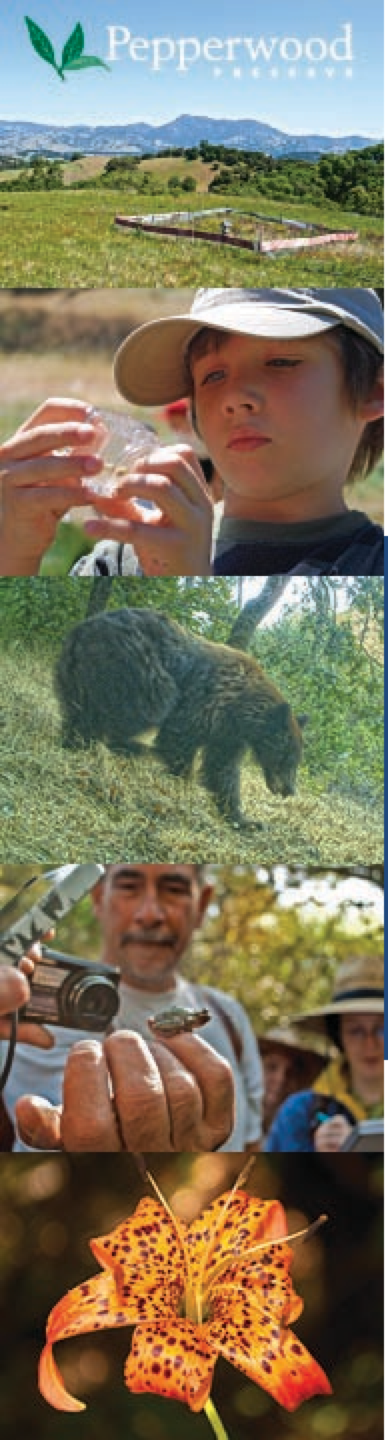

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Building on *Climate Ready North Bay* for projecting Napa Valley watershed and groundwater conditions

Groundwater Sustainability Advisory Committee

November 12, 2020

Lisa Micheli, Pepperwood
Lorraine Flint, USGS Emeritus

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3200-acre reserve in Mayacamas, partnered with CA Academy of Sciences

The Dwight Center for Conservation Science

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Today's Topics

- Overview of *Climate Ready North Bay* projections for climate and hydrology of Napa Valley: results to build on for groundwater planning
- Opportunities to interface with SGMA Groundwater Sustainability modeling guidelines

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TBC3

Terrestrial Biodiversity Climate Change Collaborative

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Berkeley
UNIVERSITY OF CALIFORNIA

