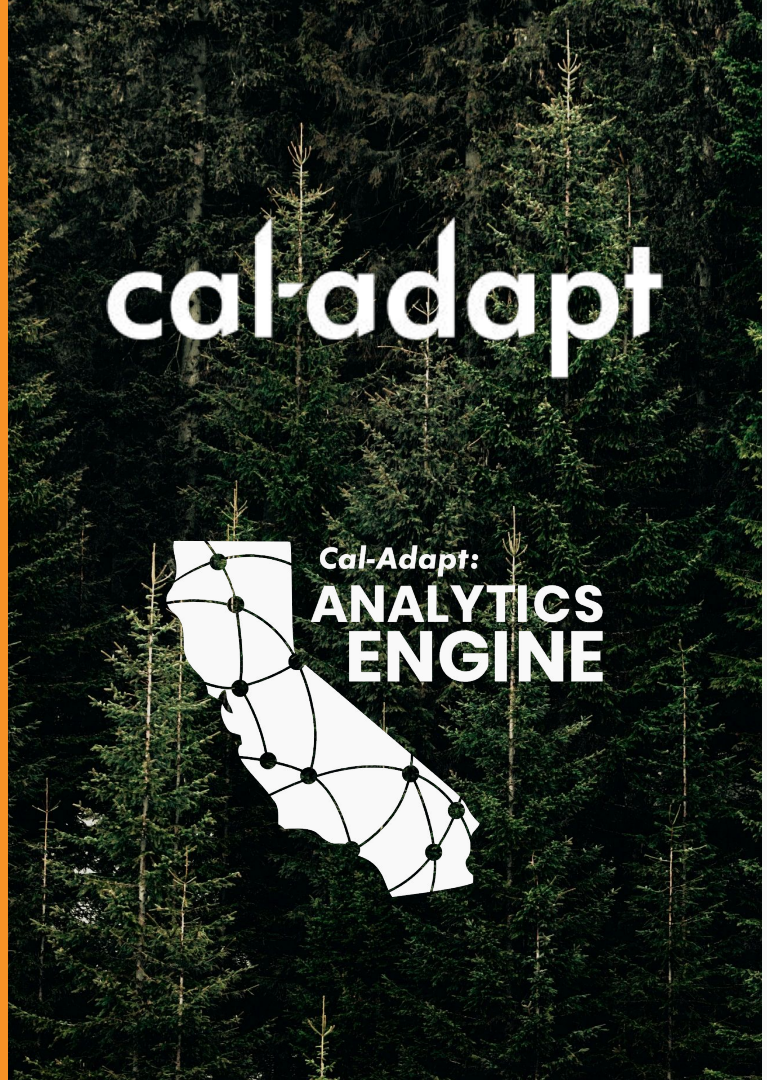


Learn to use climate data & tools for decision-making in CA through Cal-Adapt

A California Adaptation 2023 Workshop

Monday, July 31st, 1pm - 2:45pm

Primary funding provided by the California Energy Commission

cal-adapt.org
analytics.cal-adapt.org

Speakers

Justine Bui

she/her

Spatial Informatics Group

Nancy Thomas

she/her

Geospatial Innovation Facility (UC Berkeley)

Nancy Freitas

she/her

Lawrence Berkeley National Lab | UC Berkeley

Grace Di Cecco, PhD

she/her

Eagle Rock Analytics

Problem Statement

- Data portraying climate change in California is difficult to access and take action upon
- Cal-Adapt offers free public access to trustworthy data and tools that support exploration of California's climate change impacts on state infrastructure, communities, and natural resources

Problem Statement

- California has invested a lot in producing climate projections, but climate data can be difficult to access and utilize for many users
- The Analytics Engine will offer a cloud-based analytics platform to help transform the petabytes of data into useful and accessible data products

Goals for our Workshop

- Learn about the Cal-Adapt enterprise (Cal-Adapt website and Analytics Engine) and how it will be expanding with the Fifth Climate Assessment
- Understand what the Cal-Adapt enterprise can offer through tool and notebook demonstrations

cal-adapt

Cal-Adapt: ANALYTICS ENGINE

The Cal-Adapt Enterprise

Cal-Adapt.org

Local Climate Change Snapshot

A starting point to get climate impacts for your location.

EXPLORE

Annual Averages

Projected annual averages of maximum & minimum temperatures and precipitation.

EXPLORE

Sea Level Rise – Coastal Inundation Scenarios

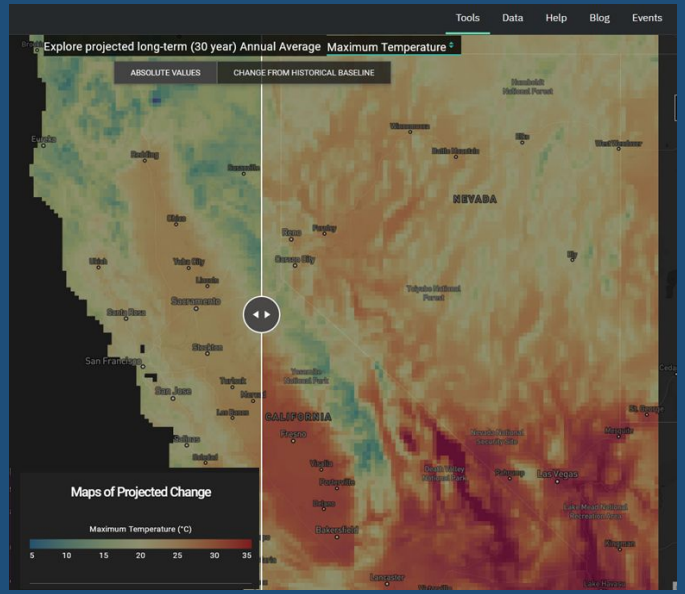
Explore the extent of coastal inundation associated with Sea Level Rise and a 100-year storm from two different SLR models.

EXPLORE

Extreme Weather

Extreme weather events for baseline and future climates.

EXPLORE



Our Mission

We make data portraying climate change in California more **accessible** and **actionable** for a broad audience, with an emphasis on energy sector stakeholders and local governments.

Cal-Adapt 2.0

Cal-Adapt provides a way to explore peer-reviewed climate change projections and scenarios approved by the State and used as the basis for the **California's Fourth Climate Change Assessment**

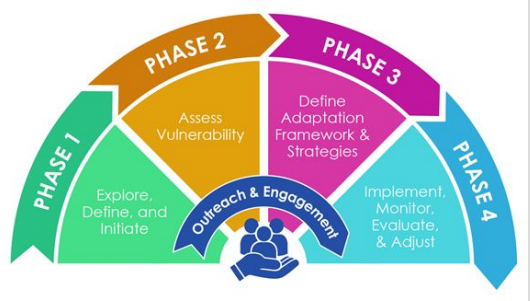
cal-adapt

How is Cal-Adapt being used?

State Climate Resource

Cal-Adapt has been recognized by California's legislature as a key resource to support ***climate adaptation resiliency and planning*** and has helped California move forward by providing easy access to climate projections sanctioned by the state.

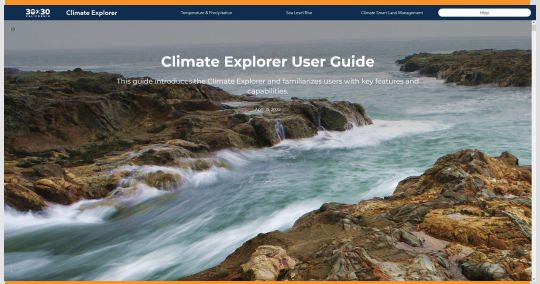
Adaptation Planning Guide (APG)



California Public Utilities Commission

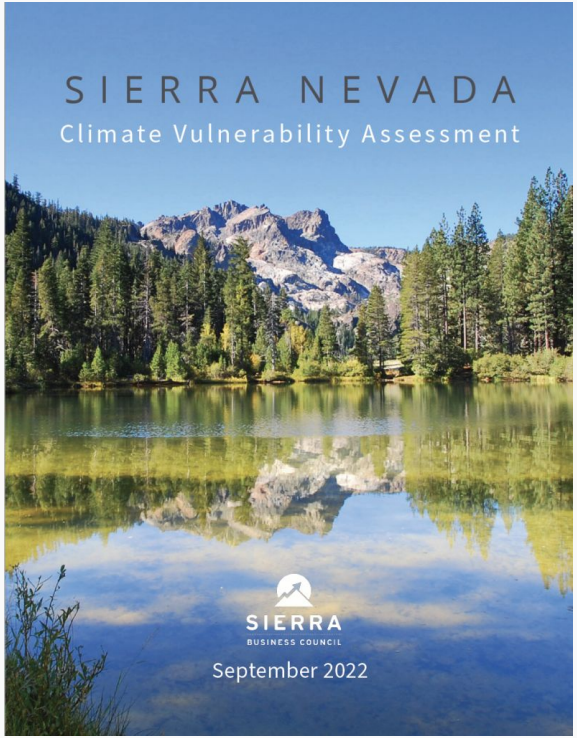
The California Public Utilities Commission (CPUC) issued an **Order Instituting Rulemaking (R.18-04-019)** to integrate climate change adaptation matters in relevant CPUC proceedings.

CA Nature 30x30 Climate Explorer



Regional Planning

The Sierra Climate Adaptation and Mitigation Partnership (Sierra CAMP) used Cal-Adapt to help inform the "Sierra Nevada Climate Vulnerability Assessment," which is designed to help Sierra Nevada communities prepare for climate change.



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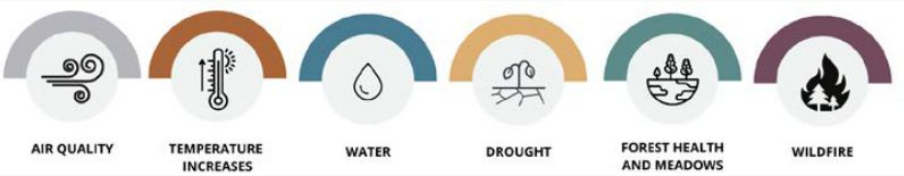
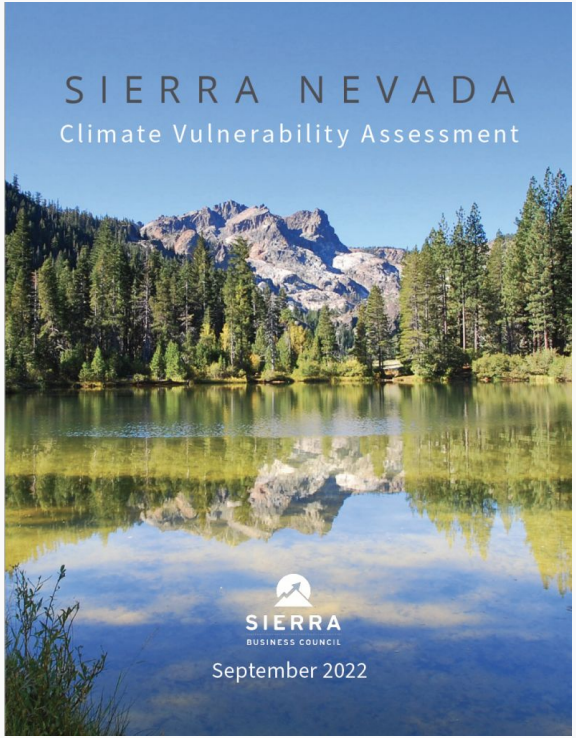




Sierra Nevada Climate Vulnerability Assessment

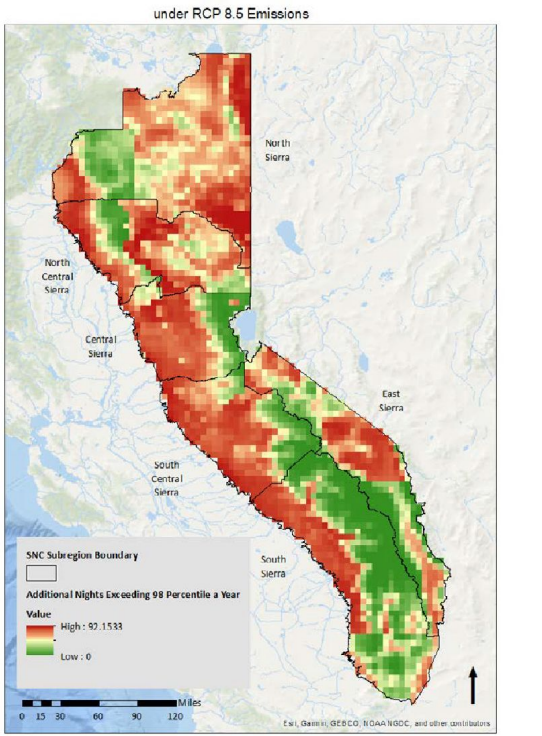
CHANGE IN NUMBER OF WARM NIGHTS A YEAR 2070-2099

