

# El Niño: All Washed Up?

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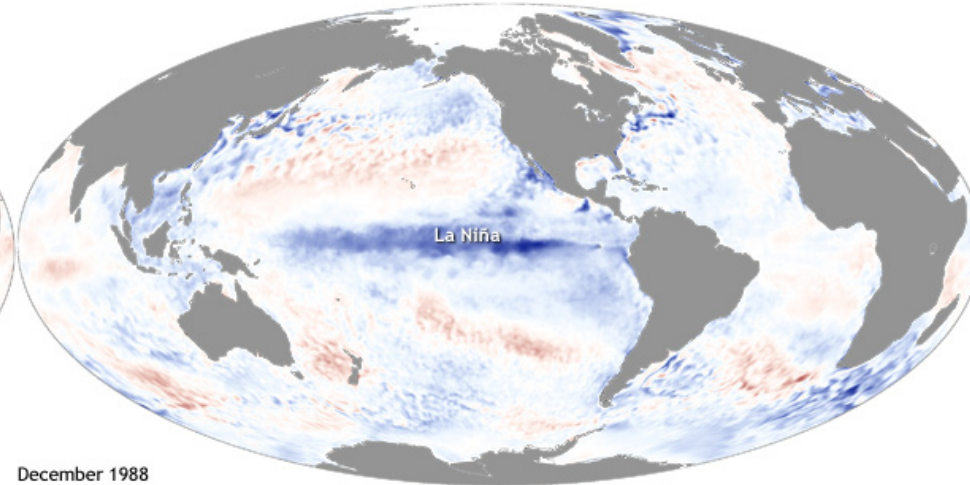
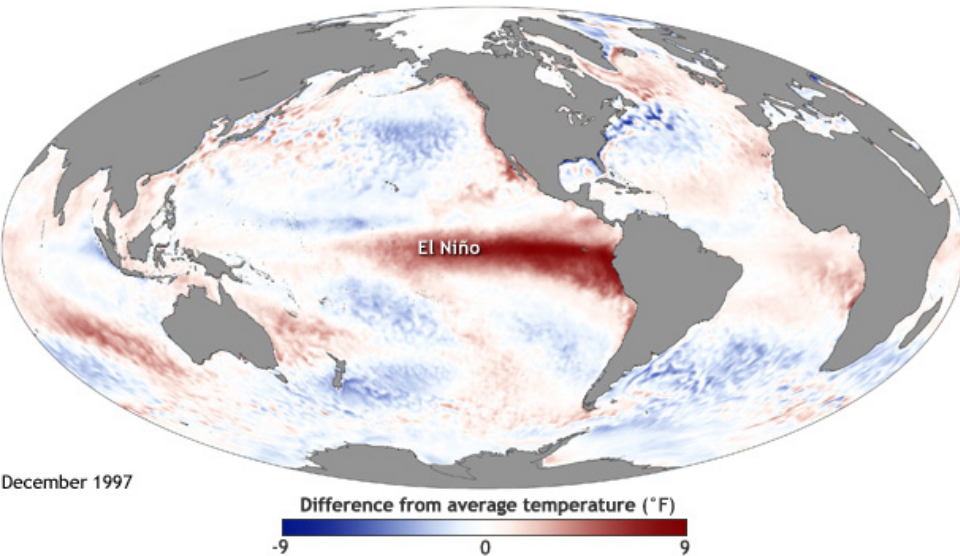
Water Year 2019: Feast or Famine?  
Dec 5 2018



# The El Niño-Southern Oscillation

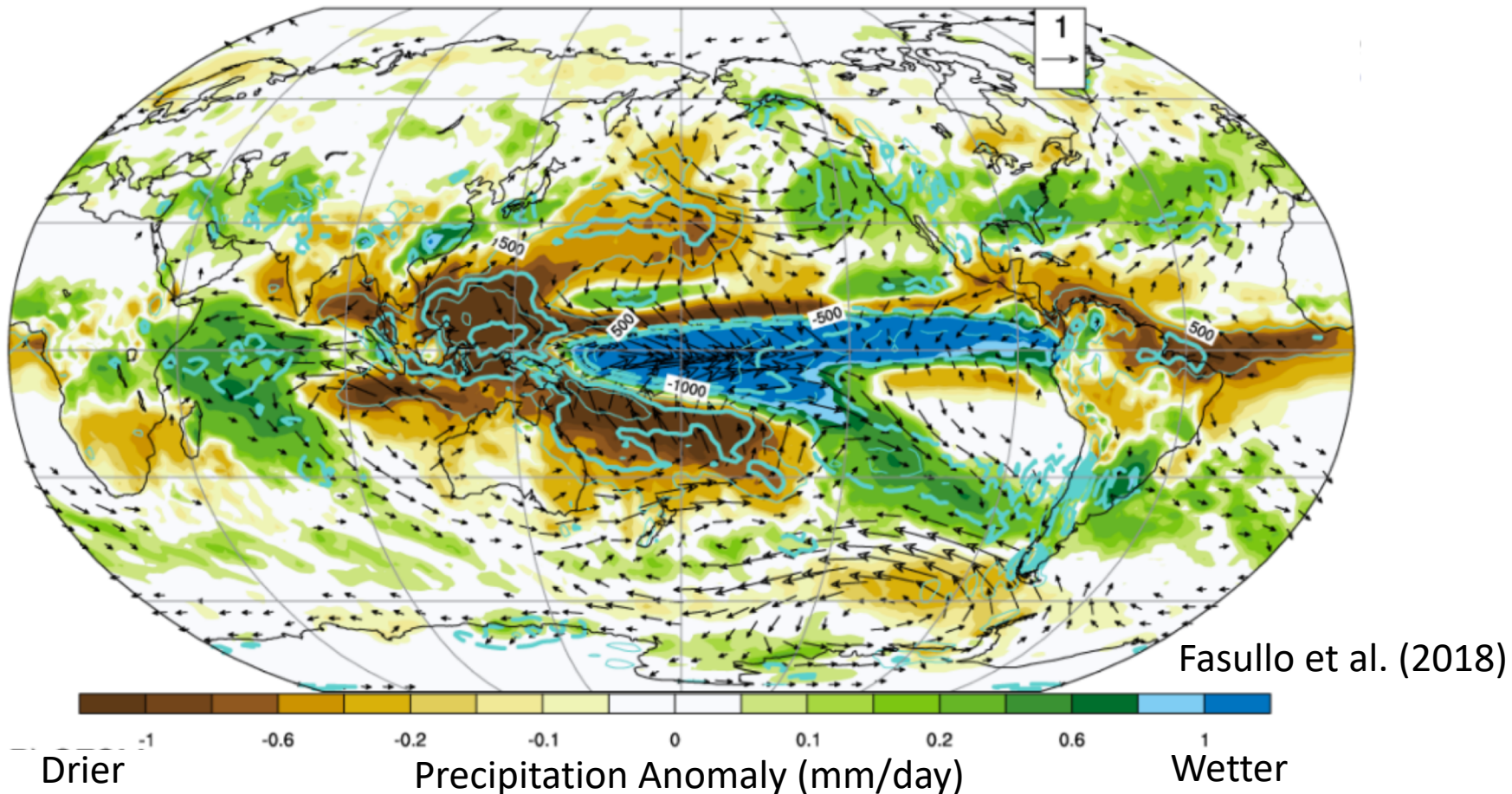
El Niño

La Niña



**El Niño** (**La Niña**) events are characterized by anomalous and widespread **warming** (**cooling**) of the central and eastern tropical Pacific sea surface temperatures

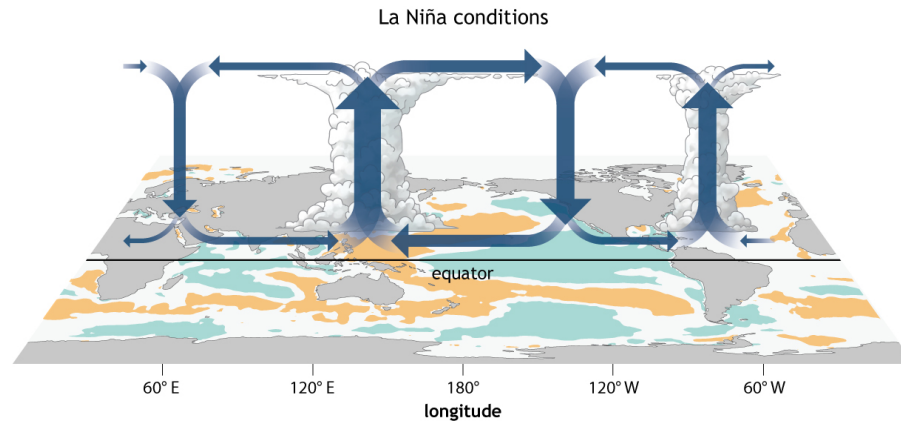
# The El Niño-Southern Oscillation



These changes result in global impacts due to the planetary-scale redistribution of heat, precipitation, and winds that are known as *teleconnections*.

