Climate Change and San Diego's Water

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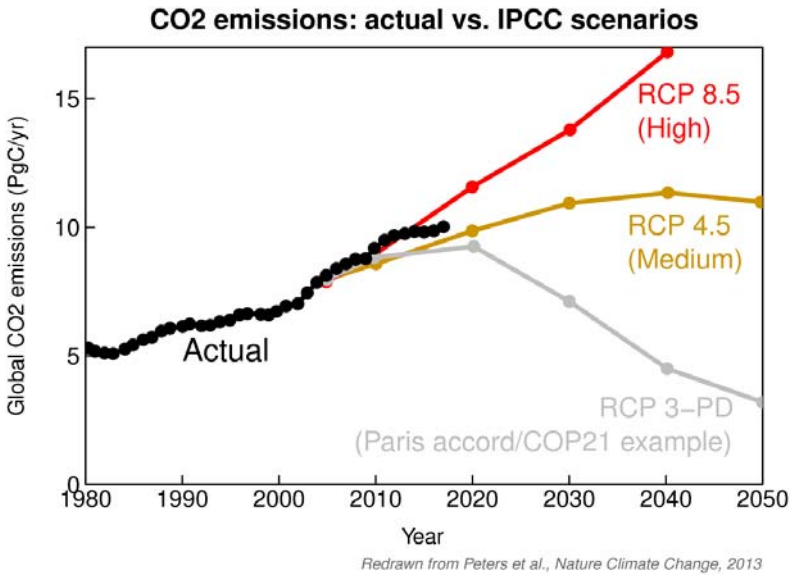
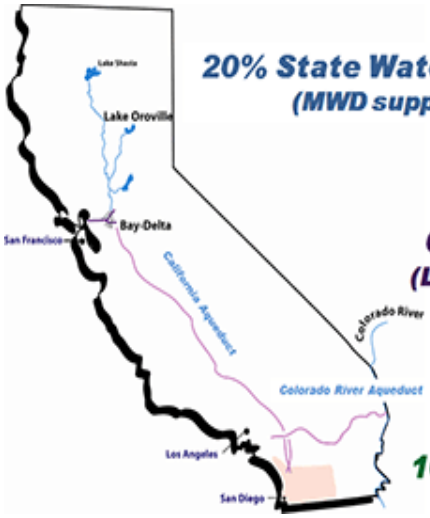
All-American Canal lining project

San Diego County Water Authority, 2018: https://www.sdcwa.org/urban-water-management-plan-0

Context of climate projections



Sources of San Diego County water



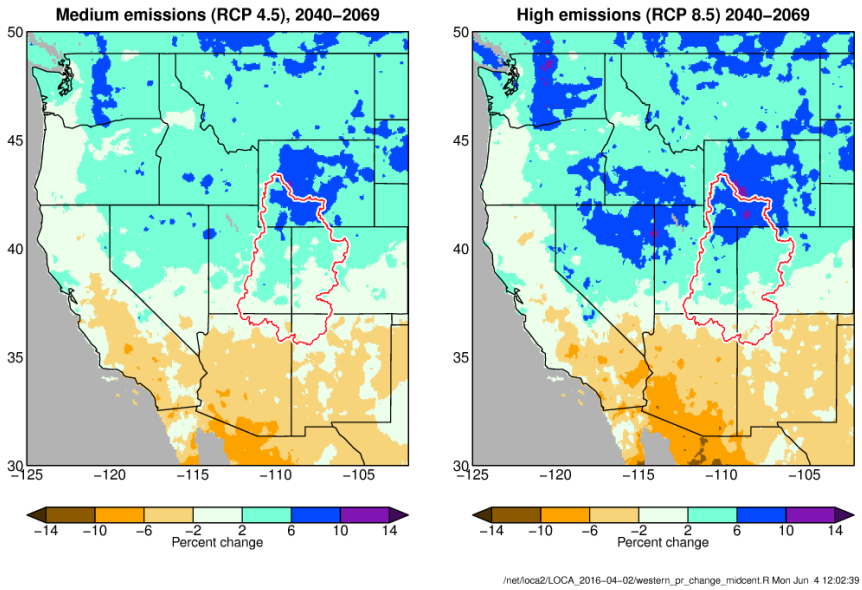
20% State Water Project (MWD supplies)