Subregion	Change Across the Subregion *Subregions Include Diverse Topographic Changes*	Average Change Across the Subregion *Average Includes Diverse Topographic Changes*
North Sierra	Will increase 3–92 days a year	On average will increase 57 days a year
North Central Sierra	Will increase 1–92 days a year	On average will increase 58 days a year
Central Sierra	Will increase 1–91 days a year	On average will increase 56 days a year
East Sierra	Will increase 0–86 days a year	On average will increase 28 days a year
South Central Sierra	Will increase 1–89 days a year	On average will increase 58 days a year
South Sierra	Will increase 0–86 days a year	On average will increase 34 days a year

County	Average Increase in Days *Average Includes Diverse Topographic Changes*
Alpine	56.9
Amador	59.2
Butte	51.6
Calaveras	66.1
El Dorado	58.2
Fresno	31.7
Inyo	28.3
Kern	31.3
Lassen	62.8
Madera	44.5
Mariposa	56.3
Modoc	64.7
Mono	58.4
Nevada	58.5
Placer	51.8
Plumas	64.5
Shasta	36.3
Sierra	55.7
Tehama	54.5
Tulare	36.0
Tuolumne	55.3
Yuba	54.1

Tables coincide with the map on the previous page (data points are represented by grid colors). For example: as seen in the subregion table, higher elevations in the North Sierra Region will experience a minimal increase in the number of warm nights per year, whereas the lower elevations will experience a much higher increase in warm nights per year over the late-century time period. On average Alpine County will experience a 56.9-night increase.

44



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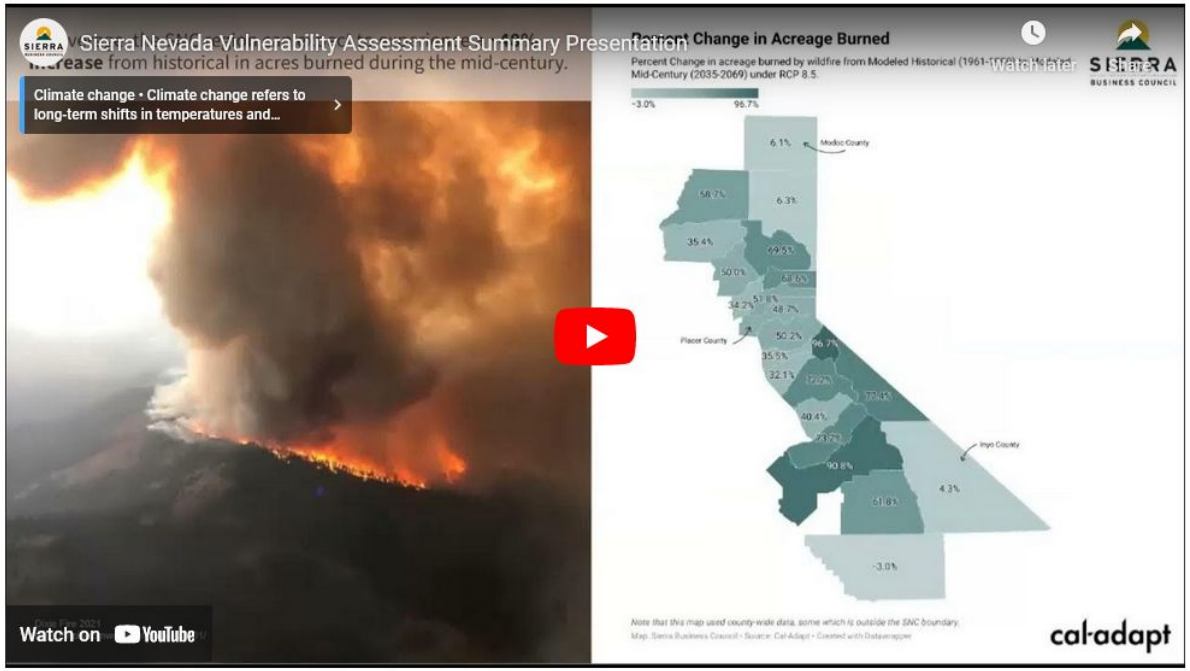
Sierra Nevada Climate Vulnerability Assessment

WATCH THE SUMMARY PRESENTATION



SIERRA BUSINESS COUNCIL

SIERRA NEVADA CONSERVANCY

Sierra Institute for Community and Environment

CNAP

City Planning

Fresno COG Transportation Network Vulnerability Assessment
Public Workshop

June 19, 2019

VRPA TECHNOLOGIES, INC.

Fresno Council of Governments

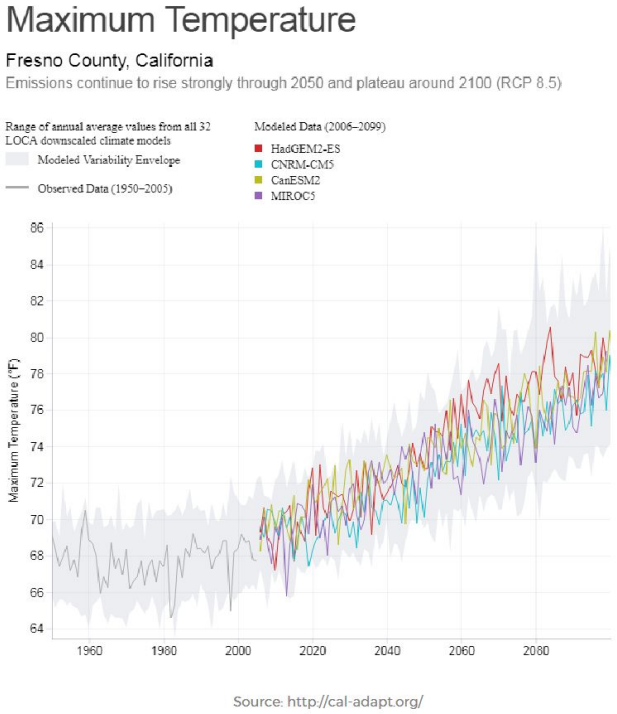
wsp

City Planning

Temperature

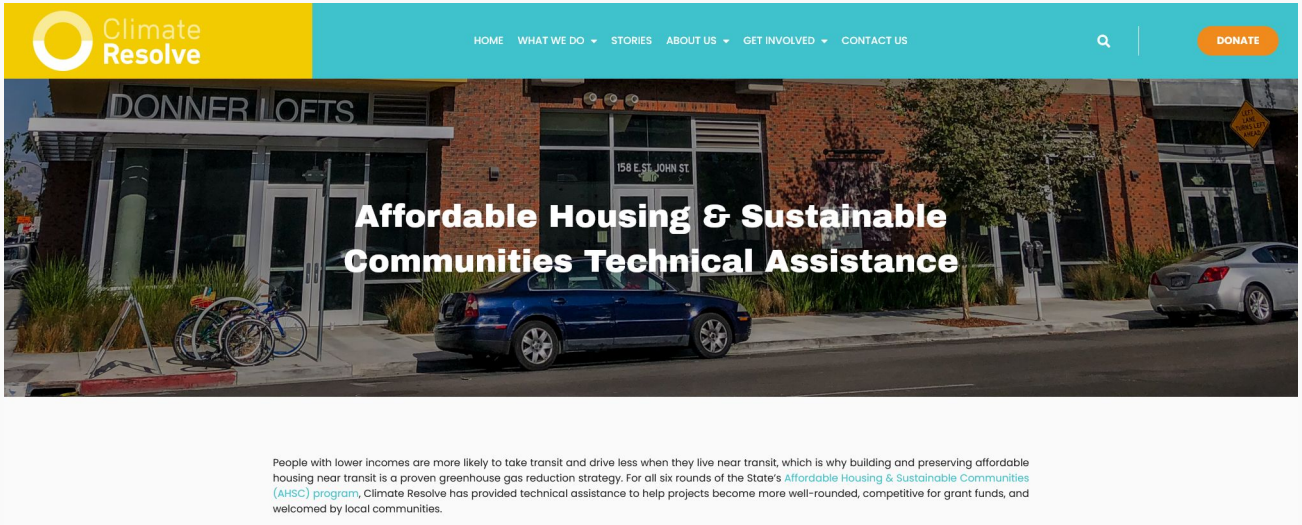
- Max and min temperatures expected to increase across Fresno County
- Average max temperature for Fresno County is expected to increase from ~67 ˚F to ~77 ˚F by end of century (RCP 8.5, model average)
- Number of extreme heat (>105 ˚F) days per year in City of Fresno are expected to increase from 7 to ~66 by end of century (RCP 8.5, model average)

wsp VRPA TECHNOLOGIES, INC. Fresno Council of Governments



Affordable Housing

The Cal-Adapt team worked with **Climate Resolve** and the **Strategic Growth Council** to make it easier for communities to meet the Climate Resiliency guidelines for the **Affordable Housing and Sustainable Communities (AHSC)** funding opportunities.



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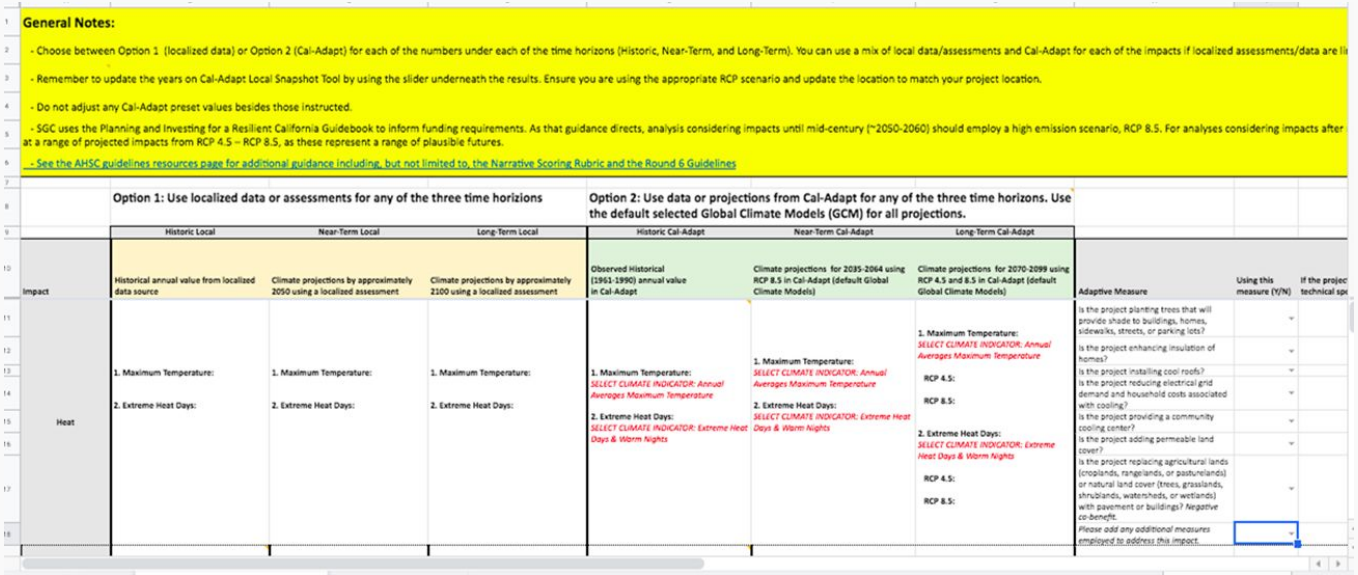


