Visualizing Climate-Related Risks to the Natural Gas System using Cal-Adapt http://cal-adapt.org/

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Workshop on Integrating Climate Change in California Extension
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Kearney Agricultural Research and Extension Center in Parlier, CA

Cal-Adapt

Cal-Adapt

A Tool for Energy Sector Resilience and Research

Developed by UC Berkeley's Geospatial Innovation Facility

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with oversight and guidance from:

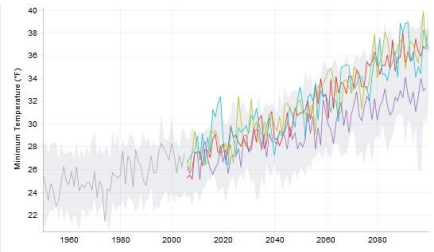
Susan Wilhelm, Energy Generation Research Office (EGRO)
Guido Franco, Team Lead for Environmental Research, EGRO

Our **Technical Advisory Committees** (past and present)
Stockholm Environmental Institute (prototype)
Amy Luers, then of google.org, key early collaborator

Cal-Adapt Mandate

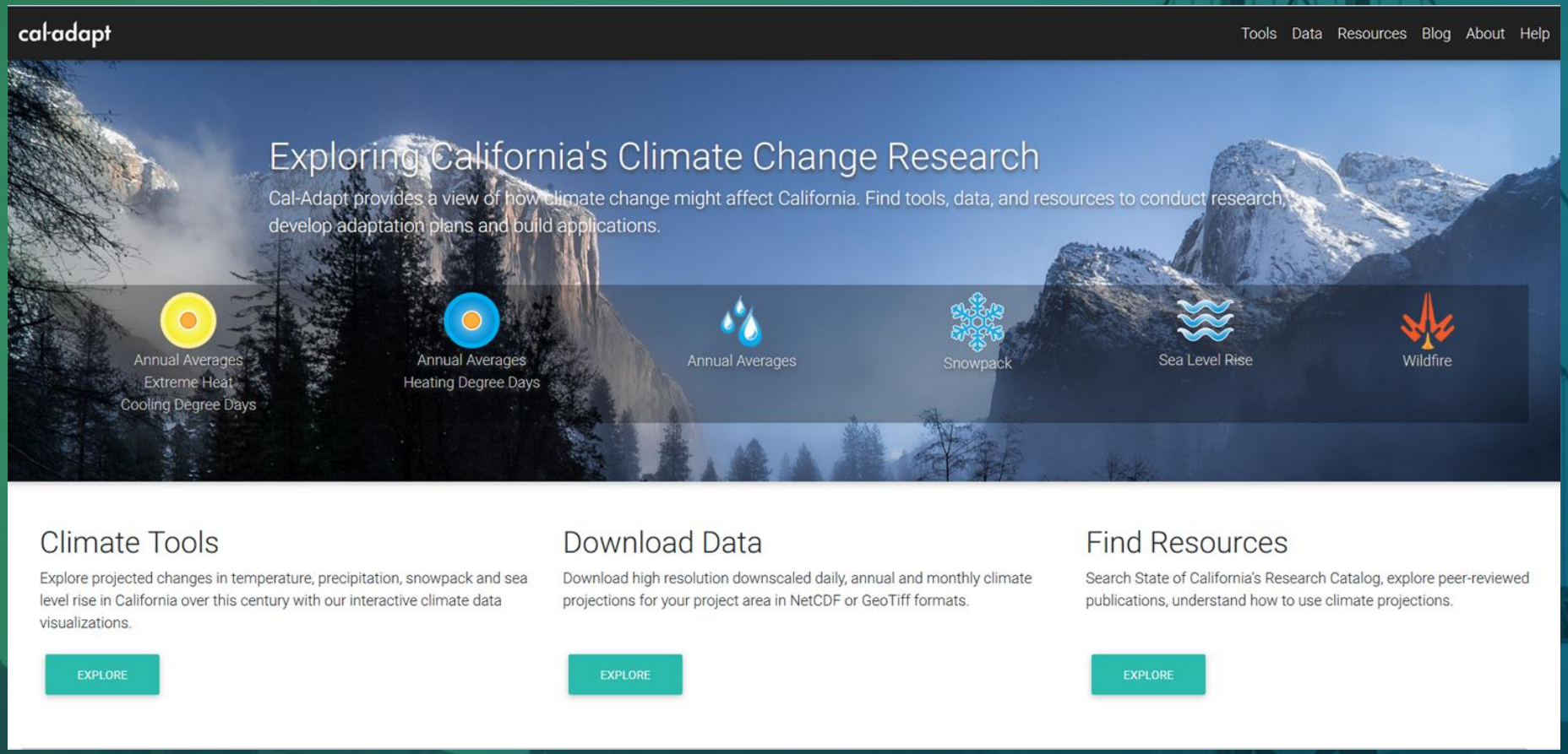
Cal-Adapt provides a scientific basis for exploring climate-related risks and resilience options for planning and adaptation.

- **Convey local climate risks** based on peer-reviewed science;
- Climate change projections presented in **easy-to-understand format** with plain English descriptions *and* scientific rigor;
- **Interactive maps and charts** provide a variety of approaches to explore different aspects of climate change;
- **Access to primary climate change data** for further analysis and research;
- Enable **development of custom tools** designed to manipulate climate change projections to support decision-making.



Cal-Adapt offers a variety of tools for exploring high-resolution projections of climate, including temperatures, precipitation, snowpack, sea level rise, and wildfire.

Cal-Adapt 2.0


cal-adapt
Tools
Data
Resources
Blog
About
Help
Exploring California's Climate Change Research
Cal-Adapt provides a view of how climate change might affect California. Find tools, data, and resources to conduct research, develop adaptation plans and build applications.
Annual Averages
Extreme Heat
Cooling Degree Days
Annual Averages
Heating Degree Days
Annual Averages
Snowpack
Sea Level Rise
Wildfire
Climate Tools
Explore projected changes in temperature, precipitation, snowpack and sea level rise in California over this century with our interactive climate data visualizations.
EXPLORE
Download Data
Download high resolution downscaled daily, annual and monthly climate projections for your project area in NetCDF or GeoTiff formats.
EXPLORE
Find Resources
Search State of California's Research Catalog, explore peer-reviewed publications, understand how to use climate projections.
EXPLORE

Cal-Adapt 2.0 Data: Higher Resolution, Higher Fidelity Data

- **Temperature and precipitation** at daily time steps from LOCA (Localized Climate Analogues) downscaled CMIP5 data, Scripps Institution of Oceanography (Pierce et al. 2014)
  - 1/16 degree grid, (~ 6km x 6km)
  - LOCA is better able to capture *extreme temperatures* and *spatial distribution* of precipitation
- **Inundation** (Delta as well as open coast and bay)
- Observed **historical** data (daily temperature, precipitation)
- **Wildfires**