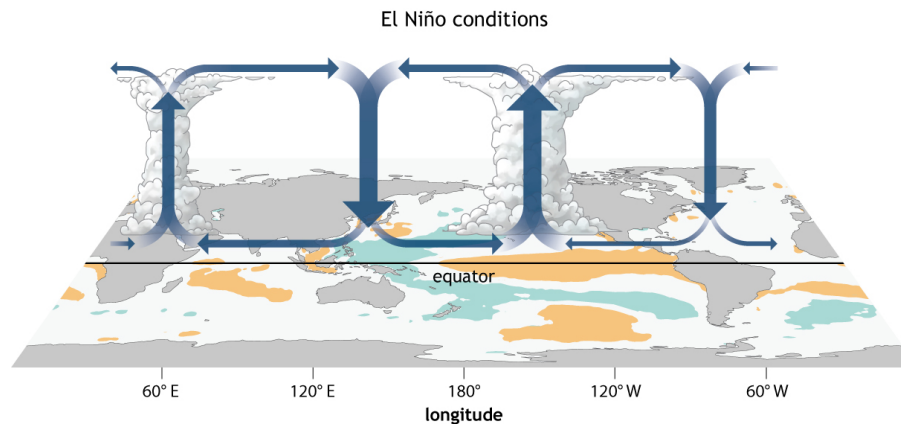
# Classic N. America

## ENSO Teleconnections: Starting in the Tropics



NOAA Climate.gov

Changes in Tropical  
Thunderstorms Influence N.  
Hemisphere Jet Stream

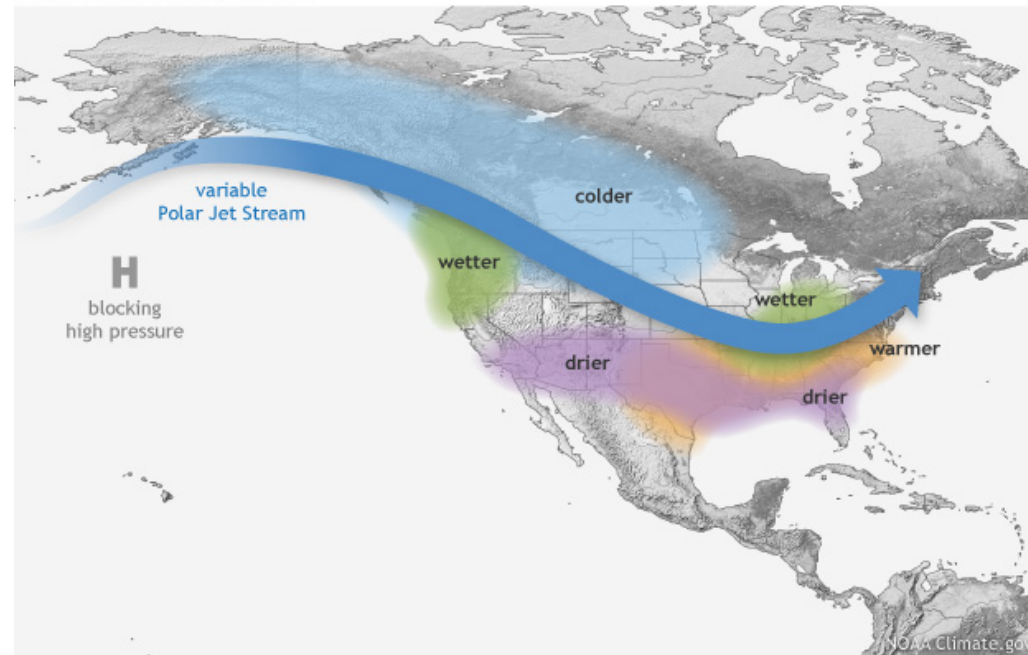


NOAA Climate.gov

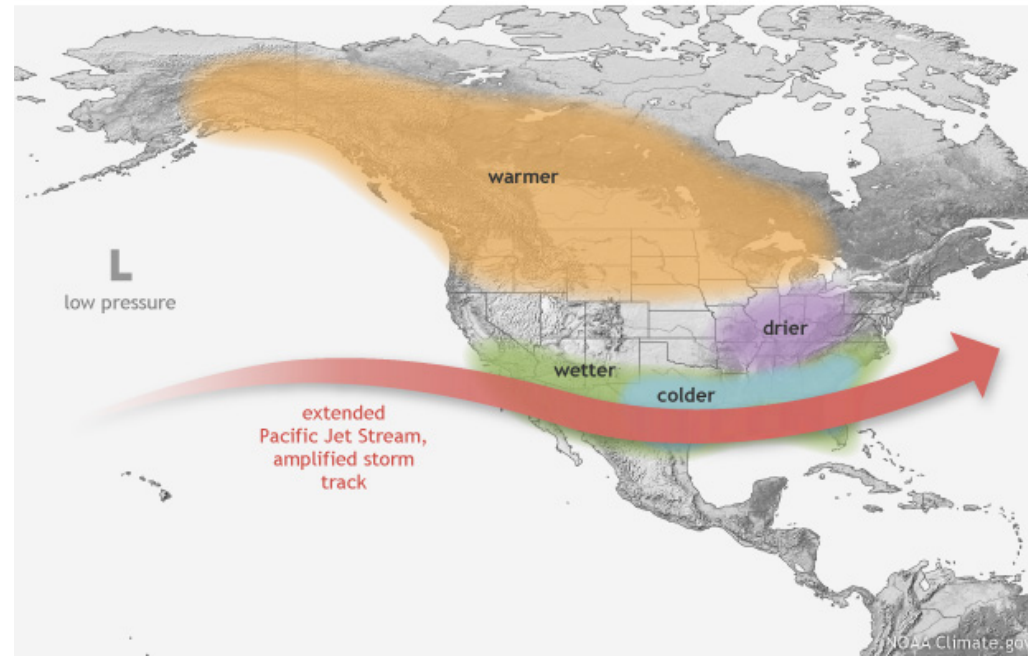
# Classic N. America ENSO Teleconnections

Changes in Tropical Thunderstorms Influence N. Hemisphere jet stream, storm track, temperature patterns across North America

WINTER LA NIÑA PATTERN

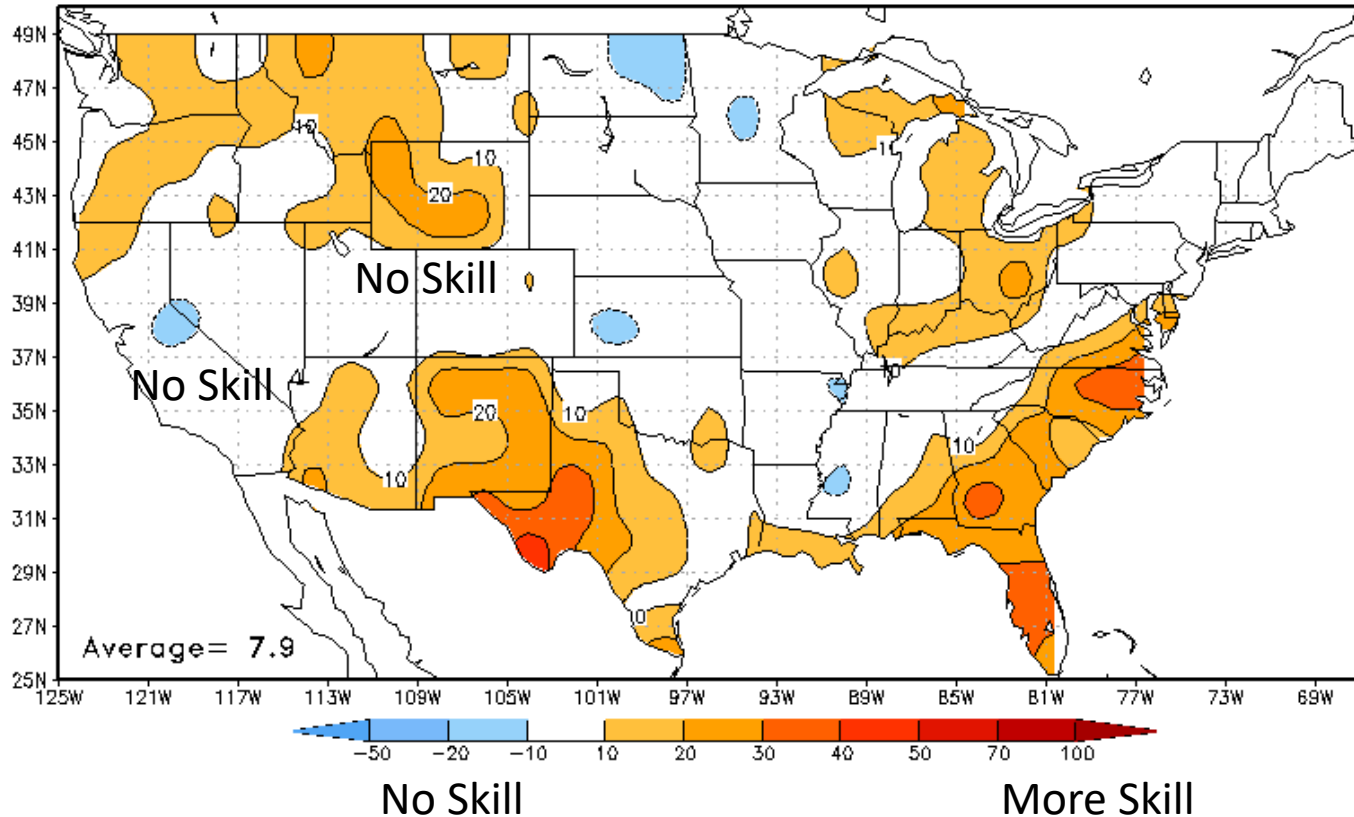


WINTER EL NIÑO PATTERN



# Winter Seasonal Forecast Skill

Seasonal (Lead 0.5 Months) Precipitation Heidke Skill Score  
DJF Manual Forecasts From 1995 to 2018