An internationally-recognized climate science initiative

USGS
science for a changing world

CA.GOV

The California ENERGY COMMISSION

GORDON AND BETTY MOORE FOUNDATION

BAY AREA | OPEN SPACE COUNCIL

Creekside Center for Earth Observation

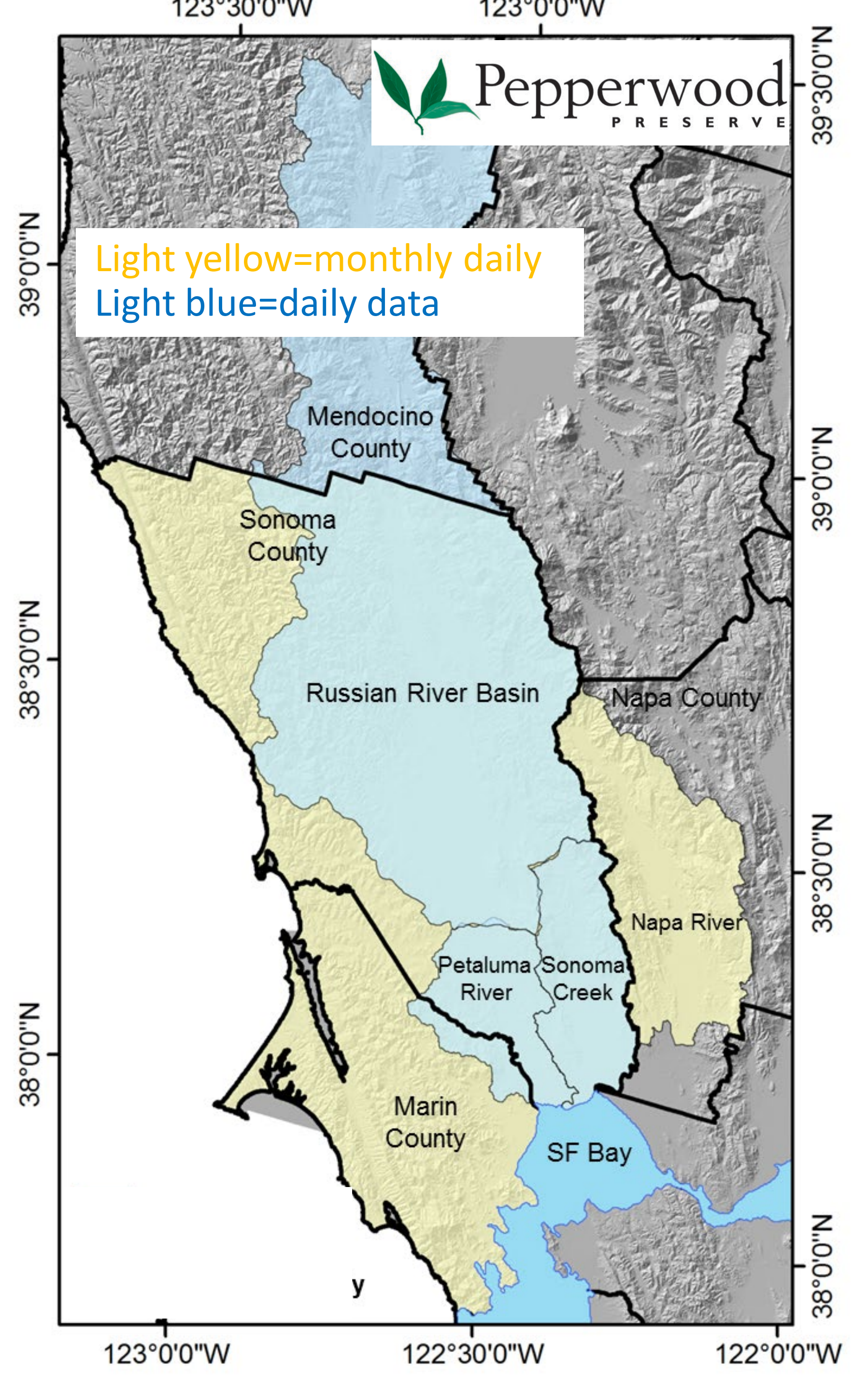
Point Blue Conservation Science

North Bay Climate Ready

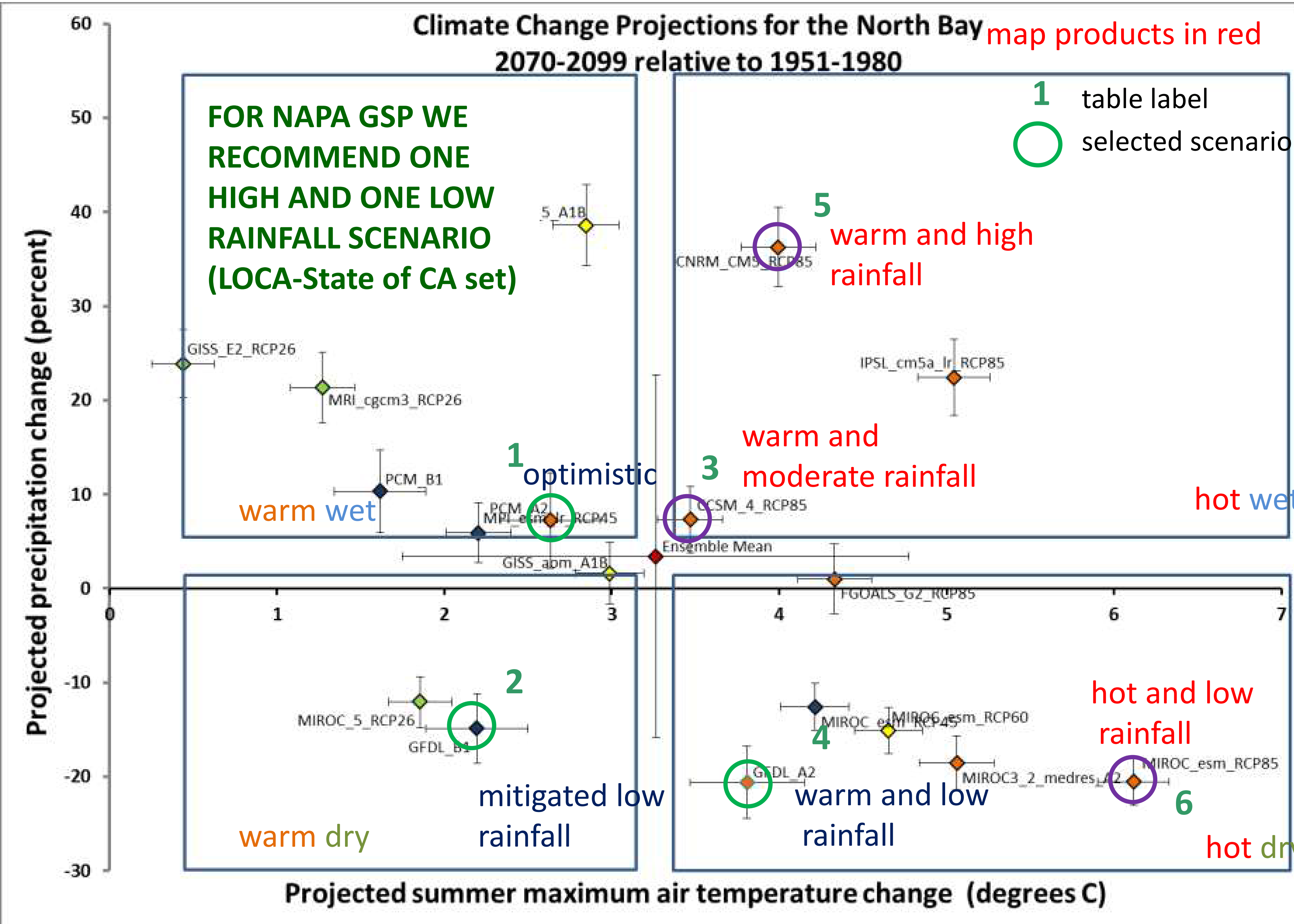
Marin, Sonoma County, Mendocino, Napa Counties

- (Not sea level rise!)
- Warmer temperatures
- Greater hydrologic variability
- Greater evapo-transpiration
- Increased water demand
- Variable runoff and recharge
- Shifts in natural vegetation types
- Increased wildfire risk

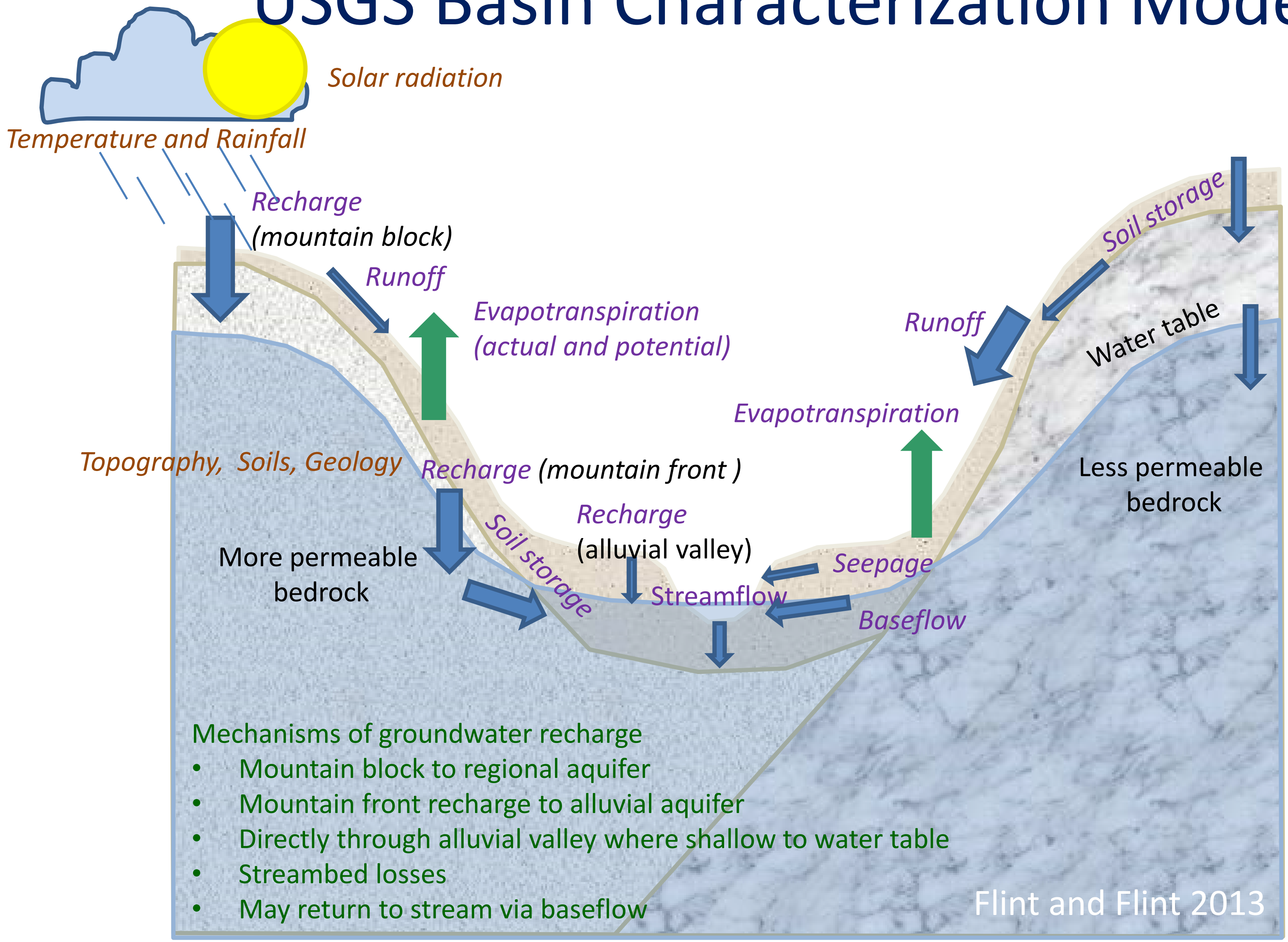
Translating landscape-level climate-hydro projections into inputs for long-term planning