Cal-Adapt 2.0: Enhanced Data Visualizations

- ***New boundary options***: users can aggregate and view data by a number of different boundary options including counties, census tracts, watersheds, etc.
  - Users can also upload their own custom boundary file in a number of different formats (shapefile, GeoJson, kml, etc.)
- ***Slider tools*** allow users to average values over user-specified time periods
- Ability to ***print charts*** to image file to easily include in reports
- Easy-to-understand ***text descriptions*** of visualization tools

Cal-Adapt 2.0: Improved Access to Data

- ***Save charts***: users can download data visualizations directly to PNG files
- ***CSV download***: time series shown can be downloaded directly as csv files for use in many software programs
- ***GeoTIFF***: users can download data for selected variables for use in many geospatial applications
- ***Primary NetCDF data***: researchers can directly access NetCDF data for many data sets including:
  - all 32 CMIP5 models for 2 RCP scenarios (RCP4.5 and RCP8.5)
  - VIC modeled variables for all 10 CA models
- ***Public API*** for custom tool development

Cal-Adapt is a Collection of Tools for Your Climate Change Work

locally relevant, based on latest peer-reviewed science, easy-to use, and useful

Climate Tools

Explore charts, maps and data of observed and projected climate variables for California. The tools show projections for two possible climate futures, one in which emissions peak around 2040 and then decline (RCP 4.5) and another in which emissions continue to rise throughout the 21st century (RCP 8.5). Both futures are considered possible depending on how much action we decide to take. Learn more about working with climate projections on our Resources page.

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 events for your location.

Sea Level Rise - CalFloD-3D

Explore maps of inundation location and depths for San Francisco Bay Area, Sacramento - San Joaquin Delta and the California coast during near 100 year storm events coupled with projected Sea Level Rise scenarios.

Snowpack

View timelapse animation and monthly averages of projected Snow Water Equivalent, a common measurement for snowpack.

Wildfire

Annual averages of area burned for combination of 4 GCMs, 2 RCPs and 3 population growth scenarios.

Cooling Degree Days and Heating Degree Days

Explore projected changes in Heating Degree Days and Cooling Degree Days, which are a common proxy for energy needed to heat and cool buildings

Stream Flow

Charts of VIC routed and bias corrected streamflows driven by LOCA downscaled temperature and precipitation.

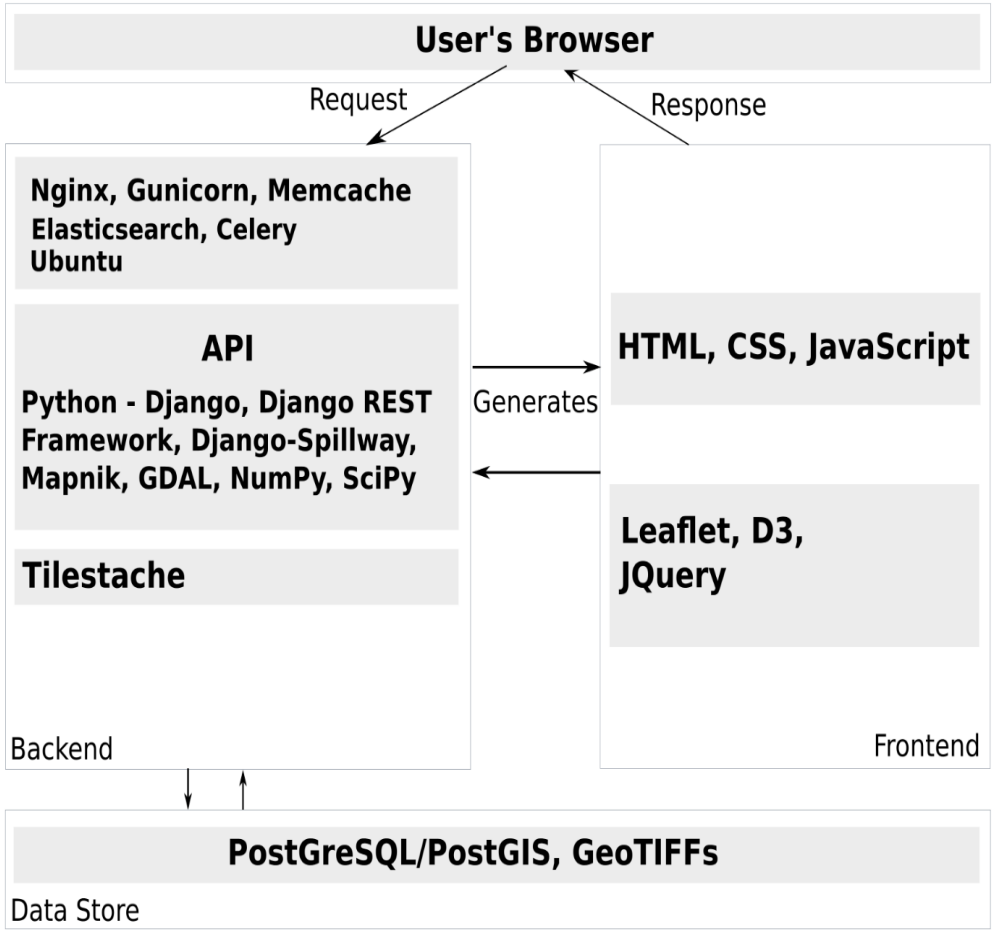
Long Drought Scenarios (LOCA)

Charts of temperature, precipitation plus a set of VIC variables from two 30 year drought periods.

