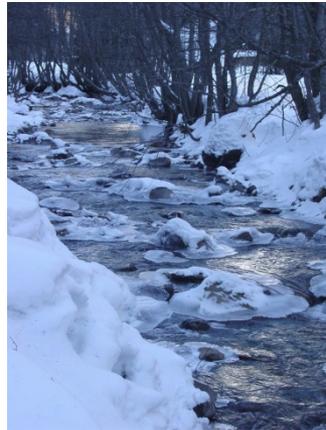


DWR Climate Change Program

Consideration of Climate Change in Water Resources Planning

Elissa Lynn
DWR

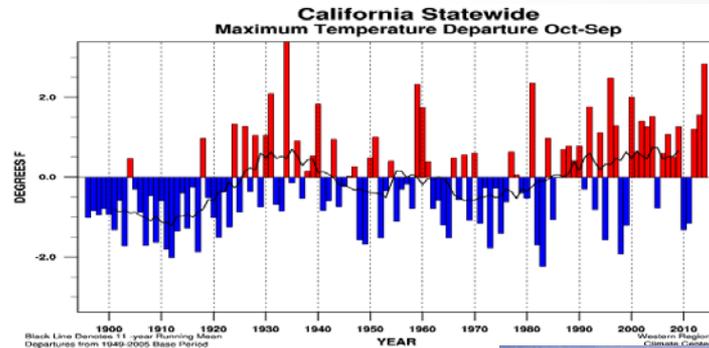


California Water Commission
January 20, 2016

What does it mean for California?



Less snow/more rain



Warming trend

Oct-Sep 2014 71.8°F (+2.8°F)



