Influence of the Northern Pacific Jet on California hydroclimate and wildfire regimes over the last 500 years

Valerie Trouet

UQAT

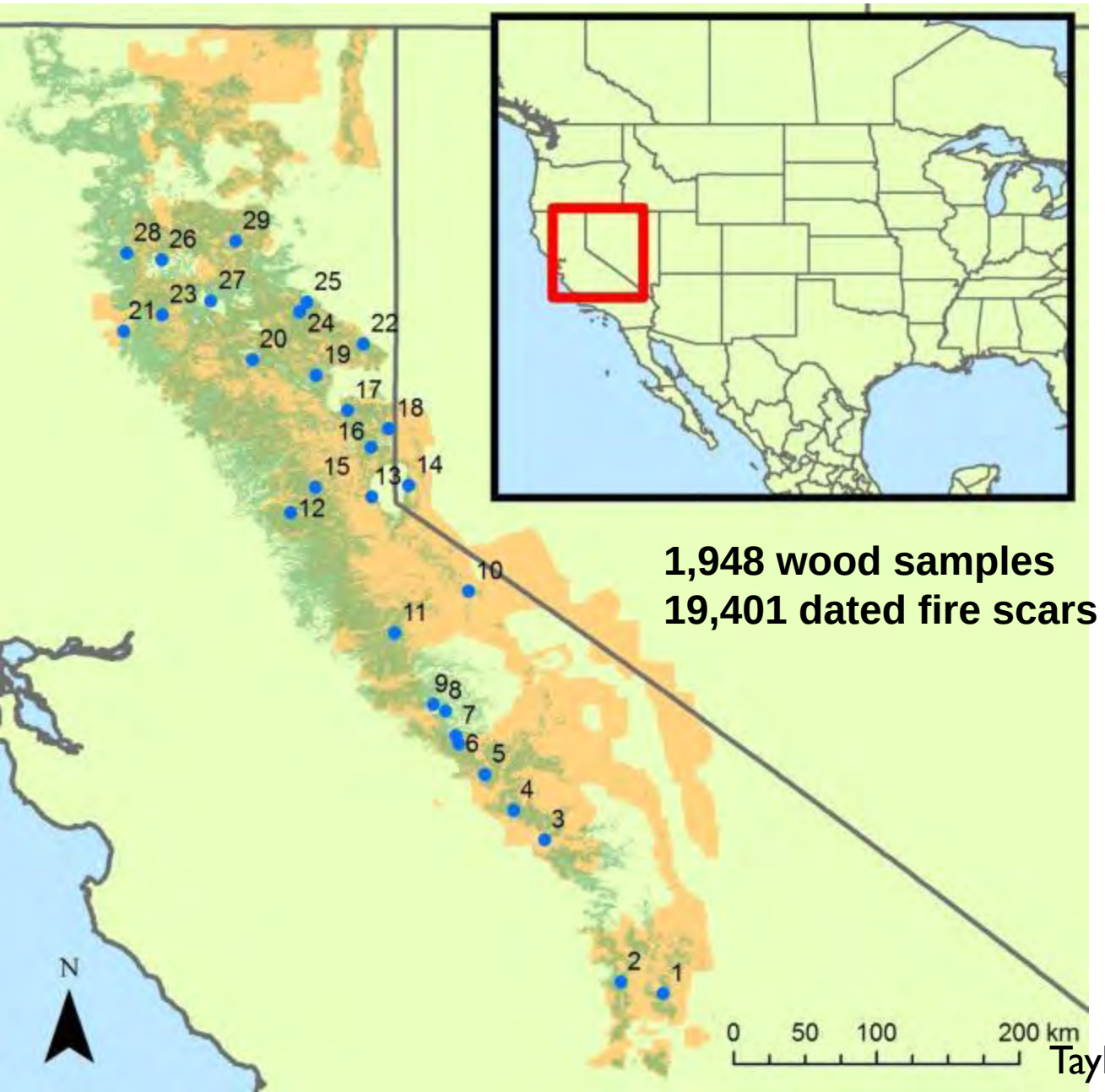
25 October 2016

1. Land-use modulation of Sierra Nevada fire regimes

2. 2015 Sierra Nevada snowpack was lowest in 500 years

3. Influence of NPJ on California hydroclimate and wildfire

Sierra Nevada fire index (1600-1900 CE)

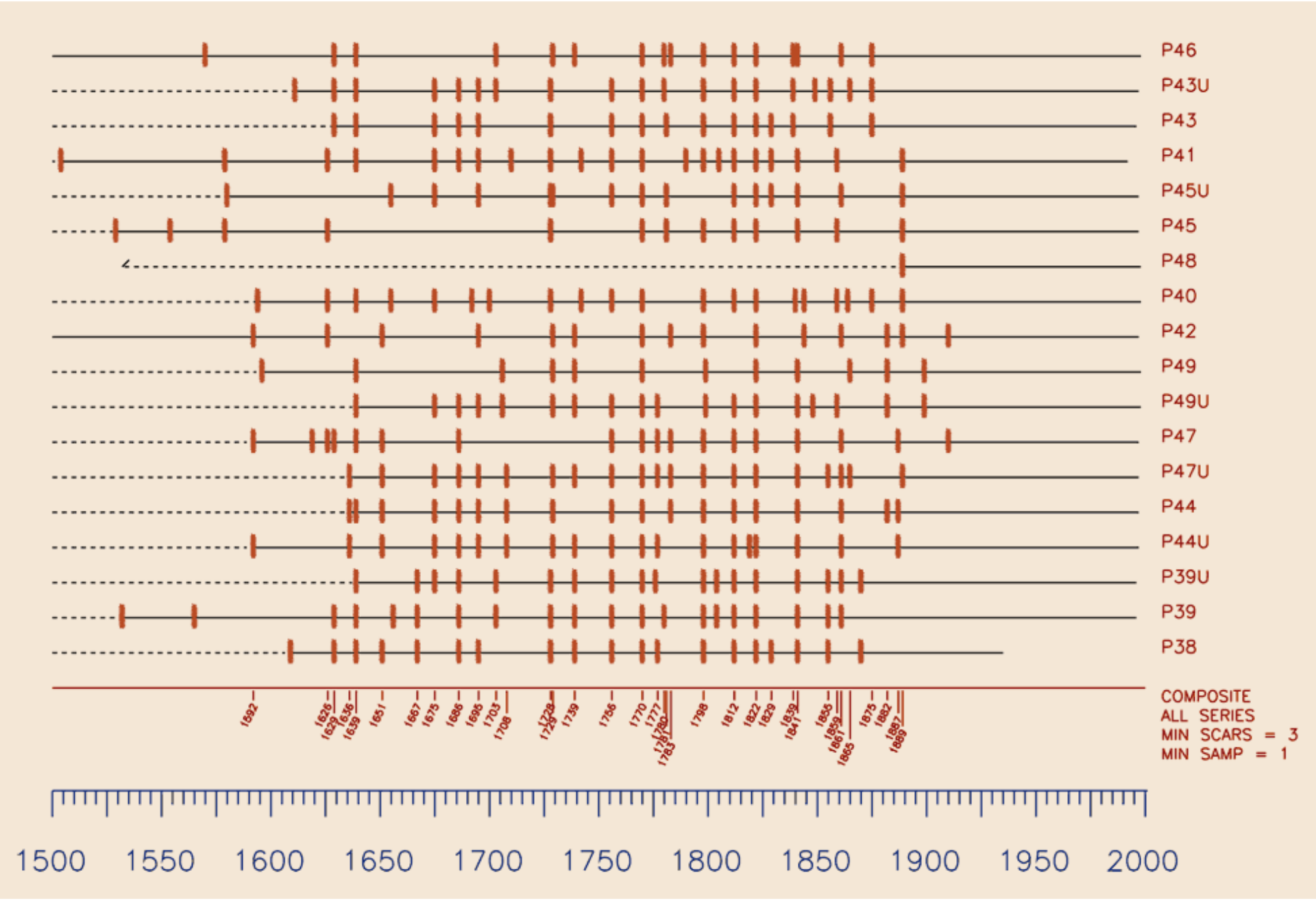


1,948 wood samples
19,401 dated fire scars

Taylor, Trouet, et al. (in press) *PNAS*


33 Fire Scars


1889 LW
1879 ME
1854 LE
1840 D
1828 D
1821 LE
1809 D
1799 D
1793 D
1787 LW
1781 ME
1775 D
1771 D
1765 LW


P46
P43U
P43
P41
P45U
P45
P48
P40
P42
P49
P49U
P47
P47U
P44
P44U
P39U
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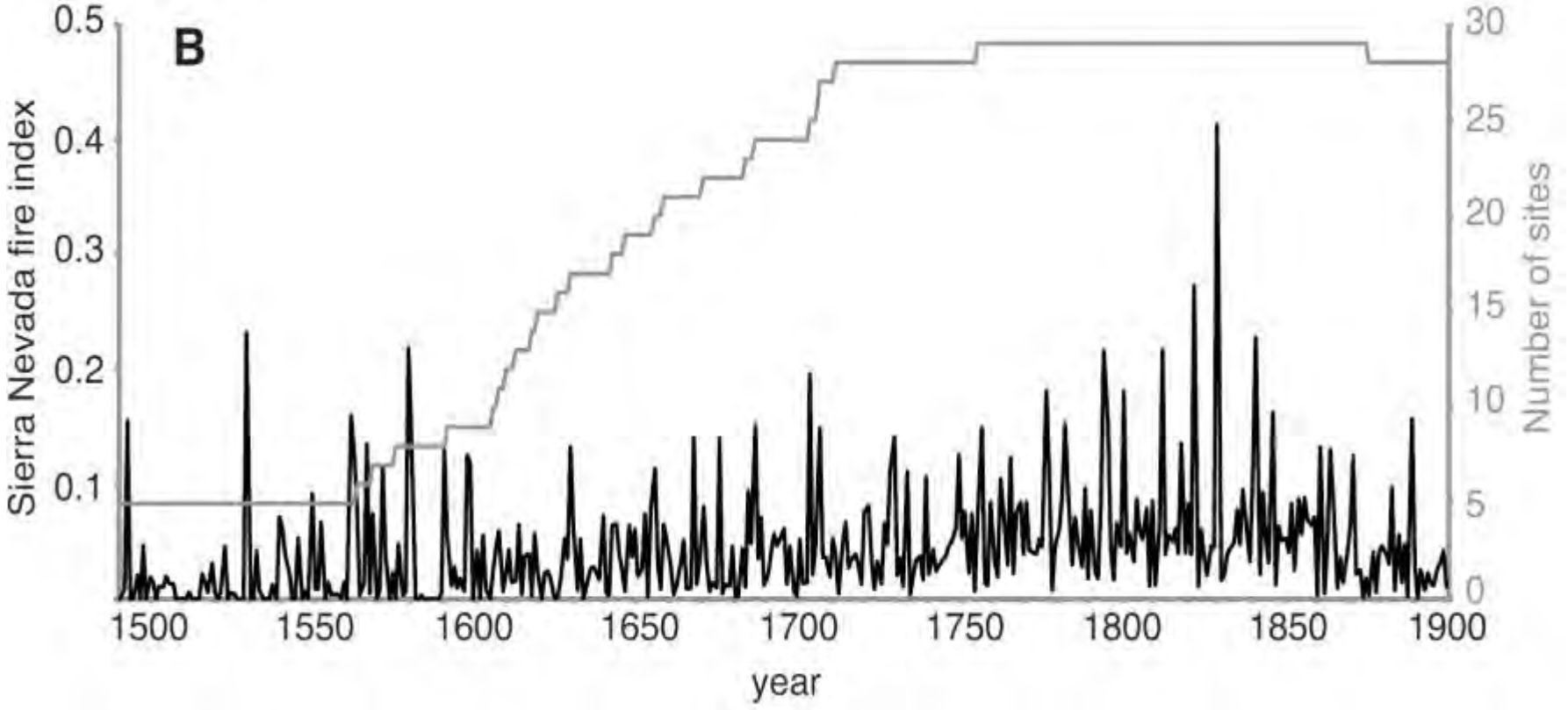
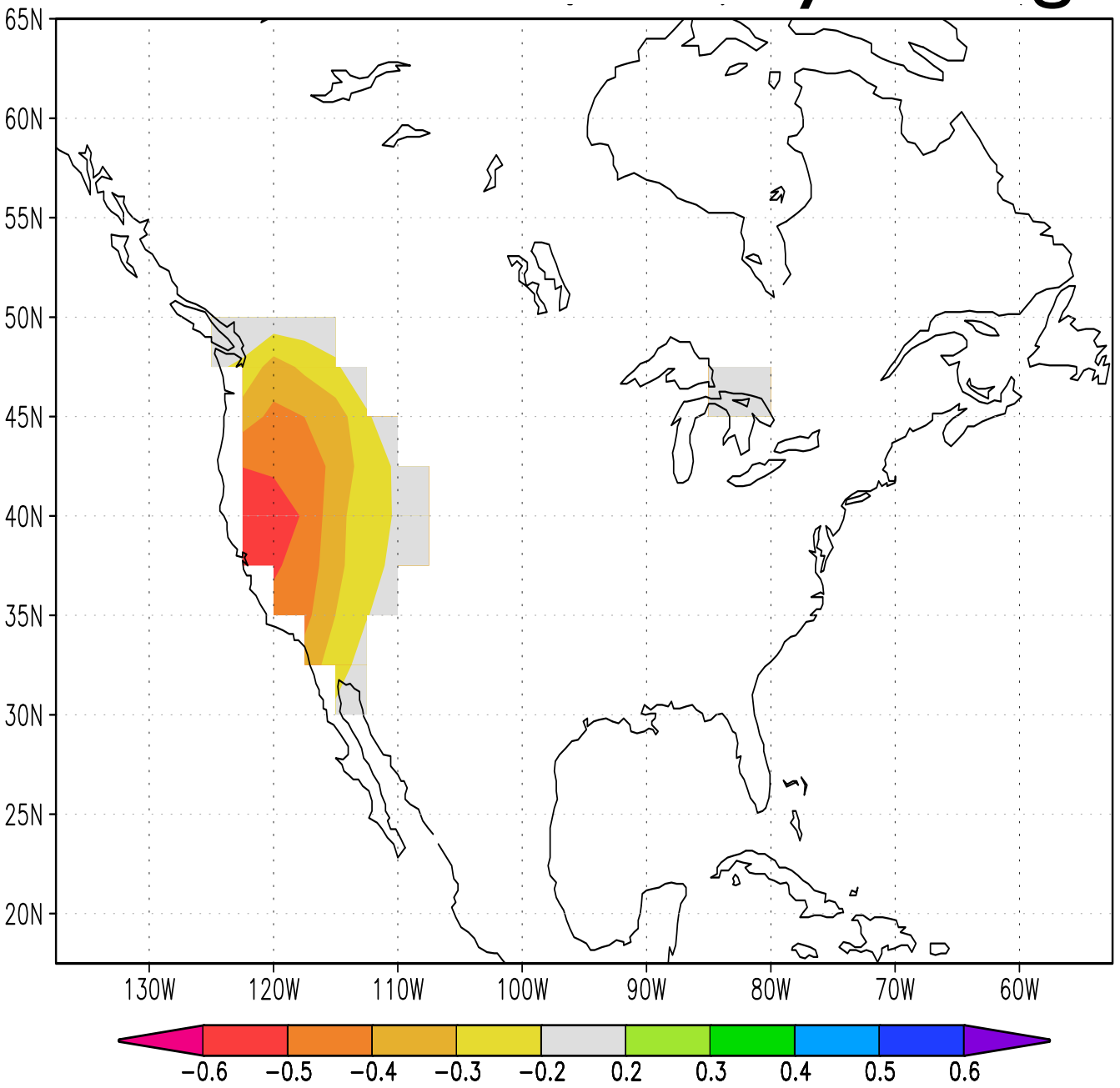
1781
1783
1798
1812
1822
1829
1839
1841
1855
1859
1861
1865
1875
1882
1887
1889
COMPOSITE
ALL SERIES
MIN SCARS = 3
MIN SAMP = 1
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000

