



NORTH AMERICA WINTER CIRCULATION CHANGE

AND IMPLICATIONS ON
S2S & S2D

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International Conferences on Subseasonal to Decadal Prediction

17-21 September 2018 | NCAR, Boulder, CO, USA

sent Sep 11

S2S



Weather

Boulder weather can be unpredictable, please come prepared for all seasons.

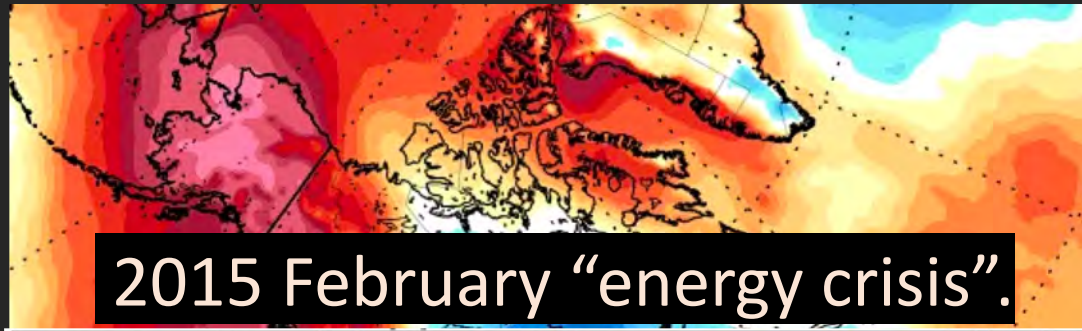
Venue

The conference will be held at the UCAR Center Green Building 1 (CG1), located at 3080 Center Green Drive, and the UCAR Foothills Laboratory 2 (FL2), located at 3450 Mitchell Lane; see [venue map](#). Use the unlocked main entrances on the south facing side of both buildings. There is plenty of free parking onsite at both locations.

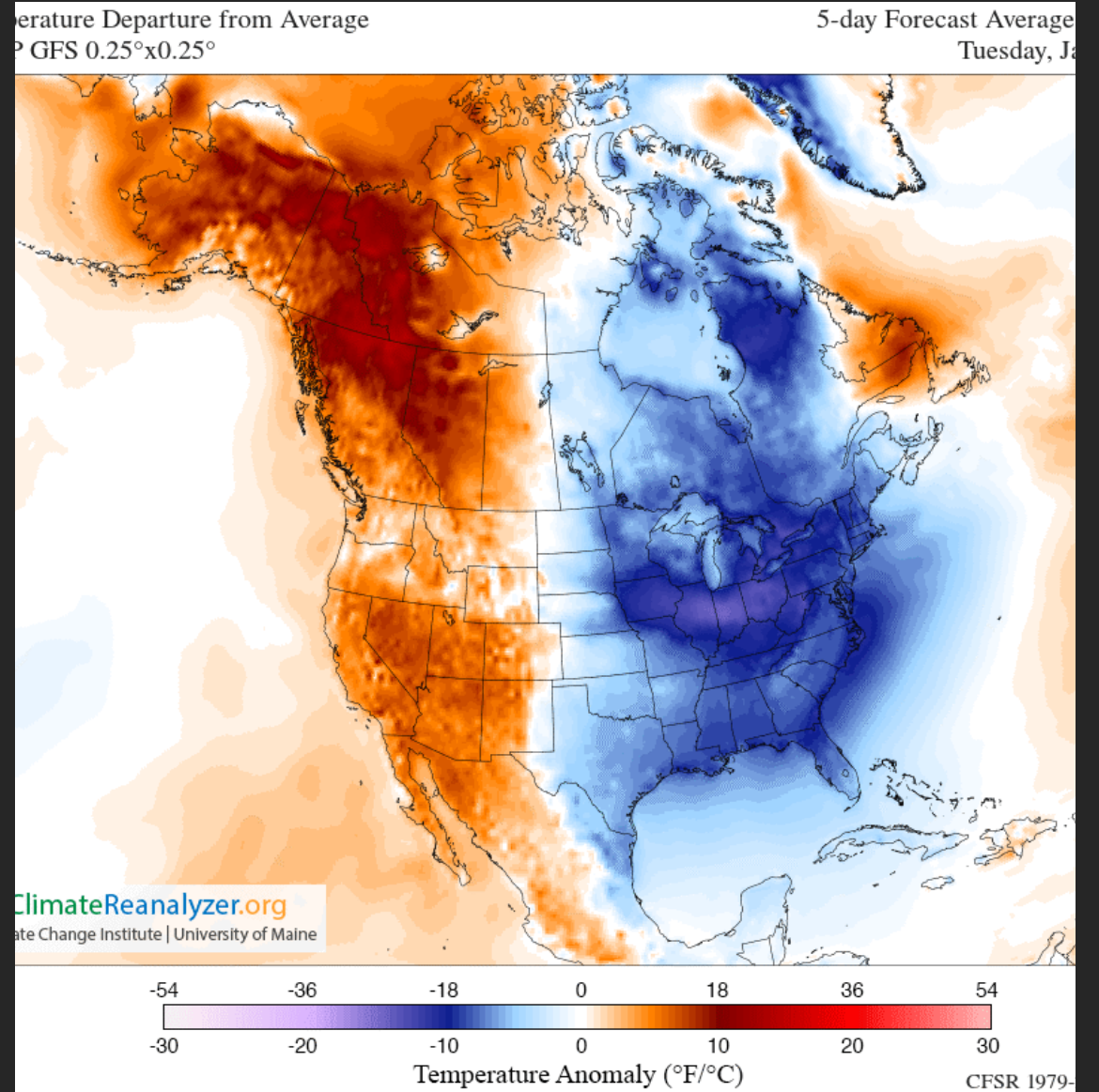
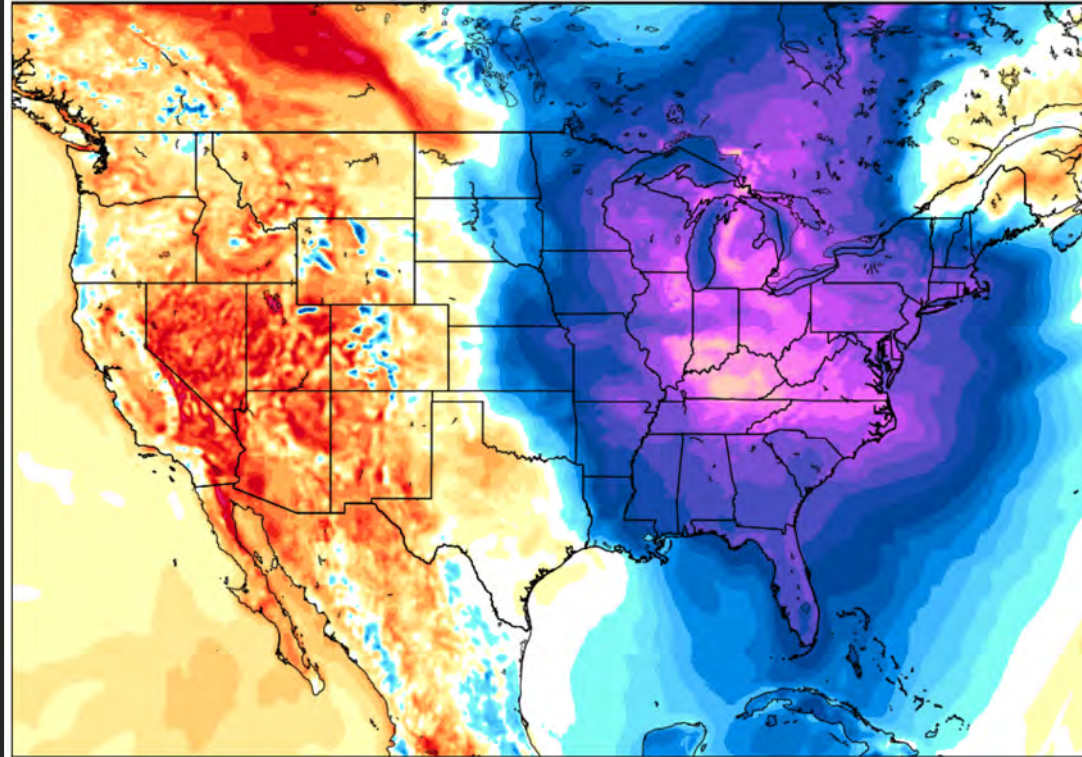
Wireless internet will be available at both locations. Please select the "UCAR Visitor" network, and then enter your name and email address to

