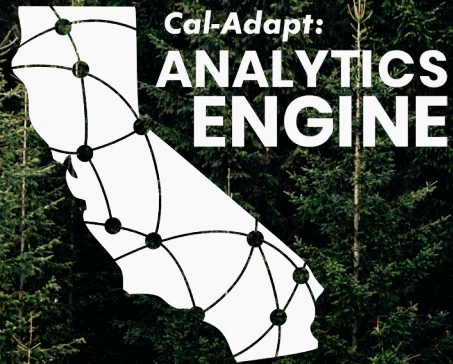


# cal-adapt



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

---

### A California Adaptation 2023 Session

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

Primary funding provided by the California  
Energy Commission

# 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



BERKELEY LAB



Owen Doherty

he/him

Eagle Rock Analytics



CAL-ADAPT



## **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 Session

- Learn about the Cal-Adapt enterprise (Cal-Adapt website and Analytics Engine) and how it will be expanding with the Fifth Climate Assessment
- Understand how engagement and co-production has informed the development of the Analytics Engine





# The Cal-Adapt Enterprise

# Cal-Adapt.org



## Explore and analyze climate data from California's Climate Change Assessments

Cal-Adapt provides the public, researchers, government agencies and industry stakeholders with essential data & tools for climate adaptation planning, building resiliency, and fostering community engagement.



### Cal-Adapt is evolving!

Learn about the Cal-Adapt enterprise and our mission to support California's climate change initiatives and preview our future plans.

[READ MORE](#)



### 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.

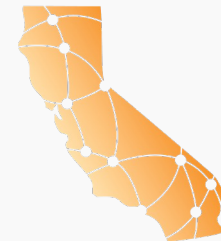
[EXPLORE](#)

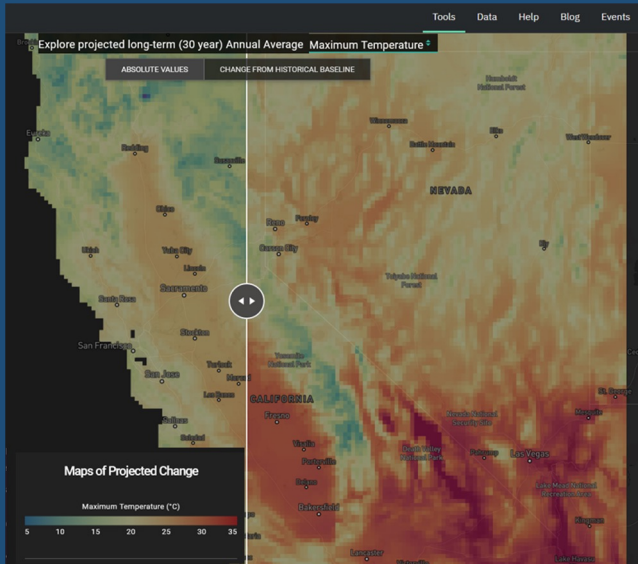


### Extreme Weather

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.

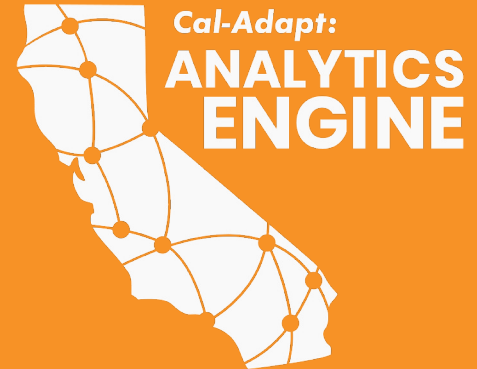


# CALIFORNIA'S FOURTH CLIMATE CHANGE ASSESSMENT

## 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.org](http://cal-adapt.org)





# 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

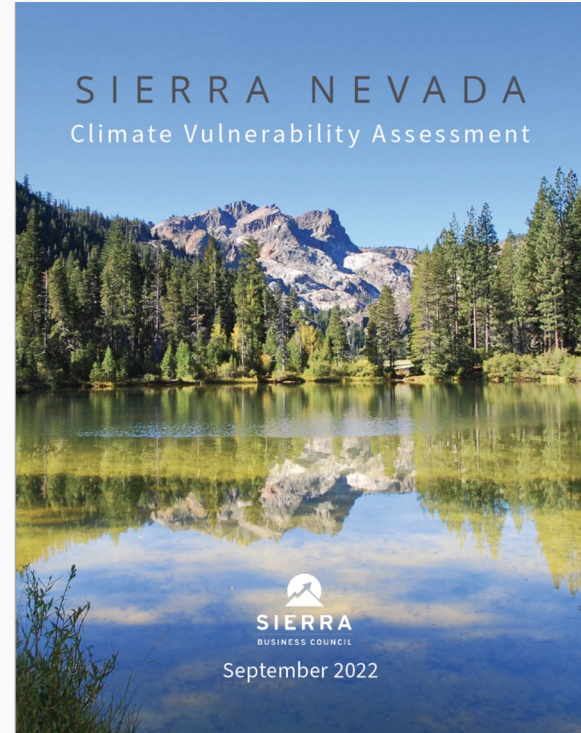
The California Public Utilities Commission (CPUC) issued an **Order Instituting Rulemaking (R.18-04-019)** to integrate climate change adaptation matters in relevant CPUC proceedings.

## CA Nature 30x30 Climate Explorer



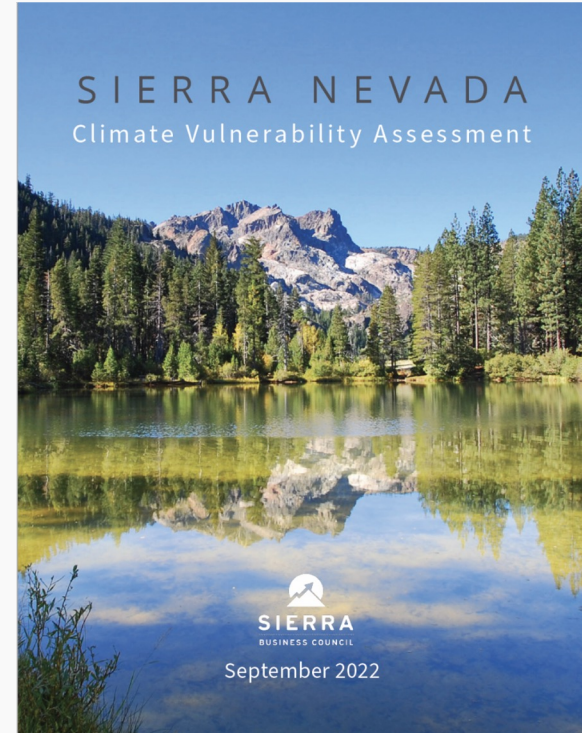
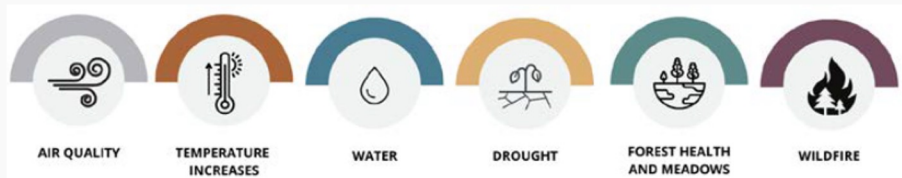
# Regional Planning

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.