64% Colorado River (Long-term Transfers and MWD supplies)

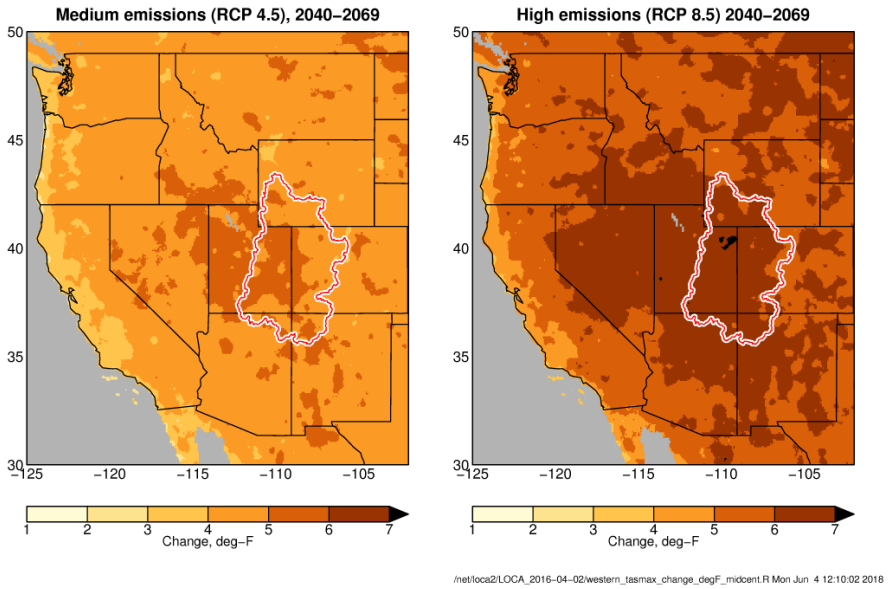
16% Local Supplies

San Diego County Water Authority, 2017:
http://www.sdcwa.org/san-diego-county-water-sources

Colorado River changes: Precipitation



Colorado River changes: Temperature



Colorado River flow sensitive to Temp & Precip

- Sensitivity to warming:
  - About -3.6% per deg-F warming (Vano et al. BAMS 2014)
  - For 5-6 deg-F warming: ~ -18 to -22% Colorado River flow tendency
- Sensitivity to precipitation:
  - About 2.5 %/% precipitation change (Vano et al. BAMS 2014)
  - For 2-6% wetter conditions: +5 to +15% Colorado river flow tendency
- Temperature and Precipitation *combined*:
  - About -3 to -17% Colorado River flow total
- Higher confidence for warming signal than precipitation

Northern California water supply

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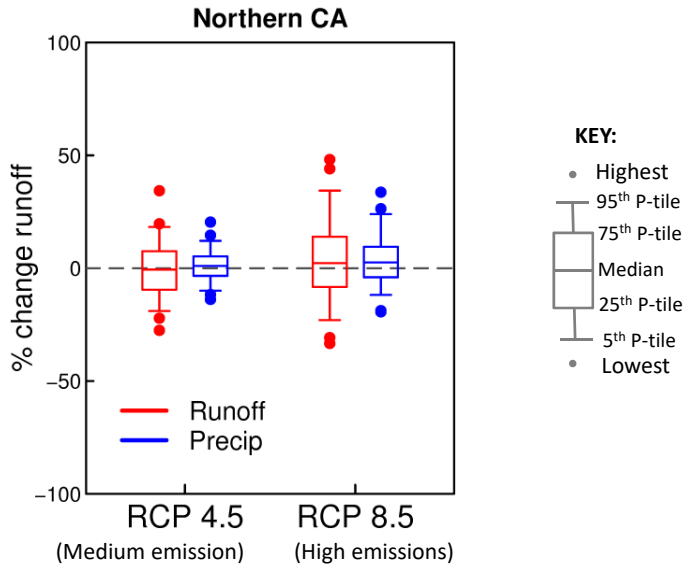