5-day temperature forecast for the 2018 New Year week

2014 January “polar vortex”



2015 February “energy crisis”.



5-day temperature forecast for the 2018 New Year week

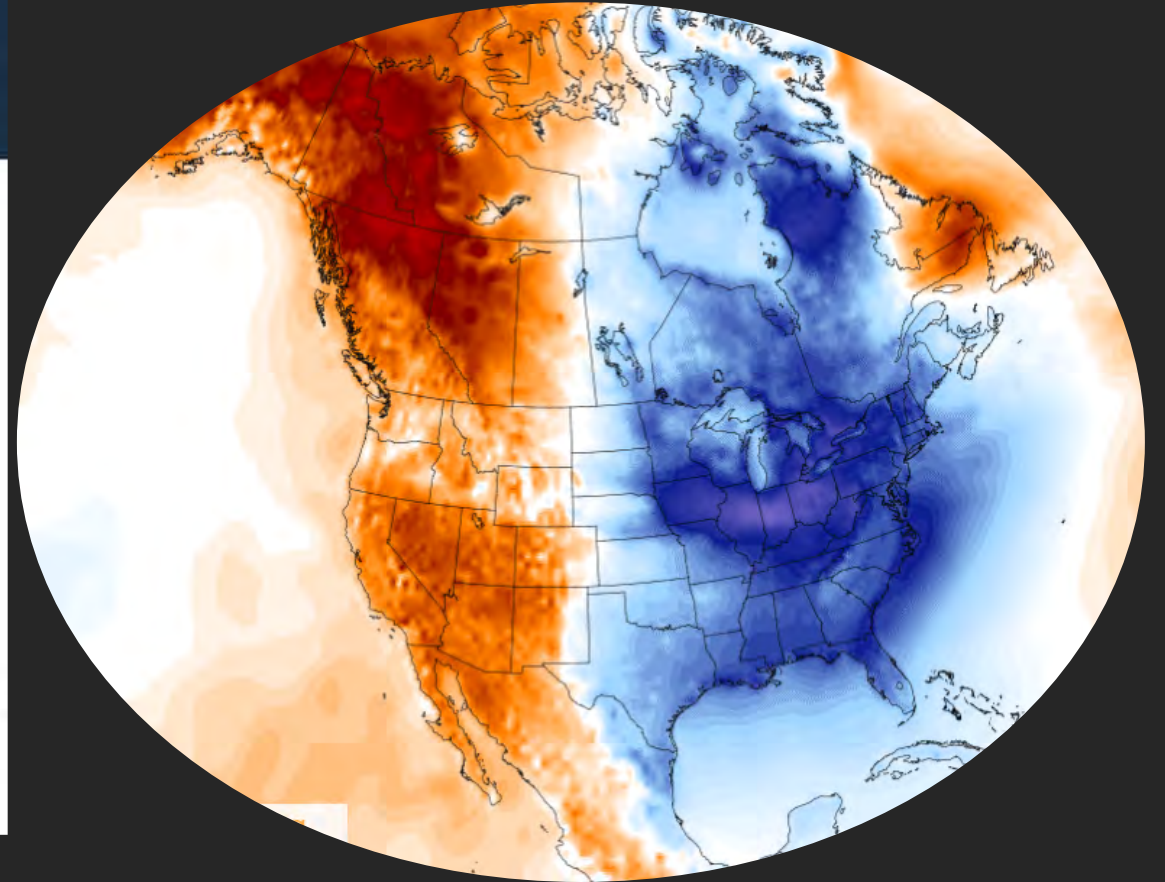


BEST STATES



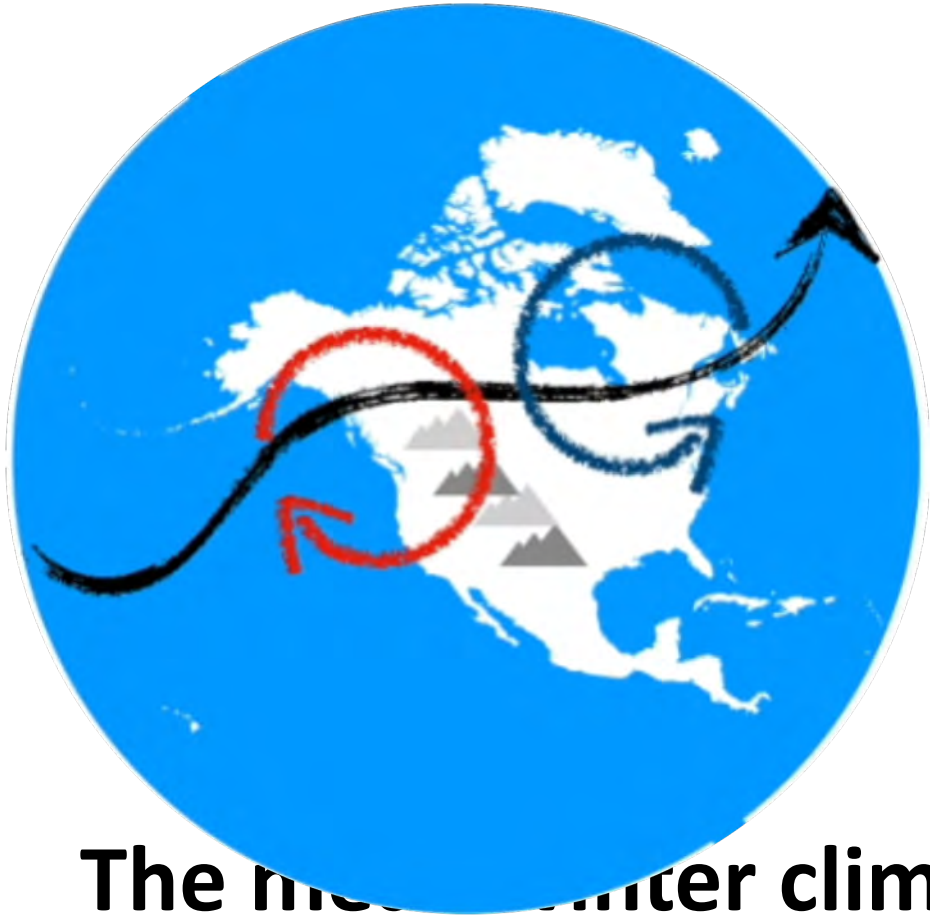
Rising Energy Costs Eyed Amid Brutal Cold Snap Gripping US

Plunging temperatures across half the US underscore stark reality heating aid dollars won't go as far this winter because of rising energy costs;

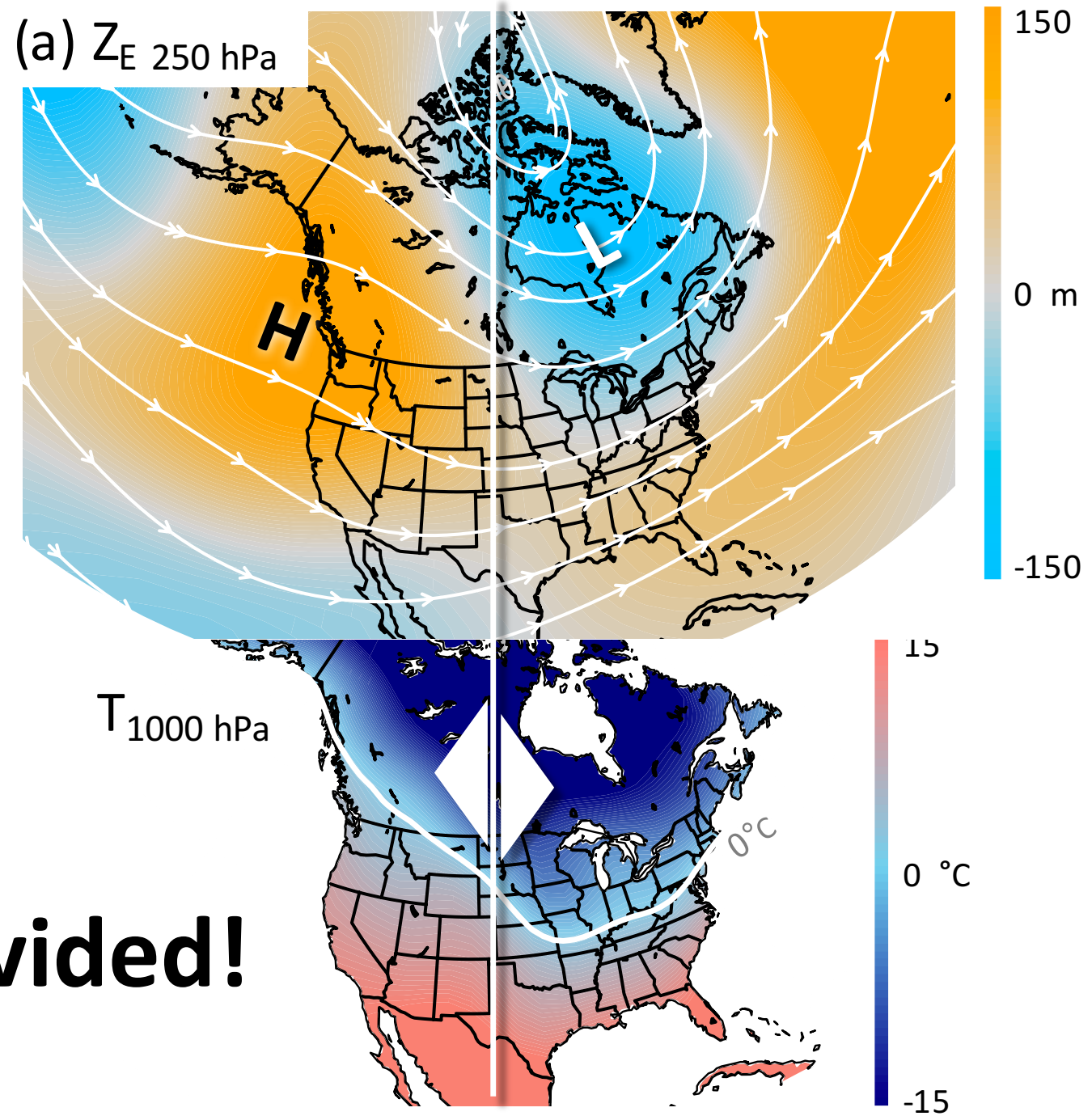




The Mean State



**The mid-winter climate
of North America
is fundamentally divided!**



Billion-Dollar Disasters By State (CPI-Adjusted)

