

Overview of New Extreme Heat Projections for California

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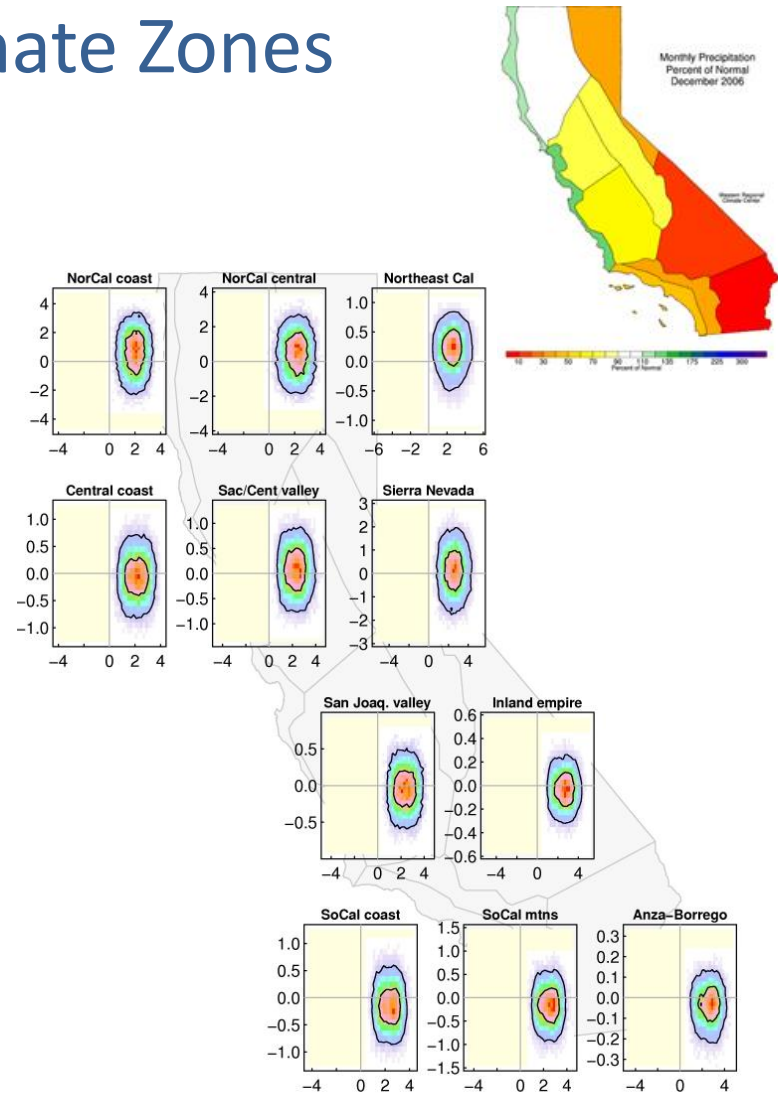
Outline

- **Probabilistic Projections for California Climate Zones:**
Regional variations and commonalities in temperature and precipitation
- **Next-Generation Model Results** (pending): What's coming?
- Projected Regional **High- and Low- Temperature Extremes**
- **Timing, Frequency, and Intensity of Heat Waves:**
Regionally Downscaled Projections as Represented by Cal-Adapt's Extreme Heat Tool

Probabilistic Projections for California Climate Zones

- “Probabilistic” climate projections for CA have been created using multiple global climate models and downscaling techniques
- Models predict warming throughout the state (*rightward shift for all regions*)
- Very wide range of uncertainty with regard to whether precipitation will increase or decrease (*not certain what will happen*)

