Golden Gate Biosphere Network (GGBN) Climate Vulnerability Assessment

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Pepperwood

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Contents

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Overview and Methods

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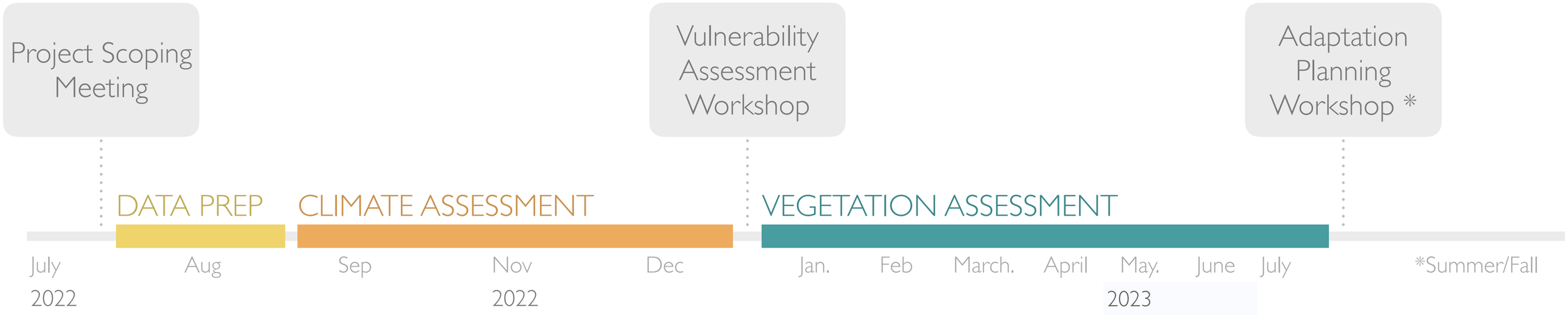
Project Overview



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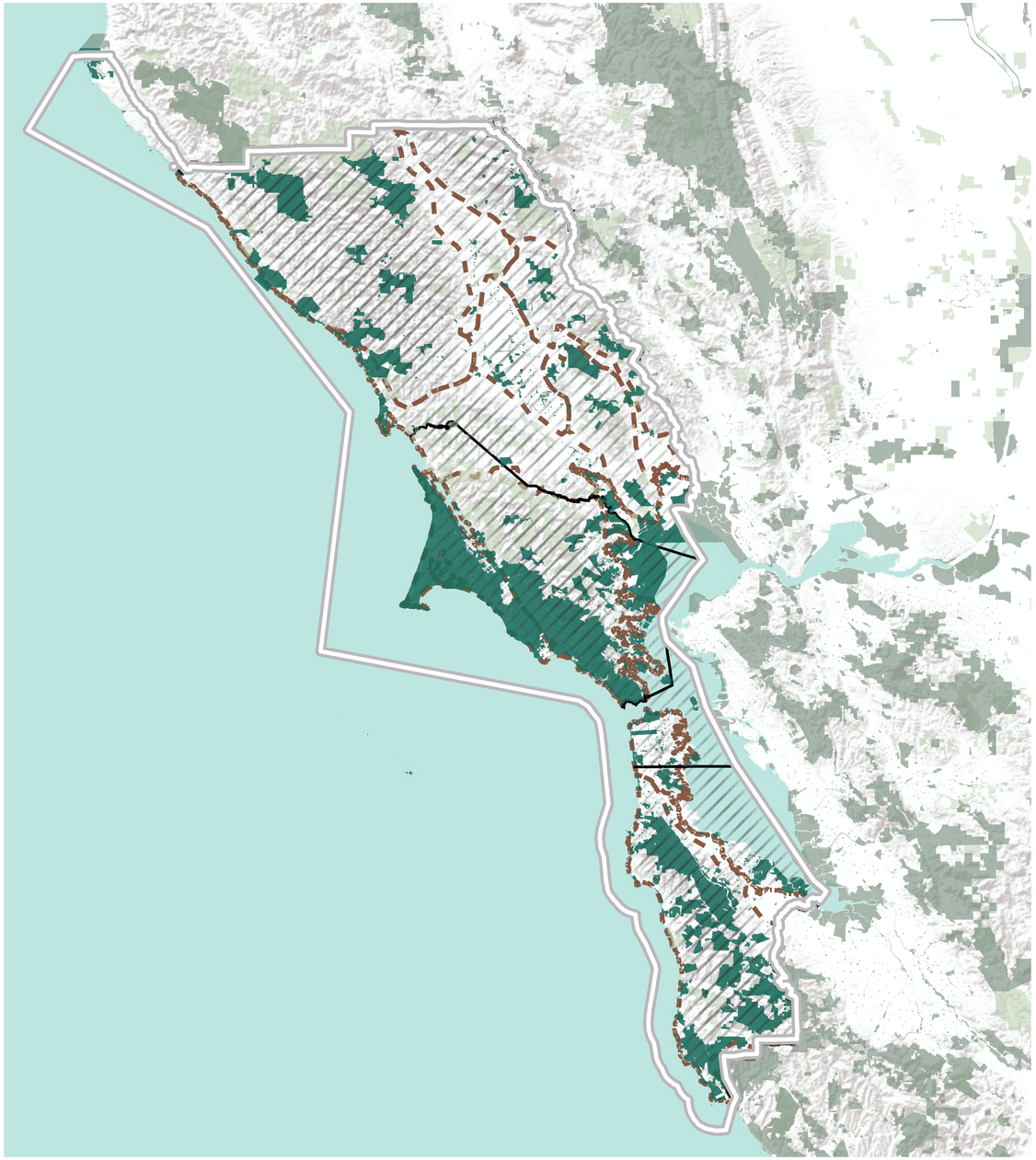
Methods | GEOGRAPHIC EXTENTS



Geographic Extent

- Golden Gate Biopshere Analysis Area
- Golden Gate Biosphere Land Unit Area

Protected Areas

- Golden Gate Biopshere Protected Areas
- Protected Areas
- Conservation Easement

Boundaries

- County Boundaries
- Landscape Unit

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We summarized climate data for the terrestrial area of GGBN (1) and Landscape Unit (14) boundaries

Landscape Units

Conservation Lands Network (CLN)

Landscape Units are geographic divisions based on physiographic* features, and inform the vegetation vulnerability model.

*Factors, excluding climatic-biotic, and edaphic conditions, affecting Prevailing habitat conditions and biotic distributions (e.g. topography, Drainage, erosion)

1 - Northern Mayacamas Mountains
2 -Russian River Valley
3 - Sonoma Coast Range
6 - Southern Mayacamas Mountains
7 - Santa Rosa Plain
10 - Sonoma Valley
11 - Sonoma Mountain
12 - Coastal Grasslands
16 - Marin Coast Range
17 - Point Reyes
22 - San Francisco Bay and Badlands
25 - San Francisco
30 - Santa Cruz Mountains North
33 - Santa Cruz Mountains Mid

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We evaluated **8 climate variables**

VARIABLE	METRIC	ABBREV.
Air temperature	Temperature ANNUAL MEAN	Temp AVG
	Summer Maximum Temperature MEAN FOR JUN, JUL, AUG	Tmax JJA
	Winter Minimum Temperature MEAN FOR DEC, JAN, FEB	Tmin DJF
Hydrology	Precipitation ANNUAL MENA	PPT AVG
	Winter Maximum Precipitation MEAN FOR DEC, JAN, FEB	PPT Max
	Winter Minimum Precipitation MEAN FOR JUN, JUL, AUG	PPT Min
	Water Supply Indicator RUNOFF + RECHARGE	WSI
	Climatic Water Deficit	CWD

3 Temperature metrics

5 Hydrologic metrics

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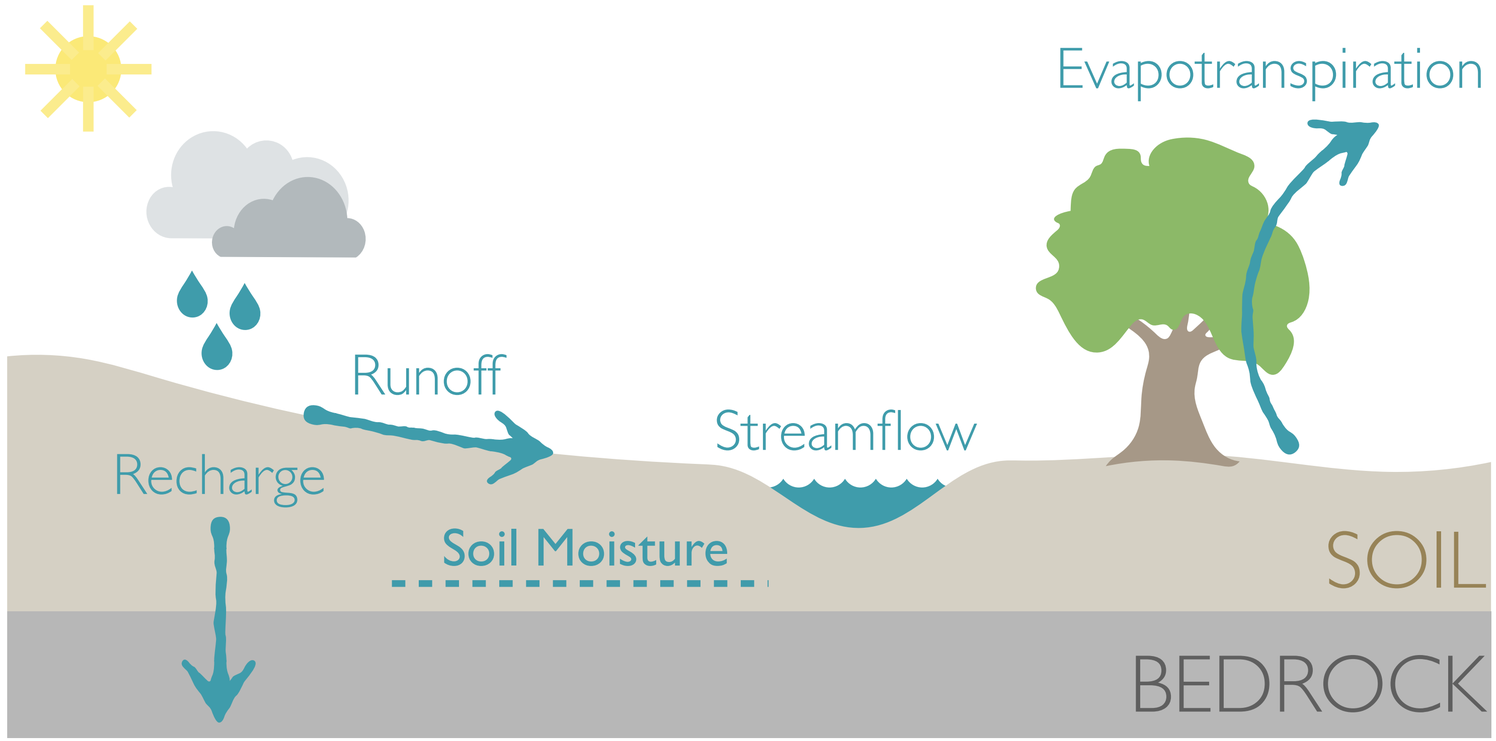
Basin Characterization Model (BCM)