Coming Soon

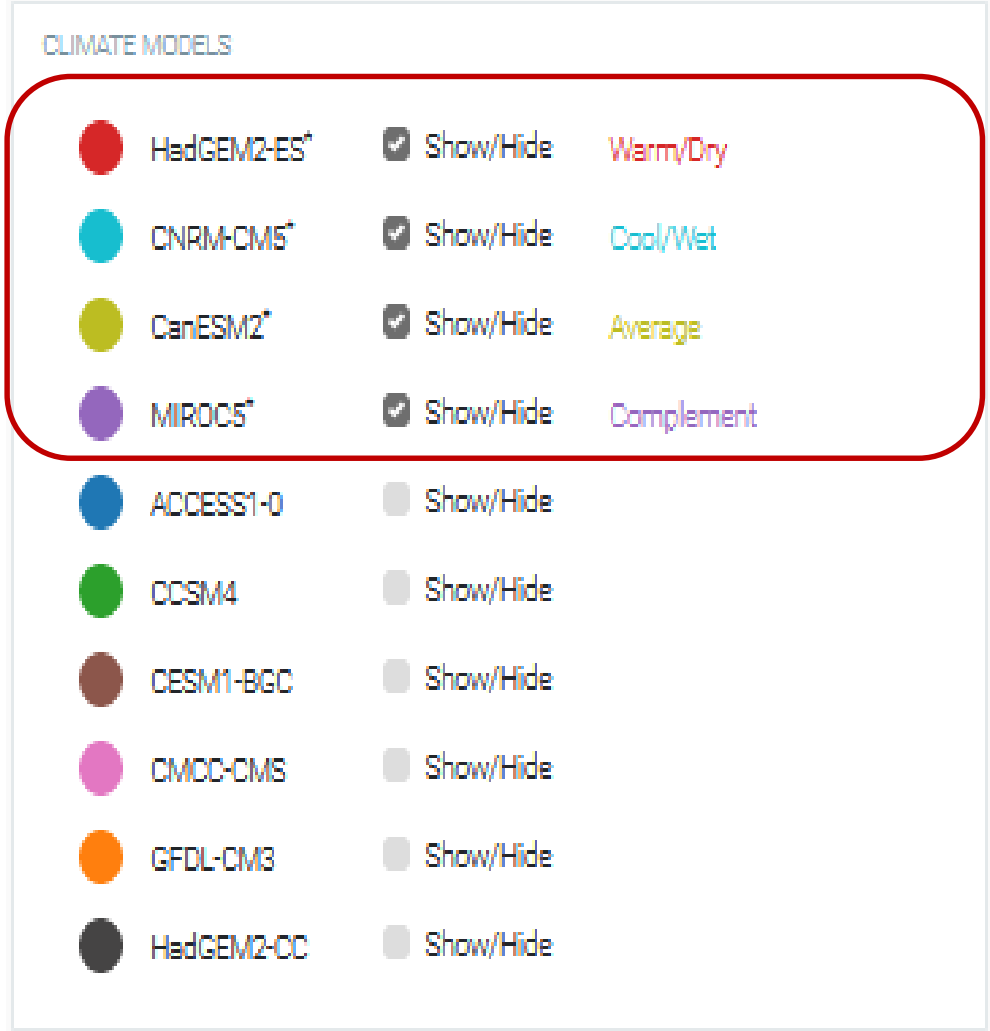
Cal-Adapt API: You Can Build Tools!

- Open source architecture powered by Django, Django REST framework and Django-Spillway, an open source library developed at the GIF
- Dynamic temporal aggregation of time series data
- Spatial aggregation by counties, climate regions, watersheds, census tracts, legislative districts
- Allows other organizations to access climate data and build domain specific visualization and planning tools



Providing Climate Scenarios To Assist Planning

- **Recommended scenarios available via Cal-Adapt**, which defaults to the four "priority" models chosen to represent a range of possible futures.
- These scenarios are the **basis for California's Fourth Climate Change Assessment.**
- IOUs requested set of common standards, timeframes, and scenarios to rely on for planning.
- OPR's <u>forthcoming guidance to state agencies will rely on these scenarios</u>, too.



Cal-Adapt 2.0 Tools

locally relevant, based on latest peer-reviewed science, easy-to use, and useful

http://cal-adapt.org/

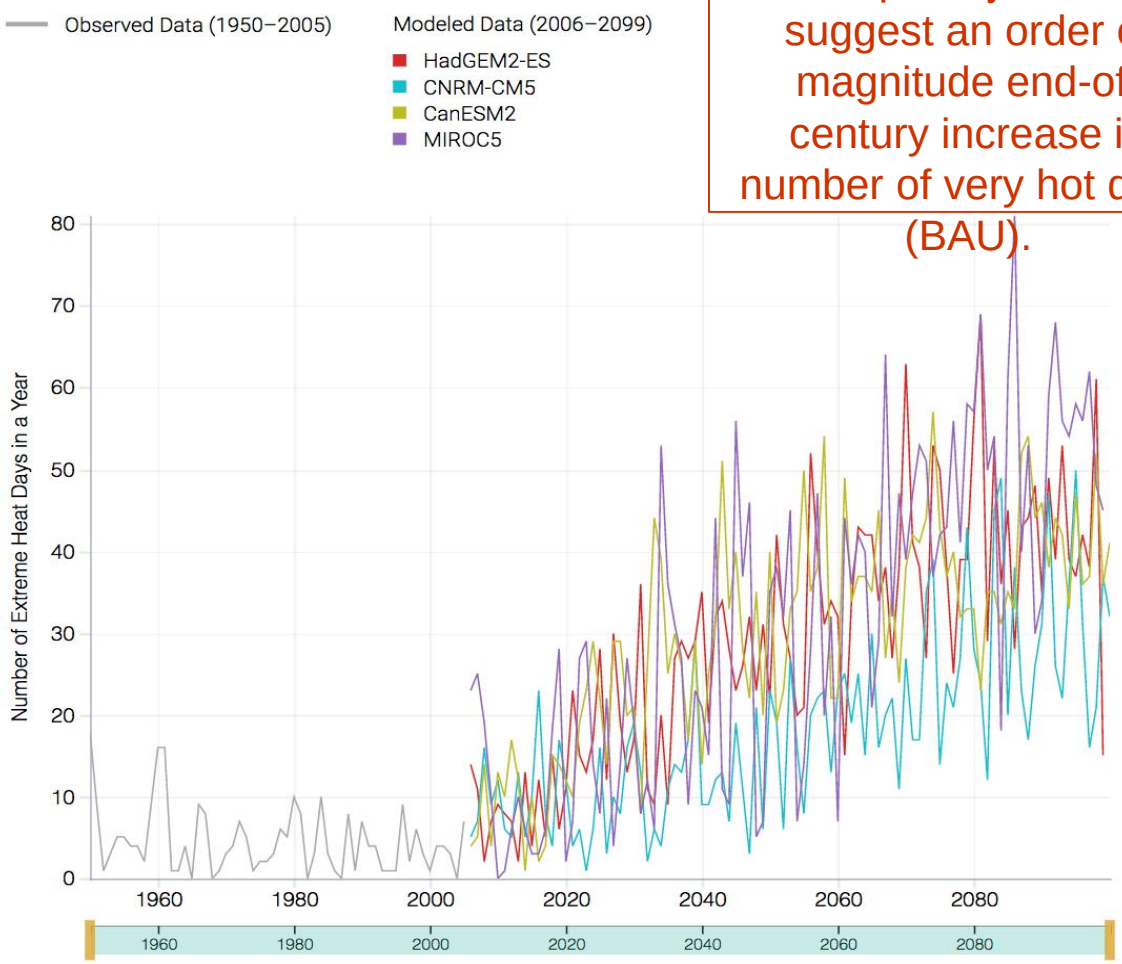
Example: Projected annual number of extreme heat days in Parlier

Number of Extreme Heat Days

GRID CELL (36.59375, -119.53125)

Emissions peak around 2040, then decline (RCP 4.5)

Four "priority" models suggest an order of magnitude end-of-century increase in number of very hot days (BAU).



