Climate Adapted Seed Tool (CAST)

Planting for the Future with Climate-Adapted Seeds

www.ReforestationTools.org

Climate Adaptation Mismatch

Tree populations tend to be genetically adapted to their local historical climate conditions. But the climate is changing fast. Trees are long-lived and can't disperse as effectively as animals to track their suitable climate. Reforestation is an opportunity to help trees move to reach their ideal climate conditions.

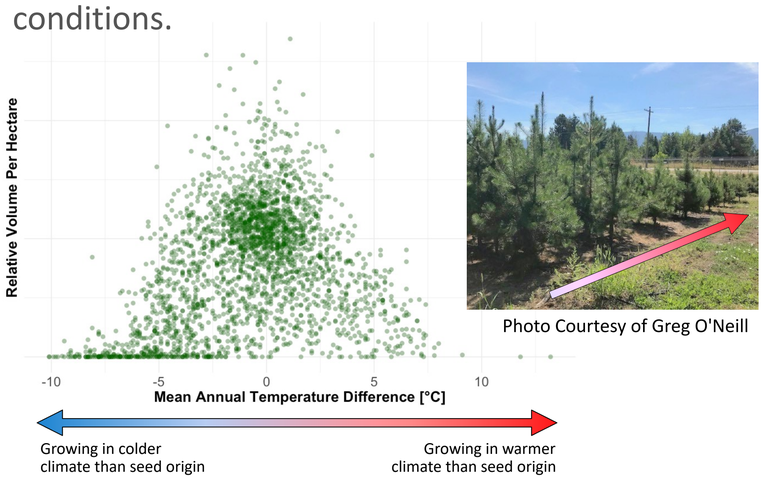
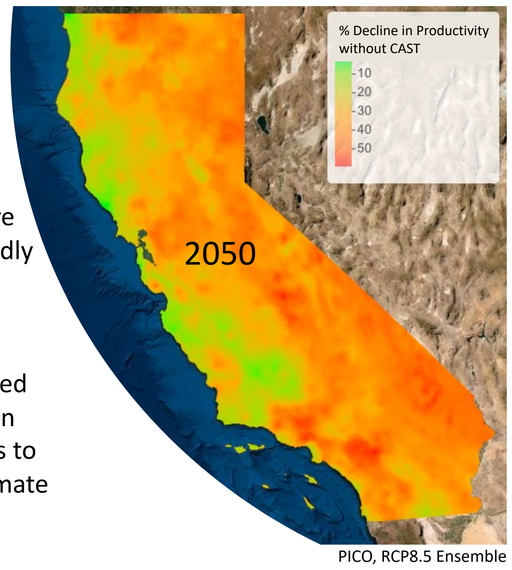


Photo Courtesy of Greg O'Neill

A Crisis and Opportunity



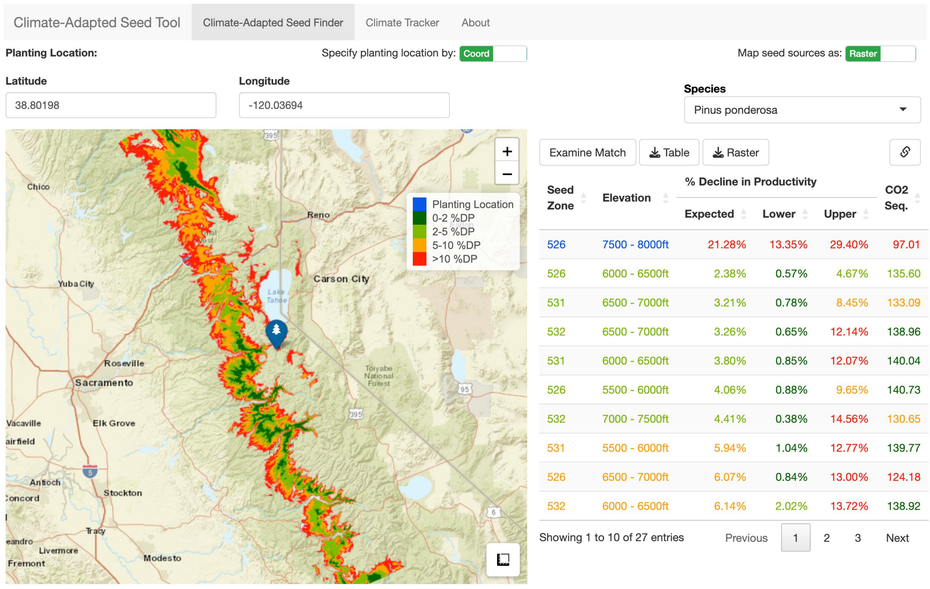
- California forests are not adapted to rapidly changing climate conditions.
- With climate-adapted seed transfer we can take proactive steps to adapt forests to climate change.