Translating climate to watershed response

V8 +Vegetation

BCM INPUT

- Temperature
- Solar Radiation
- Precipitation
- Topography
- Soils
- Geology



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Each climate variable was assessed for **4 climate scenarios**

	SCENARIO		PROJECTION TEMP.	PROJECTION PRECIP.	TIME PERIOD
1	RECENT				**Recent** 1981 - 2010
2	CNRM-CM5	RCP 8.5			**Late-Century** 2070 - 2099
3	CCSM4	RCP 8.5			
4	HadGEM2-CC	RCP 8.5			

We evaluated each climate variable at **two time periods:**

1. Recent (1981 - 2010)
2. Late-century (2070 - 2099)

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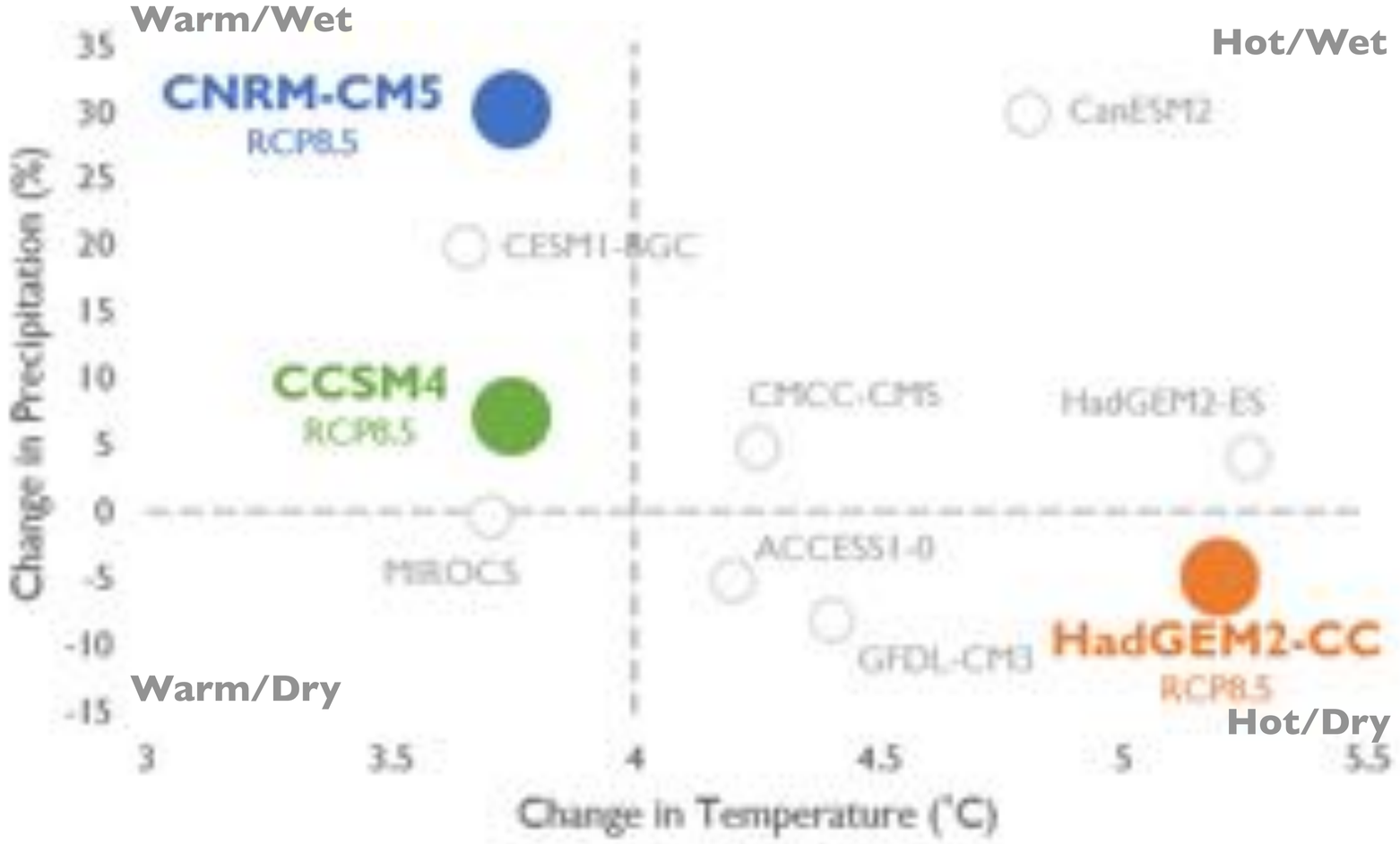
Late-*century values* were calculated for **3 climate projections** that span a range of temperature and precipitation conditions

Statewide Model Comparison



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We evaluated 4 time slices and mapped 1

VARIABLE	METRIC		RECENT	CNRM-CM5 RCP8.5	CCSM4 RCP .5	HADGEM2-CC RCP8.5
Air temperature	Temperature ANNUAL MEAN	AVG	1981-2010	2070-2099	2070-2099	2070-2099
	Summer maximum temperature MEAN FOR JUN, JUL, AUG	JJA				
	Winter minimum temperature MEAN FOR DEC, JAN, FEB	DJF				
Hydrology	Precipitation ANNUAL MEAN	AVG				
	Summer maximum precipitation MEAN FOR JUN, JUL, AUG	JJA				
	Winter minimum precipitation MEAN FOR DEC, JAN, FEB	DJF				
	Climatic Water Deficit ANNUAL MEAN	AVG				
	Water Supply Indicator RUNOFF + RECHARGE	AVG				

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Temperature

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Temperature | SUMMARY

Mean Temperature (°C)	Average (AVG)			Winter Minimum (DJF)			Summer Maximum (JJA)		
	CNRM-CM5	CCSM4	HadGEM2-CC	CNRM-CM5	CCSM4	HadGEM2-CC	CNRM-CM5	CCSM4	HadGEM2-CC
Recent	14.3			4.9			26.0		
Late-Century	16.6	16.6	17.7	5.4	7.1	7.1	29.0	28.6	30.2
Change	2.2	2.2	3.6	0.6	2.2	2.2	2.6	2.2	3.8
Range of Change	+2.2 °C to +3.6 °C			+0.6 °C to +2.2 °C			+2.3 °C to +3.8°C		

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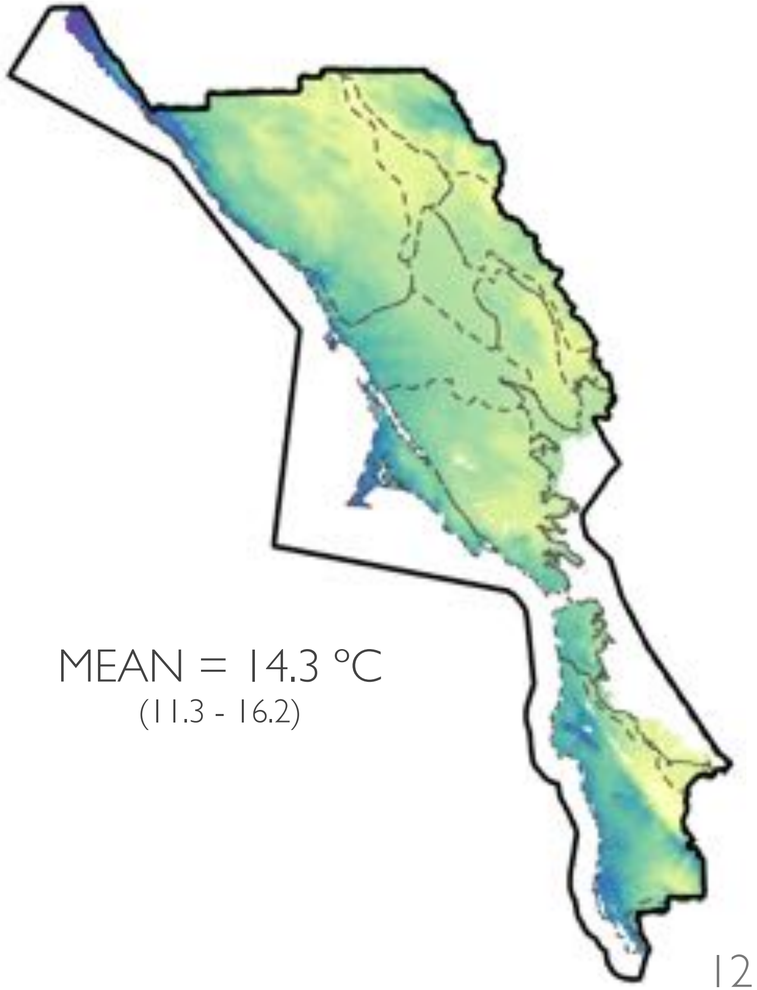
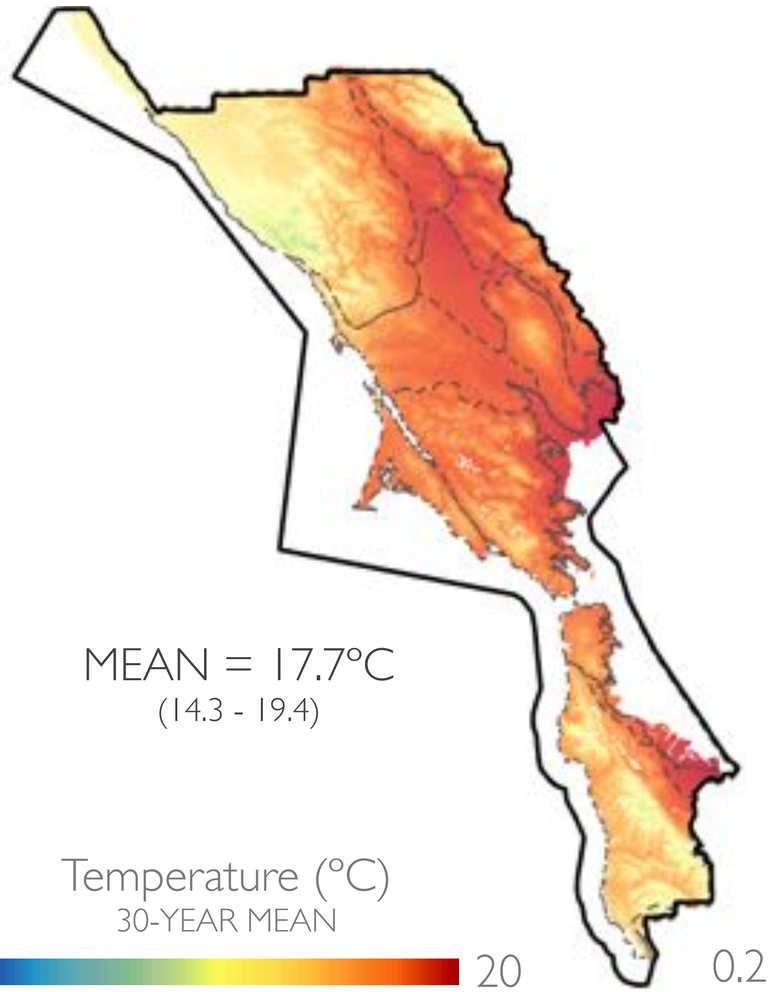
Temperature | ANNUAL AVERAGE