Sierra Nevada fire index (1490-1900 CE)



Taylor, Trouet, et al. (in press) *PNAS*

S Nevada fire driven by drought



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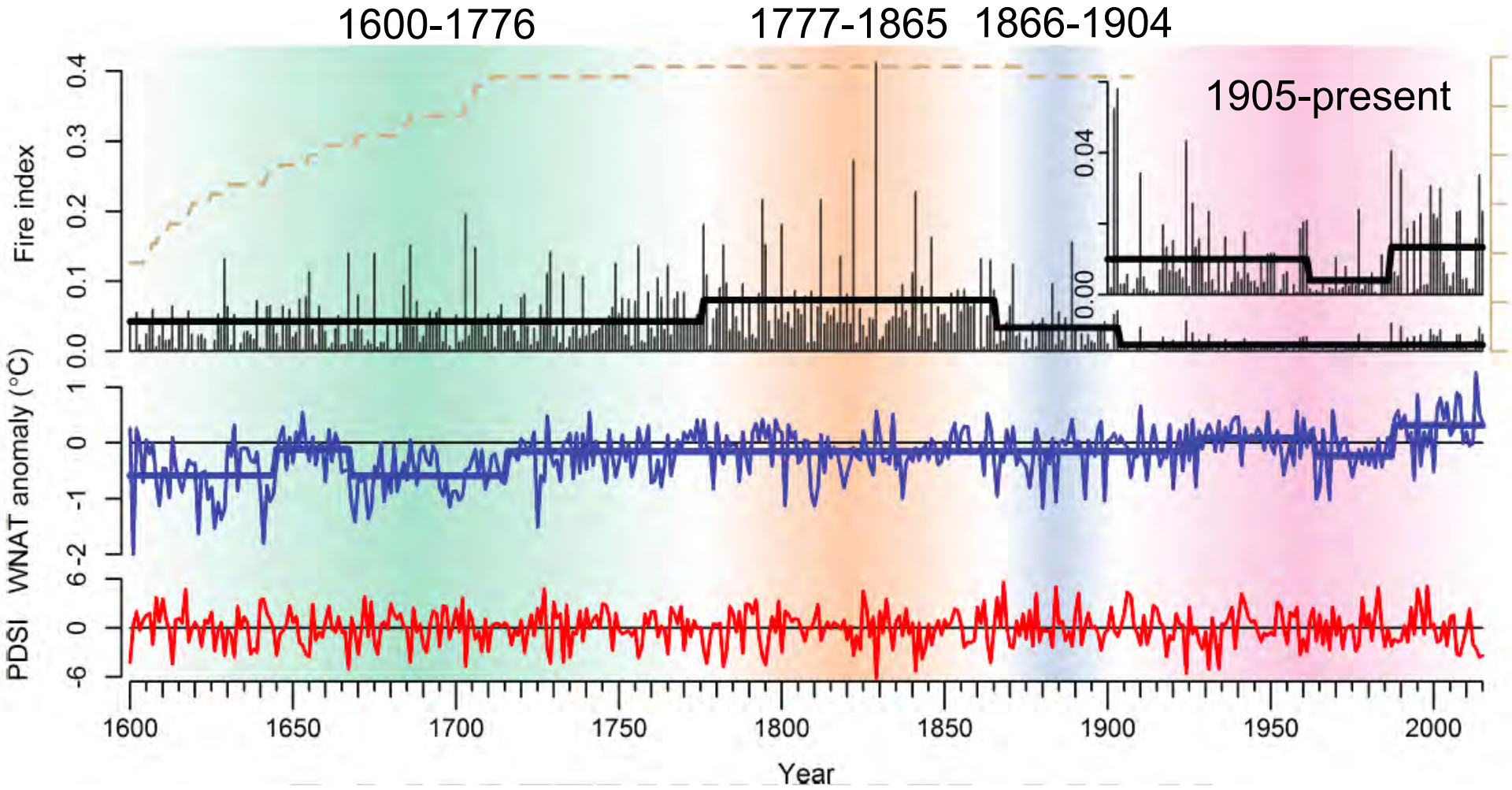

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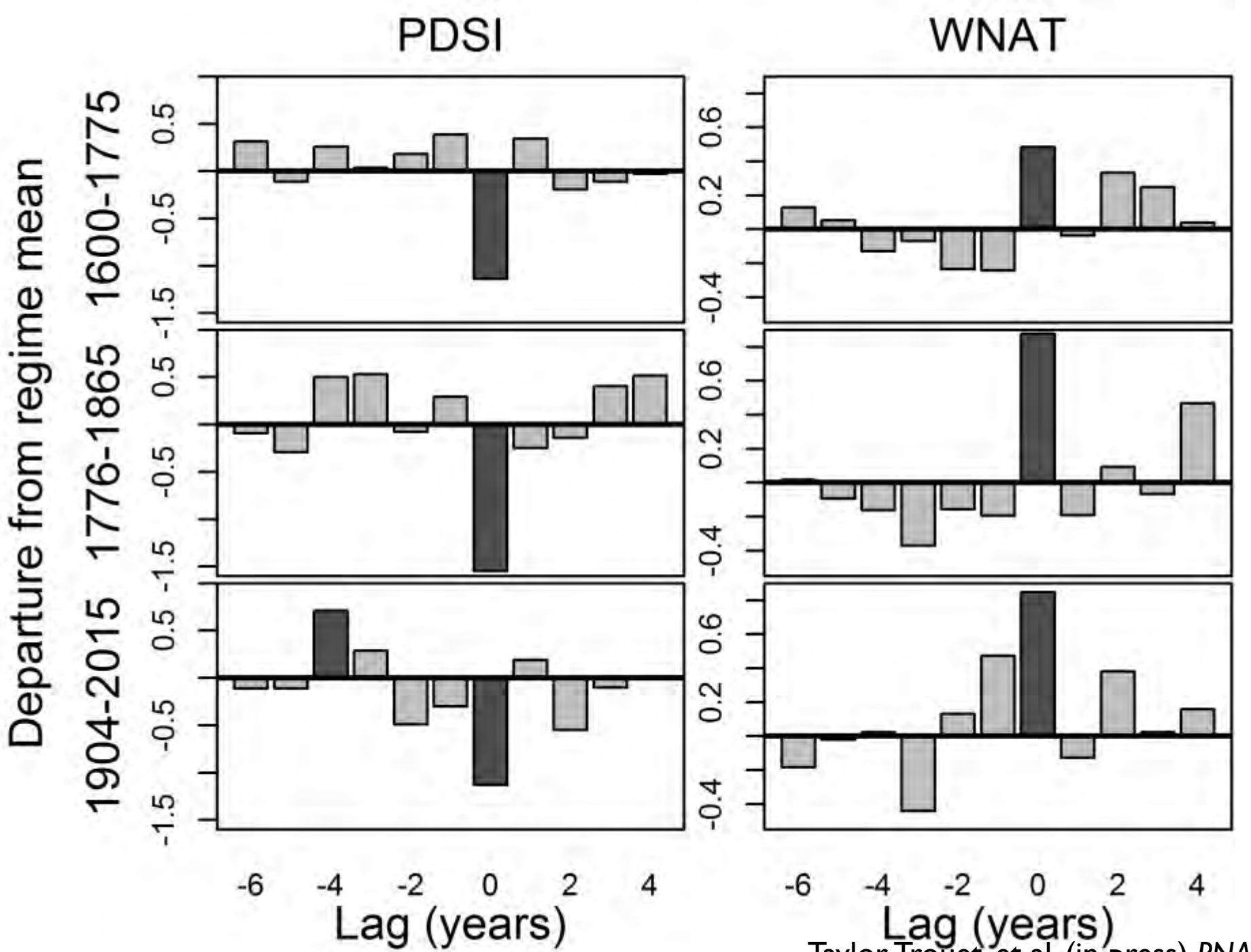
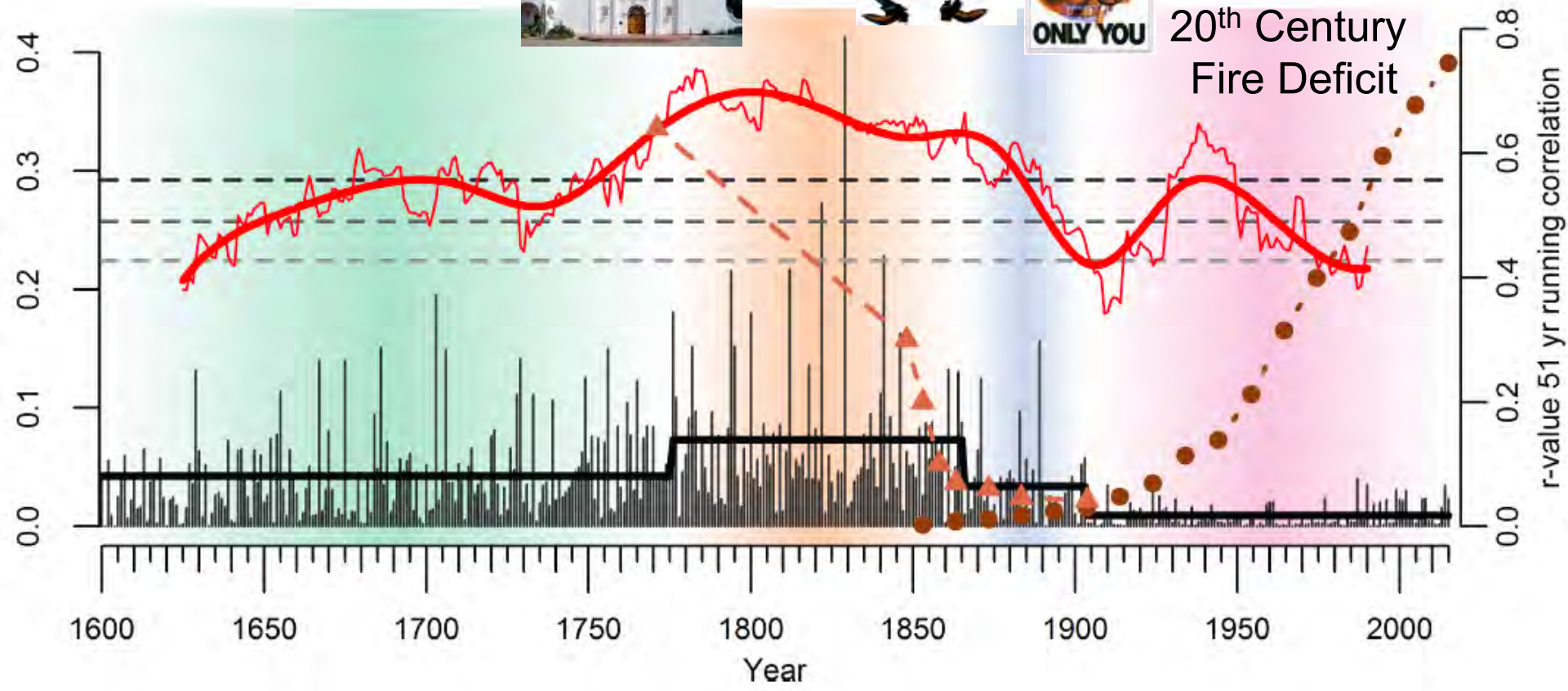


