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Unveiling Cal-Adapt 2.0: Facilitating Energy Sector Resilience and Providing Foundational Scenarios for California’s Fourth Climate Change Assessment

Susan Wilhelm
Energy Generation Research Office
Energy Research and Development Division

IEPR Workshop on Adaptation and Resilience for the Energy System
Sacramento, California
August 29, 2017
Today’s Talk

1. What is Cal-Adapt?
2. How is Cal-Adapt being used by energy sector stakeholders and researchers?
3. How is Cal-Adapt evolving to respond to energy sector needs?
4. Live tour: Explore visualizations, see “new” features on Cal-Adapt 2.0.
Acknowledgements

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Cal-Adapt: A Tool for Energy Sector Resilience and Research

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

- **Convey local climate risks** based on peer-reviewed science; new data!
- 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; expanded options, analyses
- **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. new for Cal-Adapt 2.0!

Cal-Adapt offers a variety of tools for exploring high-resolution projections of climate, including temperatures, precipitation, snowpack, sea level rise, and wildfire.
California Investor-Owned Utilities participating in the U.S. Department of Energy’s Resilience Partnership used Cal-Adapt to support vulnerability assessments:

- **PG&E**: used Cal-Adapt’s extreme heat tool to explore intensity and duration of projected mid-century heat waves
- **SoCalEdison**: used Cal-Adapt in conjunction with spatial overlays of infrastructure and as a basis for exploring uncertainty.

... and **SDG&E** has used Cal-Adapt to support on-the-ground resilience efforts.
Cal-Adapt 2.0: Providing Scenarios Approved by State for Energy Sector Planning

IOUs requested set of common standards, timeframes, and scenarios to rely on for planning.

- These scenarios were articulated in the 2016 Integrated Energy Policy Report (IEPR) Update.
- **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.
- OPR’s forthcoming guidance to state agencies will rely on these scenarios, too.
How Are Energy Resilience Researchers Using Cal-Adapt?

A few examples from California’s Fourth Climate Change Assessment. *Stay tuned for results in 2018!*

- Research investigating **wildfire impacts on transmission and distribution**: implications of projected wildfire risk on reliability, cost, resilience options. Localized analyses using data on Cal-Adapt enable investigation of development frontier, important transfer paths, and isolated load areas/load sources.

- Research investigating **vulnerability California’s transportation fuel system** is using precipitation projections coupled with hydrological models to identify places where may be vulnerable to inland (as well as coastal) flooding events in an changing climate.

- Precipitation data showcased on Cal-Adapt is being used to generate future projected curves portraying how intensity, duration, and frequency of precipitation is projected to change, with **high spatial resolution**, to **inform infrastructure risk analysis**.

*Figure:* Cal-Adapt shows electricity sector infrastructure, including transmission lines. Fourth Assessment research team’s preliminary historical analysis shows at least 17 fires within 0.25 miles of these transmission paths 25 and 66, 2000-2016 timeframe.
Cal-Adapt Embraced by Variety of Resilience Efforts

Cal-Adapt is publicly available and has been adopted by a variety of adaptation initiatives:

- **General Planning Guidelines (2017 update), §65302(g)(4), direct local governments to Cal-Adapt** as resource to support assessment of climate-related vulnerabilities and development of adaptation policies;

- The Governor’s Office of Planning and Research (OPR) is interested in supporting General Planning through custom Cal-Adapt tools designed to fulfil statutory requirements related to climate change adaptation;

- Forthcoming Adaptation Guidance from the Technical Advisory Group established by OPR directs state agencies to Cal-Adapt as a source for peer-reviewed, state-sanctioned data depicting projected climate risks and for map overlays to facilitate planning and investment;

- In March 2017, the **State Water Resources Control Board (SWRCB)** Approved a Resolution (no. 2017-0012) on “Comprehensive Response to Climate Change” directing staff to consult “the most current data available through Cal-Adapt”;