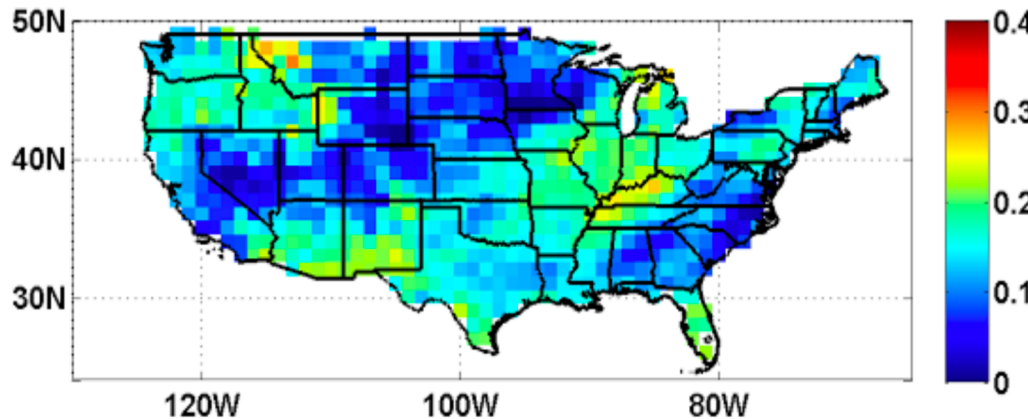


Model Skill: Compares how often the forecast category correctly matches the observations.

Best skill tends to be during ENSO years, but not by much

# More Skill in Temperature Than Precipitation at Subseasonal Scales (Week 3-4 for Dec-Feb)

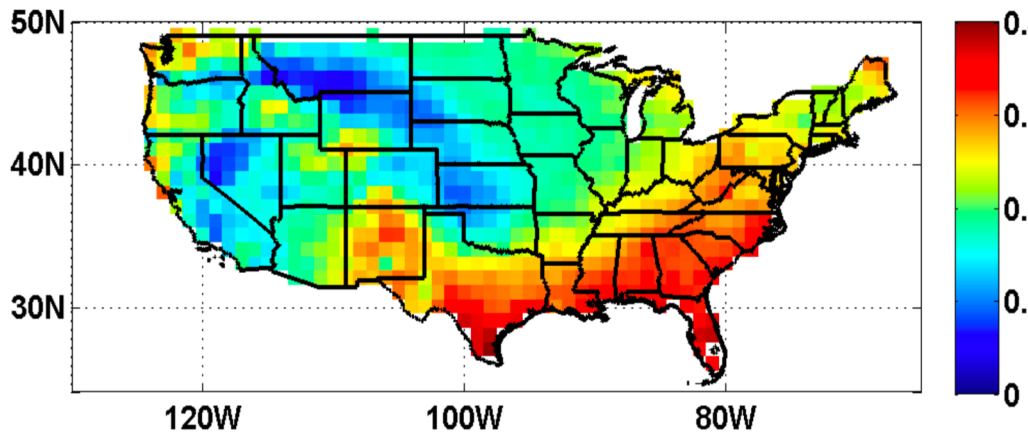
Precipitation



More Skill

Less Skill

Temperature



More Skill

Less Skill

# A Few Challenges Associated With ENSO (with a focus on southern CA)

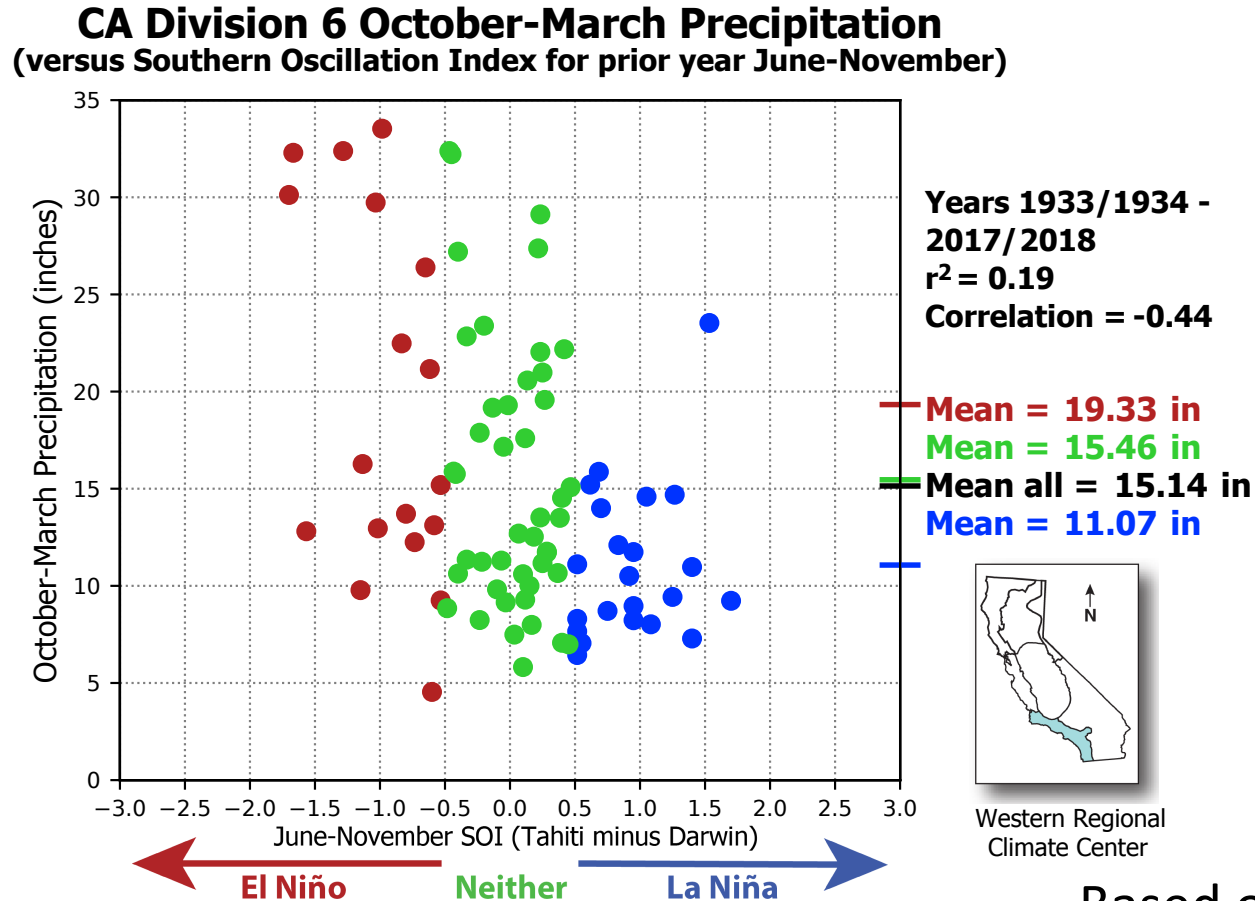
1. Teleconnections are not guaranteed
2. Cool season precipitation outcomes (i.e., above/below average) largely dependent on handful of large storms
3. Climate change is altering ENSO signal