PRIOR GENERATION OF GLOBAL CLIMATE MODELS

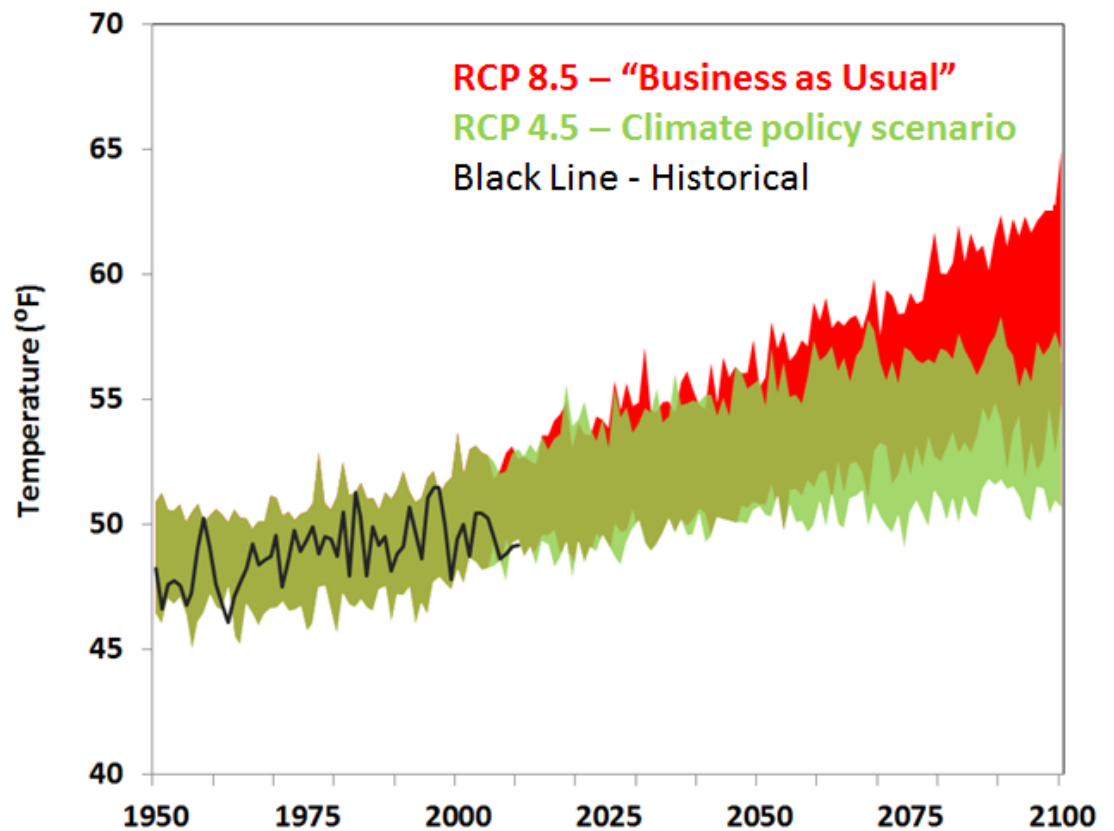


Joint distributions of change in temperature (deg C, x axis) and precipitation (mm/day, y axis) in DJF. Outer ellipse encloses 95% of the data; inner encloses 50%.

Next-Generation Model Results Using LOCA

- Increased spatial resolution (*important for resolving community-level impacts*)
- After year 2005, the green and red areas show projections.
- Very little difference in envelopes of variability associated with mid- and high-emissions trajectories before 2050.