Climate Ready North Bay: Selected Future Scenarios



USGS Basin Characterization Model



Size of arrows reflect relative magnitude of water flow

Brown text is BCM input, Purple text is BCM output

USGS science for a changing world

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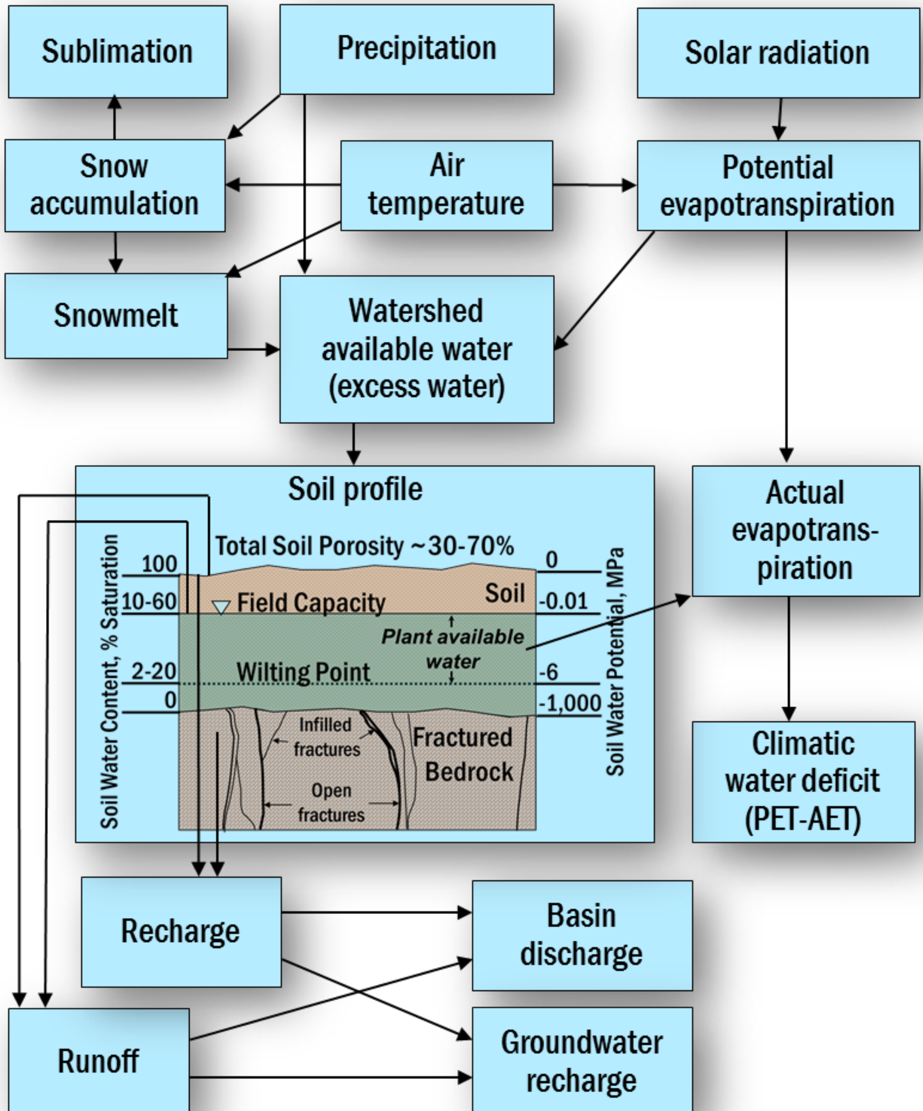
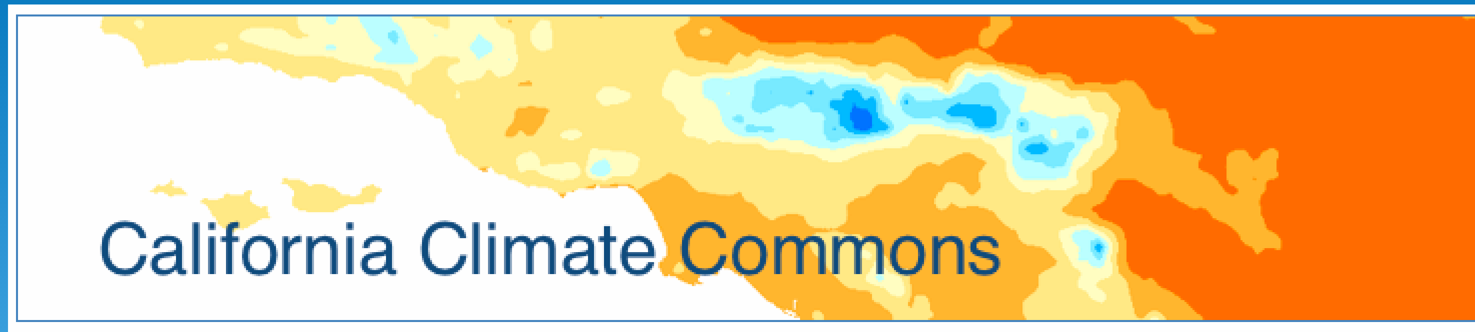
Basin Characterization Model: "boundary conditions" for water inputs to aquifer





to learn more about the watershed model….

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Dataset

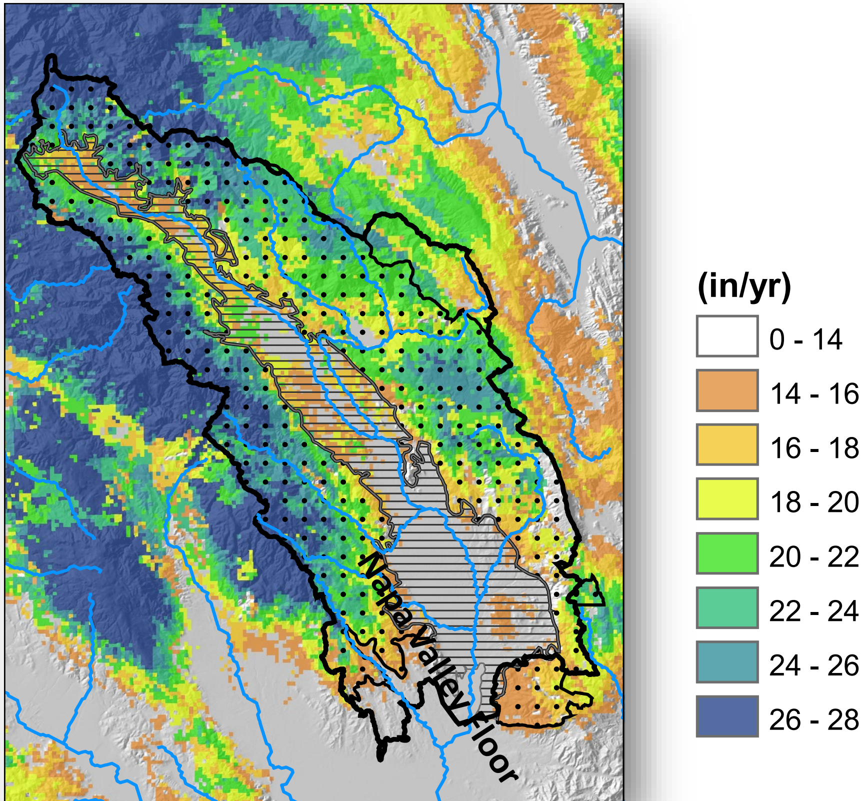
California Basin Characterization Model (BCM) downscaled climate and hydrology

Data Variables in this Dataset

- Actual evapotranspiration - Potential evapotranspiration calculated when soil water co wilting point
- Climatic Water Deficit - Potential minus Actual Evapotranspiration
- Excess water - Water remaining above evapotranspiration
- Maximum monthly temperature -
- Minimum monthly temperature -
- Potential Evapotranspiration - Water that could evaporate or transpire from plants if a

climate.calcommons.org
hosts Climate Ready North Bay products

Water Supply-Recharge + Runoff-projections



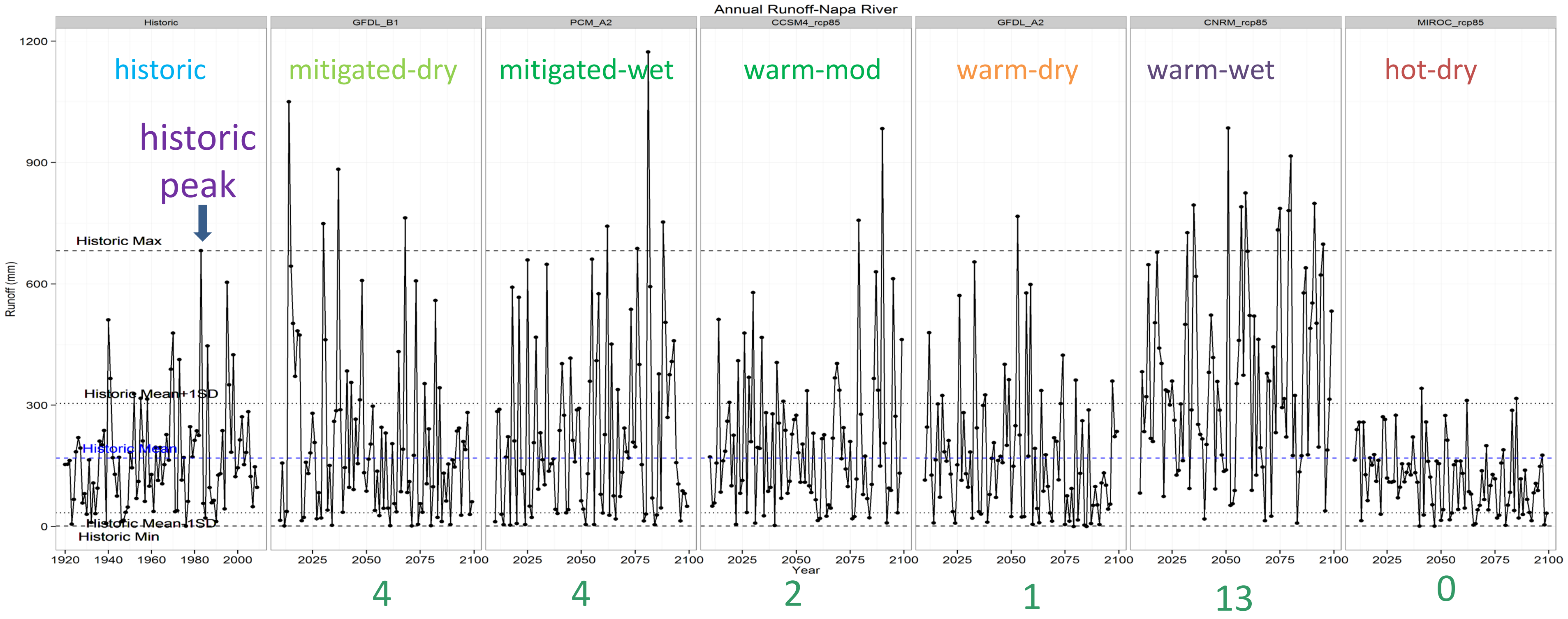
30 year averages capture trajectories with both more and less rainfall

