California's "Special" Water Resources Regime

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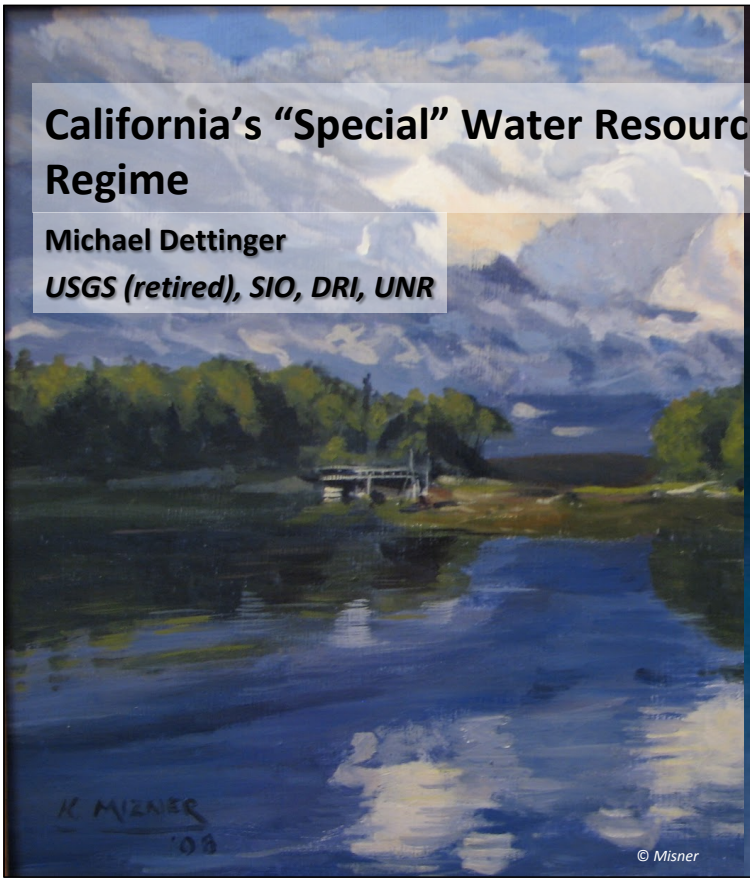
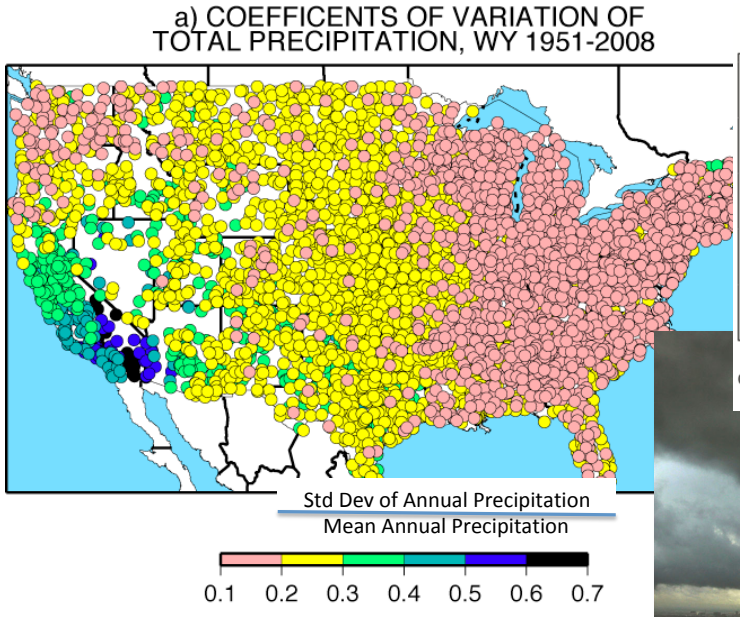
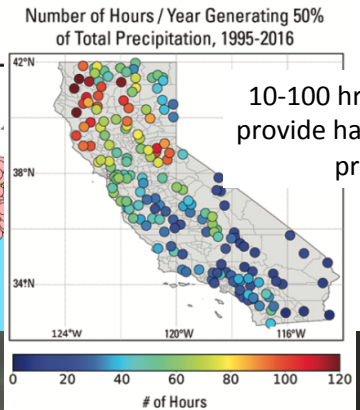