Annual average temperature for grid cell near SMF

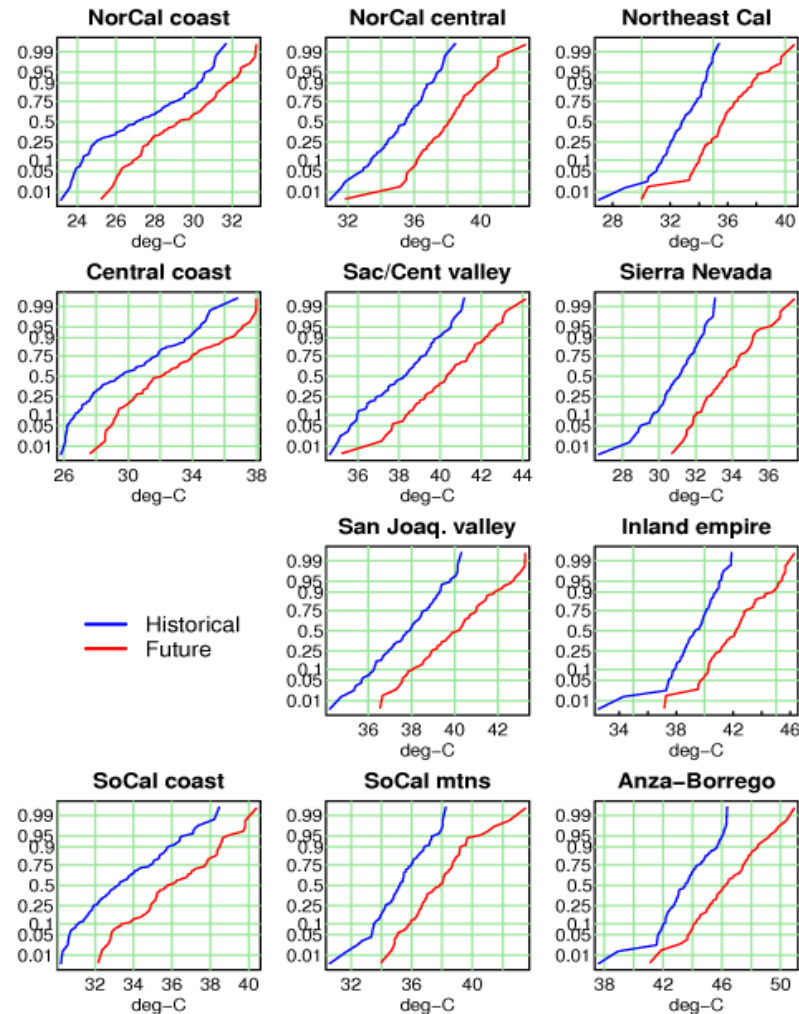


Source: Franco and Oliver using data provided by David Pierce (Scripps)

Heat Waves: Expect them to be Worse

For highest three-day average temperature:

- **Temperatures get higher** (illustrated as rightward shift of projected (blue) distribution relative to historical (red))
- **Extreme high temperatures show disproportionate shift for inland areas, including Sierra Nevada, Inland Empire** (shown as increasing distance between historical and projected temperature for highs)



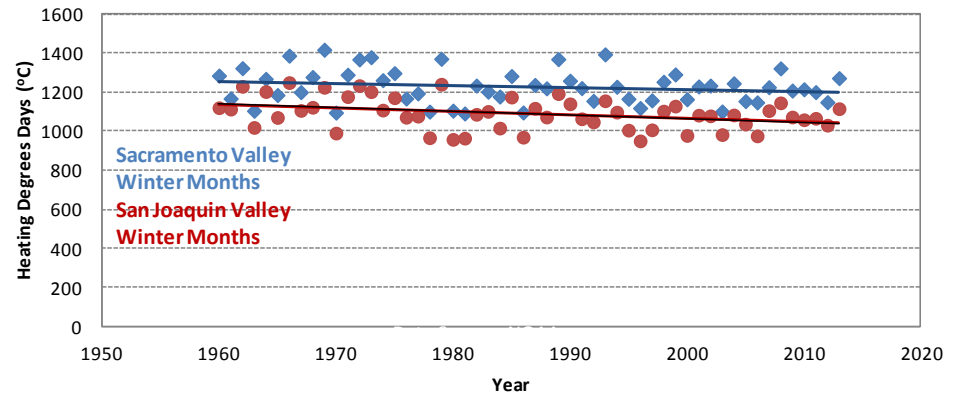
Pierce, D.W., et al. , 2013. *Climate Dynamics*, **40**, 839-856. doi:10.1007/s00382-012-1337-9.

Figure: Cumulative distribution functions of the highest 3-day average temperature in the year.