We also calculated these trends for every reservoir catchment in basin

			Current	Moderate Warming, High Rainfall		Moderate Warming, Moderate Rainfall		Hot, Low Rainfall	
Rch+Run (acre-ft)		Area (acres)	1981-2010	2040-2069	2070-2099	2040-2069	2070-2099	2040-2069	2070-2099
Mountains	total	452,476	243,131	344,656	392,444	233,723	272,710	163,522	160,806
	SD		58,769	71,890	76,404	56,910	59,658	45,580	46,690
	% change			42%	61%	-4%	12%	-33%	-34%
Valley floor	total	189,418	59,142	89,894	107,424	53,860	67,413	33,201	31,061
	SD		21,889	28,335	30,616	22,300	23,755	17,066	17,567
	% change			52%	82%	-9%	14%	-44%	-47%

Napa River Valley Runoff

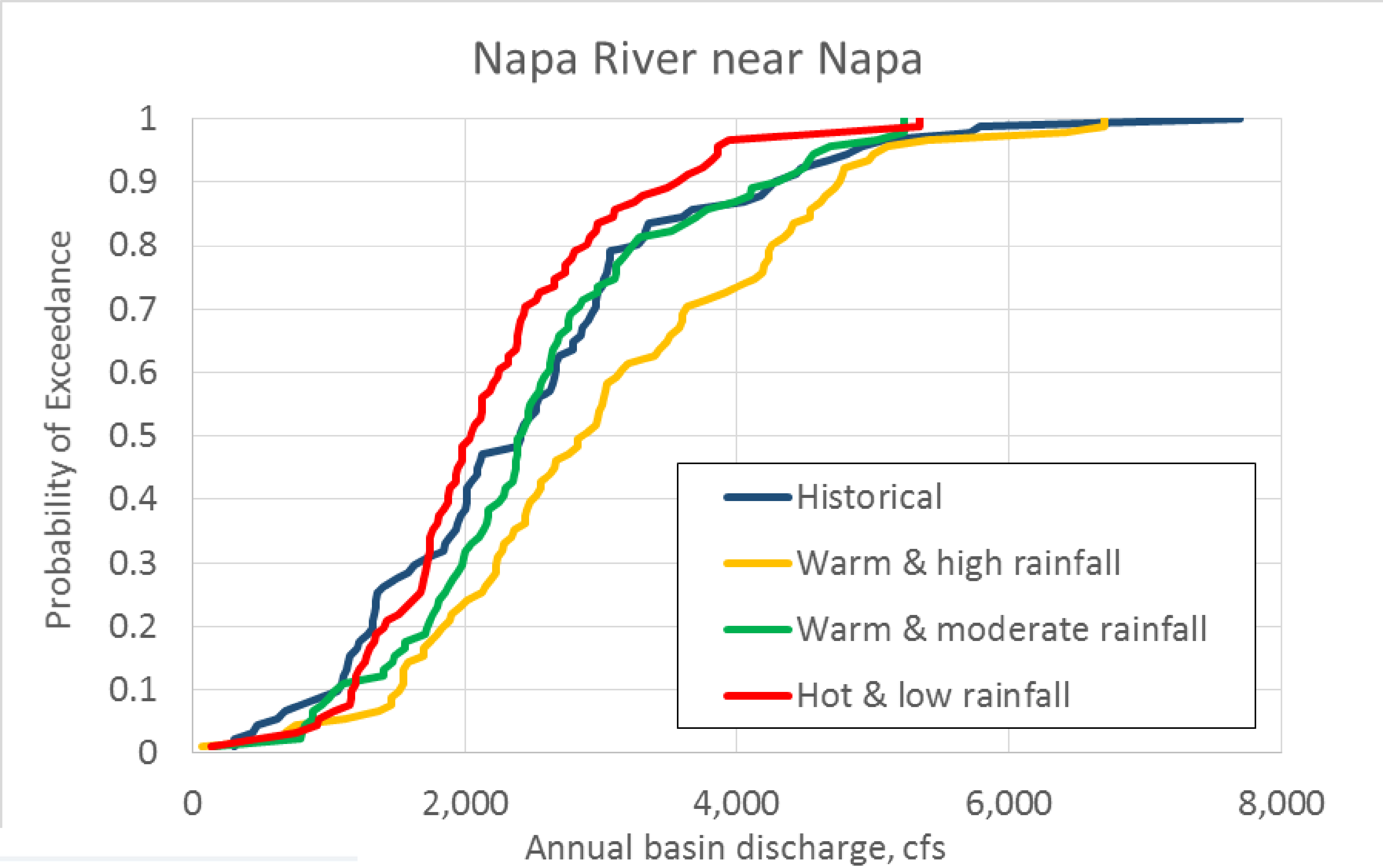
historic plus 6 models annual values



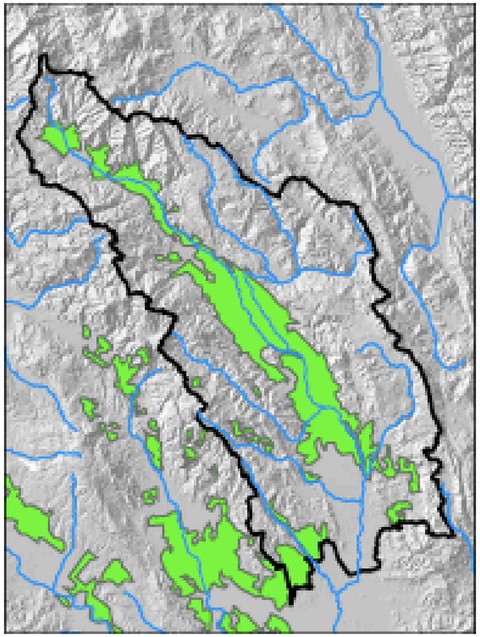
these are scenarios-not “predictions”

allow us to look at potential patterns of inter-annual variability

River managers need to design for both unprecedented HIGH and LOW flows

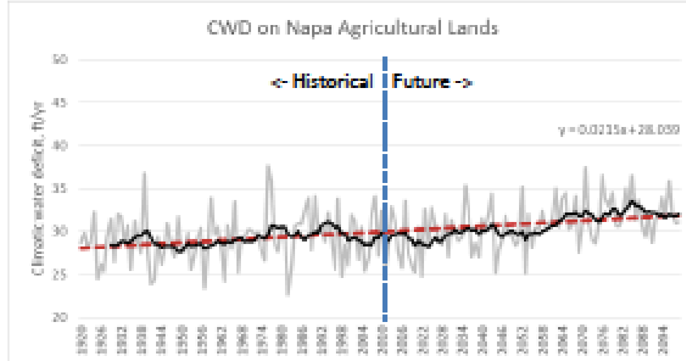


TBC3 Terrestrial Biodiversity Climate Change Collaborative



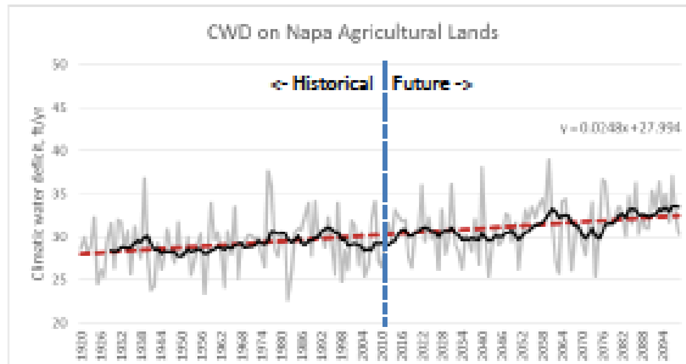
Climatic Water Deficit on Napa Agricultural Lands