BUT … lots of seasonal detail

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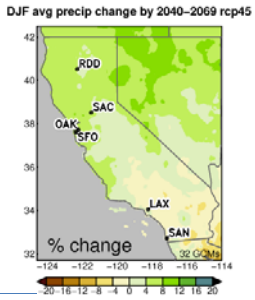
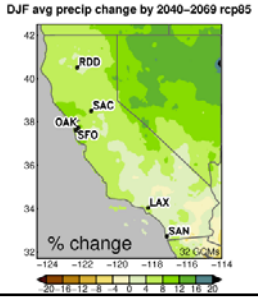
Medium emissions



High emissions



BUT … lots of seasonal detail

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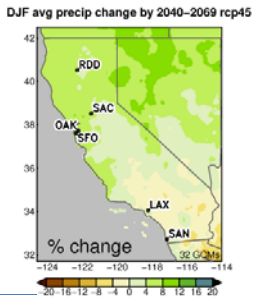
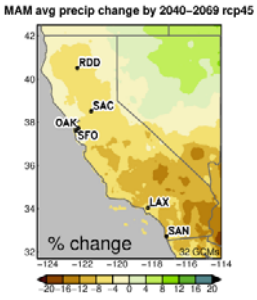
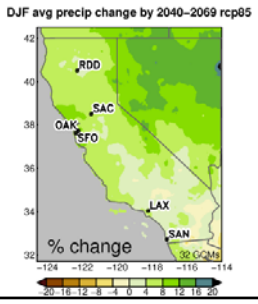
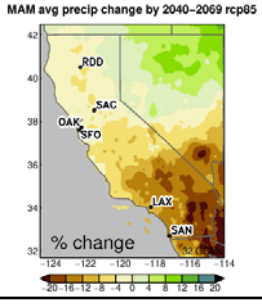