- Caltrans’ Transportation Adaptation Planning Grant Program, to distribute $20M to local and regional agencies for adaptation planning, points to Cal-Adapt as a tool to support applicants;
Cal-Adapt Embraced by a Variety of Efforts, continued

- The California Department of Public Health used climate risks portrayed by Cal-Adapt as the foundation of work to “Build Resistance Against Climate Effects” (BRACE) by preparing local and county-level public health departments for projected risks;
- The California Government Operations Agency (GovOps) leveraged Cal-Adapt’s publicly available Applications Programming Interface (API) to develop an automated tool supporting incorporation of adaptation into Sustainability Roadmaps;
- The United States Forest Service (USFS) has already used Cal-Adapt for planning at least one fuel treatment (Tatham Ridge Project) with future climate conditions in mind;
- Cal-Adapt is named as a resource by landmark legislation (SB 379) that requires integration of climate-related risks in local hazard mitigation plans;
- Safeguarding California (2017 update) notes that Cal-Adapt “is at the forefront of resources for specific communities to understand how climate change will raise temperatures and exacerbate extreme heat events, drought, snowpack loss, wildfire, and coastal flooding”;
- OPR’s Adaptation Clearinghouse (a.k.a. ICARP, or Integrated Climate Adaptation and Resiliency Program), development of which was mandated by SB 246, refers users to Cal-Adapt for exploration of local climate risks through high resolution climate projections.
Public Applications Programming Interface (API) with basic documentation, examples, & tutorials at: https://berkeley-gif.github.io/caladapt-docs/index.html
Cal-Adapt 2.0: User Needs Assessment Workshop

As part of an ongoing EPIC grant, UC Berkeley’s Geospatial Innovation Facility will hold a User Needs Assessment Workshop on September 12 in Sacramento (Energy Commission).

Workshop Goals:

• Offer a tour of the new features and capabilities of Cal-Adapt 2.0
• Elicit feedback on how Cal-Adapt 2.0, with its vastly expanded functionality and power, can serve electricity stakeholder needs through custom tools, visualizations, or other features.

More information at this link:
Future Plans for Cal-Adapt

Cal-Adapt will continue to evolve to reflect new research and understandings relevant to energy sector resilience.

- Provide visualizations and data access for additional parameters of interest to energy sector, e.g., stream flows, wind, solar irradiation, relative humidity.
- Data and tools developed by energy sector research contributing to California’s Fourth Climate Change Assessment.
- Development of new tools and visualizations in response to feedback, workshop findings, and Advisory Committee guidance.

Please send us your feedback and suggestions!

User Stories
We would like to feature how people around California are using Cal-Adapt for planning, assessment, research, teaching, and more. If you want to share your experiences, we would love to hear from you! Email us your story at support@cal-adapt.org with the heading User Story.
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.

Climate Tools
Explore projected changes in temperature, precipitation, snowpack, and sea level rise in California over this century with our interactive climate data visualizations.

Download Data
Download high-resolution downscaled daily, annual, and monthly climate projections for your project area in NetCDF or GeoTIFF formats.

Find Resources
Search State of California's Research Catalog, explore peer-reviewed publications, and understand how to use climate projections.

Use the Cal-Adapt Web API to build your own applications.
Integrate climate projections for California with your own tools and workflows. Based on accepted standards for REST, JSON and HTTP. For more information about using the Cal-Adapt API, check out the API documentation or contact us for more information.

Get updates on new Climate Tools, Data and Resources on Cal-Adapt.

Cal-Adapt synthesizes volumes of downscaled climate change projections and climate impact research from California's scientific community.
New Features: Cal-Adapt 2.0

Enhanced Visualizations

• **Boundary choices for aggregation & visualization of data:** 1/16° grid (~6 km × 6 km), counties, census tracts (with CalEnviroScreen scores), congressional districts, incorporated and census-designated places, watersheds, electric utility service territories, integrated regional water management regions, climate zones, load zones (SWITCH-WECC model), state of California.

• **Enable use of “custom” boundaries** (shape file) for aggregation & visualization.