Scenario 5
Warm &
High Rainfall



last 30 years 9 % greater deficit

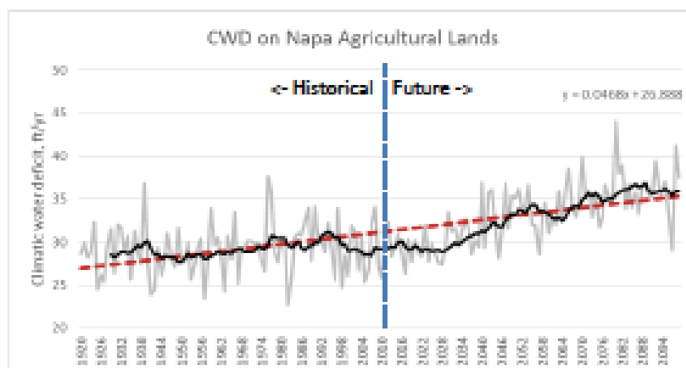
Scenario 3
Warm &
Moderate
Rainfall



last 30 years 10 % greater deficit

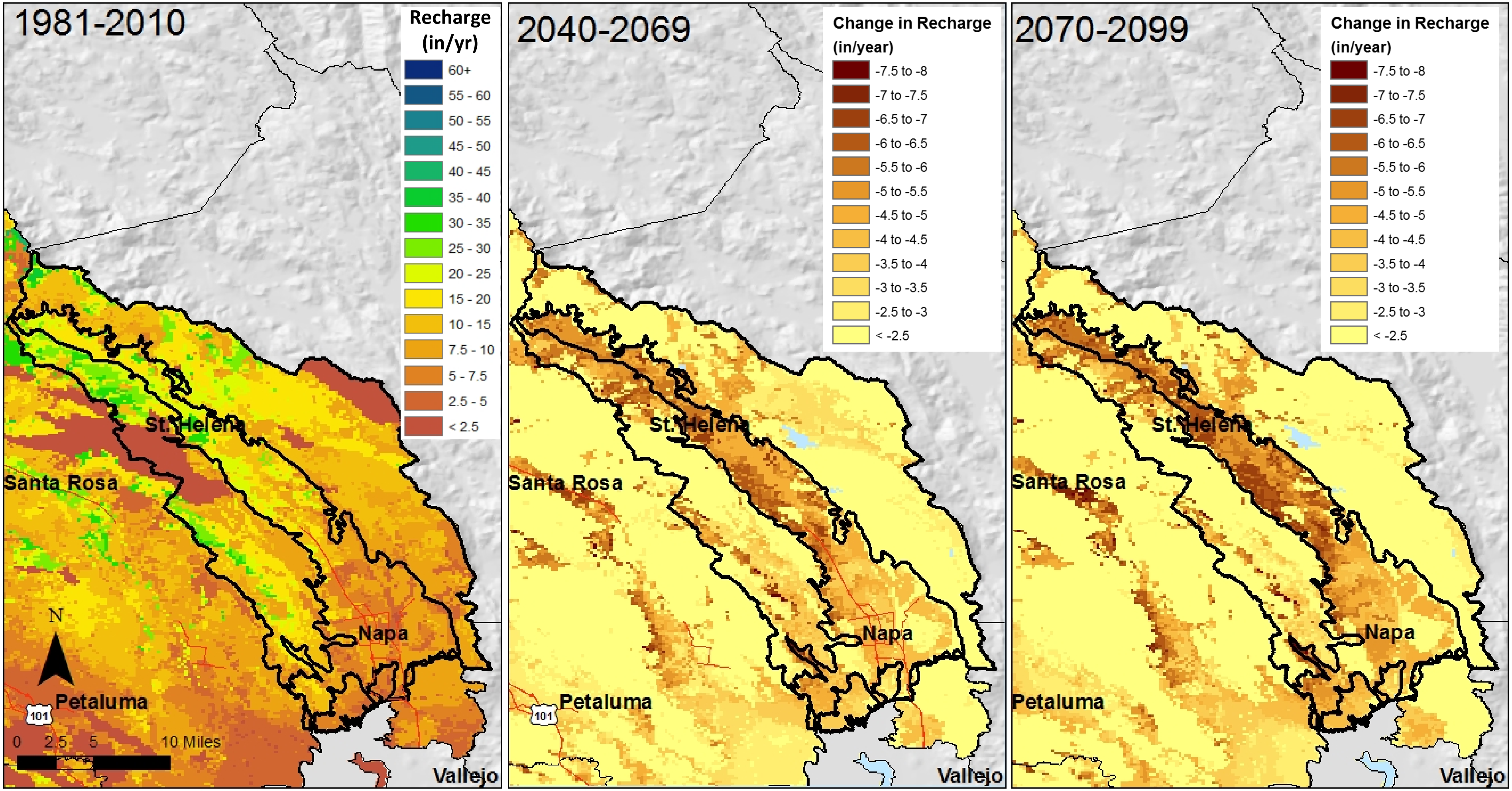
Water deficits increase in even high rainfall scenarios