Drought |

Freeze

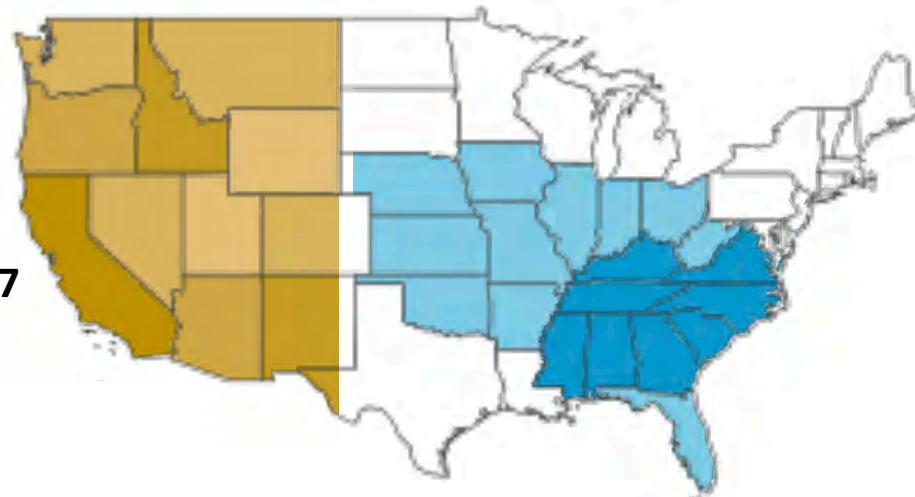
1985-2005



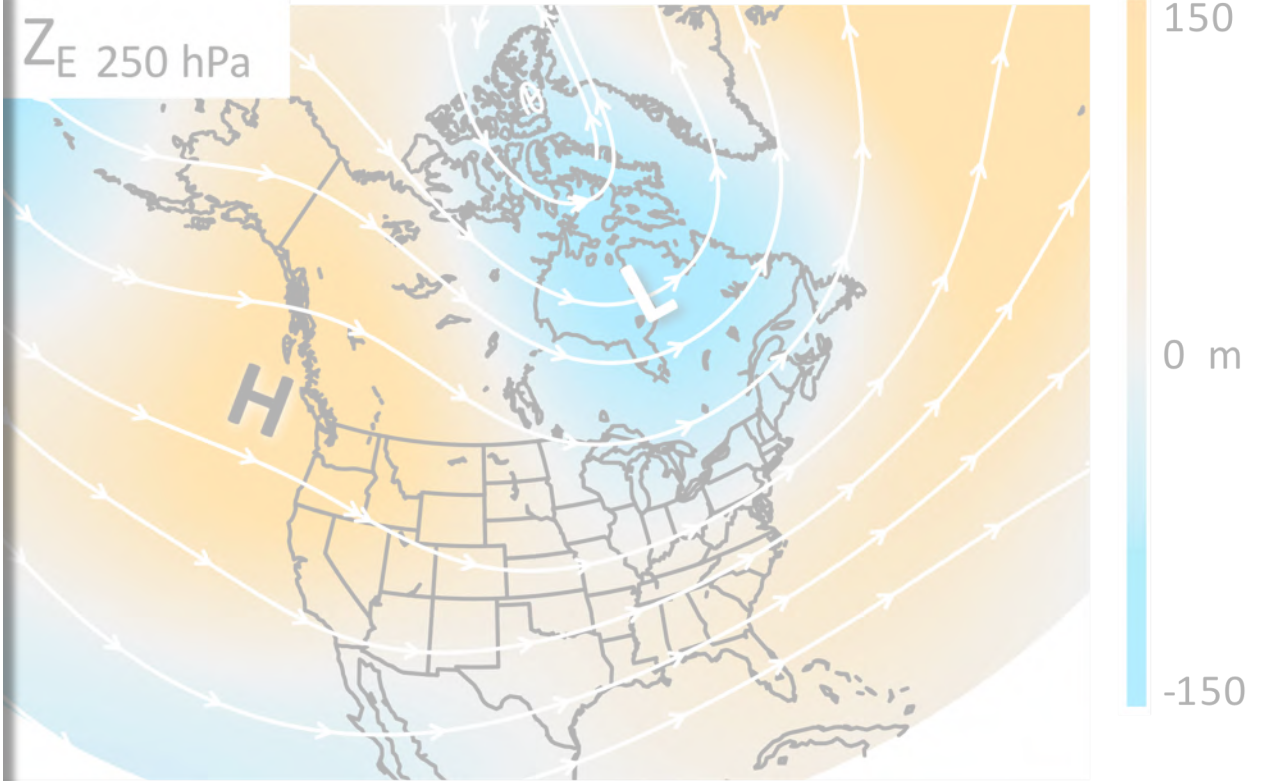
Drought |

Freeze

2006-2017

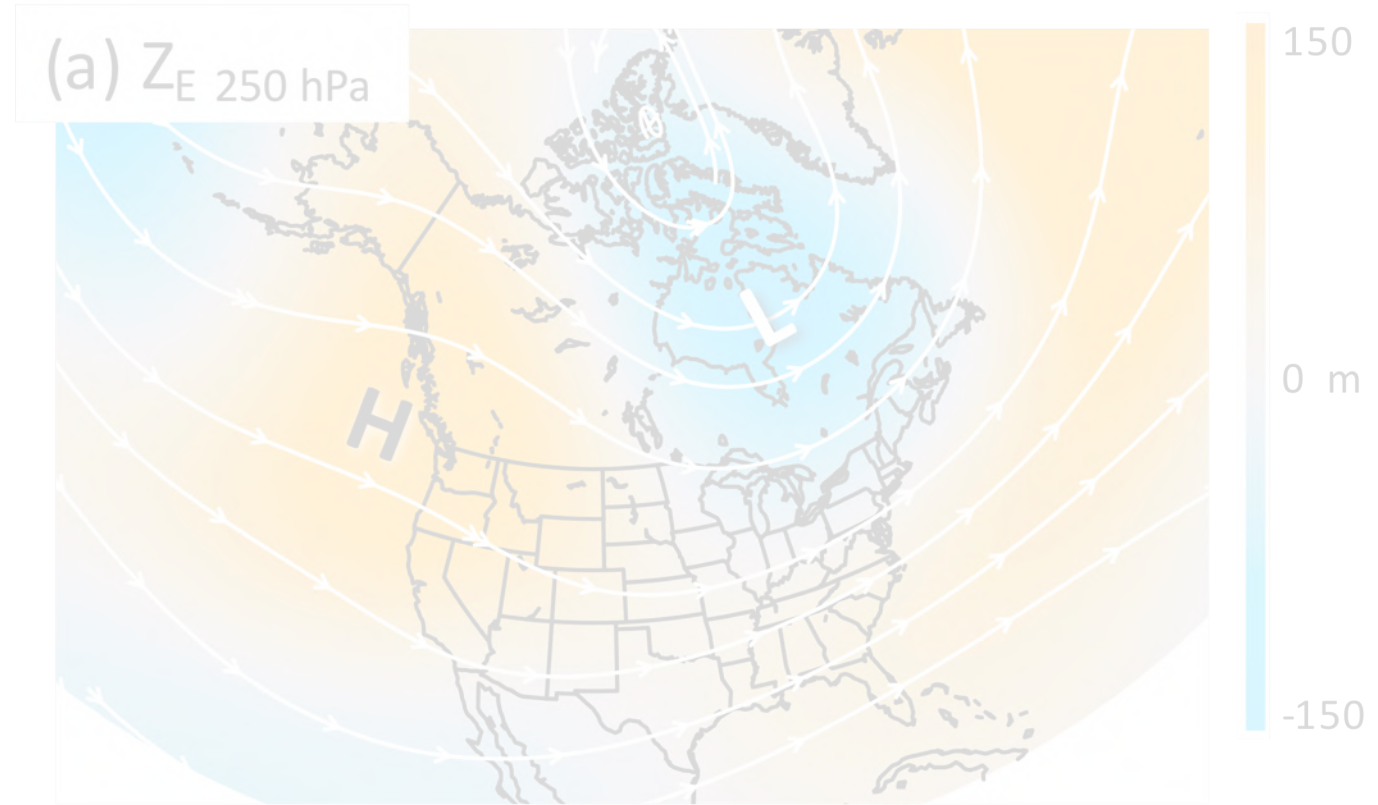
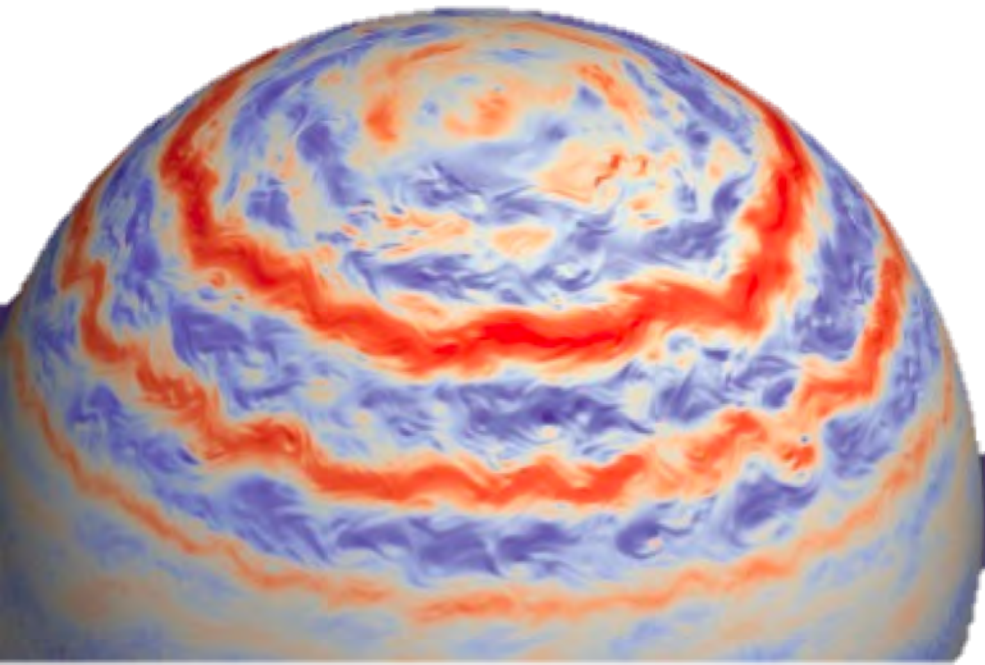


0 8 frequency 0 2

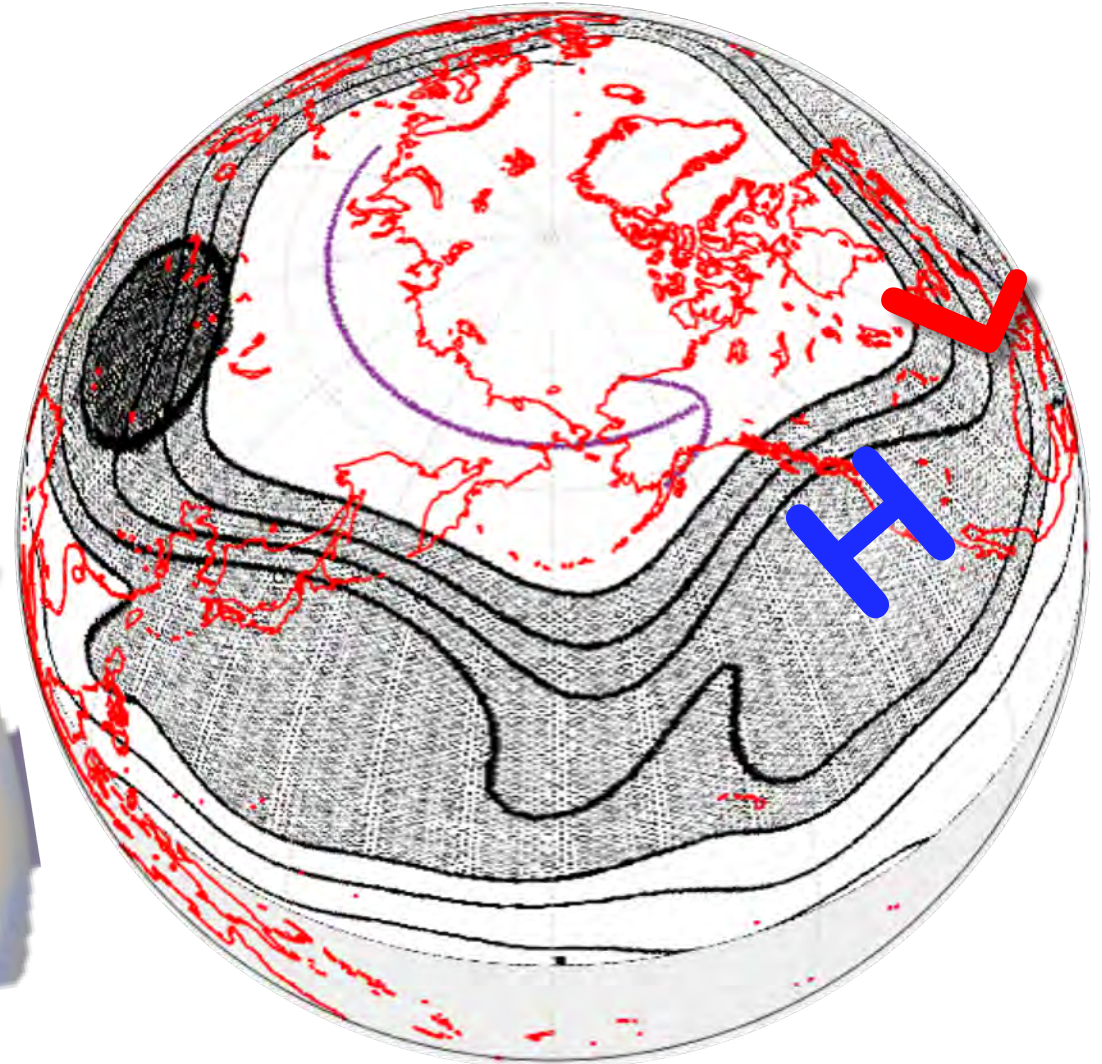
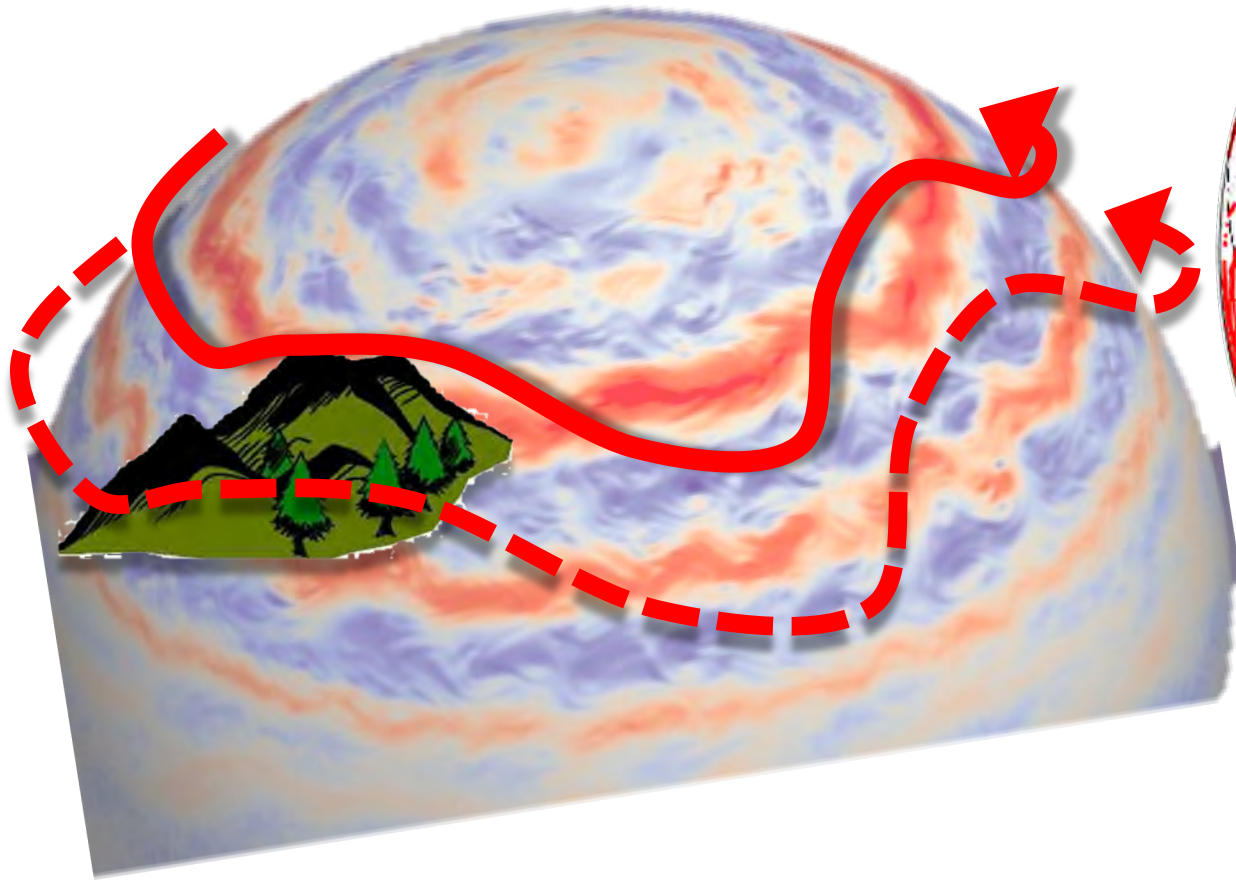


How did it form?