SCENARIOS

RCP 4.5
Emissions peak around 2040, then decline

RCP 8.5
Emissions continue to rise strongly through 2050 and plateau around 2100

QUICK STATS

Extreme Heat Threshold

104.1°F

Average number of days with high above 104.1°F in 1961–1990

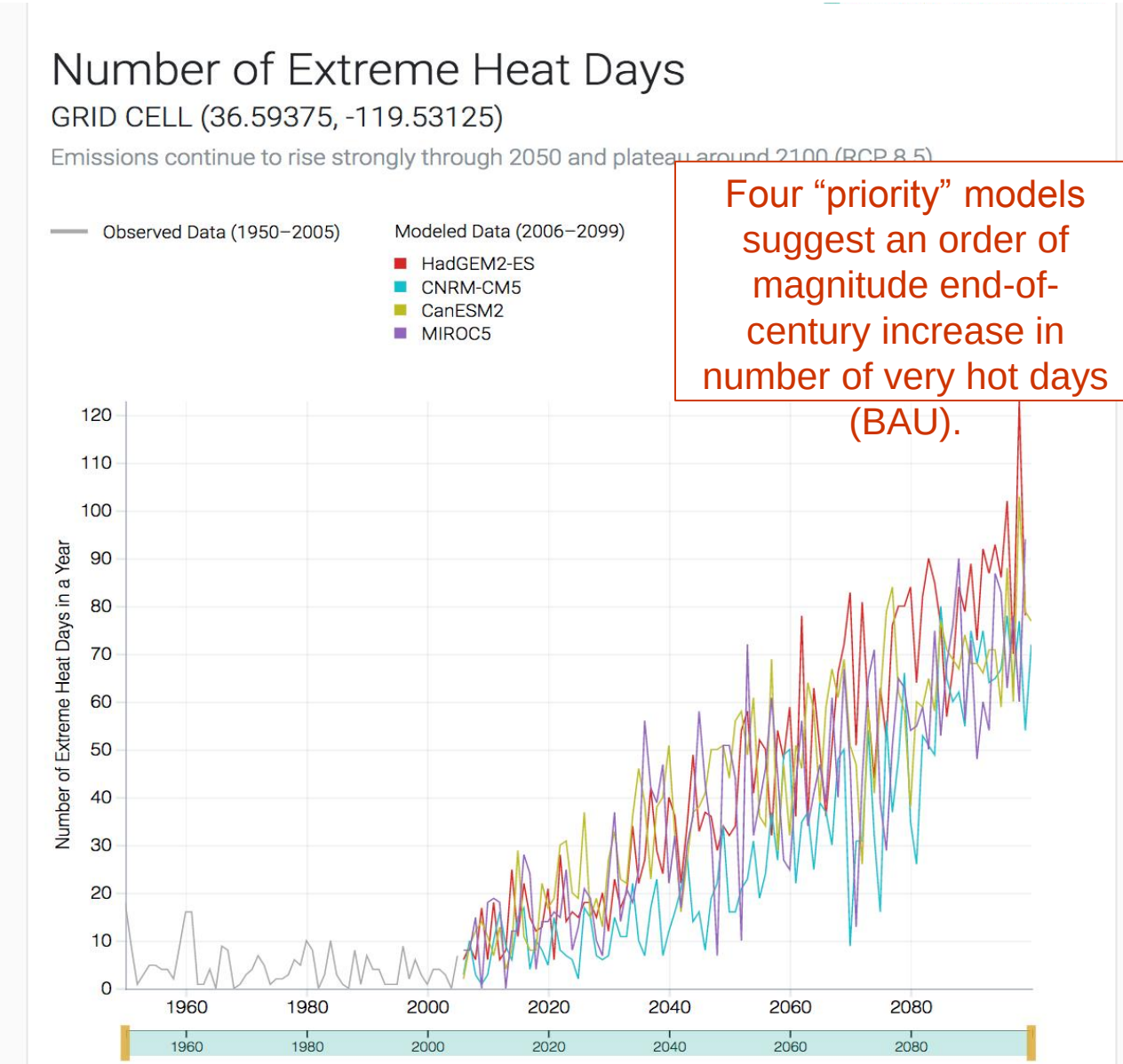
4.3

Average number of days with high above 104.1°F in 2070–2099

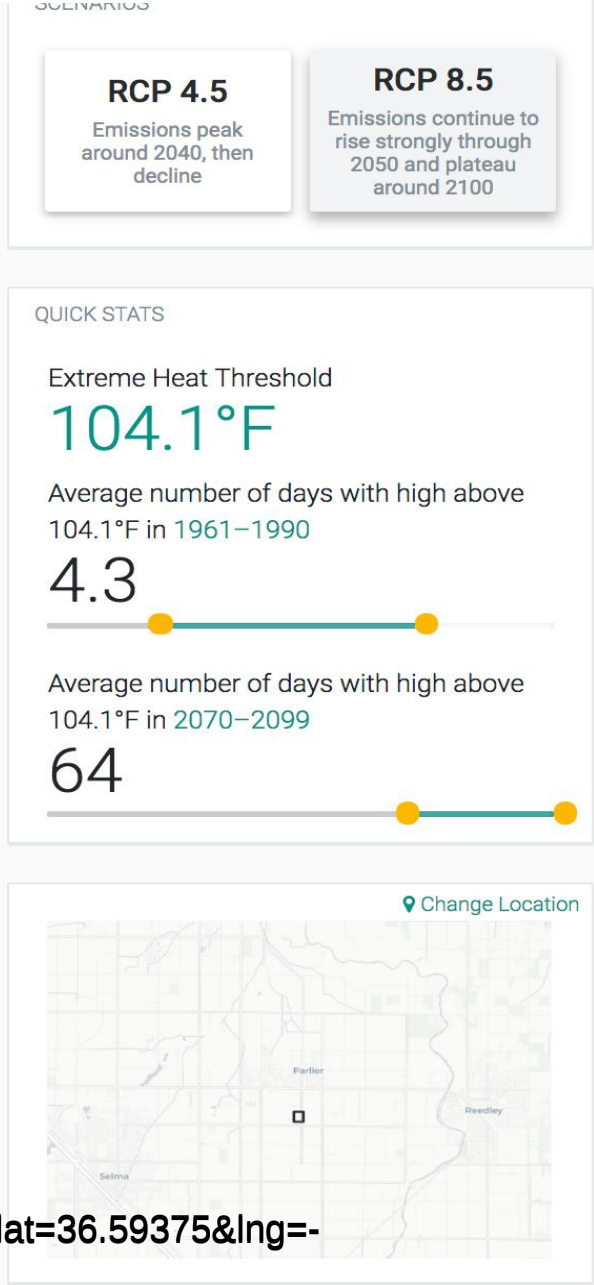
40

Change Location

Example: Projected annual number of extreme heat days in Parlier



Four "priority" models suggest an order of magnitude end-of-century increase in number of very hot days (BAU).