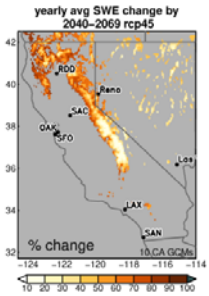
High emissions



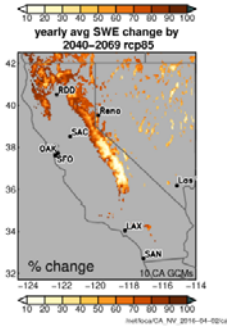


Snow decreases substantially

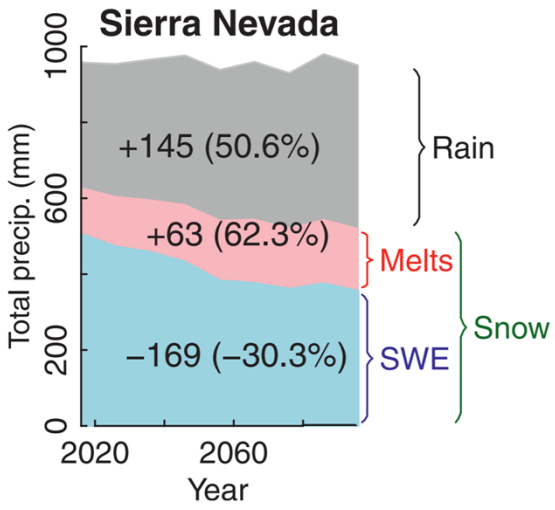
Medium emissions