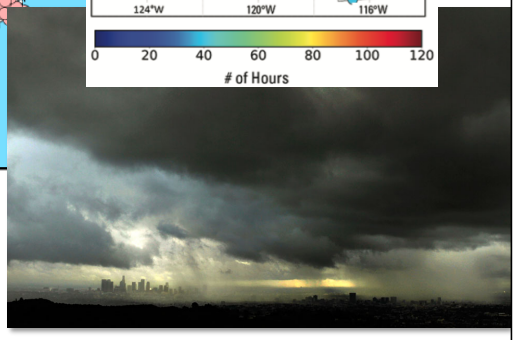
CNAP
California-Nevada Climate Applications Program
Center for Western Weather and Water Extremes
Global Water Center
University of Nevada, Reno
Solutions for sustainability

1. California's Wild Precipitation





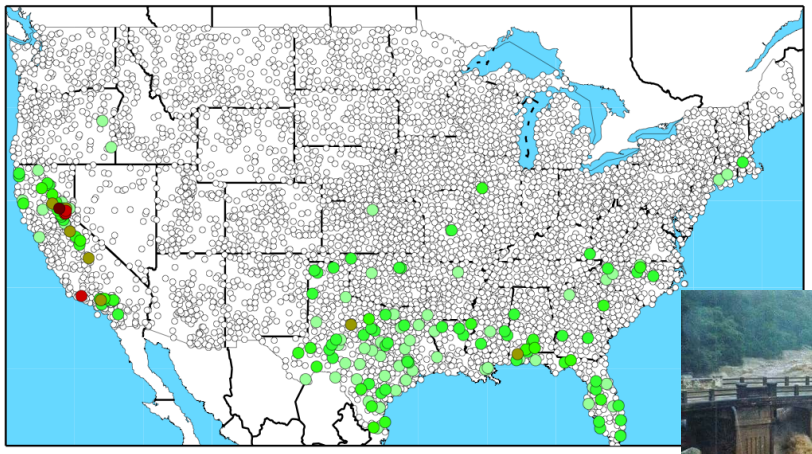
10-100 hrs/yr provide half of precip



Dettinger et al, Water, 2011; Lamjiri et al SFEWS 2018

1. California's Wild Precipitation

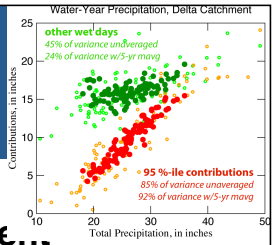
Three-day episodes with > 40 cm (15 in) precipitation since 1950



California's BIG storms are as big as any in the country!