# 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.



# Sierra Nevada Climate Vulnerability Assessment

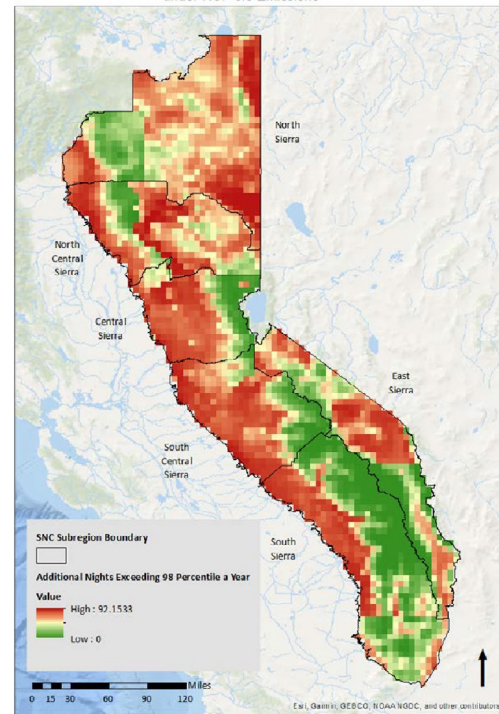
## CHANGE IN NUMBER OF WARM NIGHTS A YEAR 2070-2099

Subregion	Change Across the Subregion <i>Subregions Include Diverse Topographic Changes</i>	Average Change Across the Subregion <i>Average Includes Diverse Topographic Changes</i>
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 <i>Average Includes Diverse Topographic Changes</i>
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.

under RCP 8.5 Emissions



# Sierra Nevada Climate Vulnerability Assessment

WATCH THE SUMMARY PRESENTATION

The video player displays a slide titled "Percent Change in Acreage Burned" with a subtitle "Percent Change in acreage burned by wildfire from Modeled Historical (1961-1999) to Mid-Century (2035-2069) under RCP 8.5." The slide features a map of Sierra Nevada counties with the following data points:

County	Percent Change in Acreage Burned
Alameda	6.1%
Butte	6.3%
Colusa	58.7%
Colusa	35.4%
Colusa	50.0%
Colusa	51.8%
Colusa	34.2%
Colusa	48.2%
Colusa	69.5%
Colusa	48.0%
Colusa	50.2%
Colusa	35.5%
Colusa	32.1%
Colusa	40.4%
Colusa	72.4%
Colusa	71.2%
Colusa	40.4%
Colusa	90.8%
Colusa	51.8%
Colusa	4.3%
Colusa	-3.0%

Other text on the slide includes: "Sierra Nevada Vulnerability Assessment Summary Presentation", "Increase from historical in acres burned during the mid-century.", "Climate change - Climate change refers to long-term shifts in temperatures and...", "Watch on YouTube", "SIERRA BUSINESS COUNCIL", and "caladapt".





**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



5<sup>th</sup> 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



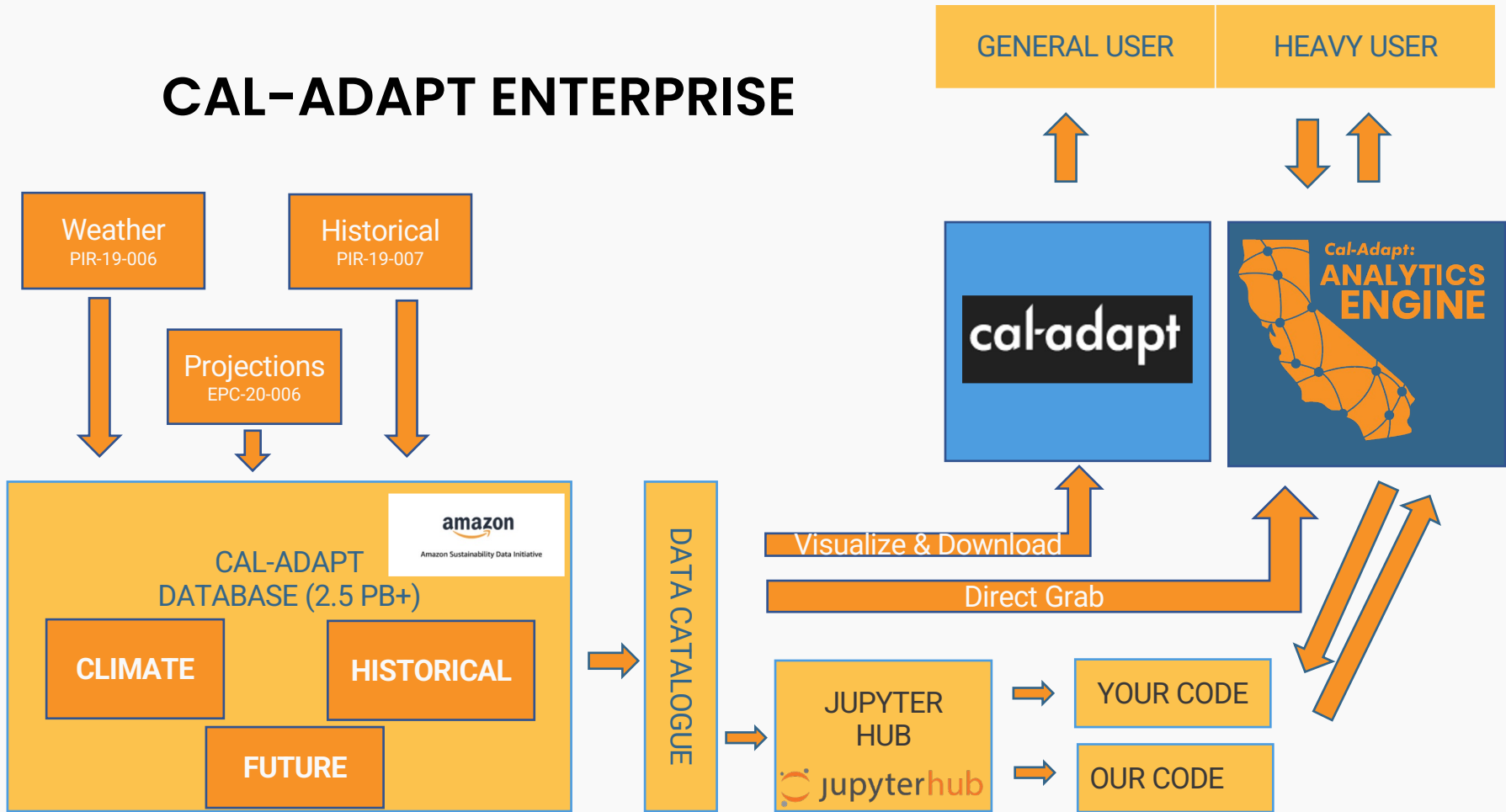
Recent weather and past weather observations and information. ERA and LBNL (PIR-19-006)

## 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





# The Analytics Engine





*Cal-Adapt:*  
**ANALYTICS  
ENGINE**

**What is the  
Analytics Engine?**

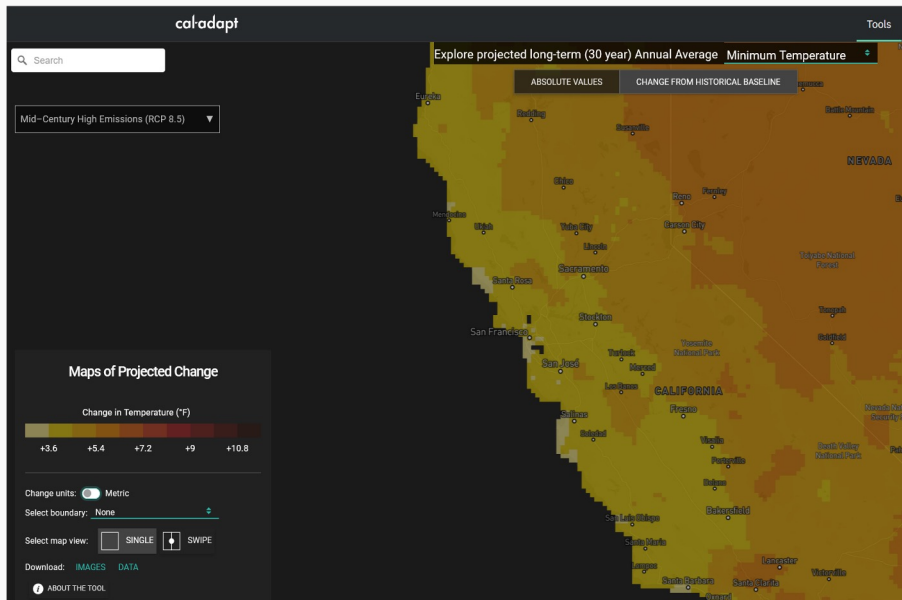
# How does the Analytics Engine work?