Recent (1981-2010)



MEAN = 14.3 °C
(11.3 - 16.2)

Late-Century (HadGEM2-CC)

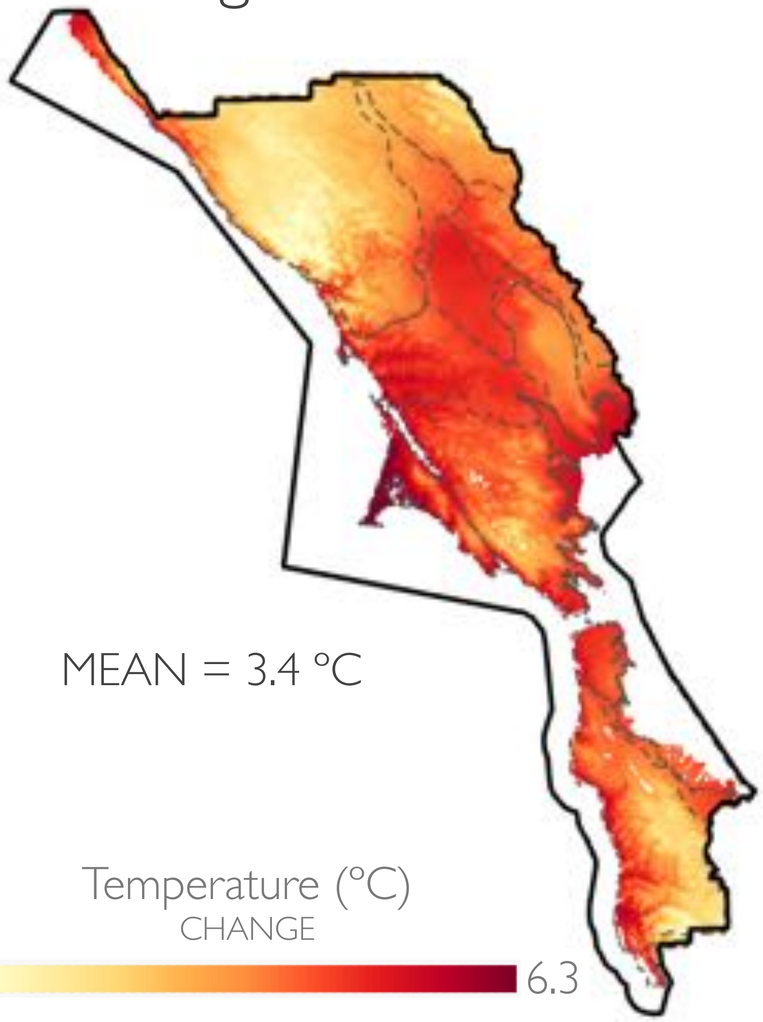


MEAN = 17.7°C
(14.3 - 19.4)

Temperature (°C)
30-YEAR MEAN

12 — 20

Change from Recent



MEAN = 3.4 °C

Temperature (°C)
CHANGE

0.2 — 6.3

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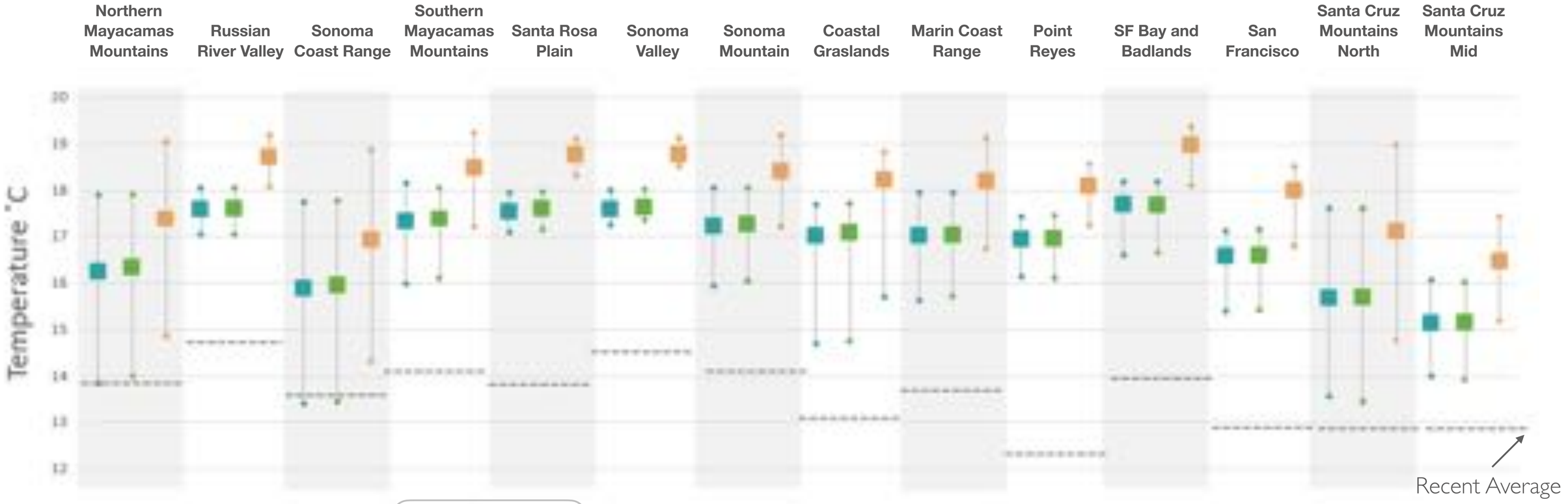
Data Source: Flint & Flint 2021

+2.6 °C
average increase

Consistent increase in average temperature



Future (2070-2099)

CNRM-CM5
CCSM4
HadGEM2-CC

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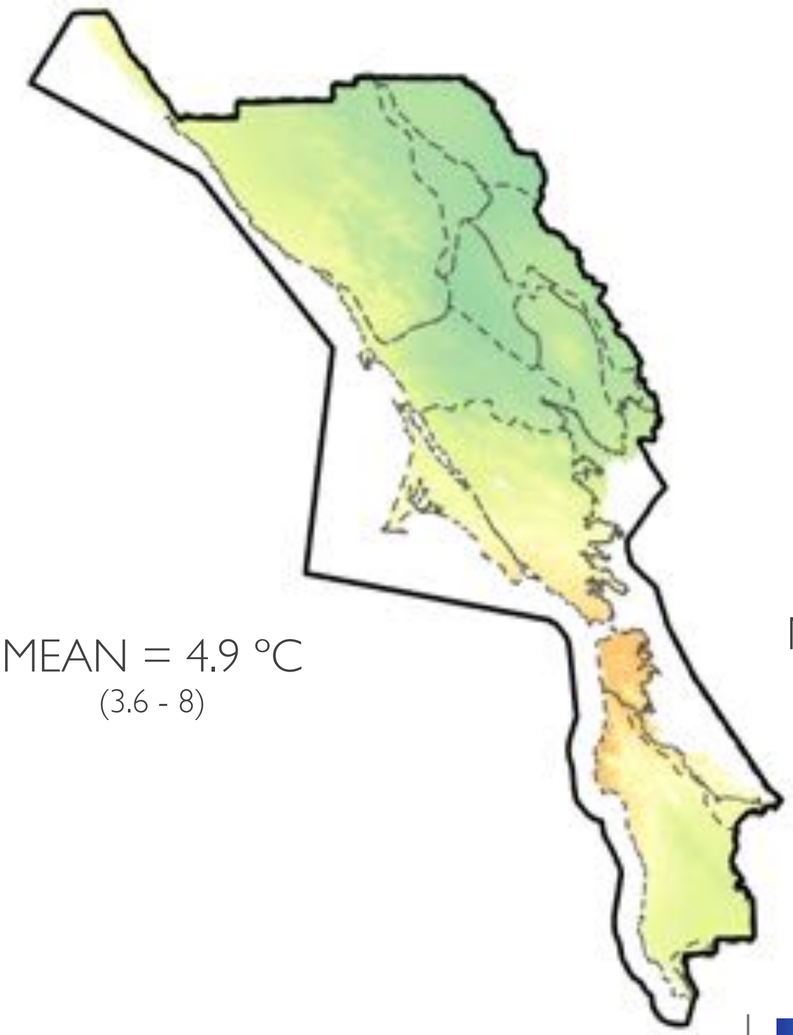
Data Source: Flint & Flint 2021

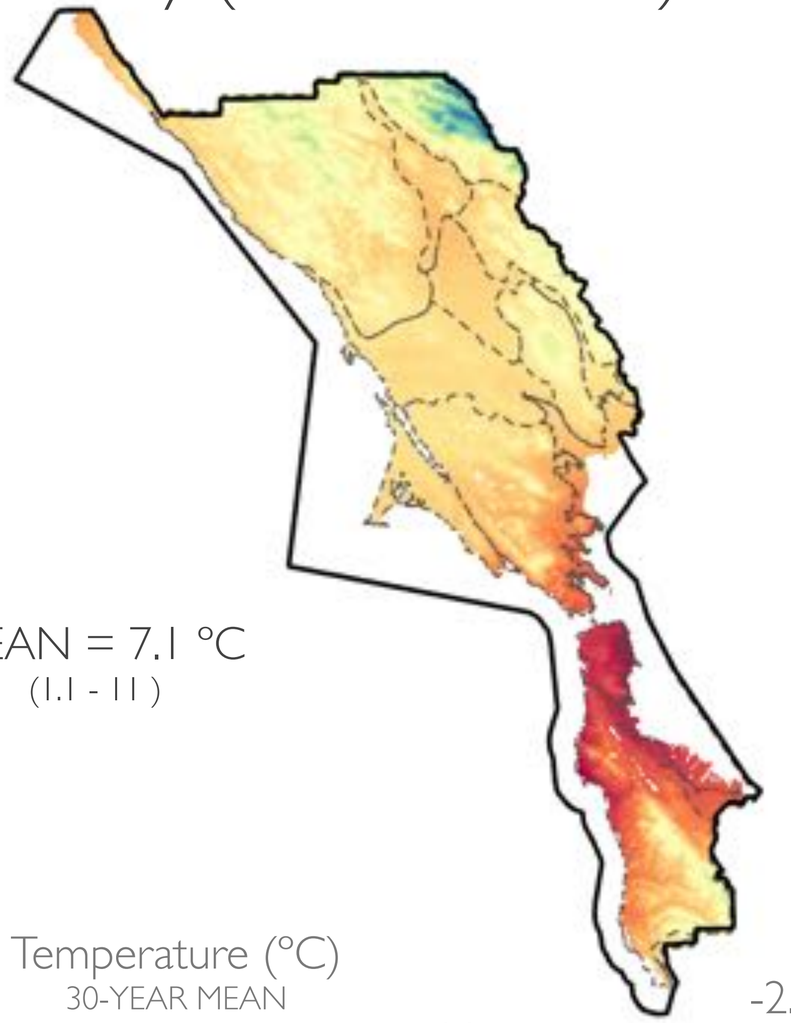
Temperature | WINTER MINIMUM

Recent (1981-2010)



MEAN = 4.9 °C
(3.6 - 8)