Taylor, Trouet, et al. (in press) *PNAS*

Land-use modulation of S Nevada fire regimes

20th Century
Fire Deficit



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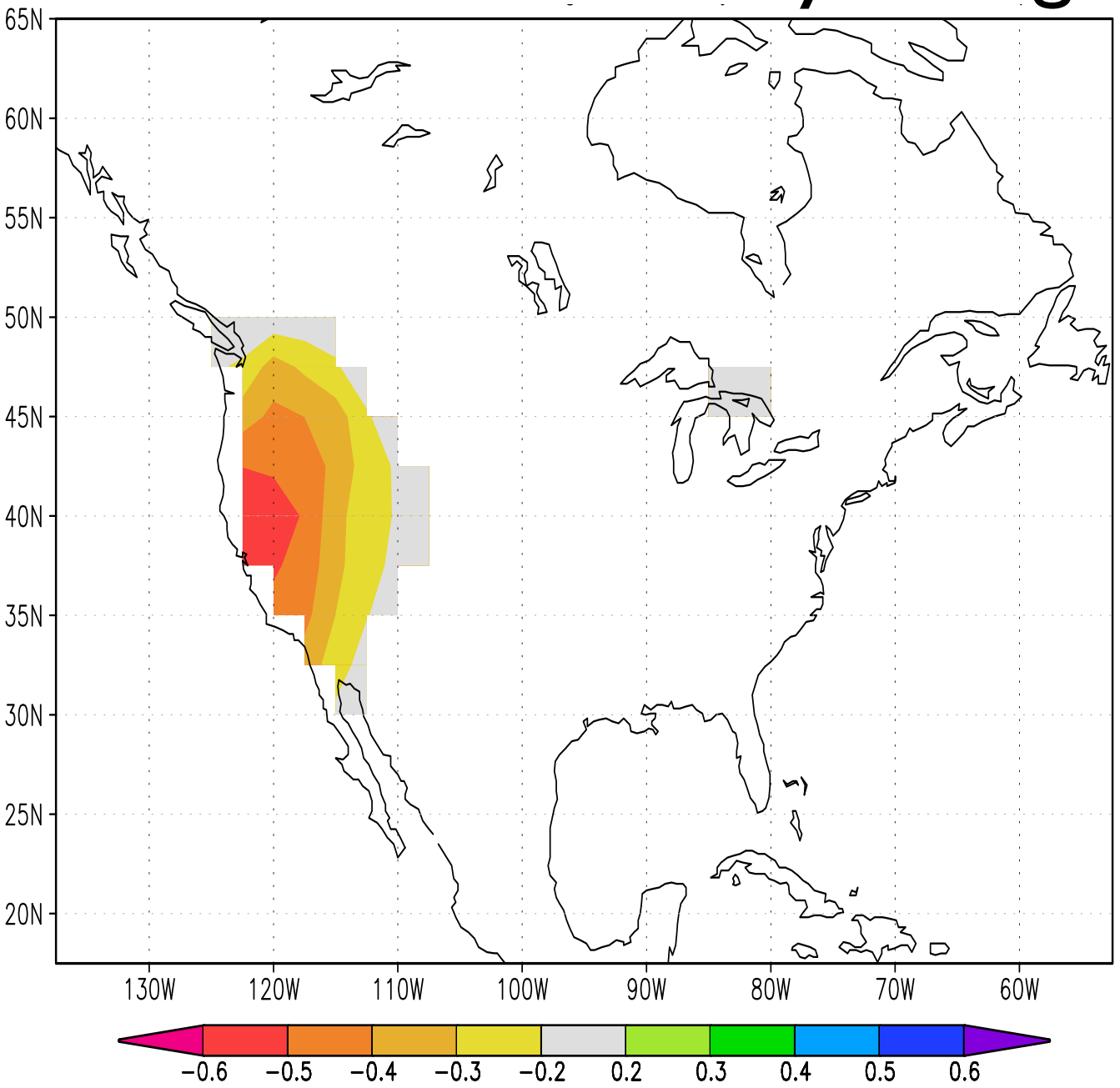
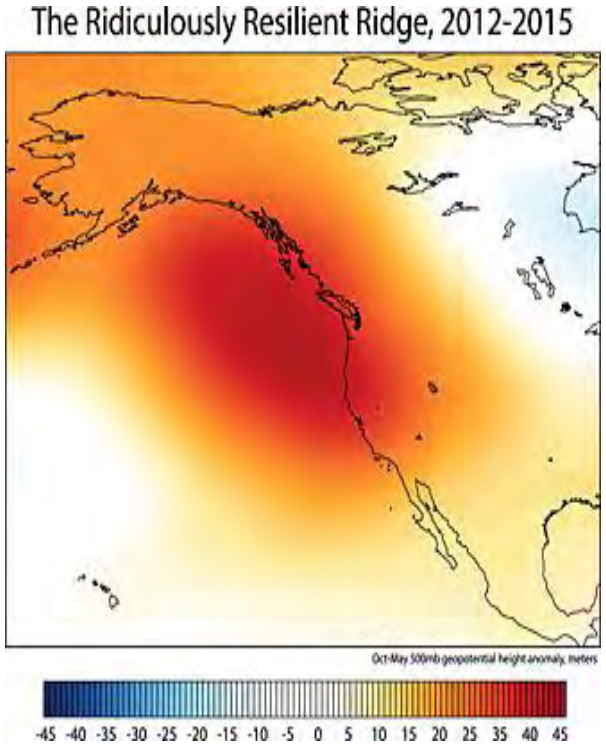


California drought 2012-2014

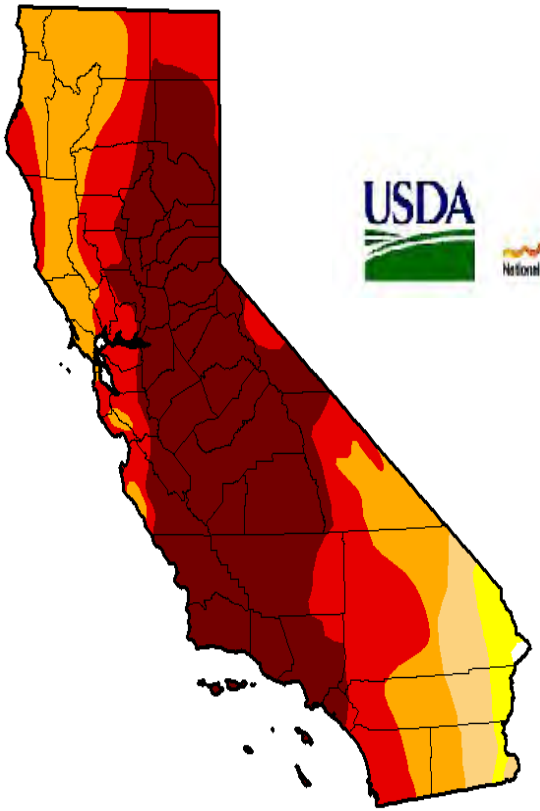
The Ridiculously Resilient Ridge



500 mbar geopotential height anomaly (meters) over four consecutive years (i.e., October–May 2012, 2013, 2014, and 2015)

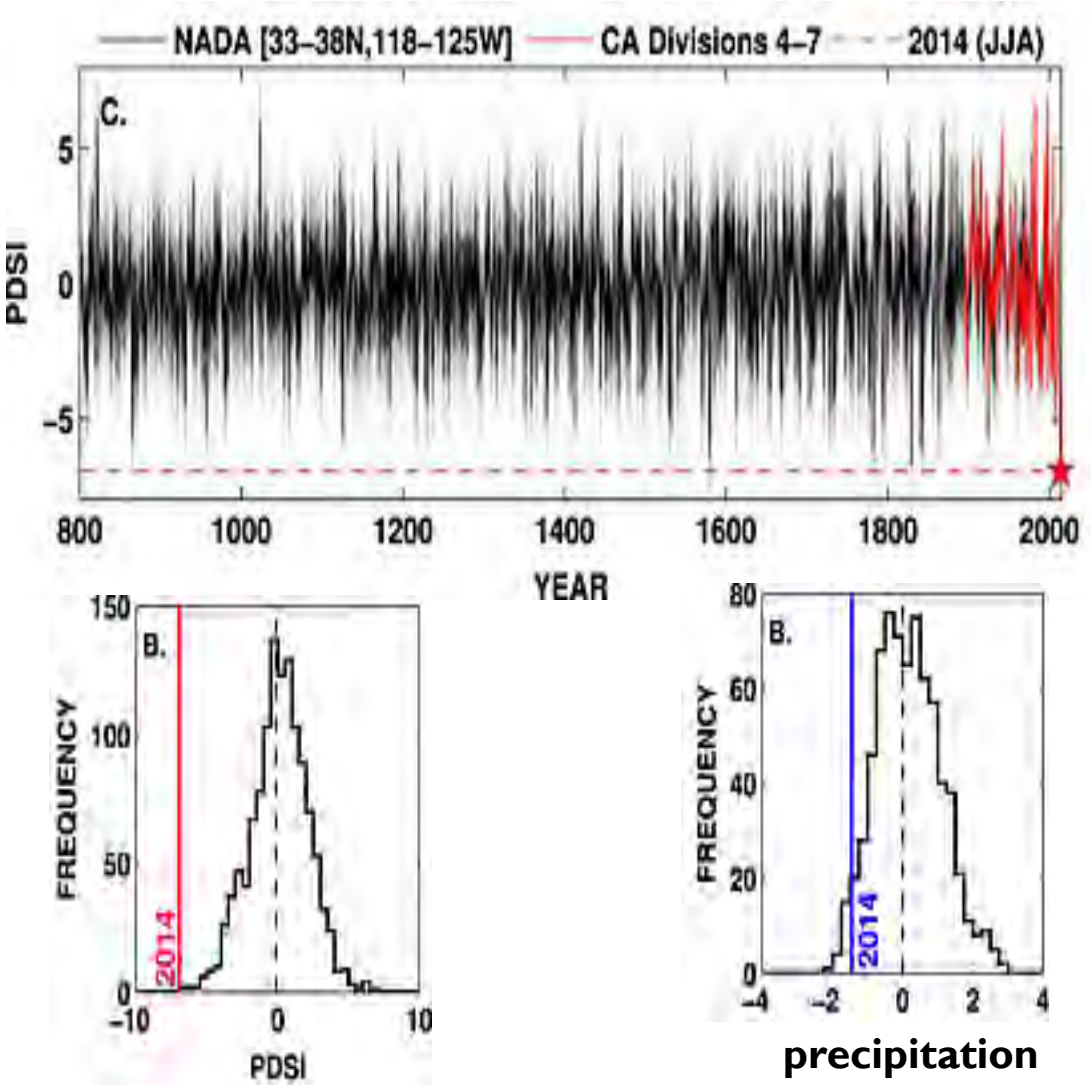
Swain et al (2014 & 2015)