# When to use Cal-Adapt vs. the Analytics Engine

cal-adapt

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



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

```
[4]: app = ck.Application()
[5]: app.select()
[5]: Timescale: monthly
Time slice: 1971 .. 2070
Variable: 2m Air Temperature
45 km | 9 km
[6]: my_data = app.retrieve()
```

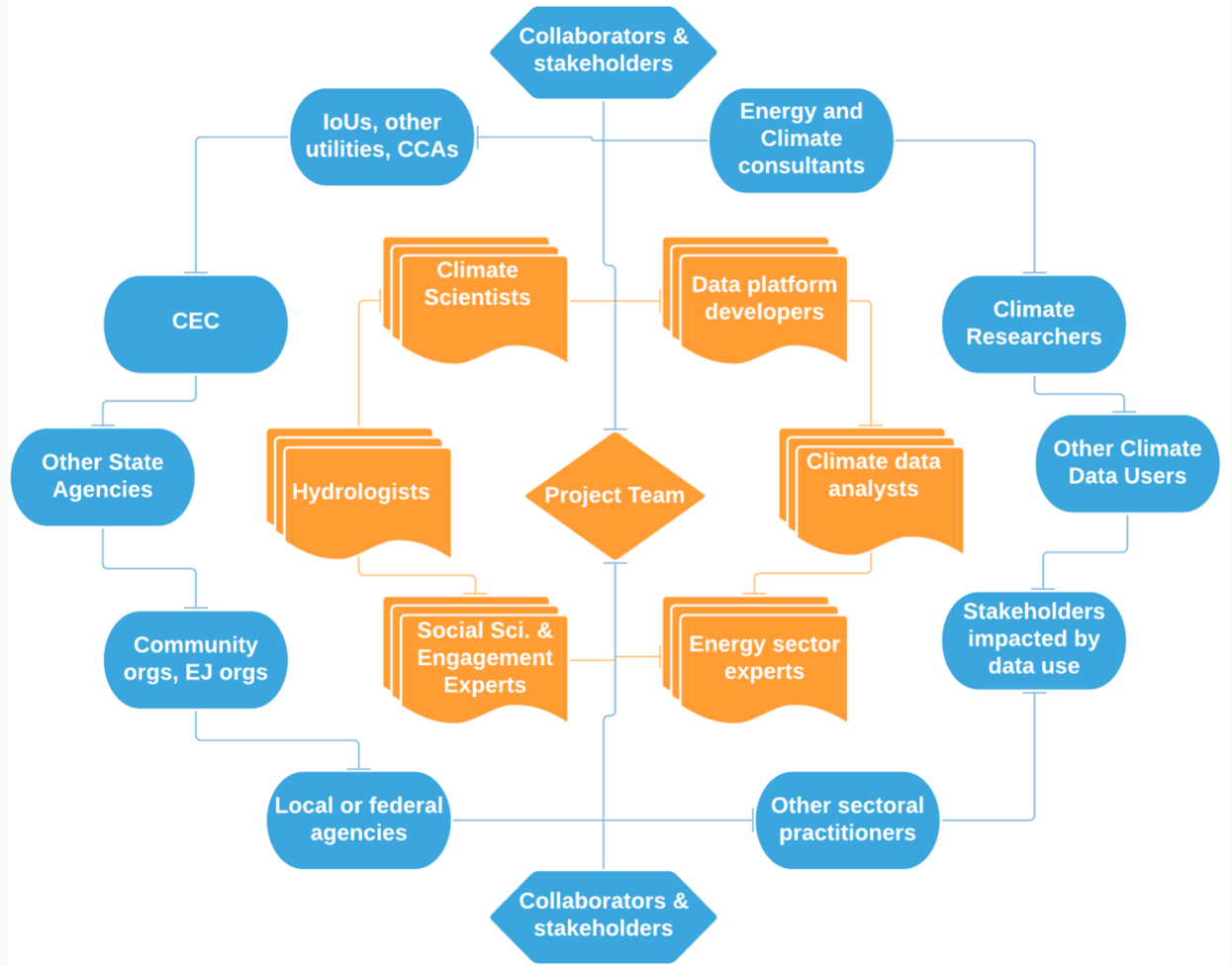


*Cal-Adapt:*  
**ANALYTICS  
ENGINE**

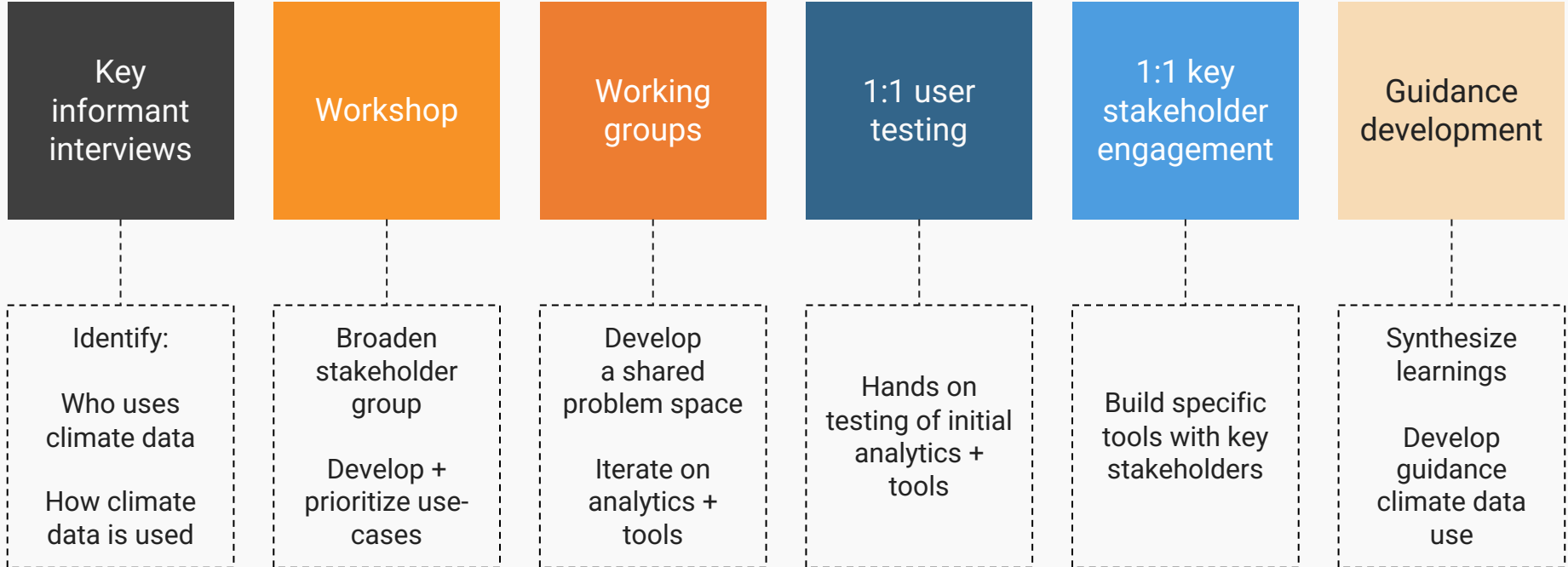
# Engagement Process

# A co-production approach

Co-create the data,  
analytics and  
platform with users,  
collaborators and  
stakeholders