Late-Century (HadGEM2-CC)

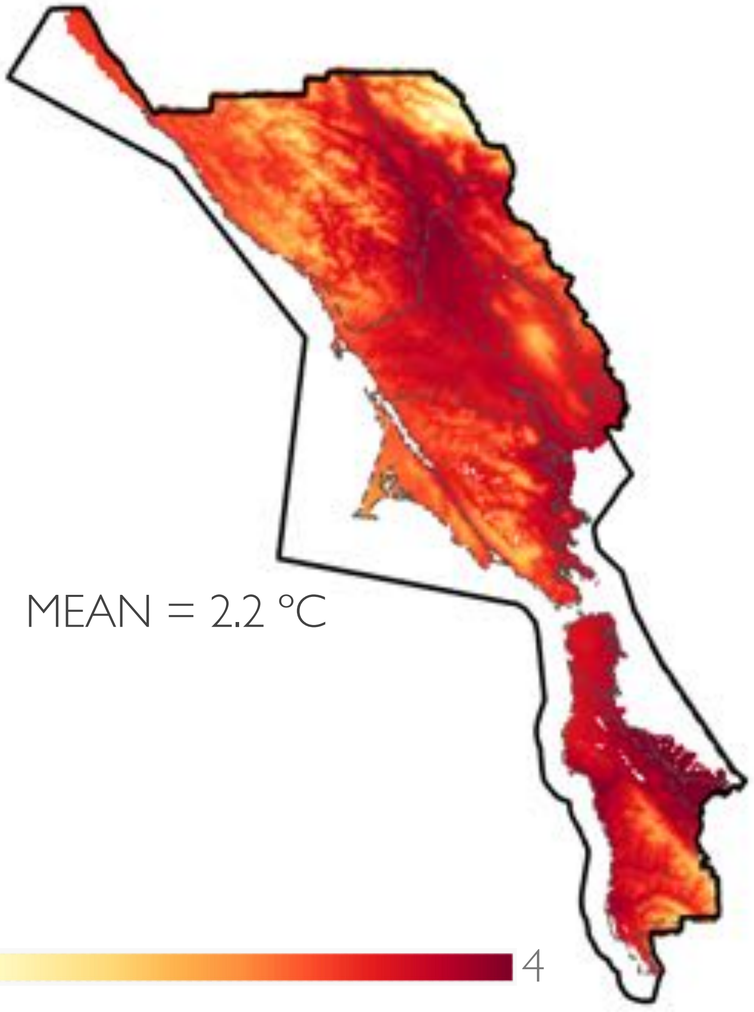


MEAN = 7.1 °C
(1.1 - 11)

Temperature (°C)
30-YEAR MEAN

1 11

Change from Recent



MEAN = 2.2 °C

-2.8 4

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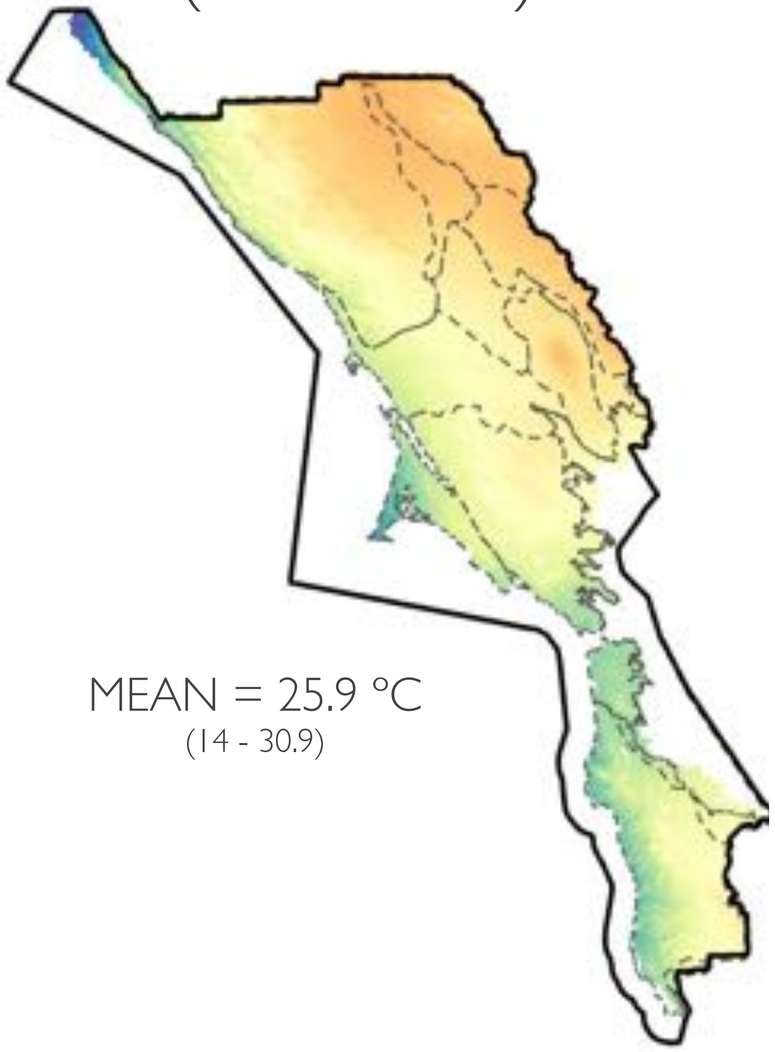
Data Source: Flint & Flint 2021

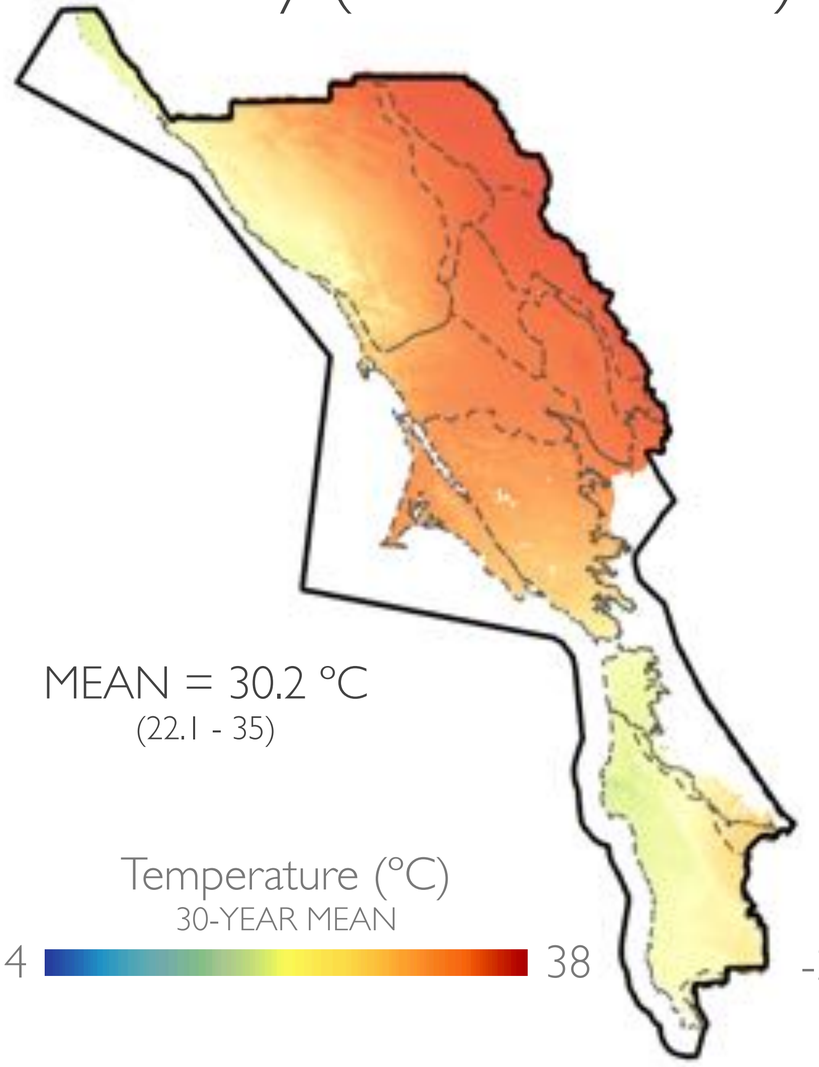
Temperature | SUMMER MAXIMUM

Recent (1981-2010)



MEAN = 25.9 °C
(14 - 30.9)

Late-Century. (HadGEM2-CC)

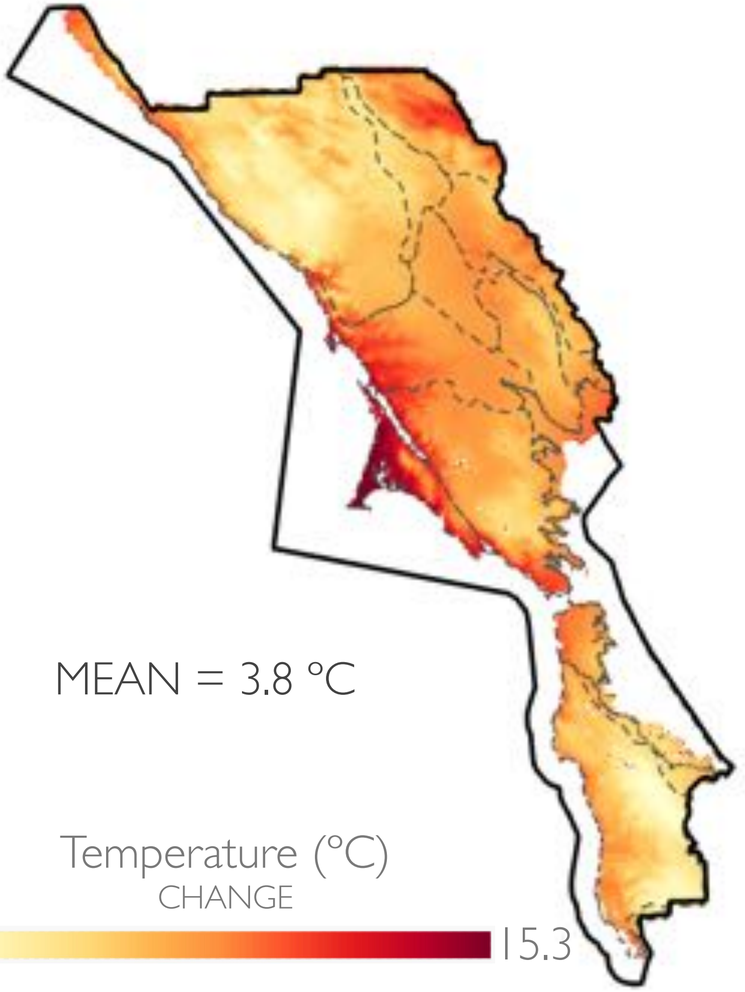


MEAN = 30.2 °C
(22.1 - 35)