PICO, RCP8.5 Ensemble

Expected Impacts of Seed Transfer

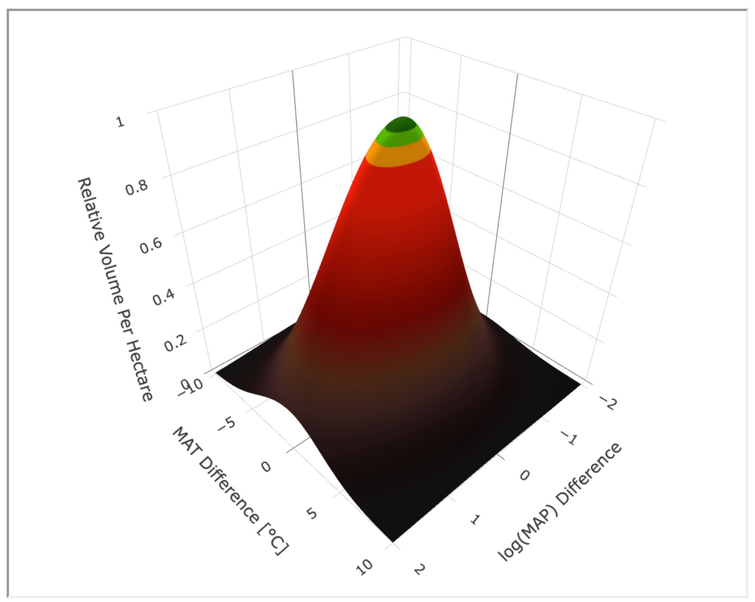
- Trees grow to become resistant to fire more quickly
- Greater carbon sequestration
- Greater timber production
- Forest Health
- Reduced mortality
- Faster recovery into desired habitat types

Expected Impacts—if deployed across private land in CA starting in 2021	By 2050	By 2060
Additional CO_2 Sequestered [million tonnes/yr]	2.3	4.1
Market Value of Additional CO_2 Sequestered [million USD/yr]	$77	$138
Additional % of Net 2018 CA GHG Emissions Sequestered [%/yr]	.5%	1%
Additional Timber Production [million board-ft/yr]	142	256



Climate Transfer Functions

CAST uses climate-transfer functions fit to data from seed-transfer experiments to estimate the relative growth rate (*e.g.*, growth, survival) of each candidate seed source.