*Jet streams in an
aqua planet*

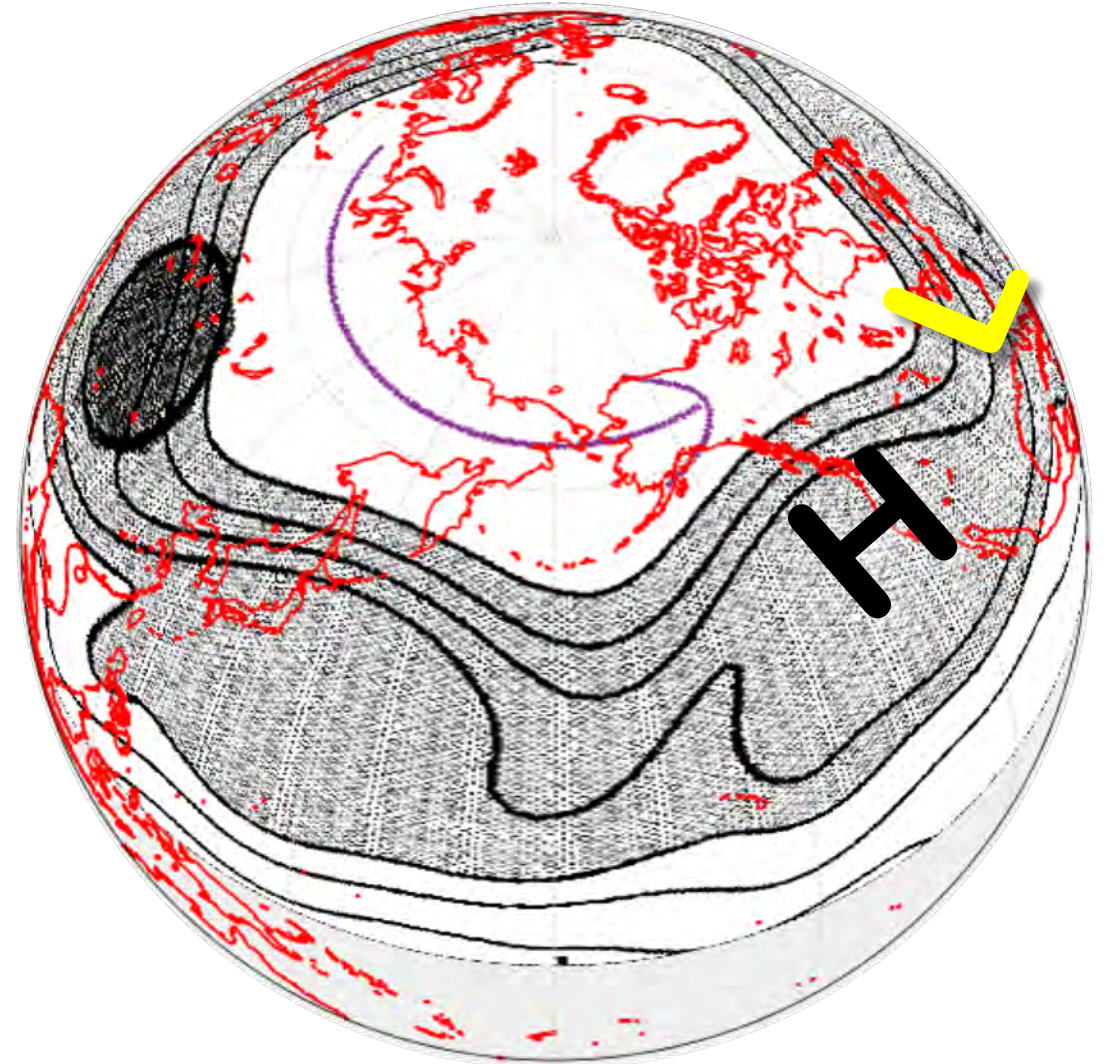


Jet stream + orography = stationary waves



POLVANI ET AL. (1999)

Jet stream + orography = stationary waves

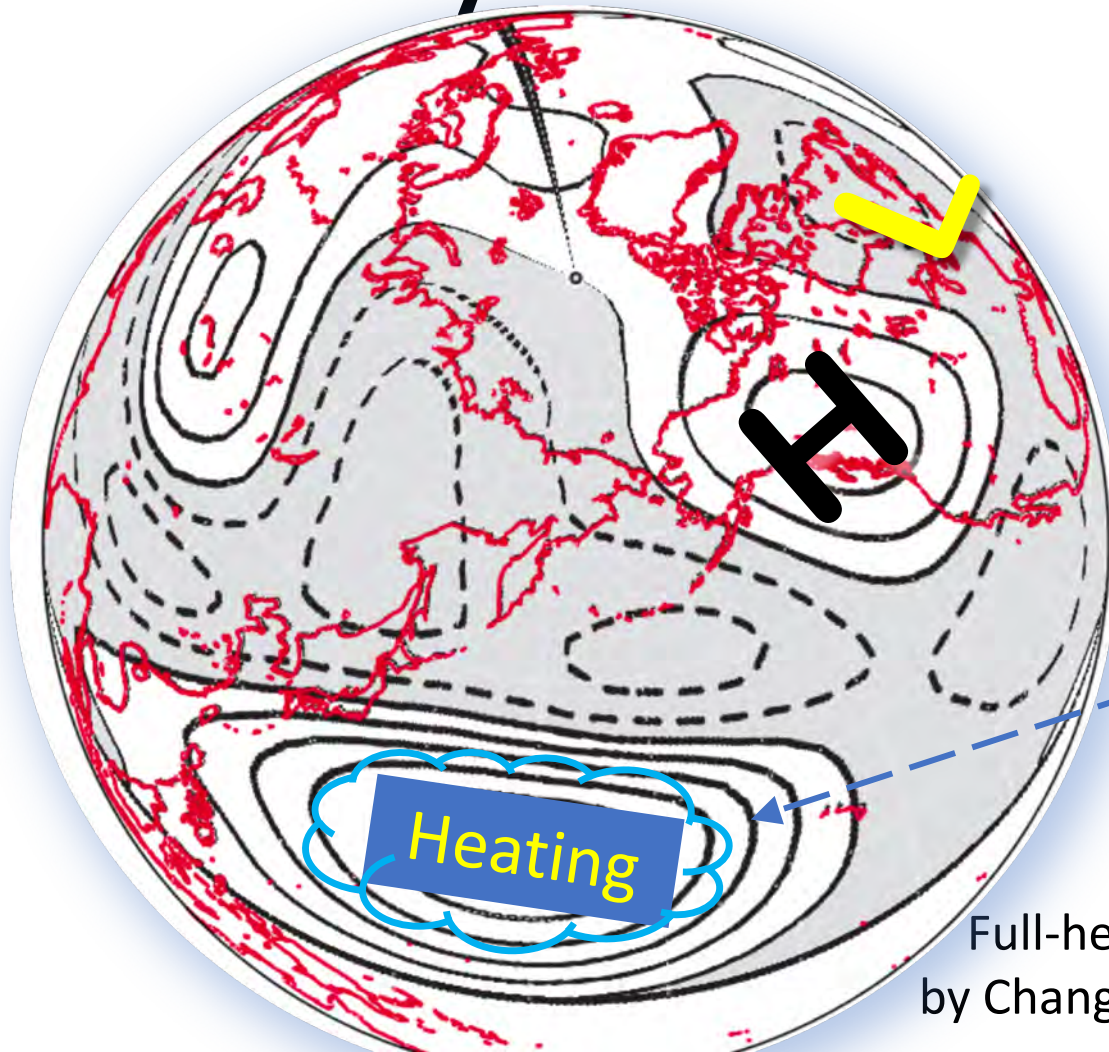


POLVANI ET AL. (1999)

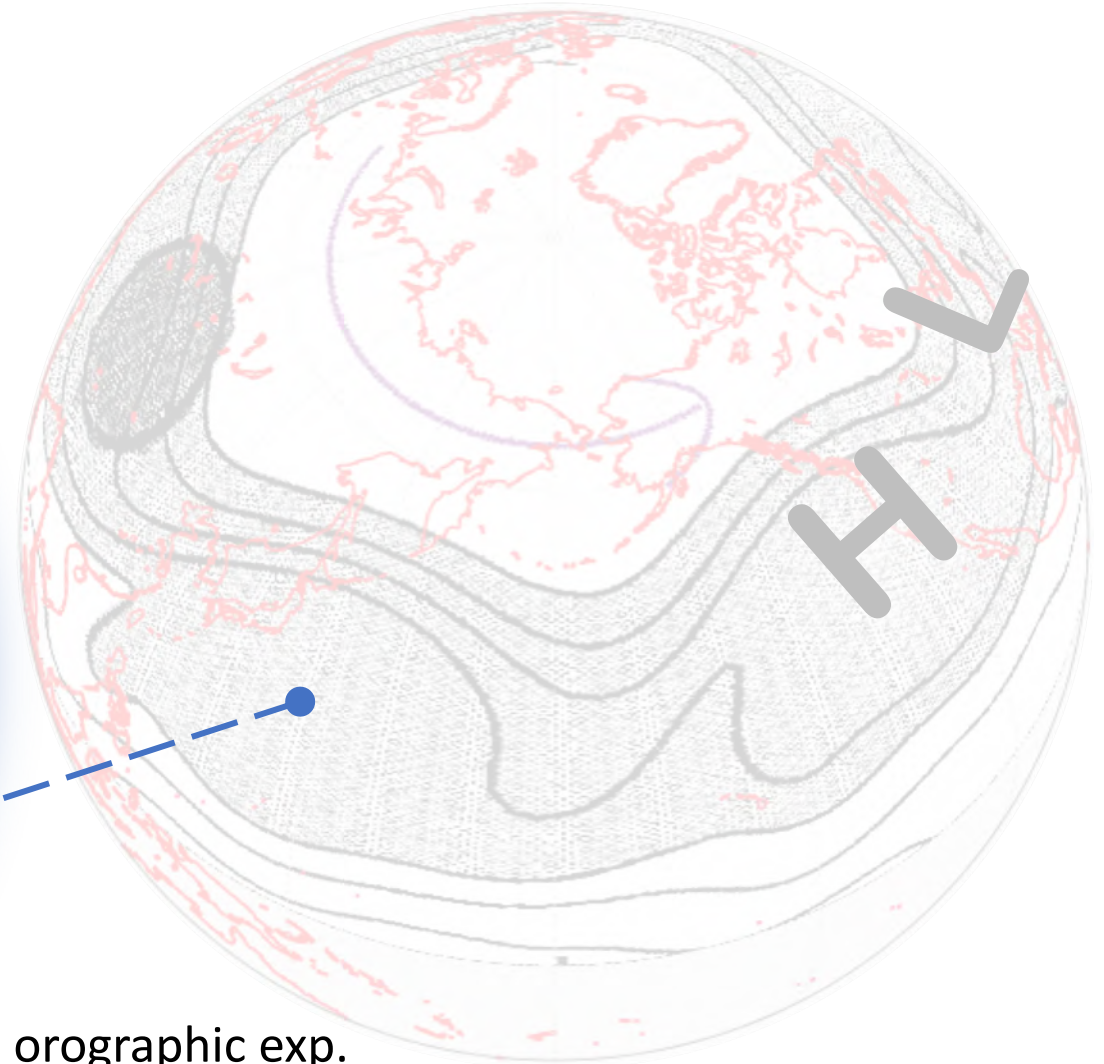
Jet stream fluctuates, so do the stationary waves