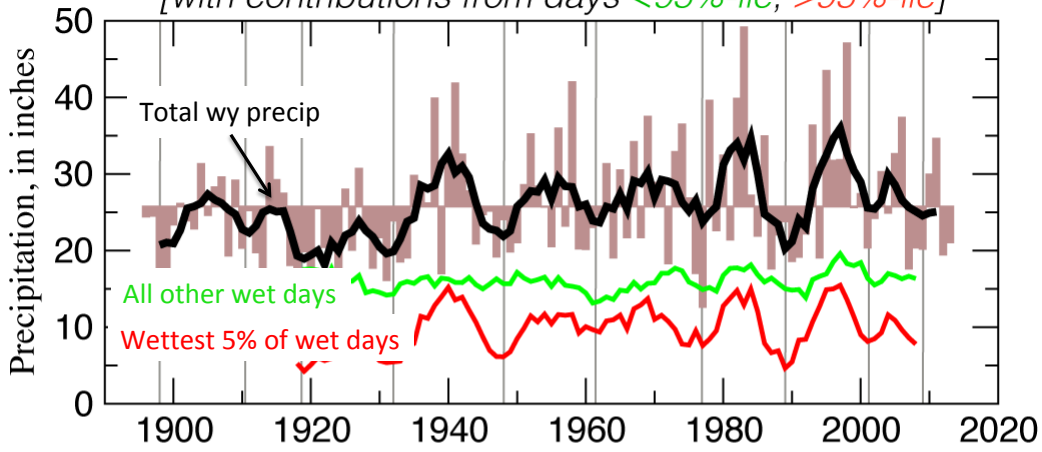
Dettinger et al, Water, 2011

2. California's floods & droughts are uniquely tied to each other



a) Water-Year Precipitation, Delta Catchme…

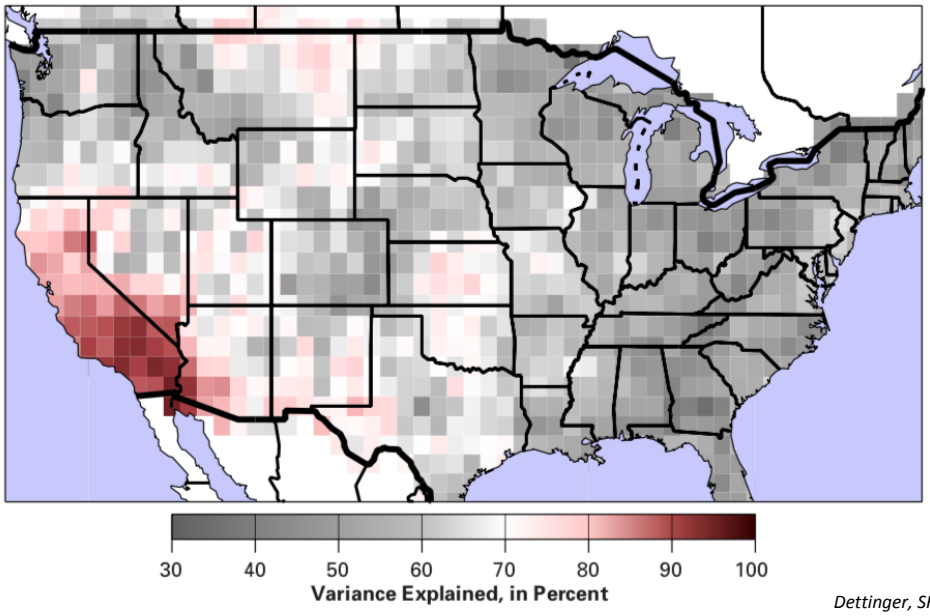
[with contributions from days <95%-ile, >95%-ile]



Dettinger & Cayan, SFEWS, 2014;
Dettinger, SFEWS, 2016

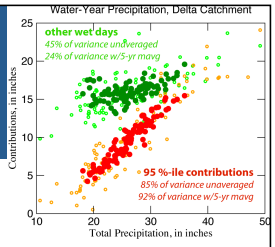
2. California's floods & droughts are uniquely tied to each other

Percentage of Water-Year Precip Variance explained by Precip from wettest 7 days/yr