Less snowpack



*Earlier greenup dates;
enhanced wildfires*



Earlier snowfed streamflow



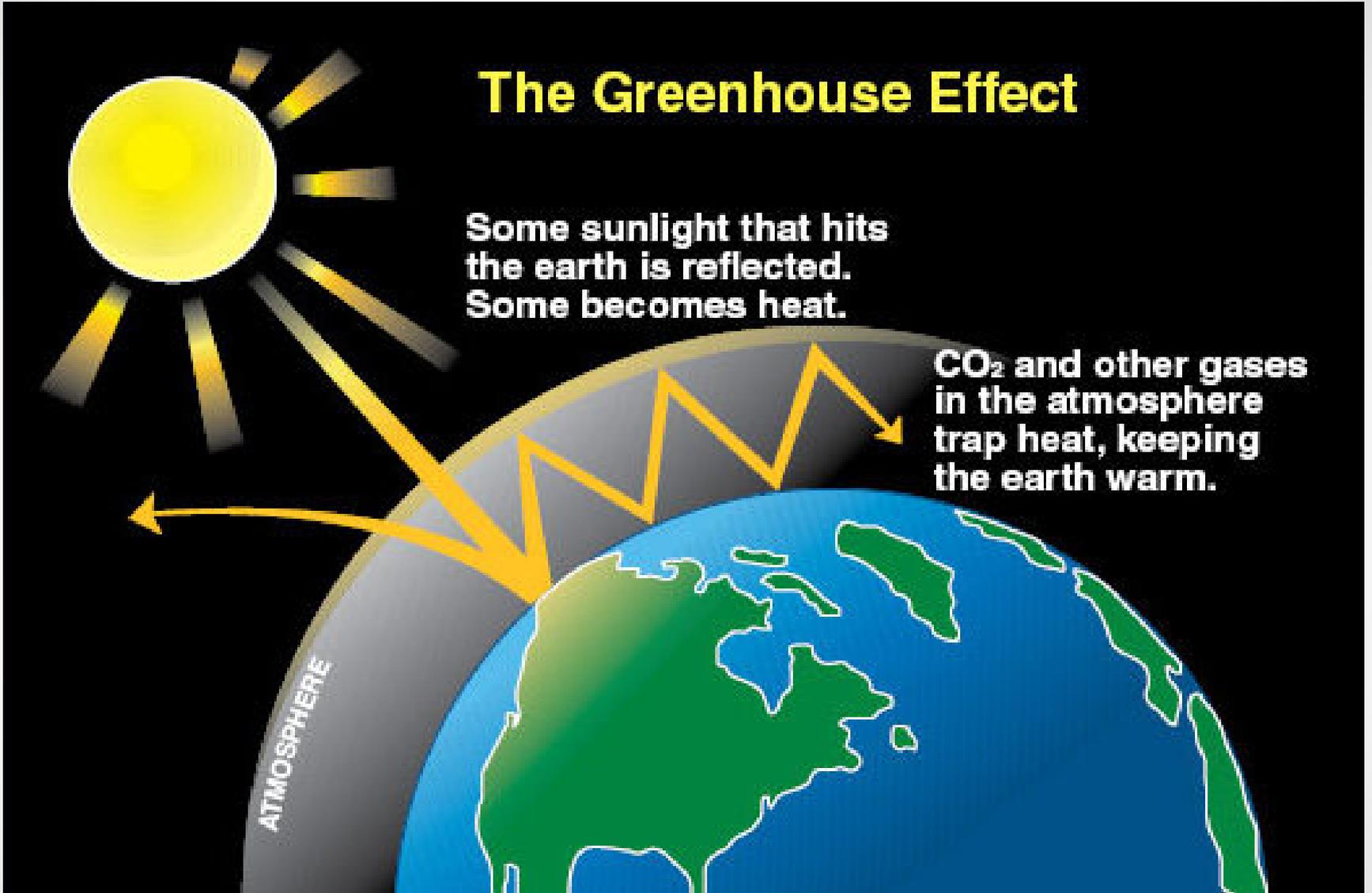
Habitat changes

The Greenhouse Effect

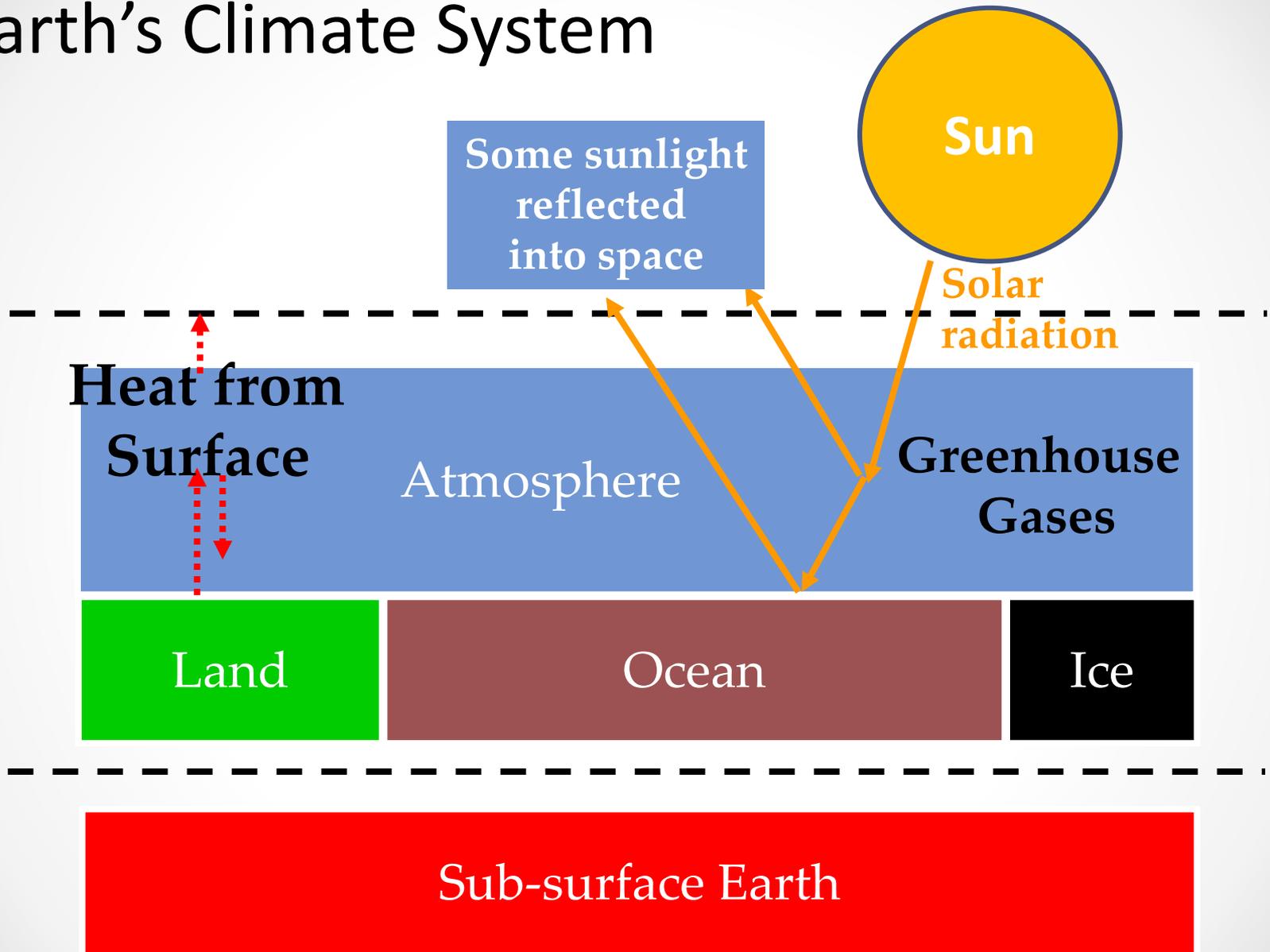
Some sunlight that hits the earth is reflected. Some becomes heat.

CO₂ and other gases in the atmosphere trap heat, keeping the earth warm.