Temperature (°C)
30-YEAR MEAN

14 — 38

Change from Recent



MEAN = 3.8 °C

Temperature (°C)
CHANGE

-3 — 15.3

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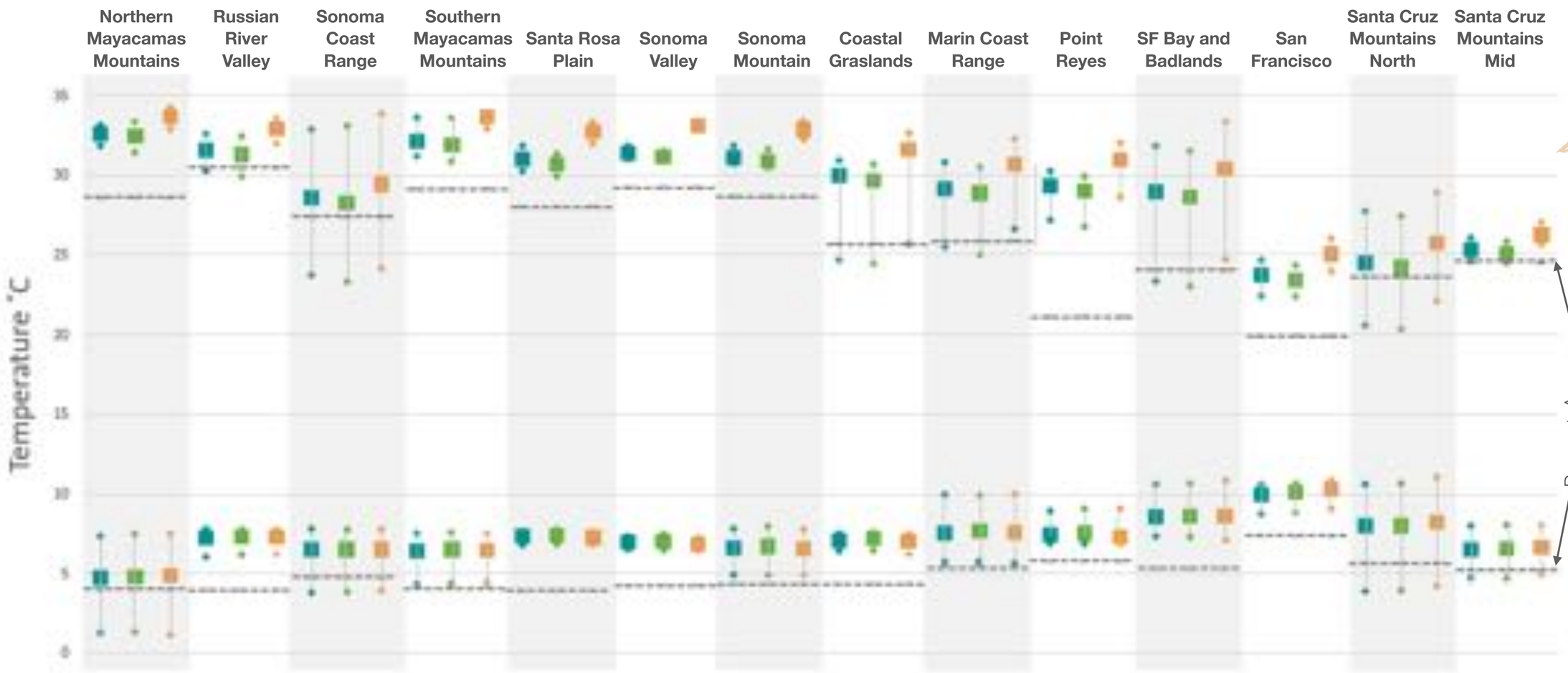
Data Source: Flint & Flint 2021

Temperature | SEASONAL (WINTER & SUMMER)



+2.9 °C
average summer increase from recent

+1.7 °C
average winter increase from recent

Future (2070-2099)

CNRM-CM5
CCSM4
HadGEM2-CC

Data Source: Flint & Flint 2021

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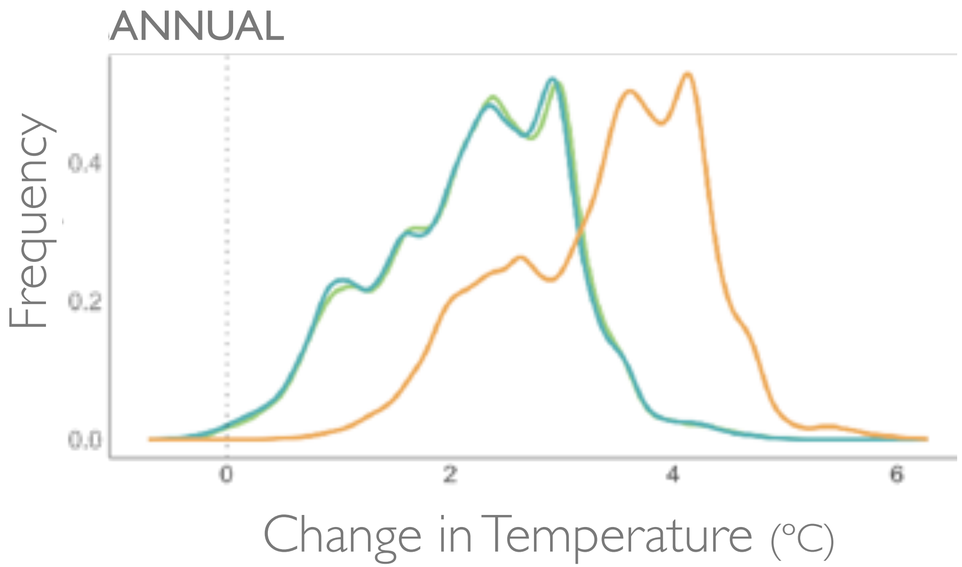
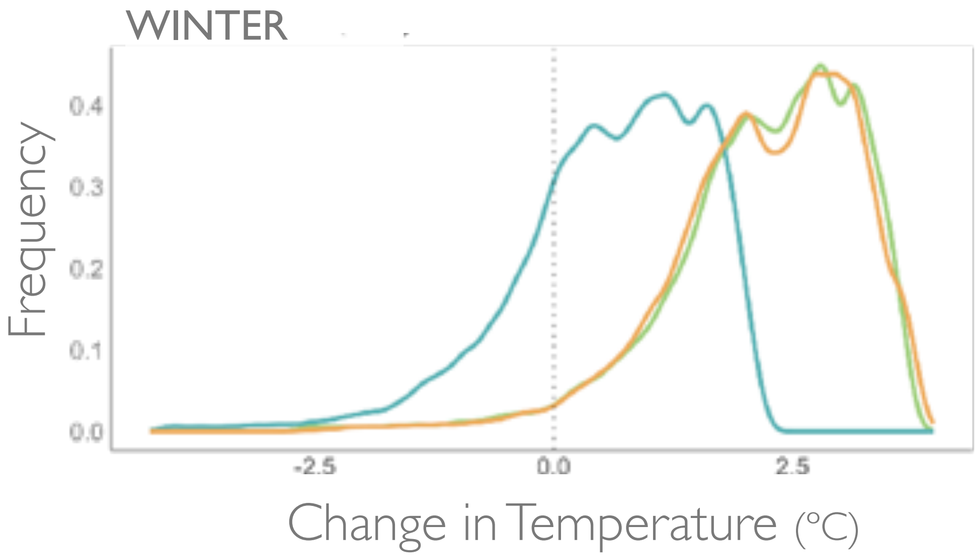
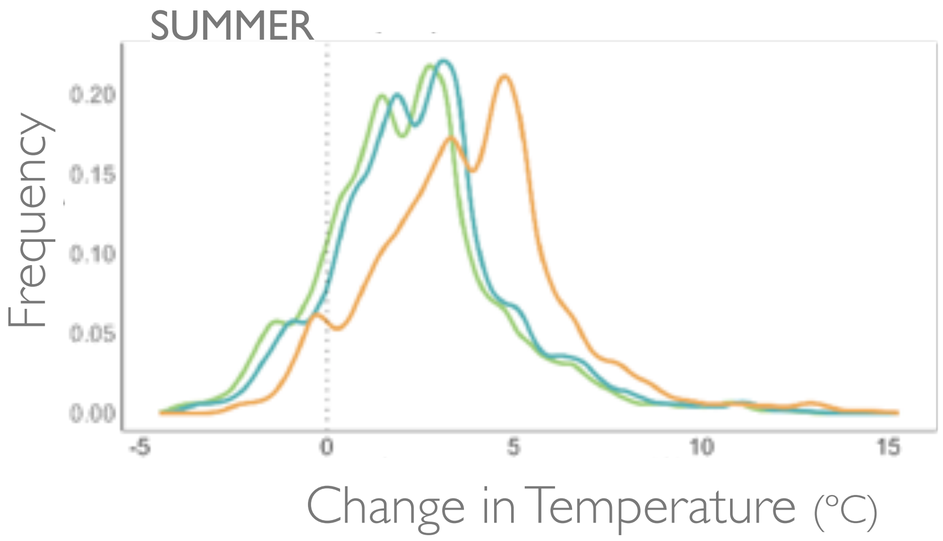
The trend for all models was an **increase** in temperature by late-century







CNRM-CM5

CCSM4

HadGEM2-CC

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Precipitation

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Precipitation | SUMMARY

Mean Precipitation (mm)	Average (AVG)			Winter Minimum (DJF)			Summer Maximum (JJA)		
	CNRM-CM5	CCSM4	HadGEM2-CC	CNRM-CM5	CCSM4	HadGEM2-CC	CNRM-CM5	CCSM4	HadGEM2-CC
Recent	1027			591			3		
Late-Century	1423	1212	1116	957	815	716	21	11	14
Change	+397	+186	+90	+365	+223	+124	+18	+7	+11
Range of Change	+90mm to +397mm			+124mm to +365 °C			+7mm to +11mm		