The most severe, record setting drought



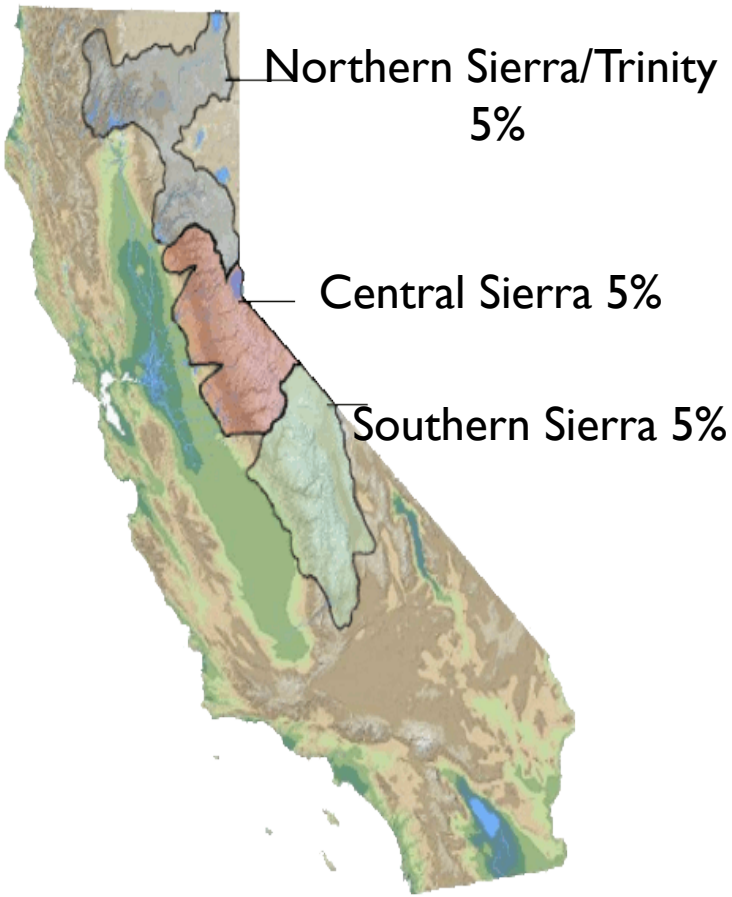
Diffenbaugh *et al.* (2015) PNAS

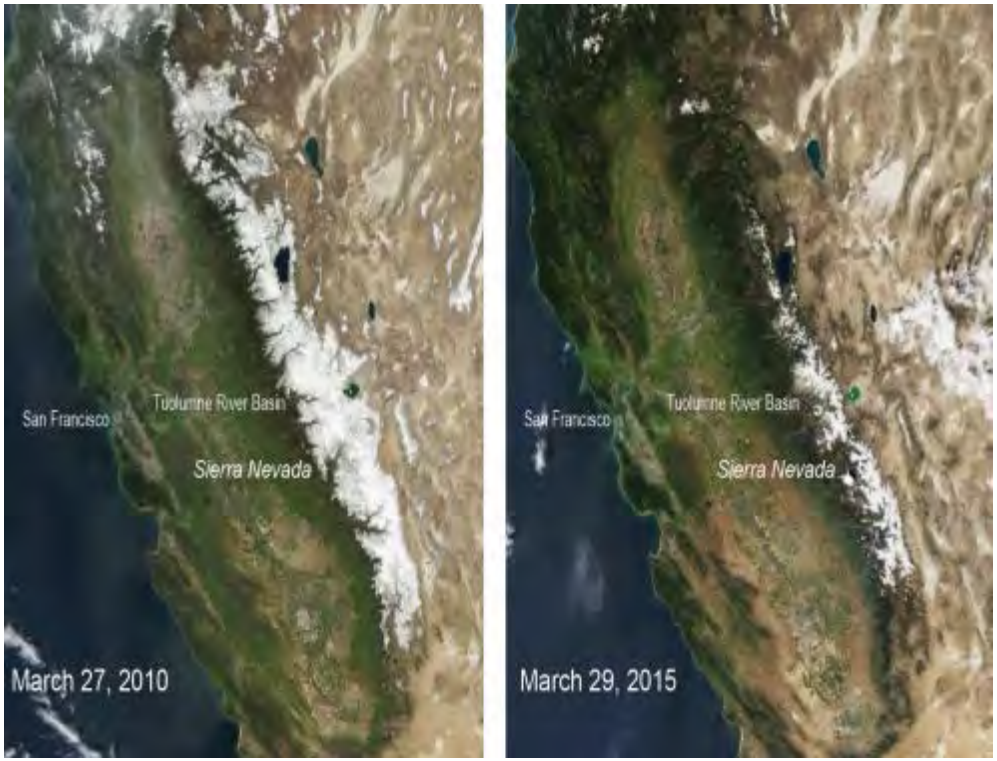
California drought: last millennium



Griffin and Anchukaitis (2014) GRL

Sierra Nevada April 1 2015 SWE



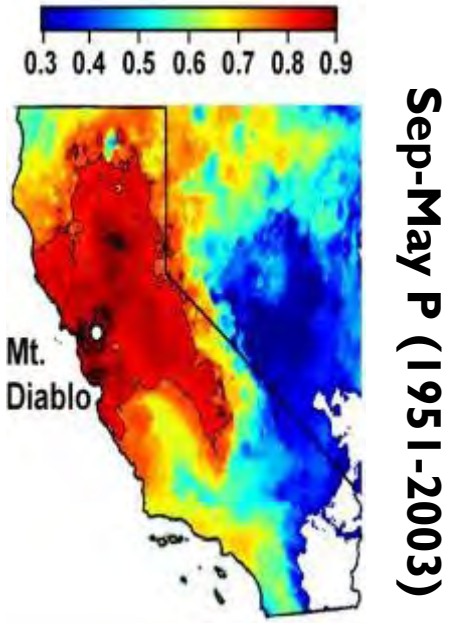


NASA / MODIS

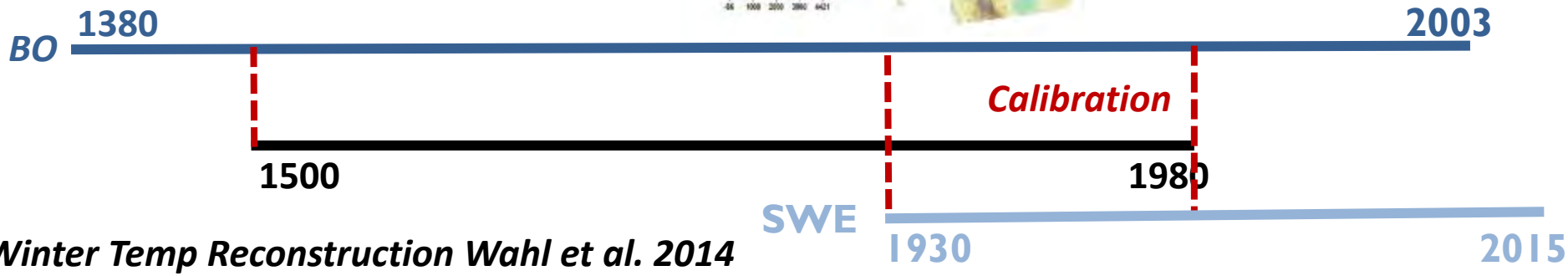
Data For: 01-Apr-2015
Provided by the California Cooperative Snow Surveys

Multi-century April 1 SWE

Credit: K.J. Anchikaitis: Blue oak (Quercus douglasii) in the Tehachapis Mountains (Kern County, California)



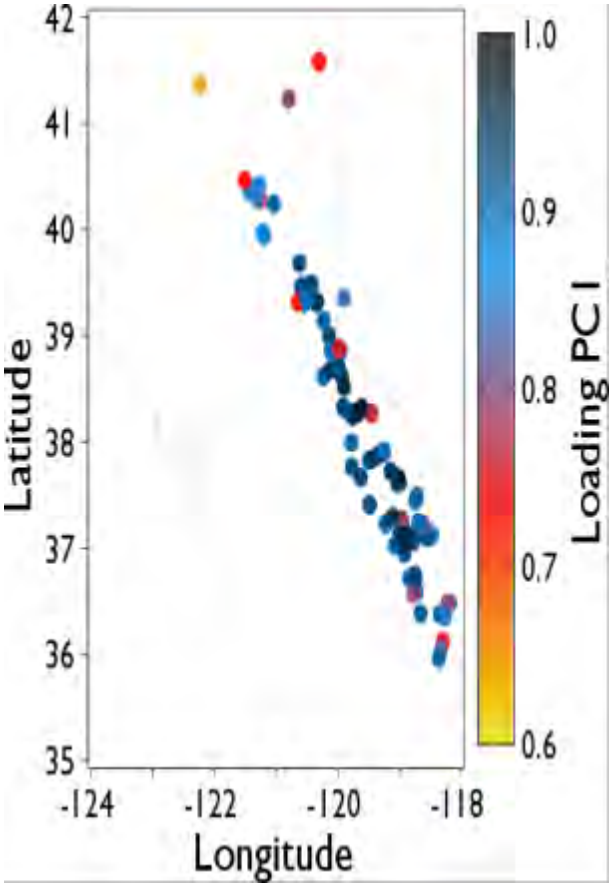
Stahle et al. 2013



Winter Temp Reconstruction Wahl et al. 2014

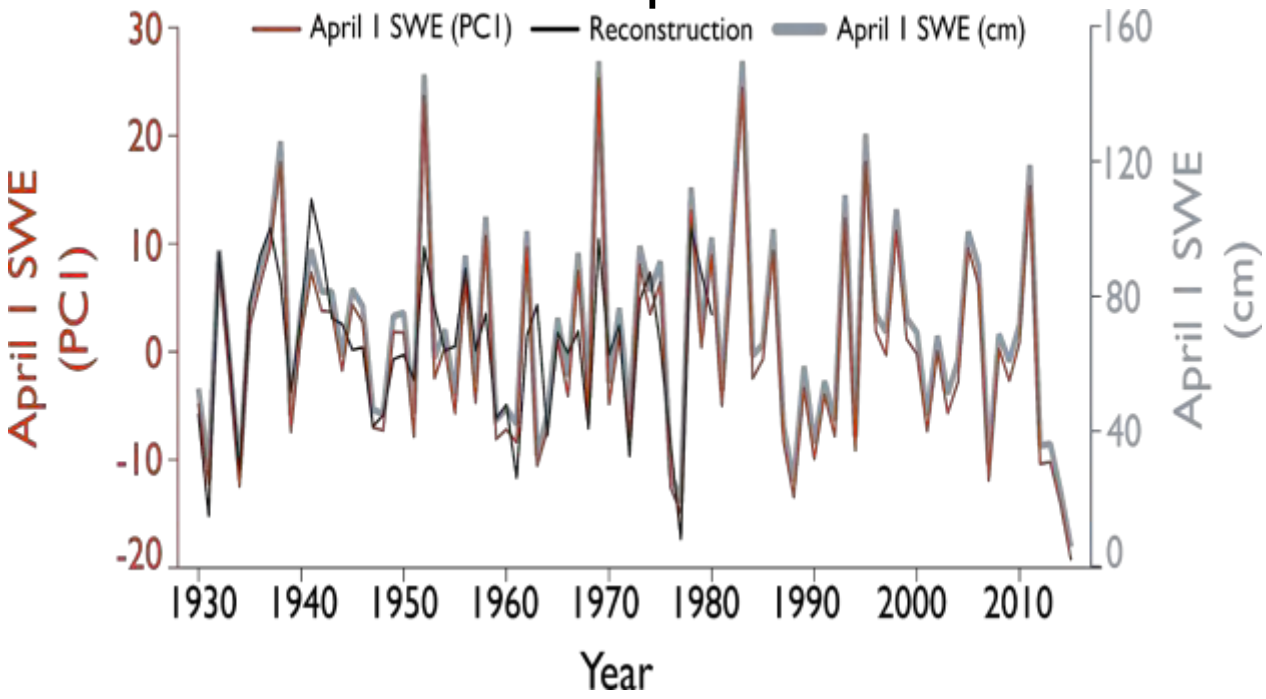
Multi-century April 1 SWE : *Calibration*