Cold Snaps Persist

- Heating Degree Days* decreasing in the Central Valley, according to NOAA
- Recent research finds a trend of decreasing winter fog in the Central Valley (Baldocci and Waller 2014, *Geophys Res. Letters*)
 - Clear nights can result in very low temperatures
- Even with warming trends, cold snaps would not disappear (2050 projections)

* Heating Degree Days are a measure of the degree and duration of cool weather

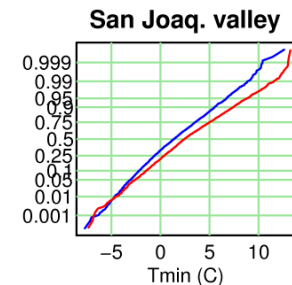
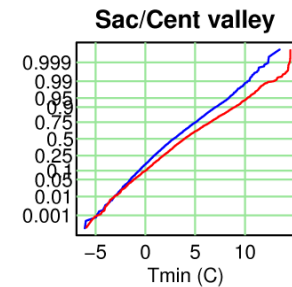


“ Winter fog is decreasing in the fruit growing region of the Central Valley of California “



NASA

2050



— Historical
— Future

Figure: Cumulative Distribution Functions of January Daily Minimum Temperatures (Tmin) in Sacramento & San Joaquin Valleys. Note that low-end extremes are expected to persist in the face of climate change.

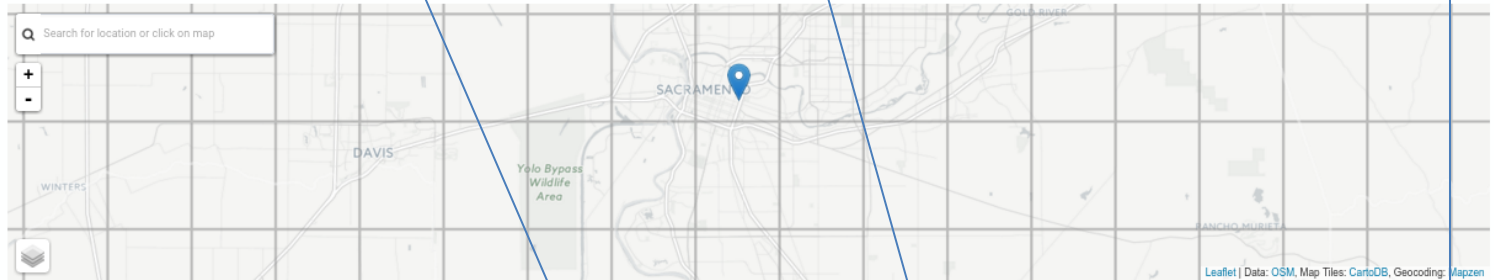
Projected Extreme Heat in Sacramento:

LOCA Results for RCP 4.5 (mid-policy scenario, peak emissions ca. 2040)

Historical data

Projected data

Scale: up to **55** days/year



NUMBER OF EXTREME HEAT DAYS BY YEAR

Gardenland, Sacramento, CA, USA

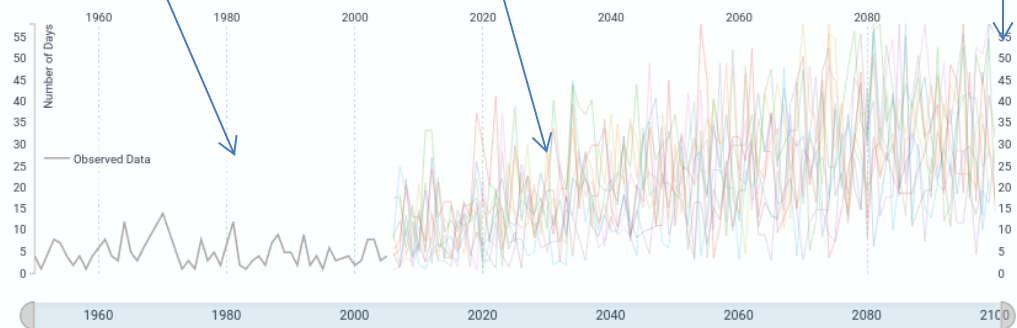
DAYS ABOVE 104.5°F

5	12	19
1961 - 1990	2016 - 2046*	2046 - 2076*

This chart displays a count of the number of days (along the y axis) that the selected area on map is projected to exceed the area's calculated Extreme Heat Threshold for each year under the RCP 4.5 scenario.