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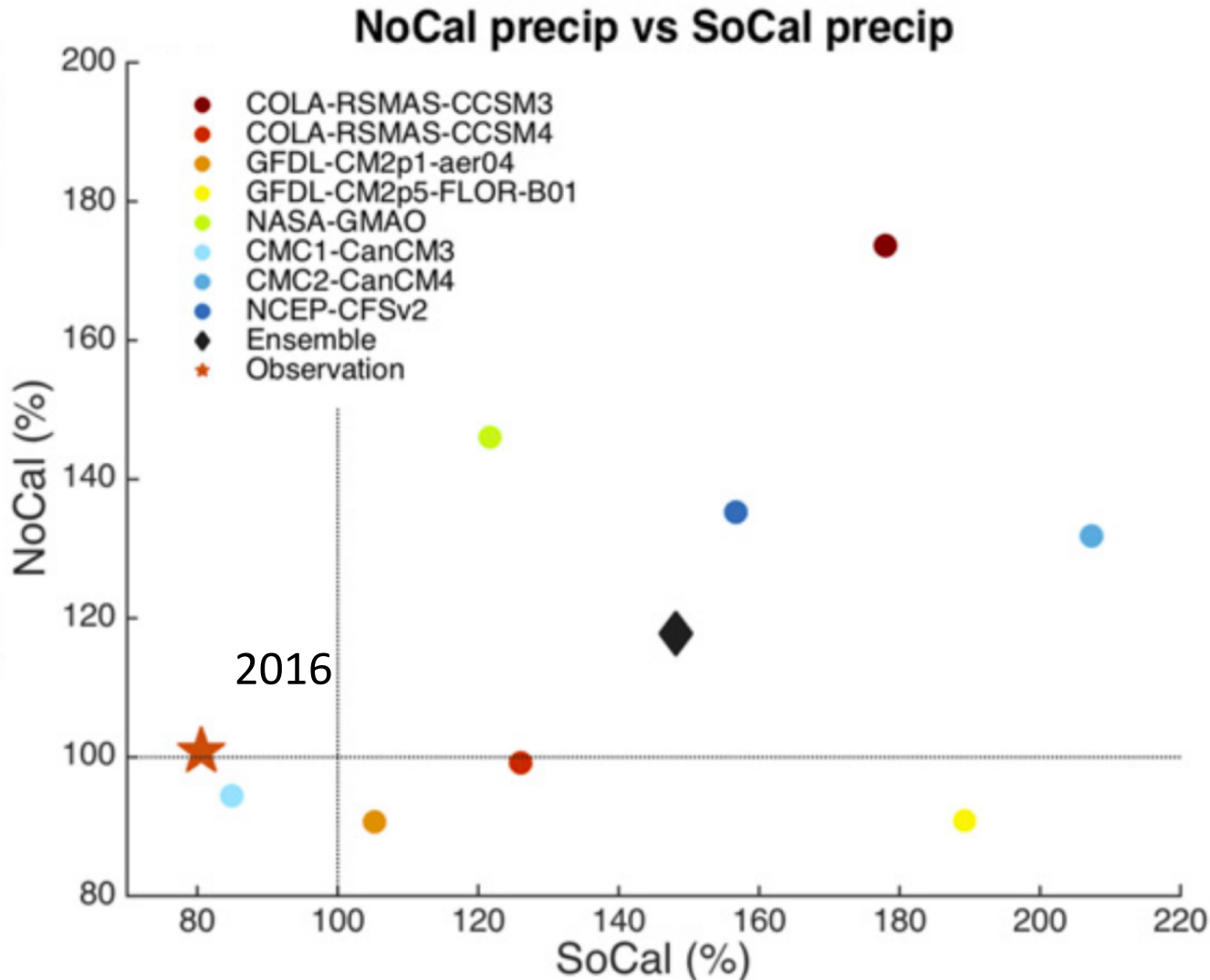
# Challenge 1: Teleconnections are not guaranteed: WY1934-WY2018



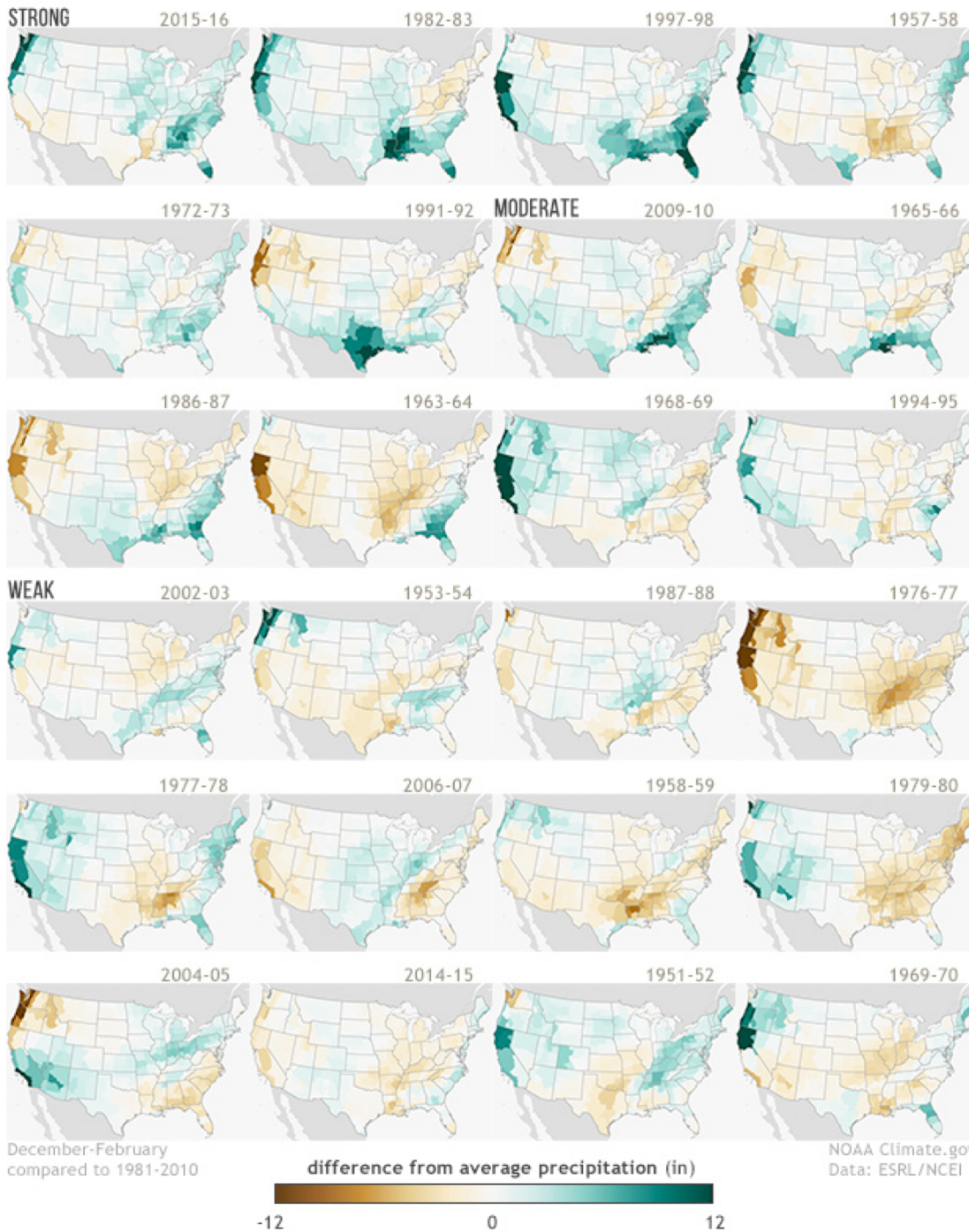
Based on Redmond and Koch (1991)

Updated scatterplots available at:  
[https://wrcc.dri.edu/Climate/soi\\_precip.php](https://wrcc.dri.edu/Climate/soi_precip.php)

# Challenge 1: Teleconnections are not guaranteed: Feb-Mar 2016 forecasts



# U.S. winter precipitation during every El Niño since 1950



## DJF precipitation during El Niño

1950-present  
Based on ONI

## The limitation:

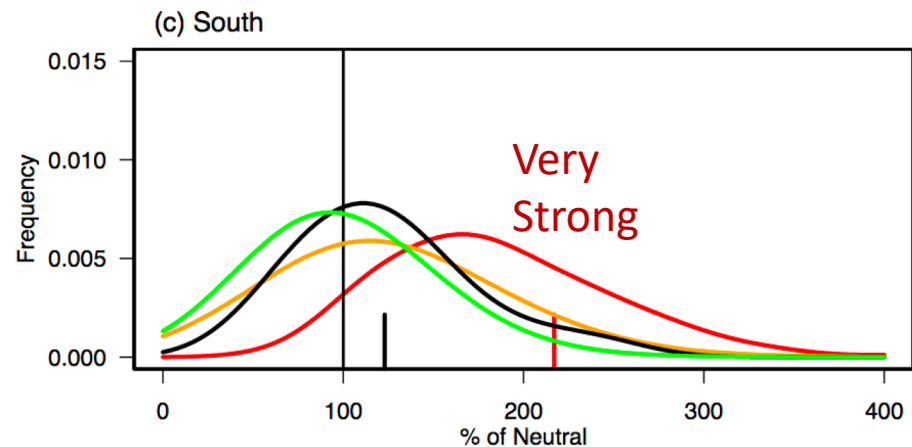
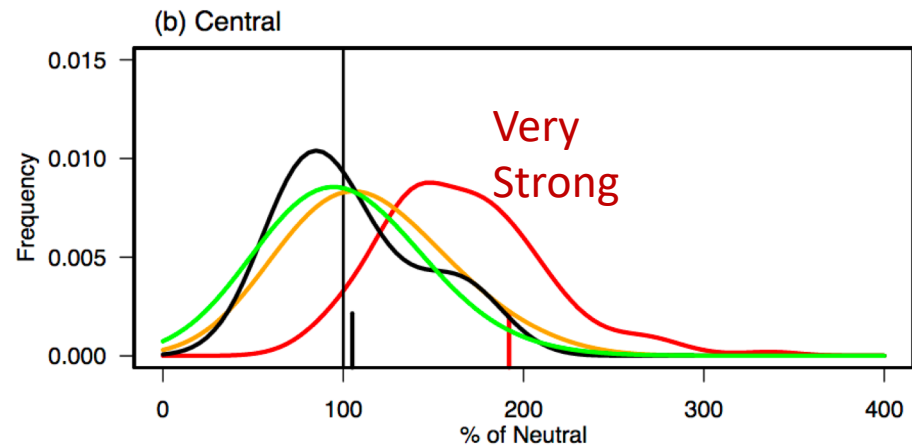
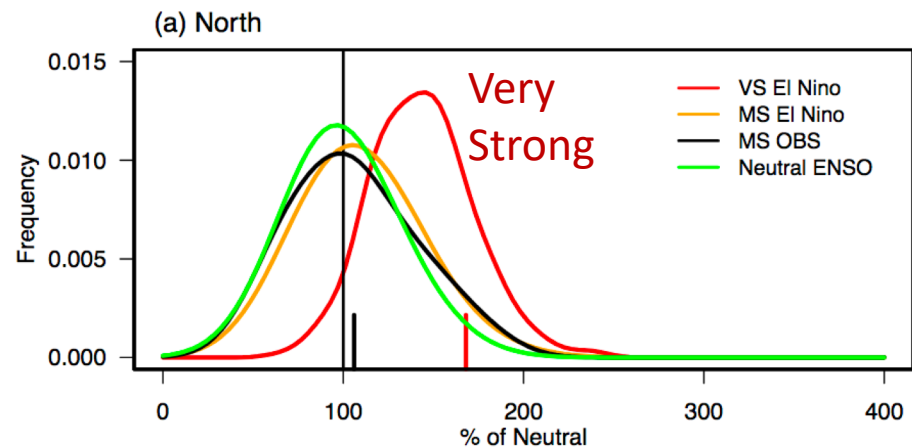
Historical relationships are based upon a limited number of observations.