PC1 78 % Variance



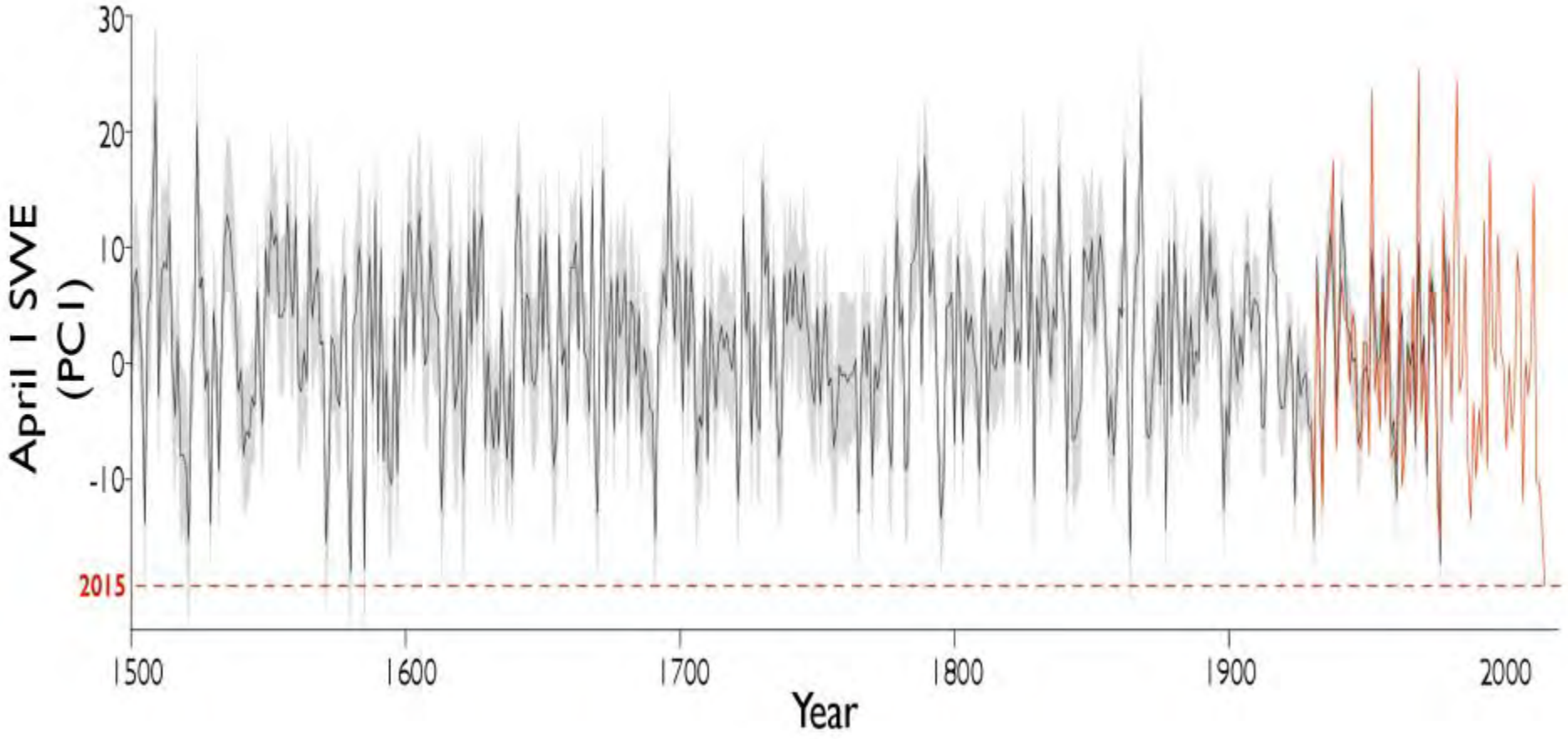
Blue oak: 58%

Temp: 5%



Belmecheri et al (2016) Nature CC

Multi-century April 1 SWE : *Reconstruction*



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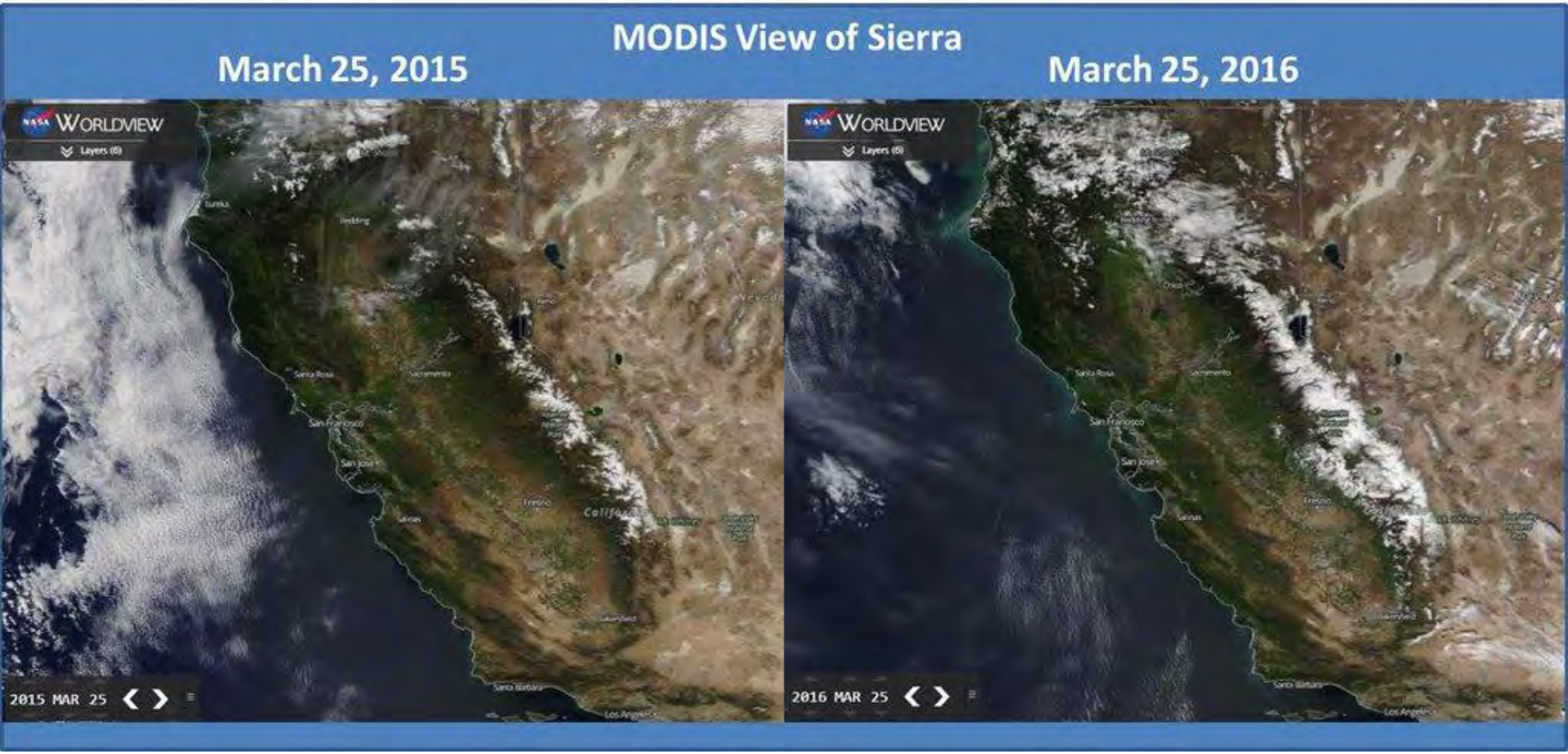
2016 snowpack



2015: 6% of average

2016: 87% of average

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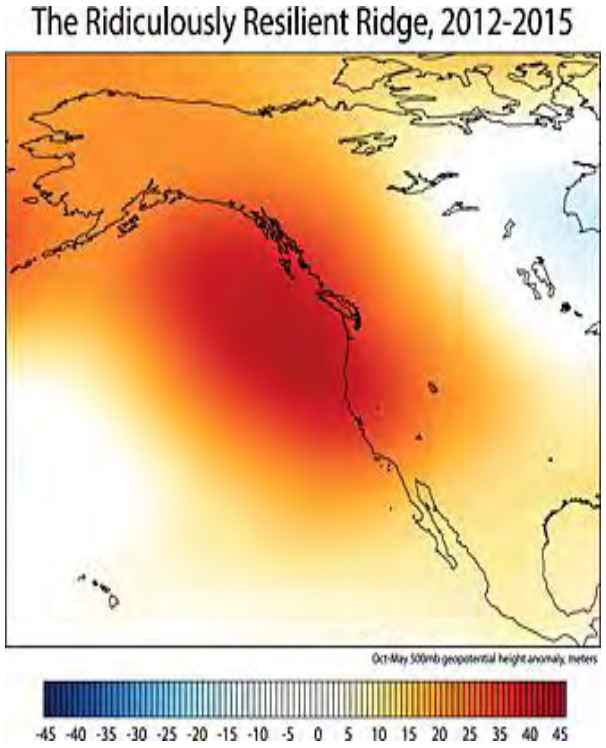

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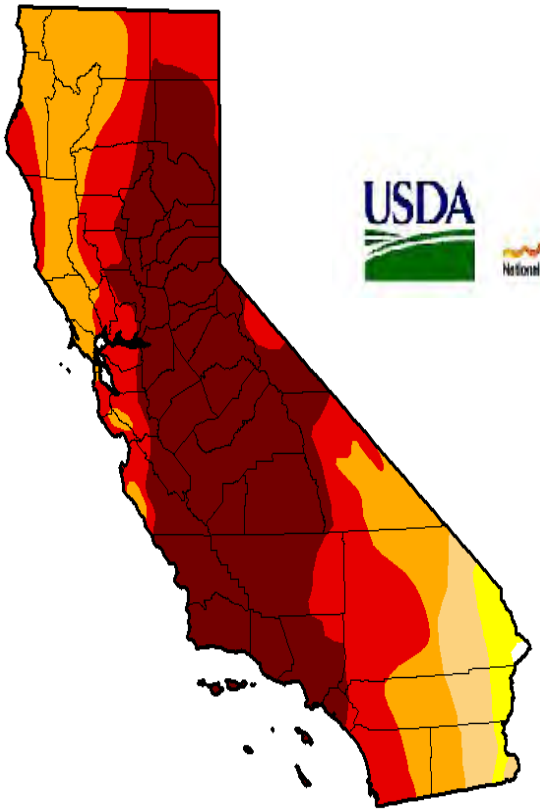
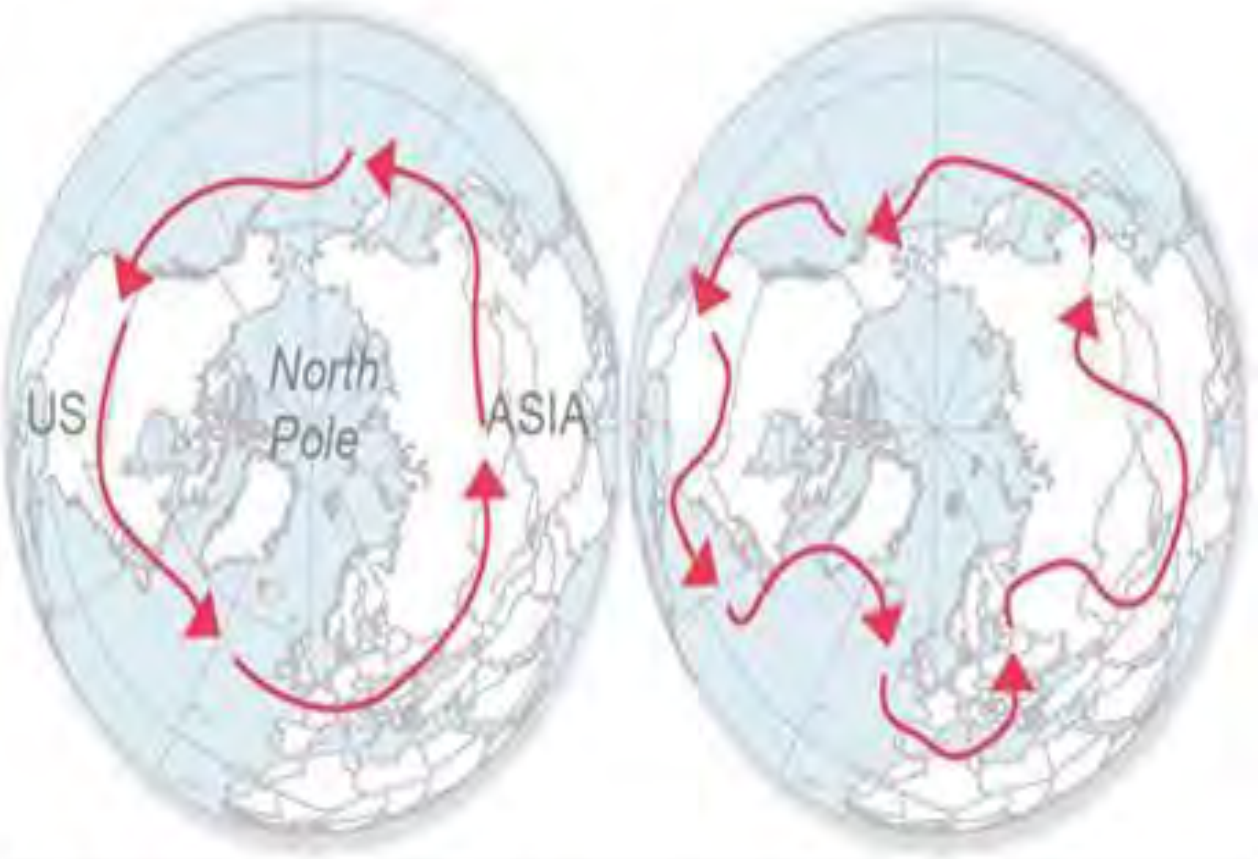


