4 Global Climate Models and Land Management

Applications of Global Climate Model Data

Online Tools Based on Global Climate Model Data

Global climate model (GCM) data can help land managers wishing to understand the potential impacts of climate change on their region, and multiple interactive online tools exist that support a variety of land management decisions. Examples of online decision-support tools include:

Using CalAdapt to Assess Projected Local Conditions

CalAdapt turns LOCA-downscaled data into snapshots of future climate conditions, packaged into a suite of 14 tools. One such tool is the local climate change snapshot, which puts temperature, precipitation, and wildfire data in one place and makes it simple to toggle between the three. This tool makes a great quick reference for resource managers.

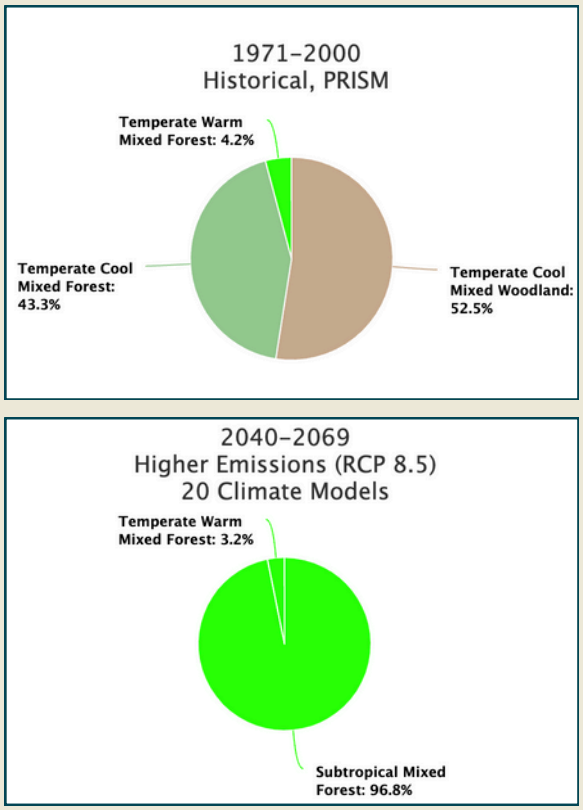
Using Climate Toolbox to Assess Future Vegetation Types

Climate Toolbox is an online collection of tools for visualizing past and projected climate trends for agriculture, fire, water, and general purposes. One of the many applications available through the website is the Future Vegetation[1] tool. The tool uses data from 20 GCMs to project the future land cover of 10 vegetation types. If a forest land manager developing a management plan wanted to reference their region's projected vegetation cover, they could input their location into the tool and choose to view data for different:

- **Output Variables**
  - Users can choose to view modeled vegetation cover with or without fire suppression.
- **Time Periods**
  - Users can view data for the periods 2010-2039, 2040-2069, or 2070-2099.
- **Emissions Scenarios**
  - Users can choose between a higher (RCP8.5) or lower (RCP4.5) emissions scenario.
- **Climate Models**
  - Either view the averaged data of 20 GCMs, or the results of an individual model.

On the right is an example of the tool's output for Mariposa, California in 2040-2069 in an RCP8.5 emission scenario with fire suppression. Compared to historical vegetation (top), all of the area's woodlands are projected to convert to mixed forest ecosystems (bottom) as a result of Mariposa's climate getting warmer. A land manager working in the area might use this information to prioritize decisions that protect valuable woodland species, like one of California's 20 native oak species.

Changes in Modeled Vegetation Type (With Fire Suppression)
Mariposa, California



The historical and future (2040-2069) vegetation types for Mariposa, California under a higher emissions (RCP8.5) scenario with fire suppression *(Climate Toolbox)*.[1]

Using CAST to Identify Conifer Seed Sources

The Climate-Adapted Seed Tool (CAST)[2] uses LOCA-downscaled data to match land managers with seed sources that are well