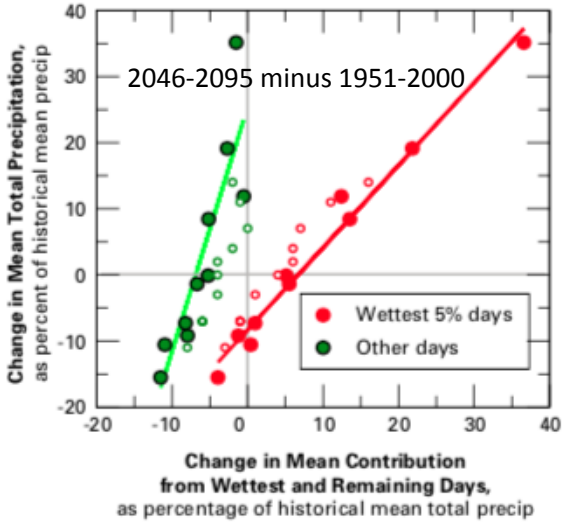


Dettinger, SFEWS, 2016

3. California's future floods & droughts will be even wilder

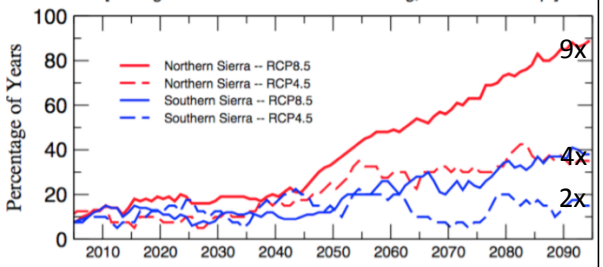


Contributions to total water-yr precip from extreme storms vs "normal" storms



SNOW DROUGHTS/decade

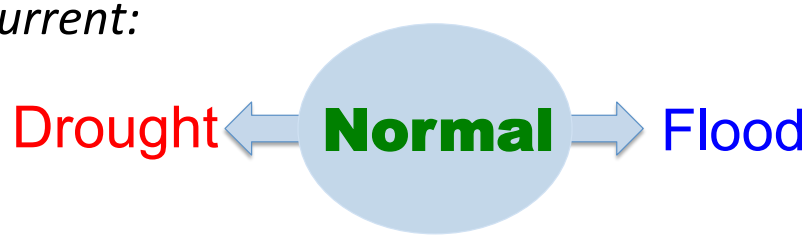
[Among 10 GCMs with decadal smoothing, Source: CalAdapt]



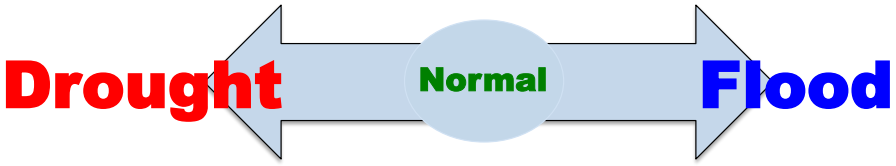
Dettinger, SFEWS, 2016;
Dettinger et al. CCC4A. 2018;

3. California's future floods & droughts will be even wilder

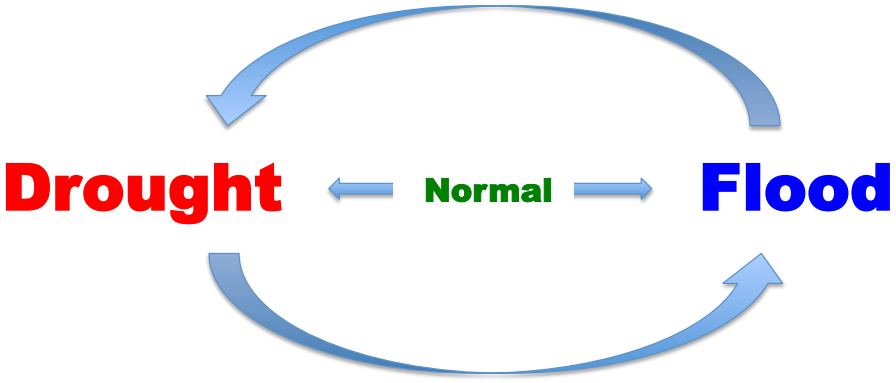
Current:



Future:



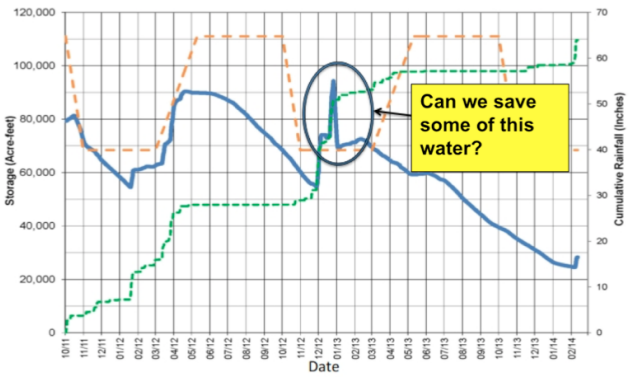
4. California will increasingly need to manage its floods to get thru its droughts, and vice versa



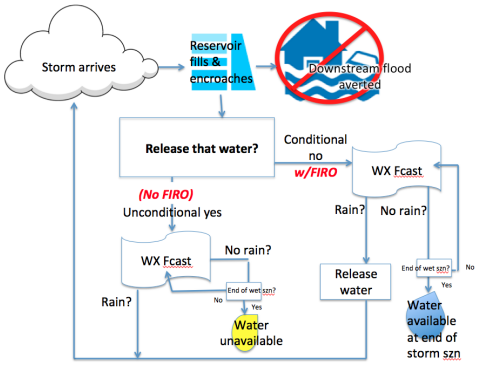
- As far as we know, mostly same amount of precip overall…just in perniciously inconvenient forms: *rain vs snow, early snowmelt, flashier flows, earlier flows, drier summers*
- Floods will be even more of the total water available for use as resource; we're going to need to fight to keep that water in the system.
- Drought will have to be managed as an opportunity to create the space for accommodating & capturing the floods to come.

4. California needs to manage its floods to get thru its droughts, and vice versa

For example, **Forecast-Informed Reservoir Operations**



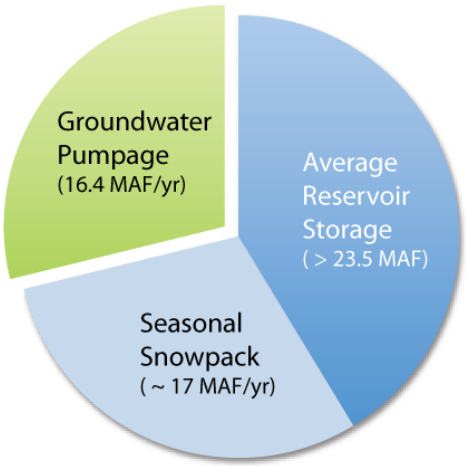
Can we increase storage of winter runoff to deal w/drought, while also enhancing flood-risk mngmt… by greater use of modern forecasts?



Ralph et al., Atmos Rivers, 2020; Lake Mendocino FIRO PVA 2017

4. California needs to manage its floods to get thru its droughts, and vice versa

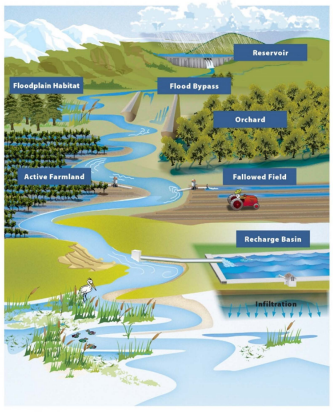
For examples, **SGMA & FloodMAR**



Typical Water Volumes for California

What is Flood-MAR?

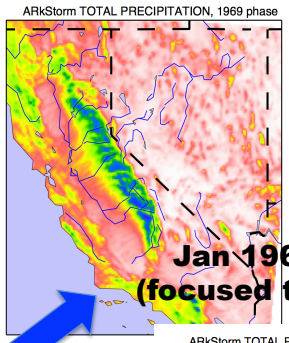
Using high flows from, or in anticipation of, rainfall or snowmelt, for managed aquifer recharge on agricultural lands and working landscapes



