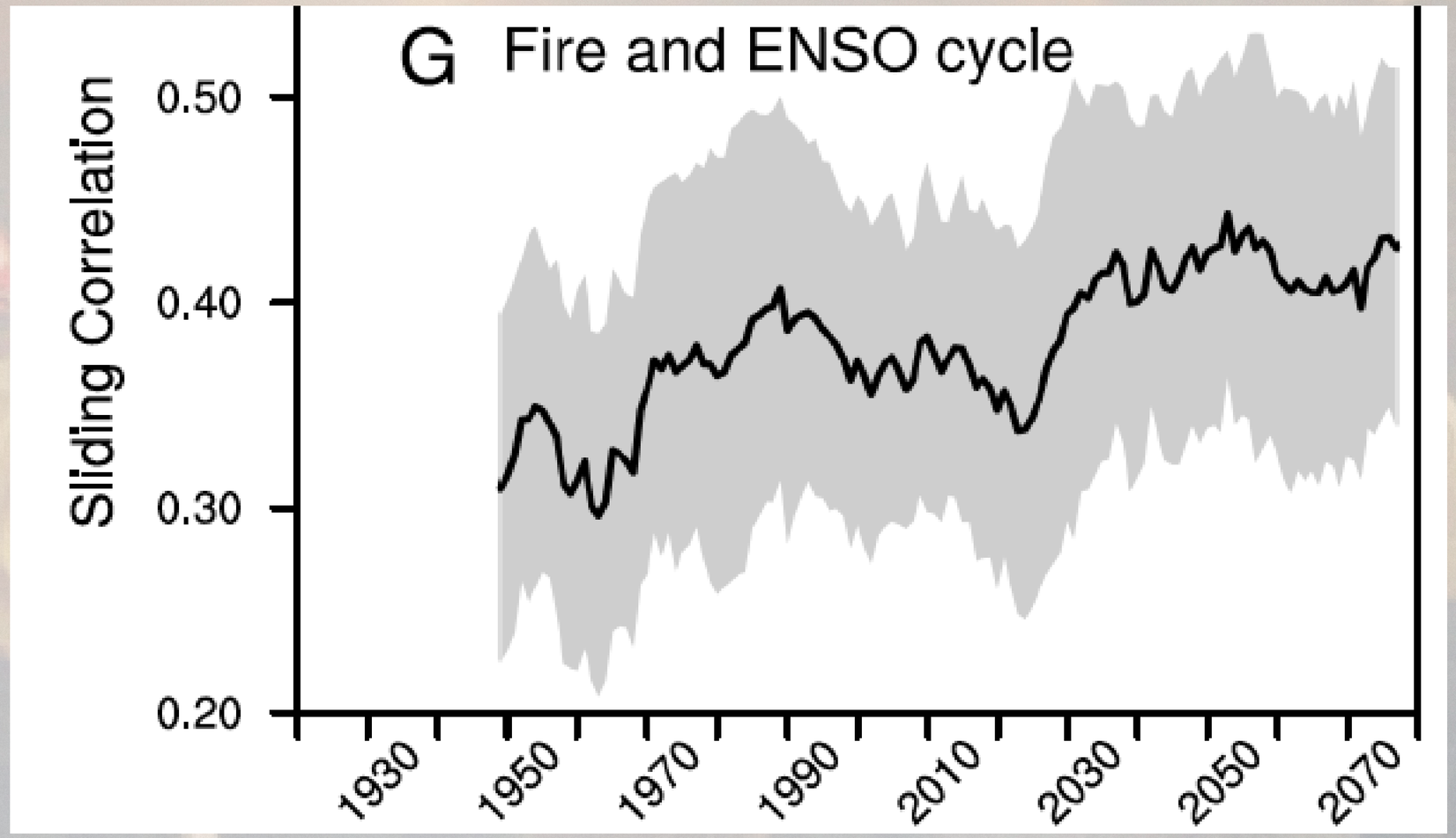


Looking ahead



NCAR UCAR | CESM
COMMUNITY EARTH SYSTEM MODEL

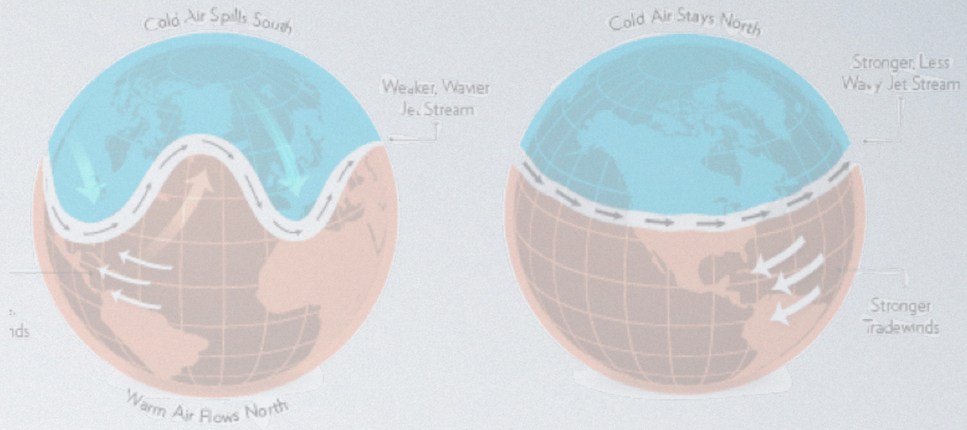


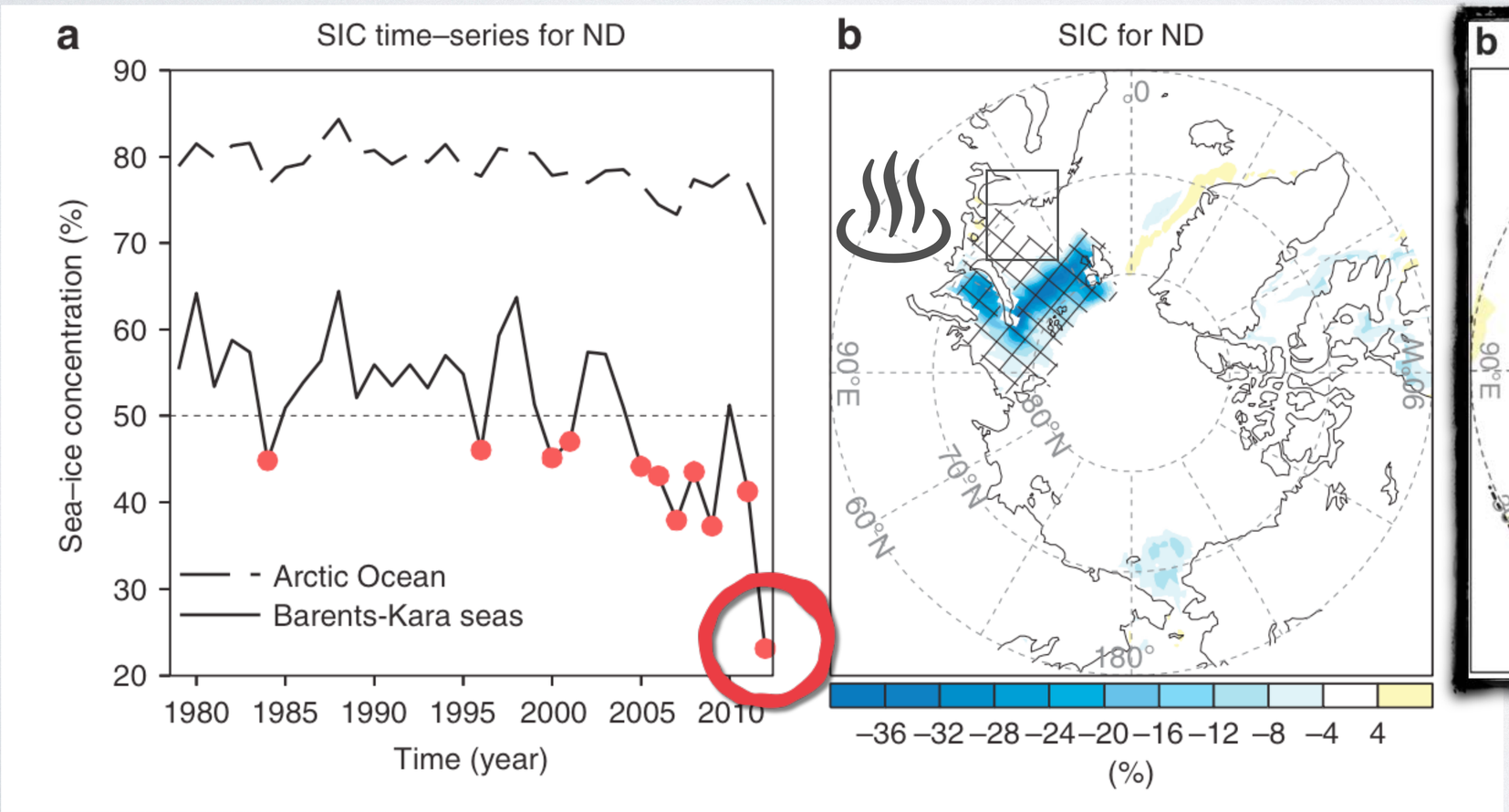


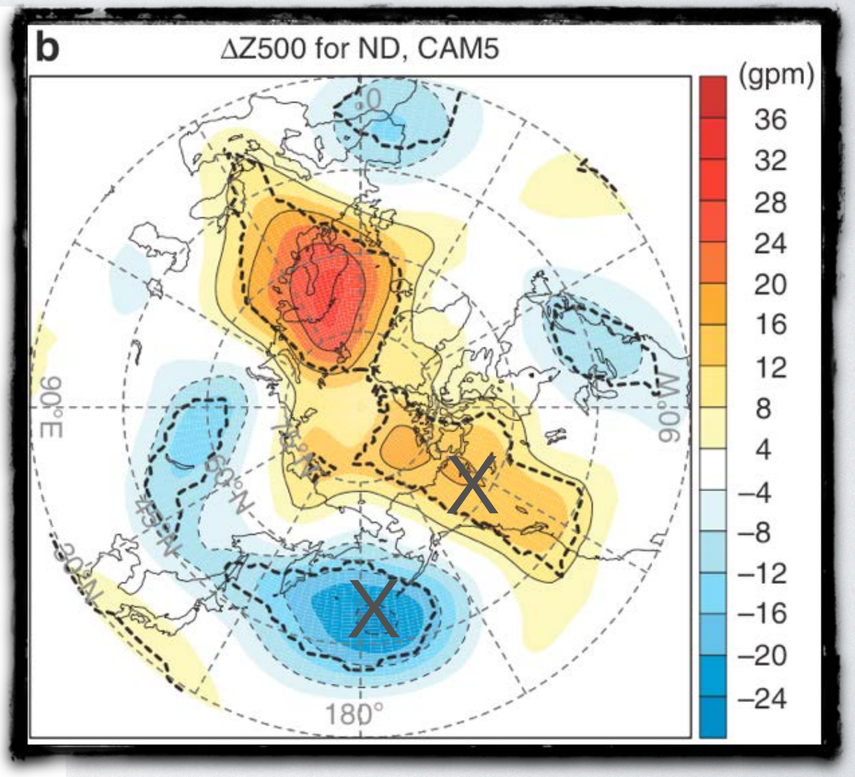
Arctic forcing?

nature COMMUNICATIONS

Kim et al. (2014)







AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER

10.1002/2014GL059748

Key Points:

- The drought-inducing ridge is recurrent
- The ridge is linked to an ENSO precursor
- The link of the ridge with ENSO precursor has grown

Supporting Information:

Probable causes of the abnormal ridge accompanying the 2013–2014 California drought: ENSO precursor and anthropogenic warming footprint

S.-Y. Wang[1,2], Lawrence Hipps[2], Robert R Gillies[1,2], and Jin-Ho Yoon[3]

[1]Utah Climate Center, Utah State University, Logan, Utah, USA, [2]Department of Plants, Soils and Climate, Utah State University, Logan, Utah, USA, [3]Pacific Northwest National Laboratory, Richland, Washington, USA