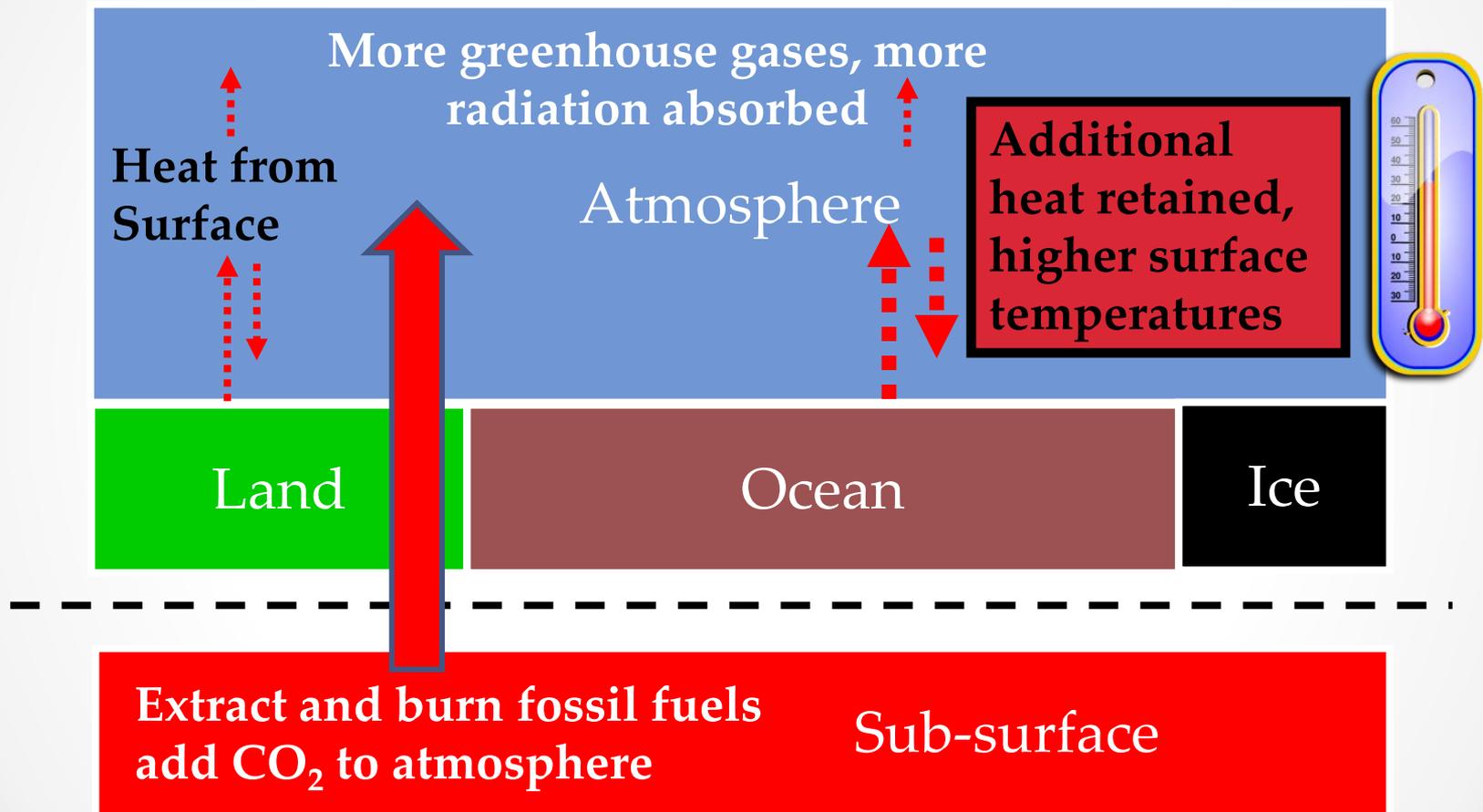
ATMOSPHERE



Earth's Climate System

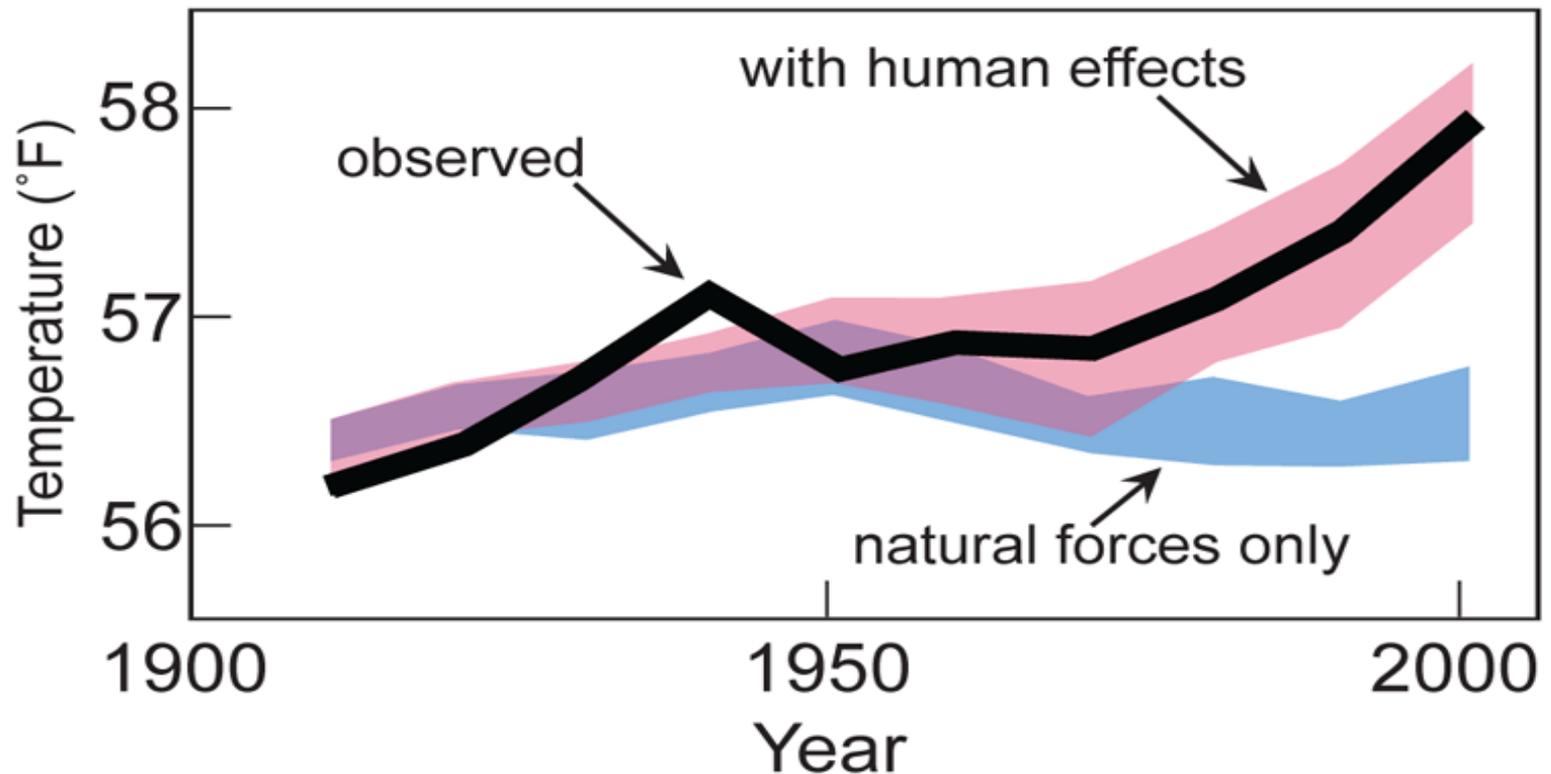


Enhanced Greenhouse Effect



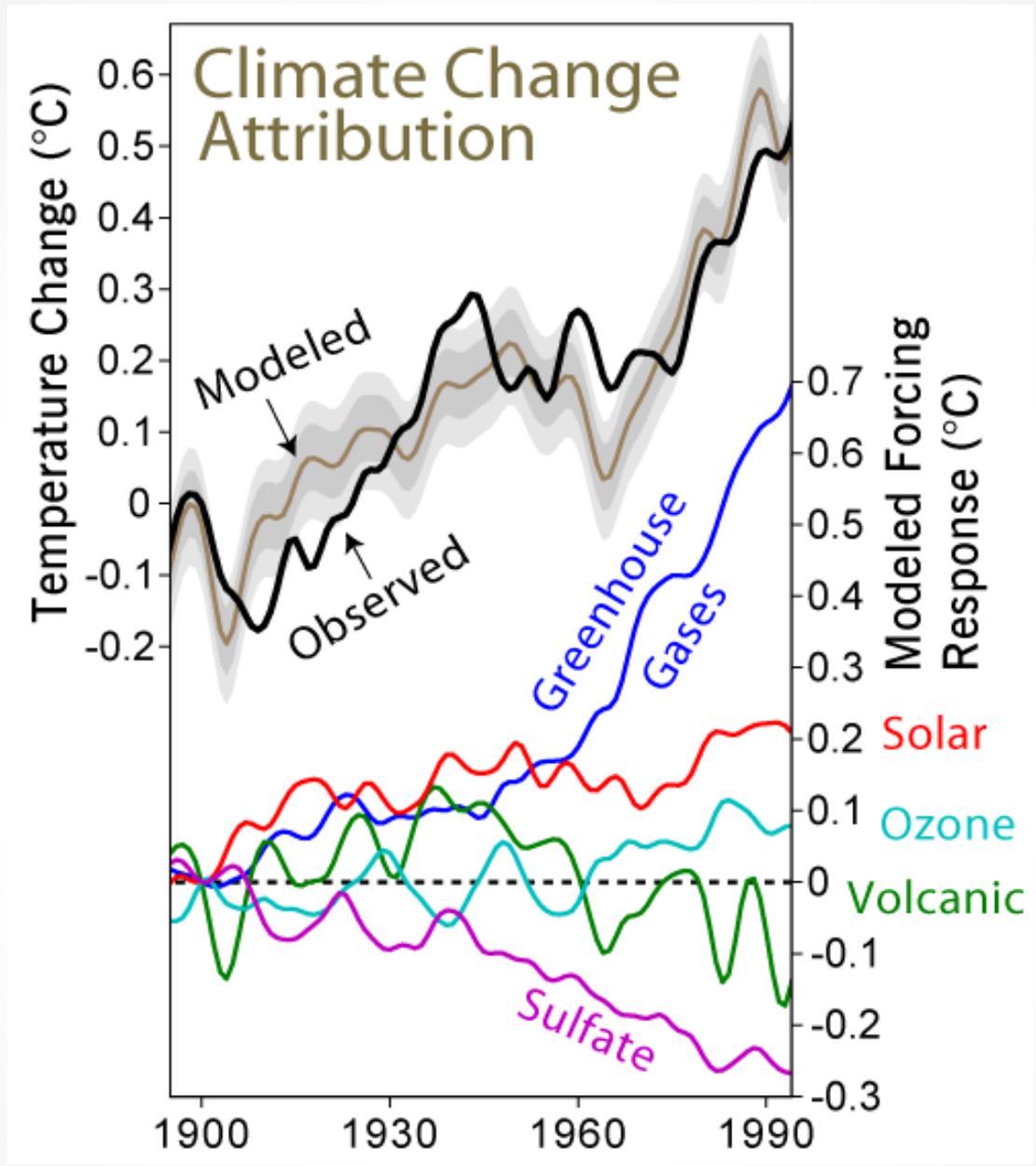
“Anthropogenic Climate Change”

What do models tell us?