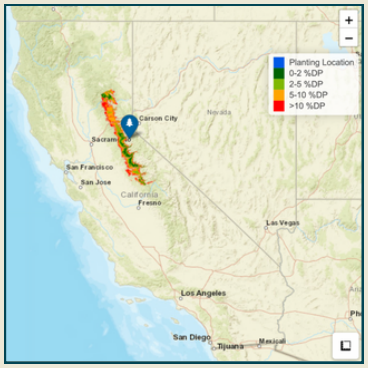
adapted to their planting location's projected future climate. The tool's main metric is percent decline in productivity (%DP), which is the loss in tree volume that is likely to result based on how suited or unsuited a seed source is to the target region. The lower the %DP, the better suited a seed source is. If a forest manager wanted to reforest their land with the goal of climate adaptation, they could input their location and a target species (*Pinus contorta, Pinus ponderosa, Pseudotsuga menziesii*) into the tool and choose to adjust the tool based on:

- **Tolerances**
  - Users can choose to set maximums for percent decline in productivity and distance of seed source from planting location.
- **Climate and Time**
  - Users can choose a year to optimize seeds for.
- **Metrics**
  - Users can choose additional metrics for evaluating seed sources, like carbon sequestration.
- **Methods**
  - To fine-tune their results, users can adjust the methods used by the tool to evaluate seed sources.

The tool outputs both a map and a table displaying seed sources, grouped into seed zones, from best to worst fit. On the right is an example of the tool's output for *Pinus ponderosa* in South Lake Tahoe with default settings. The top two results suggest that the best option for a seed source is within the same seed zone as the project site but from a lower elevation. If locally sourced seed was not available, the forest manager can also source seed from multiple elevations within seed zones 531 and 532.

Climate-Adapted Seed Sources for *Pinus ponderosa* in South Lake Tahoe, CA

These figures, a map (right) and table (below), display outputted seed sources grouped by seed zone for *Pinus ponderosa* in South Lake Tahoe with default settings (**Tolerances**: 15%DP, 100 miles; **Climate and Time**: 2045; **Metrics**: carbon sequestration at a stand age of 80; **Methods**: optimal, permissive)*(CAST)*.[2]



Seed Zone	Elevation	% Decline in Productivity			CO2 Seq.
		Expected	Lower	Upper	
526	6000 - 6500ft	16.06%	6.68%	24.07%	109.21
531	5000 - 5500ft	1.48%	0.17%	4.92%	142.12
532	5500 - 6000ft	2.29%	0.55%	6.62%	140.13
526	5000 - 5500ft	2.68%	0.18%	6.81%	138.22
531	4500 - 5000ft	2.98%	0.43%	8.02%	145.68
532	5000 - 5500ft	3.43%	0.68%	7.88%	145.28
526	4500 - 5000ft	3.49%	0.59%	9.03%	146.21
531	5500 - 6000ft	3.84%	0.28%	9.57%	133.03
532	6000 - 6500ft	4.83%	0.81%	12.22%	130.90
523	3500 - 4000ft	4.98%	1.23%	12.41%	140.08

Using GCM Data Independently

Some land managers may choose to work with GCM data themselves rather than use an online tool. When working with GCM data to assess local impacts, there are some considerations to keep in mind. It is best practice to use data from multiple GCMs (≥10) to obtain a range of varying projections. Some climate models have been shown to output data that captures California's regional climate better than others. Pierce et al. (2018),[3] for example, provide a list of ten CMIP5 climate models that more accurately represent important aspects of California's climate. Other more technical considerations in selecting GCM data include data downscaling, your project location and spatial size, the time period you are seeking results for, your desired scale, and how extreme of a future you want to plan for.

1. Hegewisch and Krosby."Future Vegetation" web tool. *Climate Toolbox* (https://climatetoolbox.org/) accessed on [March 14, 2024].
2. Stewart and Wright. (2023) Climate-Adapted Seed Tool (Version 0.03). Accessed at https://reforestationtools.org/climate-adapted-seed-tool
3. Pierce et al. (2018) Climate, Drought, and Sea Level Rise Scenarios for the Fourth California Climate Assessment. *California's Fourth Climate Change Assessment, California Energy Commission*.

Recommended Citation: Oxarart, A. Parker, L. USDA California Climate Hub (2024). Global Climate Models and Land Management: Applications of Global Climate Model Data [Fact sheet].