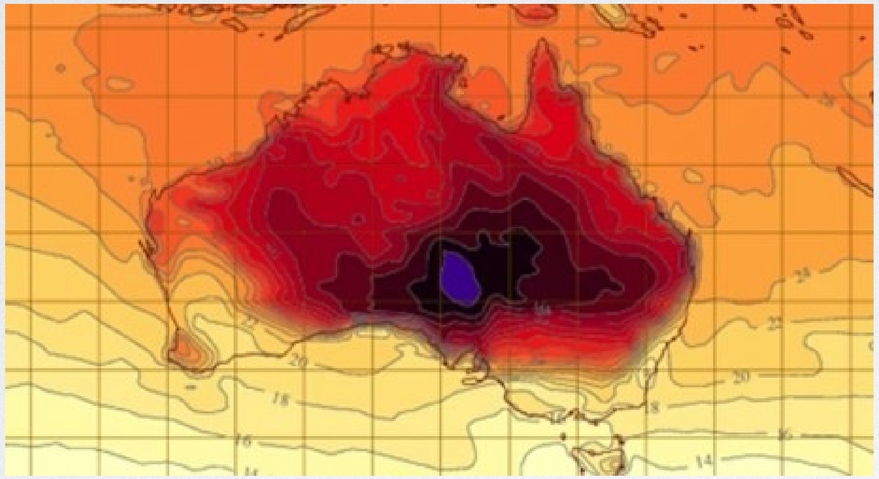
LETTERS

edited by Jennifer Sills

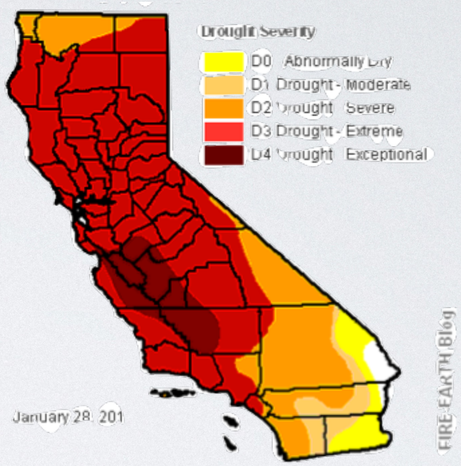
Science

AAAS

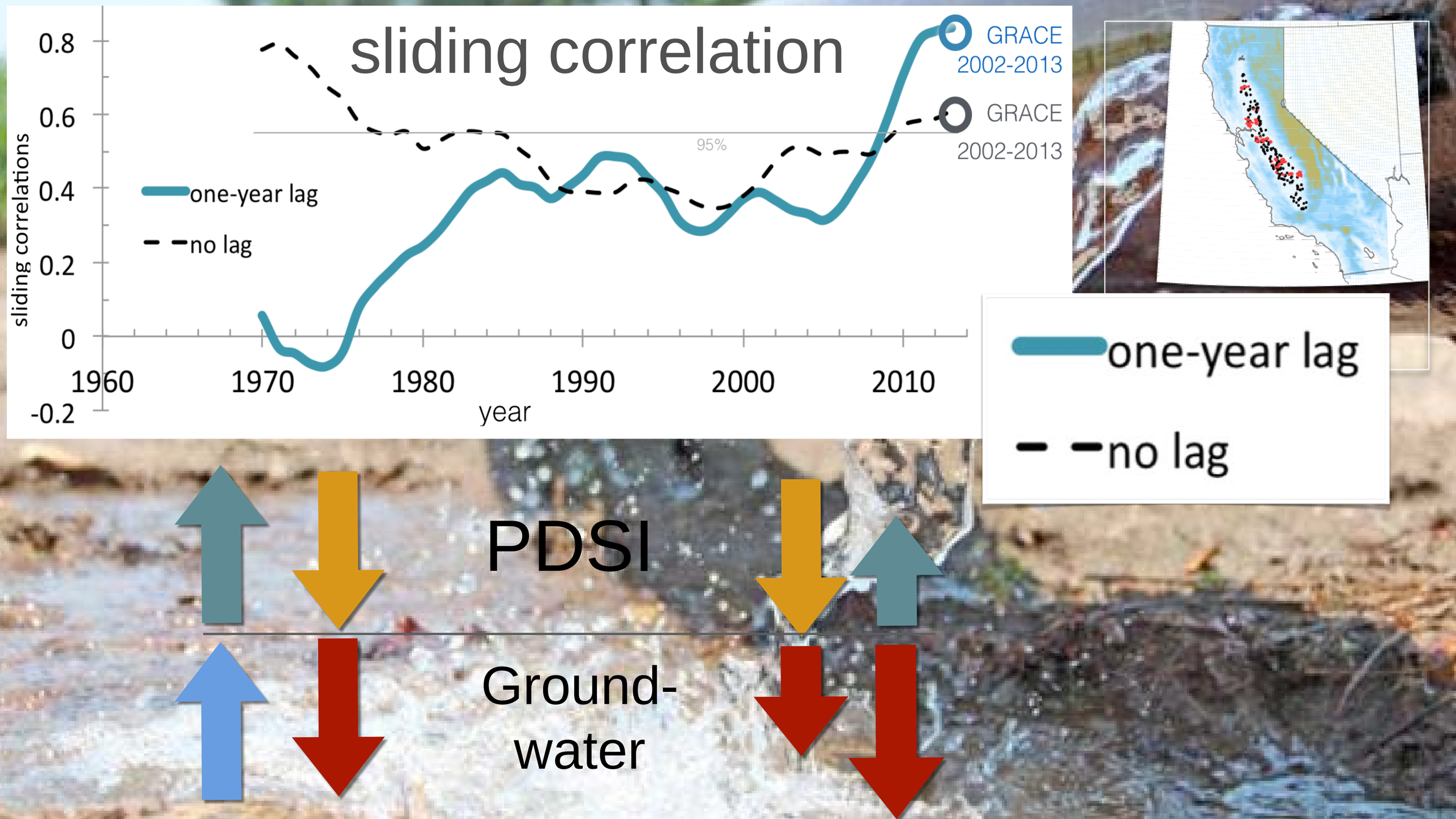
Australia's Drought: Lessons for California