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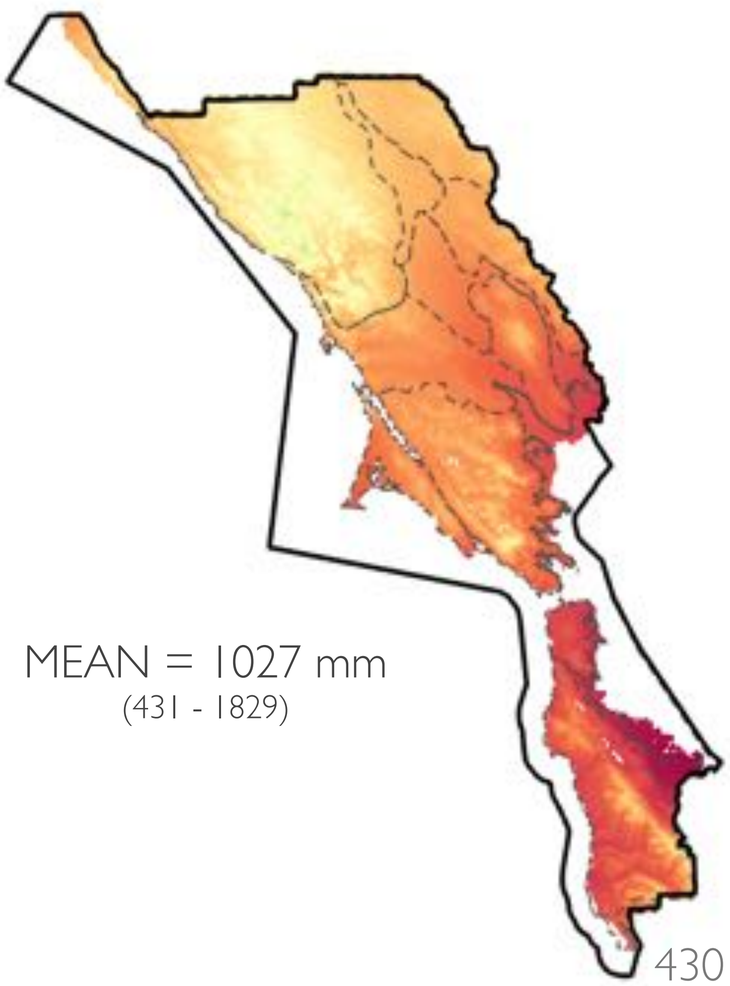
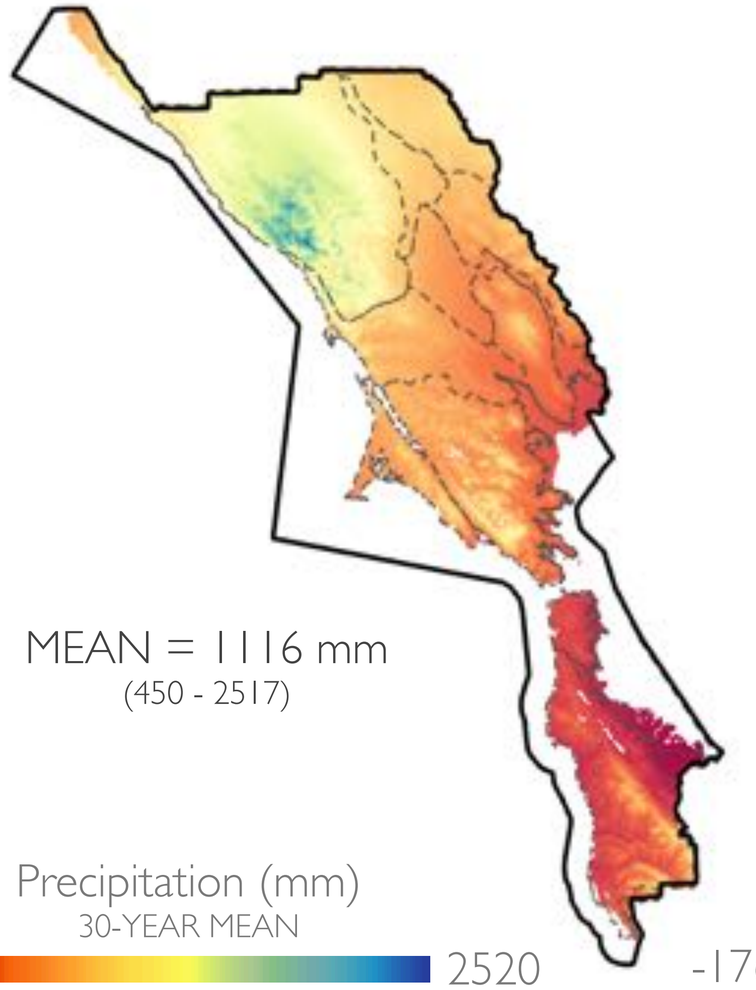
Hydrology | ANNUAL PRECIPITATION

Recent (1981-2010)



MEAN = 1027 mm
(431 - 1829)

Late-Century (HadGEM2-CC)

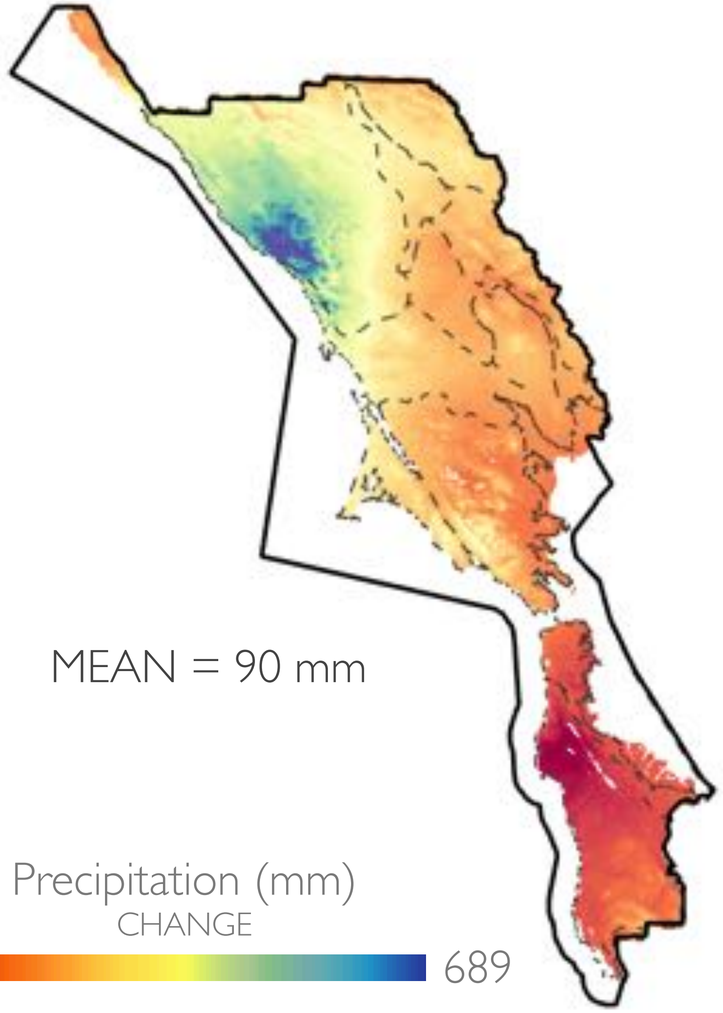


MEAN = 1116 mm
(450 - 2517)

Precipitation (mm)
30-YEAR MEAN

430 — 2520

Change from Recent



MEAN = 90 mm

Precipitation (mm)
CHANGE

-176 — 689

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Data Source: Flint & Flint 2014

Climatic Water Deficit

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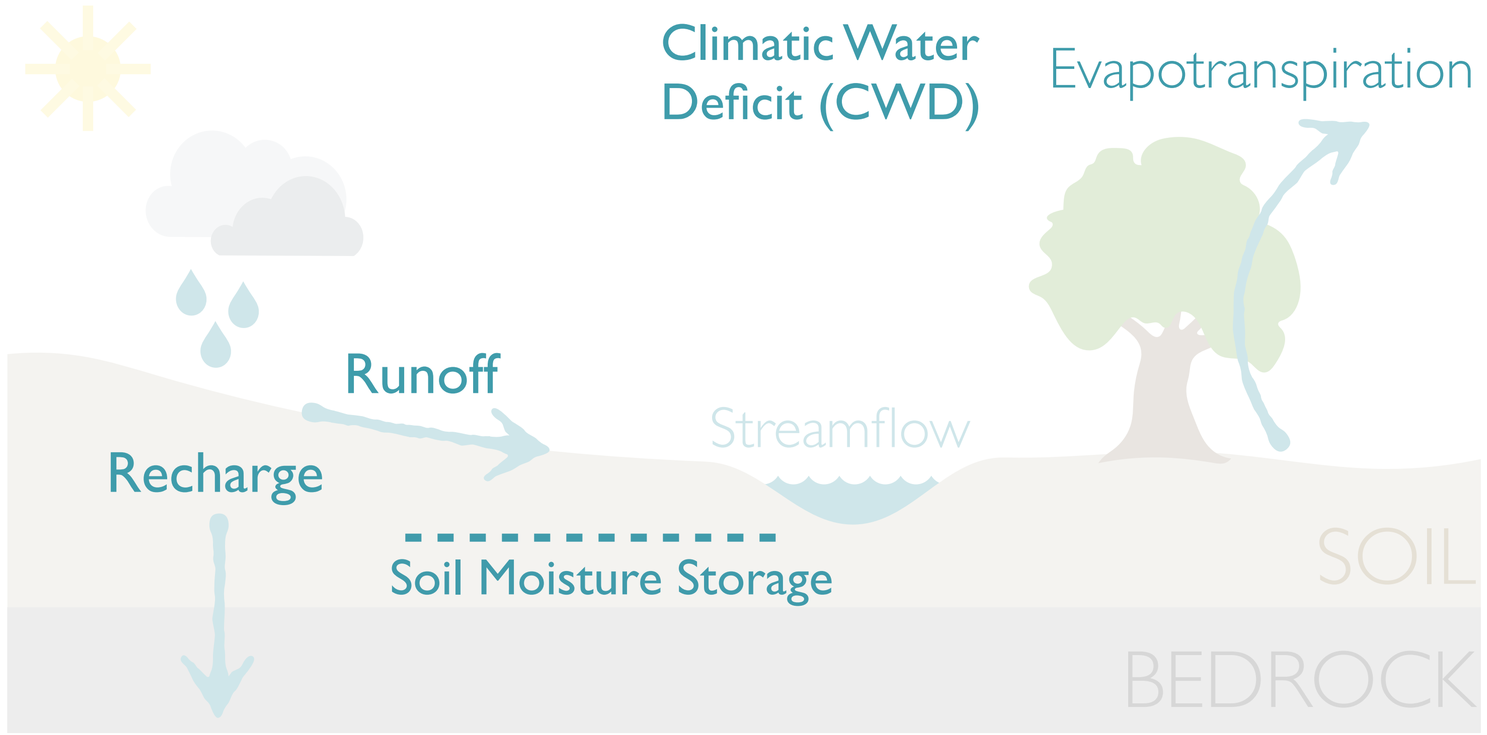
Basin Characterization Model (BCM)

Translating climate to watershed response

BCM INPUT

- V8 +Vegetation
- Temperature
- Solar Radiation
- Precipitation
- Topography
- Soils
- Geology



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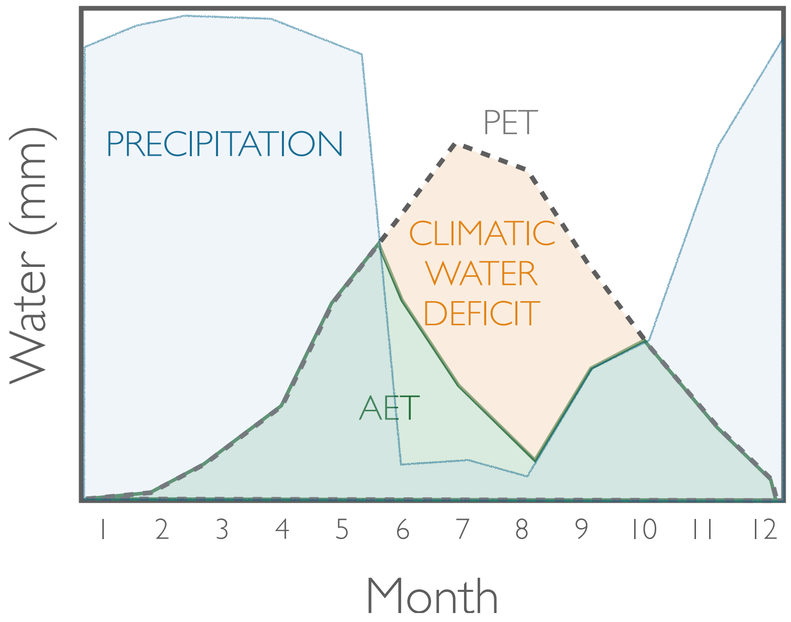
Climatic Water Deficit (CWD)
A METRIC OF DROUGHT STRESS

