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Climate Projections: Long Term Trends Punctuated by Extremes

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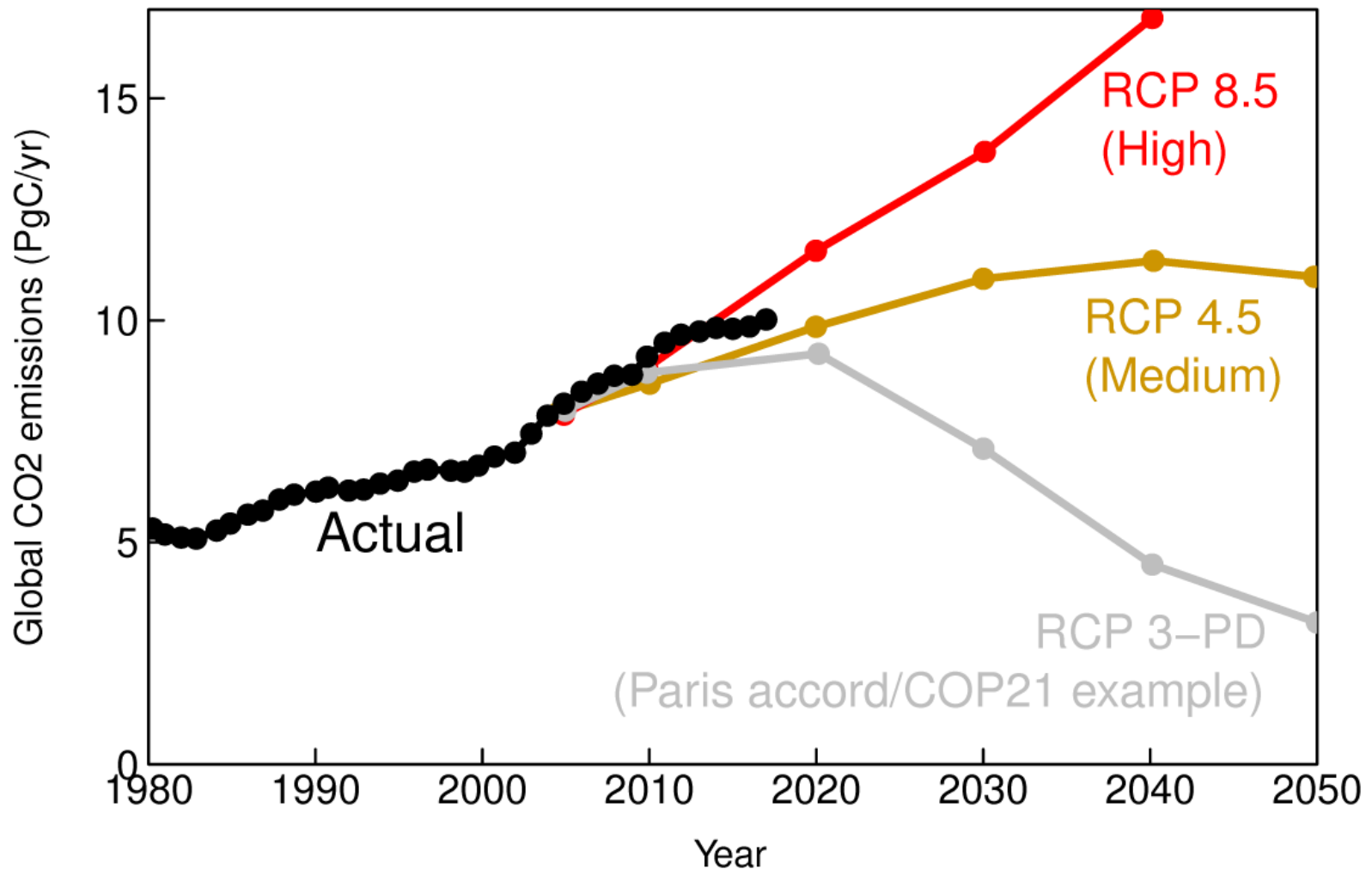
August 29th, 2018
CEC Workshop

Sponsors:

California Energy Commission (CEC)
NOAA via CNAP RISA
USGS/DOI via SW Climate Science Center
U.S. Department of Energy
US Army Corps of Engineers/ US Bureau of Reclamation

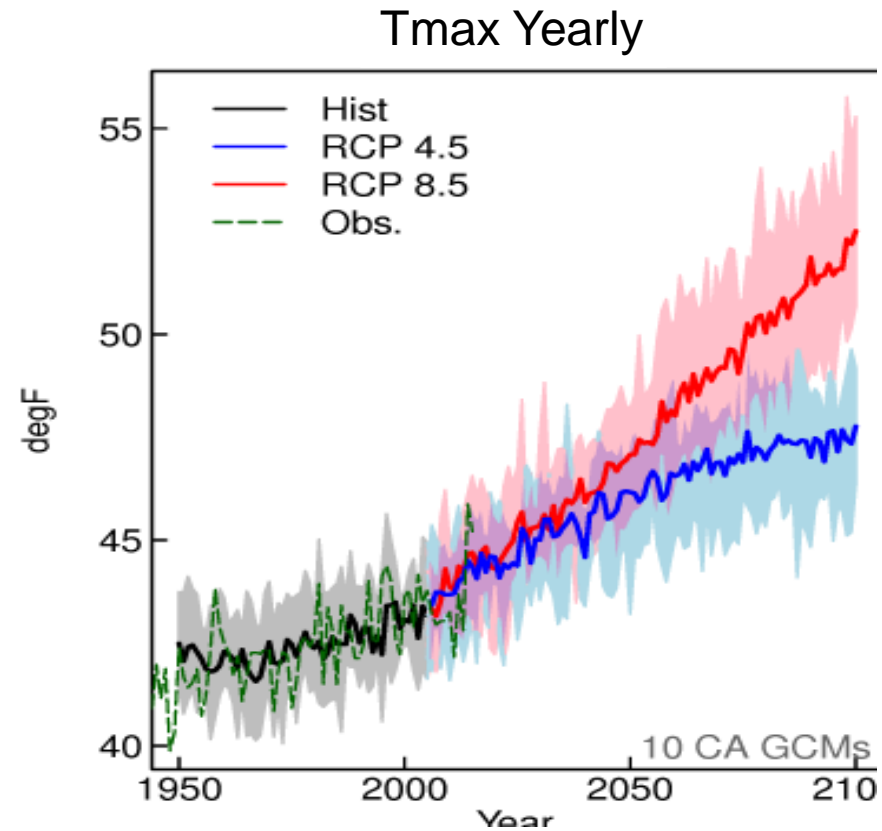
Greenhouse Gas Scenarios

CO₂ emissions: actual vs. IPCC scenarios



Temperatures are Projected to Rise

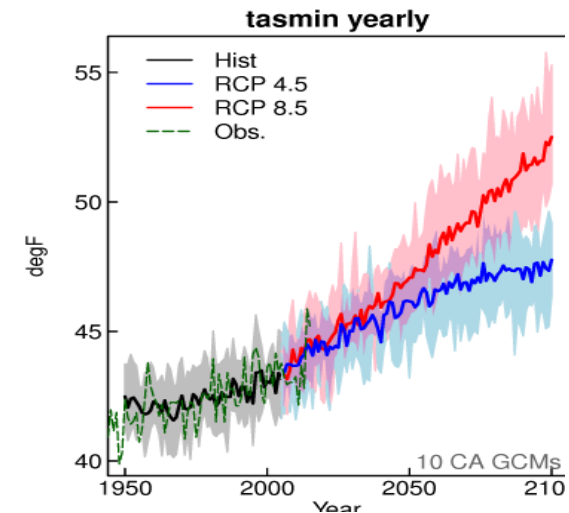
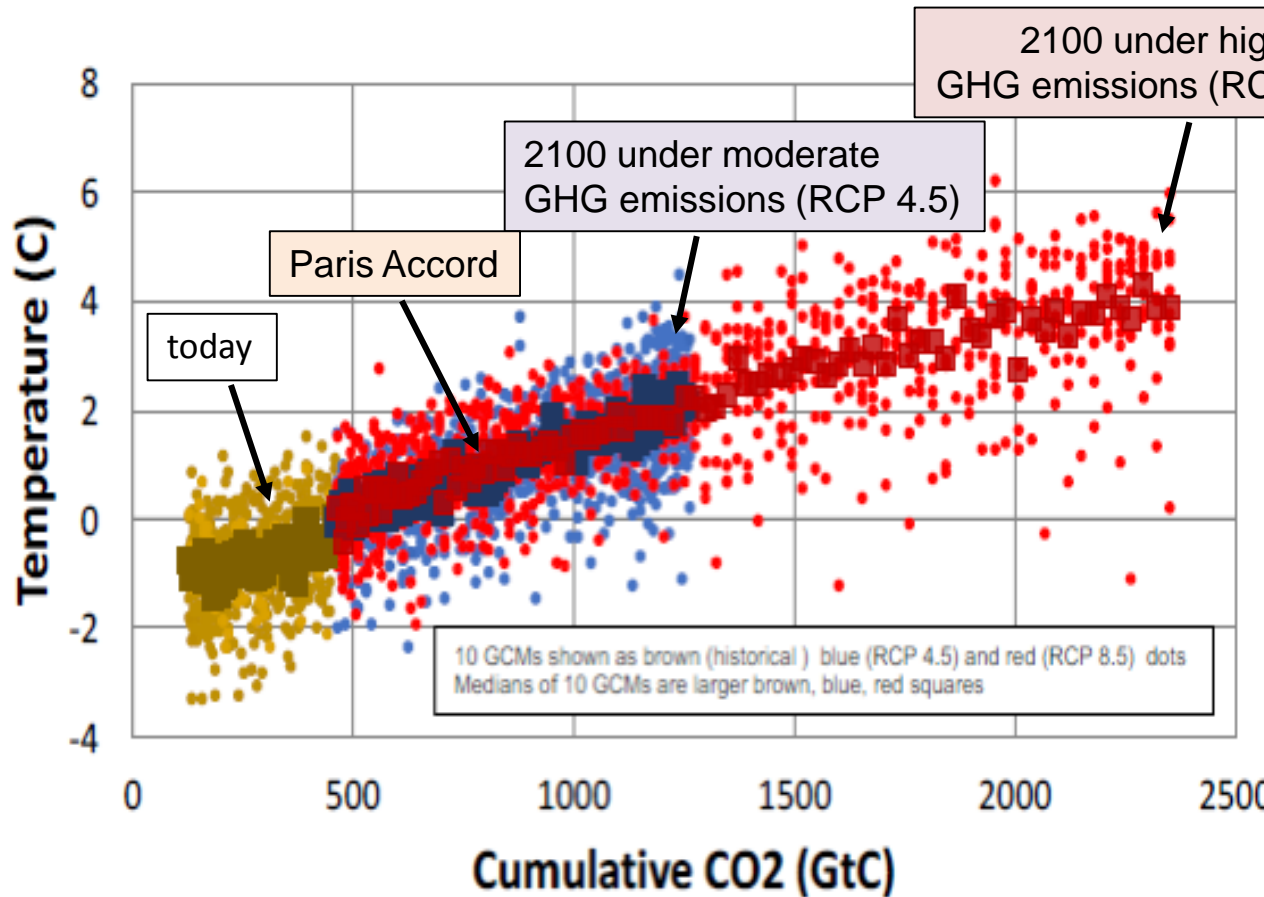
In proportion to accumulation of CO₂ and other Greenhouse gases
plots show California statewide temperature change