• **Quick stats**: slider tools coupled with build-in analyses for common queries.

• **Print visuals** to file

• **Easy-to-understand text** to describe what visualizations are showing

Improved Access to Data: download data directly from charts (text or excel), as netCDF or GeoTIFF for advanced users, through Applications Programming Interface (API) for custom tool development.

New Climate Projections: high-resolution, peer-reviewed climate projections developed at Scripps Institution of Oceanography (UCSD) to address prior limitations in representing temperature extremes and spatial distribution of precipitation. These improvements are critical: extremes associated with temperature and precipitation drive many economic and health-related impacts.
Projected annual number of extreme heat days in a Disadvantaged Community in Stockton

CENSUS TRACT ID 6077001900 (CES Score: 64)

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

Four “priority” models suggest an order of magnitude end-of-century increase in number of very hot days (BAU).
Timing, Magnitude of Stockton’s Extreme Heat Migrating Beyond Historical Bounds

Infrastructure planning: anticipate much higher temperature extremes (more yellow dots), which persist over a broader portion of the year.
Average Daily Maximum Temperatures in Blythe: Migrating Beyond Envelope of Historical Variability (observed and modeled)

http://beta.cal-adapt.org/tools/annual-averages/#climatevar=tasmax&scenario=rcp85&lat=33.59375&lng=-114.53125&boundary=locagrid&units=fahrenheit
Projected Precipitation in Truckee Donner Public Utility District (TDPUD)

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 power outages, traffic delays, school closings, downed trees, flooding.
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).
Upper Middle Fork of American River: **Substantial** Decline in **Mid-Century** Snowpack

Four priority models suggest a 22% to 65% decline by the 2030-2049 timeframe (BAU scenario).
Wildfire in Shasta County

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

Use of wildfire projections in California’s Fourth Climate Change Assessment supporting analysis in this region and other locations vulnerable to wildfire.
A new tool enables calculation of heating degree days and cooling degree days—both used as proxies of demand for heating and cooling buildings—based on user-specified parameters. This is important because we can no longer use historical climate as a legitimate proxy for future demand!
Download Data

Discover and download climate data from California’s scientific and research community in NetCDF or GeoTIFF formats. Many datasets are also available through the public Cal-Adapt API.

- **LOCA Downscaled Projections**
  - LOCA downscaled climate projections for maximum temperature, minimum temperature and precipitation from Scripps Institution of Oceanography (Pierce et al., 2014).

- **Gridded Observed Data**
  - A gridded dataset of observed maximum temperature, minimum temperature and precipitation (Lemhöf et al., 2015).

- **Sea Level Rise - CalFlod-3D**
  - Sea level rise projections from 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 (Radel et al., 2018).

- **Snowpack (Forced by LOCA)**
  - Snowpack projections generated through use of Variable Infiltration Capacity (VIC) model forced by LOCA downscaled climate projections from Scripps Institution of Oceanography (Pierce et al., 2014).

- **Snowpack (Forced by Gridded Observed Data)**
  - Snowpack data generated through use of Variable Infiltration Capacity (VIC) model forced by gridded observed data (Lemhöf et al., 2015).

- **Wildfire**
  - Annual averages of area burned for combination of 4 DOMs, 2 RCPs and 8 population growth scenarios. (LeRoy Butler, UC Merced).

- **Long Drought Scenarios (LOCA)**
  - Temperature precipitation plus a set of VIC variables from two 30 year drought periods. (Pierce et al., 2014).

- **Additional VIC Variables (forced by LOCA)**
  - Additional climate variable generated through use of Variable Infiltration Capacity (VIC) model forced by LOCA downscaled climate projections from Scripps Institution of Oceanography (Pierce et al., 2014).

- **Relative Humidity**
  - LOCA downscaled climate projections for relative humidity from Scripps Institution of Oceanography (Pierce et al., 2014).

- **Streamflow**
  - VIC routed and bias corrected streamflows driven by LOCA downscaled temperature and precipitation.
Thank you!

www.cal-adapt.org