



The western US needs new datasets and improved decision support tools to prepare its natural lands and forests for climate change. Powered by a team of nearly 50 scientists at 8 major research institutions, with partners in state and federal agencies, nonprofits, and the private sector, the Center for Ecosystem Climate Solutions (CECS) is developing open-source, California-wide datasets and tools to support ecosystem management. CECS is building scientifically rigorous data products that document California’s current and recent ecosystem conditions, assess ecosystem vulnerabilities, and evaluate the effects of management options on water supply, vegetation health, wildland fuels, fire hazard, and carbon stocks.

### Natural Climate Solutions Toolbox

CECS is creating a toolbox to help managers, planners, decision makers, and scientists better evaluate and compare land management options for climate mitigation and adaptation. The tool box includes a [Data Engine](#) that creates new datasets to fill critical gaps; an on-online [Data Atlas](#) that visualizes the newly-created data layers; and a desktop-based [Data Bridge](#) that easily extracts and transfers this information to existing software tools.

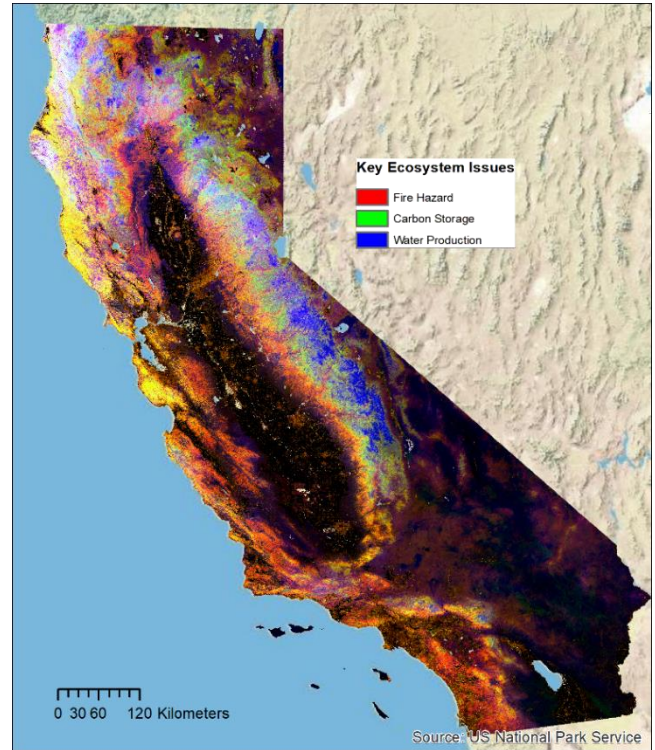
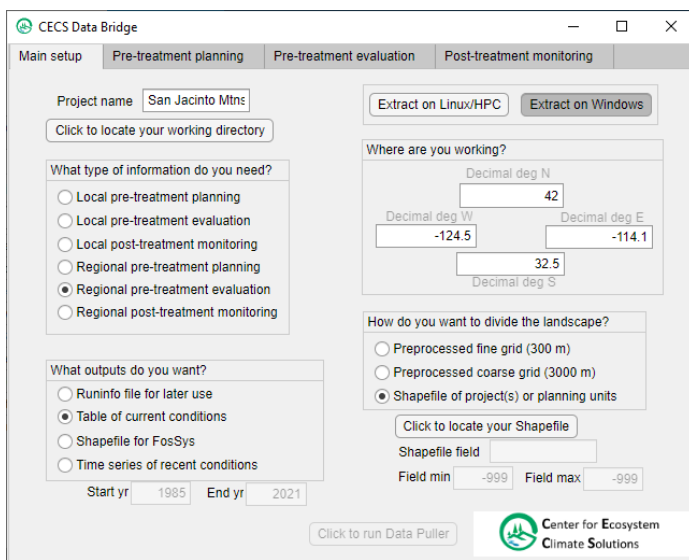
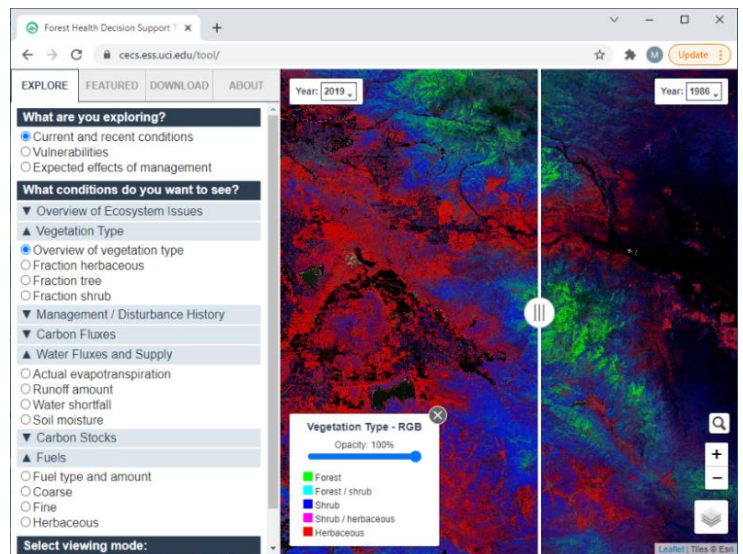


Figure 1: CECS color composite of ecosystem issues (Red: hazardous surface fuels; Green: high carbon storage; Blue: producing abundant runoff. Areas with multiple ecosystem issues are shown as mixed colors).