<https://www.climate.gov/news-features/featured-images/us-winter-precipitation-during-every-el-ni%C3%B1o-1950>

Challenge 1:  
Teleconnections  
are not  
guaranteed:

However, a  
strong El Niño  
does tilt the odds  
towards  
statewide wet

Hoell et al. (2016)



# Challenge 1: Strong El Niño does tilt the odds

North/Central CA  
sensitive to very strong  
(VS) El Niño, SoCal  
sensitive to moderate  
strength (MS)

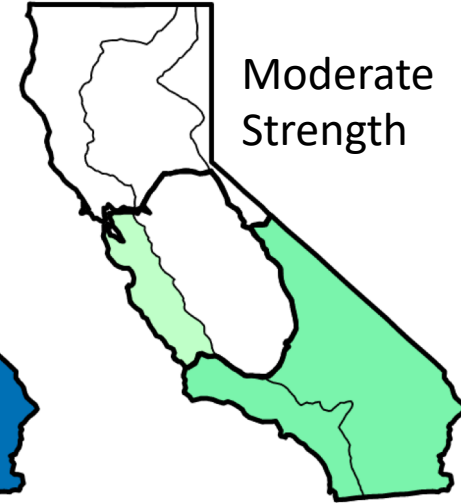
Simulations consistent  
with observations

Observed

(a) VS El Niño

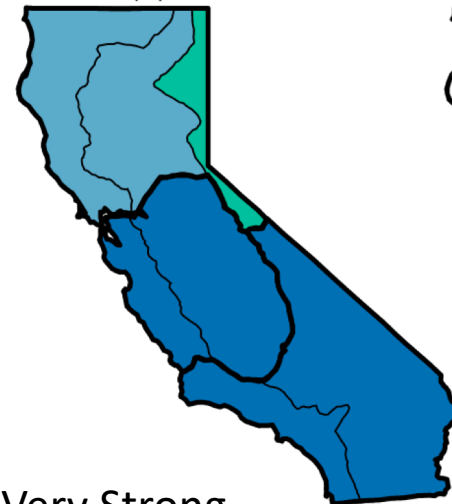


(c) MS El Niño



Simulated

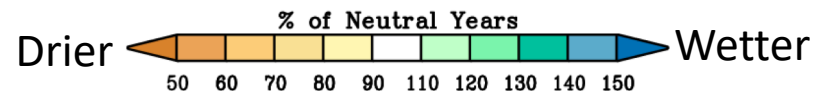
(b) VS El Niño



(d) MS El Niño



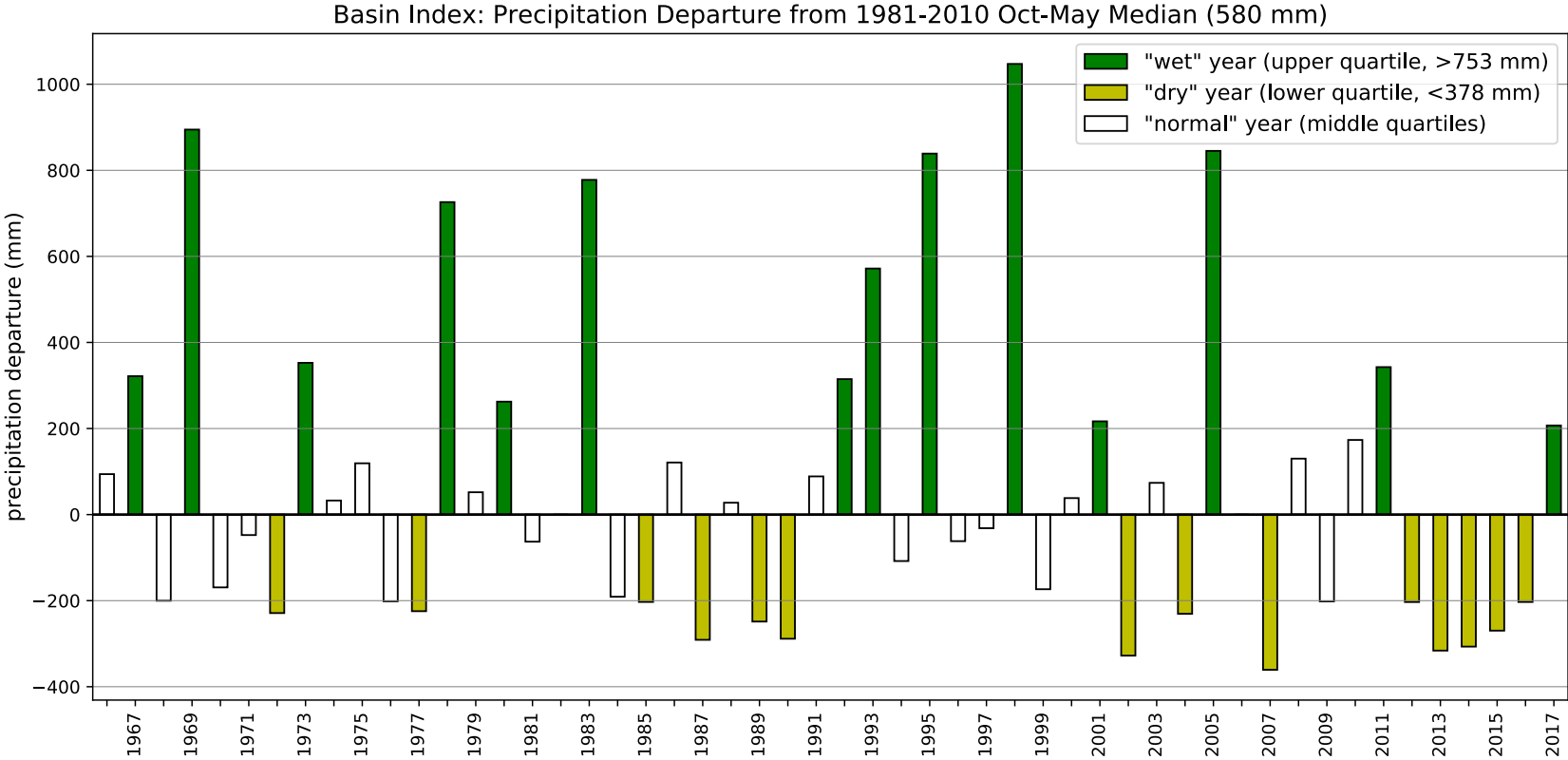
Hoell et al. (2016)