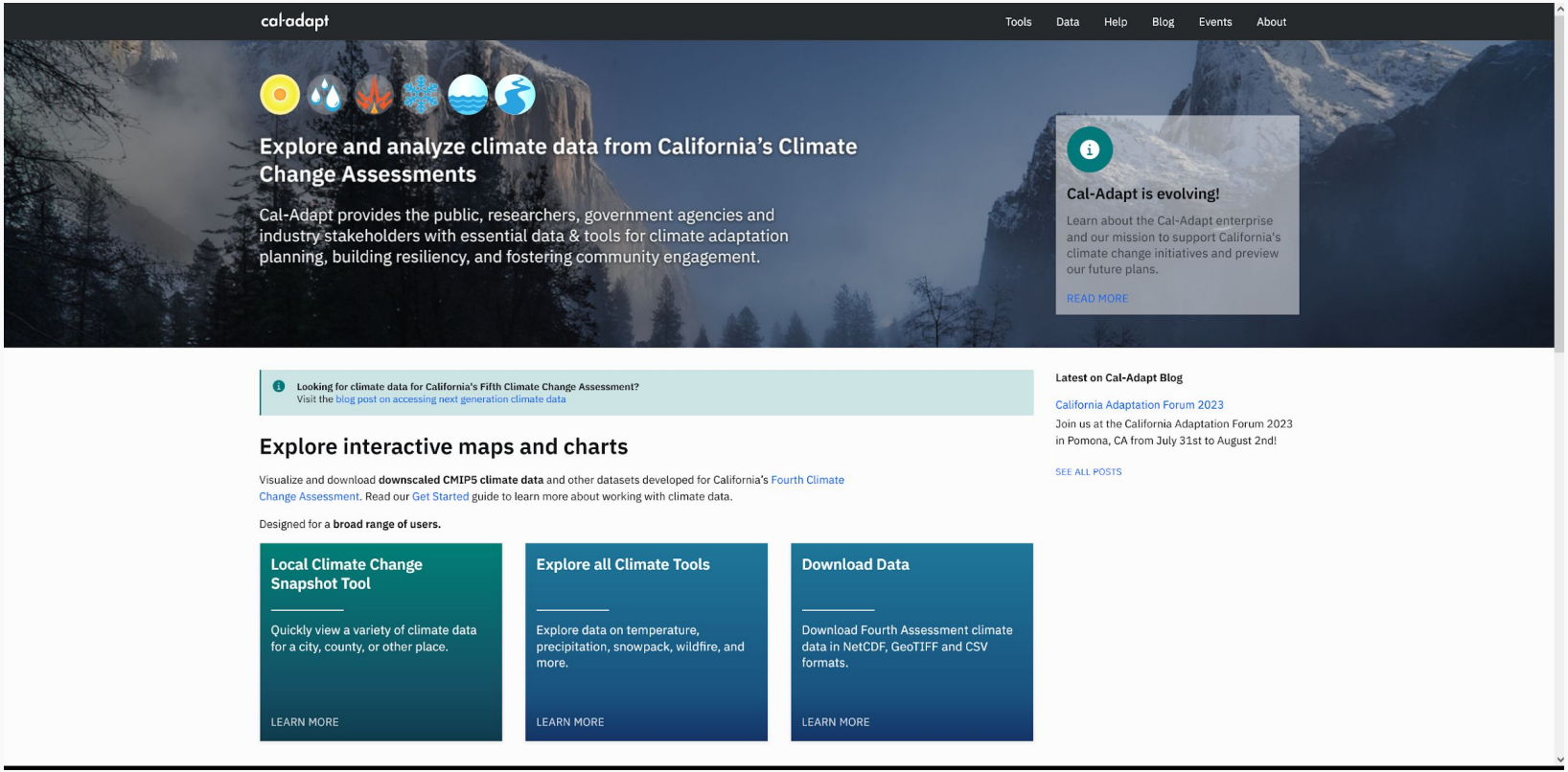
General Notes:

- Choose between Option 1 (localized data) or Option 2 (Cal-Adapt) for each of the numbers under each of the time horizons (Historic, Near-Term, and Long-Term). You can use a mix of local data/assessments and Cal-Adapt for each of the impacts if localized assessments/data are li
- Remember to update the years on Cal-Adapt Local Snapshot Tool by using the slider underneath the results. Ensure you are using the appropriate RCP scenario and update the location to match your project location.
- Do not adjust any Cal-Adapt preset values besides those instructed.
- SGC uses the Planning and Investing for a Resilient California Guidebook to inform funding requirements. As that guidance directs, analysis considering impacts until mid-century (~2050-2060) should employ a high emission scenario, RCP 8.5. For analyses considering impacts after at a range of projected impacts from RCP 4.5 – RCP 8.5, as these represent a range of plausible futures.
- See the AHSC guidelines resources page for additional guidance including, but not limited to, the Narrative Scoring Rubric and the Round 6 Guidelines

	Option 1: Use localized data or assessments for any of the three time horizions			Option 2: Use data or projections from Cal-Adapt for any of the three time horizons. Use the default selected Global Climate Models (GCM) for all projections.				
	Historic Local	Near-Term Local	Long-Term Local	Historic Cal-Adapt	Near-Term Cal-Adapt	Long-Term Cal-Adapt		
Impact	Historical annual value from localized data source	Climate projections by approximately 2050 using a localized assessment	Climate projections by approximately 2100 using a localized assessment	Observed Historical (1961-1990) annual value in Cal-Adapt	Climate projections for 2035-2064 using RCP 8.5 in Cal-Adapt (default Global Climate Models)	Climate projections for 2070-2099 using RCP 4.5 and 8.5 in Cal-Adapt (default Global Climate Models)	Adaptive Measure	Using this measure (Y/N)
Heat	1. Maximum Temperature: 2. Extreme Heat Days:	1. Maximum Temperature: 2. Extreme Heat Days:	1. Maximum Temperature: 2. Extreme Heat Days:	1. Maximum Temperature: *SELECT CLIMATE INDICATOR: Annual Averages Maximum Temperature* 2. Extreme Heat Days: *SELECT CLIMATE INDICATOR: Extreme Heat Days & Warm Nights*	1. Maximum Temperature: *SELECT CLIMATE INDICATOR: Annual Averages Maximum Temperature* 2. Extreme Heat Days: *SELECT CLIMATE INDICATOR: Extreme Heat Days & Warm Nights*	1. Maximum Temperature: *SELECT CLIMATE INDICATOR: Annual Averages Maximum Temperature* RCP 4.5: RCP 8.5: 2. Extreme Heat Days: *SELECT CLIMATE INDICATOR: Extreme Heat Days & Warm Nights* RCP 4.5: RCP 8.5:	Is the project planting trees that will provide shade to buildings, homes, sidewalks, streets, or parking lots? Is the project enhancing insulation of homes? Is the project installing cool roofs? Is the project reducing electrical grid demand and household costs associated with cooling? Is the project providing a community cooling center? Is the project adding permeable land cover? Is the project replacing agricultural lands (croplands, rangelands, or pasturelands) or natural land cover (trees, grasslands, shrublands, watersheds, or wetlands) with pavement or buildings? Negative co-benefit. *Please add any additional measures employed to address this impact.*	

How to Get Started Working with Climate Data

Tools and Guidance



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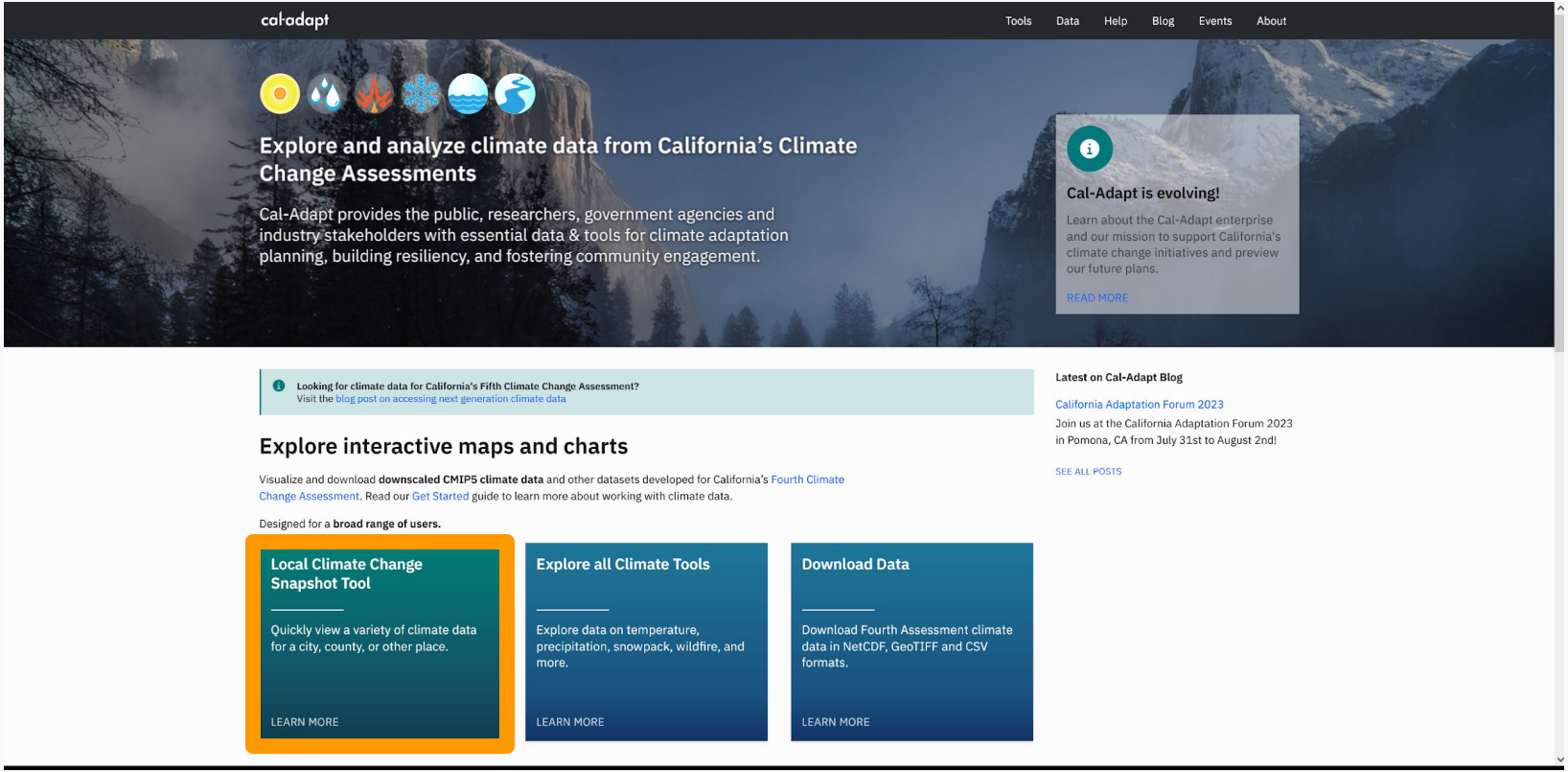