Seed-Transfer Datasets

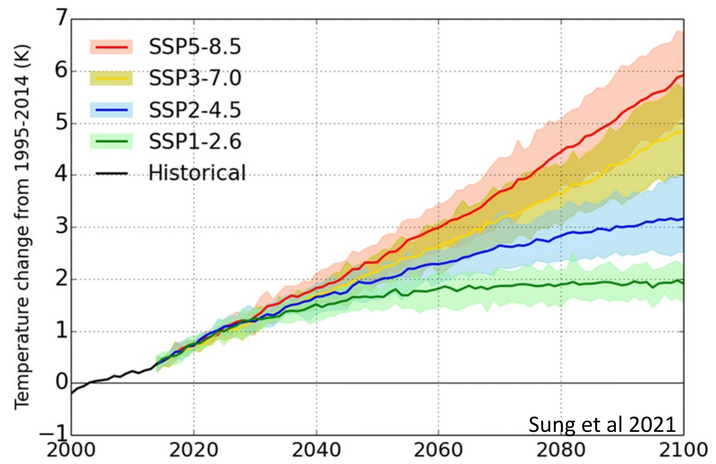
We're working to incorporate data from 368,000 trees planted in seed-transfer experiments across western North America into CAST. Forward thinking scientists began establishing these experiments in 1910 and scientists are still working to establish new experiments. However, the bulk of our data currently comes from outside California. Scaling up the number of seed transfer experiments planted in California's diverse regions will be critical to best adapting our forests to climate change.

Species	abco	abma	acma	alru	pico	pije	pimo	pien	pipo	pisi	potr	psme	qulo	thpl	tshe
N. Provenances	14	9	42	47	184	3	145	182	42	30	180	77	95	10	57
N. Sites	5	5	3	2	60	3	7	26	10	9	3	6	2	6	5
N. Trees	9.1k	3.3k	13.8k	4.1k	70.7k	4.6k	22.1k	110k	10k	31.9k	9k	25.3k	7k	4.1k	42.7k
Last Meas. Age [field-yrs]	18-26	18-26	10	10	20-35	41	16	10-15	8-80	10-15	3	17-100	6	15	5-25
Planting Yr(s)	1976-1979	1976-1979	2008-2009	1995	1974	1973	1988	2000-2005	1910 - 1992	2000	2000-2007	1915-1975	2014-2015	1991	1993-2005

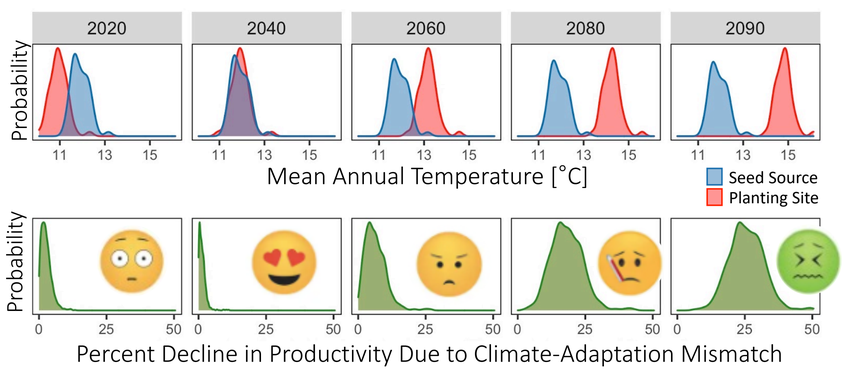
Spatial Accuracy and Uncertainty

CAST allows users to input precise spatial information and is also backwards compatible with California's legacy system of seed zones and elevation bands. Because of considerable climatic heterogeneity (*i.e.*, uncertainty) within the legacy spatial units, users who use precise spatial information are likely to achieve better outcomes (*i.e.*, ≈ 5% greater growth rates).

Climate is a Moving Target



Selecting seed for warming climate conditions inherently involves tradeoffs between optimizing for colder conditions in the near term and hotter conditions in the long term. CAST currently defaults to balancing this tradeoff by to optimizing for anticipated climate conditions ≈ 20 yrs. in the future. It also includes options for optimizing over longer or shorter time horizons.



Team

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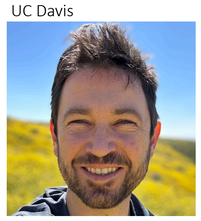

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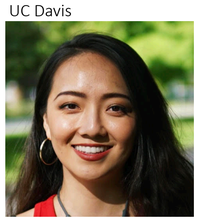

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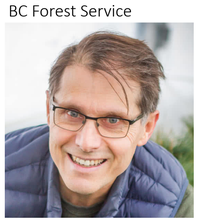

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