Scenario 6
Hot &
Low Rainfall



last 30 years 20 % greater deficit

Projected Change in Recharge, Hot and Low Rainfall



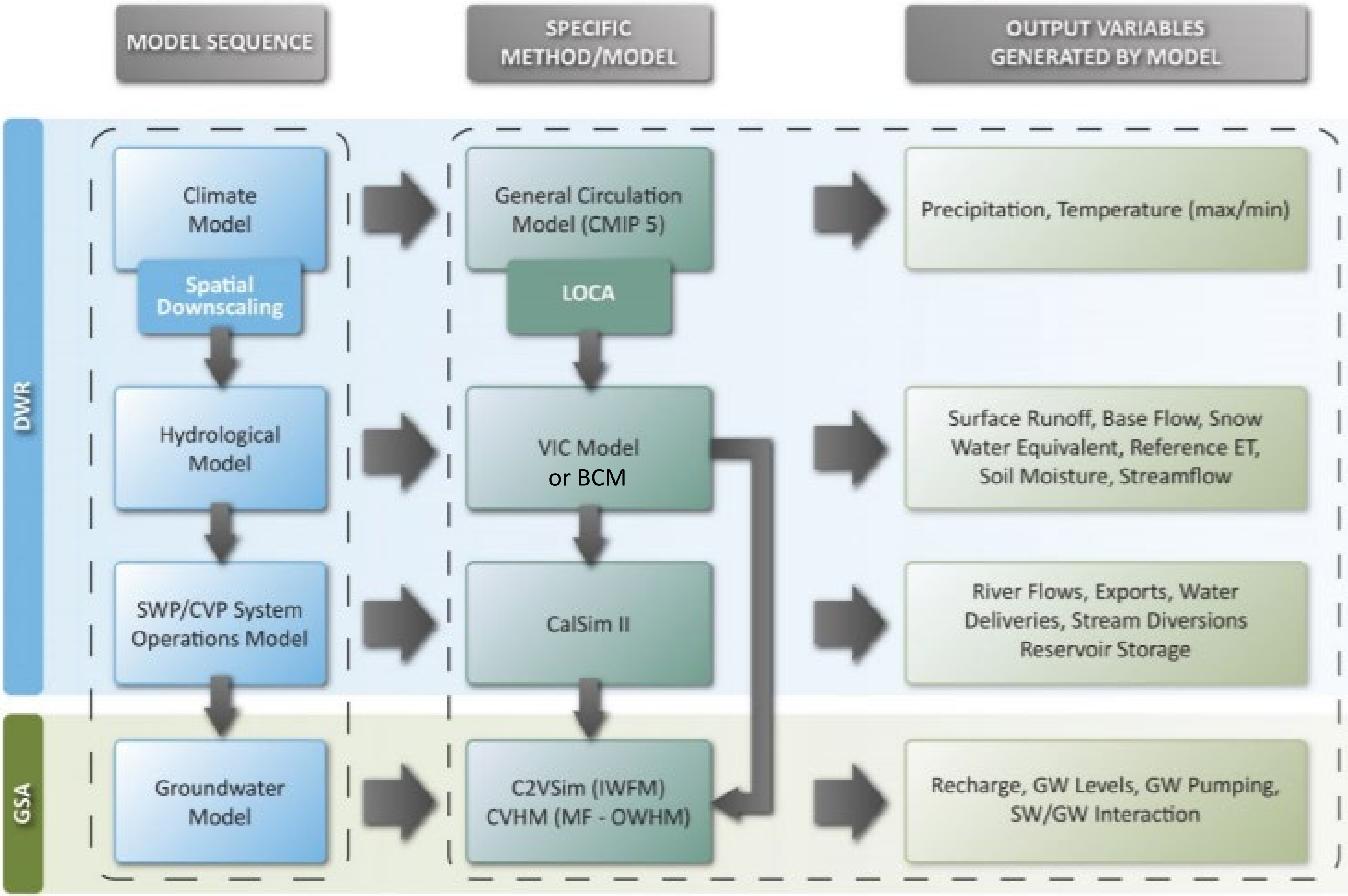
11 in/y average for valley

29% reduction
to 7.5 in/y average for valley

27% reduction
to 7.8 in/y average for valley

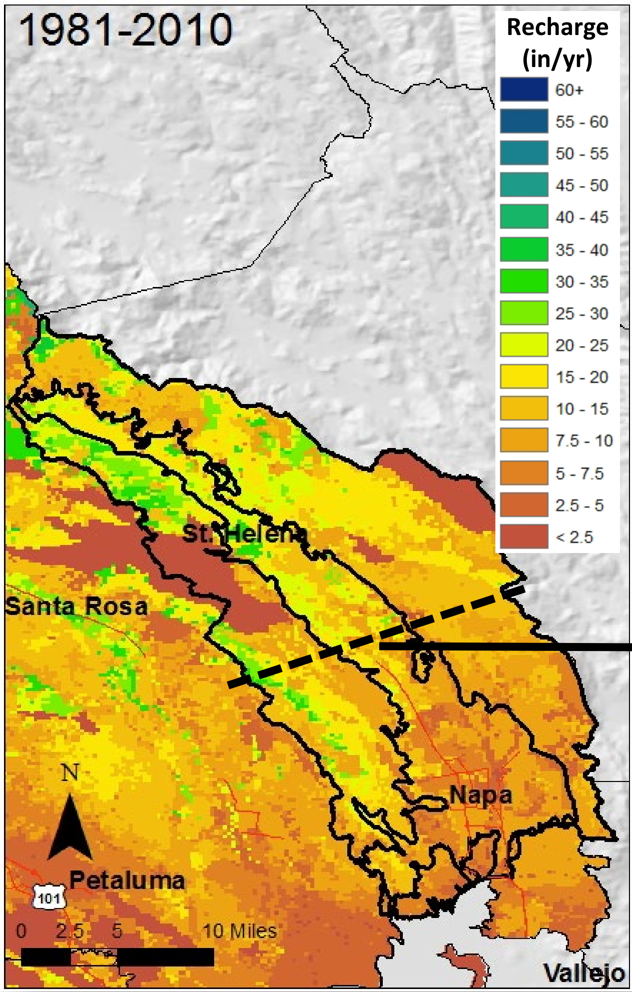
Low rainfall scenario results in losses of 2.5 inches of groundwater recharge per unit area annually

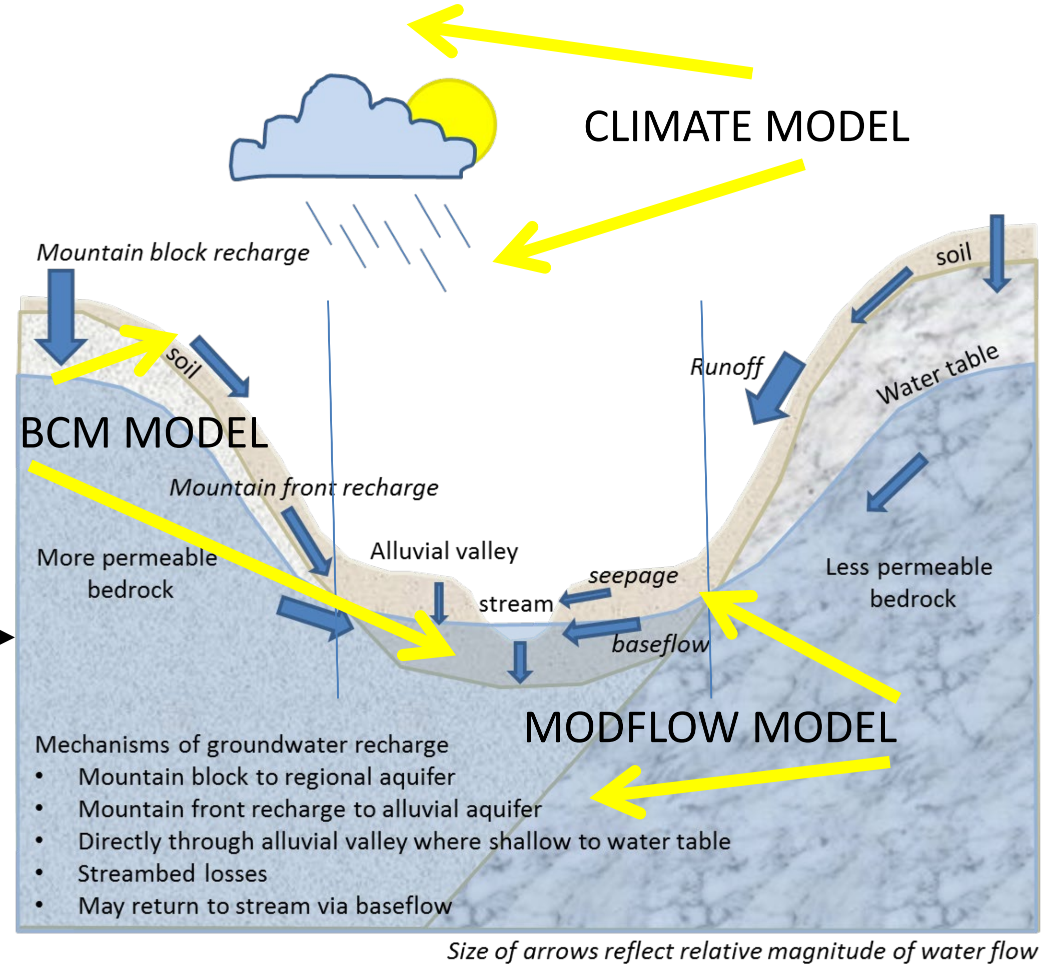
DWR Approach - Integrating Climate into GSP



DWR: Department of Water Resources; GSA: Groundwater Sustainability Agency; SWP: State Water Project; CVP: Central Valley Project; LOCA: Localized Constructed Analogs; VIC: Variable Infiltration Capacity; CalSim: SWP & CVP Operations Model; C2VSim: California Central Valley Groundwater - Surface Water Simulation Model; IWFM: Integrated Water Flow Model; CVHM: Central Valley Hydrologic Model; MF - OWHM: MODFLOW One Water Hydrologic Flow Model; ET: Evapotranspiration, SW: Surface Water; GW: Groundwater; CMIP 5: Coupled Model Intercomparison Project

Surface Recharge





Basin Characterization Model: "boundary conditions" for water inputs to aquifer

Other communities are using the BCM for SGMA applications

- Humboldt GSA
- Sonoma Water GSA
- Eagle-Anderson GSP OWHM
- Pajaro Valley OWHM model
- Anza Borrego Valley Modflow model
- Indian Wells Valley recharge
- Upper, middle and lower Santa Ynez GSP models
- Salinas Valley-Paso Robles OWHM
- Ventura River and Ojai GSPs
- Upper Coachella Valley
- USGS Coastal Basins project is developing BCMs for 123 basins draining to Pacific with an online interface to allow GSAs to download historical and future model data