D. Pierce, Scripps

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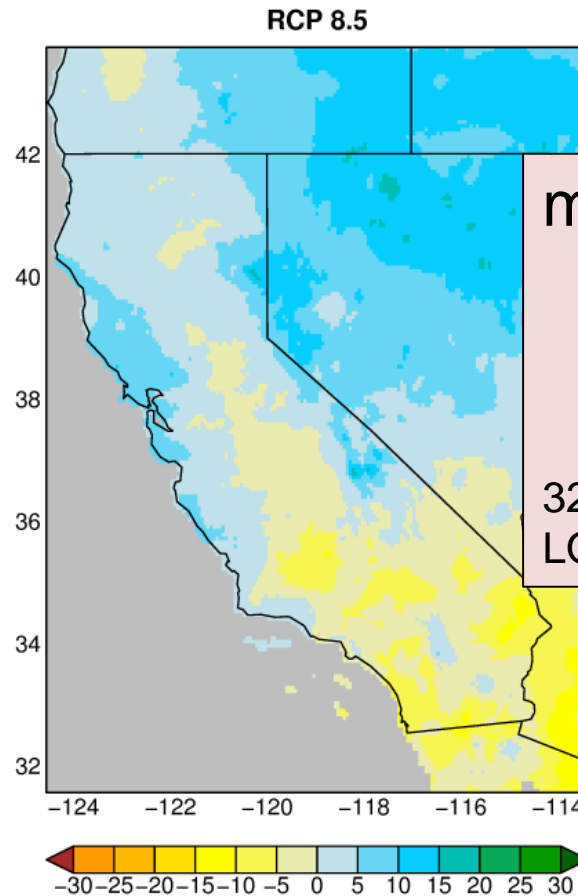
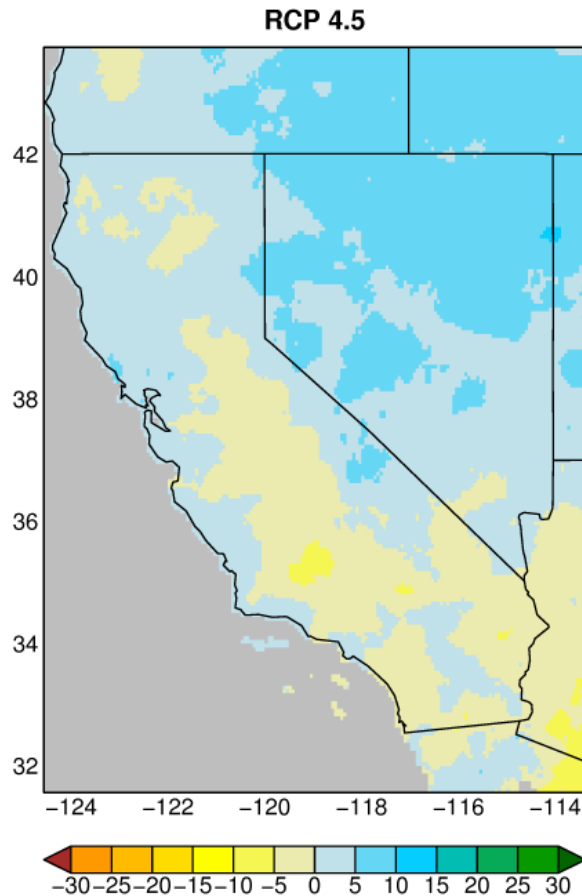


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Precipitation Minimal Long-Term Trend

Changes in Seasonality: wetter winter, drier shoulders

Changes in annual precip [%] 2070-2100 w.r.t. 1950-2005



models suggest:
somewhat *wetter* NoCal
somewhat *drier* SoCal

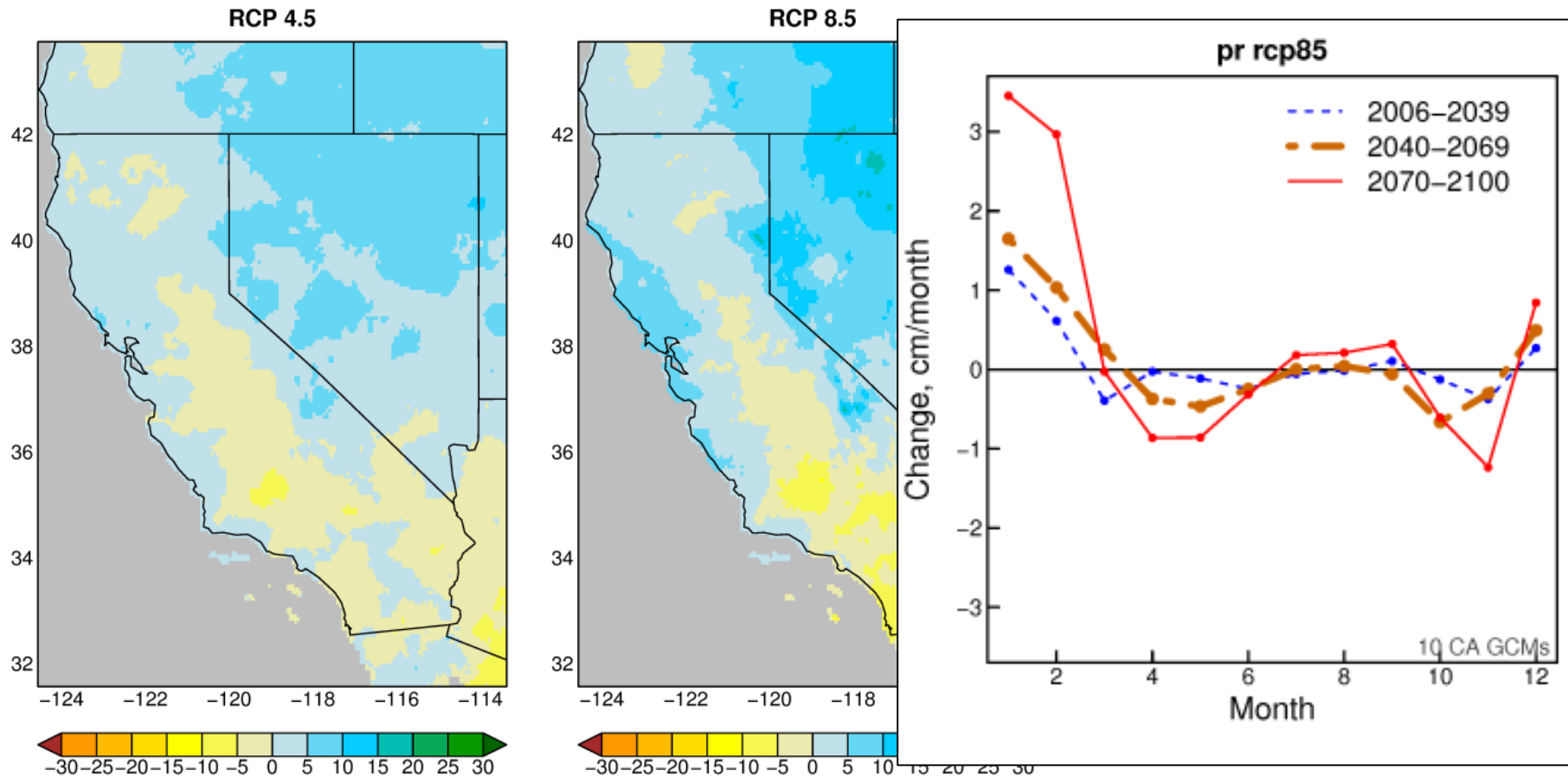
32 CMIP5 GCMs downscaled w
LOCA

/net/valve2/data/CA_NV_VIC_redo_2016-08-25/plot_precip_change.R Mon Jun 26 13:33:33 2017