- Observations
- Models using only natural forces
- Models using both natural and human forces

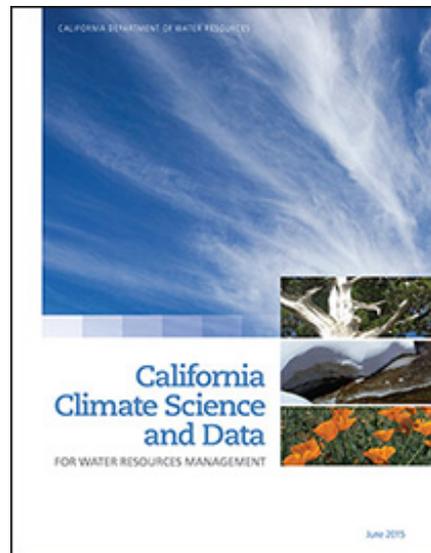
Meehl et al. (2004)



Meehl et al. (2004)

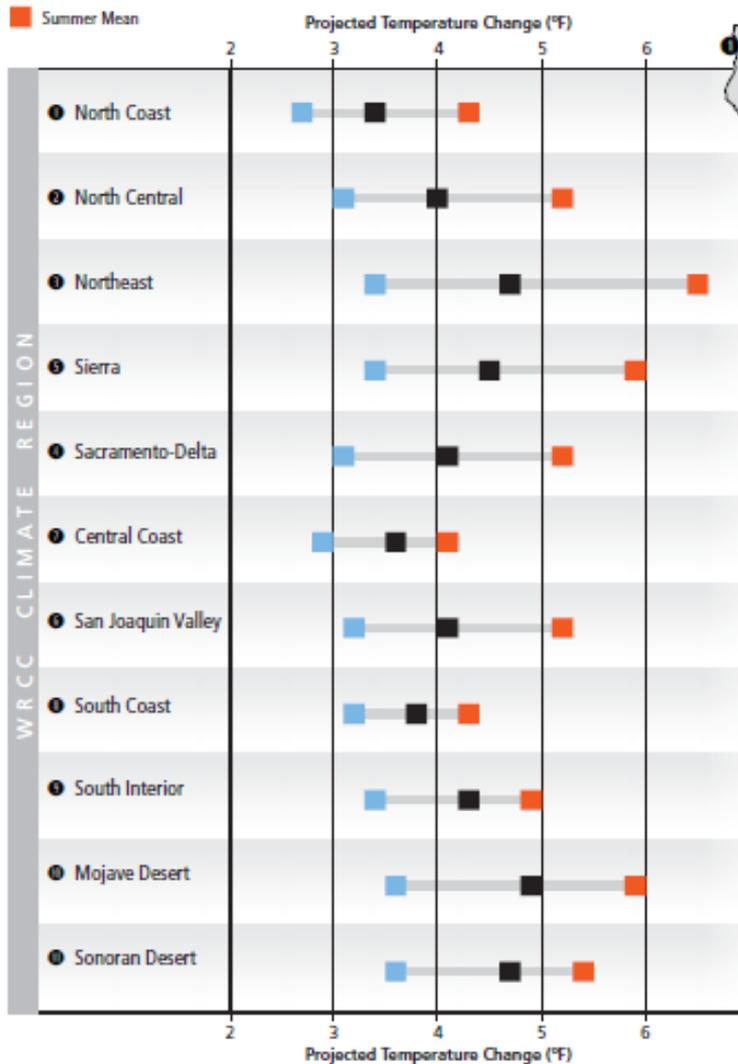
California Climate Science and Data

for Water Resources Management



[http://www.water.ca.gov/climatechange/docs/CA Climate Science and Data Final Release June 2015.pdf](http://www.water.ca.gov/climatechange/docs/CA_Climate_Science_and_Data_Final_Release_June_2015.pdf)