RCP 4.5
Emissions peak around 2040, then decline

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



- ACCESS1-0
- CanESM2
- CCSM4
- CESM1-BGC
- CMCC-CMS
- CNRM-CM5
- GFDL-CM3
- HadGEM2-CC
- HadGEM2-ES
- MIROC5

Click on a model to highlight it. Show all models.

An extreme heat day is defined as a day in April through October where the maximum temperature exceeds the 98th historical percentile of maximum temperatures based on observed daily temperature data between 1961-1990.
 * Number of extreme heat days averaged over given time period across all highlighted models.

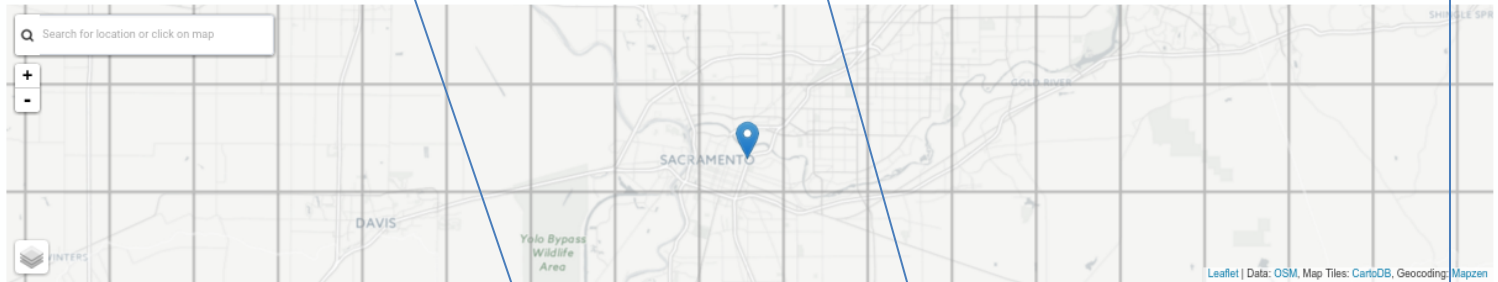
Projected Extreme Heat in Sacramento:

LOCA Results for **RCP 8.5** (continued “BAU” growth at 2%/yr)

Historical data

Projected data

Scale: up to **70** days/year



NUMBER OF EXTREME HEAT DAYS BY YEAR

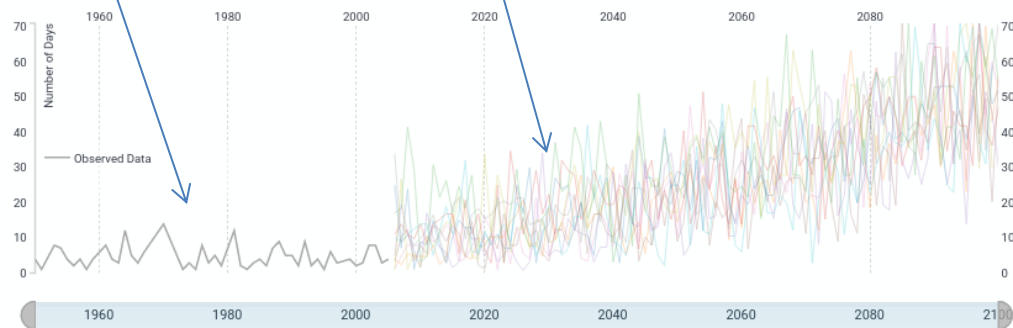
Gardenland, Sacramento, CA, USA

DAYS ABOVE 104.5°F

5	14	28
1961 - 1990	2016 - 2046*	2046 - 2076*

This chart displays a count of the number of days (along the y axis) that the selected area on map is projected to exceed the area's calculated Extreme Heat Threshold for each year under the RCP 8.5 scenario.