Diffenbaugh *et al.* (2015) PNAS

Westerly wind slows and meanders

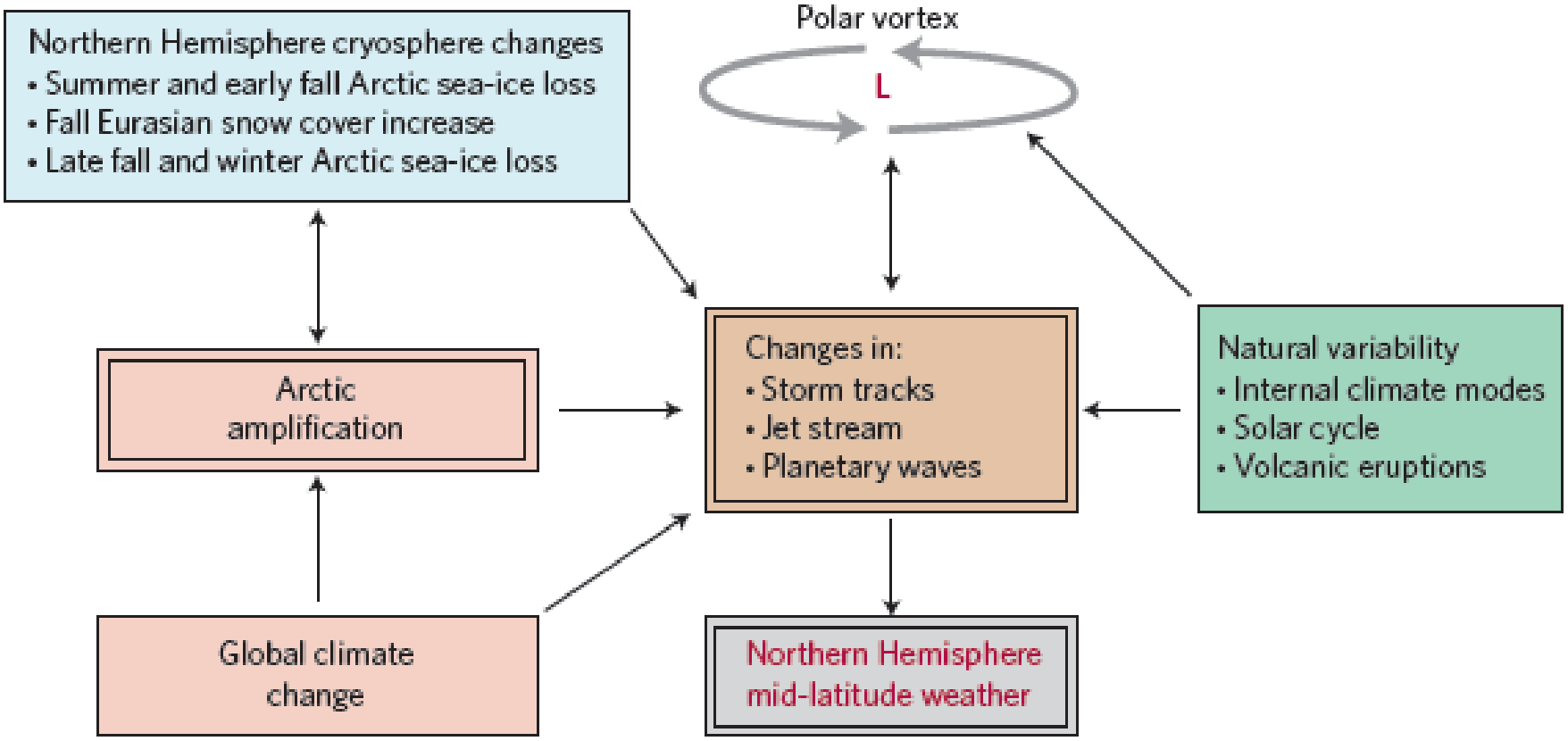
The jet stream, 3 miles above Earth, usually moves fast and straight. But lately it's often been slow and undulating, causing strange weather.

Path of northern jet stream changes



SOURCE: National Oceanic and Atmospheric Administration AP

Jet stream slow-down due to anthropogenic climate change?



Cohen et al 2014 Nature Geo

Can tree rings provide a long-term perspective on jet stream variability?

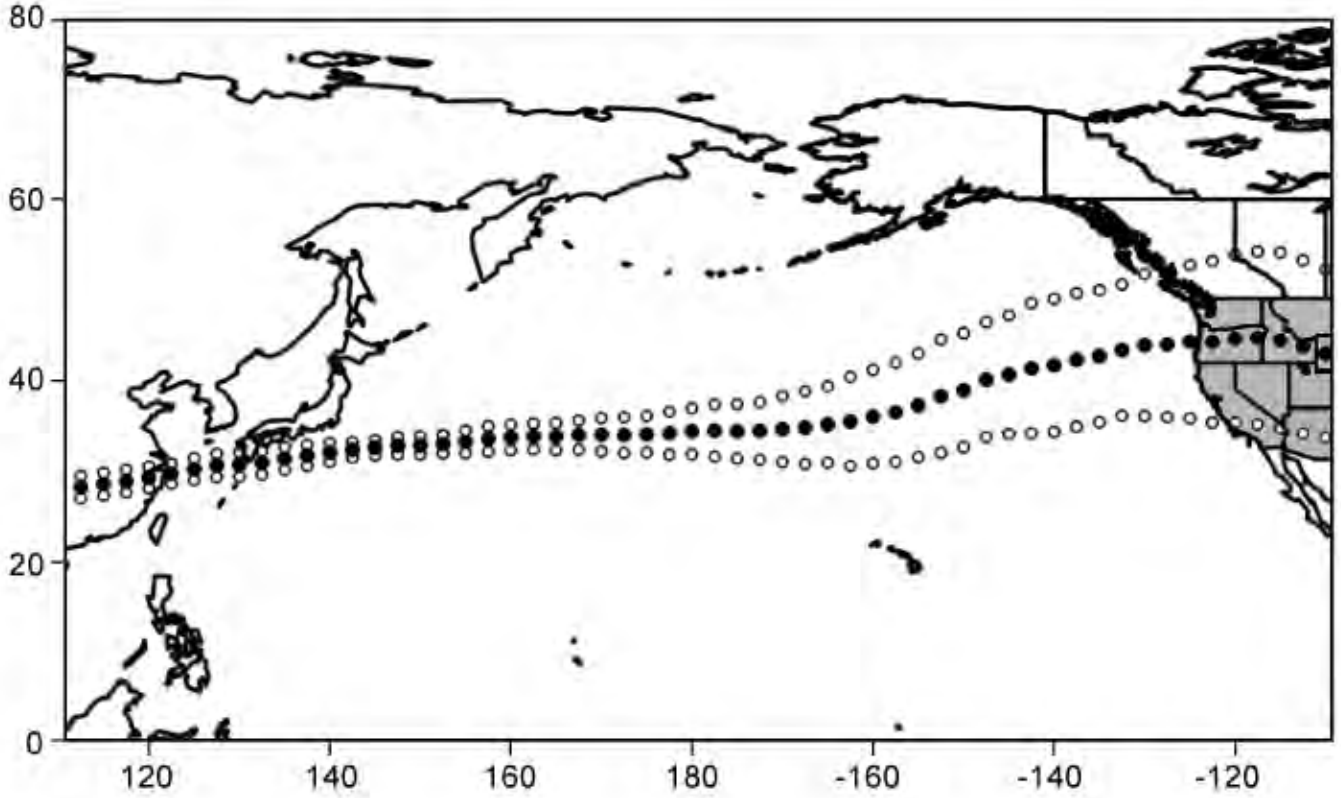
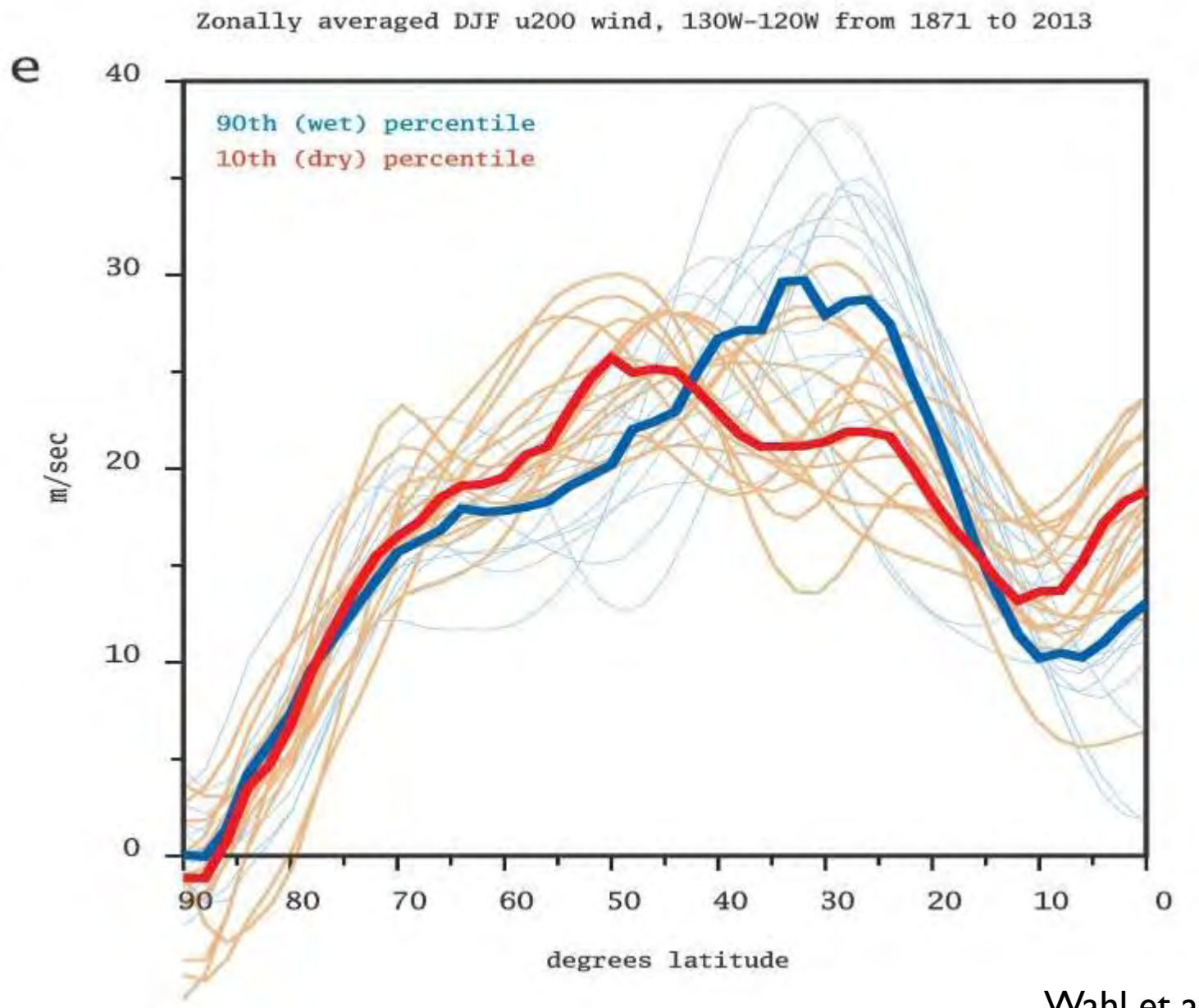


Fig. 1. The mean latitudinal position (shaded circles) of the Northern Pacific Jet (NPJ) and one standard deviation above and below the mean (open circles) (1948/1949 through 2007/2008), and the precipitation study region of the western United States (shaded). The mean latitude of the NPJ as a whole is 35°55′.

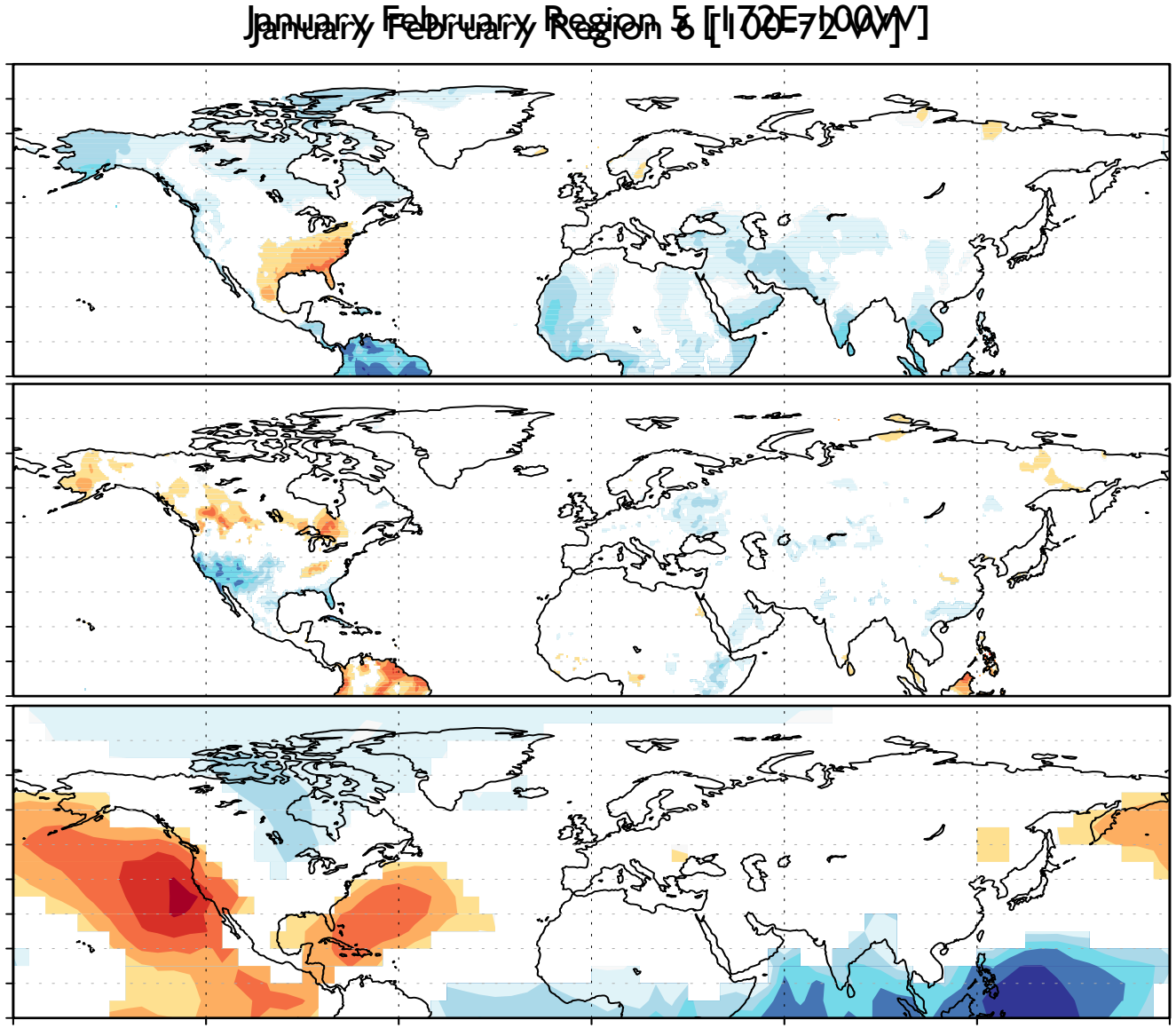
Ellis and Barton (2012) Phys Geogr

Winter North Pacific Jet



Wahl et al. (submitted)