Precipitation Minimal Long-Term Trend

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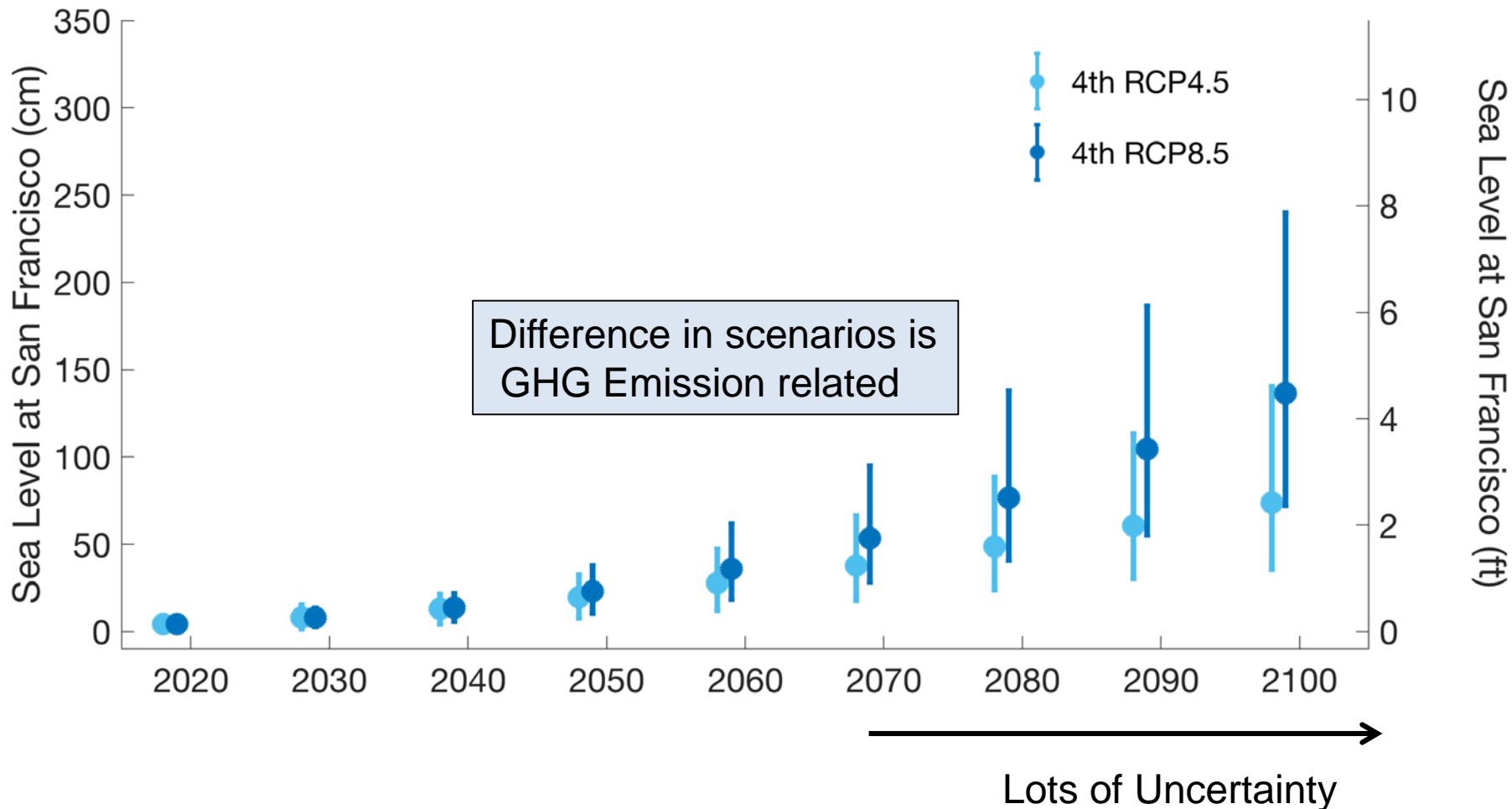
Changes in annual precip [%] 2070-2100 w.r.t. 1950-2005



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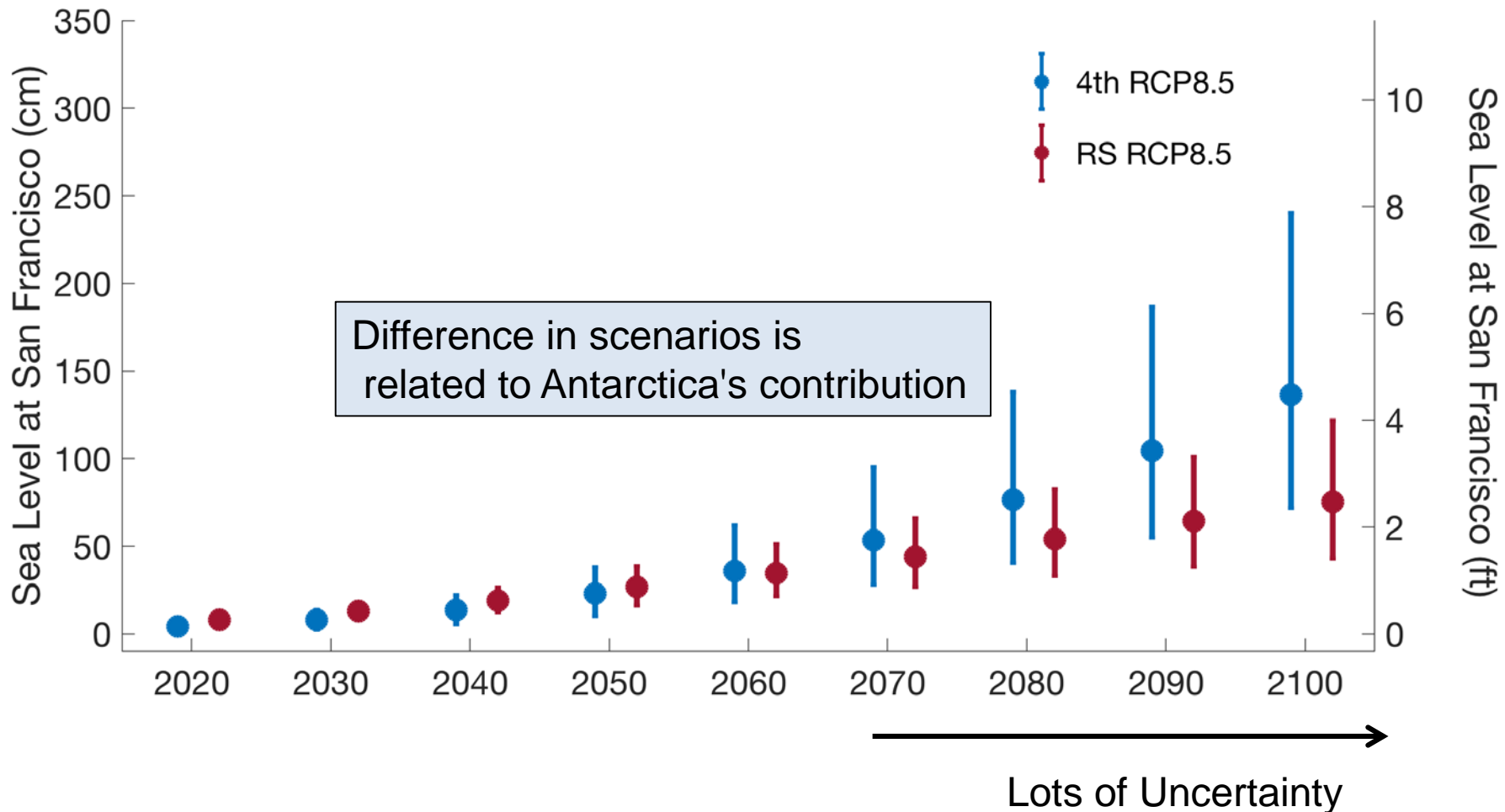
Sea Level Rise

Lots of uncertainty end of century GHG emissions and Ice Sheets (Antarctica)