CALIFORNIA DEPARTMENT OF WATER RESOURCES

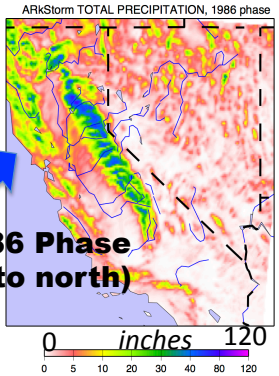
Dettinger & Anderson SFEWS 2015

5. California needs to accept/explore—in depth--the novel extremes that will come.

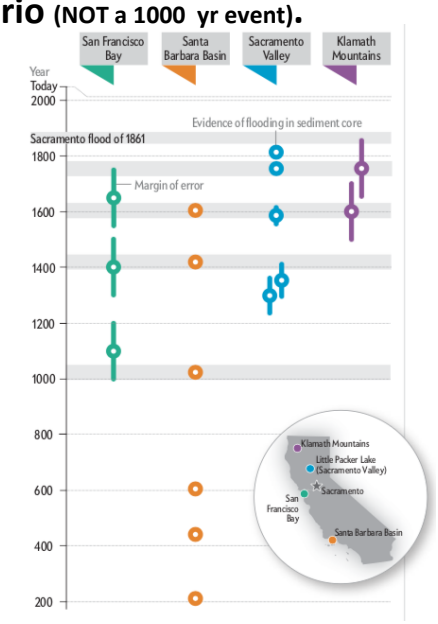


"ARkStorm" is roughly a 200-300 yr storm scenario (NOT a 1000 yr event).

Jan 1969 Phase (focused to south)



Feb 1986 Phase (focused to north)



Dettinger et al. NatHaz 2012;
Dettinger & Ingram SciAm 2013

5. California needs to accept/explore—in depth--the novel extremes that will come.

ESTIMATED ARkStorm DAMAGES & COSTS

- **Property Damage: > $300 billion, most from flooding.**
- **Agricultural Losses: Loss of crops ~ $5 billion**
- **Lifeline Damage: Roads, power, water, sewer, and other lifelines damages: ~$20 billion**
- **Long-term Business Interruption: $400 billion**

- **Total: <u>$725 billion (53% of gross annual state product)</u>** *…compared to 60% in Louisiana so far from Katrina or 26% from a major SoCal quake*

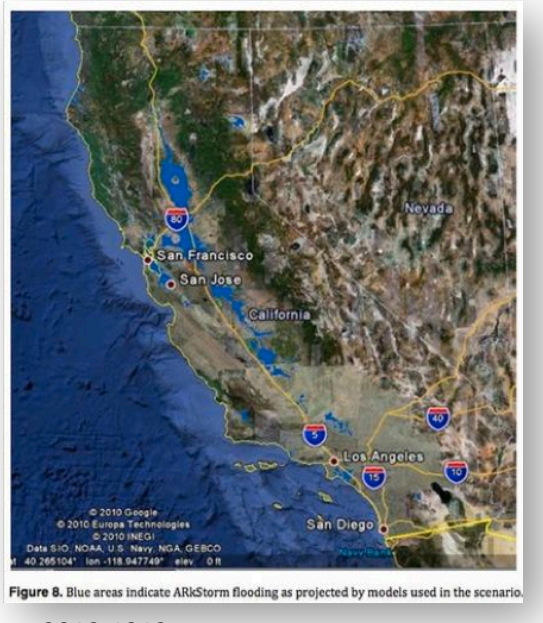


Figure 8. Blue areas indicate ARkStorm flooding as projected by models used in the scenario.