http://cal-adapt.org/tools/extreme-heat/#climatevar=tasmax&scenario=rcp85&lat=36.59375&lng=-119.53125&boundary=locagrid&units=fahrenheit

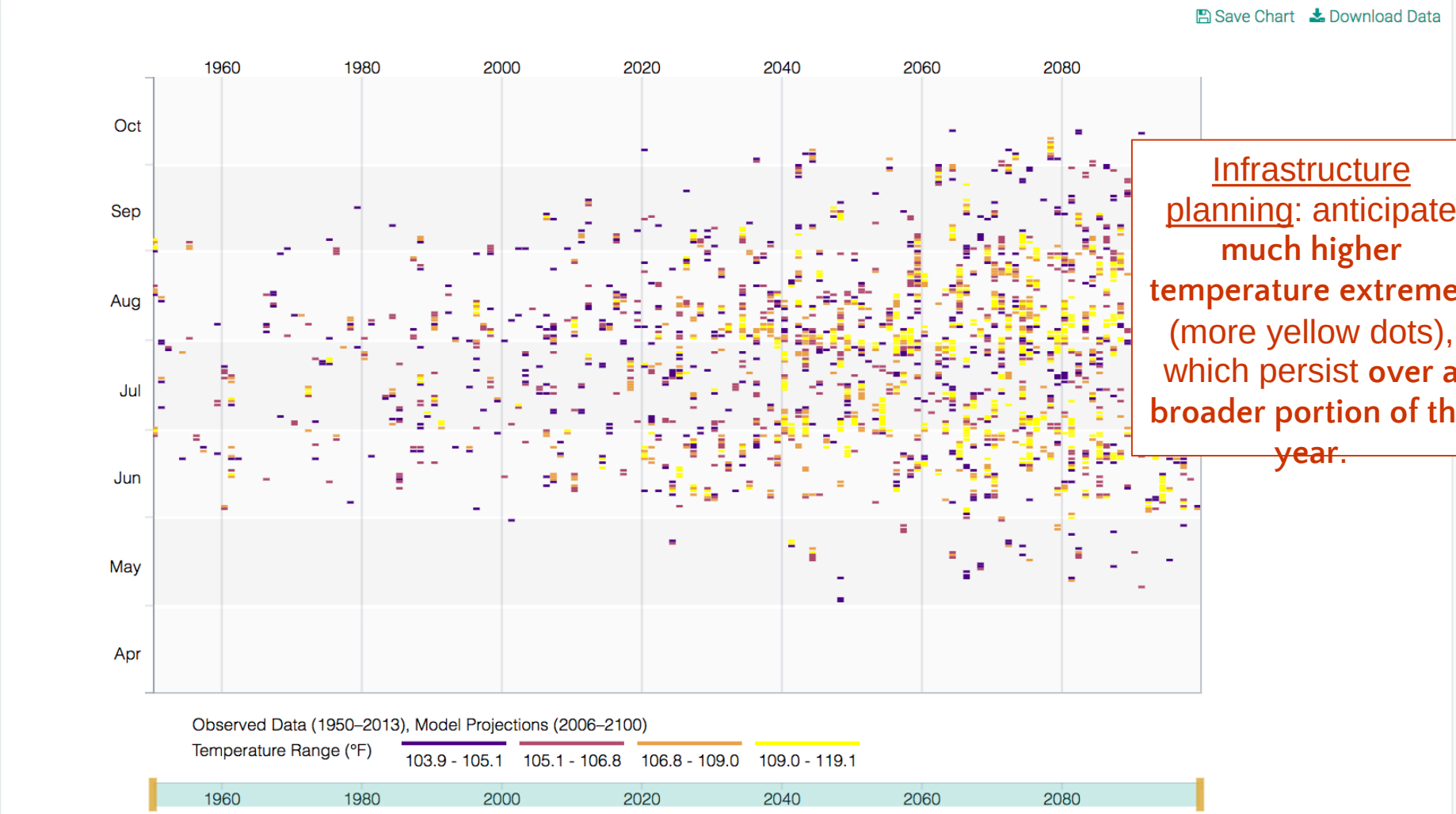
Example: Timing, Magnitude of Parlier's Extreme Heat Migrating Beyond Historical Bounds