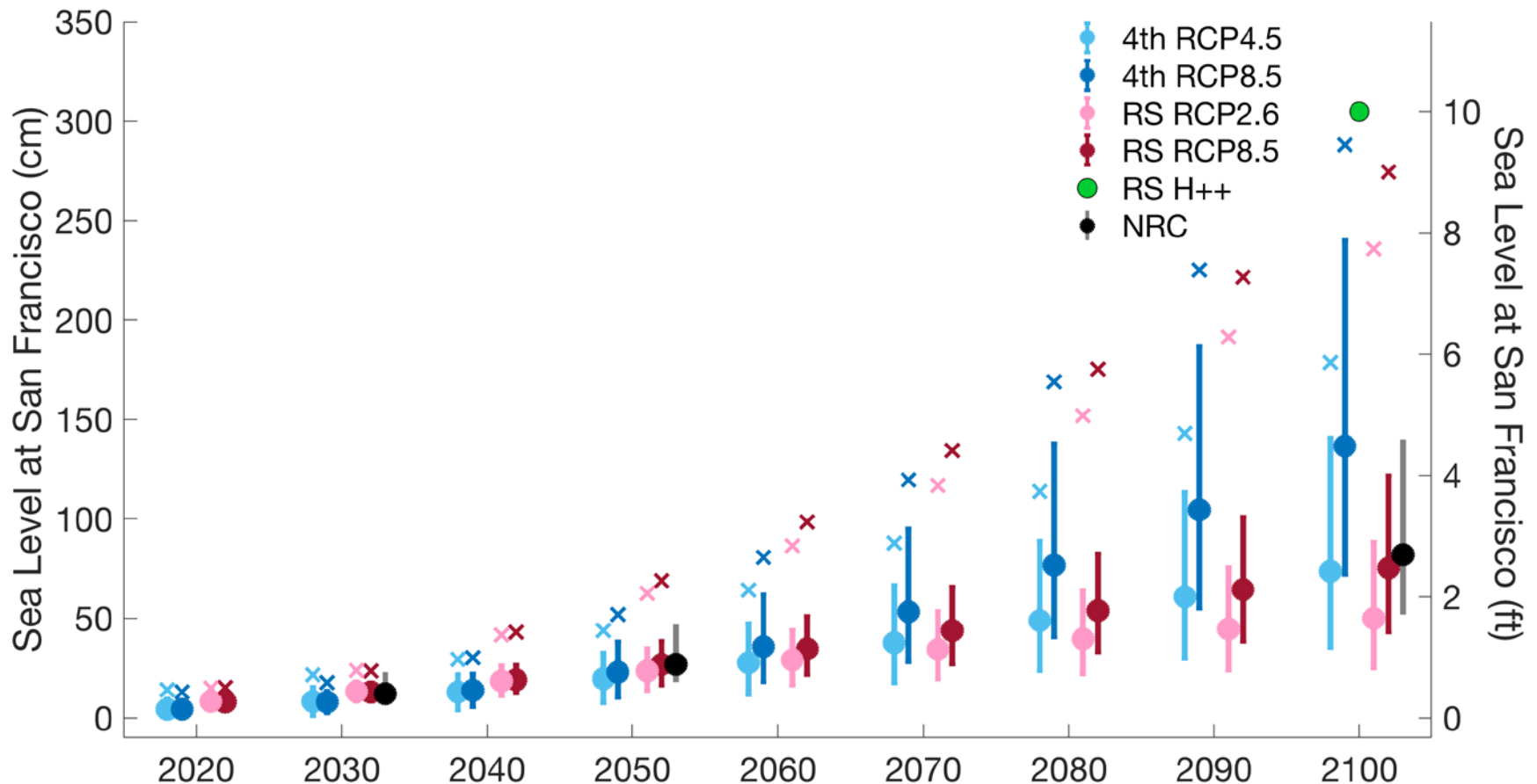
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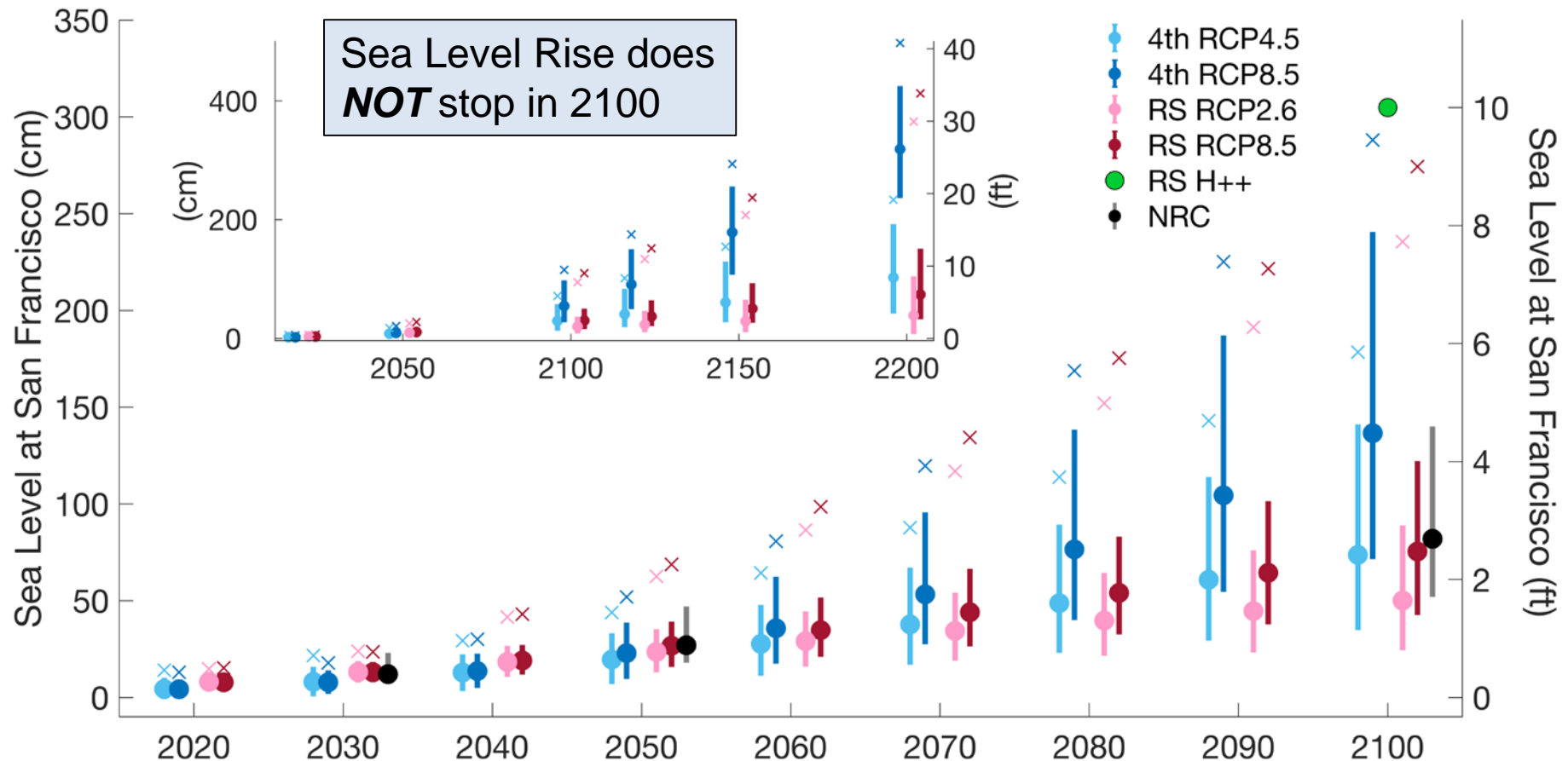
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Sea Level Rise

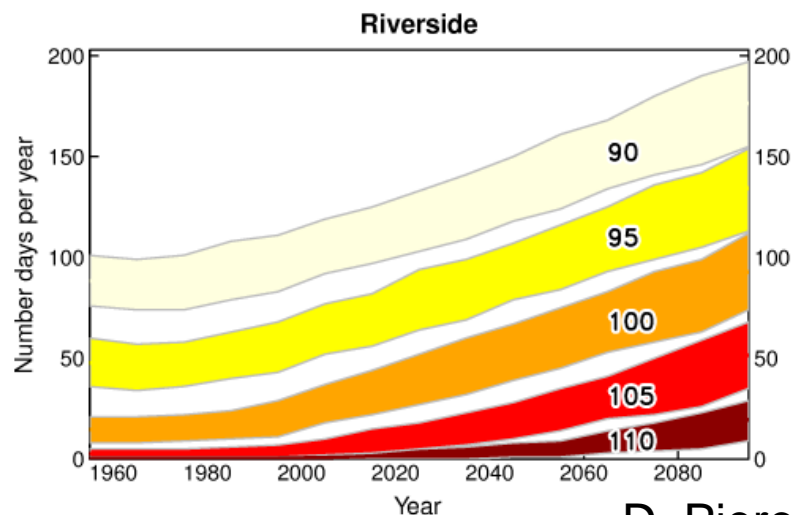
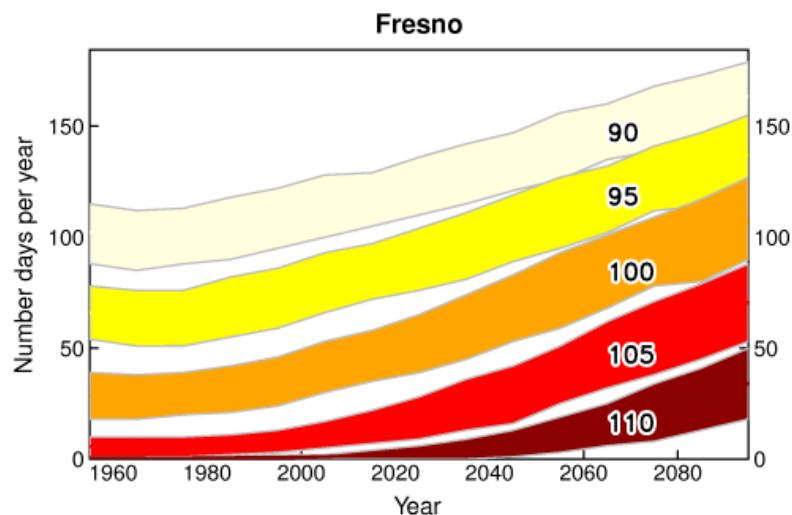
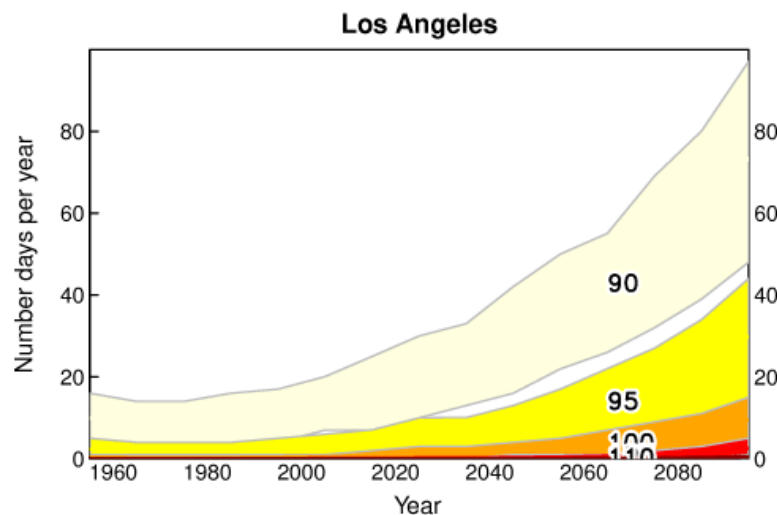
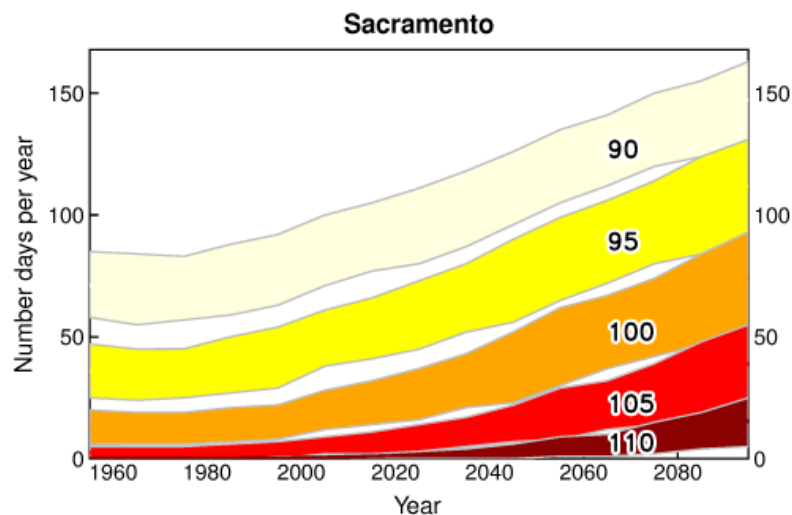
Lots of uncertainty end of this century GHG emissions and Ice Sheets (Antarctica)



Heat Waves will Increase

Range of Number of Days/year \geq threshold (deg F): RCP 8.5

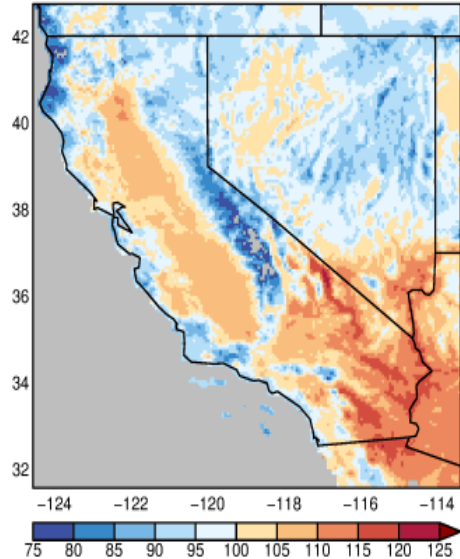
(range encompasses 2/3rds of years)