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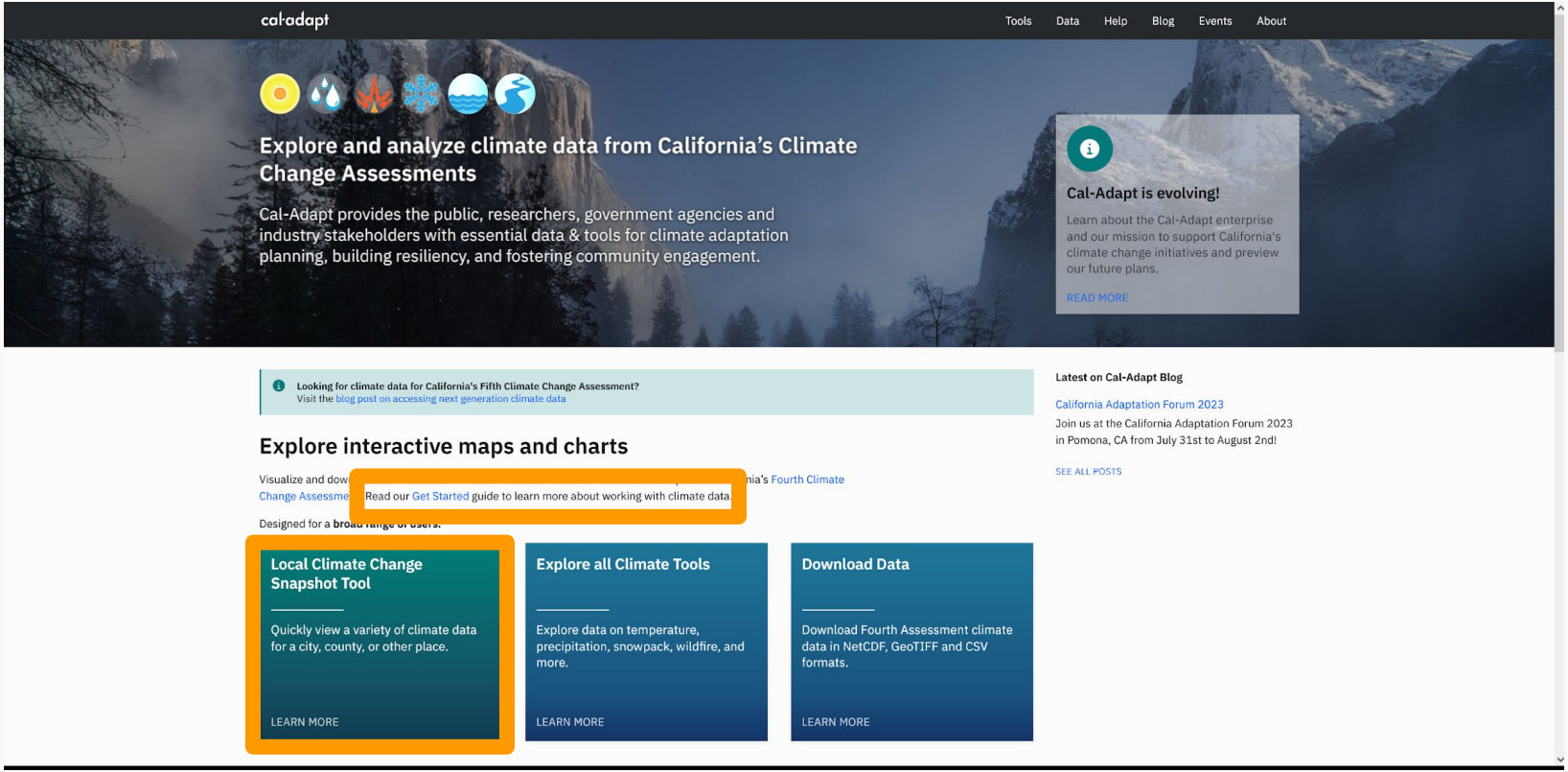
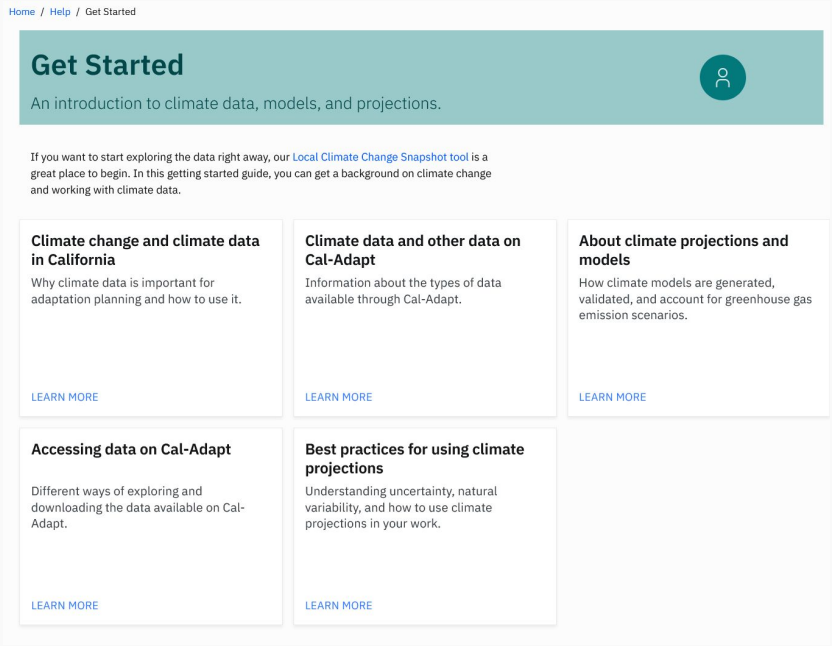


Get Started!


Home / Help / Get Started
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An introduction to climate data, models, and projections.
If you want to start exploring the data right away, our Local Climate Change Snapshot tool is a great place to begin. In this getting started guide, you can get a background on climate change and working with climate data.
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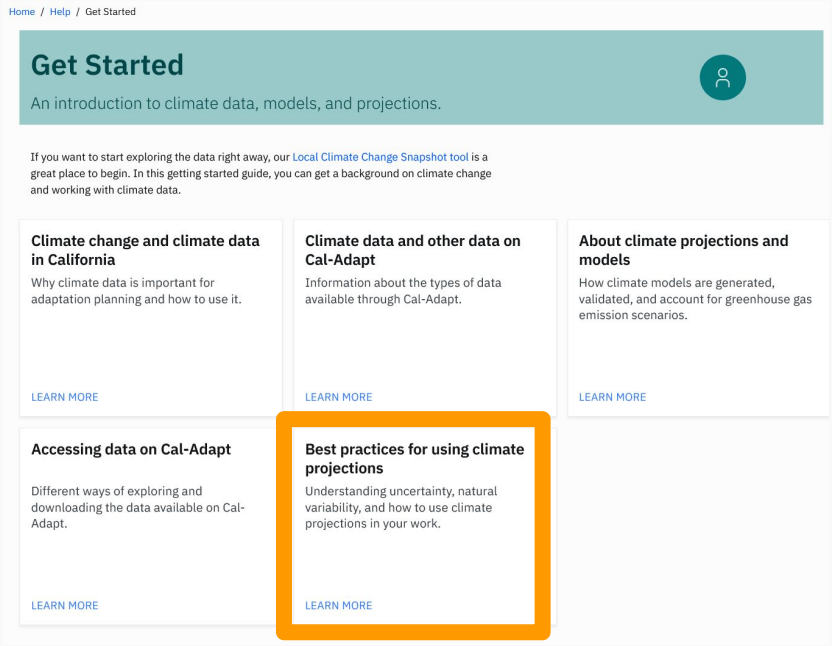
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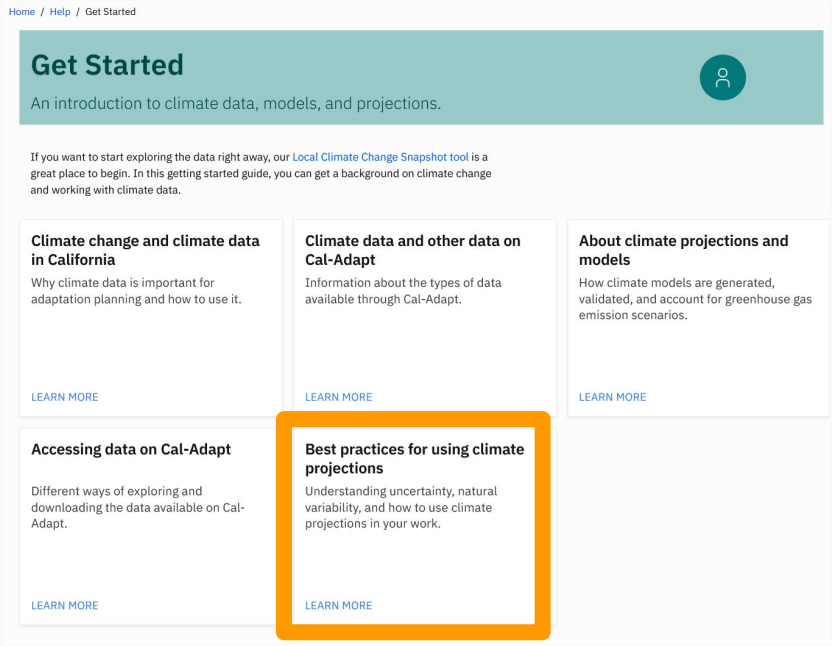


Guidance on using climate projections

We recommend a few principles for working with climate projections:

1. Analyze data at a community scale, rather than looking at individual buildings, parcels, or grid cells.

Climate models have been proven to skillfully provide outputs that describe both past and future climate conditions. However, they are not capable of describing exact future climate conditions for small areas (like a single property parcel); they're much better suited for community-scale analysis, even when model outputs have been downscaled.

2. Select longer time periods for more useful information.

Because future climate projections express natural climate variability, analyzing a longer time period gives you a better sense of overall future conditions. In other words, if you analyze just a few years of a future climate projection, you might happen to select years that are anomalous. You will get a more accurate picture of future conditions if you look at a period of at least a few decades.

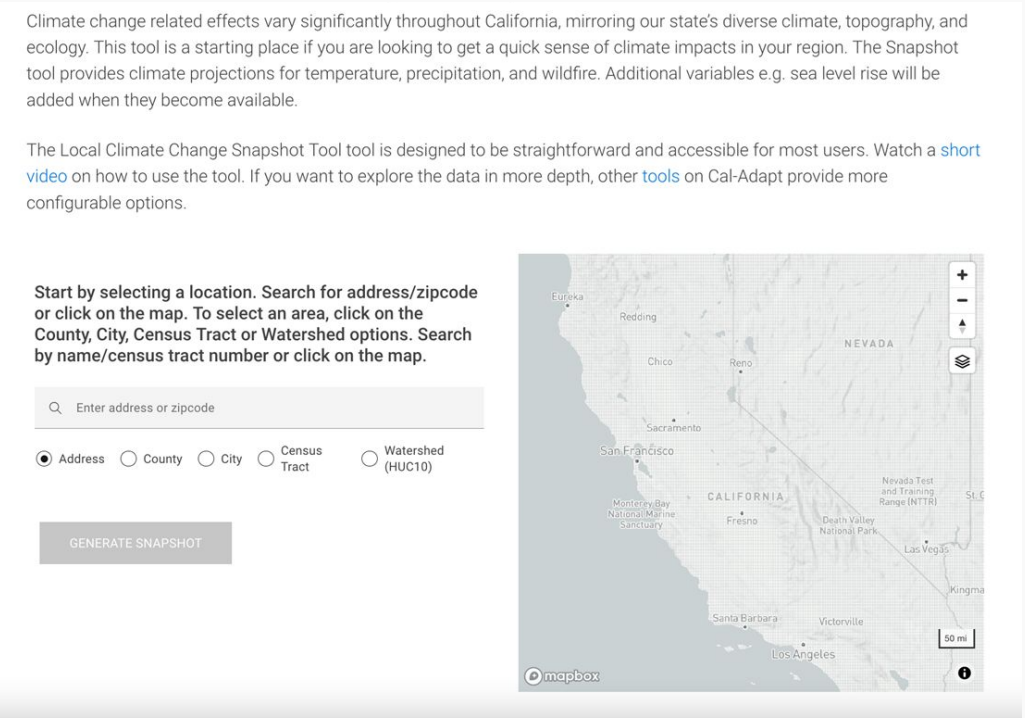
Many scientific entities endorse using a thirty-year window for climate analysis so as to align with standard analyses of climatological normals. For example, within a thirty-year window, you can calculate average and extreme conditions using annual values as your dataset. You can also compute rolling thirty-year averages to study projected change through time.

Two thirty-year climate change adaptation planning periods are often used in California and are embedded in Cal-Adapt's tools. These two periods align with those used in the Fourth National Climate Assessment.

- Mid-century: 2035 – 2064
- End-of-century: 2070 – 2099

Local Climate Change Snapshot Tool

1. Select an aggregation boundary and location.
2. View projections for a collection of physical climate variables.
3. Connect with additional resources.



Local Climate Change Snapshot

Climate change related effects vary significantly throughout California, mirroring our state's diverse climate, topography, and ecology. This tool is a starting place if you are looking to get a quick sense of climate impacts in your region. The Snapshot tool provides climate projections for temperature, precipitation, and wildfire. Additional variables e.g. sea level rise will be added when they become available.

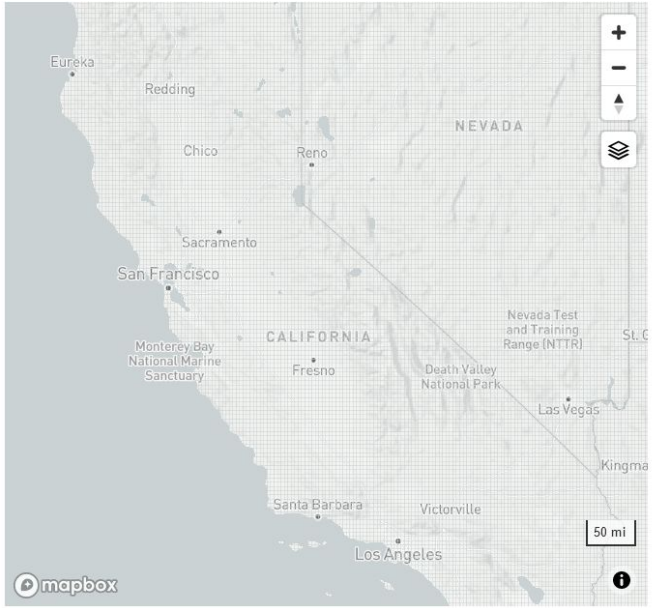
The Local Climate Change Snapshot Tool tool is designed to be straightforward and accessible for most users. Watch a short video on how to use the tool. If you want to explore the data in more depth, other tools on Cal-Adapt provide more configurable options.