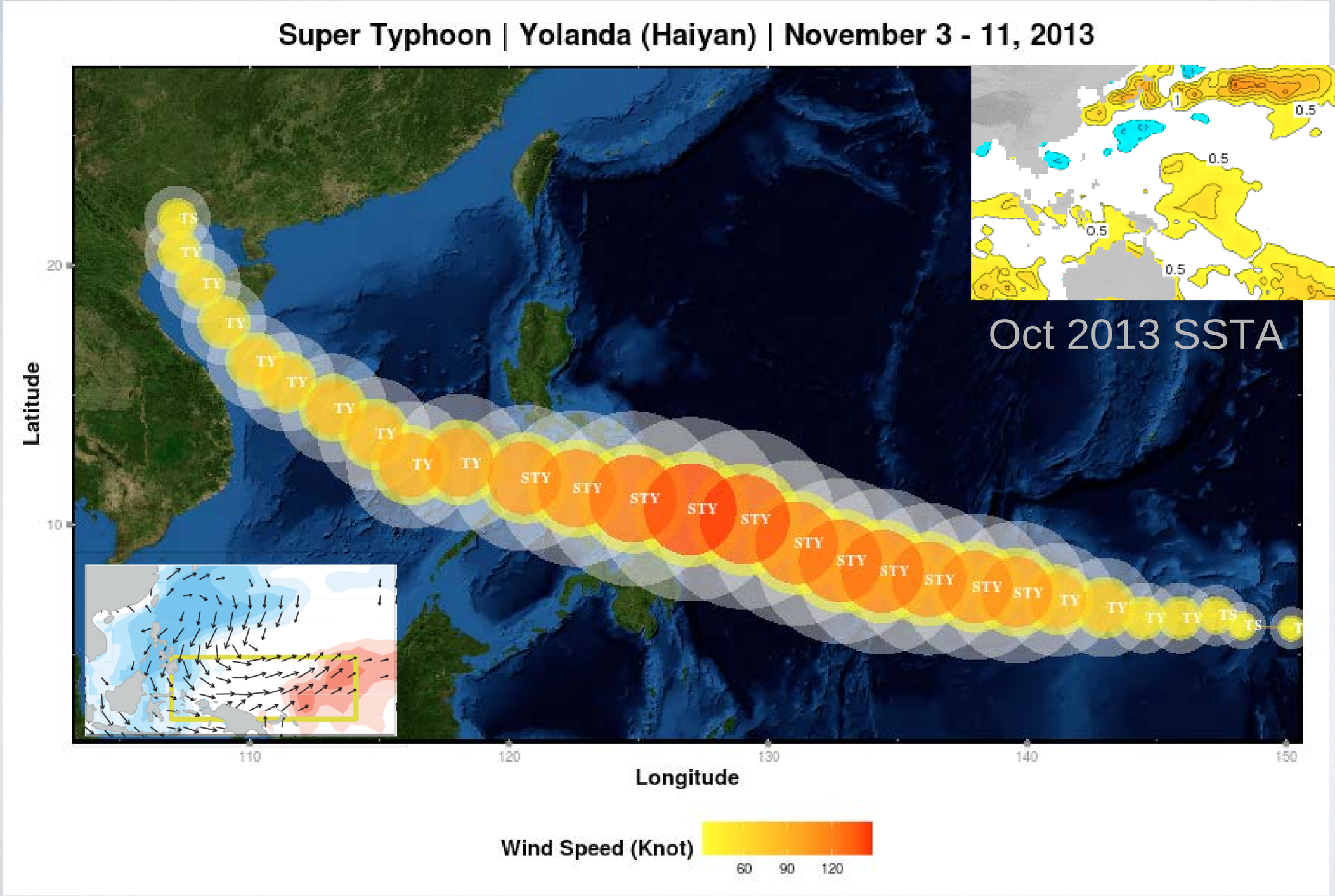


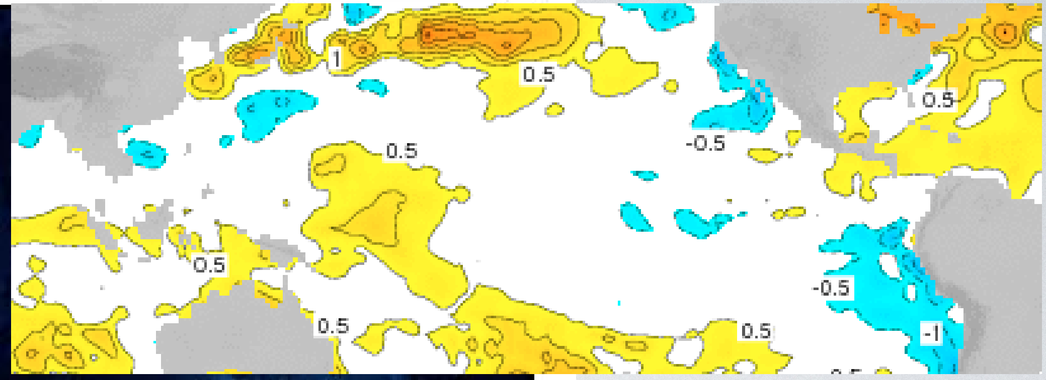
vs.



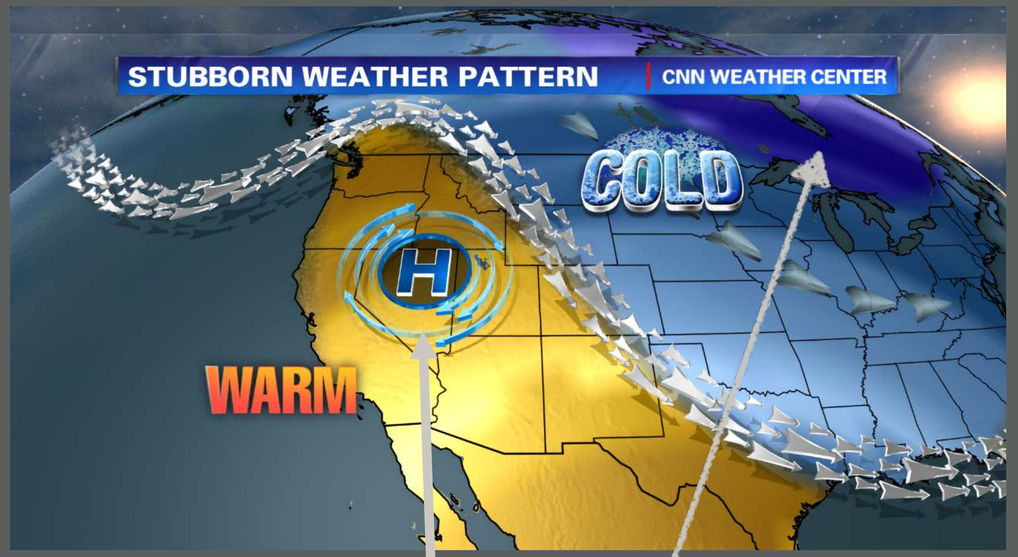
- well developed water markets
- modernize irrigation infrastructure
- clear water entitlements