USGS Open-File Report 2010-1312

Main Points

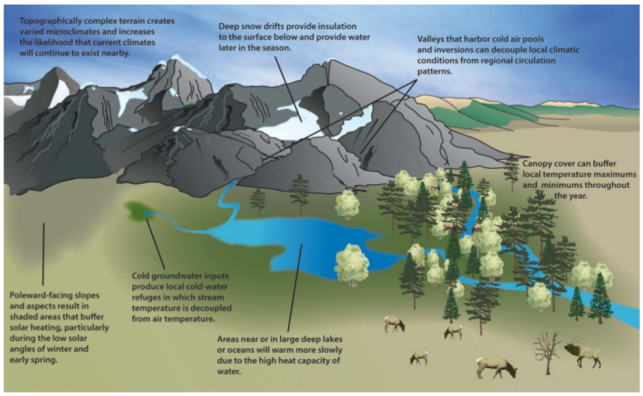
- **California has a uniquely wild precip/water regime**
  - ✧ ***Highest yr to yr variability in CONUS***
- **California's floods & drought are uniquely tied to each other**
  - ✧ ***It is almost entirely a lack of extreme storms that causes California drought***
- **California's future floods & droughts will be even wilder**
  - ✧ ***More of available water resource will be flood waters***
- **California will increasingly need to manage its floods to get thru its droughts, and vice versa**
  - ✧ ***They are no longer separable problems***
- **California needs to accept/prepare for new extremes to come**
  - ✧ ***ARkStorm is just one historically-based example; many other extreme scenarios need to be explored***

A brief addendum that I didn't speak about, but that I added here following discussions that afternoon:

The Four Rs of Climate Adaptation

Resistance: refusing to give an inch

- Remove tree seedlings encroaching into meadows
- Protect climate refugia



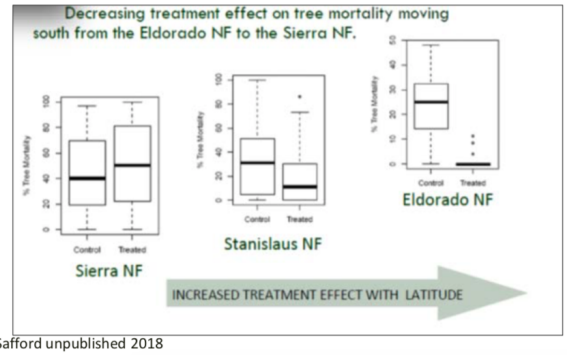
- Suppress Fire

California 4th Climate Assmt (Sierra Nv regional report), 2018

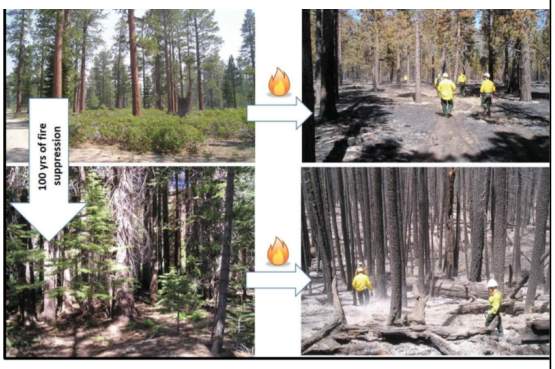
The Four Rs of Climate Adaptation

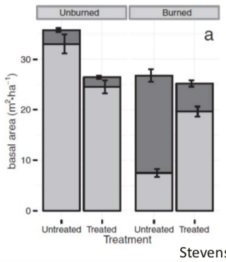
Resilience: increasing capacity to return

- Reduce forest densities
- Manage rather than suppress wildfires



Safford unpublished 2018





Stevens et al. 2014

California 4th Climate Assmt (Sierra Nv regional report), 2018

The Four Rs of Climate Adaptation

Reduce or Realign:

Unlike the 1st two, these are responses when you realize that (unlike the first 2 Rs) we cannot retain or return to present conditions, & when you accept that you will not be able to avoid major changes…but perhaps you can REDUCE the worst or at very least help along any decent aspects of the coming REALIGNMENT (new landscape).

- Assisted migration/managed relocation to favorable FUTURE climates
- Cessation of planting or protecting species where their sustainability is highly doubtful
- Decommissioning roads and trails in areas where climate change will most stress landscapes and habitats

NB: My point in including the 4 Rs here is that I fear that Cal water is still stuck on the first two Rs, and hasn't acknowledged the severity of the problem (moving on to 3rd/4th Rs)

California 4th Climate Assmt (Sierra Nv regional report), 2018