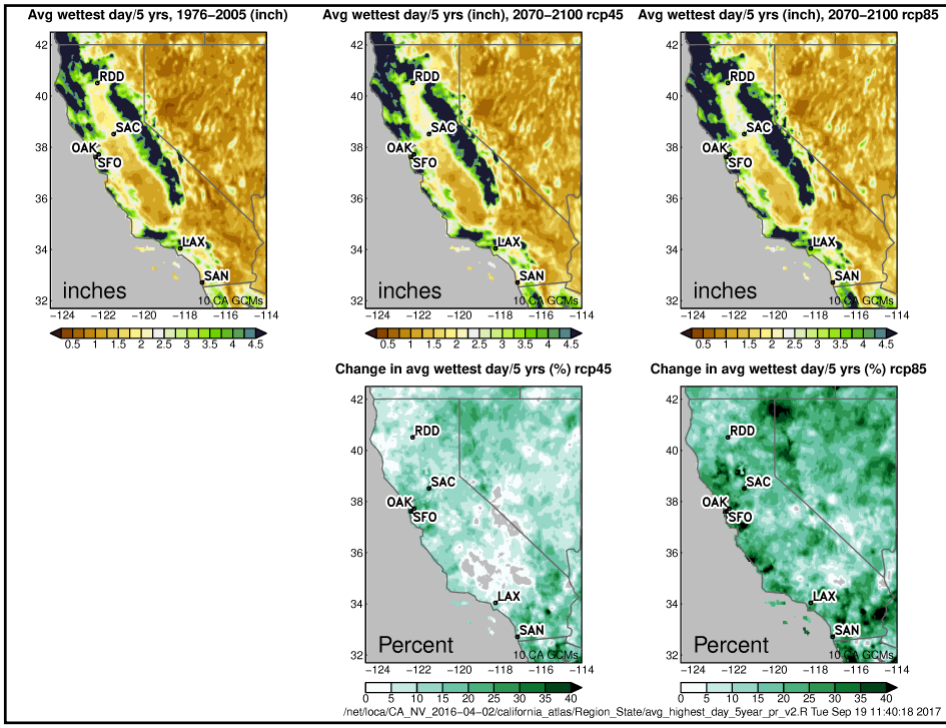


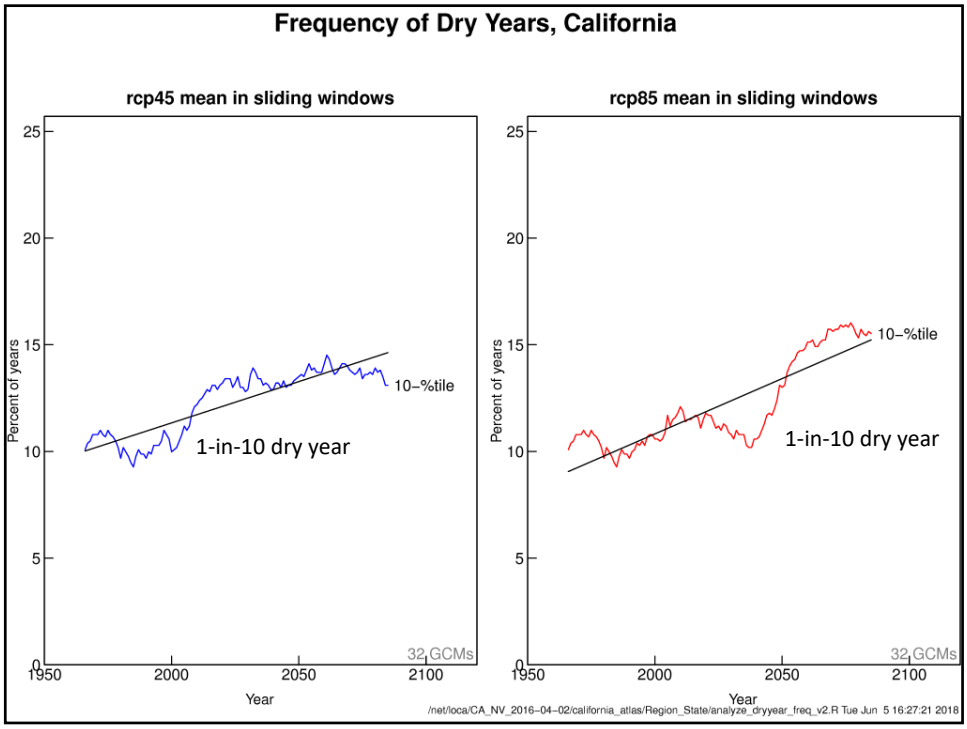
High emissions

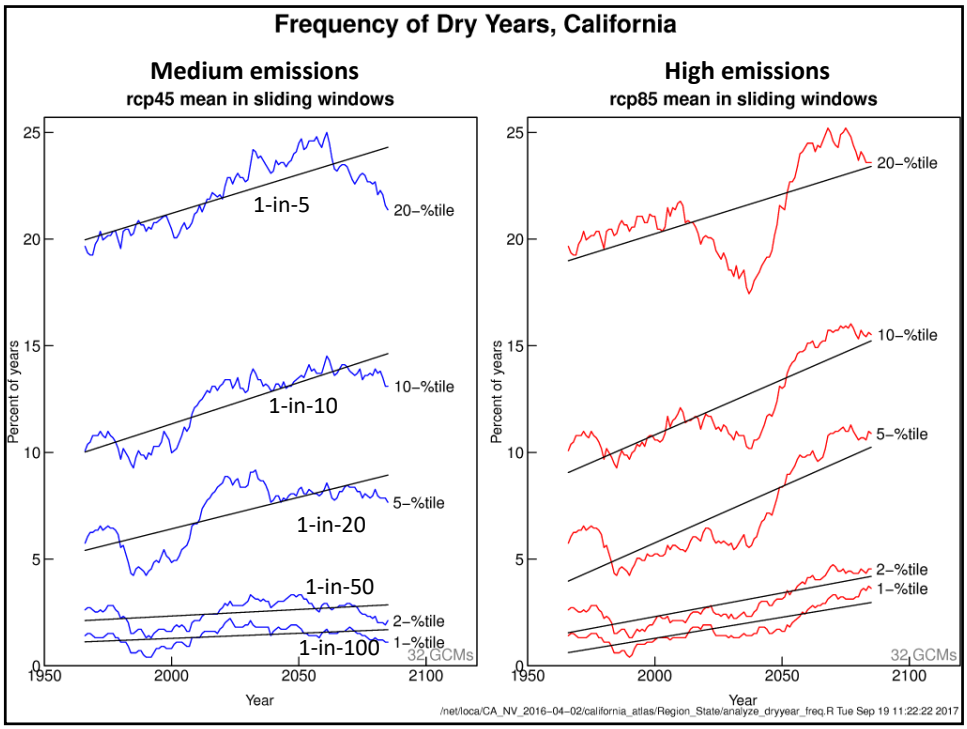


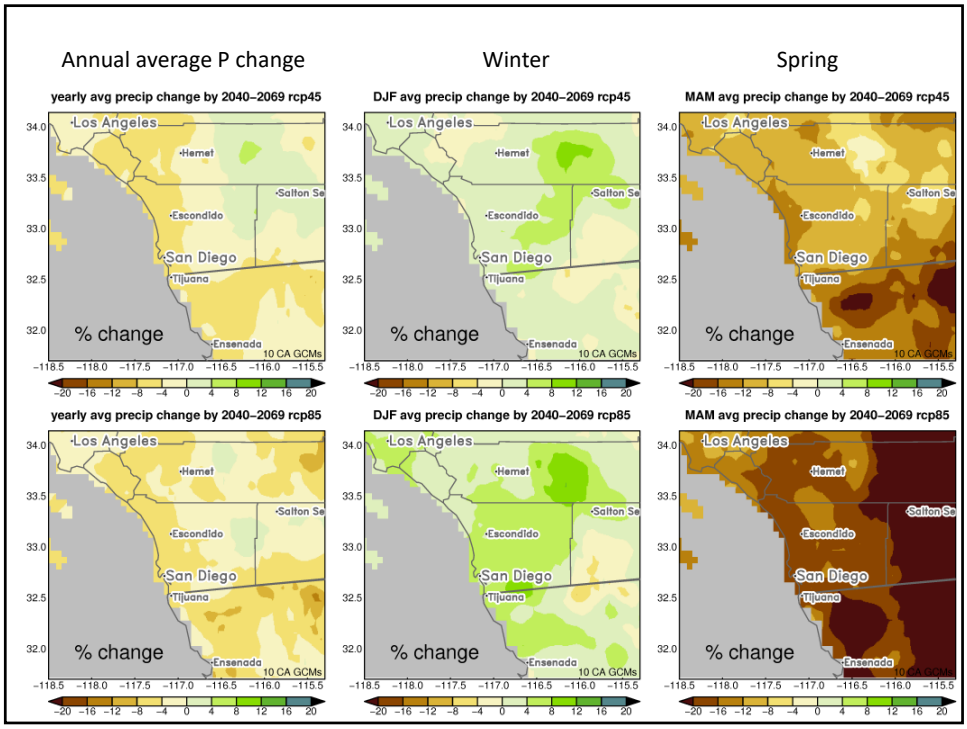
Changing disposition of California water