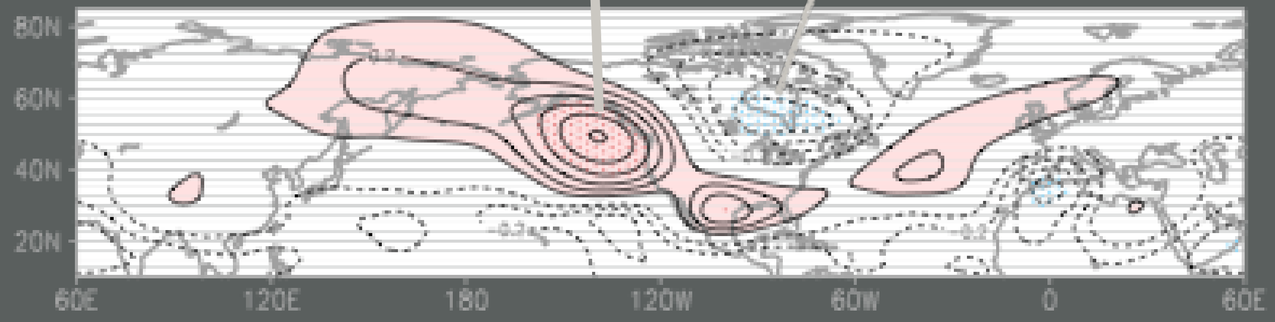

sliding correlation
sliding correlations
0.8
0.6
0.4
0.2
0
-0.2
1960
1970
1980
1990
2000
2010
year
one-year lag
no lag
95%
GRACE
2002-2013
GRACE
2002-2013
one-year lag
no lag
PDSI
Ground-
water