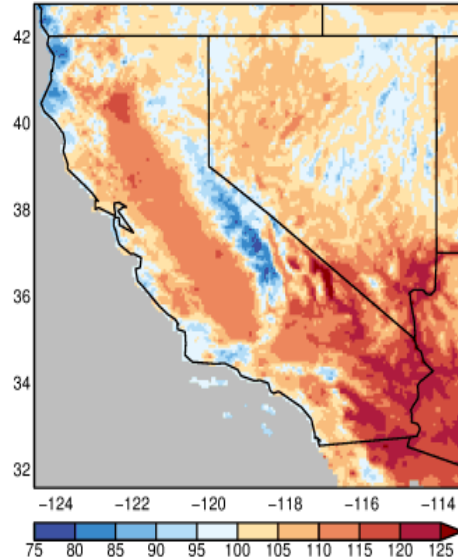
Heat Wave Intensity will Increase

Hottest day of the year historical vs. end of century (deg F)

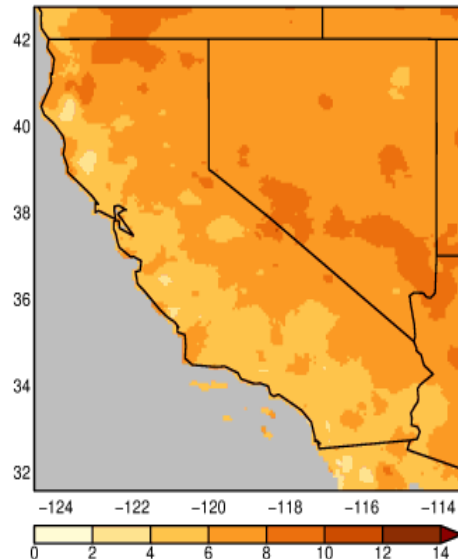
Historical 1950–2005



Low Emissions 2070–2100



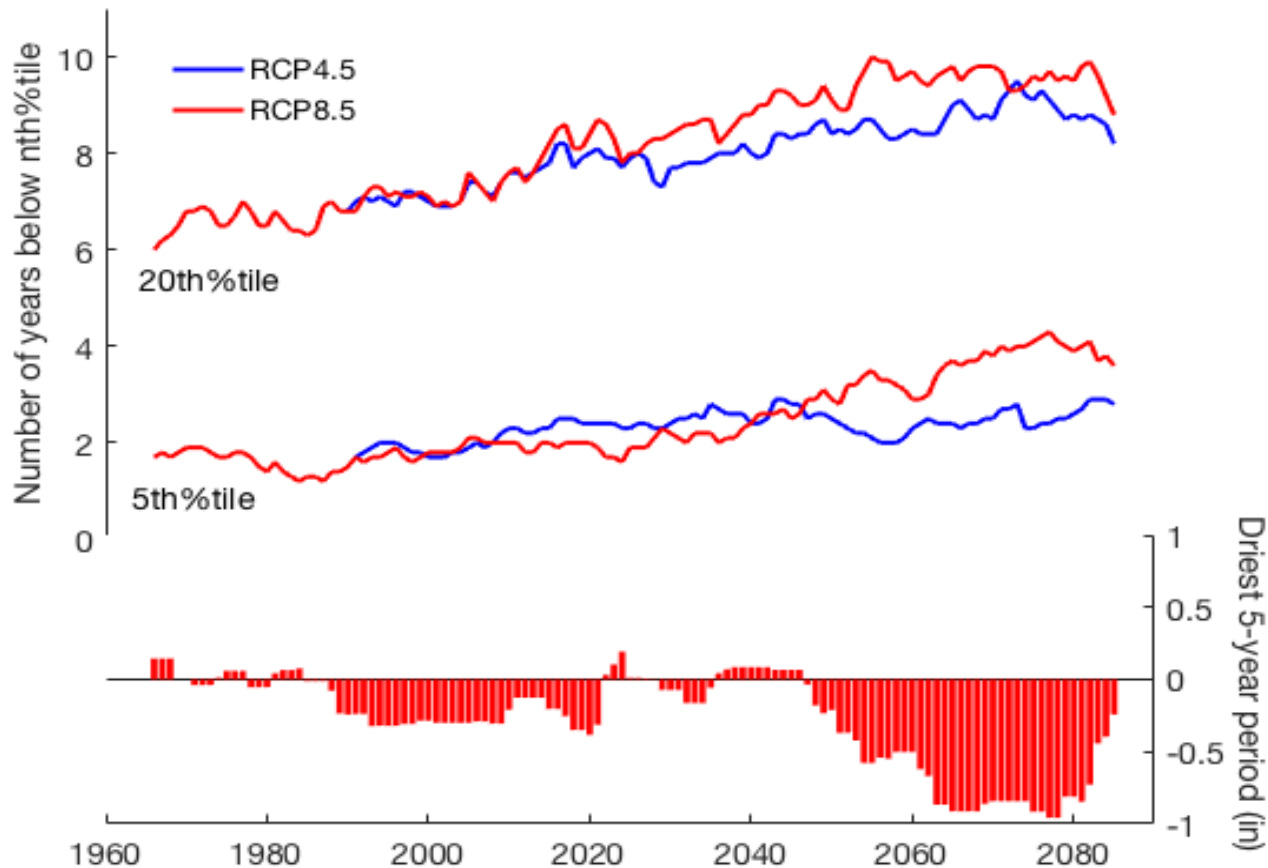
Low Emissions 2070–2100



intensity of
heat waves increases
(RCP 4.5, 10 model average)

More Frequent and Intense Drought:

More dry years & temperature exacerbates droughts

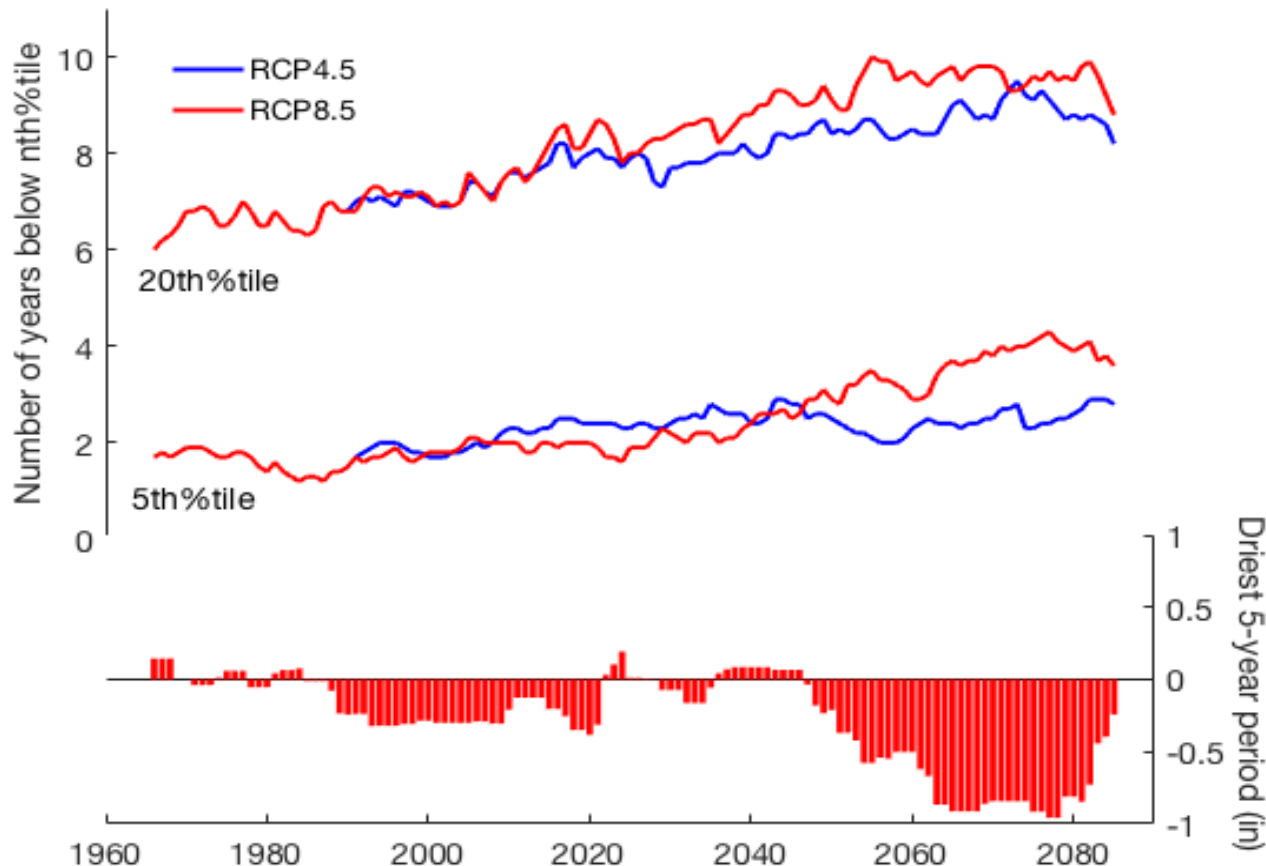


Jennings et al., 2018

CA 4th Climate Change Assessment

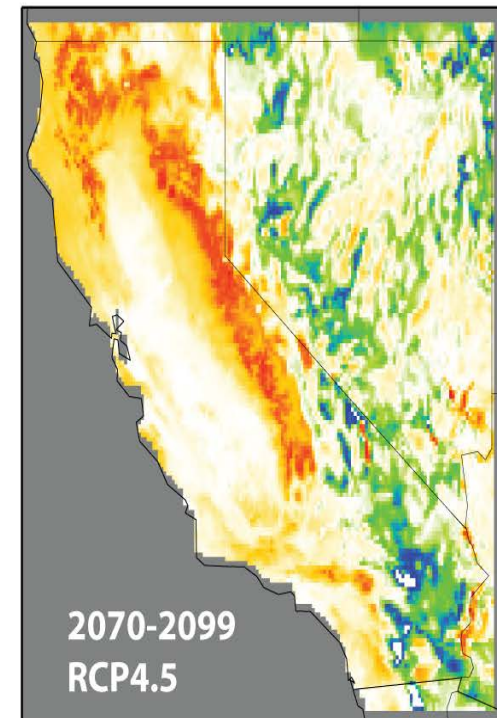
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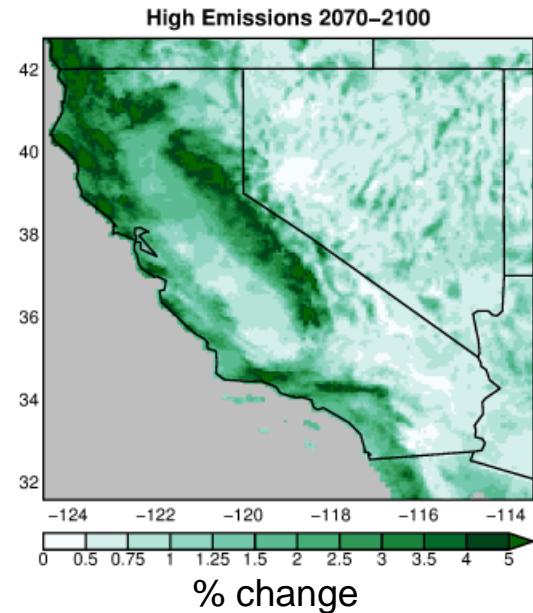
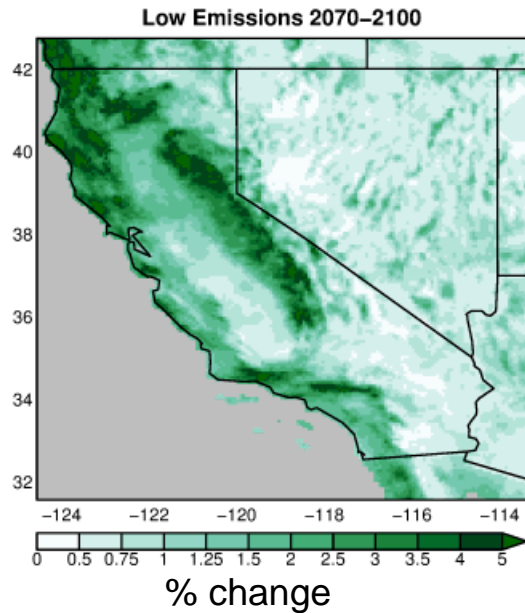
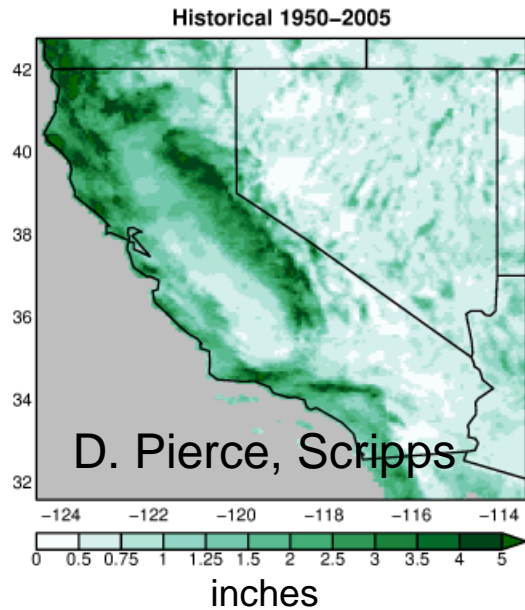
Jennings et al , 2018
CA 4th Climate Change Assessment

Change in June-Sept
Soil Moisture
(w.r.t. 1961-199)