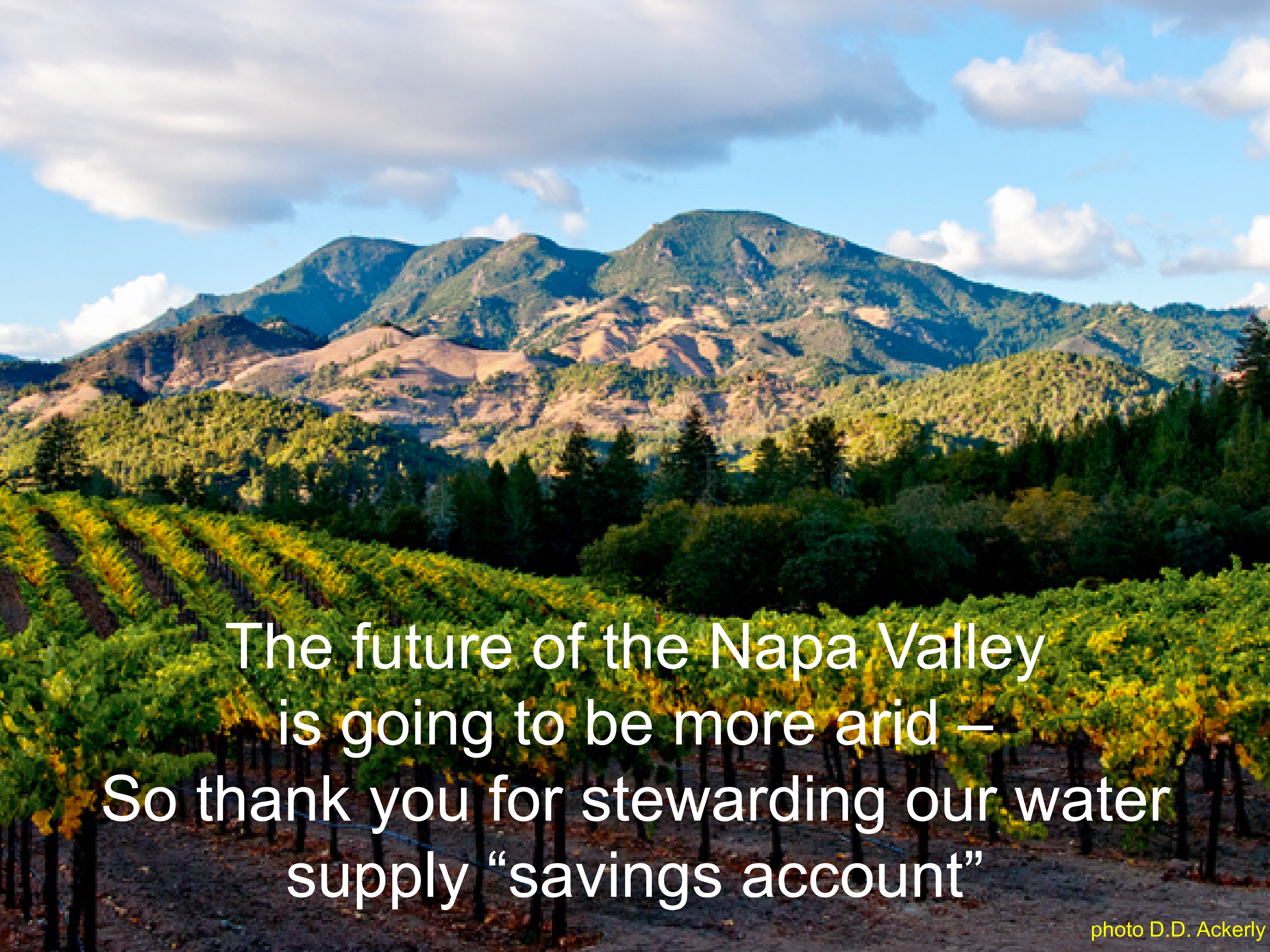


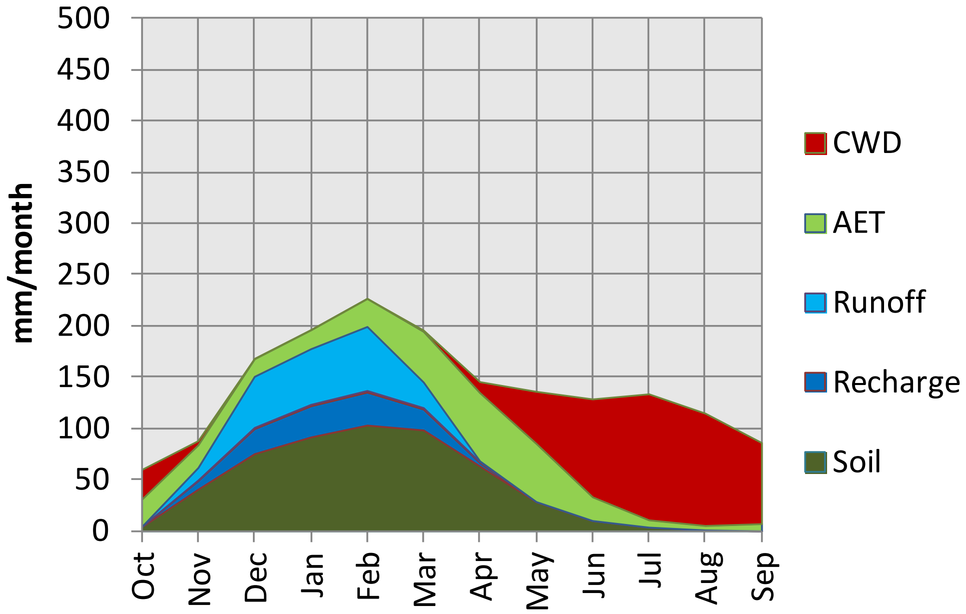
photo D.D. Ackerly

Extras

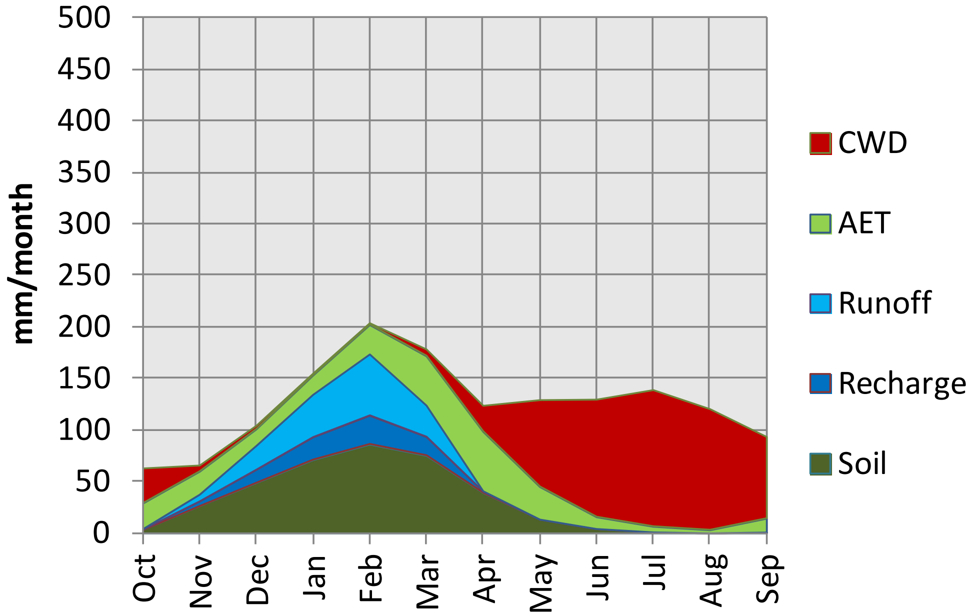
Updates to USGS BCM V 8

- To improve model performance, water balance components were addressed
  - Soil properties were refined to incorporate soil organic matter, increase AET to match regional estimates, and improve recharge and runoff estimates
  - Dry out function below wilting point to represent droughts
  - Spatially variable snow parameters for SWE improvements
  - Vegetation specific ET plus seasonality for 62 vegetation types
  - Vegetation specific root exploration depth
  - Streamflow losses and gains
  - Solar function to include radiation in snowmelt
- Model calibrations were done regionally to compare to measured data
  - Snowpack, evapotranspiration, reservoir inflows, Modflow recharge, baseflows from baseflow separation, streamflow
- To enable scenario testing switches/enhancements were incorporated to assess hydrologic outcomes due to
  - Changes in climate (complete set of LOCA models downscaled to 270 m, 1950-2099)
  - Changes in soil management
  - Changes in urbanization or other land uses
  - Changes in vegetation due to wildfire, forest management, or agriculture
  - Flooding for managed aquifer recharge
- Application of historical and future projections of climate, recharge and runoff boundary conditions to MODFLOW models

Seasonal Water Diagram 1980-2009



Seasonal Water Diagram 2070-2099



Seasonality of Water Cycle

1980-2009	**Annual Average**	
PPT	25.9	in
CWD	19.8	in
AET	13.0	in
Runoff	8.2	in
Recharge	4.8	in
Recharge/runoff	0.58	
Tmax	59.2	F
Tmin	41.7	F