Timing of Extreme Heat Days

Days above 103.9°F derived from HadGEM2-ES model

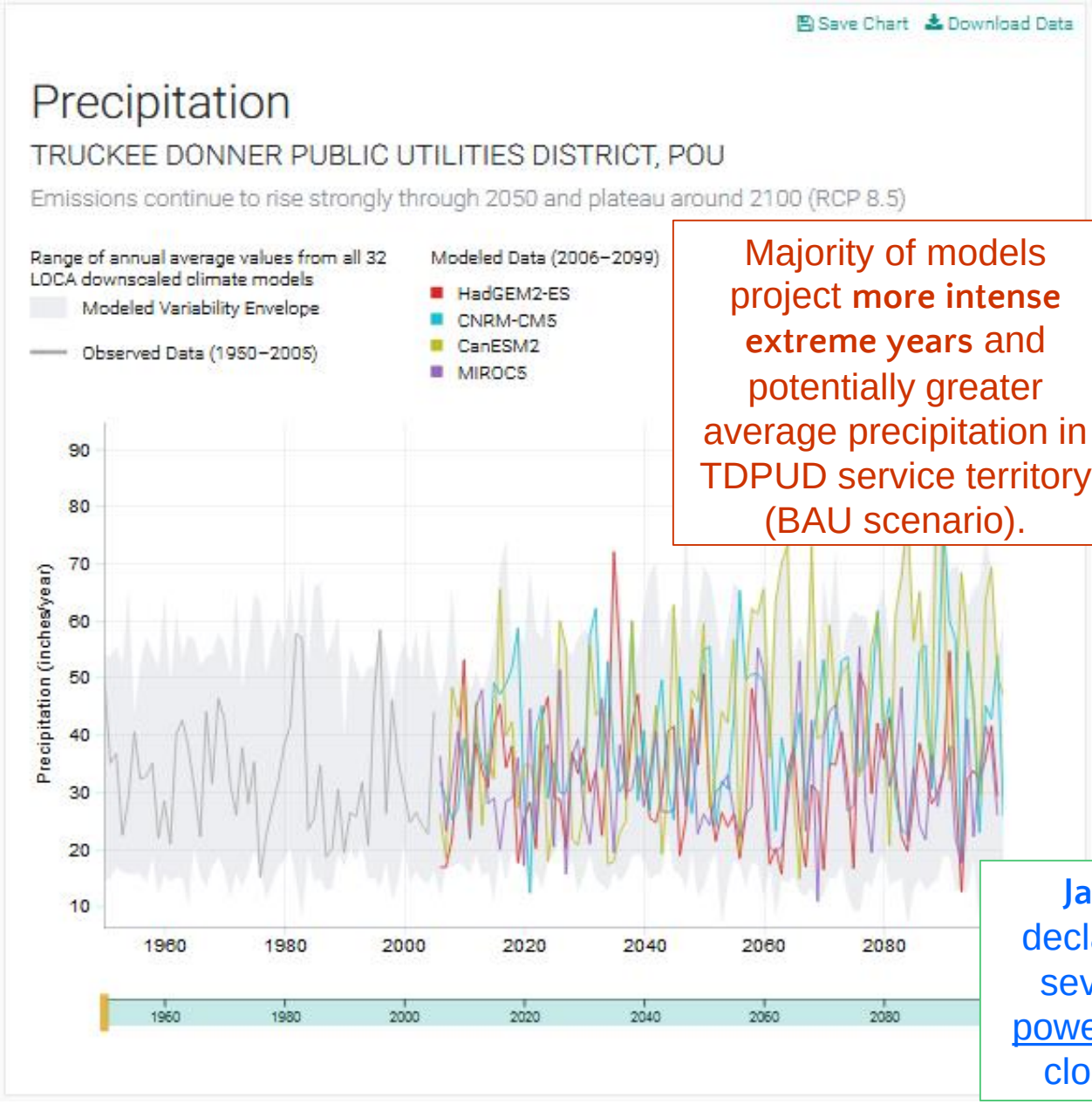
GRID CELL (38.59375, -121.46875)

Emissions peak around 2040, then decline (RCP 4.5)

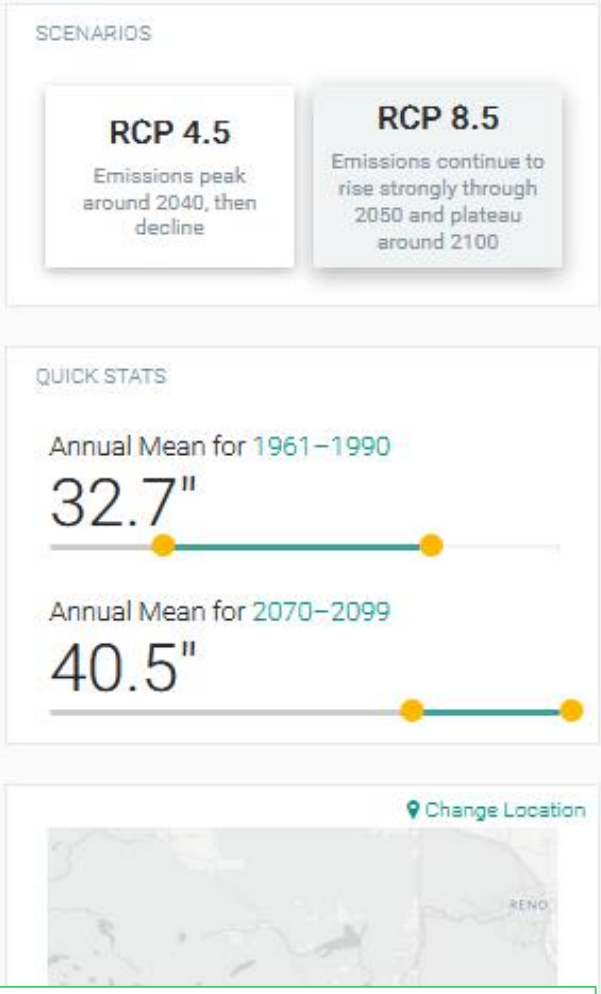


Infrastructure planning: anticipate **much higher temperature extremes** (more yellow dots), which persist **over a broader portion of the year**.