# Co-production process and activities



# Stakeholder map + interviews

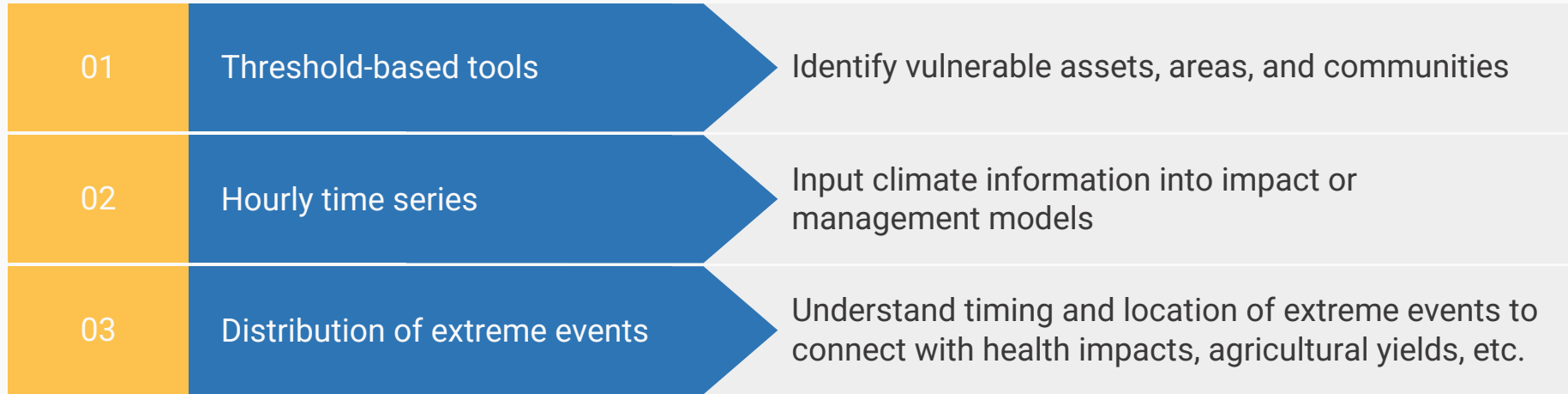


*Users of climate information for climate adaptation include:*

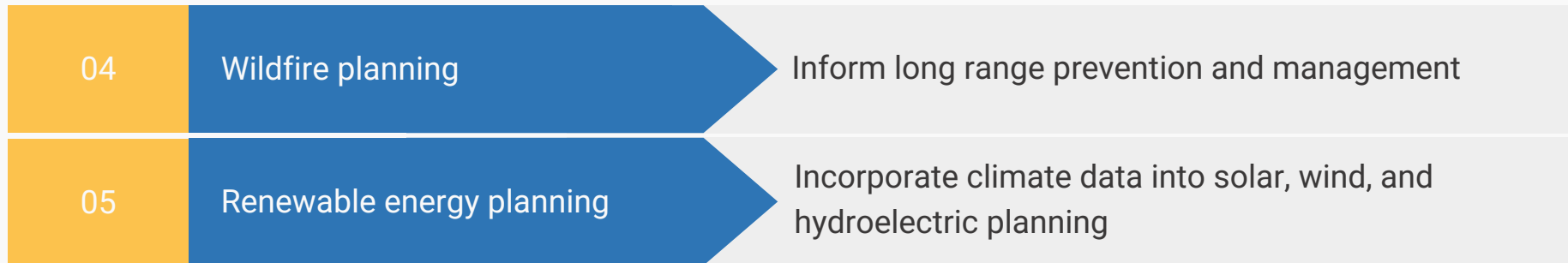
Policy Users, Academics / Researchers, Public Consumer & Learners, and  
Semi-Technical & Technical Users

# Use-Cases

Initial priorities:



In development:





# Cross-cutting issues

01

Uncertainty of climate data

Understand climate model uncertainty and natural variability of the climate system

02

Credibility of climate data

Assess data credibility and learn which data to use to address a specific problem

# Notebook development

## Cal-Adapt Analytics Engine

WORKING GROUP 3 - June 23, 2022

### Group discussion 2: Stakeholder feedback on the Threshold Tools notebook

#### Definitions refresher

**Return period:** estimates the average time between extreme events of a certain value. This is sometimes worded as a "1 in x years" event.

**Return value:** refers to a value or intensity (of temperature, precipitation, or another variable) that would be expected to be exceeded once every return period, or a 1-in-X year event. Effectively it is the inverse of the return period. Instead of wondering how often an extreme heat event will occur, we are instead considering what an extreme temperature event would look like once in any given time period.

#### Guiding questions

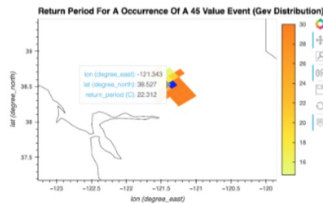
1. What specific **applications** would you use a 1-in-X year threshold event result for?
  - a. What applications would you use a **return period** for, for a selected return value? [e.g. how frequently an extreme event of x-degrees temperature or x-inches rainfall could occur]

Calculate return period for a selected return value

**Use-Case Example:** A electric utility with existing electrical infrastructure in Sacramento wants to calculate the return period of a 45 degrees C temperature event that occurred historically (during the 1980-2010 time period) as a benchmark input for their recurring asset vulnerability assessment.

Visualize return period

```
threshold_tools.get_geospatial_plot(sacramento_1980_ry, data_variable='return_period', bar_max=37)
```



- What specific applications would use use this tool to address?
- How do you currently do these analyses at your agency?
- What variables, resolutions, temporal and spatial scales of data are required?
- What data platform features are required?
- How do you want to output the data?

# Notebook development

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#### Guiding questions

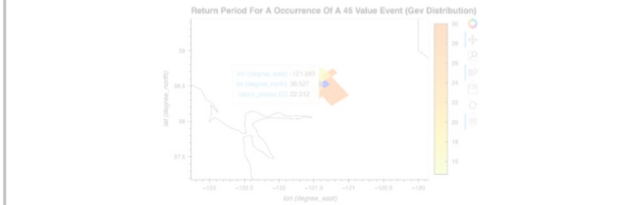
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Calculate return period for a selected return value

Use-Case Example: A electric utility with existing electrical infrastructure in Sacramento wants to calculate the return period of a 45 degrees C temperature event that occurred historically (during the 1960-2010 time period) as a benchmark input for their resourcing asset vulnerability assessment.

Visualize return period

threshold\_tools\_get\_precipital\_100\_returnperiods\_1960\_pp\_data\_variable=return\_period; var\_precip(3)



## Cal-Adapt Analytics Engine

WORKING GROUP 3 - June 23, 2022

State Agency - Drainage design, sizing based on historical data. I will be interested about the overall distribution. Let's say what is the distribution of a 3-day 100-year duration event. It will be important for economic analysis. It is a back and forth exercise. I am trying to find a figure...

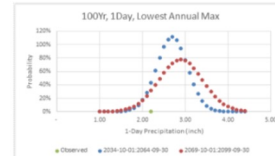


Figure 4: Normal probability distribution function of the 100-year return period 1-day extreme precipitation representative of 10 General Circulation Model with 2 Representative Concentration Pathways. The green dot represents the historical data, the blue dots represent the mid-century projection, and the red dots represent the late-century projection.

Table 3. 100-year return period event with a 1-day duration for the mid- and late-century precipitation projection and multiple probabilities ranging from 50% to 95% and their corresponding percentage change from historical data.

Probability	Mid-Century (2034-10-01:2064-09-30)		Late-Century (2069-10-01:2099-09-30)	
	Precipitation P (inch)	Percentage Change from Historic	Precipitation P (inch)	Percentage Change from Historic
50%	2.7	22%	2.9	32%
60%	2.8	27%	3.0	38%
70%	2.9	31%	3.2	41%
80%	3.0	36%	3.3	51%
90%	3.2	43%	3.6	62%
95%	3.4	49%	3.7	70%

IOU - We use these estimates mostly for asset-specific analyses. For example, if we know an asset class is sensitive to 110 degree heat, we can prioritize where we want to further study our system. It is also helpful to look at which regions change the most for this type of analysis.

Research Organization - Knowing the return period for a specific value is helpful, but it would also be helpful to know the return period for a specific variable for a particular duration. For example, how often would you expect to see temperature exceeding a threshold for 3 days? 5 days, etc.?