Super Typhoon | Yolanda (Haiyan) | November 3 - 11, 2013
Latitude
Longitude
20
10
110
120
130
140
150
TS
TY
STY
Wind Speed (Knot)
60
90
120


Oct 2013 SSTA
1
0.5
-0.5
-1

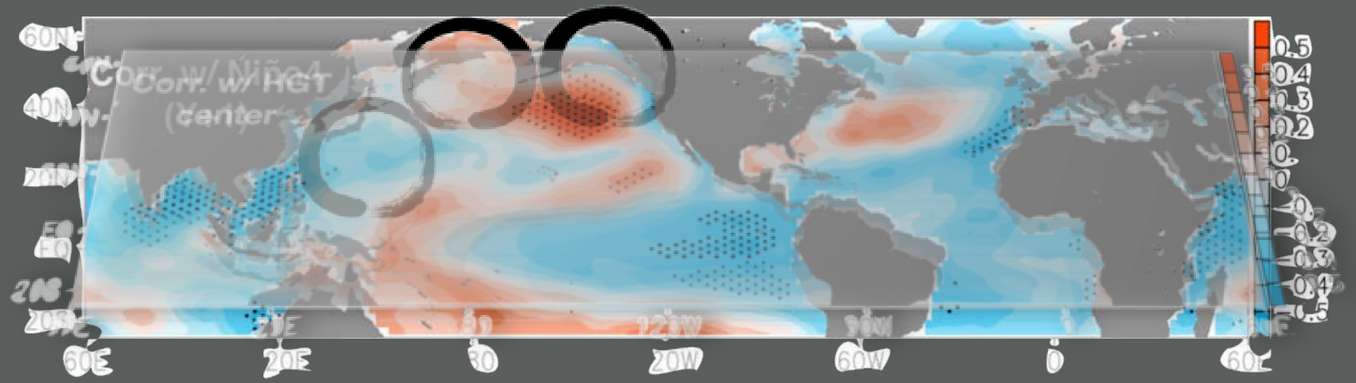
“Dipole”