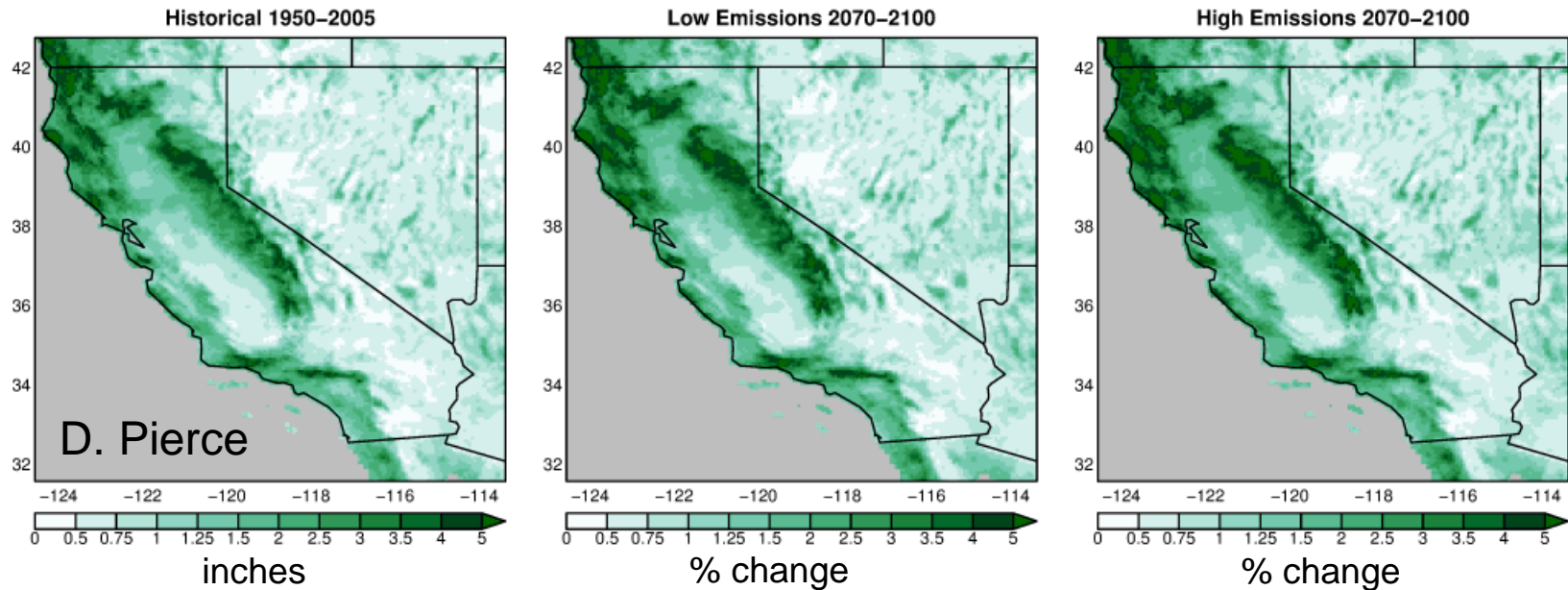


Dettinger et al , 2018
Sierra Nevada Assessment

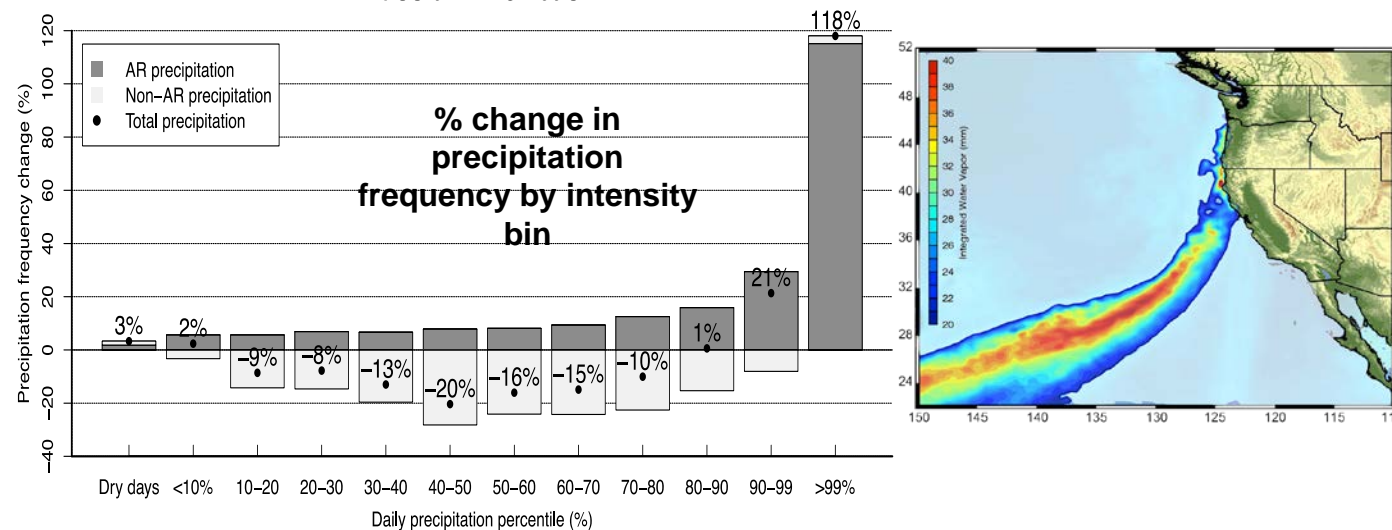
Extreme Precipitation & Floods



Extreme Precipitation & Floods



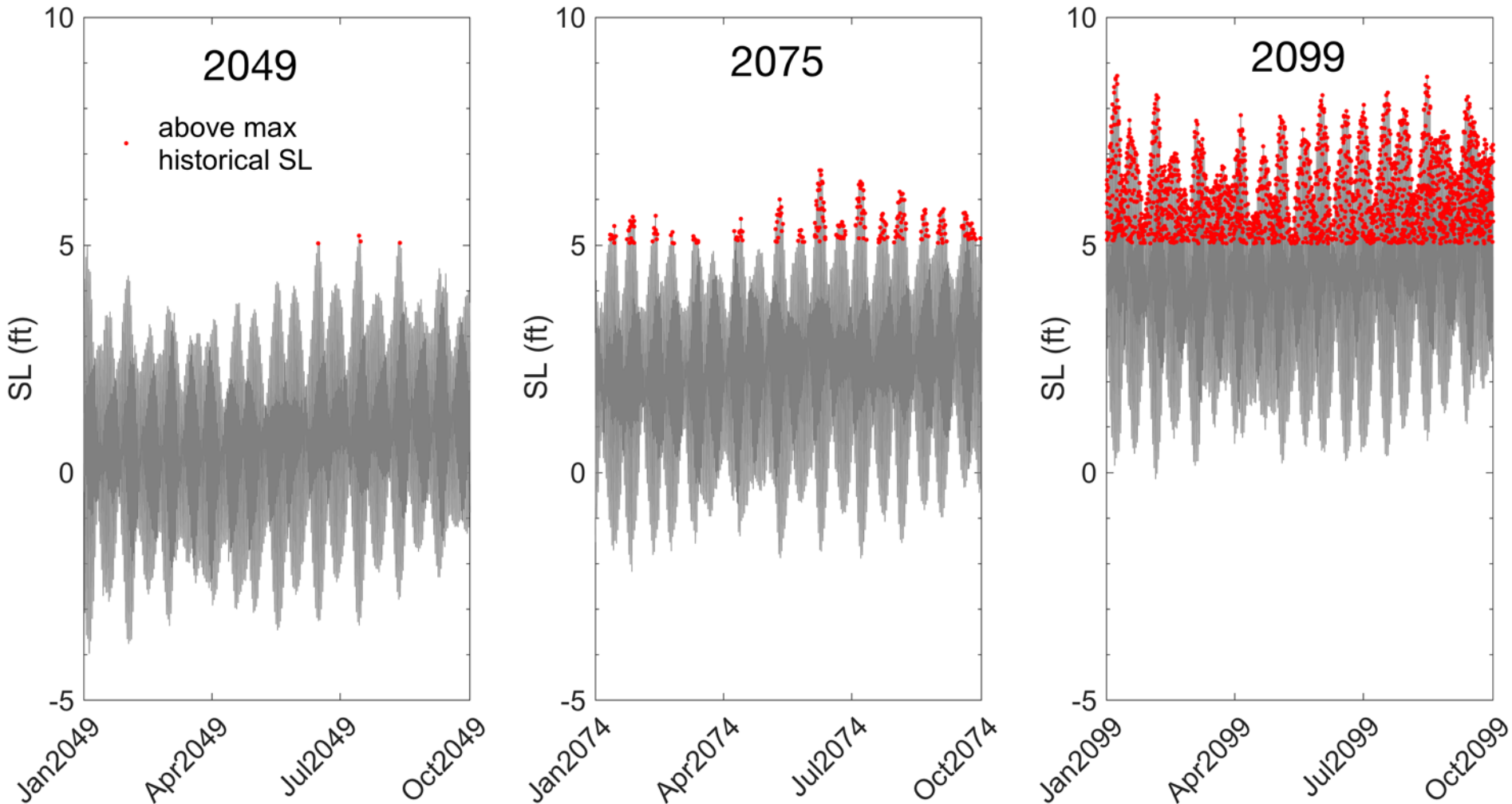
- The changes in the most extreme precipitation is due to increase atmospheric river intensity.



Hourly Sea Level projected for La Jolla from single model:

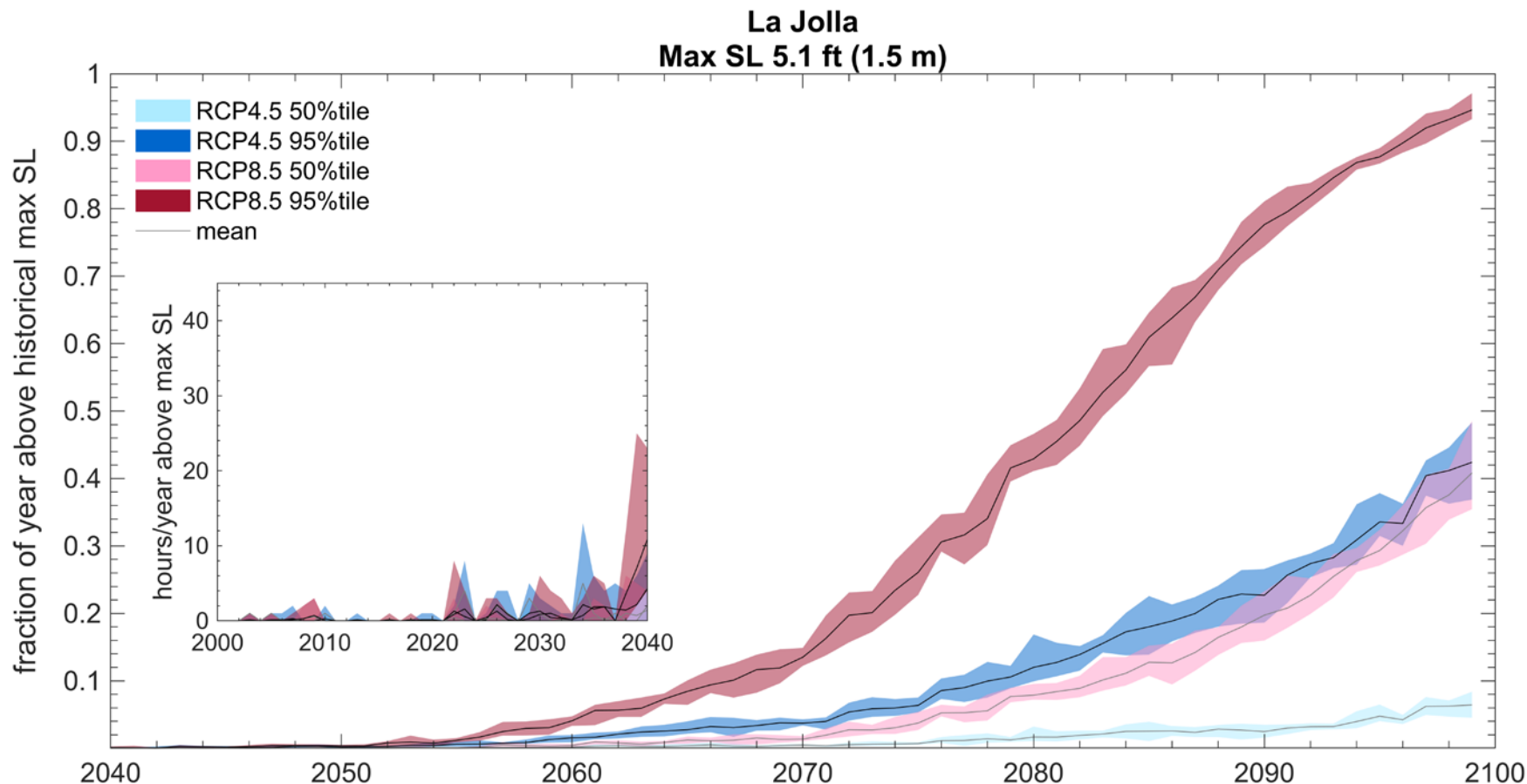
High sea levels increase rapidly end of century

La Jolla CNRM-CMS5 RCP4.5 50th%tile



Hourly Sea Level projected for La Jolla from 8 model:

High sea levels increase rapidly end of century



Summary

- Long Term Trends
 - Temperature will increase → Cumulative GHG important
 - Precipitation wetter winter, drier springs/autumns
 - Sea Level – rise rapidly and lost of uncertainty after 2060
- Extremes
 - Heatwaves more frequent and intense
 - More frequent and intense drought
 - Large extreme precipitation (less snow) → more flooding
 - Extreme sea level events increase rapidly in second half of century

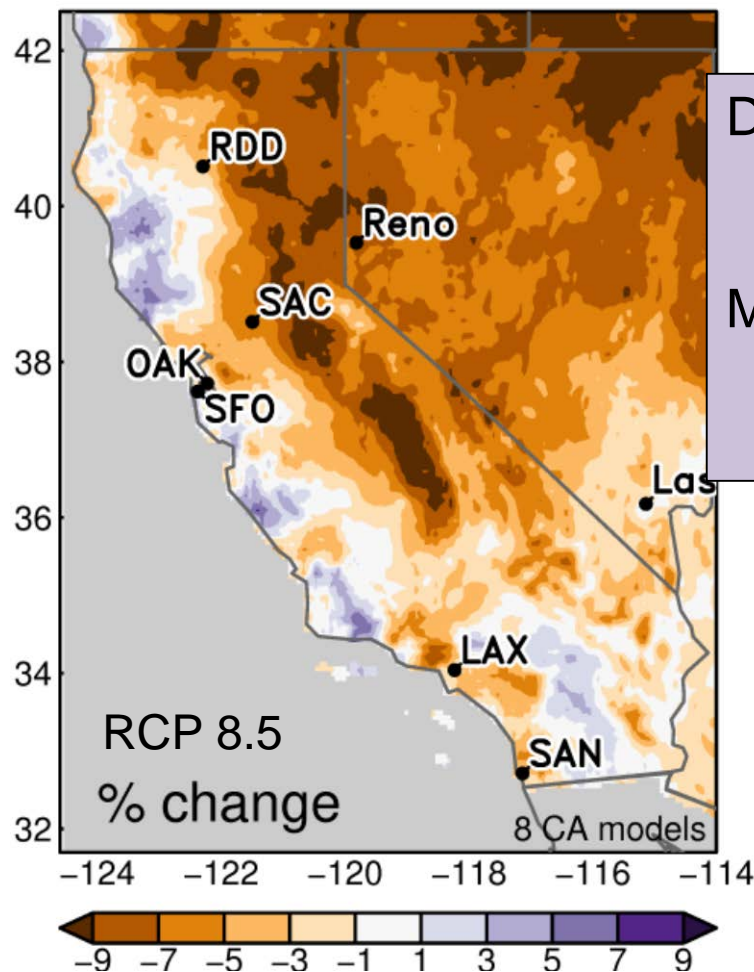
Back Up slides on Relative
Humidity, Solar Radiation and
Santa Ana Winds

Summer Change in Daily Minimum Relative Humidity

(Humidity during the warmest part of the day)