Climatic influence of winter NPJ variability



Winter temperature

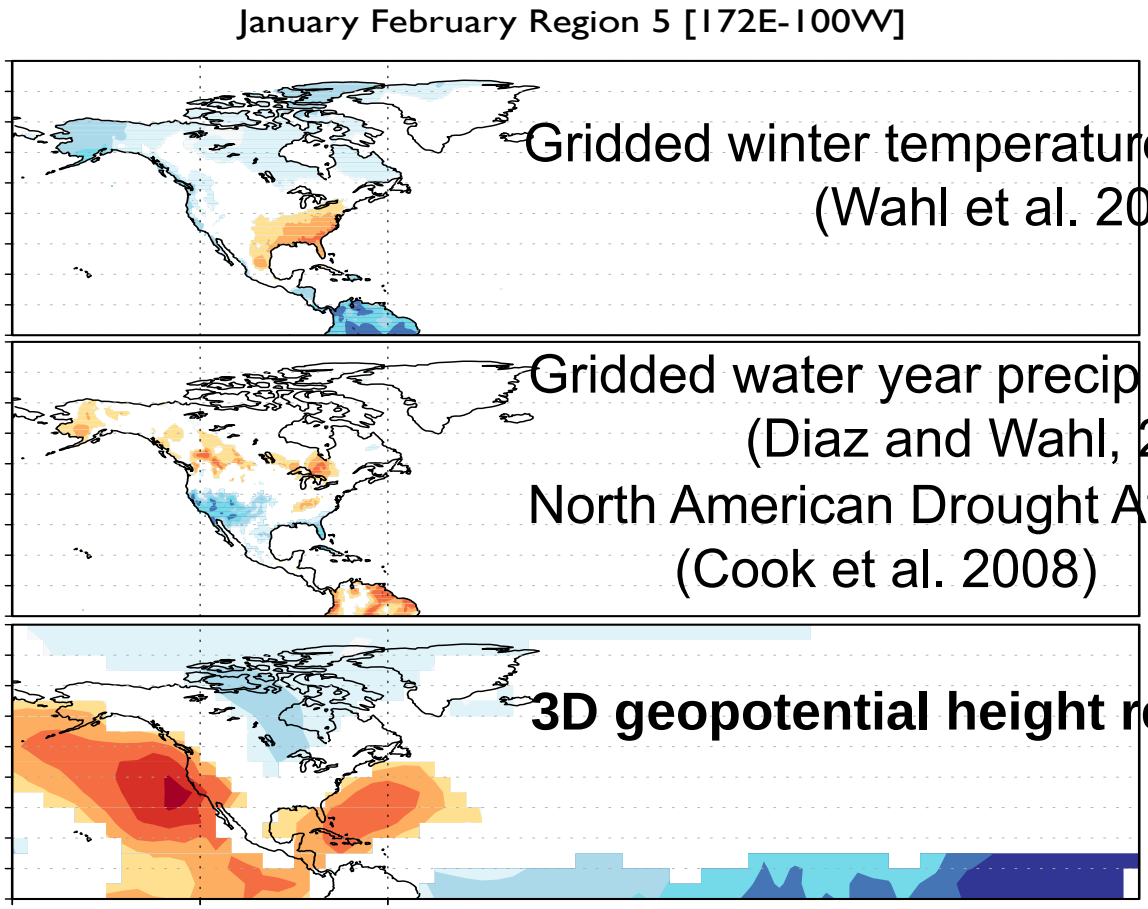
Winter precipitation

Winter SLP

−0.6 −0.5 −0.4 −0.3 −0.2 0.2 0.3 0.4 0.5 0.6

Belmecheri et al (in revision)

Winter NPJ reconstruction

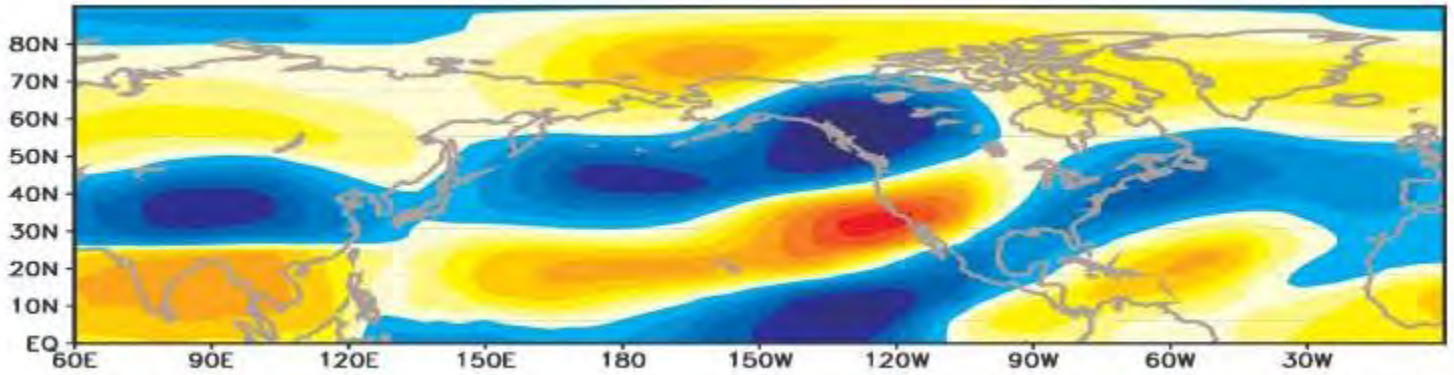


Wahl et al. (submitted)

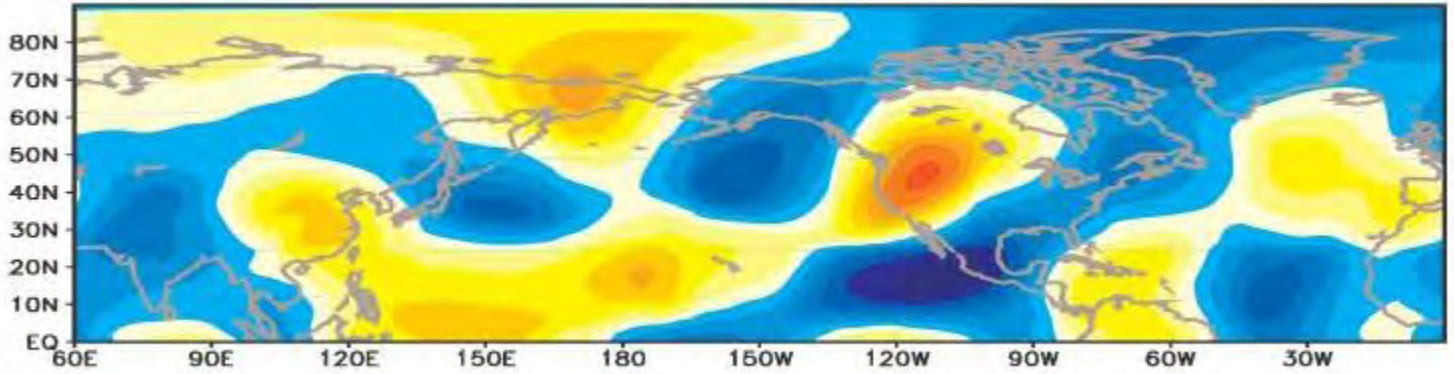
Winter NPJ reconstruction 1571-present

Griffin and Anchukaitis precipitation correlations

u200



v200

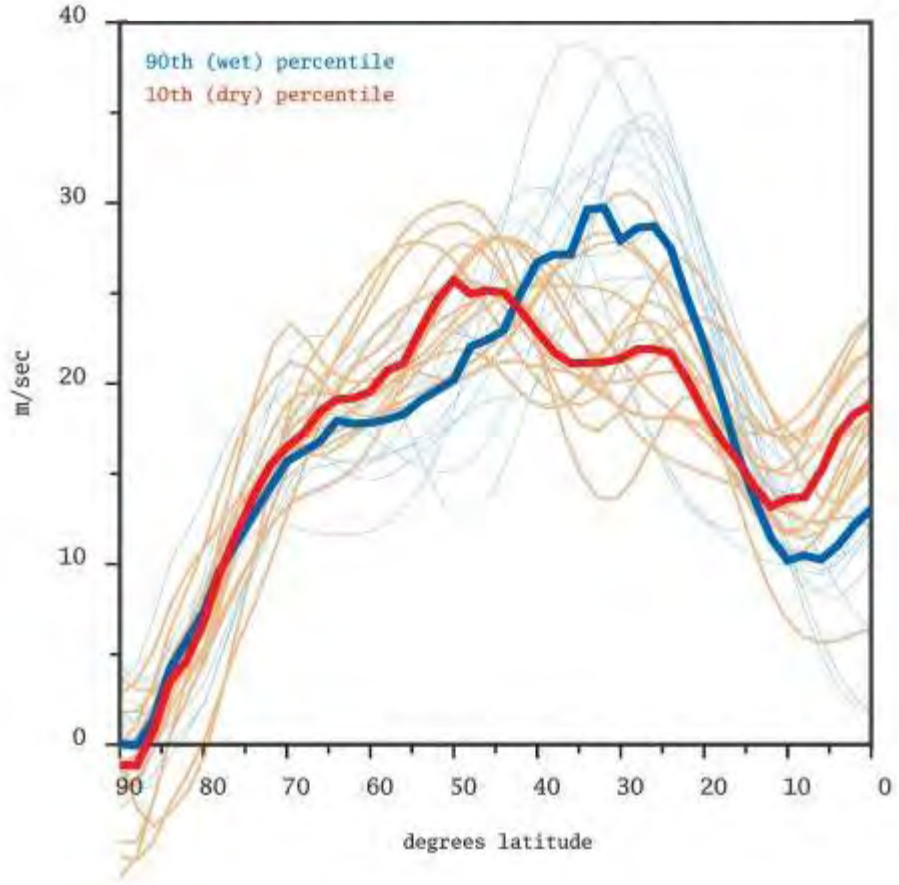


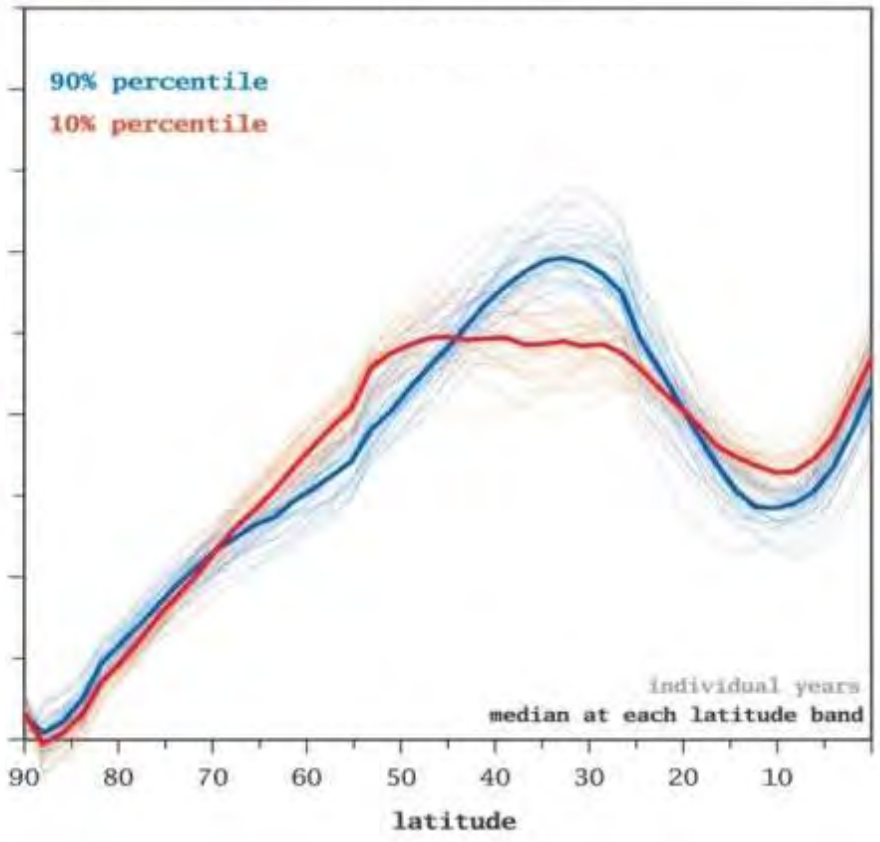
Wahl et al. (submitted)