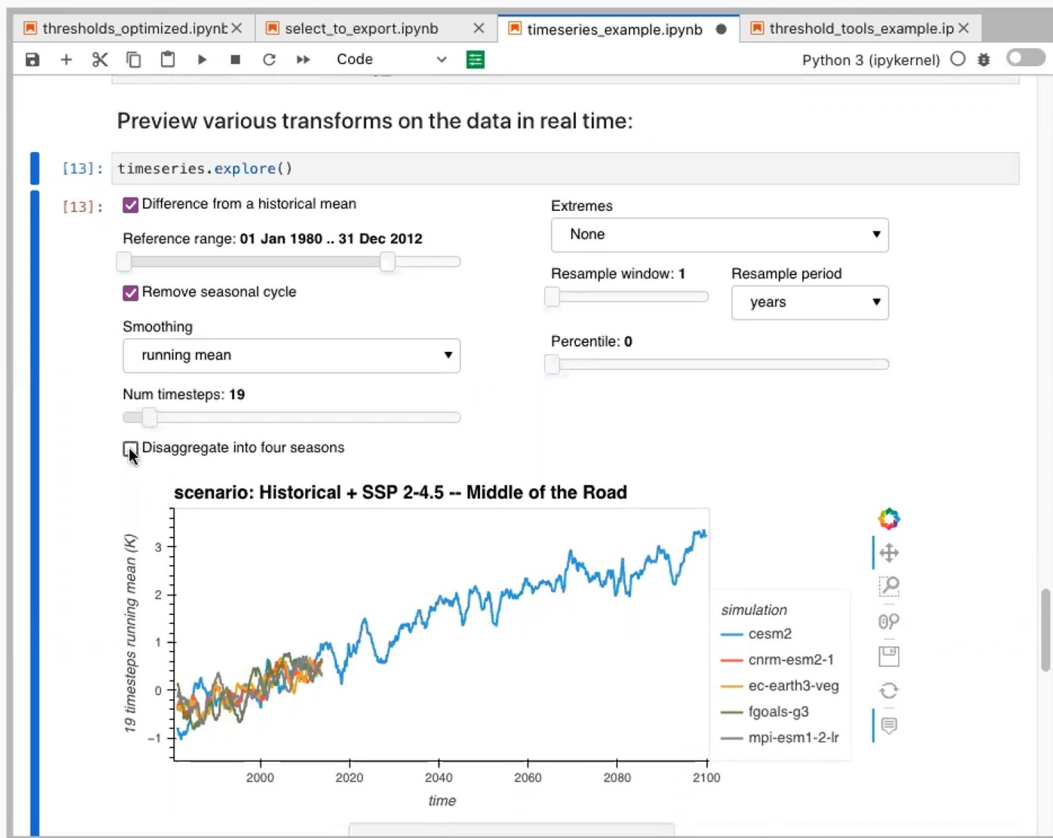
- I see a similar comment from SCE above. The ability to specify the temporal duration would be a valuable functionality.

State Agency - Not using this functionality at this time

IOU - For asset thresholds and building standards, understanding how often an asset will be exposed to a certain hazard or level of hazard is very helpful for system planning

Consultant - We would use it to convert to load or grid events for the purpose of reliability planning.

# Notebook development



# Systematic review of data

## Lack of data

- Hourly data
- Granular spatial data
- Data on application-relevant metrics
- Translating climate data into impact metrics
- Cascading and compounding events

## Accessing and working with available projections

- Downloading large data
- Computing power
- Cleaning and aggregating data

## Appropriateness of approach for different contexts

- RCP 8.5 for all decisions? Median vs 90th percentile of models?
- Sampling variability?
- How to compute delta?
- To what extent do results differ if approaches change?

# Current engagement



1:1 key stakeholder engagement

# Current engagement



1:1 key stakeholder engagement



Develop guidance on best practices  
for using climate data



*Cal-Adapt:*  
**ANALYTICS  
ENGINE**

# How You Can Benefit from the Analytics Engine



**Analytics Engine  
Benefits**

# **The Cal-Adapt Analytics Engine**

1. Reputable, sanctioned climate data localized for California
2. Scientifically rigorous (but approachable) analytical tools
3. Computational resources to assess vulnerability and plan

**Analytics Engine  
Benefits**

# **What data will be included?**

Users Expect:

- Rigorous, scientifically sound
- Sanctioned
- Appropriate for California

We Require:

- Open, peer-reviewed and reproducible
- Rigorous metadata and documentation
- Consistent with state guidelines for climate data use

**Analytics Engine  
Benefits**

# **Overview of data sources**

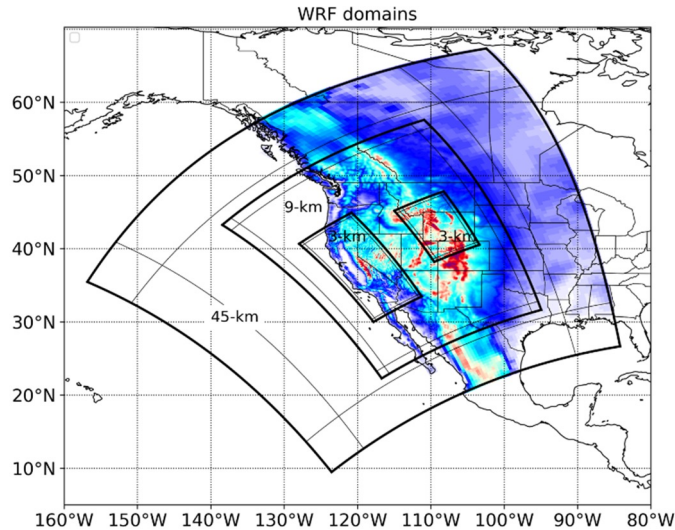
Foundational climate data for California's Fifth Climate Assessment

- Localized climate projections
- Historical observations

Derived products:

- Wildfire projections
- Renewable energy potential
- Hydrological modeling

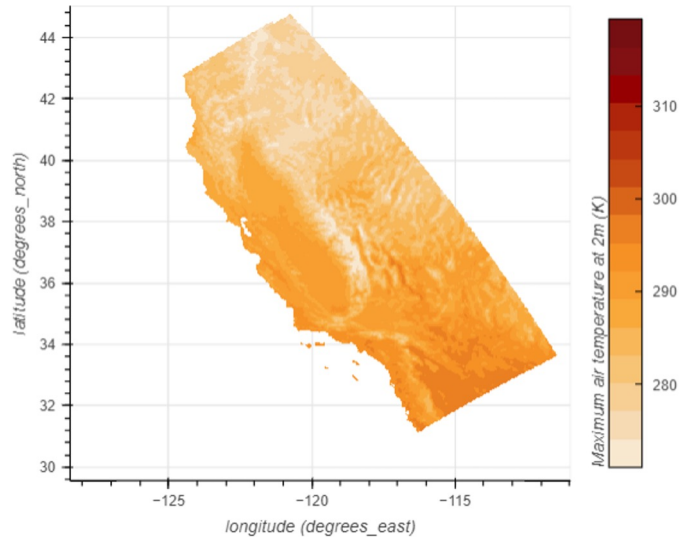
# Downscaled Climate Projections: WRF



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

**Data selection depends on your question of interest**

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

# Analytics Engine Benefits **Challenges**

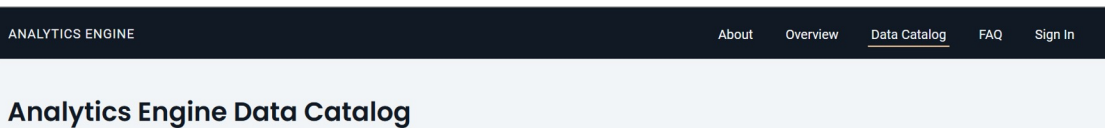
1. Types of Downscaling
2. Bias Correction
3. How fine scale?
4. What time points?
5. Massive datasets
6. Difficult to use formats