Jet stream + orography + heating 🖊️ stationary waves



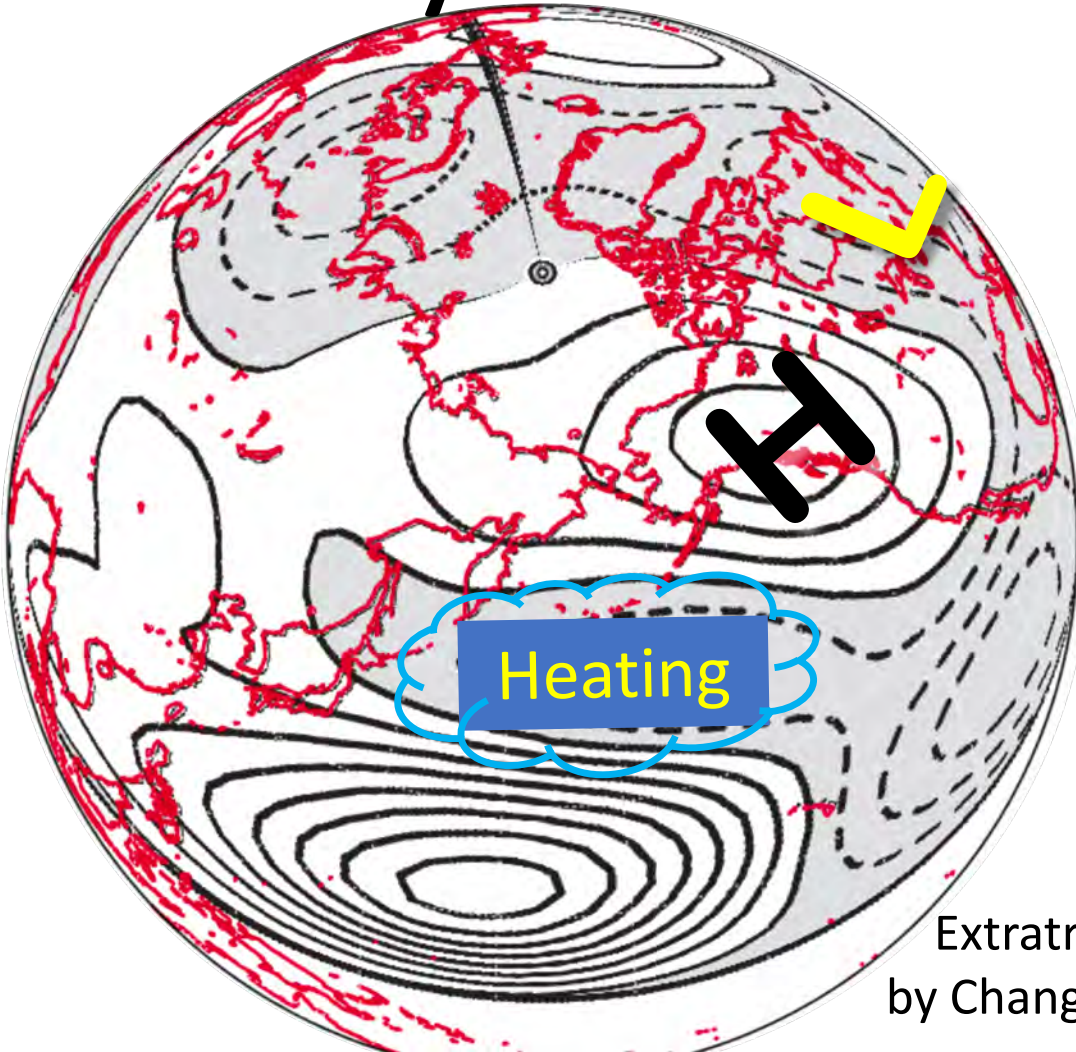
Full-heat orographic exp.
by Chang, E. (2009)



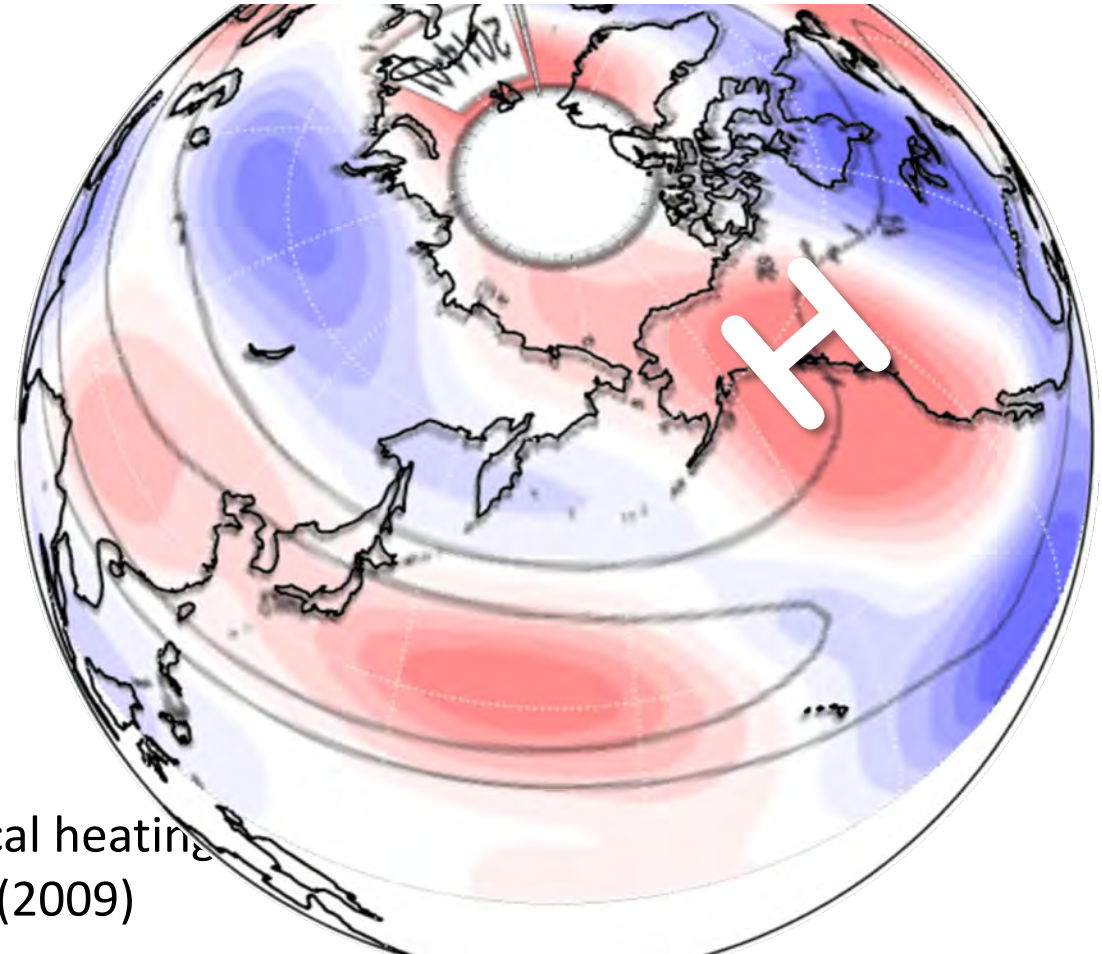
POLVANI ET AL. (1999)

Jet stream + orography + heating 🖐️ stationary waves

2014 January - CA drought
(Teng and Branstator 2016)



Extratropical heating
by Chang, E. (2009)





The Variability

Global warming

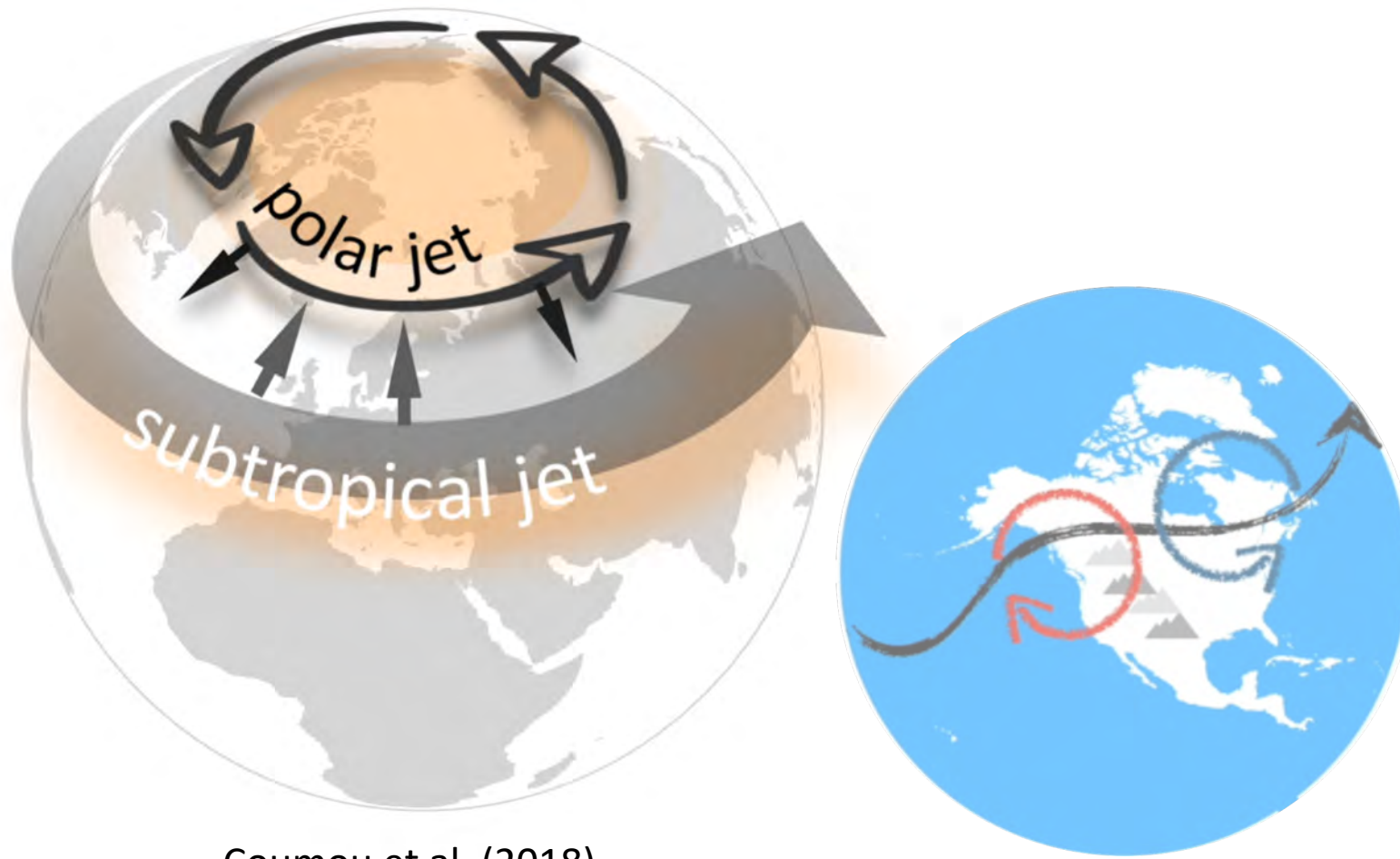
- Hadley cell expansion
- Arctic amplification

→ Jet shifts...