# A Few Challenges Associated With ENSO (with a focus on southern CA)

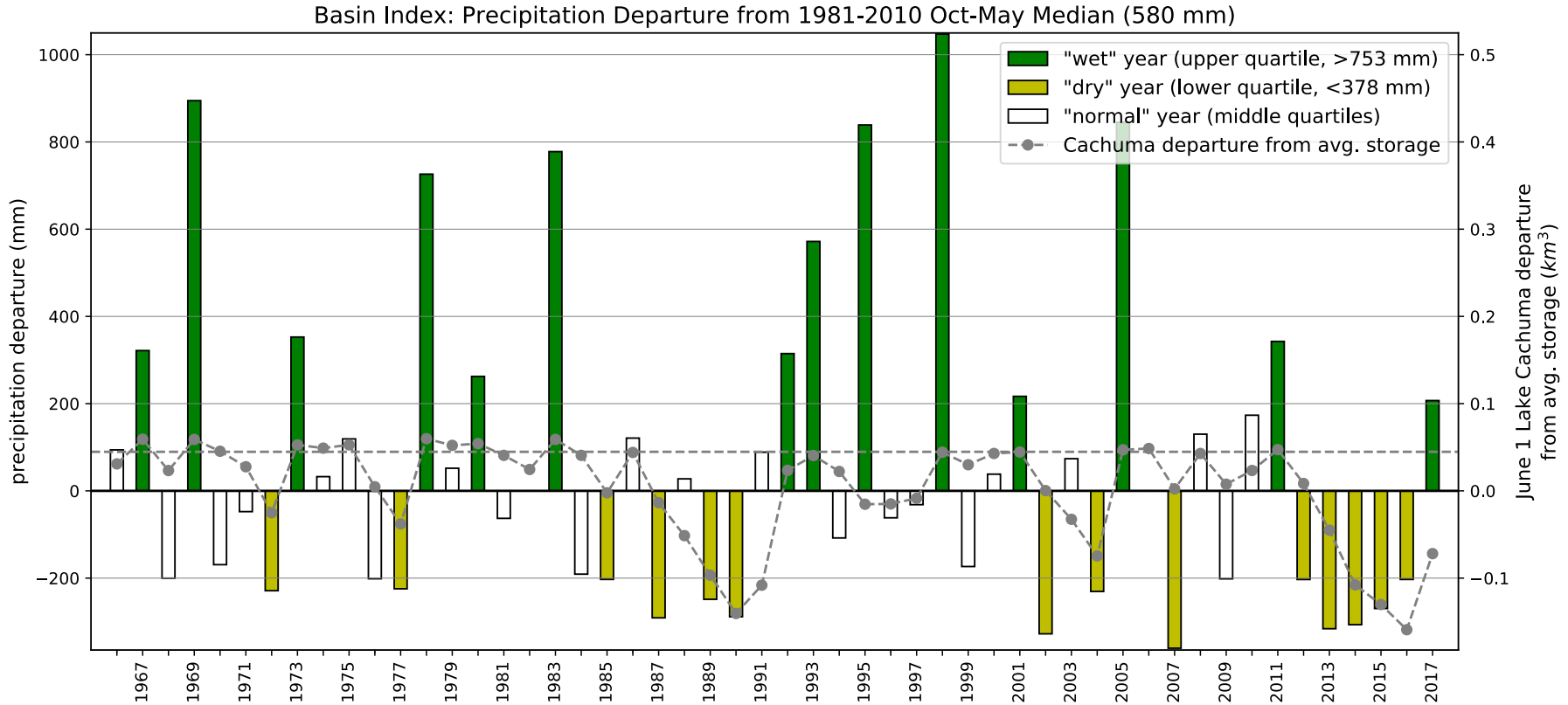
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# Challenge 2: Wet or Dry Water Years in Southern CA (and much of the west) Are Controlled by Few Large Events





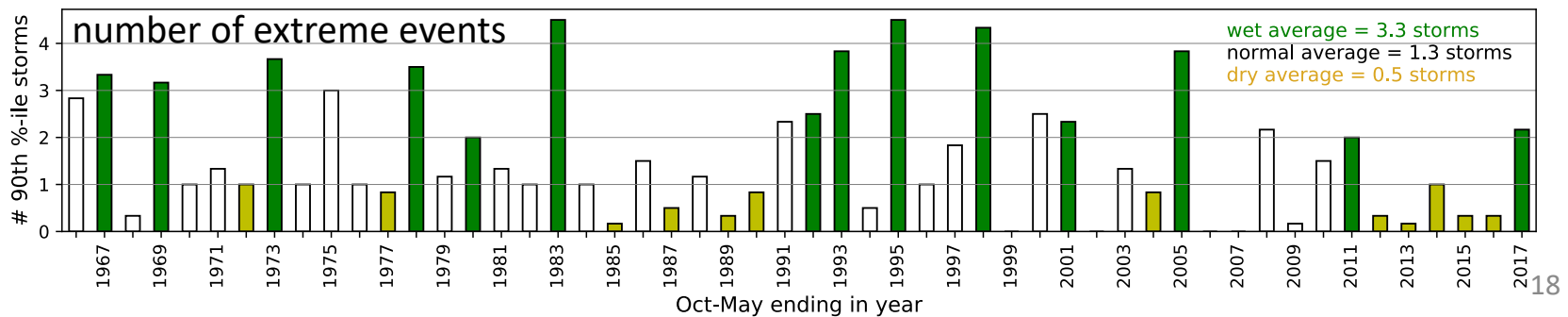
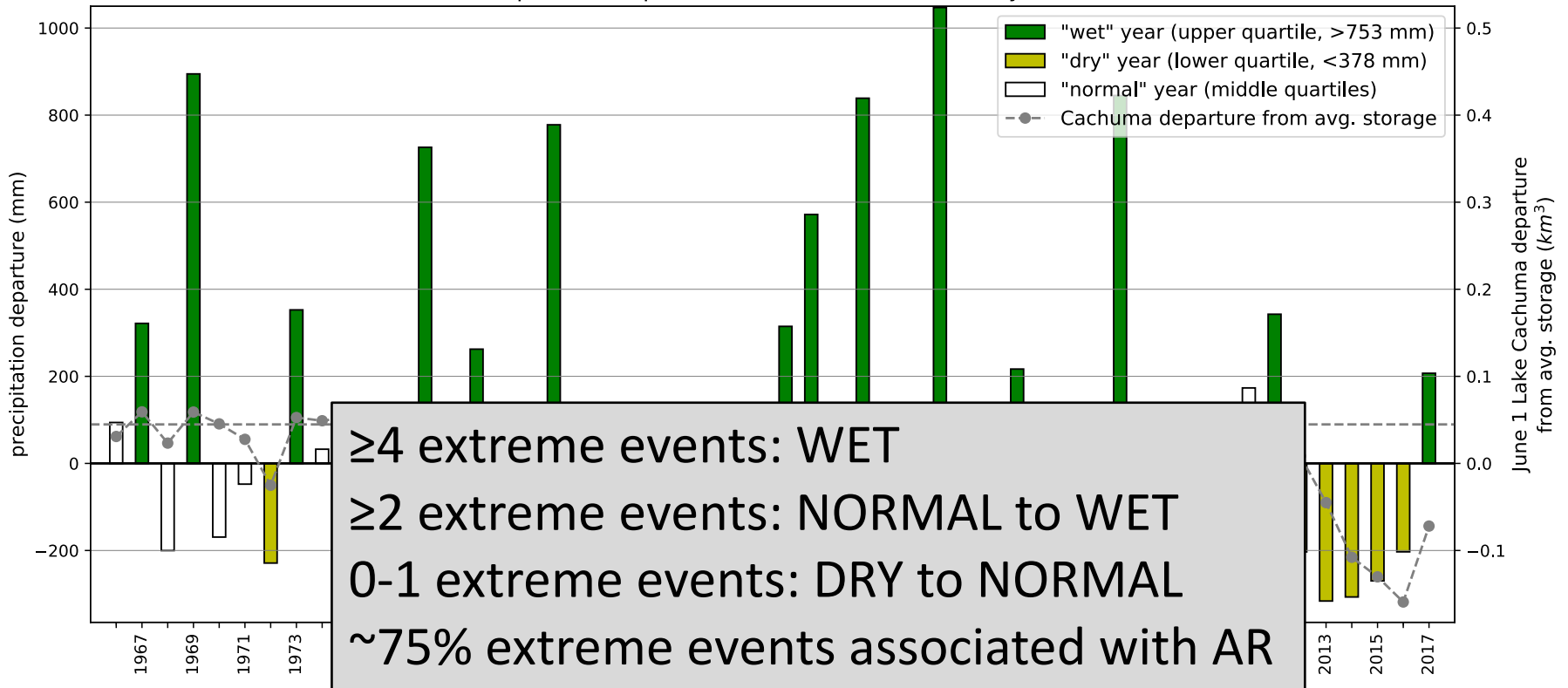
# Dependence on Few Large Storms



Extreme events: >90<sup>th</sup> percentile in a station record

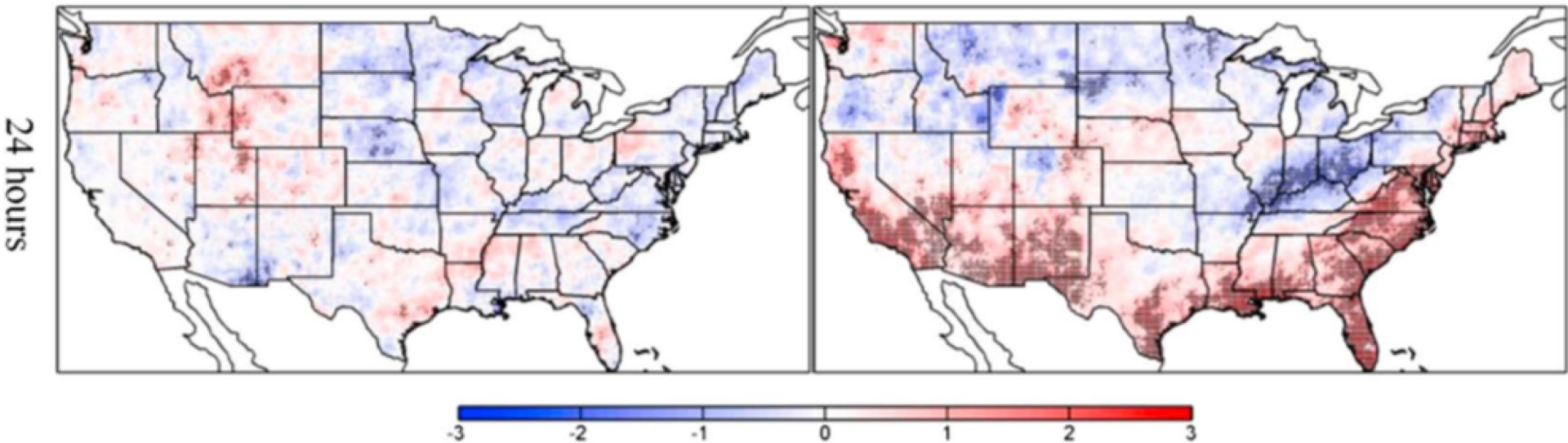
# Dependence on Few Large Storms

Basin Index: Precipitation Departure from 1981-2010 Oct-May Median (580 mm)