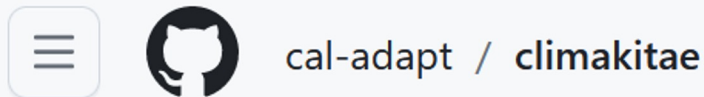
## Analytics Engine Benefits

# What's In the Analytics Engine

1. Data Catalogue



2. Climate functions



3. Notebooks for analysis



# Analytics Engine Benefits Data Catalogue

## Current Analytics Engine Data Catalog

Datasets available to download and analyze through Cal-Adapt: Analytics Engine

×

Downscaling Method	Institution	Source	Experiment	Variant	Frequency	Variable*	Resolution	Path
WRF	UCLA Center for Climate Science	CESM2	ssp245	r11i1p1f1	Hourly	prec	9-km (d02)	s3://cadcat/wrf/ucla/cesm2/ssp245/1hr/prec/d02/
WRF	UCLA Center for Climate Science	CESM2	ssp370	r11i1p1f1	Hourly	prec	45-km (d01)	s3://cadcat/wrf/ucla/cesm2/ssp370/1hr/prec/d01/
WRF	UCLA Center for Climate Science	CESM2	ssp370	r11i1p1f1	Hourly	prec	9-km (d02)	s3://cadcat/wrf/ucla/cesm2/ssp370/1hr/prec/d02/
WRF	UCLA Center for Climate Science	CESM2	ssp370	r11i1p1f1	Hourly	prec	3-km (d03)	s3://cadcat/wrf/ucla/cesm2/ssp370/1hr/prec/d03/
WRF	UCLA Center for Climate Science	CESM2	ssp585	r11i1p1f1	Hourly	prec	45-km (d01)	s3://cadcat/wrf/ucla/cesm2/ssp585/1hr/prec/d01/
WRF	UCLA Center for Climate Science	CESM2	ssp585	r11i1p1f1	Hourly	prec	9-km (d02)	s3://cadcat/wrf/ucla/cesm2/ssp585/1hr/prec/d02/
WRF	UCLA Center for Climate Science	CNRM-ESM2-1	historical	r1i1p1f2	Hourly	prec	45-km (d01)	s3://cadcat/wrf/ucla/cnrm-esm2-1/historical/1hr/prec/d01/
WRF	UCLA Center for Climate Science	CNRM-ESM2-1	historical	r1i1p1f2	Hourly	prec	9-km (d02)	s3://cadcat/wrf/ucla/cnrm-esm2-1/historical/1hr/prec/d02/
WRF	UCLA Center for Climate Science	CNRM-ESM2-1	historical	r1i1p1f2	Hourly	prec	3-km (d03)	s3://cadcat/wrf/ucla/cnrm-esm2-1/historical/1hr/prec/d03/
WRF	UCLA Center for Climate Science	CNRM-ESM2-1	ssp370	r1i1p1f2	Hourly	prec	45-km (d01)	s3://cadcat/wrf/ucla/cnrm-esm2-1/ssp370/1hr/prec/d01/

Items per page: 10 ▾

11–20 of 37 items

2 ▾ of 4 pages

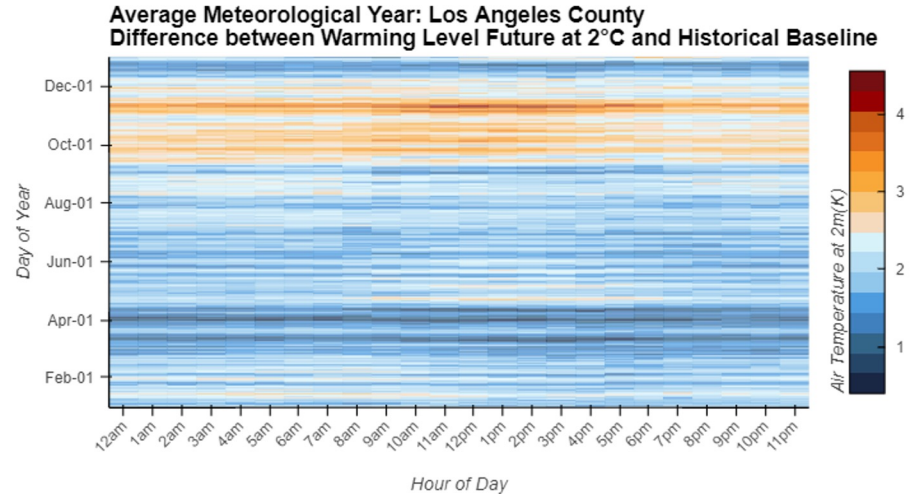
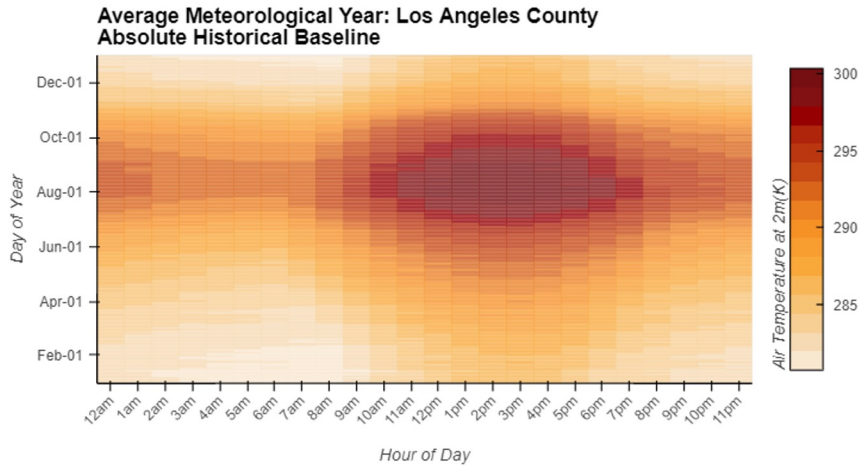
◀ ▶

\* See variable descriptions here

# Analytics Engine Benefits

## Climate Functions

Prebuilt functions which can be called through the ClimakitAE library



# Analytics Engine Benefits

## Jupyter 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

### Threshold event options

Direction:  Value (units: K):

I'm interested in extreme conditions that last for ...

Show me a timeseries of the number of occurrences every ...

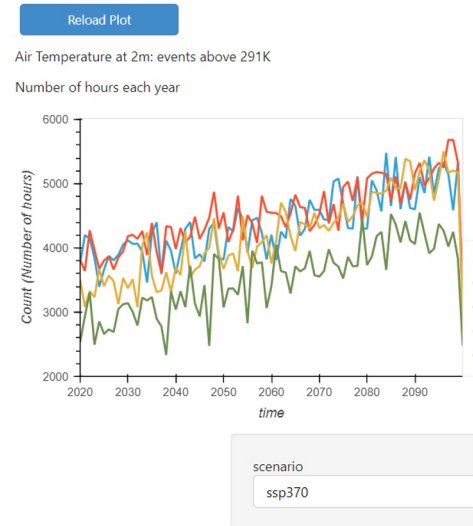
Examples: for an annual timeseries, select '1-year'. For a seasonal timeseries, select '3-month'.

Optional aggregation: I'm interested in the number of \_\_\_ that contain at least one occurrence.

After aggregation, I'm interested in occurrences that last for ...

### Smoothing

Smoothing:





*Cal-Adapt:*  
**ANALYTICS  
ENGINE**

# Getting Started with the Analytics Engine

# Getting Started with the Analytics Engine

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

Variable:

Air Temperature at 2m

Temperature of the air 2m above Earth's surface. This is the measure of air temperature used for most modeling applications.

**Historical Data:**

Estimates of recent historical climatic conditions

- Historical Climate  
 Historical Reconstruction

**Future Model Data:**

Shared Socioeconomic Pathways (SSPs) represent different global emissions scenarios

- SSP 3-7.0 -- Business as Usual  
 SSP 2-4.5 -- Middle of the Road  
 SSP 5-8.5 -- Burn it All

**Variable Units:**

- K  
 degC  
 degF

**Timescale:**

- monthly  
 daily  
 hourly

**Model Grid-Spacing:**

- 3 km  
 9 km  
 45 km



Subset the data by...

none

Location selection

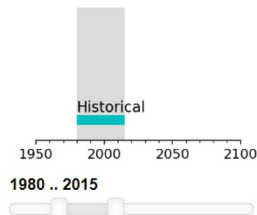
entire domain

Latitude: 32.50 .. 42

Longitude: -125.50 .. -114

Compute an area average across grid cells within your selected region?

- Yes  No



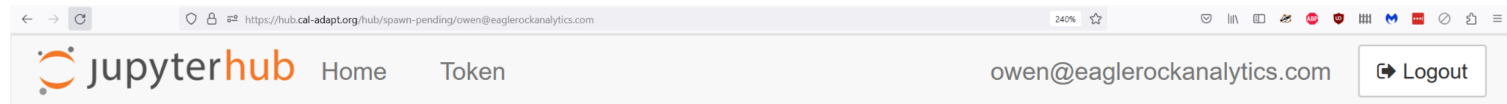
# Getting Started with the Analytics Engine



Regular Site

Sign in with AWS Cognito

# Getting Started with the Analytics Engine



Your server is starting up.

You will be redirected automatically when it's ready for you.