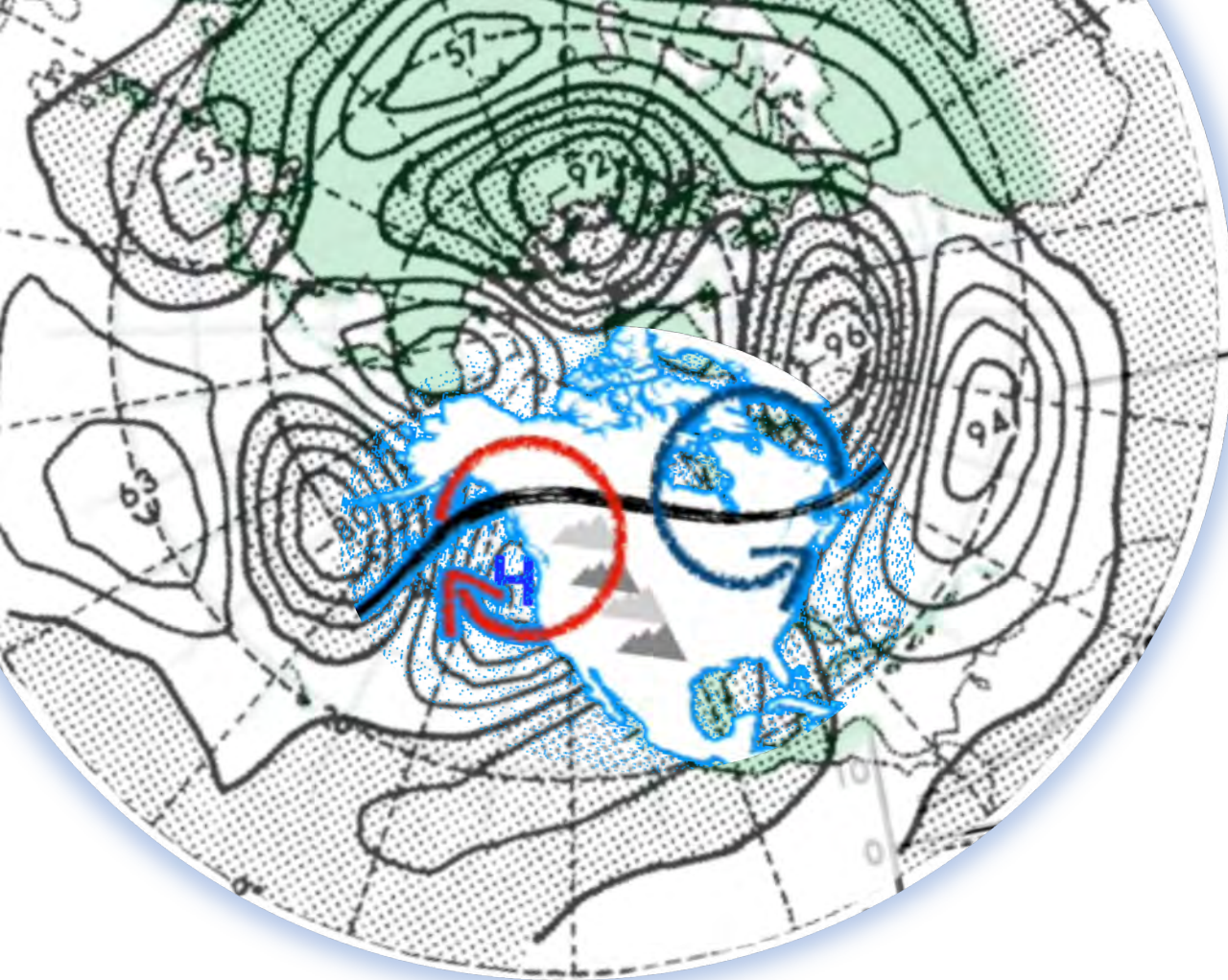
- Jet fluctuation (AO)
- Tropical heating (SubS)
- Extratropical (weather)

“tug of war”



Coumou et al. (2018)

← Jet shifts...

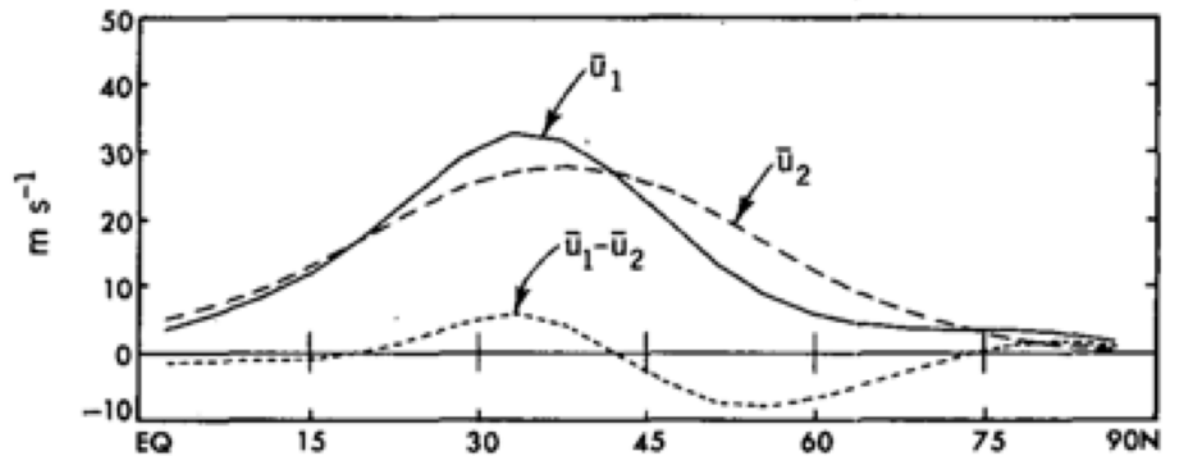


Kang (1990)

← Jet shifts...

Kang (1990)