Percent Change 2070-2100 w.r.t. 1976-2005

JJA



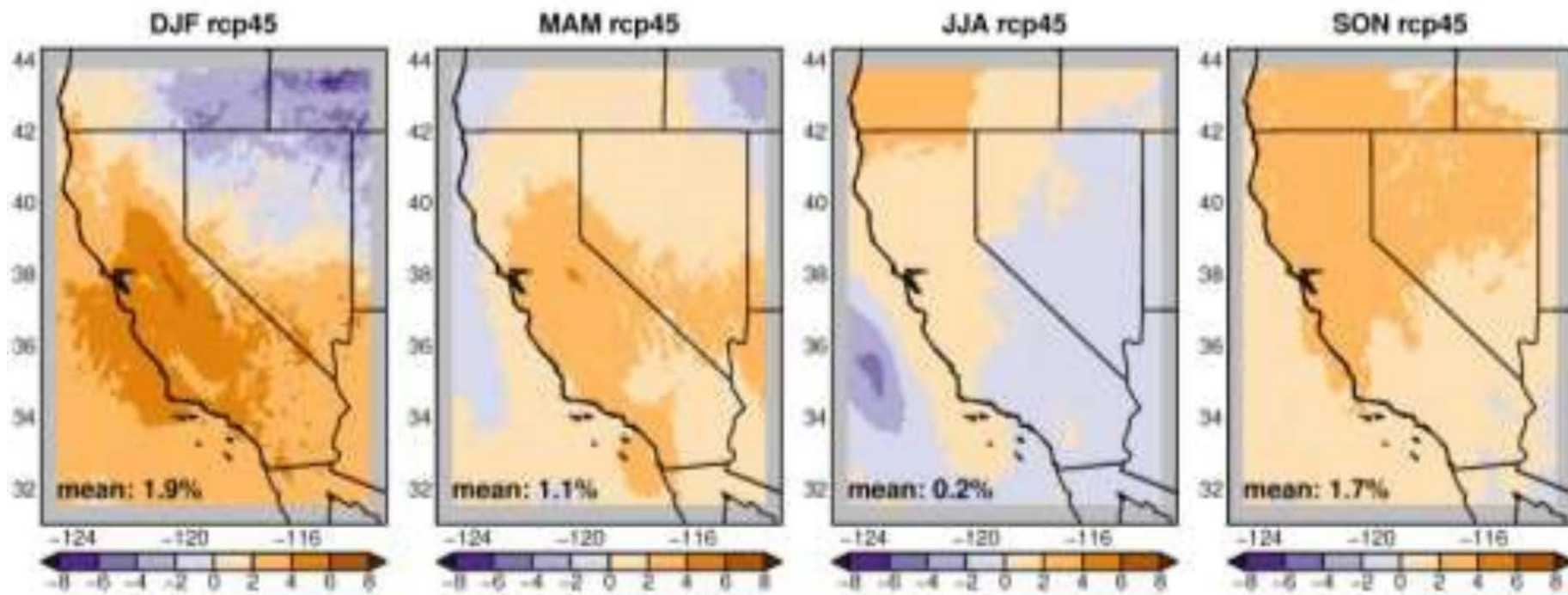
Drier Interior
Possible Enhanced Wildfire
risk
More humid coasts
Possible enhanced heat-
health impacts

Pierce et al., 2018, CA
4th Climate Change
Assessment

Solar Radiation

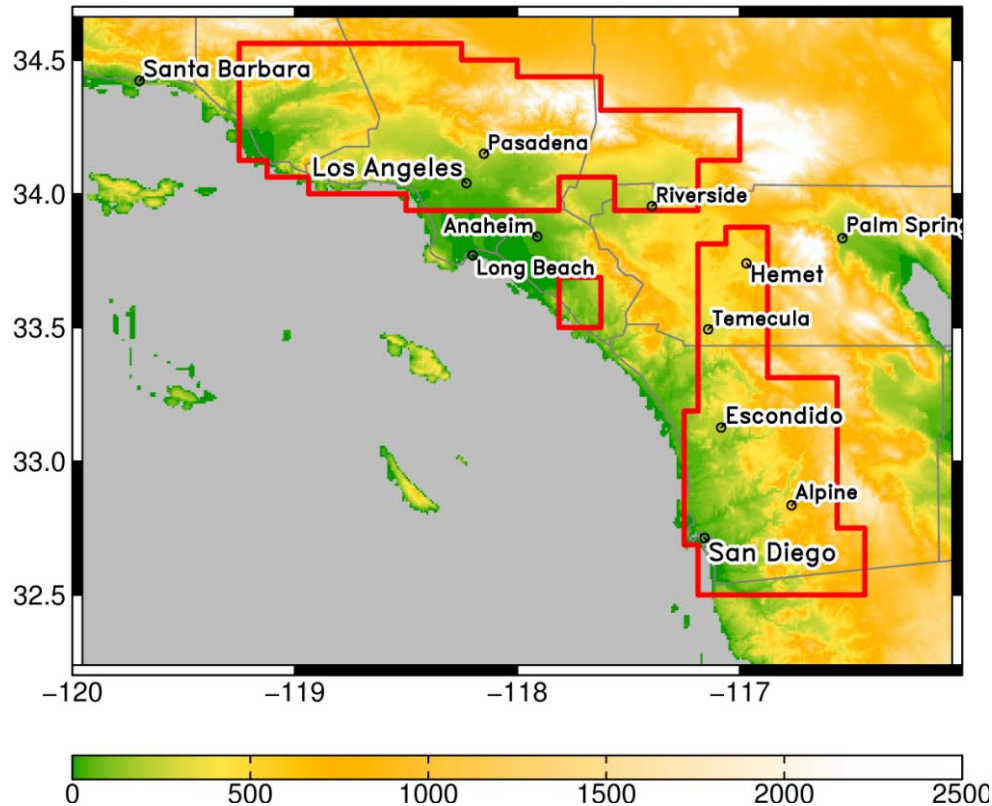
Small projected changes – natural variability continues to dominate climate trend

Seasonal projected change in surface solar radiation [%]
by the end of the century (2070-2100) w.r.t. 1985-2005; RCP 4.5



Pierce et al., 2018, CA
4th Climate Change
Assessment

Santa Ana Winds



Santa Ana Wind Criteria

Wind speeds ≥ 8 m/s

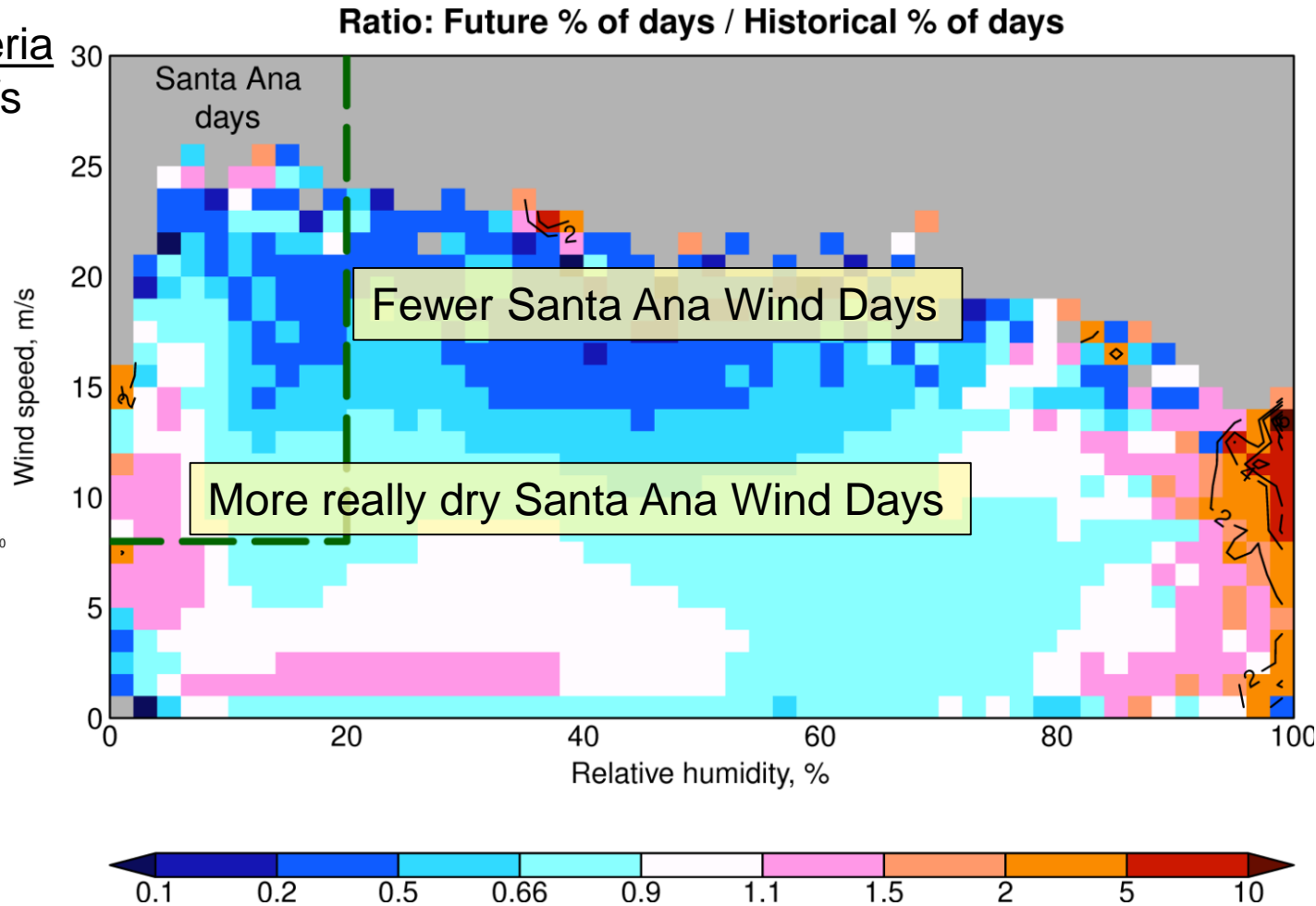
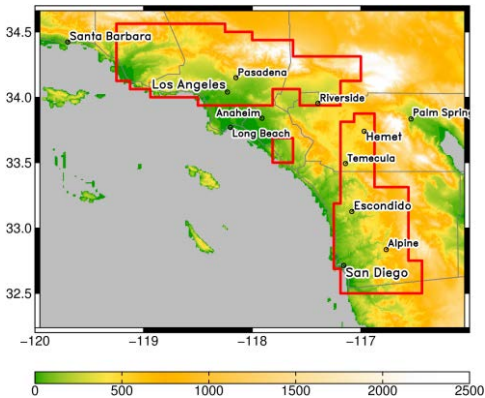
RH $\leq 20\%$

Santa Ana Winds

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Pierce et al., 2018, CA
4th Climate Change
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