Climatic Water Deficit = Potential Evapotranspiration − Actual Evapotranspiration



This metric integrates the effects of temperature and rainfall

CWD correlated with both vegetation vulnerability and fire risk

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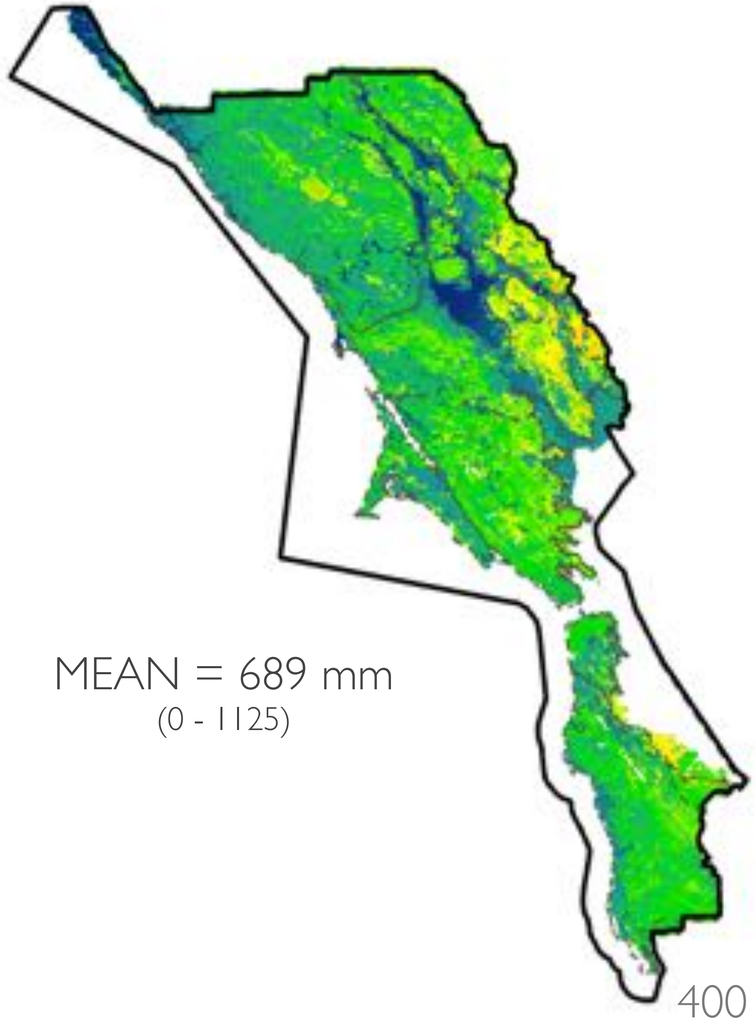
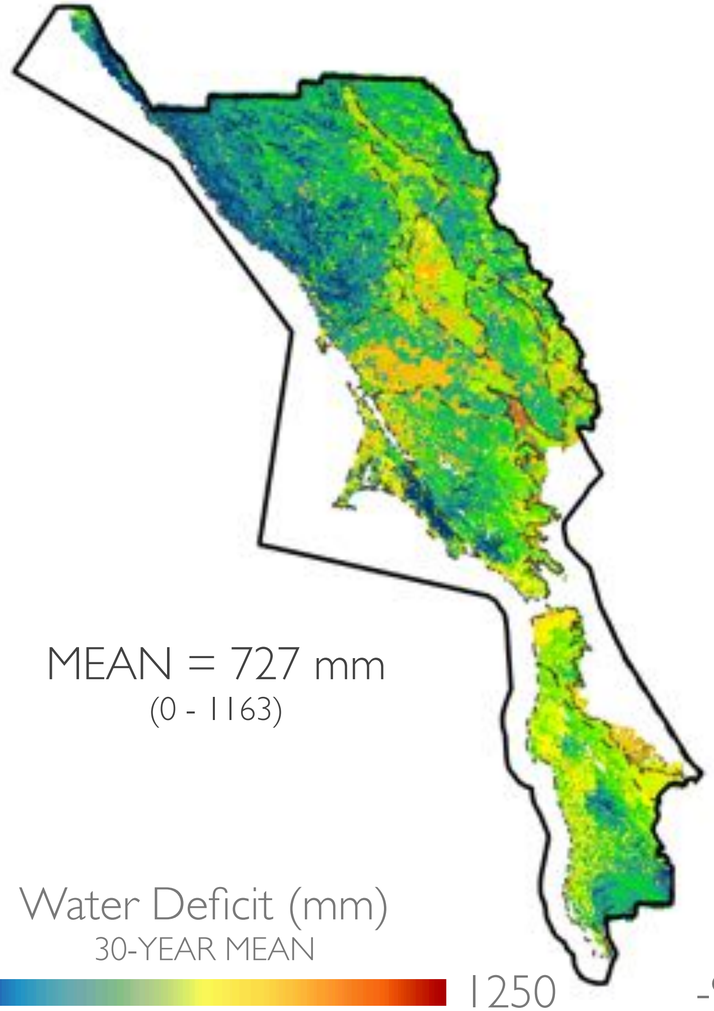
Hydrology | CLIMATIC WATER DEFICIT

Recent (1981-2010)



MEAN = 689 mm
(0 - 1125)

Late-Century (HadGEM2-CC)

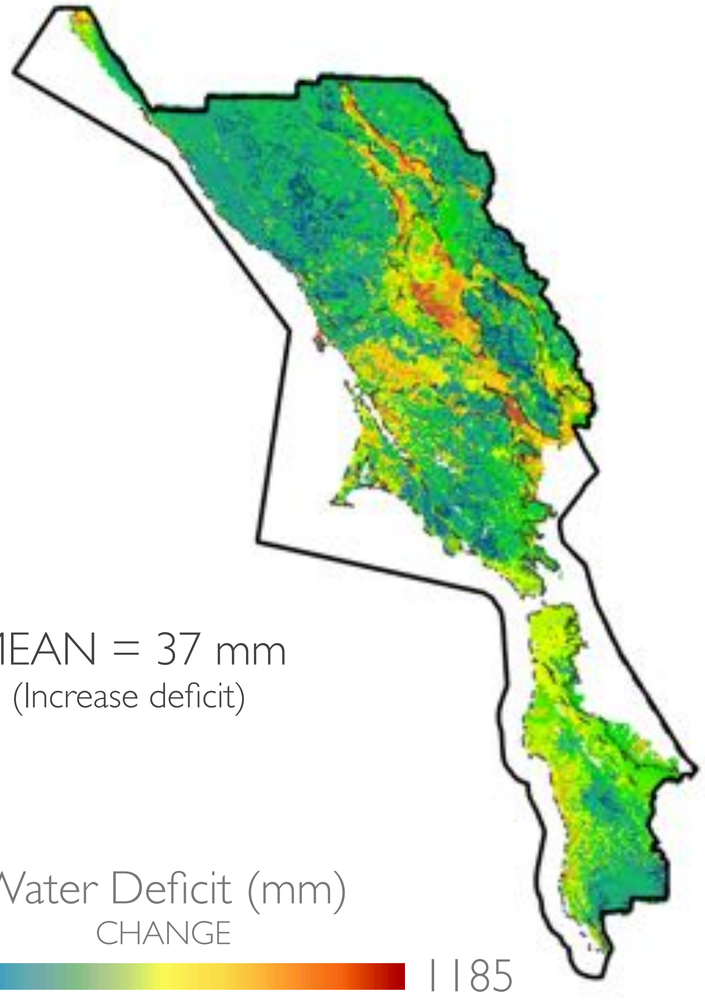


MEAN = 727 mm
(0 - 1163)

Water Deficit (mm)
30-YEAR MEAN

400 — 1250

Change from Recent



MEAN = 37 mm
(Increase deficit)

Water Deficit (mm)
CHANGE

-959 — 1185

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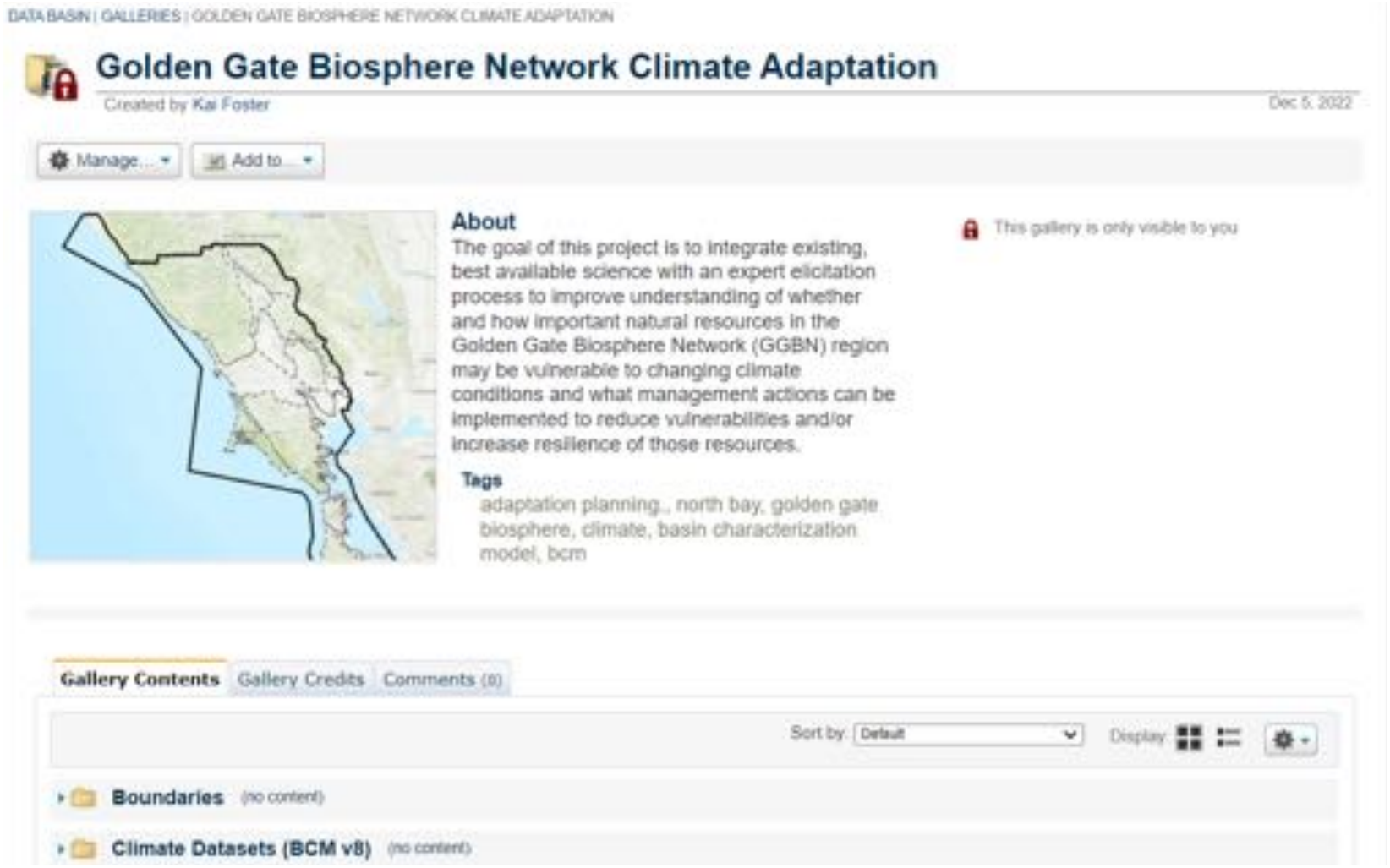
Data Source: Flint & Flint 2021