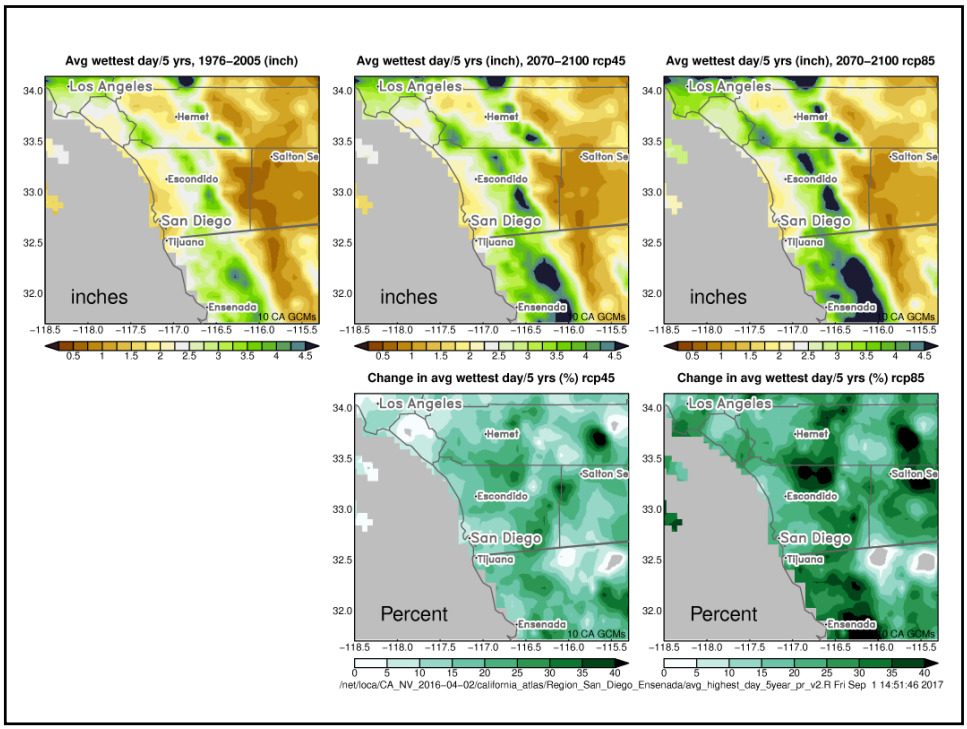


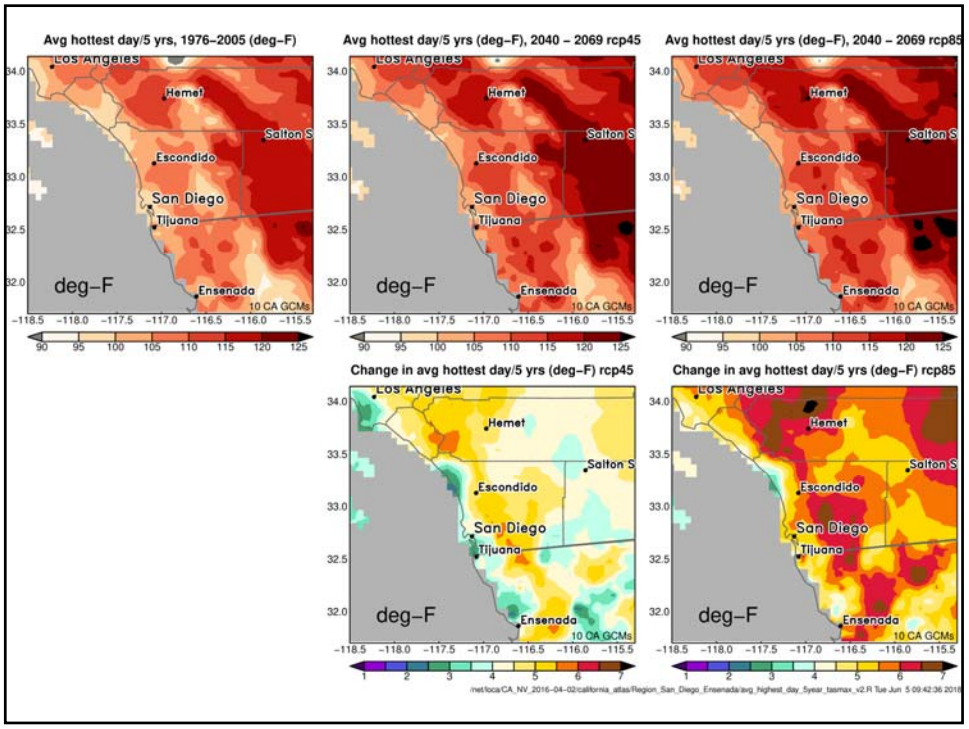



Frequency of Dry Years, California
rcp45 mean in sliding windows
rcp85 mean in sliding windows
Percent of years
Year
10−%tile
1-in-10 dry year
32 GCMs
/net/loca/CA_NV_2016−04−02/california_atlas/Region_State/analyze_dryyear_freq_v2.R Tue Jun 5 16:27:21 2018


Frequency of Dry Years, California
Medium emissions
High emissions
rcp45 mean in sliding windows
rcp85 mean in sliding windows
Percent of years
Year
1-in-5
20−%tile
1-in-10
10−%tile
1-in-20
5−%tile
1-in-50
2−%tile
1-in-100
1−%tile
32 GCMs
/net/loca/CA_NV_2016−04−02/california_atlas/Region_State/analyze_dryyear_freq.R Tue Sep 19 11:22:22 2017


Annual average P change
Winter
Spring
yearly avg precip change by 2040–2069 rcp45
DJF avg precip change by 2040–2069 rcp45
MAM avg precip change by 2040–2069 rcp45
yearly avg precip change by 2040–2069 rcp85
DJF avg precip change by 2040–2069 rcp85
MAM avg precip change by 2040–2069 rcp85
% change
10 CA GCMs
Los Angeles
Hemet
Salton Se
Escondido
San Diego
Tijuana
Ensenada


Avg wettest day/5 yrs, 1976–2005 (inch)
Avg wettest day/5 yrs (inch), 2070–2100 rcp45
Avg wettest day/5 yrs (inch), 2070–2100 rcp85
Change in avg wettest day/5 yrs (%) rcp45
Change in avg wettest day/5 yrs (%) rcp85
inches
Percent
10 CA GCMs