2070-2099	**Annual Average**	
PPT	20.8	in
CWD	23.8	in
AET	11.1	in
Runoff	6.4	in
Recharge	3.4	in
Recharge/runoff	0.53	
Tmax	63.7	F
Tmin	45.5	F

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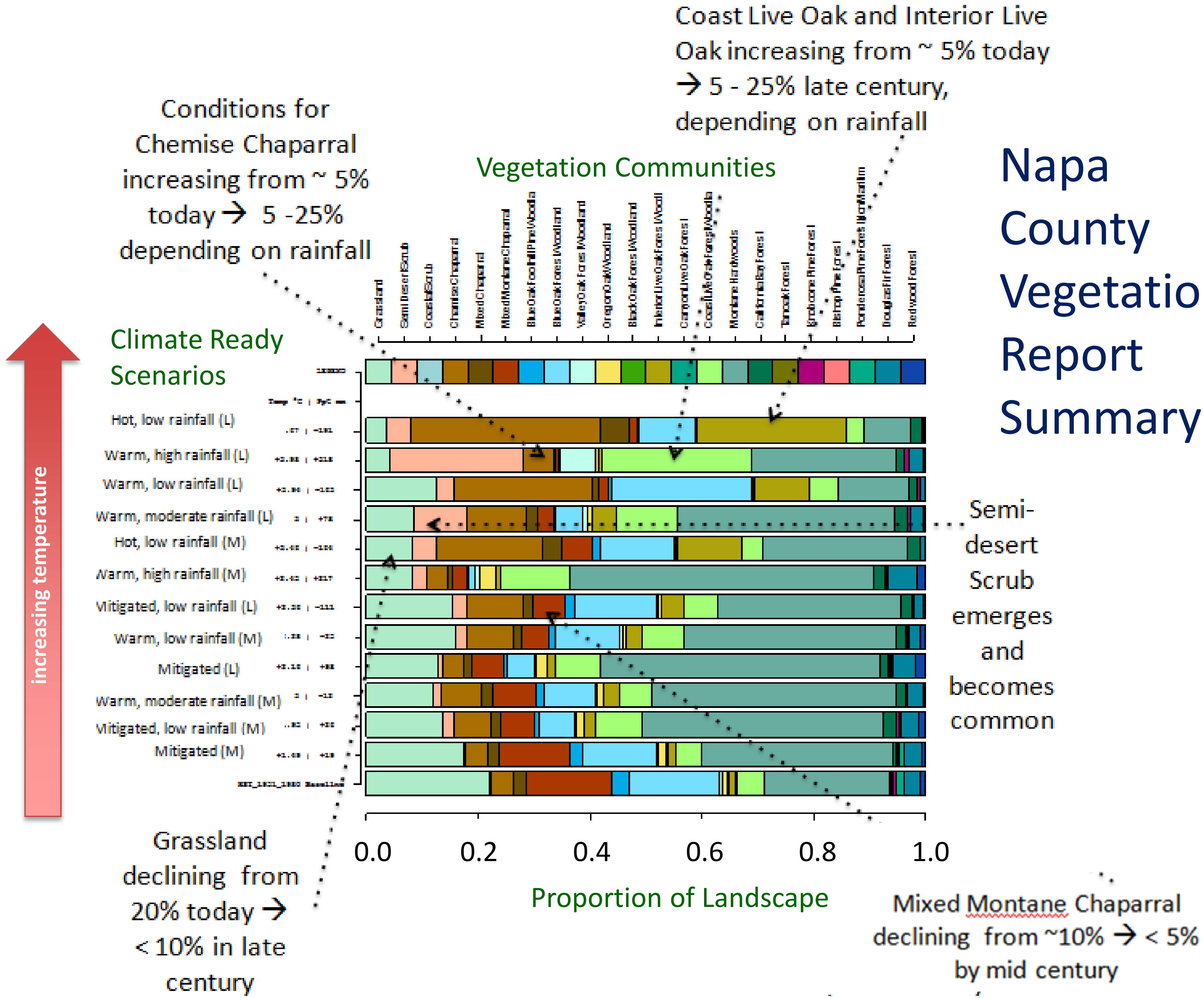
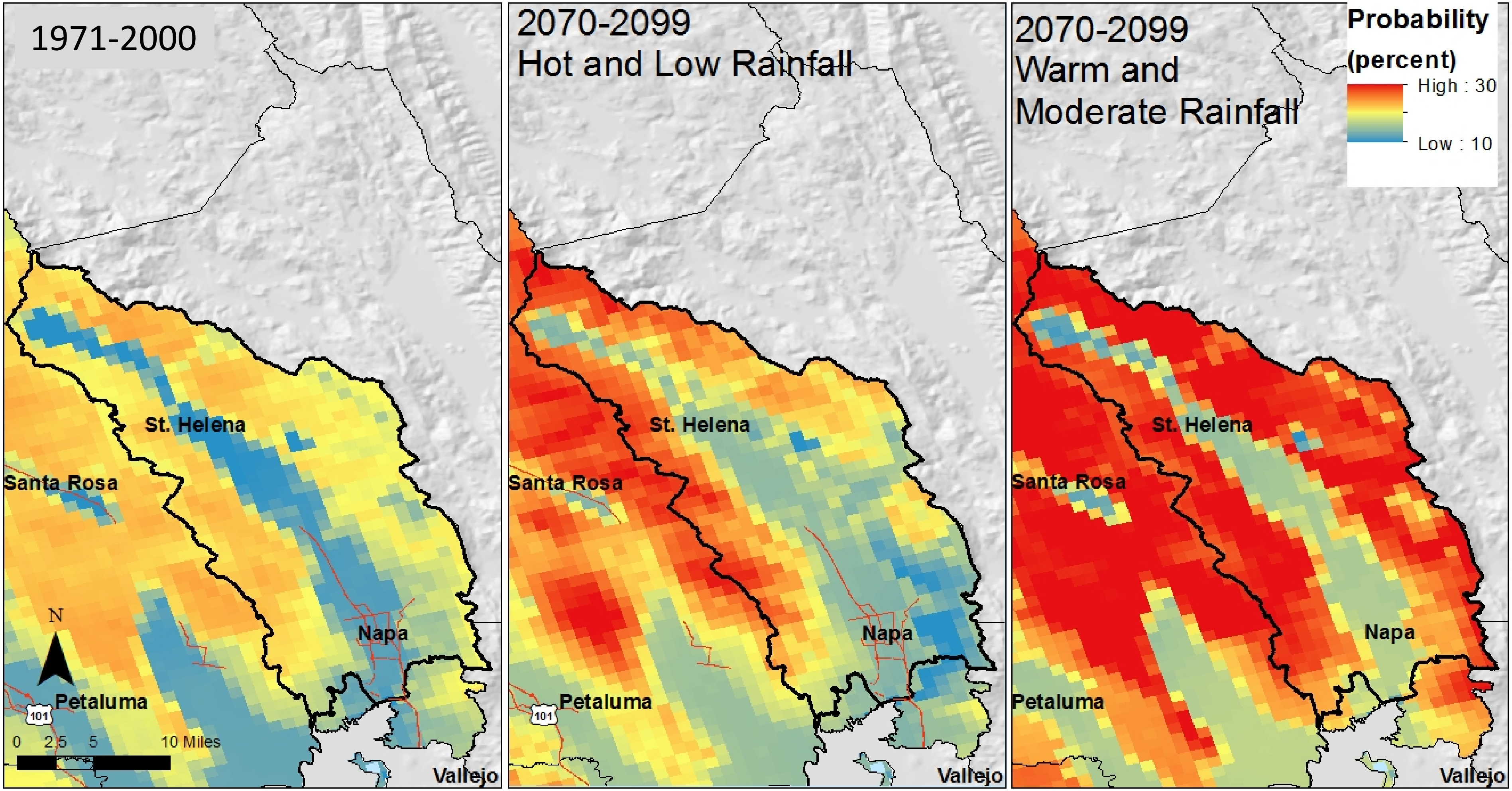
Napa County Vegetation Report Summary



Change in Projected Probability of Burning One or More Times



Probability of a fire in a 30y period doubles
in some locations

		Current	Hot, Low Rainfall	Moderate Rainfall
Variable	Units	1971-2000	2070-2099	2070-2099
Probability of burning 1	Percent	18%	19%	25%
or more times	SD	4%	5%	6%