Example: Projected Precipitation in Truckee Donner Public Utility District

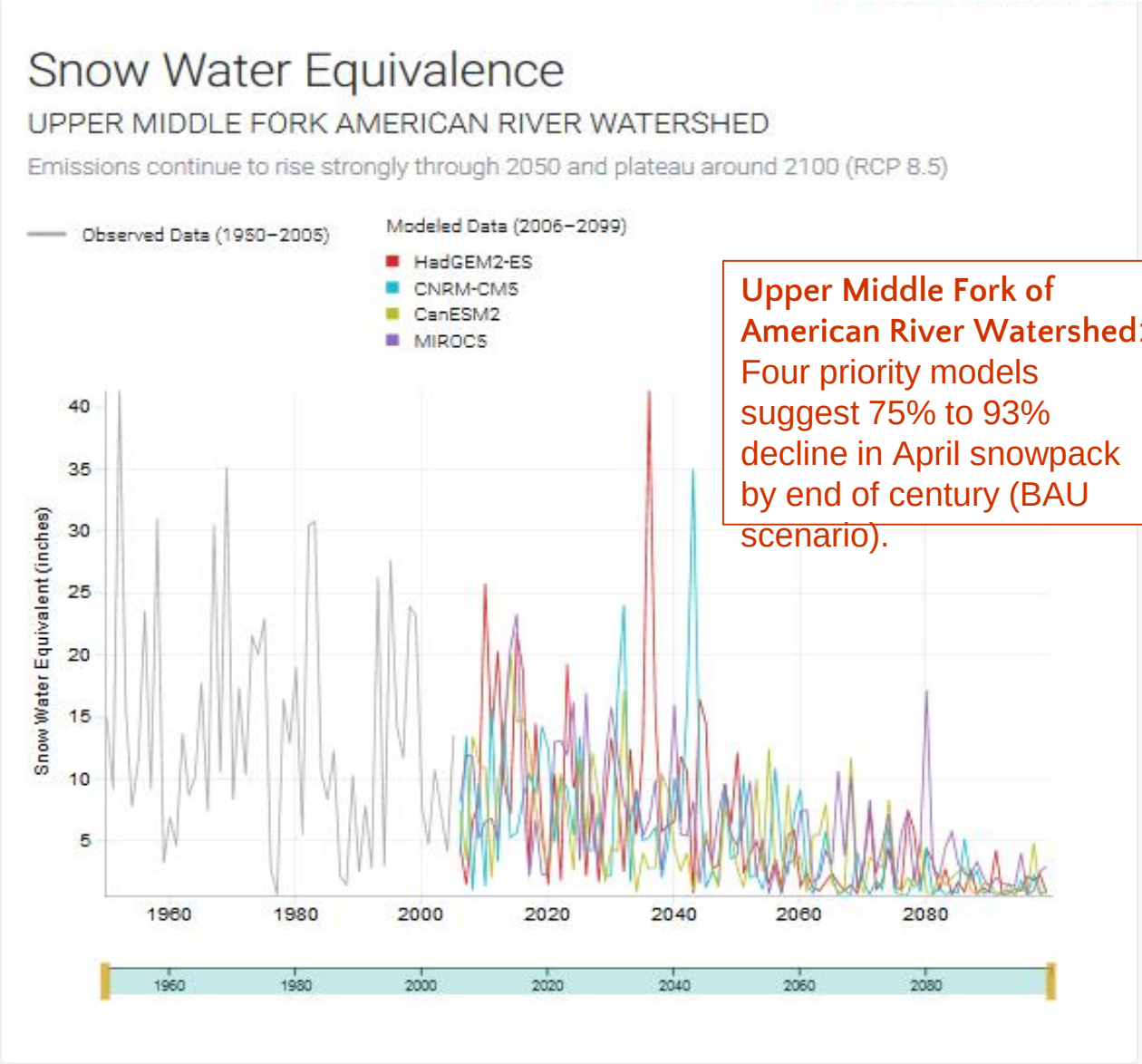


Majority of models project **more intense extreme years** and potentially greater average precipitation in TDPUD service territory (BAU scenario).

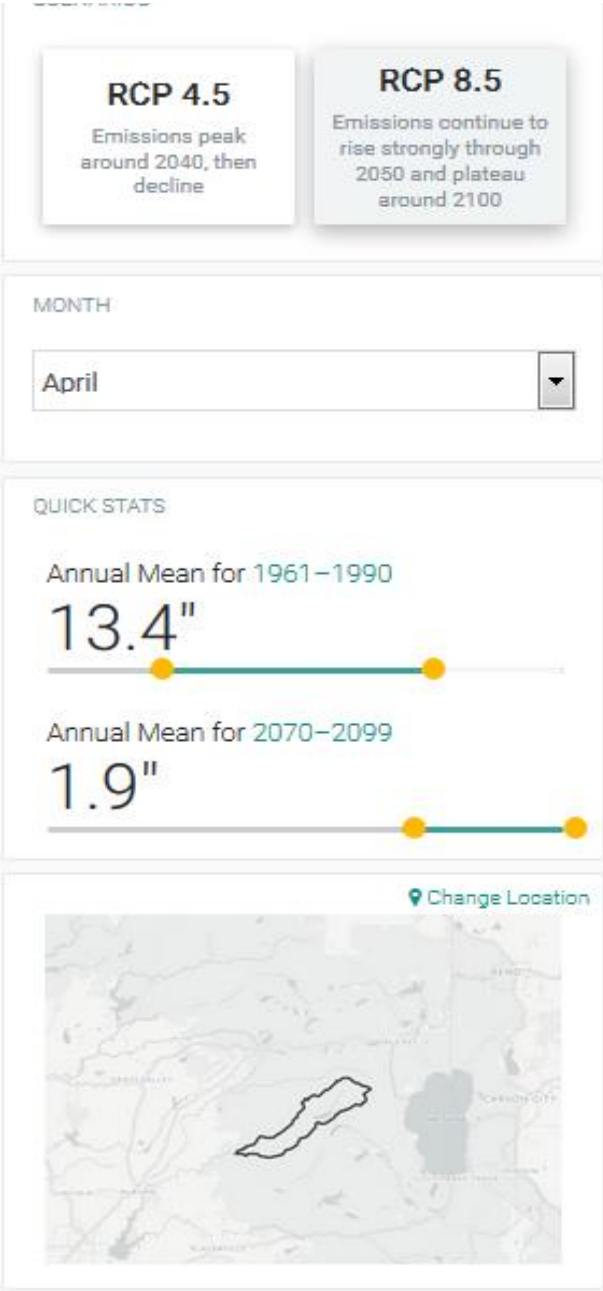


January 2017: Town of Truckee declared state of emergency due to severe winter storms that caused <u>power outages</u>, traffic delays, school closings, downed trees, flooding.

Example: Upper Middle Fork of American River: Substantial Decline in End-of Century Snowpack



Upper Middle Fork of American River Watershed: Four priority models suggest 75% to 93% decline in April snowpack by end of century (BAU scenario).



Example: Wildfire in Shasta County

Save Chart Download Data

Annual Average of Area Burned

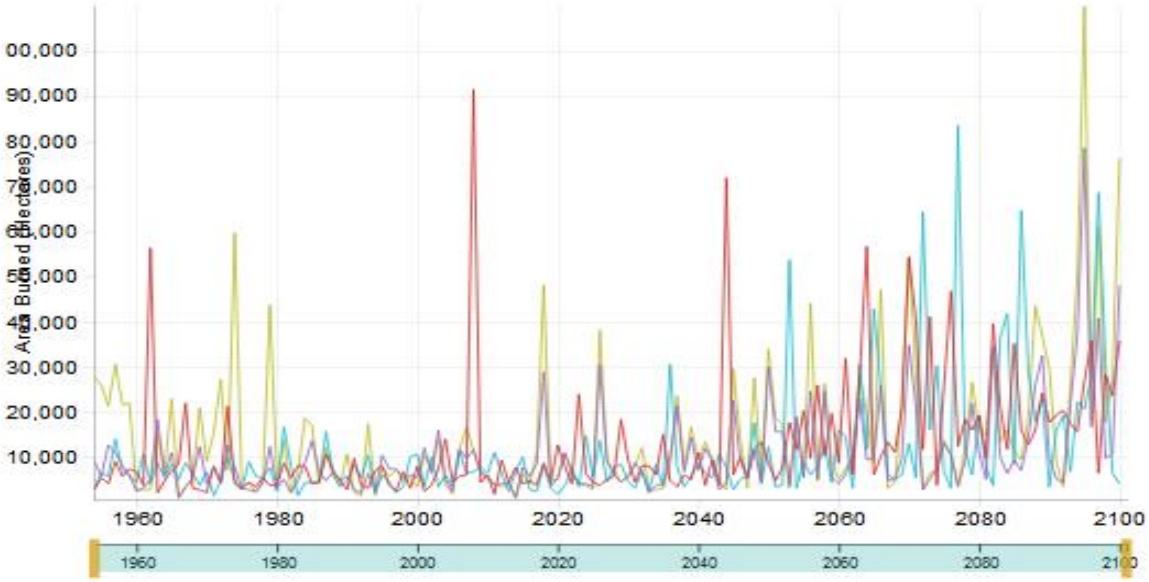
SHASTA COUNTY, CALIFORNIA

Emissions continue to rise strong

Two of four models project ca. 30% increase in mid-century wildfire in Shasta County.