Los Angeles
Hemet
Salton Se
Escondido
San Diego
Tijuana
Ensenada
/net/loca/CA_NV_2016-04-02/california_atlas/Region_San_Diego_Ensenada/avg_highest_day_5year_pr_v2.R Fri Sep 1 14:51:46 2017



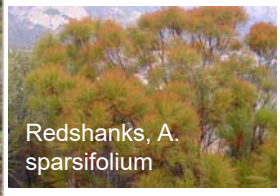
Summary

- Colorado River:
  - Temperature will reduce flow more than precipitation will increase it
  - Flow reduction 3-17% (w.r.t. pre-2005) by mid century
- Northern California source:
  - Wetter winter balanced by drier spring and autumn
    - Large increase in liquid water (as opposed to snow)
    - Precipitation on heaviest days increases
  - More year-to-year variability -> increase in drought frequency
- Local water:
  - Modest annual drying (4-8%)
  - Wetter winter, drier spring and autumn
  - Much wetter on heaviest precipitation days

Drought and Chaparral

Drought avoiders are more resilient to drought due to more extensive root systems.

Research Question: *What are drought thresholds that can lead to structural changes in regional ecosystems?*



2014 Drought

"Drought Tolerator"
93% mortality

"Drought Avoider"
8.7% mortality

Venturas et al., 2016

Vernal Pools

Vernal pools are naturally resilient to highly variable precipitation.

If vernal pool watersheds remain undisturbed, they may be less vulnerable to changes in precipitation regime.