Start by selecting a location. Search for address/zipcode or click on the map. To select an area, click on the County, City, Census Tract or Watershed options. Search by name/census tract number or click on the map.

Enter address or zipcode

Address | County | City | Census Tract | Watershed (HUC10)

GENERATE SNAPSHOT



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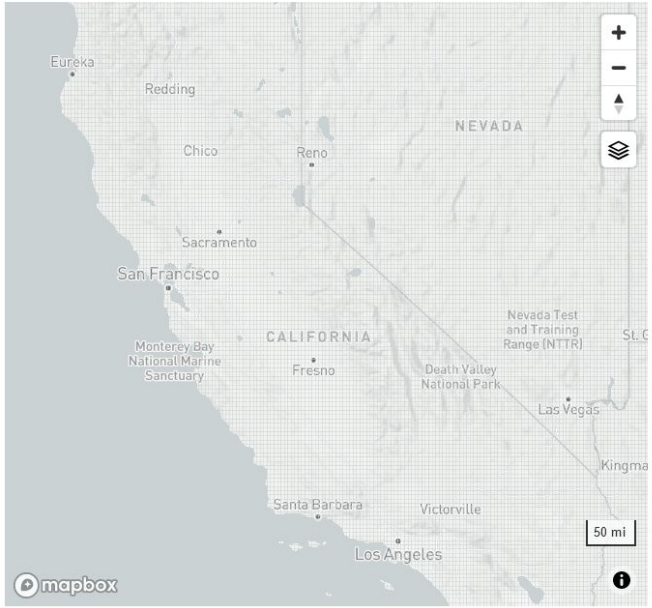

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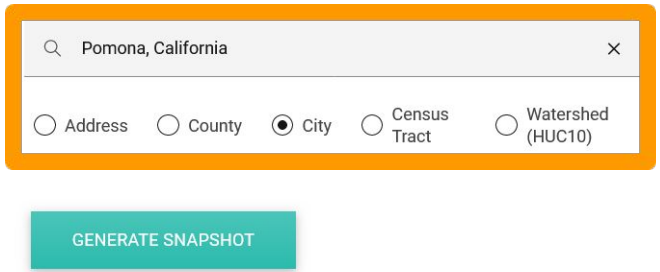

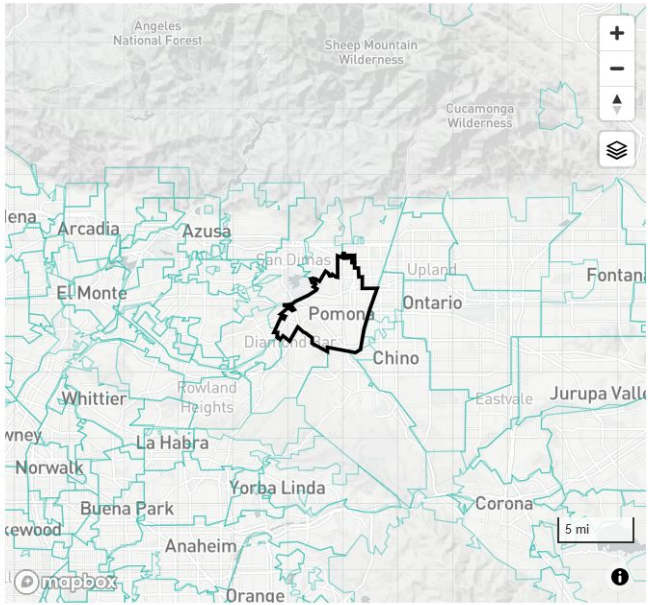

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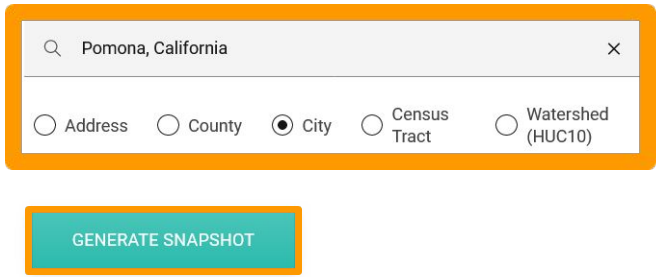

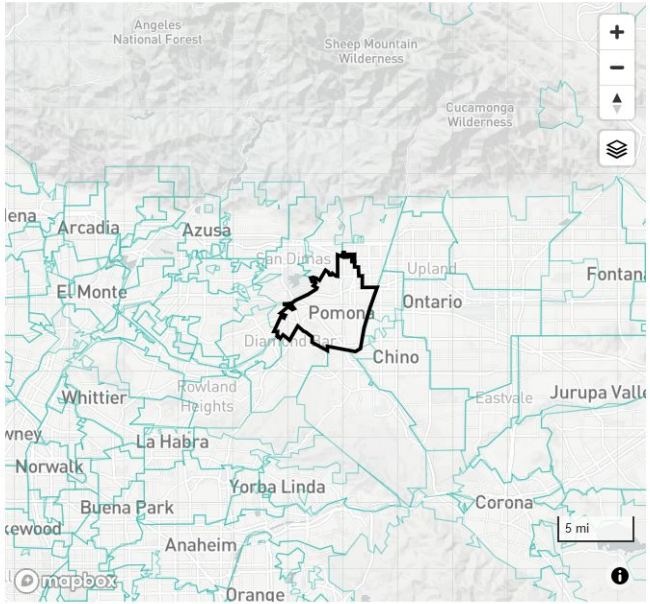

- Annual average maximum temperature
- Annual average minimum temperature
- Extreme heat days
- Warm nights

- Maximum 1-day precipitation
- Maximum length of dry spell
- Annual precipitation
- April SWE
- SPEI 1-month

- Annual average area burned
- KBDI > 600

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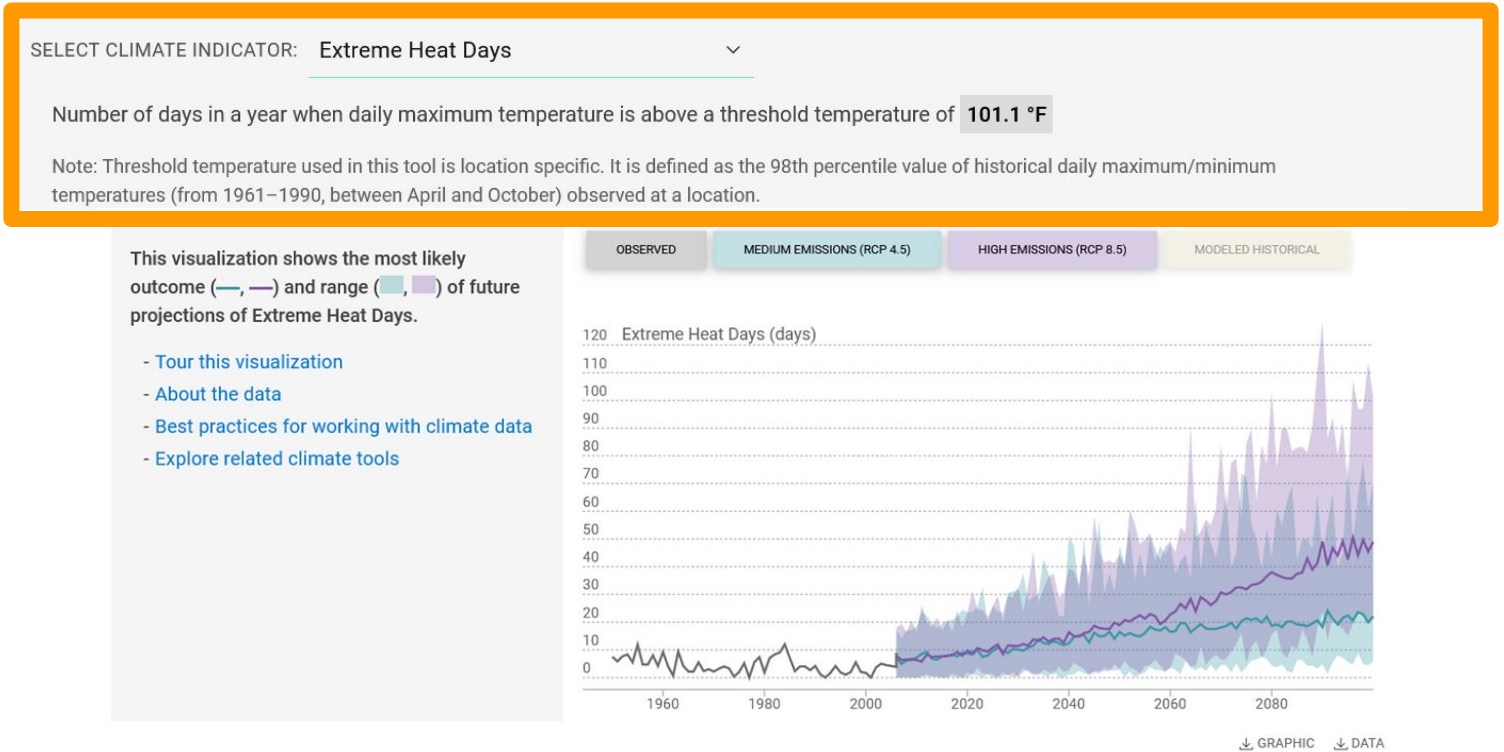
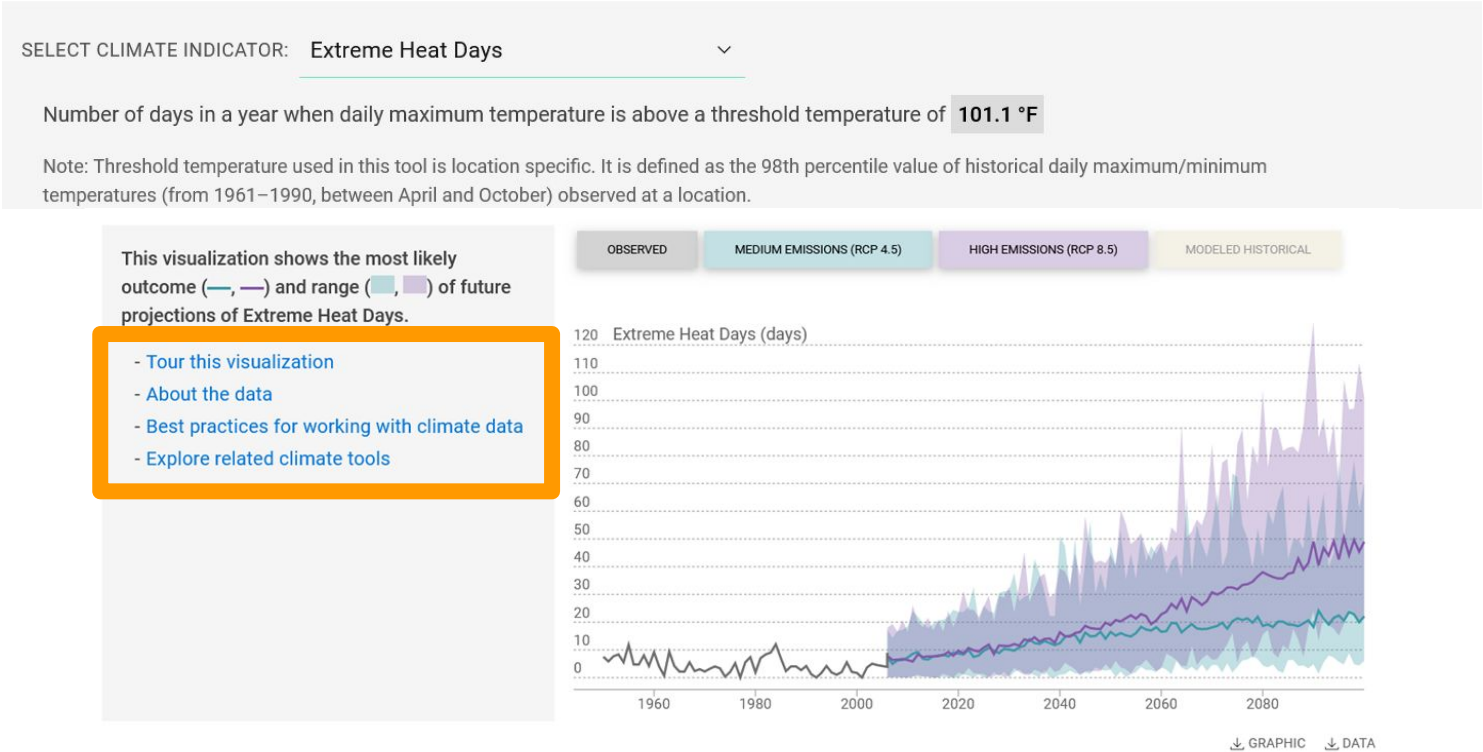


- Two emissions scenarios (RCPs) - RCP 4.5 and RCP 8.5
- 32 Fourth Assessment LOCA downscaled projections (models)
  - Average of all 32 models - dark lines
  - Range of all 32 models - shaded region



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  - Average of all 32 models - dark lines
  - Range of all 32 models - shaded region

Emissions scenarios – RCPs

- RCP 4.5, *medium emissions scenario*: global CO_2 emissions peak by 2040 and then decline.
- RCP 8.5, *high emissions scenario*: global CO_2 emissions continue to rise throughout the 21st century.