2023-07-28T21:39:57Z [Normal] Started container notebook

Event log



# Getting Started with the Analytics Engine

The image shows the 'Launcher' application interface. At the top, there is a menu bar with 'File', 'Edit', 'View', 'Run', 'Kernel', 'Git', 'Tabs', 'Settings', and 'Help'. Below the menu bar is a toolbar with icons for adding, deleting, and refreshing. A search bar labeled 'Filter files by name' is present. The left sidebar shows a file explorer for the directory '/ cae-notebooks /'. It lists files and folders with their last modified dates. The main workspace is titled 'cae-notebooks' and contains a 'Notebook' section with three options: 'Python 3 (ipykernel)', 'panel [/]', and 'Python [conda env.notebook] \*'. Below this is a 'Console' section with two options: 'Python 3 (ipykernel)' and 'Python [conda env.notebook] \*'. At the bottom, there is an 'Other' section with five icons: 'Terminal', 'Text File', 'Markdown File', 'Python File', and 'Show Contextual Help'. The status bar at the bottom shows 'Simple', a progress indicator, '0', '2', 'main', and 'Mem: 539.61 / 6144.00 MB'.

Launcher

File Edit View Run Kernel Git Tabs Settings Help

Filter files by name

/ cae-notebooks /

Name	Last Modified
catalog_a...	a month ago
specific_u...	5 months ago
work_in_...	21 days ago
AE_navig...	a month ago
compare_...	15 days ago
dfo_annu...	8 months ago
dfo_annu...	9 months ago
explore_a...	a month ago
explore_l...	a month ago
explore_...	a month ago
explore_...	a month ago
explore_...	a month ago
getting_st...	a month ago
LICENSE	a year ago
README...	a year ago
threshold...	5 months ago
threshold...	7 months ago
threshold...	a month ago
threshold...	21 days ago
threshold...	15 days ago

cae-notebooks

Notebook

- Python 3 (ipykernel)
- panel [/]
- Python [conda env.notebook] \*

Console

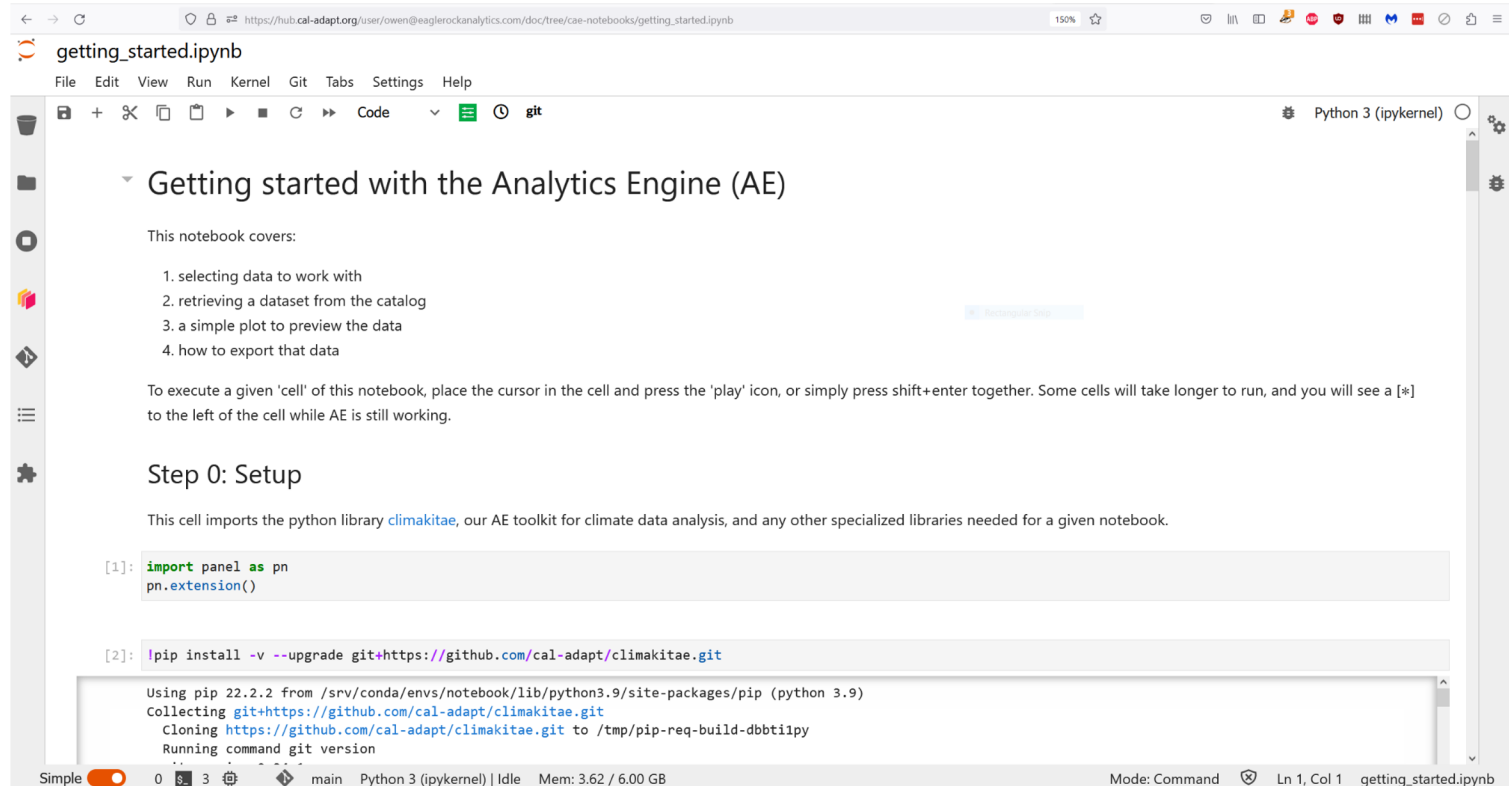
- Python 3 (ipykernel)
- Python [conda env.notebook] \*

Other

- Terminal
- Text File
- Markdown File
- Python File
- Show Contextual Help

Simple 0 2 main Mem: 539.61 / 6144.00 MB Launcher

# Getting Started with the Analytics Engine



getting\_started.ipynb

File Edit View Run Kernel Git Tabs Settings Help

Python 3 (ipykernel)

## Getting started with the Analytics Engine (AE)

This notebook covers:

1. selecting data to work with
2. retrieving a dataset from the catalog
3. a simple plot to preview the data
4. how to export that data

To execute a given 'cell' of this notebook, place the cursor in the cell and press the 'play' icon, or simply press shift+enter together. Some cells will take longer to run, and you will see a [\*] to the left of the cell while AE is still working.

### Step 0: Setup

This cell imports the python library [climakitae](#), our AE toolkit for climate data analysis, and any other specialized libraries needed for a given notebook.

```
[1]: import panel as pn
     pn.extension()
```

```
[2]: !pip install -v --upgrade git+https://github.com/cal-adapt/climakitae.git
```

```
Using pip 22.2.2 from /srv/conda/envs/notebook/lib/python3.9/site-packages/pip (python 3.9)
Collecting git+https://github.com/cal-adapt/climakitae.git
  Cloning https://github.com/cal-adapt/climakitae.git to /tmp/pip-req-build-dbbti1py
  Running command git version
```

Simple 0 3 main Python 3 (ipykernel) | Idle Mem: 3.62 / 6.00 GB Mode: Command Ln 1, Col 1 getting\_started.ipynb

# Getting Started with the Analytics Engine

The screenshot shows a Jupyter Notebook window titled 'getting\_started.ipynb'. The main content area displays a configuration panel for the Cal-Adapt Analytics Engine. The panel is titled 'Choose Data Available with the Cal-Adapt Analytics Engine' and contains several sections for data selection:

- Data type:** Radio buttons for 'Gridded' (selected), 'Station', and 'Station'.
- Downscaling method:** Checkboxes for 'Dynamical' (checked) and 'Statistical'.
- Variable:** A dropdown menu set to 'Air Temperature at 2m'. Below it is a descriptive text: 'Temperature of the air 2m above Earth's surface. This is the measure of air temperature used for most modeling applications.'
- Historical Data:** Checkboxes for 'Historical Climate' (checked) and 'Historical Reconstruction'.
- Future Model Data:** Checkboxes for 'SSP 3-7.0 -- Business as Usual', 'SSP 2-4.5 -- Middle of the Road', and 'SSP 5-8.5 -- Burn it All' (checked). Below this is a small bar chart showing 'Historical SSP 5-8.5' with a red bar from 1950 to 2100.
- Variable Units:** Radio buttons for 'K', 'degC', and 'degF' (selected).
- Timescale:** Radio buttons for 'daily' (selected), 'monthly', and 'hourly'.
- Model Grid Spacing:** Radio buttons for '3 km', '9 km' (selected), and '45 km'.
- Weather station:** Checkboxes for 'Set data type to 'Station' to see options' (checked).
- Location selection:** A dropdown menu set to 'Los Angeles County'.
- Latitude:** A slider set to 32.50 .. 42.
- Longitude:** A slider set to -125.50 .. -114.
- Compute an area average across grid cells within your selected region?** Radio buttons for 'Yes' and 'No' (selected).