<p>RCP 4.5</p> <p>Emissions peak around 2040, then decline</p>	<p>RCP 8.5</p> <p>Emissions continue to rise strongly through 2050 and plateau around 2100</p>
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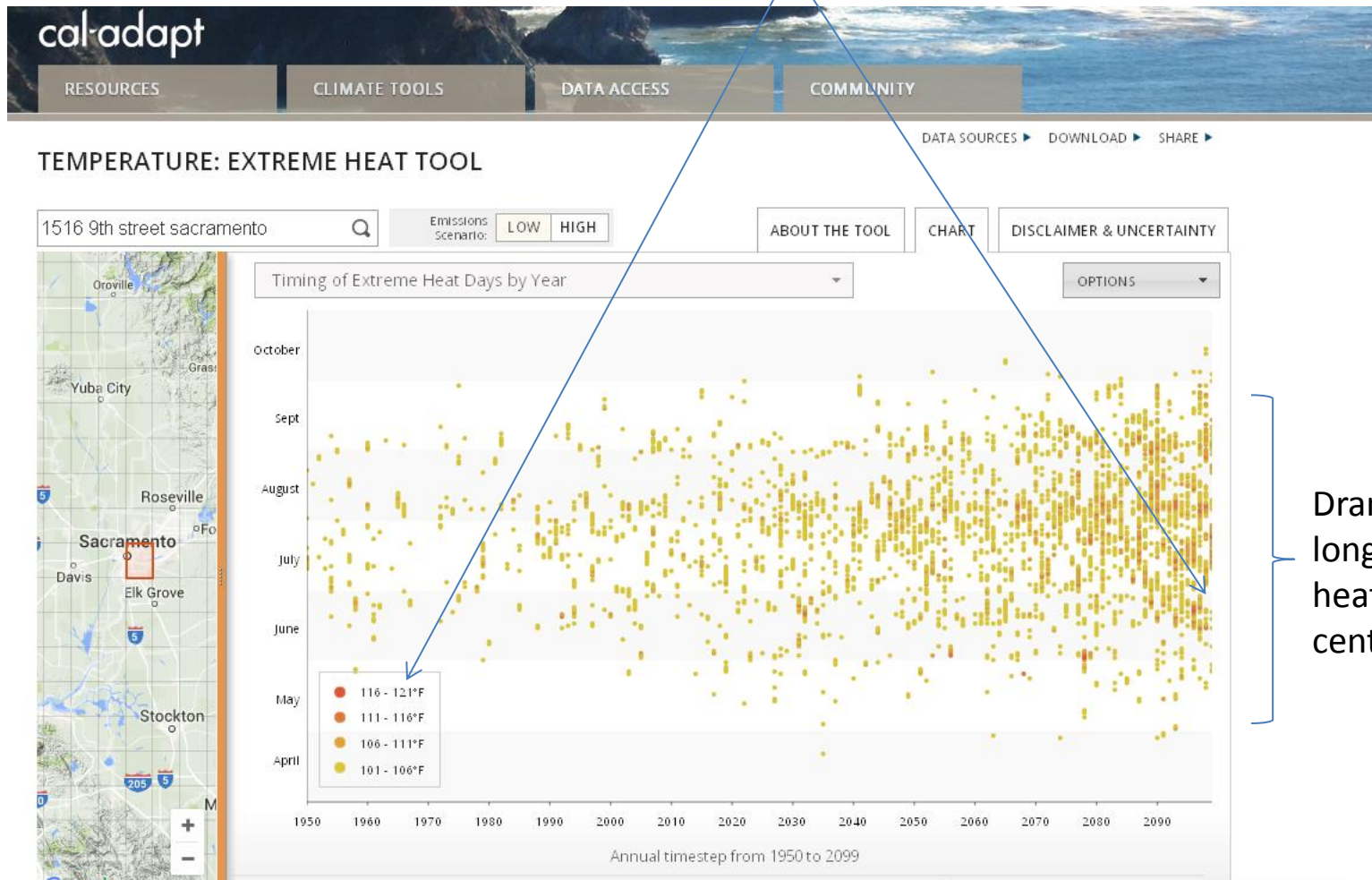
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Projected Extreme Heat in Sacramento:

Wider season, **higher** extremes

Toward latter part of century, unprecedented extremes as high as 116 to 121 degrees F projected



Thank You!

Extreme heat tool for LOCA results will be available soon on the beta-site of Cal-Adapt 2.0:

<http://beta.cal-adapt.org/>

Please send your comments, questions, and tell us how you are using the data:

support@cal-adapt.org

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