Your choice of RCP scenario will depend on your risk tolerance, grant application instructions, and other context. When in doubt, consider both.

Observed (1961-1990) 30yr Average: 4 days

	Change from baseline ⓘ	30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	4 days	2 - 5 days
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+11 days	15 days	9 - 37 days
HIGH EMISSIONS (RCP 8.5)	+15 days	19 days	11 - 40 days
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+16 days	20 days	13 - 55 days
HIGH EMISSIONS (RCP 8.5)	+35 days	39 days	26 - 86 days

GRAPHIC DATA

Related Cal-Adapt Tools

Annual Averages

Explore projected annual averages of maximum temperature, minimum temperature and precipitation for your location.

Extreme Heat

Explore projected frequency and duration of extreme heat days and warm nights for your location.

Maps of Projected Change

Explore maps of projected long-term (30 years) changes in annual average temperature and precipitation.

Additional Resources

Cal-Adapt is evolving!

How does the Analytics Engine differ from Cal-Adapt?

Cal-Adapt 2.0

- **Fourth Climate Change Assessment** data: CMIP5 downscaled climate data
  - Daily temporal resolution
  - ~6km spatial resolution
- Optimized for **fast interactive data visualization** on a web browser
- Hosted on Amazon Web Services using EBS (Elastic Block Store) data storage and Elastic Compute Cloud (EC2)

Analytics Engine

- **Fifth Climate Change Assessment** data: CMIP6 downscaled climate data
  - Sub-daily (~hourly) temporal resolution
  - ~3km spatial resolution
- Optimized for **big data computational analysis** using the power of the cloud
- Hosted on Amazon Web Services using S3 data storage and Pangeo stack

Expanded Cal-Adapt Enterprise

DATA

Projections

SIO/UCSD and UCLA are generating the next generation climate projections. (EPC-20-006)

Historical Products

Historical climate products. SIO/UCSD and UCLA (PIR-19-007)

Future Climate Research

5th Assessment and other future research work.

ACCESS

Cal-Adapt: Analytics Engine

Computing resources on top of climate data information for technical users. ERA, UCB, SIG, E3 (EPC-20-007)

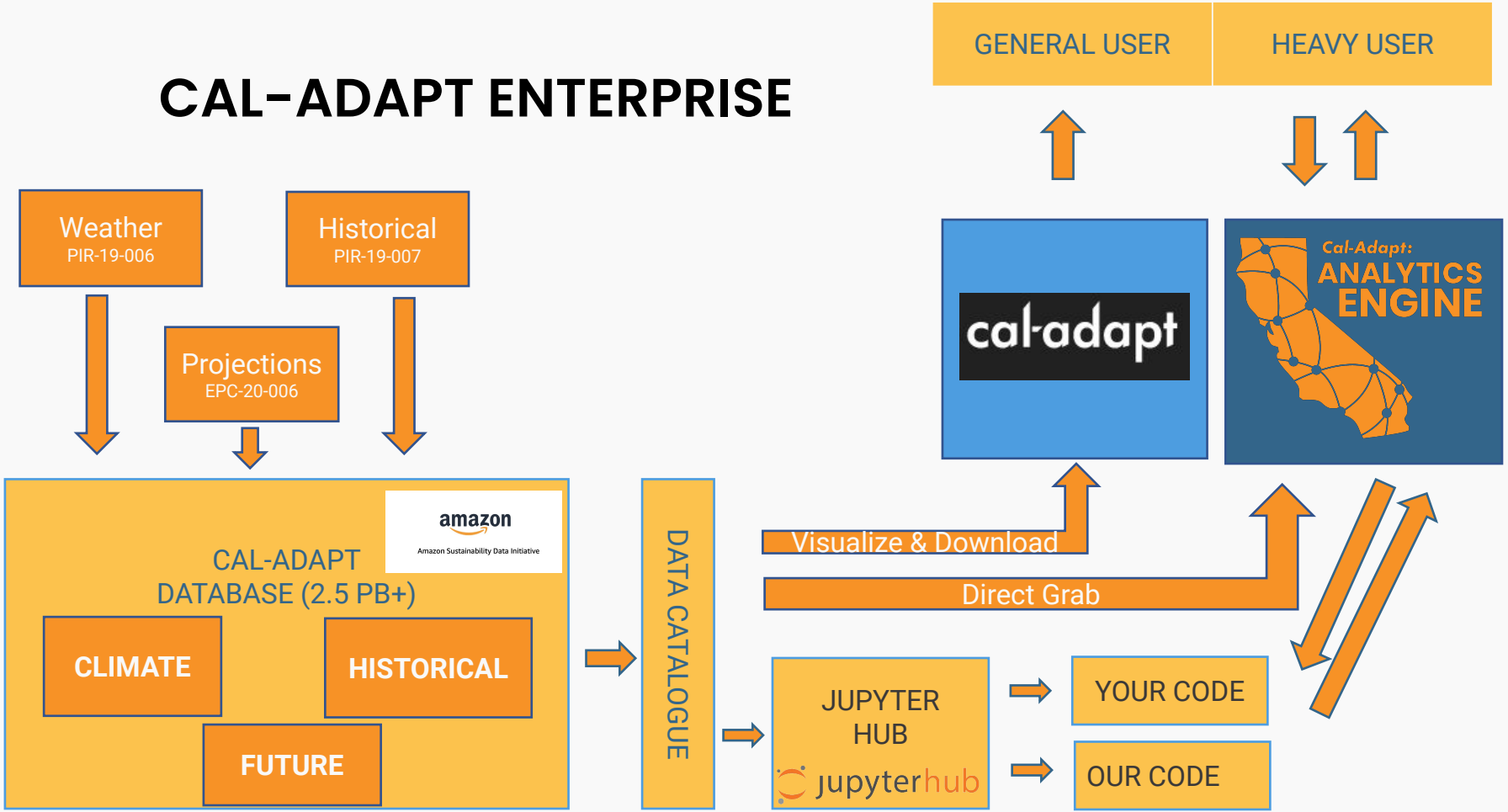
Historical Data Platform

Recent weather and past weather observations and information. ERA and LBNL (PIR-19-006)

Cal-Adapt

Cal-Adapt.org has visualizations and download capacities. ERA/GIF (EPC-21-038)

CAL-ADAPT ENTERPRISE



What is being developed?

Cal-Adapt Web Application 3.0

We are building the next-generation web application to update a subset of climate tools with the latest Fifth Assessment climate data (EPC-21-038)

Key Upcoming Activities

User Needs Assessment

Listening sessions and working groups of key stakeholders to co-produce an updated Cal-Adapt web application that uses the next-generation Fifth Assessment climate data

Beta Data Download Tool

Incorporating Fifth Assessment climate (link) data access

- Daily data
- 3km across California
- 100+ datasets from various GCMs, ensembles, etc.

Tool Launch and Webinar

Full launch of the new Data Download tool to allow easy access to key Fifth Assessment climate variables

How Can You Get Involved?

- Join our co-production process!
- Become a beta tester for our new Data Download tool
- Let us know what data, tools, and guidance materials you need to make Cal-Adapt.org more useful

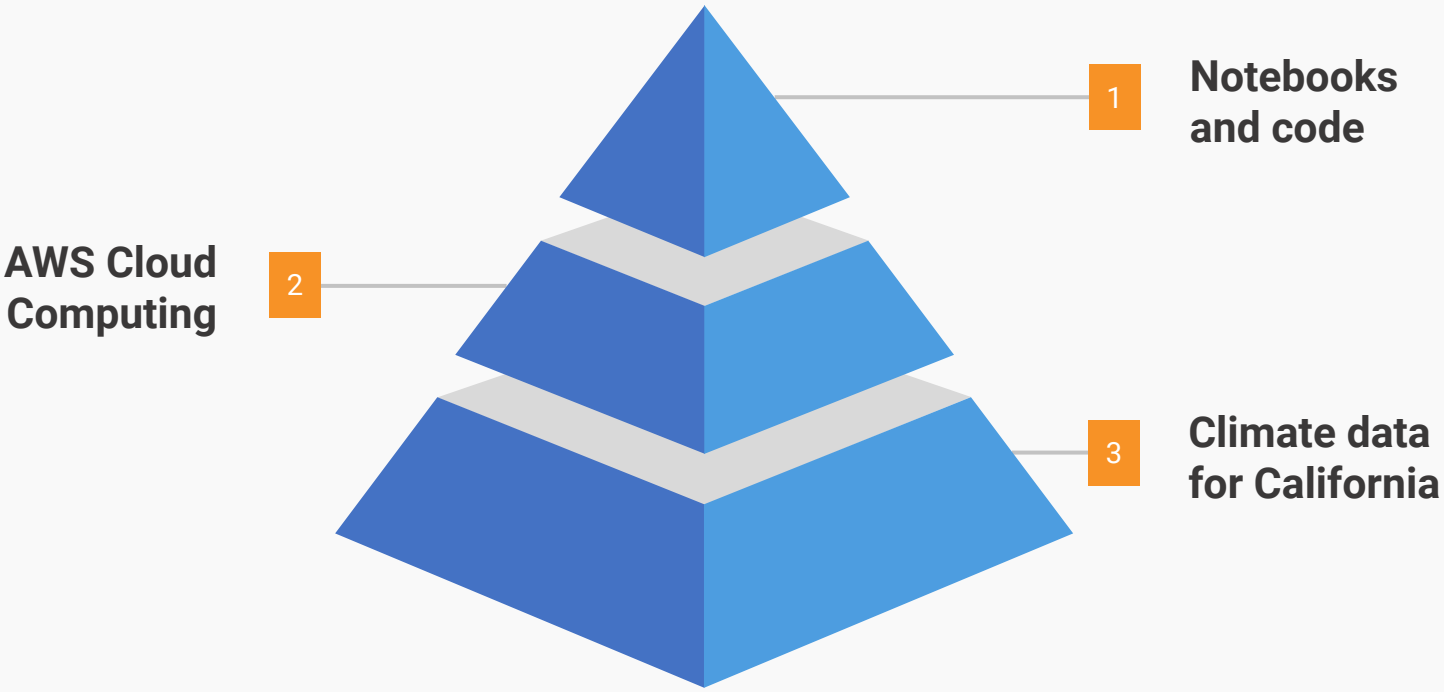
Any questions about the Cal-Adapt enterprise?

support@cal-adapt.org

Q&A

The Analytics Engine

How does the Analytics Engine work?



Co-produced, actionable climate information

Attend our session presentation to learn more!