At the bottom of the panel, it says: 'Nothing is required to enter these selections, besides moving on to Step 2.'

The Jupyter Notebook interface includes a top menu bar (File, Edit, View, Run, Kernel, Git, Tabs, Settings, Help) and a bottom status bar showing 'Simple', '0', '3', 'main', 'Python 3 (ipykernel) | Idle', and 'Mem: 3.73 / 6.00 GB'.

# Getting Started with the Analytics Engine

getting\_started.ipynb

File Edit View Run Kernel Git Tabs Settings Help

(+ will create a new cell, following the currently selected)

## Step 2: Retrieve data

Call `app.retrieve()`, to assign the subset/combo of data specified to a variable name of your choosing, in an xarray `DataArray` format.


```
[14]: data_to_use = app.retrieve()
```

You can preview the data in the retrieved, aggregated dataset when this is complete.

```
[15]: data_to_use
```

```
[15]: xarray.DataArray 'Air Temperature at 2m' (scenario: 1, simulation: 1, time: 43808, y: 23, x: 22)
```

	Array	Chunk	1
Bytes	84.56 MiB	5.69 MiB	1
Shape	(1, 1, 43808, 23, 22)	(1, 1, 3388, 20, 22)	
Count	56 Graph Layers	40 Chunks	
Type	float32	numpy.ndarray	



Coordinates:

	(time)	datetime64[ns]	1980-09-01 ... 2100-08-31
time	(time)	datetime64[ns]	1980-09-01 ... 2100-08-31
x	(x)	float64	-4.215e+06 ... -4.026e+06
y	(y)	float64	7.459e+05 7.549e+05 ... 9.439e+05
simulation	(simulation)	<U26	'WRF_CESM2_r11p1f1'
lakemask	(y, x)	float32	0.0 0.0 0.0 0.0 ... 0.0 0.0 0.0 0.0
landmask	(y, x)	float32	0.0 0.0 0.0 0.0 ... 1.0 1.0 1.0 1.0
lat	(y, x)	float32	32.76 32.81 32.86 ... 35.18 35.23
lon	(y, x)	float32	-118.5 -118.4 ... -118.1 -118.0
Lambert_Confor...	0	int64	0
scenario	(scenario)	<U37	'Historical + SSP 5-8.5 -- Burn ...

Attributes:

variable\_id: t2  
extended\_descri... Temperature of the air 2m above Earth's surface. This is the measure of air temperature use  
d for most modeling applications.  
units: degF  
data\_type: Gridded  
resolution: 9 km  
frequency: daily  
location\_subset: Los Angeles County  
institution: UCLA  
grid\_mapping: Lambert\_Conformal

Simple 0 0 3 0 main Python 3 (ipykernel) | Idle Mem: 3.74 / 6.00 GB

# Getting Started with the Analytics Engine

getting\_started.ipynb

File Edit View Run Kernel Git Tabs Settings Help

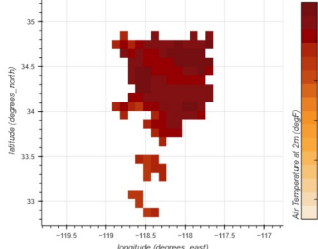
Step 3: Visualize data

Preview the data before doing further calculations.

```
[17]: app.view(data_to_use)
```

```
[17]:
```

time: 2098-08-19 00:00:00, scenario: Historical + SSP 5-8.5 -- Burn  
simulation: WRF\_CESM2\_r11i(p1f1)



latitude (degrees\_north)

longitude (degrees\_east)

Air Temperature at 2m (degF)

time: 2098-08-19 00:00:00

scenario  
Historical + SSP 5-8.5 -- Burn # All

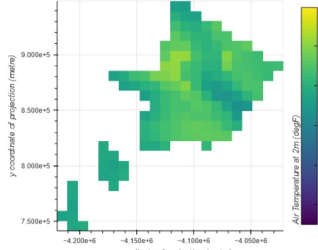
simulation  
WRF\_CESM2\_r11i(p1f1)

The data previewer is also customizable: Check out an example where the display colors and coordinates are modified.

```
[18]: app.view(data_to_use, lat_lon = False, cmap = "viridis")
```

```
[18]:
```

scenario: Historical + SSP 5-8.5 -- Burn # All, simulation: WRF  
time: 1980-09-01 00:00:00



y coordinate of projection (metre)

x coordinate of projection (metre)

Air Temperature at 2m (degF)

scenario  
Historical + SSP 5-8.5 -- Burn # All

simulation  
WRF\_CESM2\_r11i(p1f1)

time: 1980-09-01 00:00:00

# Getting Started with the Analytics Engine

The screenshot shows a JupyterLab notebook titled "getting\_started.ipynb". The interface includes a top menu bar with "File", "Edit", "View", "Run", "Kernel", "Git", "Tabs", "Settings", and "Help". Below the menu is a toolbar with icons for file operations and a "Code" dropdown menu. The notebook content is as follows:

## Step 4: Export data

To export, first pick a format from the dropdown menu.

- We recommend NetCDF, which will work with any number of variables and dimensions in your dataset
- CSV and GeoTIFF can only be used for data arrays with one variable
- CSV works best for up to 2-dimensional data (e.g., lon x lat), and will be compressed and exported with a separate metadata file
- GeoTIFF can accept 3 dimensions total:
  - X and Y dimensions are required
  - The third dimension is flexible and will be a "band" in the file: time, simulation, or scenario could go here
  - Metadata will be accessible as "tags" in the .tif

```
[12]: app.export_as()
```

[12]: **\_FileSelector**

Output file format

Pick a file format

Next, write in the object you wish to export and your desired filename (in single or double quotation marks).

```
[13]: app.export_dataset(data_to_use, 'my_filename')
```



*Cal-Adapt:*  
**ANALYTICS  
ENGINE**

**What's in  
Development?**

# Analytics Engine Developments

## Guidance and Help



- Convey appropriate use guidelines for climate data
- Help finding the subset of projections right for you



## Analytics Engine Developments

# More Data!

*Coming soon:*

- **Wildfire Projections**
- **Renewable Generation Profiles**
- **Three Hydrological Models**
- **Historical Weather Observations**
- **Potentially Additional Contributed Research Data**

## Analytics Engine Developments

# New Tools and Capabilities

*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
- **Wildfire indices:** derived proxies of wildfire risk from climate model data

# Analytics Engine Developments

## User Contributions

### *Co-Generation*

- Capacity to benefit less resourced groups

### **First examples of Cogeneration:**

- Department of Water Resources methods
- Derived data




# Check out the Analytics Engine!

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

Please email [analytics@cal-adapt.org](mailto:analytics@cal-adapt.org) with your request.



Let's jump into a panel Q&A session  
with our speakers!

# Q&A Session

# Thank you for your time!

**cal-adapt**



*Cal-Adapt:*  
**ANALYTICS  
ENGINE**

Learn more by visiting our websites!

Cal-Adapt: [cal-adapt.org](https://cal-adapt.org)

Analytics Engine: [analytics.cal-adapt.org](https://analytics.cal-adapt.org)

Get in touch!

Cal-Adapt: [support@cal-adapt.org](mailto:support@cal-adapt.org)

Analytics Engine: [analytics@cal-adapt.org](mailto:analytics@cal-adapt.org)