Current monitoring efforts will increase understanding

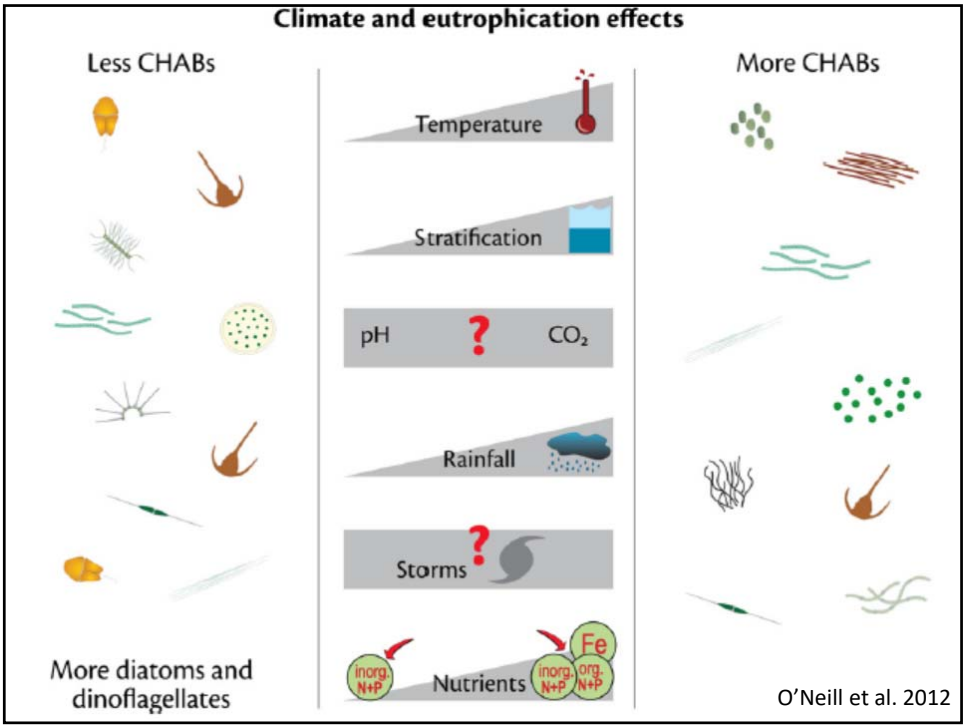
Riparian Environments

Spring drying → potential impacts on riparian environment life cycles

- Will species have enough time to breed before too dry?
- What about systems with artificial flows?

Extreme events:

- Increase variability in streamflow
- Increased erosion during severe precip events

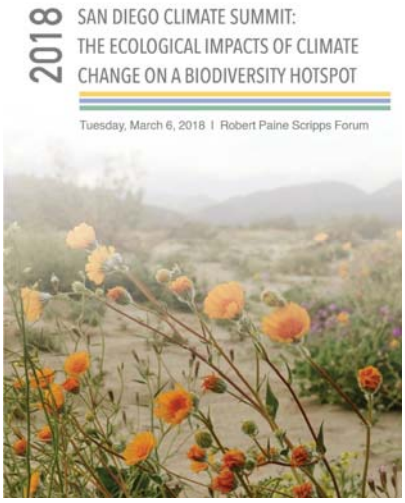


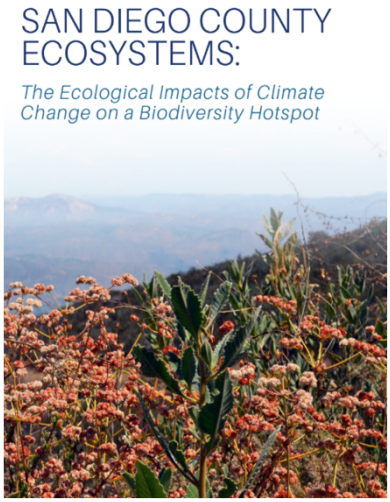
Key Points & Next Steps

- Precipitation regime will become more variable
  - More intense and frequent drought → Structural changes in ecosystems
  - Extreme wet days wetter → Riparian ecosystems most affected
- Spring and Fall expected to become drier causing longer seasonal drought → reduce biomass and affect riparian species' life cycles (e.g., T&E species)

NEXT STEPS

- Coordinate monitoring efforts of stream gauges, precipitation and ecosystem impacts
- Hydrologic modeling effort to better understand "bio-availability of water" given climatic changes





http://www.climatesciencealliance.org/climatesummit

http://www.climatesciencealliance.org/sdc-ecosystems-assessment