# El Niño Also Favors More Frequent Extreme Precipitation Events

**Anomalous Number of 24h Precipitation Extremes (1979-2013) Regressed on Indices**  
*(Similar pattern for 1,3,6,12 hours as well)*



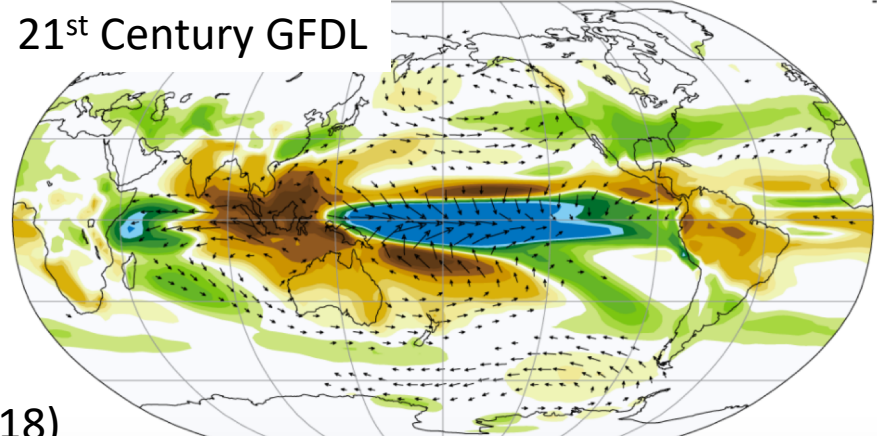
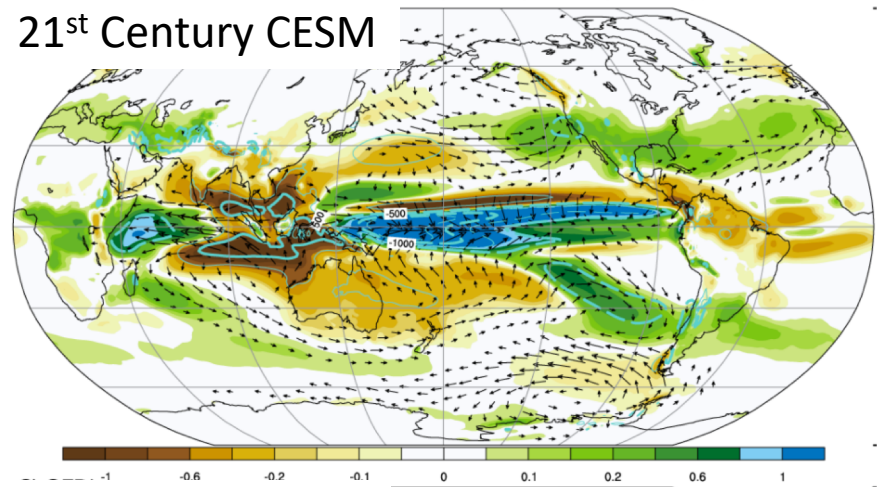
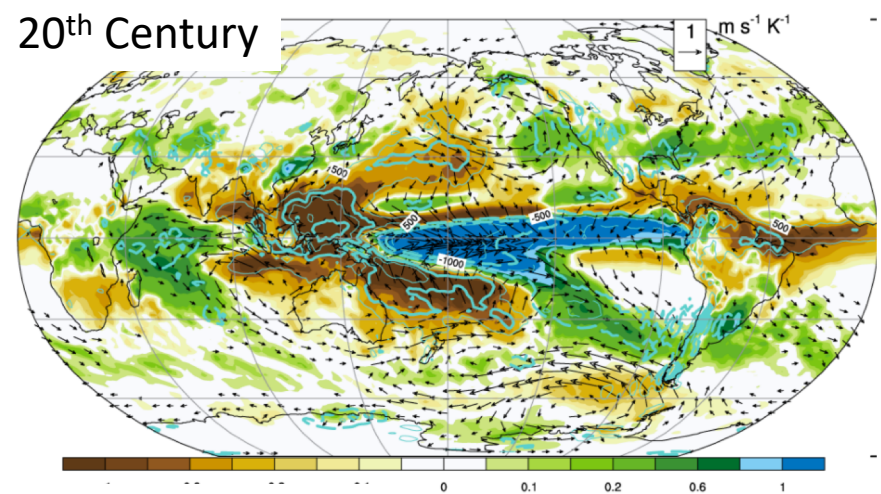
# A Few Challenges Associated With ENSO (with a focus on southern CA)

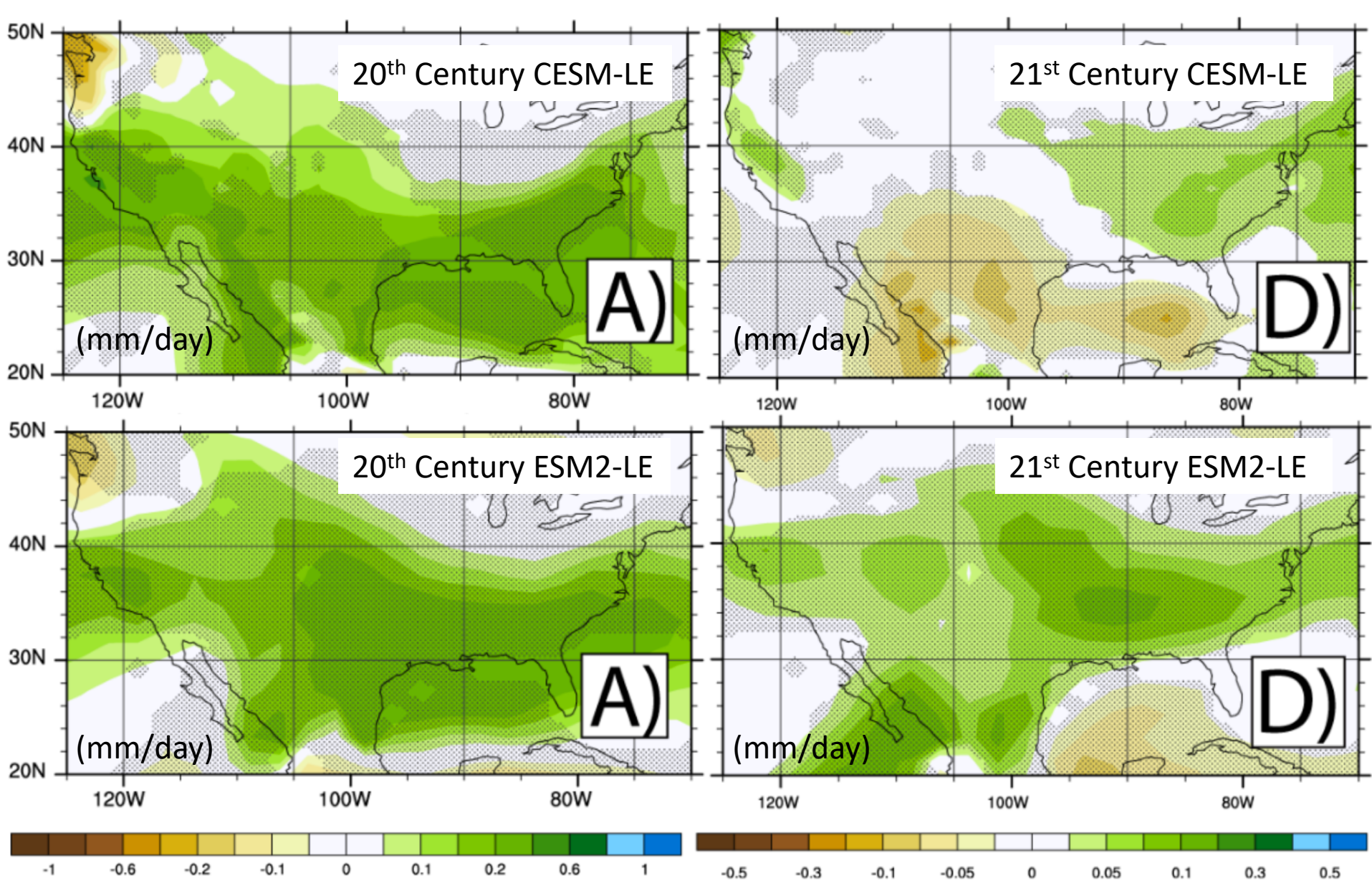
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# Challenge 3: In a Warming World, ENSO Teleconnections Won't Be What They Used to Be

Large internal variability complicates the matter in past and future...

Are contrasts in regional climate the result of randomness or part of systematic shifts?