Modeled Data (2006–2099)

- CanESM2
- CNRM-CM5
- HadGEM2-ES
- MIROC5



SCENARIOS

RCP 4.5
Emissions peak around 2040, then decline

RCP 8.5
Emissions continue to rise strongly through 2050 and plateau around 2100

POPULATION SCENARIO

Central

QUICK STATS

Annual Mean for 1961–1990
8,243.6 Hectares

Annual Mean for 2030–2049
9,443.4 Hectares

Change Location

Use of wildfire projections in **California's Fourth Climate Change Assessment** supporting analysis in this region and other locations vulnerable to wildfire.

Another Project: Climate Adaptation Clearinghouse

The state of California has been supporting projections and models, vulnerability assessments, and downscaled data for climate change impacts throughout the state, at statewide, regional, and local levels for both near-term and longer term timescales, including year 2050 and year 2100 projections.

We have been tasked to develop:

- Tools that allow for visualization or identification of regional and local impacts across the state and that integrate best-available data on vulnerable populations and infrastructure.
- A library of relevant white papers, case studies, research articles, funding opportunities and climate adaptation best practices that is searchable by relevance to region, locality, and sector.
- Regionally prioritized best-practice adaptation projects that, as appropriate, integrate efforts to reduce greenhouse gas emissions across the state.

Climate Adaptation Clearinghouse

California Naturalist Climate Stories | California Naturalist Climate Stories2

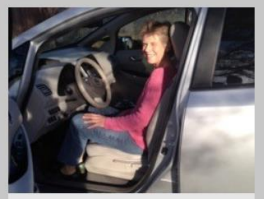

Living Simply and Conserving Resources


Using Rainwater at School & Home


For My Grandchildren, Advocating for Energy...


Replanting After Tree Loss

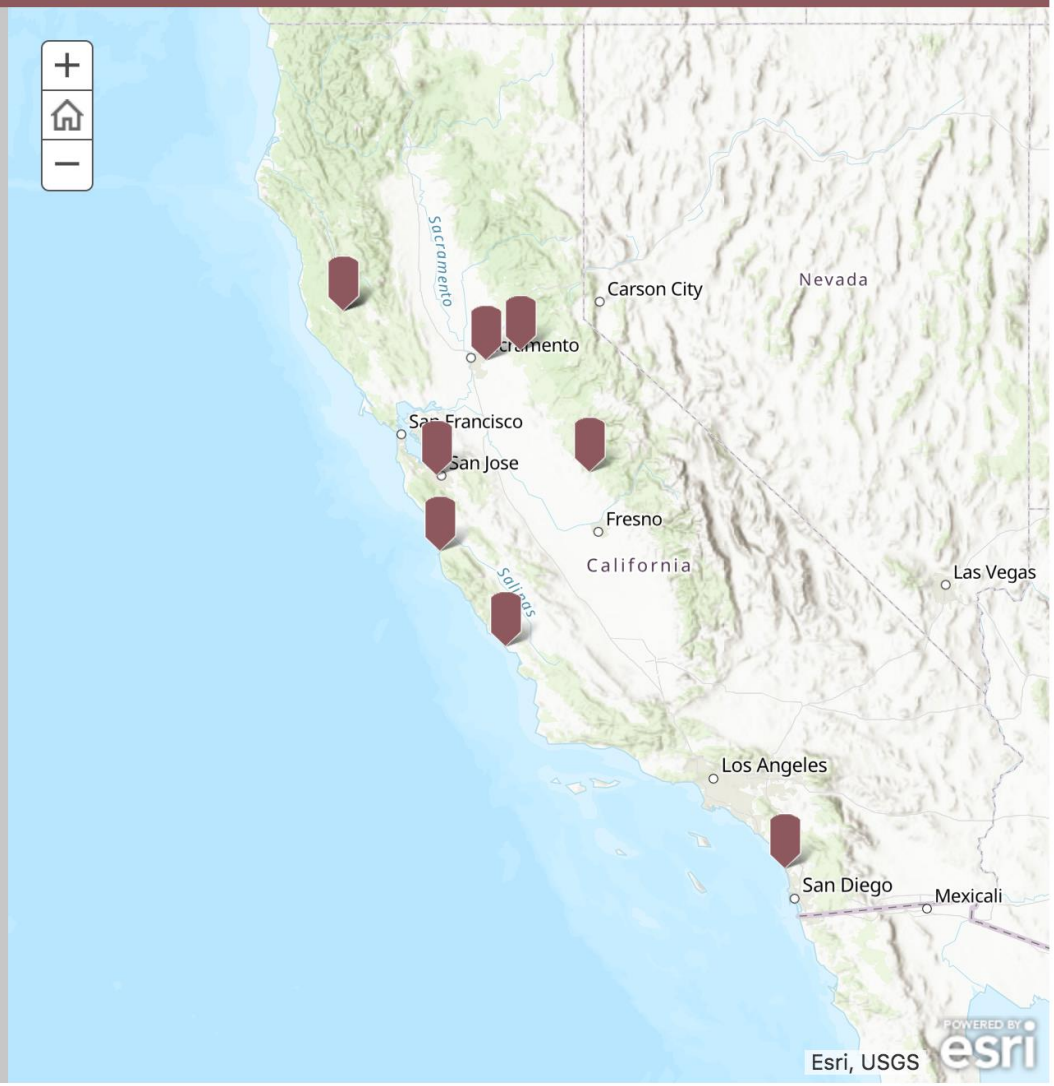
Promoting Wildfire Education for Youth and...


Starting a Climate Action Group in My Community


Learning How to Interpret Climate Change for the...


Restoring California's Native Grasslands

Advocacy and Education through Letter Writing...



IGIS Vision

IGIS envisions an ANR where all local and statewide research and extension programs integrate cutting edge geospatial tools into project planning, analysis, implementation, and communication.

We provide:

training

software

data

tools & technology

IGIS is ANR's leader for geospatial knowledge and innovation, meeting the growing demand for spatial tools, data, training, and support across the ANR continuum.

Thank you

Questions? We welcome your feedback.

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