Projected Climate Change

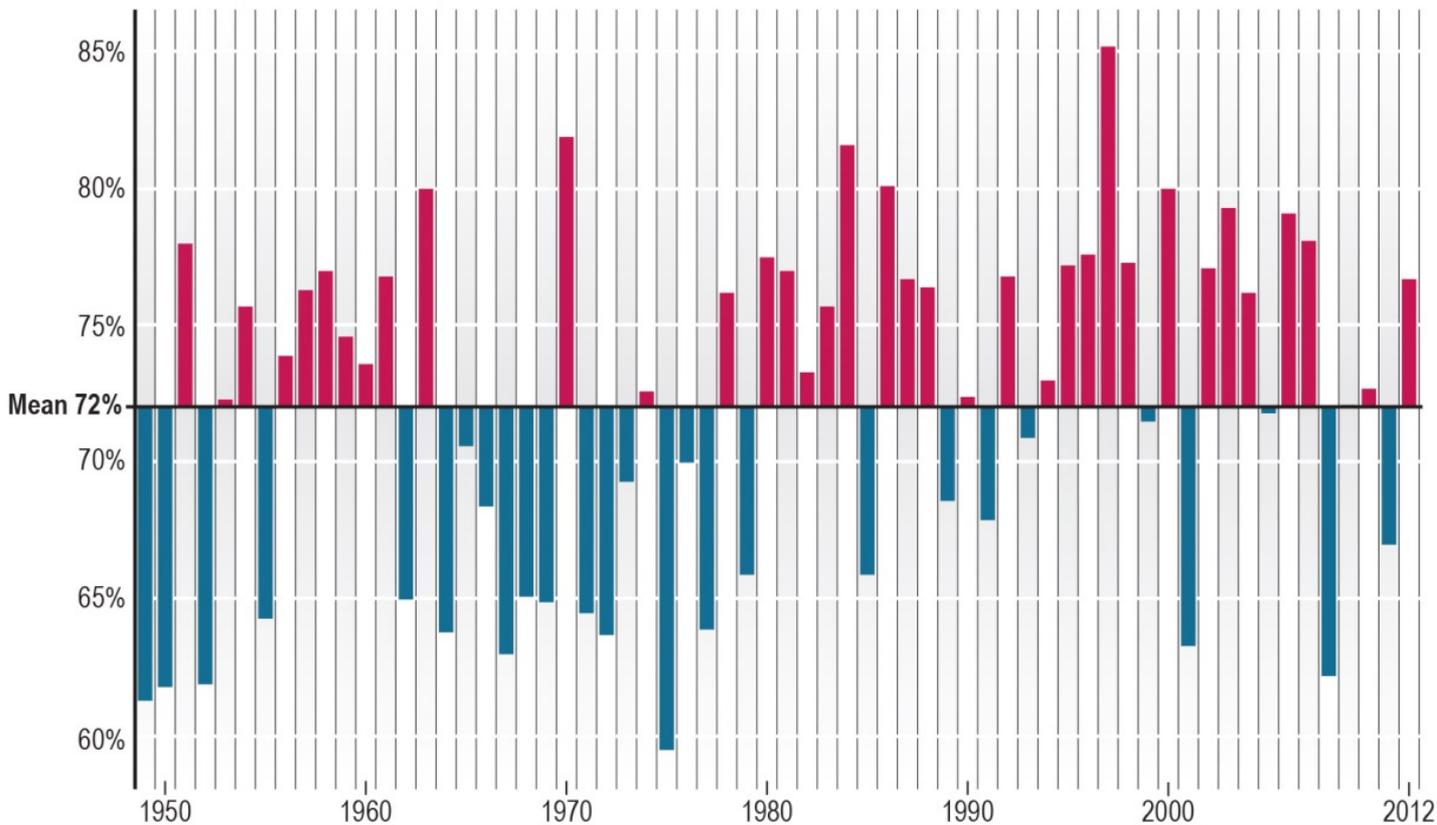


Temperatures

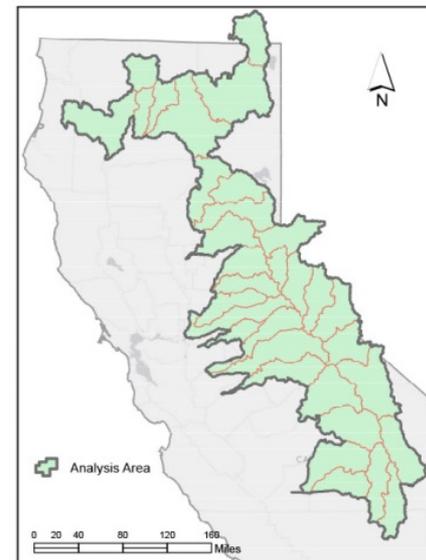
- +3 to 6.5 °F by end of century
- Summer warming will be more significant than winter warming
- Inland areas will experience more warming than coastal areas
- Evening and nighttime warming more significant than daytime warming