Wednesday @ 10:15 am

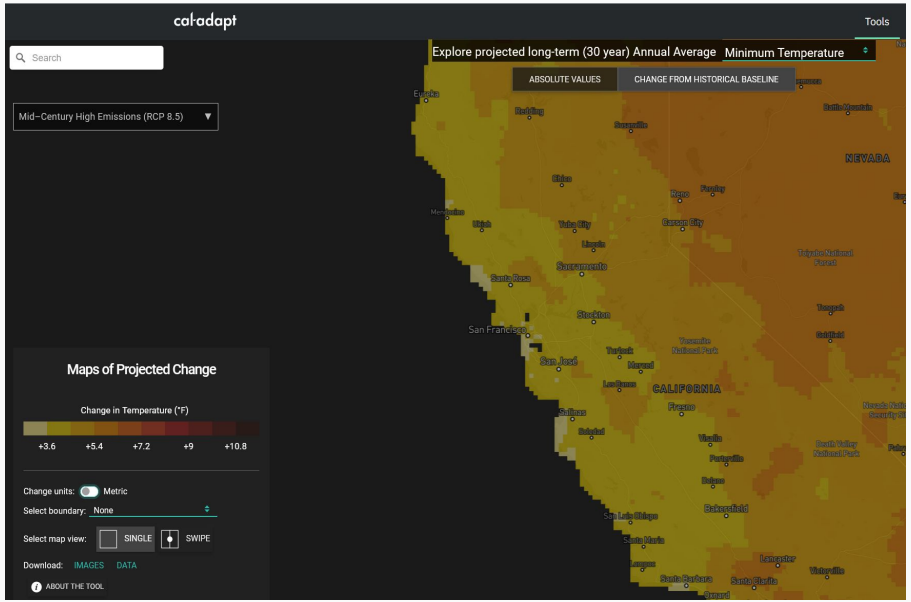
Users of climate information for hazard mitigation include:

Policy Users, Academics / Researchers, Public Consumer & Learners, and Semi-Technical & Technical Users

When to use Cal-Adapt vs. the Analytics Engine

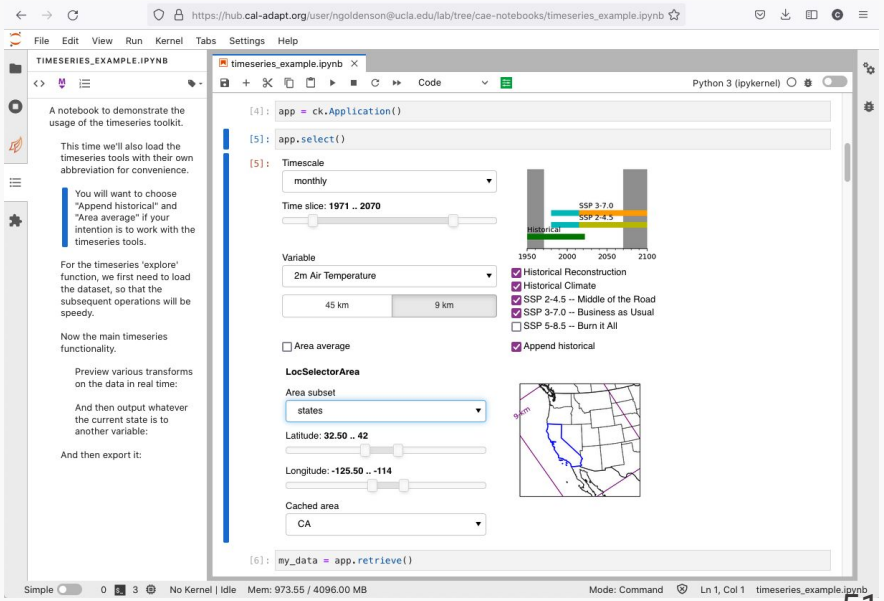
cal-adapt

- Interactive maps and tools
- CMIP5 data
- Daily + 6km resolution



Cal-Adapt: ANALYTICS ENGINE

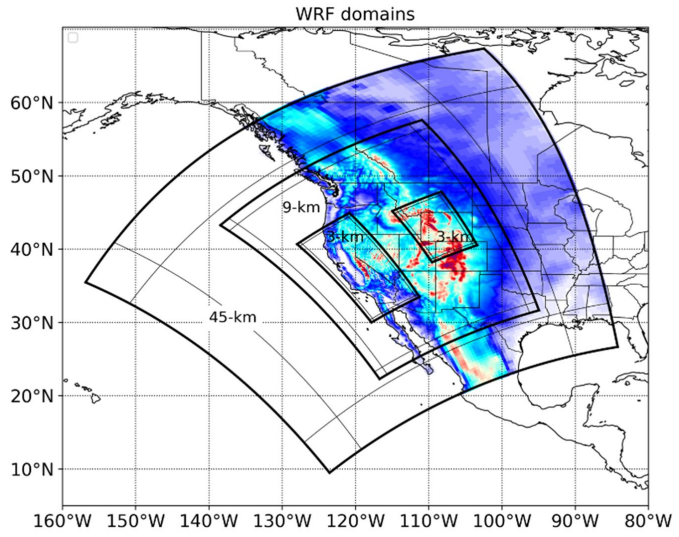
- Detailed data analysis
- CMIP6 data
- Hourly + 3km resolution



Climate Data

Cal-Adapt: ANALYTICS ENGINE

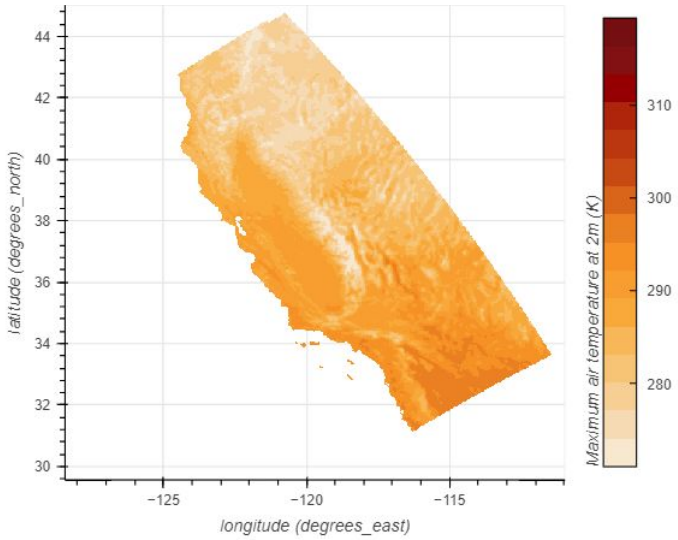
Downscaled Climate Projections: WRF



Source: Stefan Rahimi, UCLA

- Dynamically downscaled from **4** CMIP6 Global Climate Models using WRF model
- Shared Socioeconomic Pathways 2-4.5, 3-7.0, 5-8.5
- **Hourly,** daily, and monthly time resolution
- 3km, 9km, and 45km
- 20+ variables: air temperature, precipitation, wind speed, humidity, etc.

Downscaled Climate Projections: LOCA2



- Hybrid statistically downscaled from **64** CMIP6 Global Climate Models using LOCA approach
- Shared Socioeconomic Pathways 2-4.5, 3-7.0, 5-8.5
- Daily and monthly time resolution
- 3km
- 8 variables: air temperature, precipitation, wind, humidity, solar radiation

WRF

Not bias corrected: can be used as-is to examine relative change but not absolute values

Suitable for applications that require **sub-daily observations** and focus on **extremes**

Compare across GCM and global emissions scenario

LOCA2

Bias corrected: absolute values can be used as direct inputs into models

However, sub-monthly extremes may be distorted by this approach

Can characterize within-model variability in addition to across GCM and emissions scenario

WRF

Not bias corrected: can be used as-is to examine relative change but not absolute values

Suitable for applications that require **sub-monthly** data and focus on **extremes**

Compare across GCM and global emissions scenario

LOCA2

Bias corrected: absolute values can be used as direct inputs into models

However, sub-monthly extremes

Can characterize within-model variability in addition to across GCM and emissions scenario

Data selection depends on your question of interest

→ The Analytics Engine provides tools to help assess which model output is right for your application

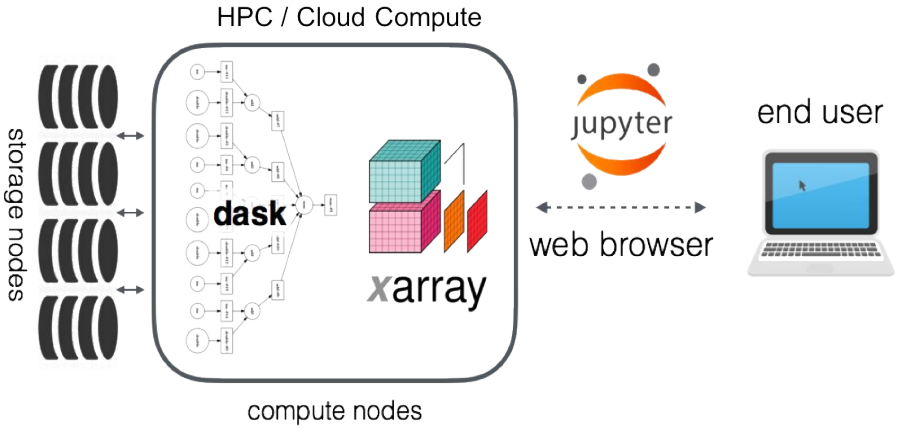
Climate Analytics

Cal-Adapt: ANALYTICS ENGINE

analytics.cal-adapt.org/

Building the Analytics Engine

Promoting open, reproducible, and scalable science



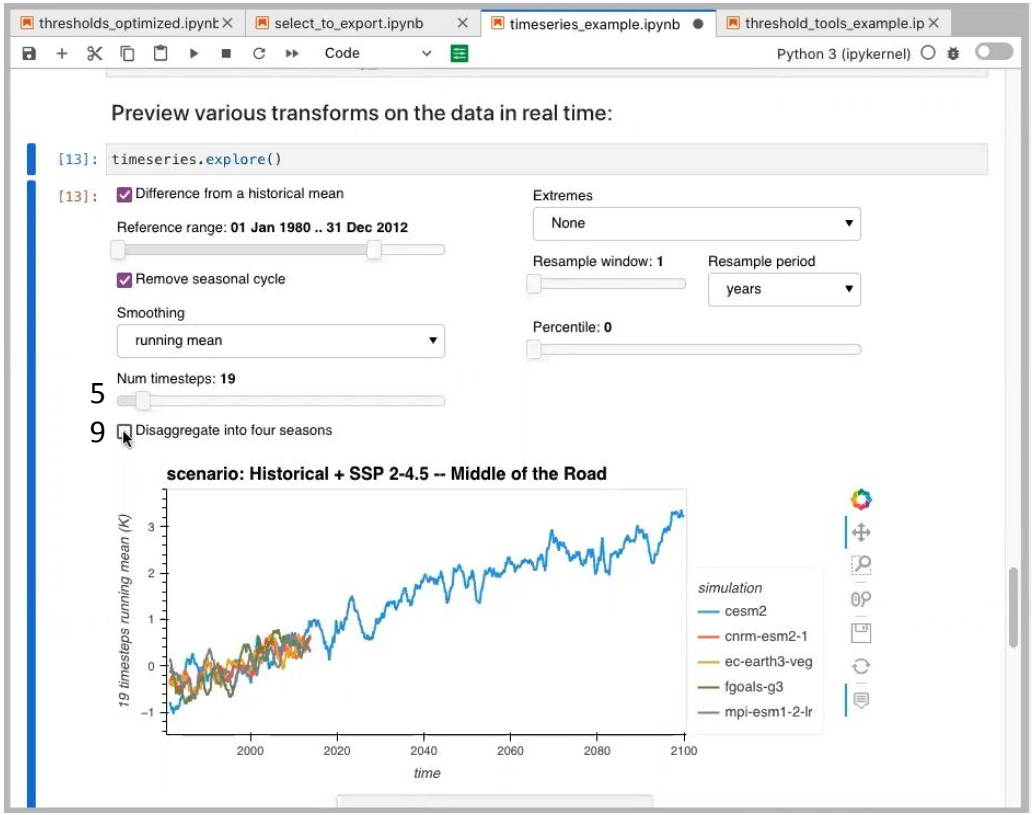
Building from Pangeo stack which provides:

- Ability to use high-level data models (Xarray)
- Ability to work interactively in computing environment (JupyterLab)
- Ability to leverage distributed parallel computing on cloud computing systems (Dask)