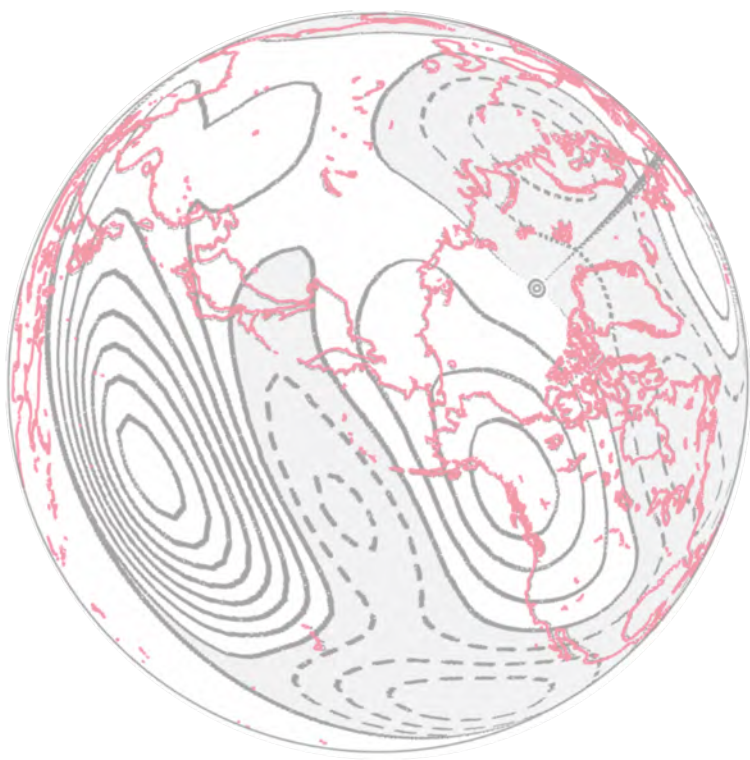
background jet speed



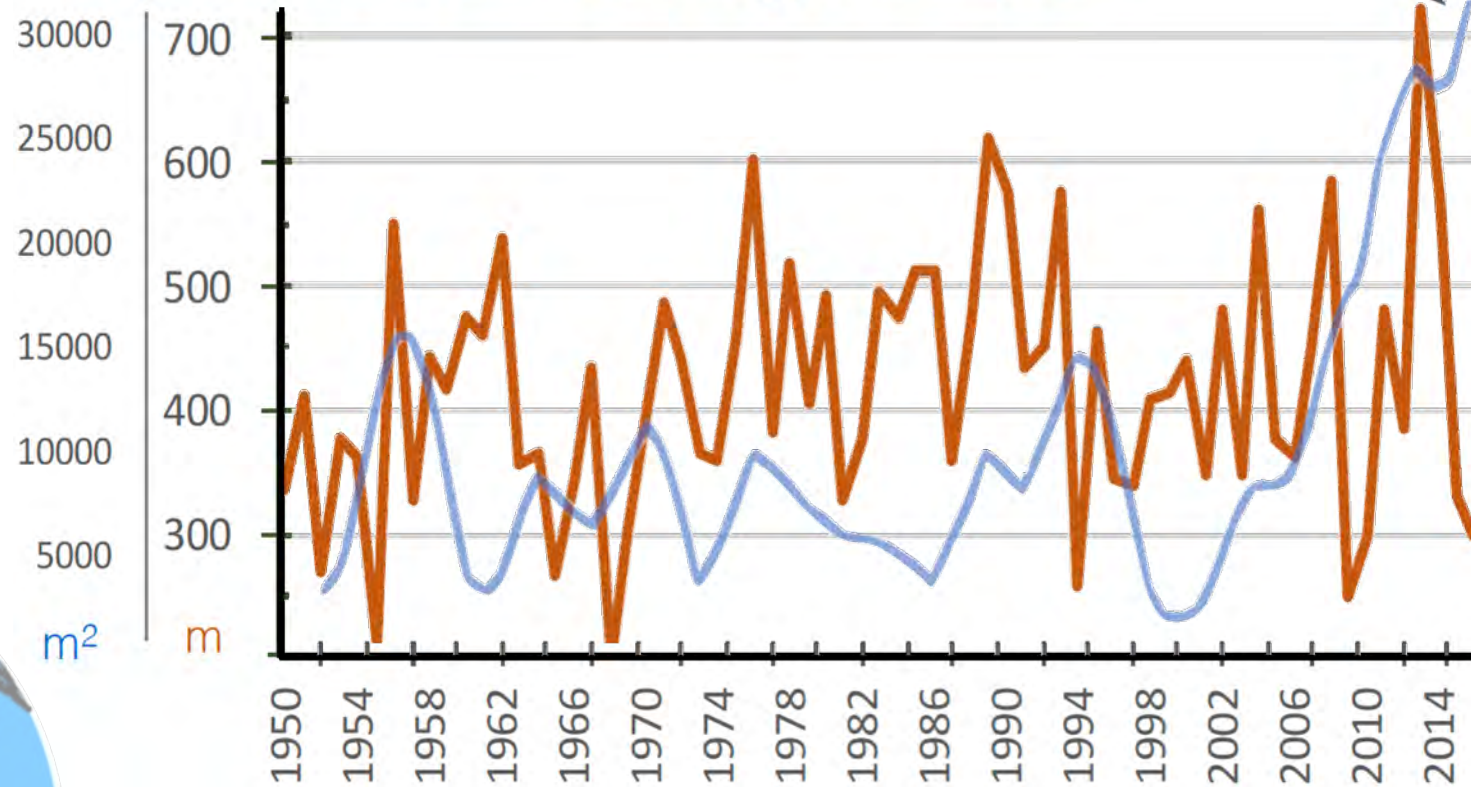
Equator

N. Pole

In real world, jet shifts trigger heating change as well



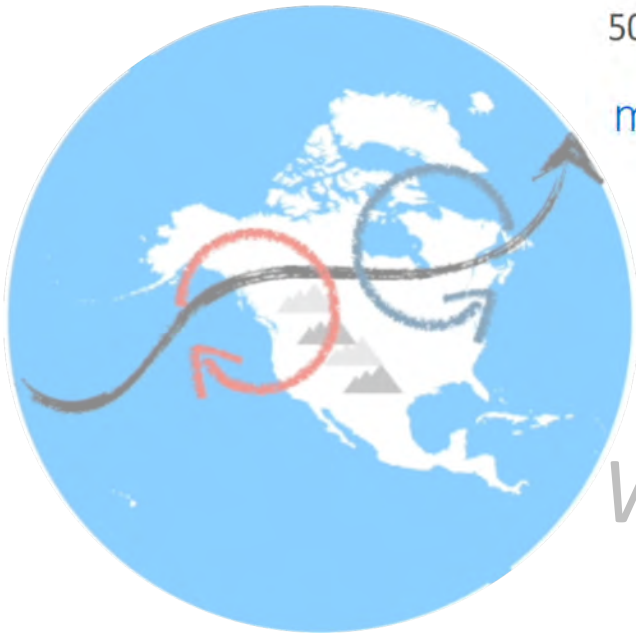
Dipole index & running variance



2013-2014
California drought

2016-2017
California flood

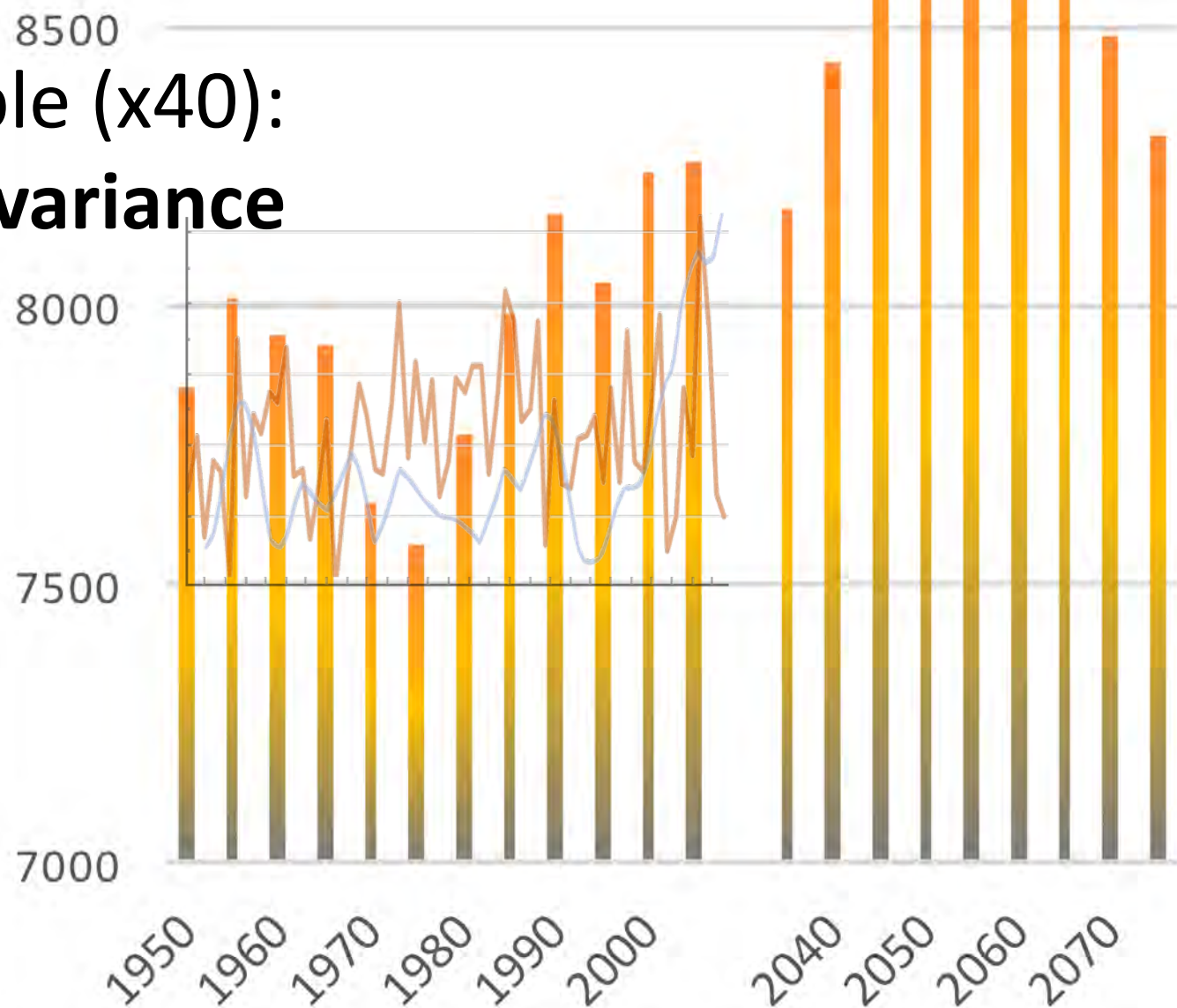
dipole index = $\text{red circle} - \text{blue circle}$



What's the observation showing?

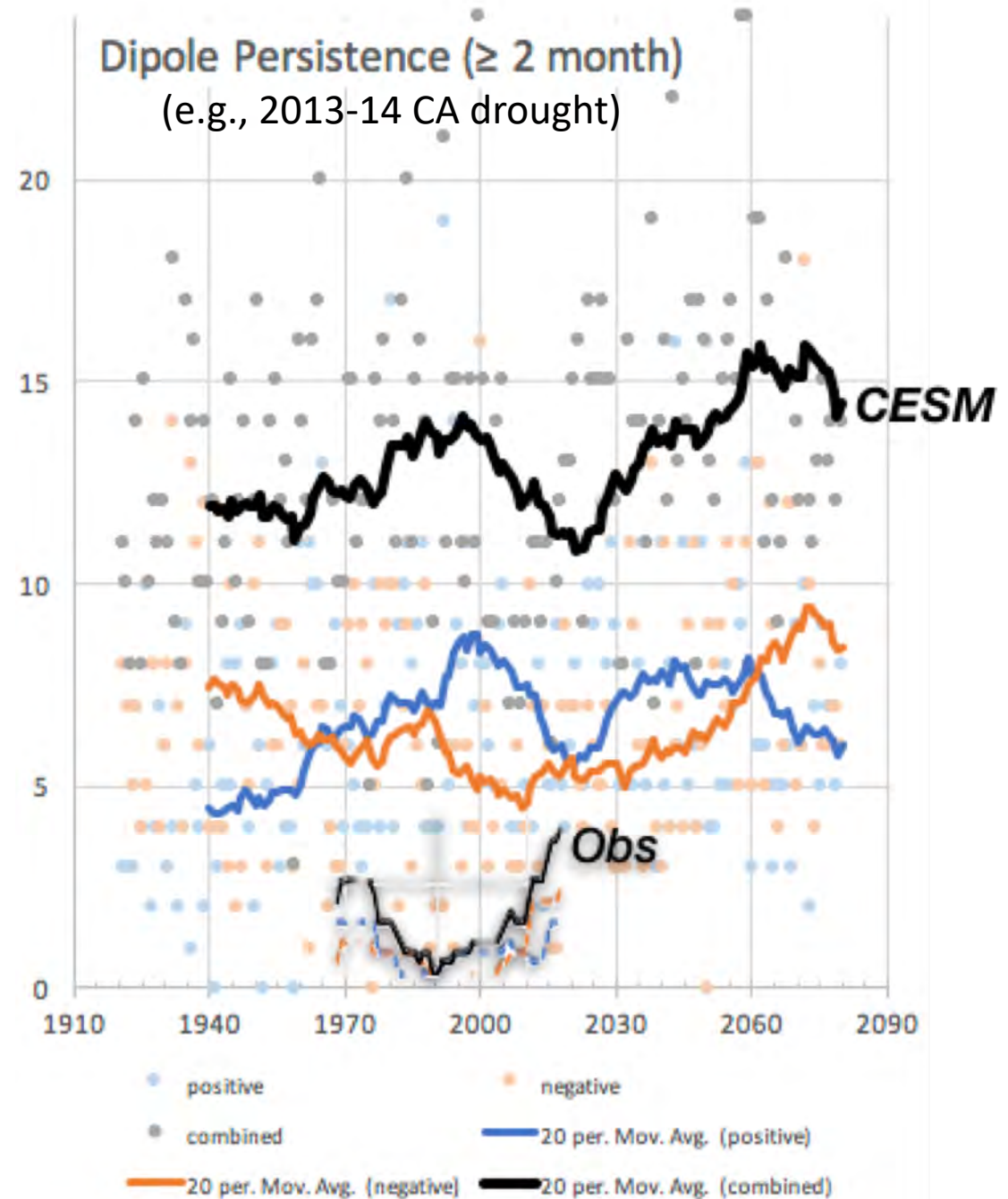
CESM Large Ensemble (x40): 30-yr dipole variance