Observed Change

Rain as Percentage of Total Precipitation



Location of 33 watersheds sampled



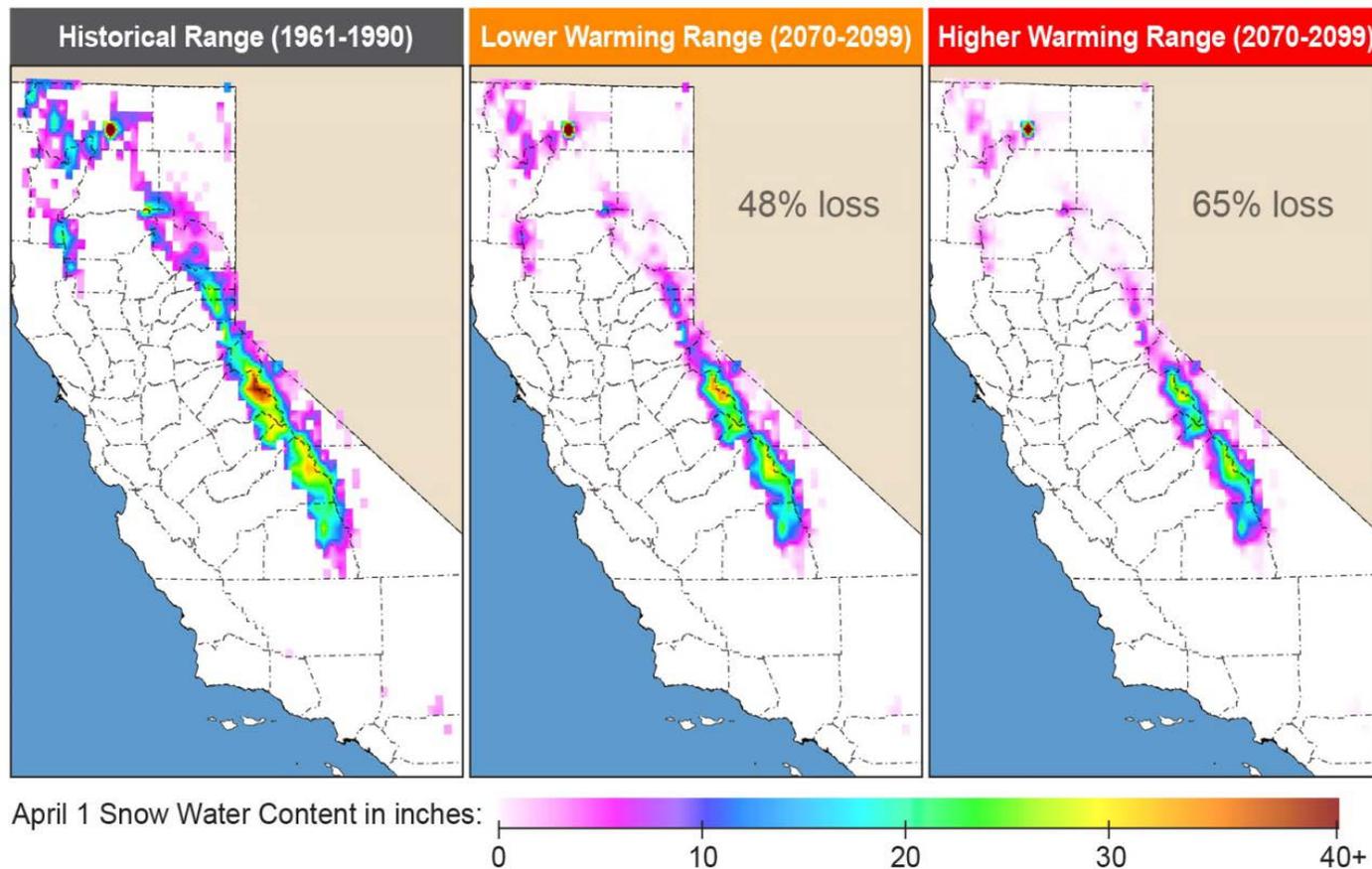
More rain, less snow

Brochure, PAGE 3

Projected Climate Change

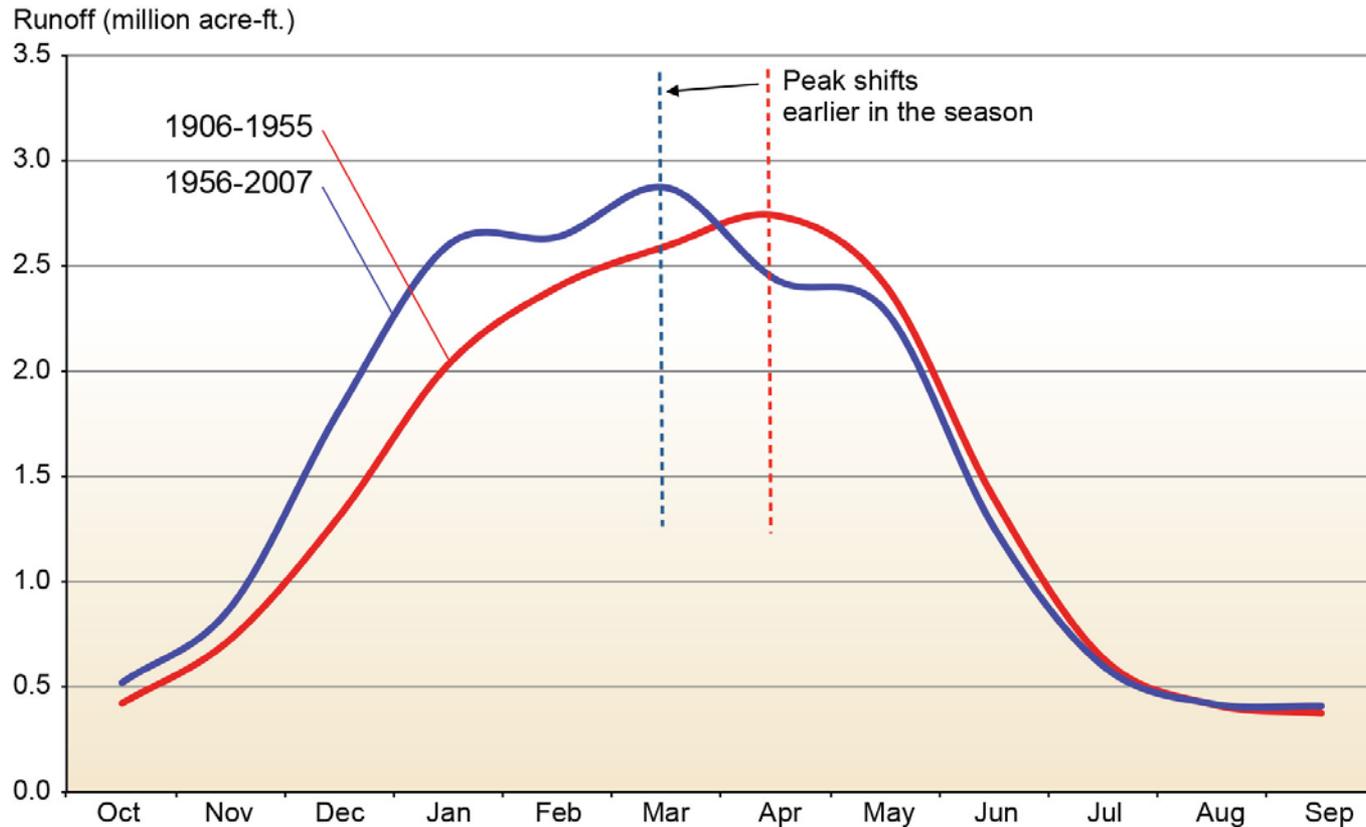
Snow Pack and Water Supply

Historical and projected California snowpack



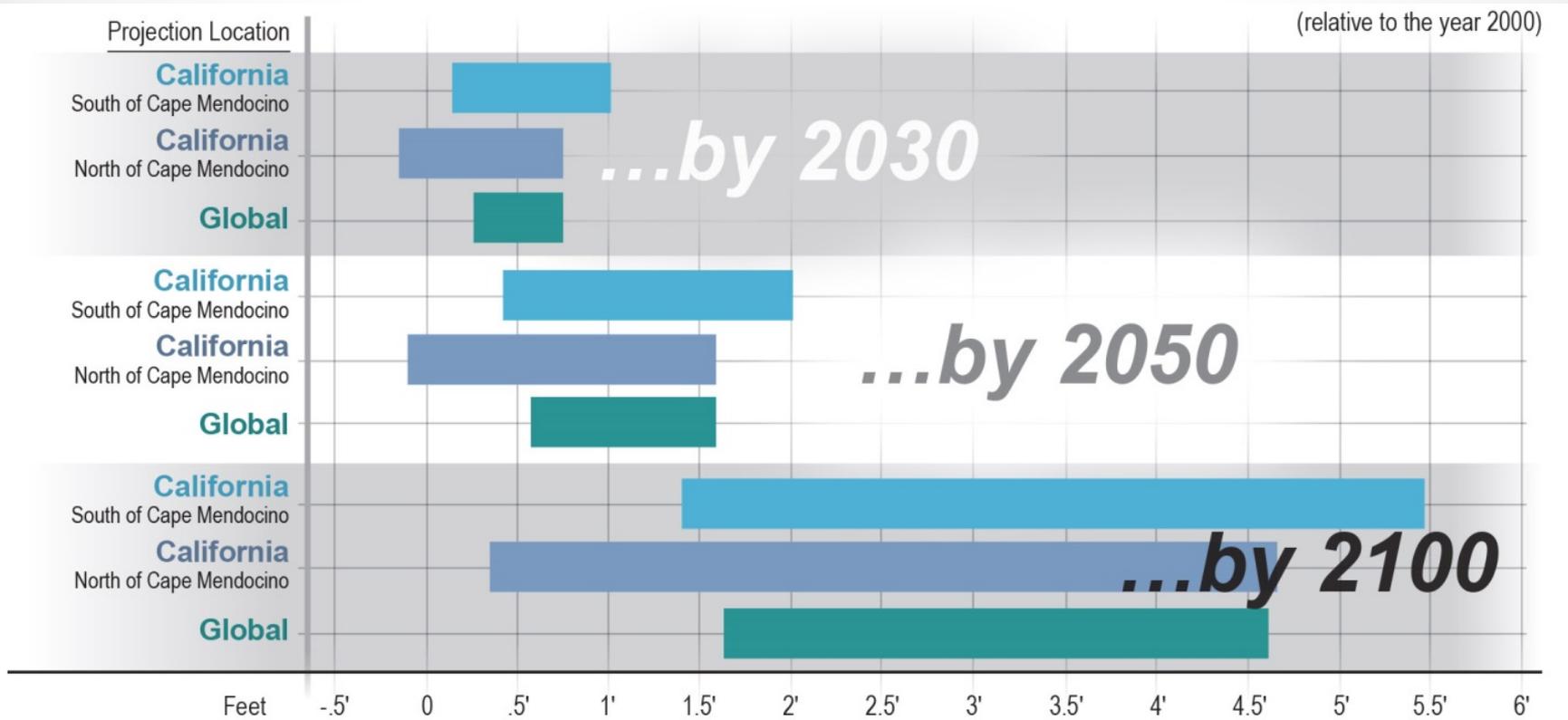
Observed Change

Runoff Timing Earlier Monthly Average / Sacramento River System



Projected Climate Change

Sea Level Rise



Reprinted with permission from "Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future," 2012, from the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C.

CA Regional Vulnerabilities

Climate Change Vulnerabilities

Because of the economic, geographic, and biological diversity of California, vulnerabilities to anticipated future climate changes are best assessed on a regional basis. A few of the key climate change vulnerabilities are indicated. For more in-depth descriptions please go to: http://www.water.ca.gov/climatechange/docs/CA_Climate_Science_and_Data_Final_Release_June_2015.pdf.



North Coast • Longer drought periods could reduce local fractured-rock groundwater supplies.

- Sea level rise may make tidal marshland susceptible to more frequent, longer and deeper flooding.



San Francisco Bay • Sea level rise may increase the susceptibility of tidal wetlands to more frequent, longer and deeper flooding.



Sacramento-San Joaquin Delta • Sea level rise may increase stress on Delta levees and change water quality.



Central Coast • Coastal infrastructure and nearshore ecosystems are vulnerable to increasing sea level and storm surges, while coastal aquifers could be affected by increasing salinity intrusion.



South Coast • Extreme precipitation events may result in greater flood risk, debris flows, and degradation of habitat.

- Higher temperatures and longer dry seasons would increase wildfire risk and impair water quality in local streams and lakes.



North Lahontan • Increased air and water temperatures would place additional stress on sensitive ecosystems and species.