DATA BASIN | databasin.org



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Next Steps

Vegetation Vulnerability Assessment

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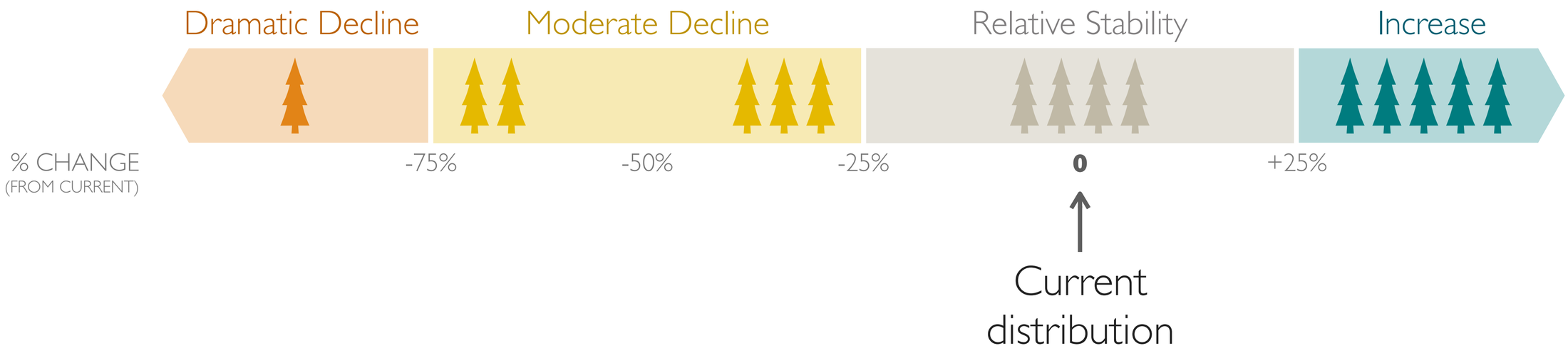
How are vegetation types expected to shift in response to climate change?



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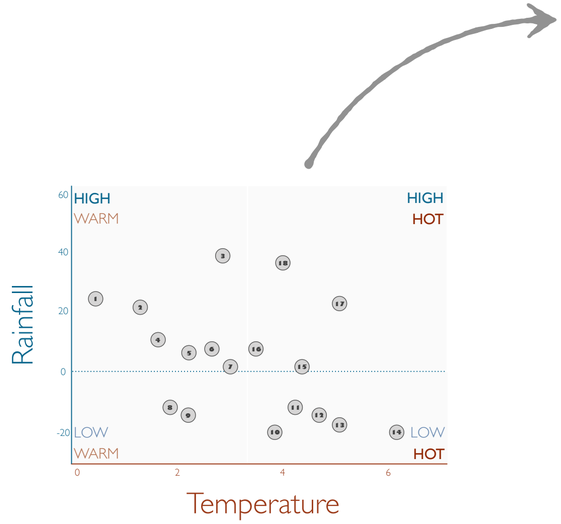
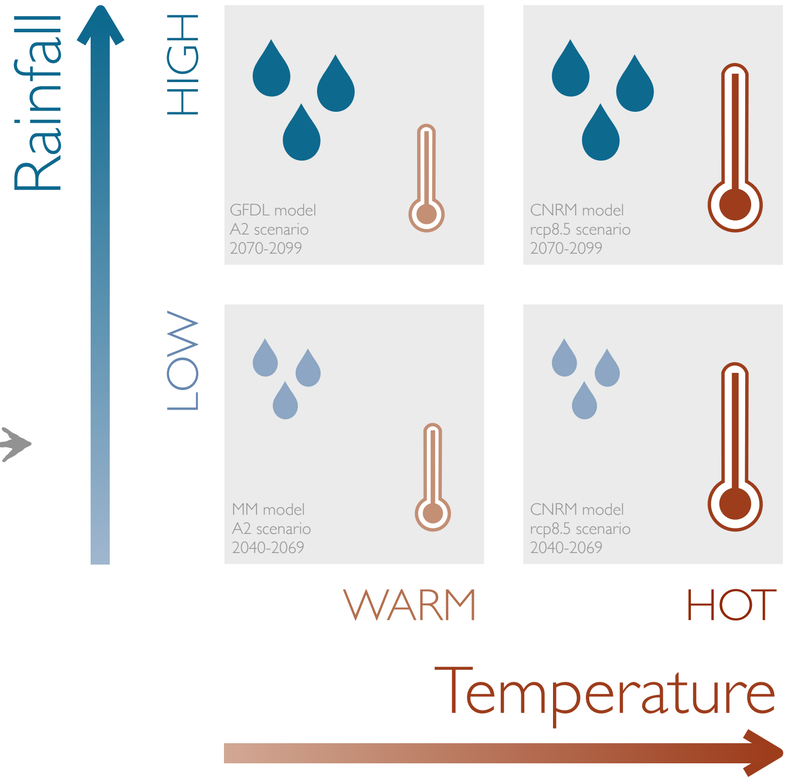
Vegetation distribution were mapped for four climate futures

Representing key **rainfall** and **temperature** combinations





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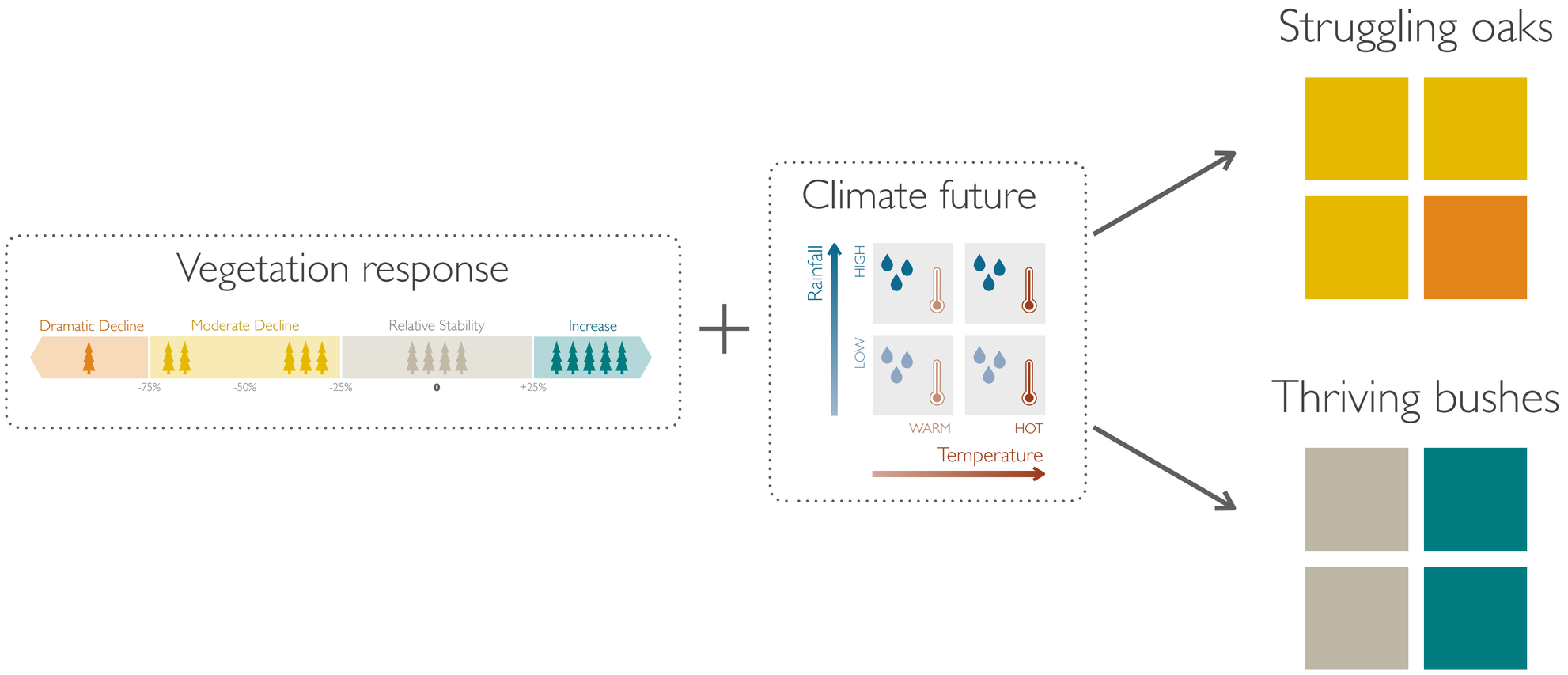
Species-specific potential responses to climate change



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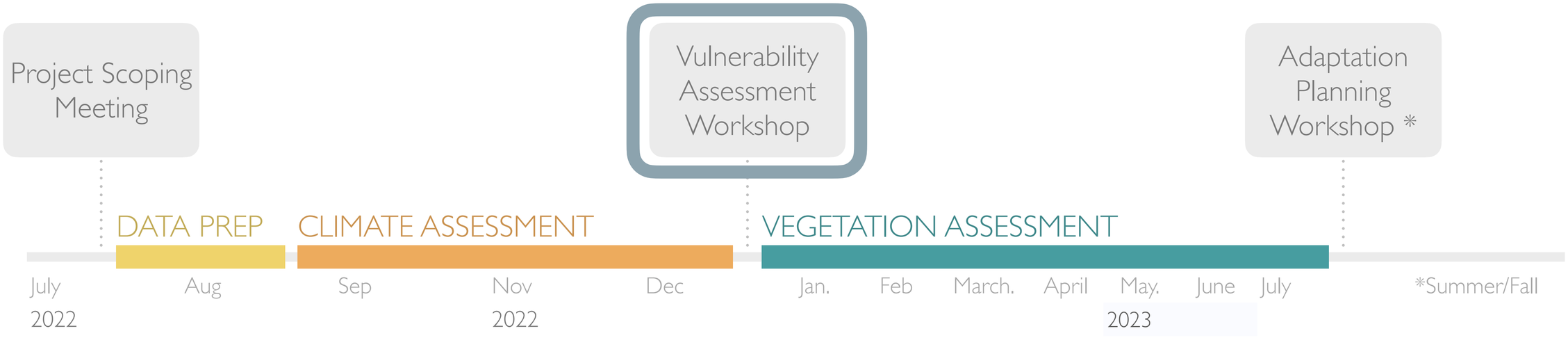
Project Timeline



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