Analytics Tools

Ways to use the tools

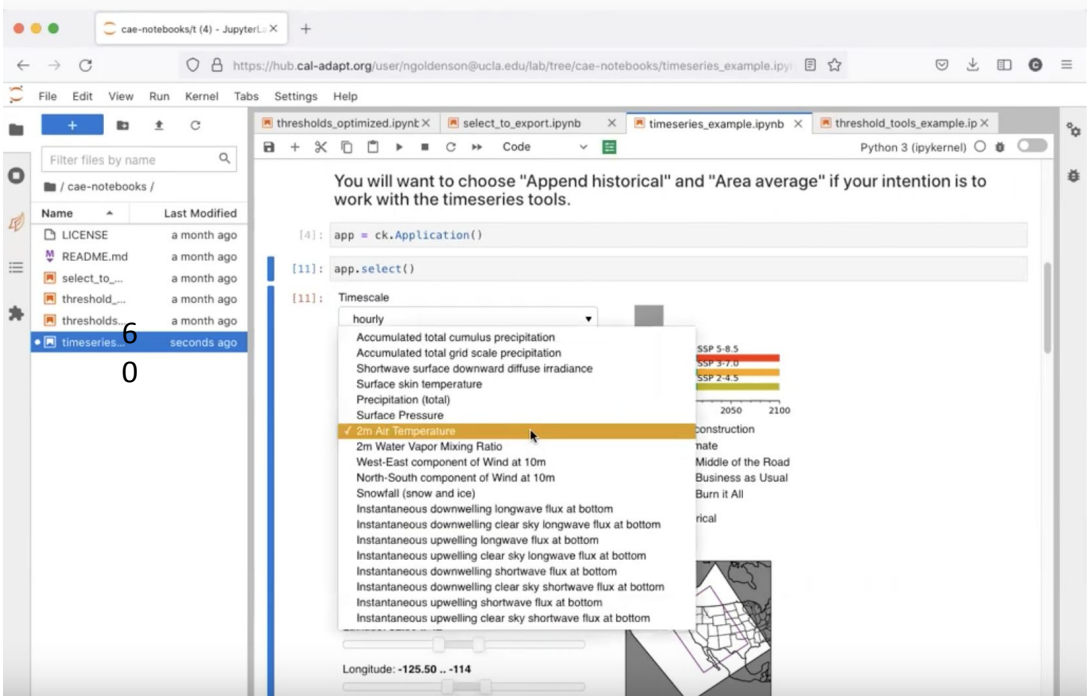
- Interactive panels to customize data and visualizations
- Basic climate data processing functions and advanced features in a custom open-source code library (*climakitae*)



Analytics Goals

We want users to understand:

- Fitness for purpose
- Range of possibility
- How to approach use-cases



Analytics Engine Notebooks

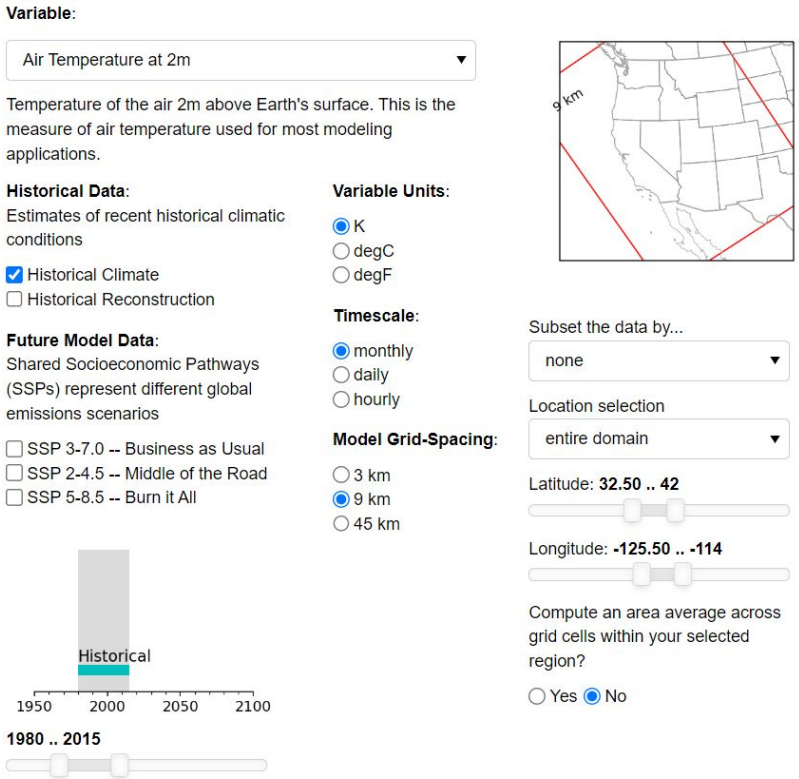
- **Uncertainty tools:** understand sources of uncertainty in using climate data
- **Threshold tools:** explore extreme events
- **Warming levels:** apply global warming level framework to analyze regional responses

Coming soon

- **Typical meteorological years:** create time series of hourly annual data representing ‘typical’ conditions
- **Model selection tool:** evaluate model skill and select the right models for your study needs

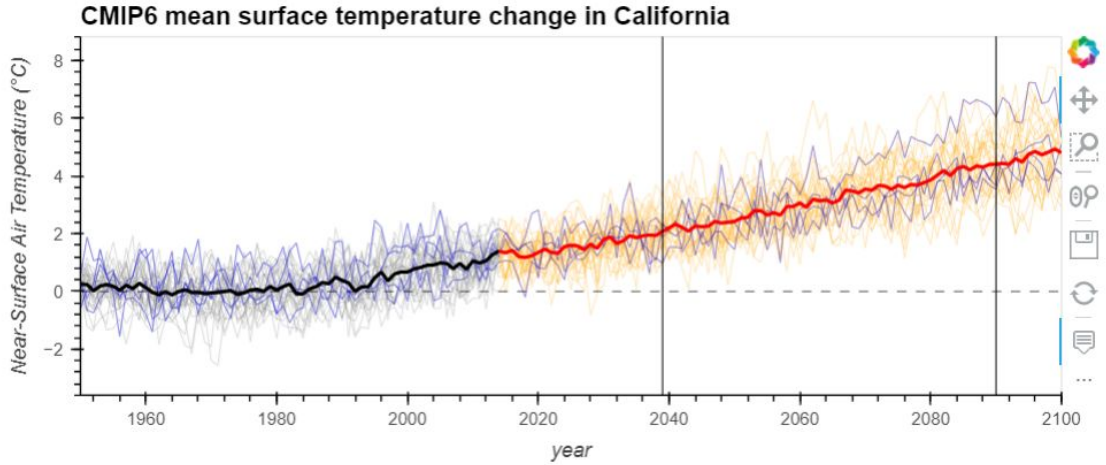
Getting Started with the Analytics Engine

- **getting_started.ipynb:** Introduction to retrieving, visualizing, and exporting climate data using python and the Analytics Engine



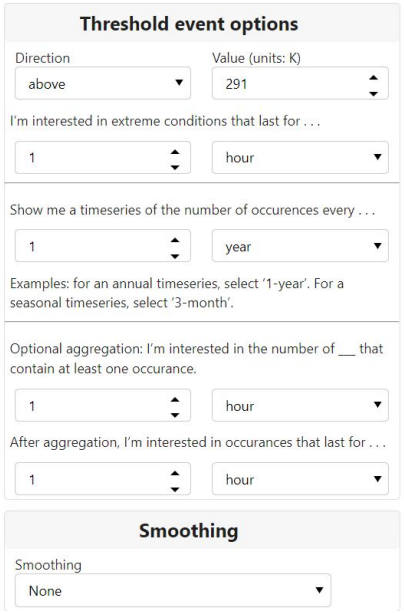
Climate Uncertainty

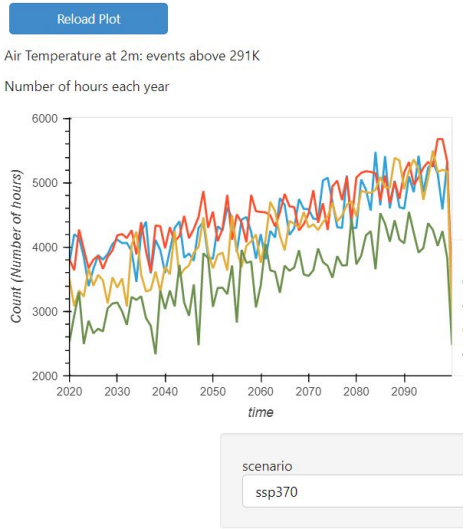
- **explore_internal_variability.ipynb:** Explore uncertainty within climate models due to internal variability in the climate system, using projected changes in extreme precipitation across different climate model simulations
- **explore_model_uncertainty.ipynb:** Explore uncertainty across climate models, using projected variations in air temperature trends across different climate model simulations



Extreme Weather Events

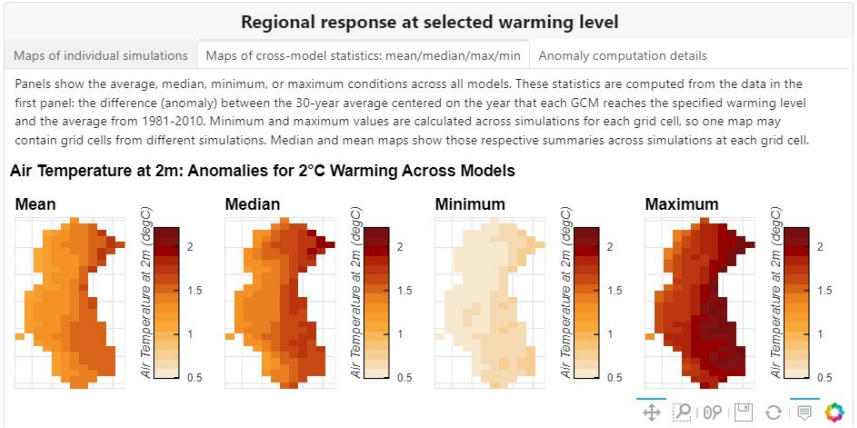
- **threshold_tools_basics.ipynb:** Introduction to extreme value analysis. Demonstrates how to compute statistical values of interest related to extreme weather events.
- **threshold_tools_exceedance.ipynb:** Perform calculations and explore visualizations of threshold exceedance events using an interactive graphical user interface (GUI). An extension of the topics introduced in threshold_tools_basics.

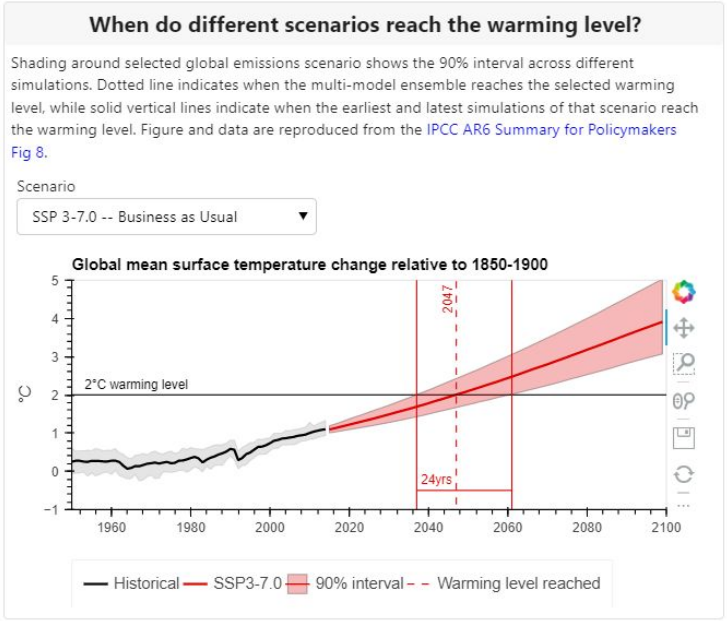




Warming Levels

- **explore_warming.ipynb:** Explore the concept of Global Warming Levels, which can be used to compare possible climate outcomes across multiple scenarios or model simulations.





Demo!

Cal-Adapt: ANALYTICS ENGINE

Check out the Analytics Engine!

For the month of **August 2023** we're happy to extend temporary logins to non-energy stakeholders!

Please email analytics@cal-adapt.org with your request.

Does anyone have any questions about the Analytics Engine?

analytics@cal-adapt.org

Q&A

Thank you for your time!

cal-adapt

Cal-Adapt:
ANALYTICS
ENGINE

Learn more by visiting our websites!

Cal-Adapt: cal-adapt.org

Analytics Engine: analytics.cal-adapt.org

Get in touch!

Cal-Adapt: support@cal-adapt.org

Analytics Engine: analytics@cal-adapt.org

Come check out our Wednesday session!

"Actionable data & tools to enable climate-informed decision-making in California"

Wednesday, August 2nd, 10:15-11:45 AM