- Higher temperatures and longer dry seasons would increase wildfire risk.



Sacramento River • Increased air and water temperatures would place additional stress on sensitive ecosystems and species.

- Loss of snowpack storage may reduce reliability of surface water supplies and result in greater demand on groundwater resources.



Mountain Counties • Loss of snowpack storage may reduce reliability of surface water supplies.

- Snowpack reduction may have significant impacts on the water-related tourism industry.



San Joaquin River • Increasing temperatures and variable precipitation patterns would affect agricultural crops by reducing winter chill-hours, increasing extreme heat days and increasing evapotranspiration.



South Lahontan • Higher temperatures and longer dry seasons would increase wildfire risk and impair water quality in local streams and lakes.

- Reduced snowpack would impact the winter-dependent economy which also supports disadvantaged communities.



Tulare Lake • Loss of snowpack storage may reduce reliability of surface imported water supplies and replenishment of local supplies, and result in greater demand on groundwater resources.

- Increased air and water temperatures would place additional stress on sensitive ecosystems and species.



Colorado River • More frequent and longer droughts would reduce imported water supply reliability and decrease local water quality and habitat.

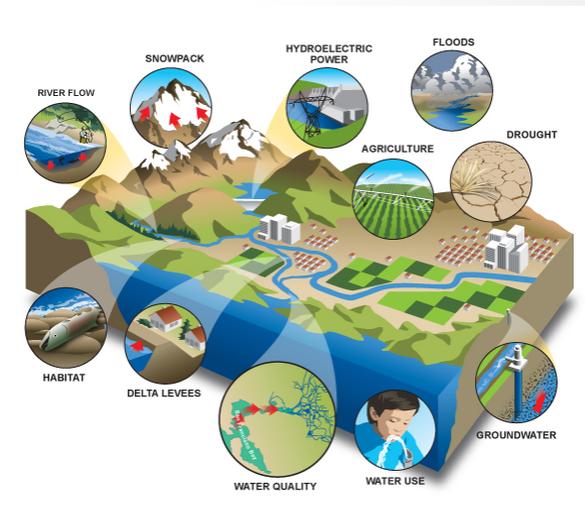


Climate Adaptation

Efforts by society or ecosystems to prepare for or adjust to changes in the climate

Protective – guarding against negative impacts of climate change

Opportunistic – taking advantage of any beneficial effects of climate change



Climate Mitigation

Efforts to reduce or prevent emission of greenhouse gases

Using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior

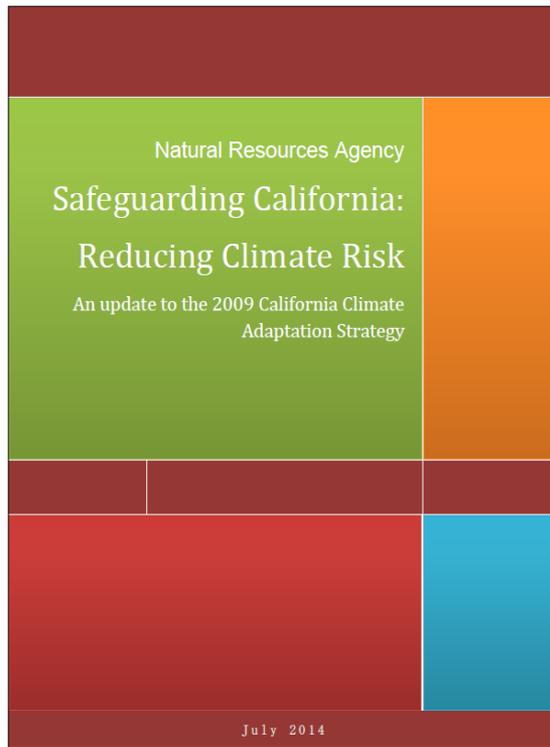
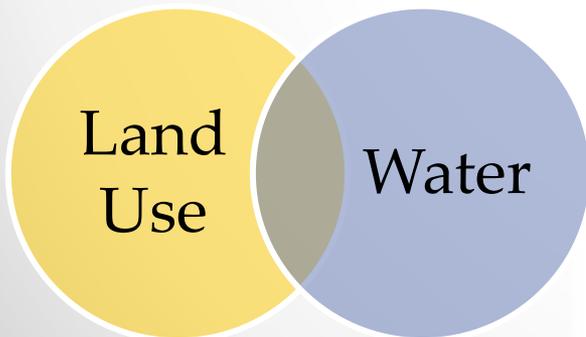


Adaptation Strategies Safeguarding California Implementation Plan 2016 Water Sector

Groundwater

Efficiency

Ecosystems

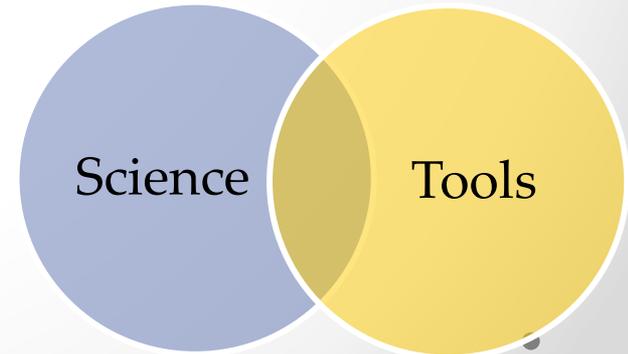


Local Supplies

Storage

Flood

Drought



DWR's

Climate Action Plan

(CAP)

Comprehensive Response to Climate Change

<http://www.water.ca.gov/climatechange/CAP.cfm>

Department of Water Resources
Climate Change Program
January 2016



The California Department of Water Resources (DWR) has 10 full time staff in its Climate Change Program to support climate change activities across the State. Specialists in both adaptation and mitigation are located in Sacramento and four regional offices. The goal of the program is to provide regionally-specific climate change information to local water managers and to support all DWR programs, projects, and documents by providing access to the latest research, data, tools, and guidance for California's unique water management issues related to a warming climate.

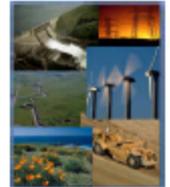
DWR CLIMATE ACTION PLAN

Phase I: DWR Greenhouse Gas Emissions Reduction Plan

Phase I of DWR's Climate Action Plan covers mitigation of greenhouse gases (GHG's). This plan lays out steps to cut the Department's GHG emissions by 30 percent below 1990 levels by 2020, and 80 percent below 1990 levels by 2030.

In 2013, DWR received the Climate Leadership Award for "Excellence in Greenhouse Gas Management: Goal Setting" for its work on the Greenhouse Gas Emissions Reduction Plan. The award, presented by the U.S. EPA, the Association of Climate Change Officers, The Climate Registry, and The Center for Climate and Energy Solutions, is the highest national award given for greenhouse gas management. DWR is one of only two public agencies to be honored with this award. The Department's Climate Action Plan also garnered a Sacramento Area Sustainable Business Award in 2012.

<http://www.water.ca.gov/climatechange/CAP.cfm>



Phase II: Climate Change Analysis Scenario Selection and Guidance

Phase II of DWR's Climate Action Plan will be a framework and data toolbox to guide analysis of the effects of climate change on DWR projects and activities. The project will ensure that all DWR projects meet standards for consistency, quality, and adequacy in climate change analysis for planning activities. This guidance may provide assistance to local water managers, as well.