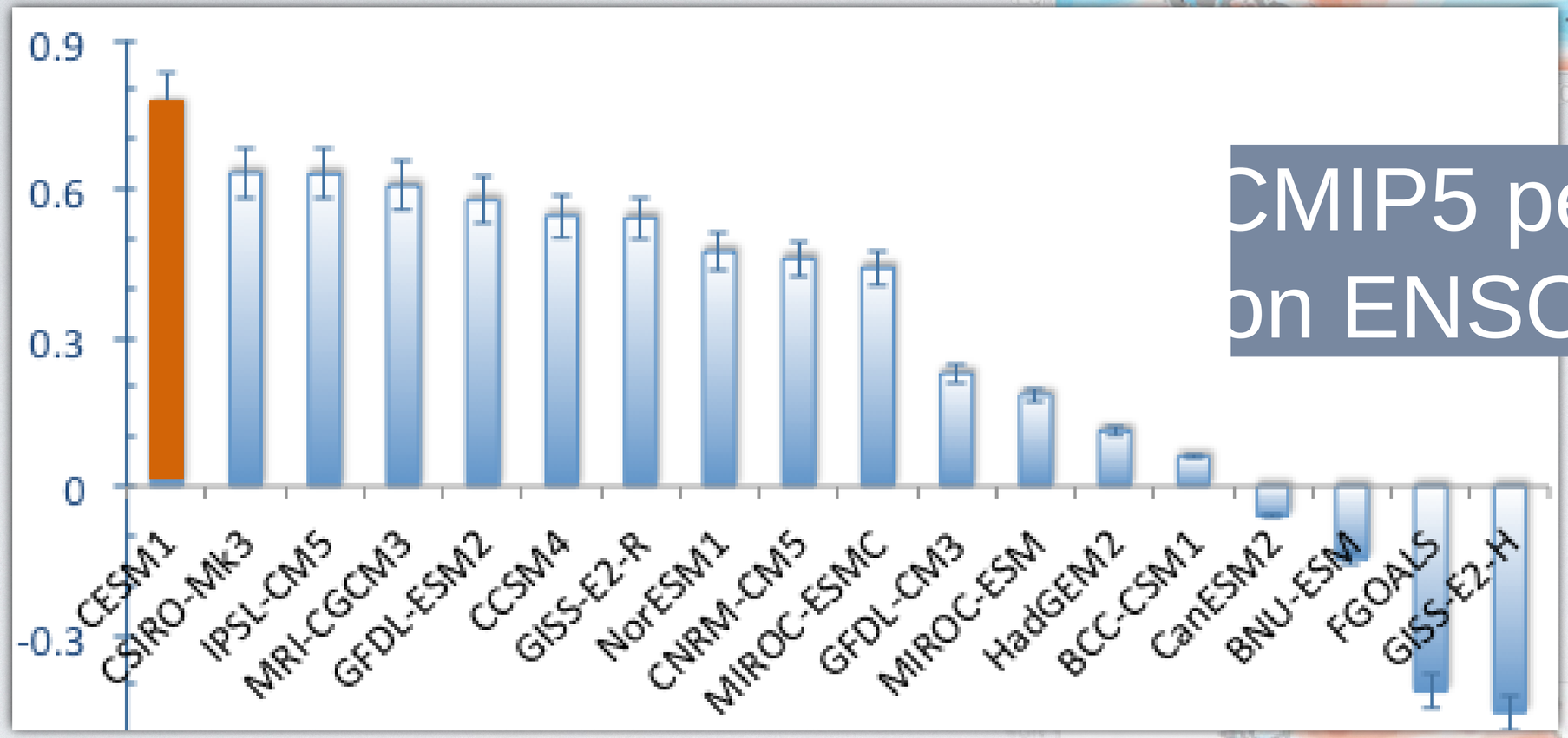


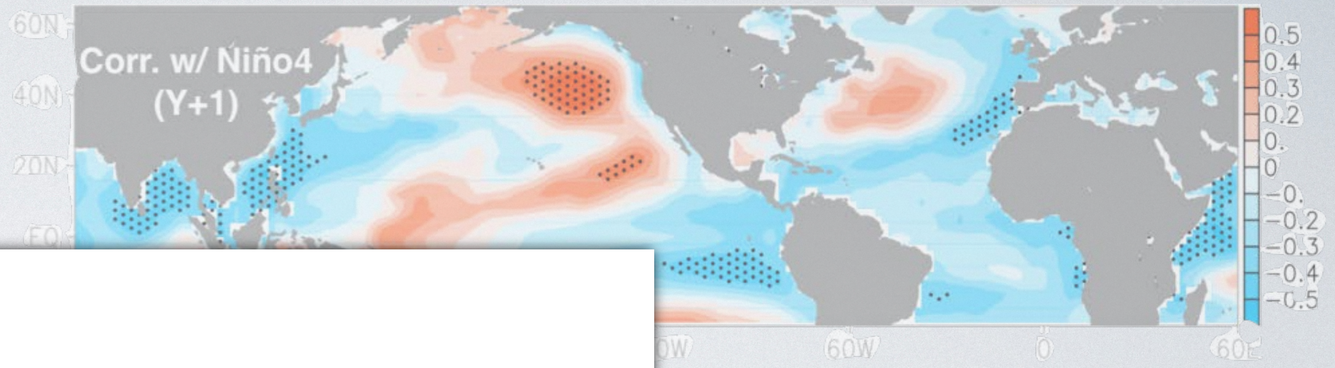
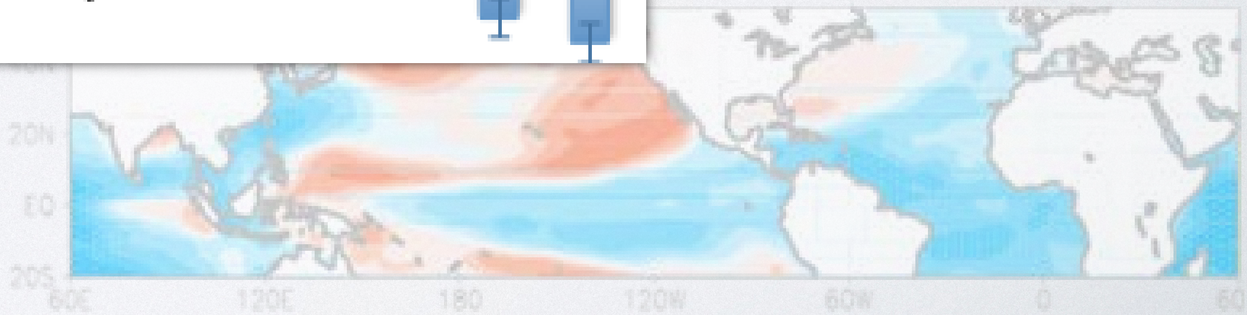
1 yr before

El Niño



Spatial correlation of SSTA





CMIP5 performance
on ENSO precursor