Winter North Pacific Jet

Instrumental period

reconstruction



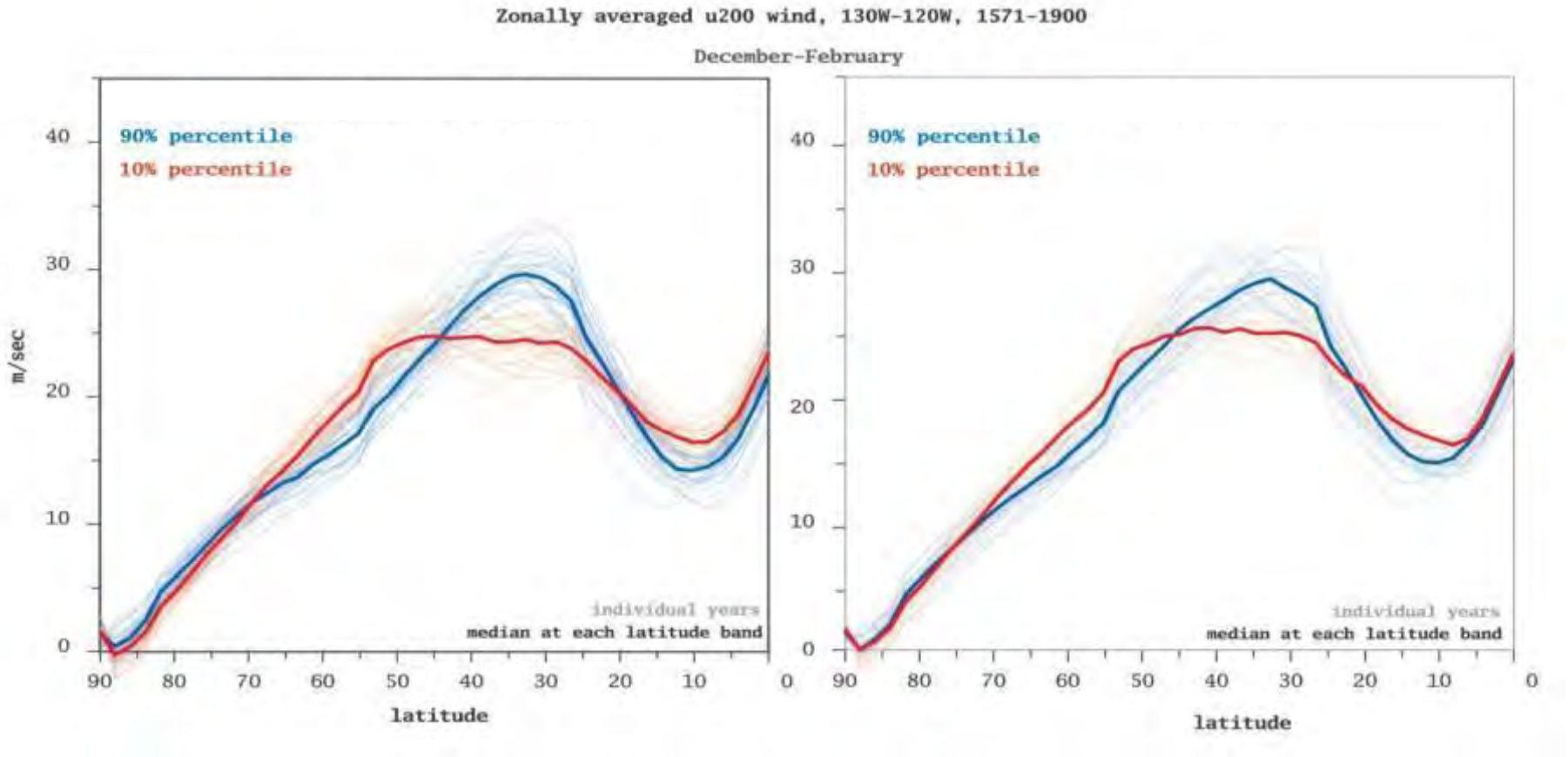


Wahl et al. (submitted)

Winter NPJ reconstruction 1571-present

stratified by precipitation

stratified by fire index



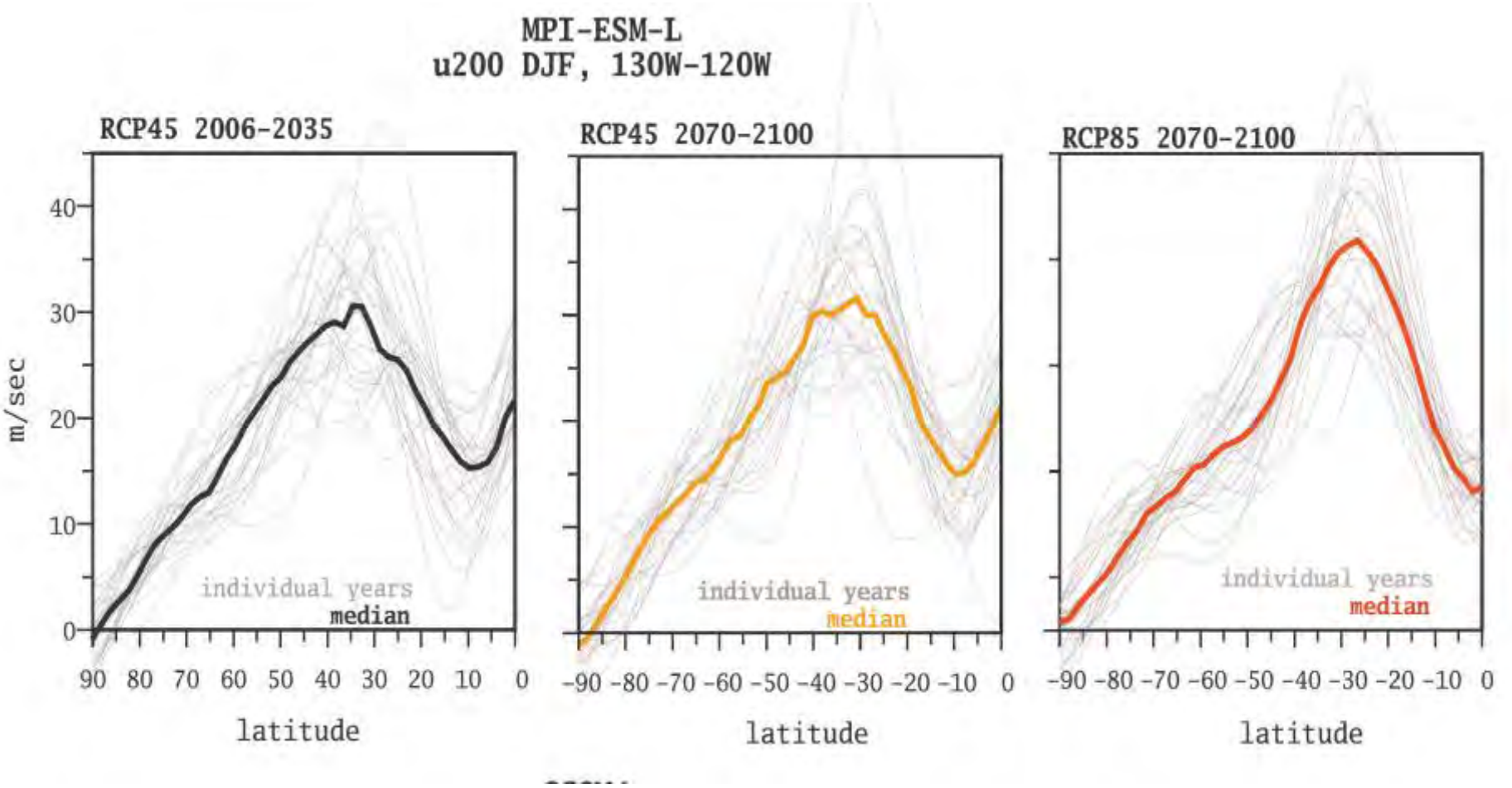
Wahl et al. (submitted)

Winter North Pacific Jet

dry and high-fire extremes are strongly associated with
a weakening,
reduction of southward extent,
and more latitudinal spread
of the zonal NPJ

Wahl et al. (submitted)

Future NPJ projections



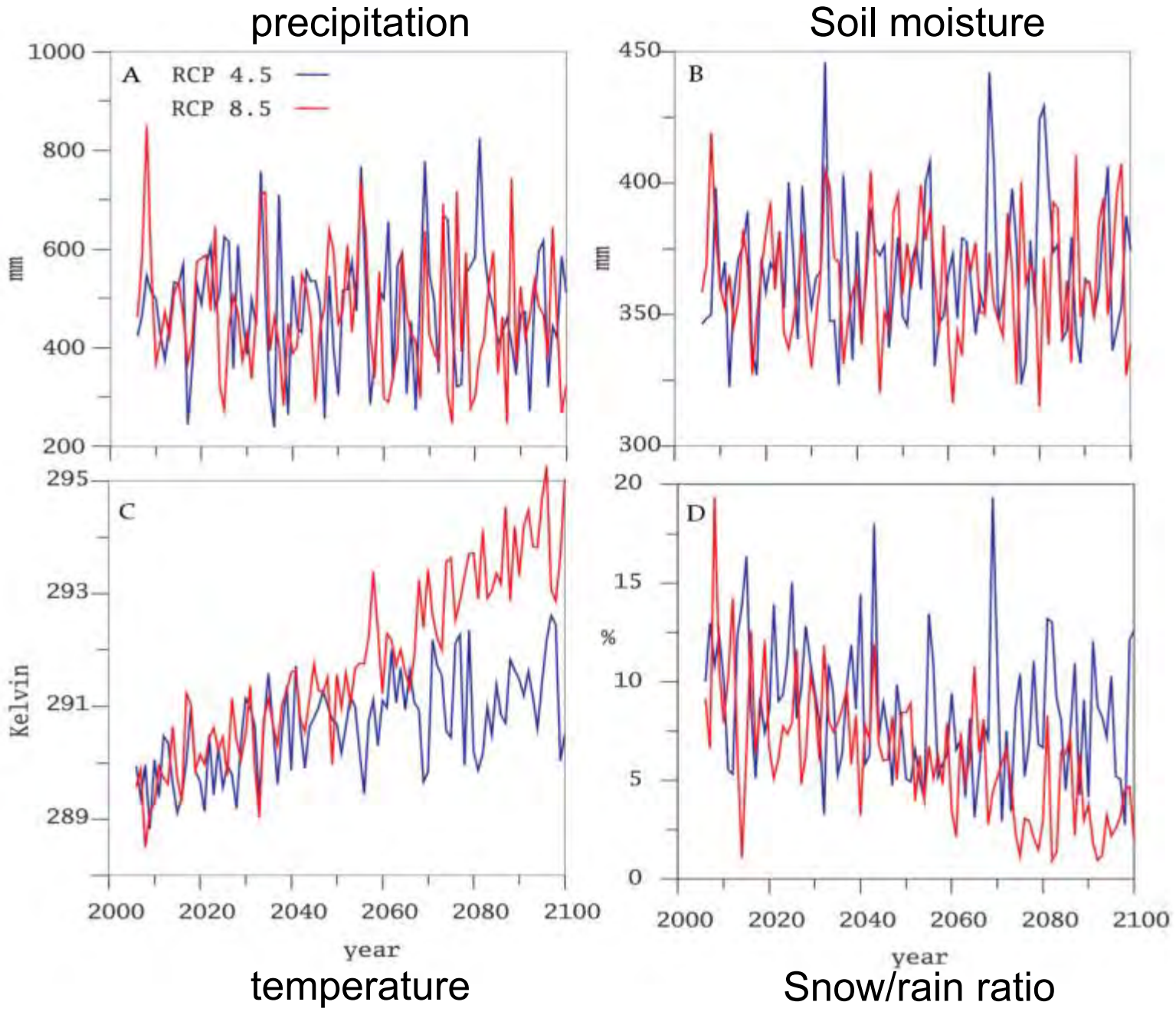
Wahl et al. (submitted)

Winter North Pacific Jet

Model simulations suggest a tendency towards the "wet/low-fire" NPJ state in California by the end of the 21st century, particularly for RCP8.5.

BUT
the '20th century fire deficit',
increased rain-to-snow ratios,
and direct thermodynamic influence of rising temperatures
will also influence future fire regimes.

Wahl et al. (submitted)



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Thank you

Trouetlab.arizona.edu