Climate Change Technical Advisory Group

As part of DWR's Climate Action Plan Phase II, DWR empaneled the Climate Change Technical Advisory Group (CCTAG) in order to engage the academic and research community for the best climate science available. Comprised of 14 experts in the disciplines of atmospheric science, hydrology, civil engineering, environmental science, climate data, social science, resource economics, land use planning and climate modeling, the group explored DWR's needs for technical analysis, global climate model selection, scenario development for extremes analysis and downscaling. In August 2015, the CCTAG provided its recommendations to DWR on how best to use available climate information, which are described in the report "Perspectives and Guidance for Climate Change Analysis".

http://www.water.ca.gov/climatechange/docs/2015/Perspectives_Guidance_Climate_Change_Analysis.pdf

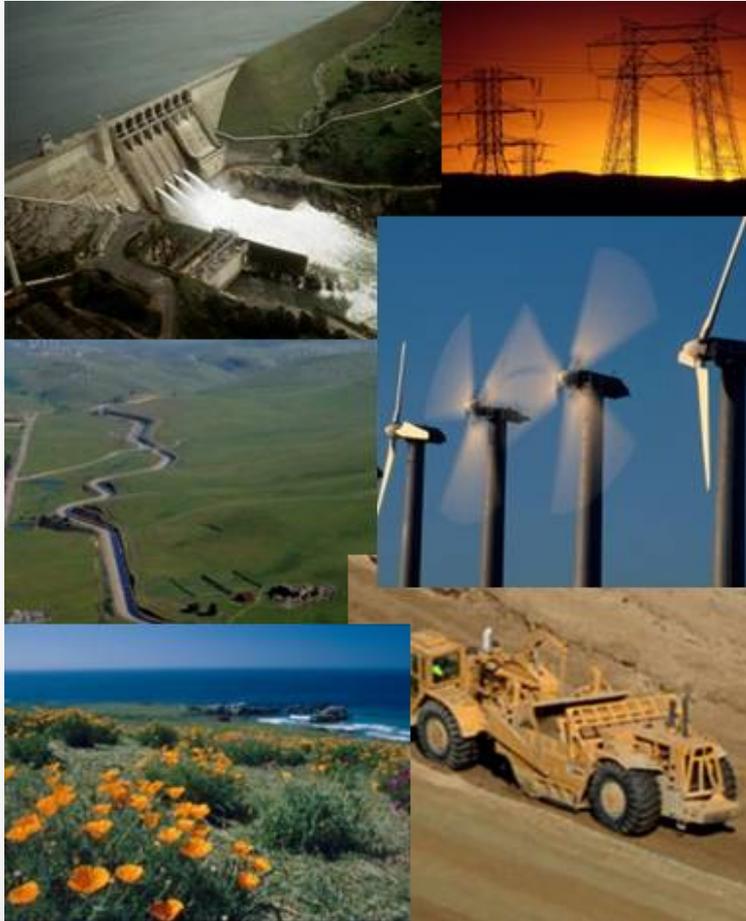
Phase III: Climate Change Vulnerability Assessment and Adaption Plan

Phase III will evaluate the vulnerability of DWR facilities, operations, and people to key climate change impacts, and develop adaptation strategies to improve DWR's resiliency to climate change. The Vulnerability Assessment will be released in 2016.



CAP Phase I

Greenhouse Gas Reduction Plan



- 50% Emissions Reduction from 1990 levels by 2020
- 80% Emissions Reduction from 1990 levels by 2050
- Won National Climate Leadership Award, 2015



CAP Phase II

Framework for Consistent Climate Change Handling

Goal: Improve standardization and quality in climate change analyses across all DWR programs

Climate Change Technical Advisory Group:

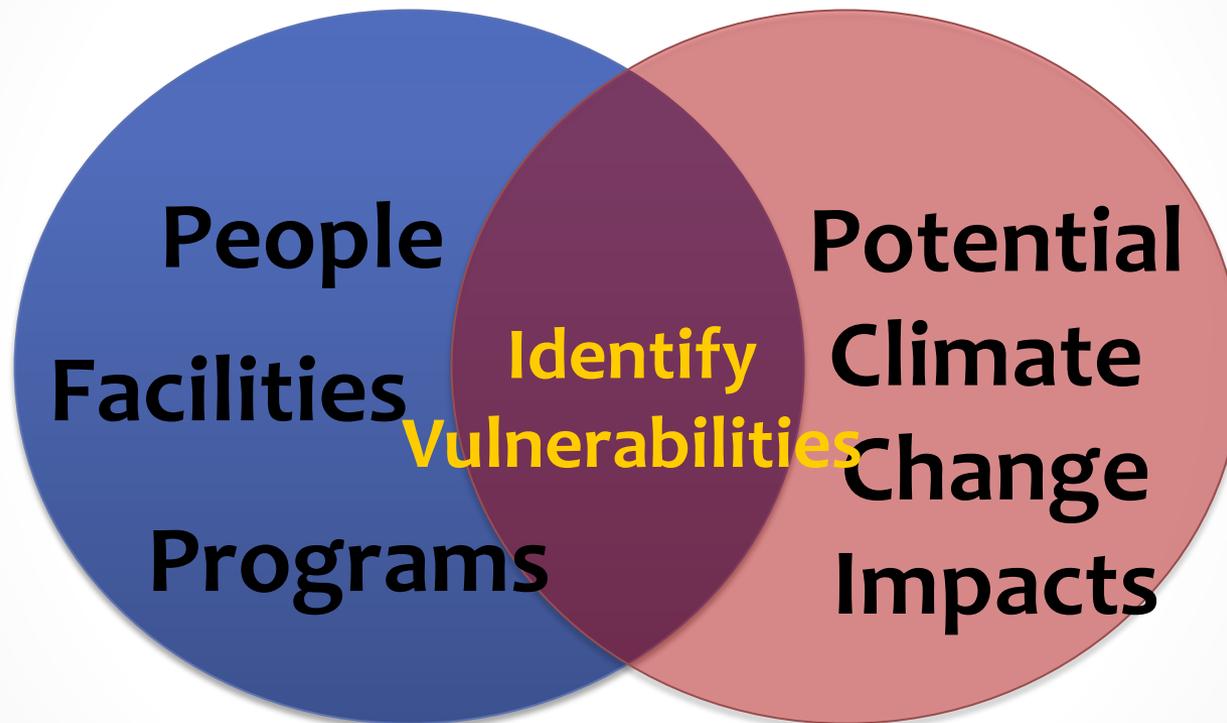
Provided perspectives and guidance on climate change and “GCM” assessment

NEXT STEPS:

- ❖ Department-wide guidance for Climate Change using “recommended” models/scenarios
- ❖ Provide “best science” to local water managers
- ❖ Engage with other State agencies to align with our methodology (CEC – 4th Assessment)

CAP Phase III

DWR Vulnerability Assessment and Adaptation Plan



Goal: Assess risk levels & identify most vulnerable activities and develop adaptation goals & create a plan of action