dipole index = ○ - ○

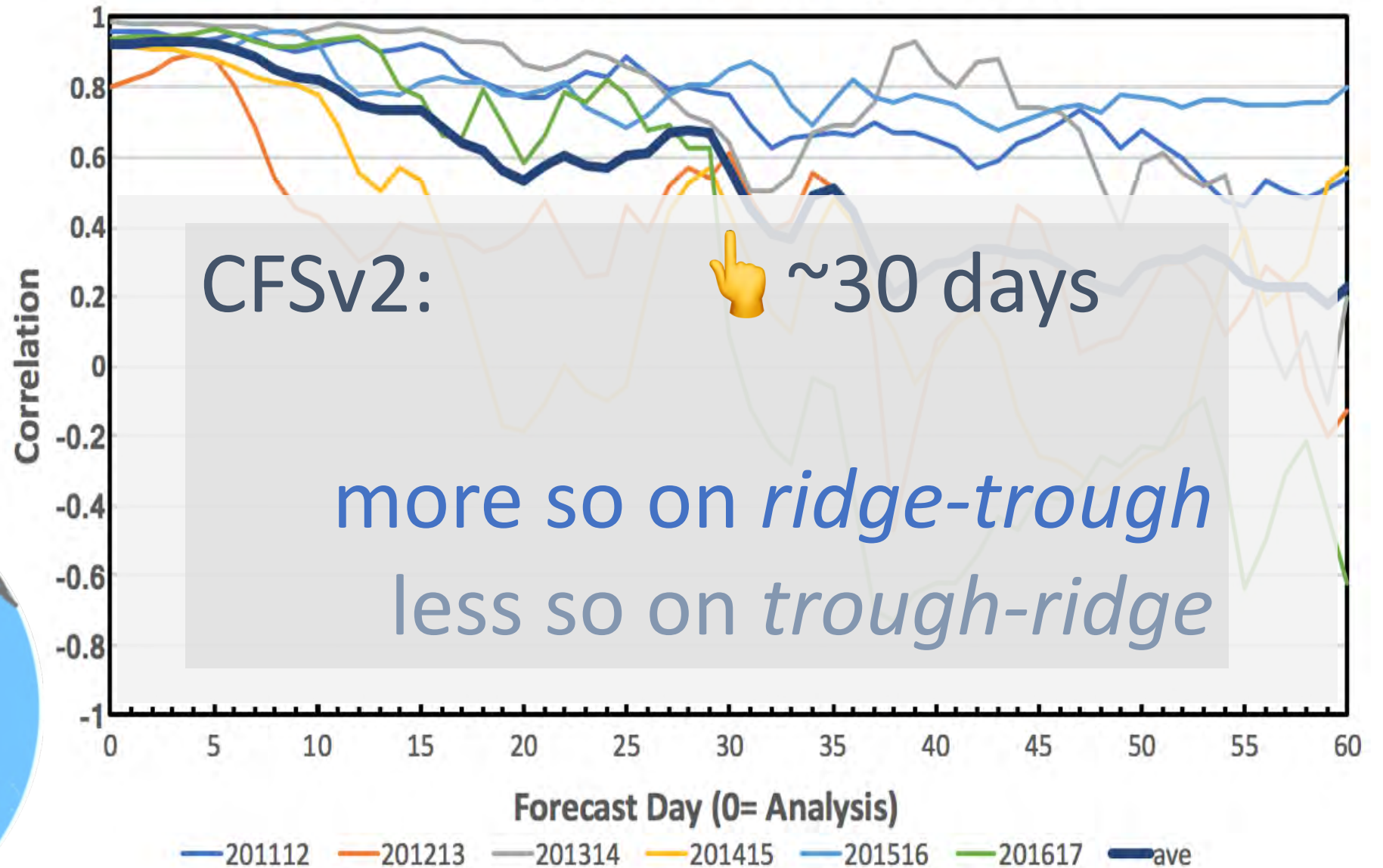


CESM Large Ensemble (x40): Dipole persistence

dipole index = ○ - ○



Z200 Spatial Corr. NDJ (2011-12~2016-17) CFSv2 vs NCEP



dipole index = ○ - ○



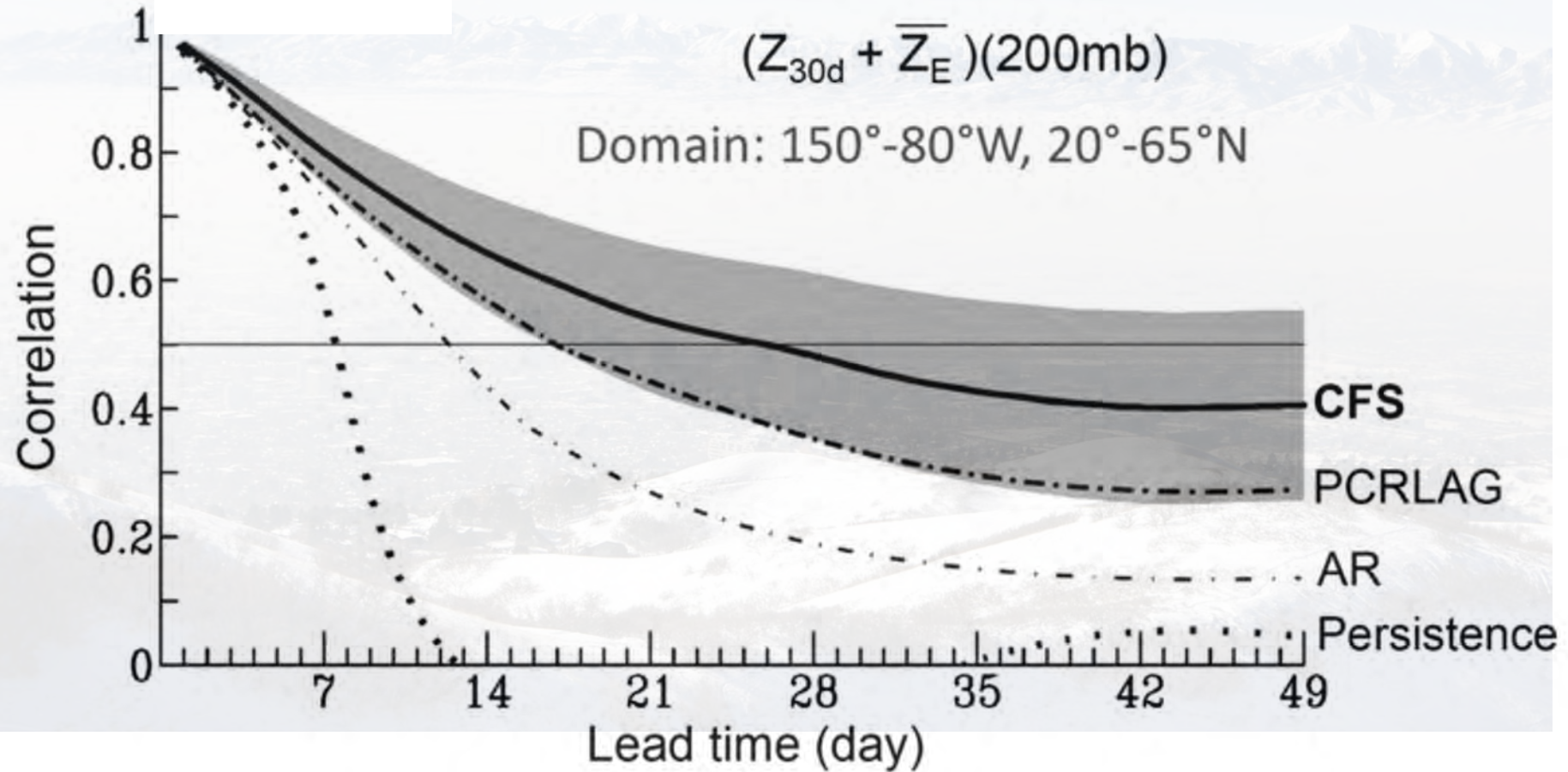
10 years ago...

ridge index = **O** only



GILLIES ET AL. (2010 WAF)

CFSv1



“prolonged” winter inversion + bad air
(@ Salt Lake City, Utah)

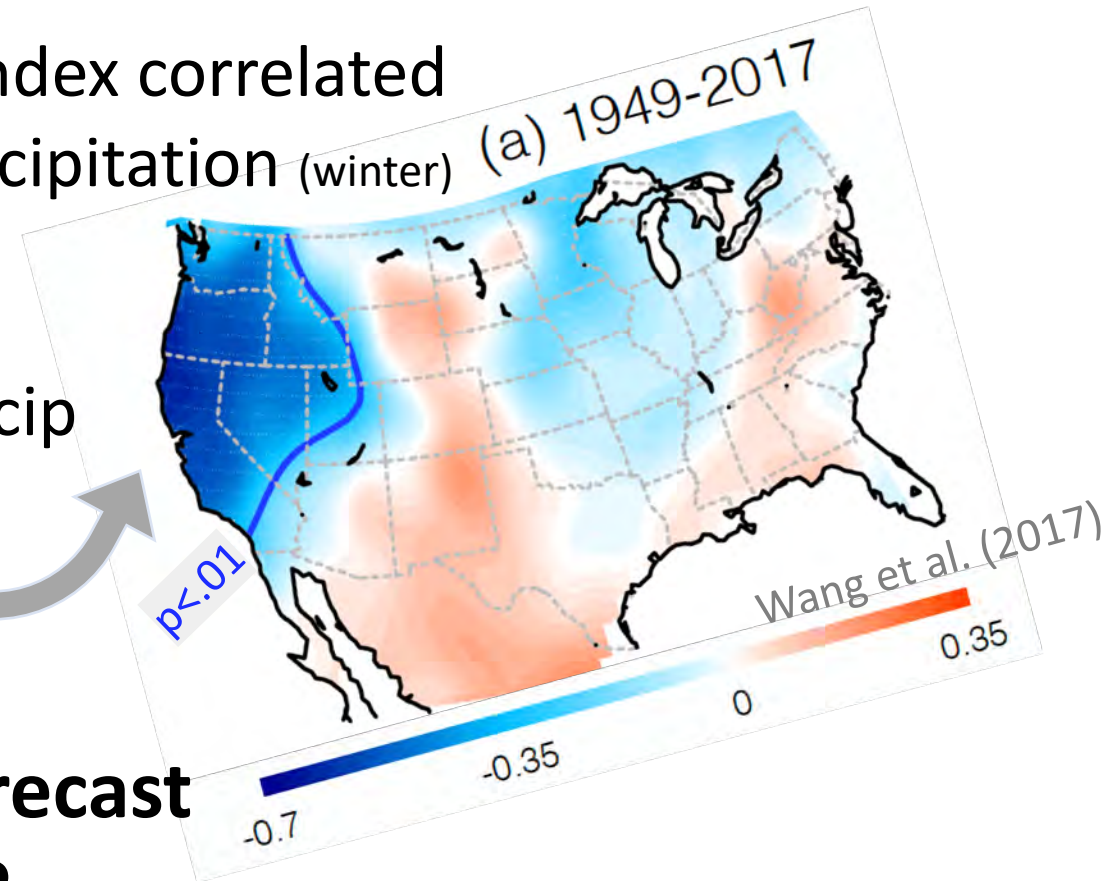
dipole index = O - O



Dipole index correlated
with precipitation (winter)

>60% of CA precip
made by ARs...

→ 30-day forecast
on ARs?



**Atmospheric River Tracking Method
Intercomparison Project (ARTMIP):**

doi:10.5194/gmd-11-2455-2018



Commentary

Published: 30 June 2017

California from drought to deluge

S.-Y. Simon Wang , Jin-Ho Yoon, Emily Becker & Robert Gillies

Nature Climate Change **7**, 465–468 (2017) | [Download Citation](#) 

The dramatic switch from extreme drought to severe flooding in California, and the accompanying flip from atmospheric ridge to trough in the northeastern Pacific, exemplifies the pathways to an intensified water cycle under a warming climate.



Summary

Papers:

- Wang, S.-Y., J.-H. Yoon, E. Becker, and R. R. Gillies, 2017: **California from drought to deluge**. *Nature Climate Change*, [7, 465-468](#). ([PDF](#))
- Lin, Y.-H., L. Hipps, S.-Y. Wang, and J.-H. Yoon, 2016: **Empirical and modeling analysis of the circulation influences on California precipitation deficits**. *Atmospheric Sciences Letters*, DOI: 10.1002/asl.719 ([PDF](#))
- Wang, S.-Y., Y.-H. Lin, R. R. Gillies, and K. Hakala, 2016: **Indications for protracted groundwater depletion after drought over the Central Valley of California**. *Journal of Hydrometeorology*. DOI: [10.1175/JHM-D-15-0105.1](#) ([PDF](#)).
- Yoon, J.-H., Wang, S.-Y., R. R. Gillies, B. Kravitz, L. Hipps, and P. Rasch, 2015: **Increasing Water Cycle Extremes in California and in Relation to ENSO Cycle Under Global Warming**. *Nature Communications*, DOI: 10.1038/ncomms9657 ([PDF](#)).
- Yoon, J.-H., Wang, S.-Y., R. R. Gillies, L. Hipps, B. Kravitz, and P. Rasch, 2015: **Extreme Fire Season in California: A Glimpse into the Future?**. *Bulletin of the American Meteorological Society*, 96, S#(in press) [PDF](#).
- 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*, ([PDF](#)), [doi: 10.1002/asl2.565](#).
- Wang, S.-Y., L. Hipps, R. R. Gillies, and J.-H. Yoon, 2014: **Probable causes of the abnormal ridge accompanying the 2013-14 California drought: ENSO precursor and anthropogenic warming footprint**. *Geophysical Research Letters*. [DOI: 10.1002/2014GL059748](#)