TABLE 1: NEW CECS DATASETS (30 m rasters for all CA wildlands x 37 years x ~100 ecosystem properties.)		
October 2021 progress: <span style="background-color: #e0f0e0;">First draft complete</span> ; <span style="background-color: #ffe0b2;">Developing prototype</span> ; <span style="background-color: #ffe0b2;">Exploratory data analysis</span>		
	Current and recent: Annual observations for 1985-2021	Alternative: Predicted effects of management ( <span style="background-color: #e0f0e0;">immediate</span> and <span style="background-color: #ffe0b2;">recovery trajectory</span> )
<b>ECOLOGICAL CONDITIONS</b> (water, fuel, carbon pools, and fluxes)	Disturbance and management history: Type (fire, die-off, management) and severity (% tree and shrub canopy removed)	Disturbance and management scenarios: Type (fire, die-off, management) and severity (% tree canopy removed, % shrub canopy removed, % surface fuel removed)
	Water pools and fluxes: Evapotranspiration, runoff, plant moisture deficit (mm/yr)	Water pools and fluxes after disturbance or management
	Wild fire fuel loads: Dead and live fuel (1, 10, 100, 1000 hr, live herb, shrub, canopy, g/m)	Fuel load after disturbance or management
	Carbon pools and fluxes: Stocks (leaf, wood, roots, detritus, g/m <sup>2</sup> ) and fluxes (production, mortality, decomposition, g/m <sup>2</sup> yr)	Carbon pools and fluxes after disturbance or management
<b>VULNERABILITY AND HAZARD</b> (water supply, vegetation die-off, wildfire, carbon)	Water supply vulnerability: Sensitivity of water supply to drought or disturbance (change in water supply with drought or disturbance, mm/yr)	Water supply vulnerability after management: Avoided water shortfall during drought
	Vegetation vulnerability: Probability of vegetation die-off with drought (long term %/yr)	Vegetation vulnerability after management: Avoided die-off
	Wildfire hazard: Rate of spread (m/min), intensity/flame length (ft), <span style="background-color: #ffe0b2;">probability (long term %/yr)</span>	Wildfire hazard after management: Avoided fire, rate of spread, intensity and <span style="background-color: #ffe0b2;">probability</span>
	Carbon vulnerability: Probability of C loss from fire or die-off (long term based on disturbance probability and effect, g/yr)	Carbon vulnerability after management: Avoided carbon loss from fire or die-off, immediate and over recovery trajectory

**Data Engine:** The high-performance computing-based Data Engine creates new geospatial datasets that fill key gaps, including statewide maps of disturbance, water balance, vegetation stress, fuels, and ignition probability (see Table 1 for list). The Data Engine tracks water, stress, fire, and carbon as a wholistic web of tightly-linked ecological conditions. The Data Engine quantifies ecosystem properties in transparent physical units that allow apples-to-apples comparisons across space and time. The Data Engine is built with scientific software that emphasizes reproducibility, rapid refresh, and continuous improvement.

**Data Atlas:** The web-based Data Atlas displays the data listed in Table 1. The Atlas allows users to visualize interactive maps and to explore and compare ecosystem properties at 30-m to statewide resolution.



**Data Bridge:** The desktop-based Data Bridge provides an easy route to move information from the Atlas to a user's preferred analysis software. The Bridge creates formatted tables, time series, or shapefiles that can be imported into software such as ArcGIS, QGIS, Excel, R, or ForSys.

The Data Bridge asks the user to identify their data and information needs, and allows the user to specify project areas with lat.-long. boxes and grids, or by uploading a shapefile. The Bridge allows the user to select from 50 pre-loaded ecological and societal attributes for output and analysis; these attributes are organized by goal under separate tabs, and include all of the layers in the Atlas.

## Ecosystem Service Valuation

CECS is exploring approaches for valuing ecosystem services to overcome information roadblocks to monetizing and apportioning the benefits of restoration. The focus is on carbon, water, and wildfire risk reduction, further extending to air quality, public health, and local community benefits. These valuation tools can be leveraged to support partnerships and agreements on a project-by-project basis; to motivate project investments from the different beneficiaries; and to accelerate the pace and scale of much needed restoration.

We'd like to collaborate! Please reach out with your input and ideas.

Contact: [ecosystemclimate@ess.uci.edu](mailto:ecosystemclimate@ess.uci.edu)

Director: Michael Goulden, UC Irvine, [mgoulden@uci.edu](mailto:mgoulden@uci.edu)

Co-Director: Roger Bales, UC Merced, [rbales@ucmerced.edu](mailto:rbales@ucmerced.edu)



Rev. Nov. 12, 2021