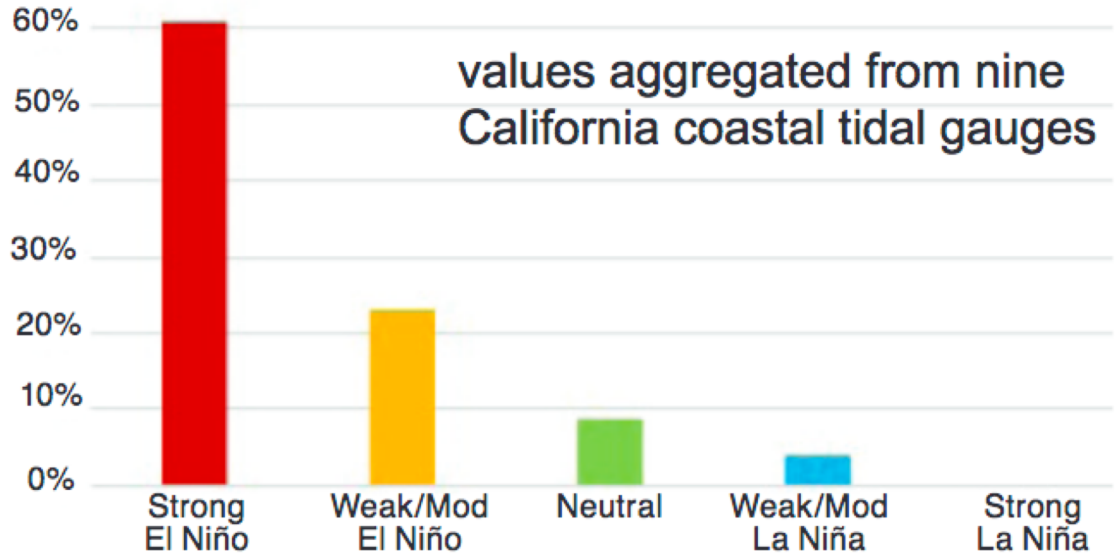


Projected 21<sup>st</sup> century ENSO impacts on precipitation (mm/day) varies across models

Fasullo et al. (2018)

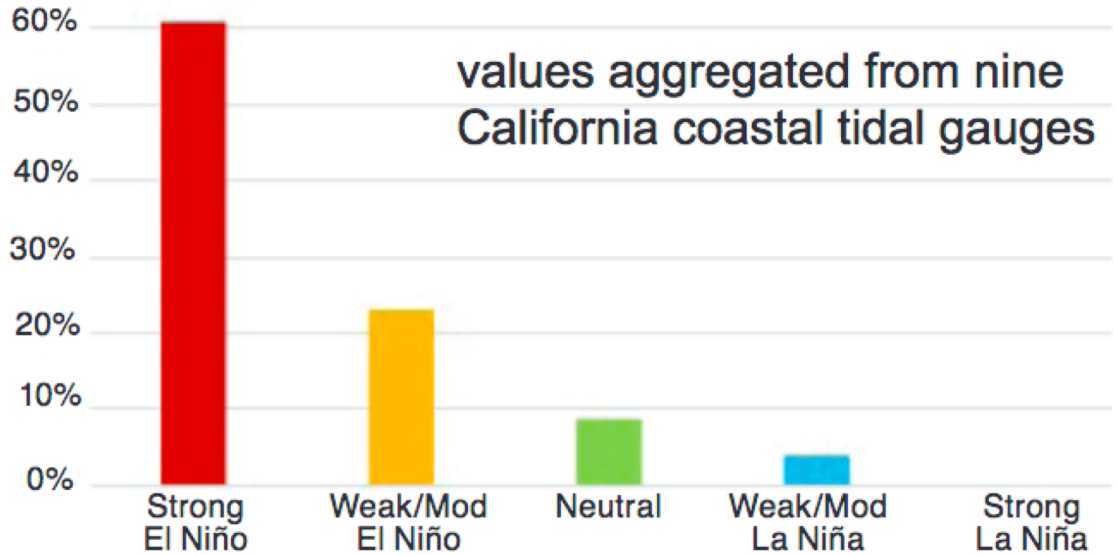
We Can Be  
Confident in  
Coastal ENSO  
Impacts...

PERCENT OF EXTREME SEA LEVEL EVENTS BY ENSO PHASE



# We Can Be Confident in Coastal ENSO Impacts...

PERCENT OF EXTREME SEA LEVEL EVENTS BY ENSO PHASE



Annual Days with High Tide Flooding

Historic Lower Emissions Higher Emissions

Los Angeles, CA  
Local threshold: 0.57m over MHHW  
<https://toolkit.climate.gov/#climate-explorer>

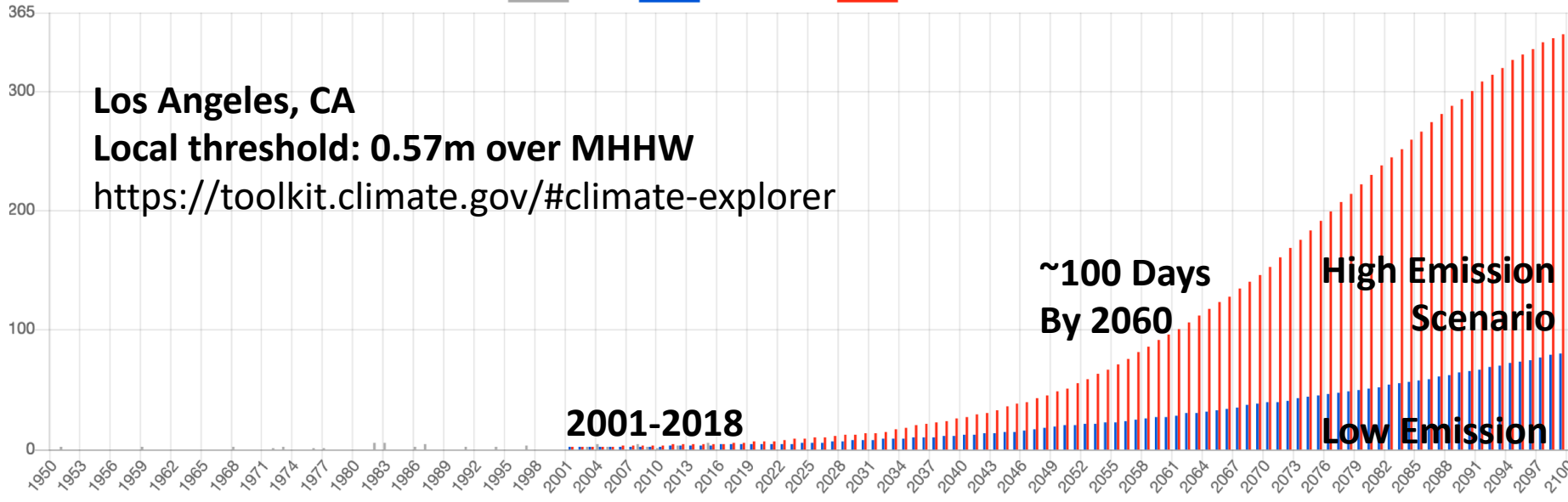
2001-2018

~100 Days  
By 2060

High Emission  
Scenario

Low Emission

Year





# So, Is ENSO All Washed Up?

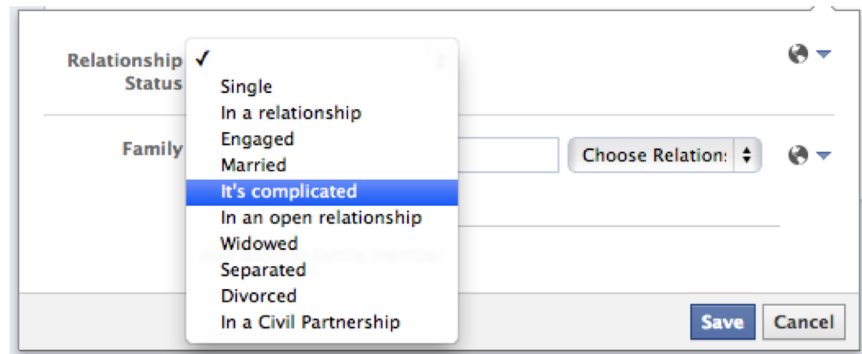
## Yes

Increased ENSO-related variance in precipitation is associated with 21<sup>st</sup> century warming

Moderate to weak El Niño not useful predictor in soCal, marginally so in noCal

As conditions change, need for reliable SST and tropical convection predictions will limit long range skill

Unknown influences: Arctic amplification, other modes of variability



## No

ENSO's impact on 21<sup>st</sup> century temperature signals become stronger

Very strong El Niño favors wet CA

Daily precipitation extremes more likely with El Niño

Coastal flooding impacts will continue (and worsen)

# Concluding Remarks

ENSO teleconnections **do not** guarantee a wet or dry outcome.

Very strong El Niño conditions **tilt the odds** towards a wetter than average winter in California.

In a changing climate, ENSO teleconnections may change sign or even magnitude, leading to **increased variance** in precipitation.

Improved prediction of SSTs and tropical convection will **enhance** subseasonal-seasonal forecasting capabilities, but requires additional computing resources

# References

Please take a WRCC ENSO handout!

Cannon et al. (2018) J. Geophys. Res. Atmos.

<https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2018JD029045>

Fasullo et al. (2018) Geophys. Res. Lett.

<https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2018GL079022>

Hoell et al. (2016) Geophys. Res. Lett.

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015GL067102>

Jong et al. (2018) J. Climate

<http://ocp.ldeo.columbia.edu/res/div/ocp/WestCLIM/PDFS/JongEtAl2018JC.pdf>

Oakley et al. (2018) J. Hydrol. Reg. Stud.

<https://www.sciencedirect.com/science/article/pii/S2214581818300624>

Yu et al. (2017) J. Geophys. Res. Atmos.

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017JD026683>