Climate Impact in Agriculture and UC ANR Research and Resources

Tapan Pathak, Ph.D.
Cooperative Extension Specialist – Climate Adaptation in Ag
Department of Civil and Environmental Engineering
University of California, Merced

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Agriculture and Natural Resources

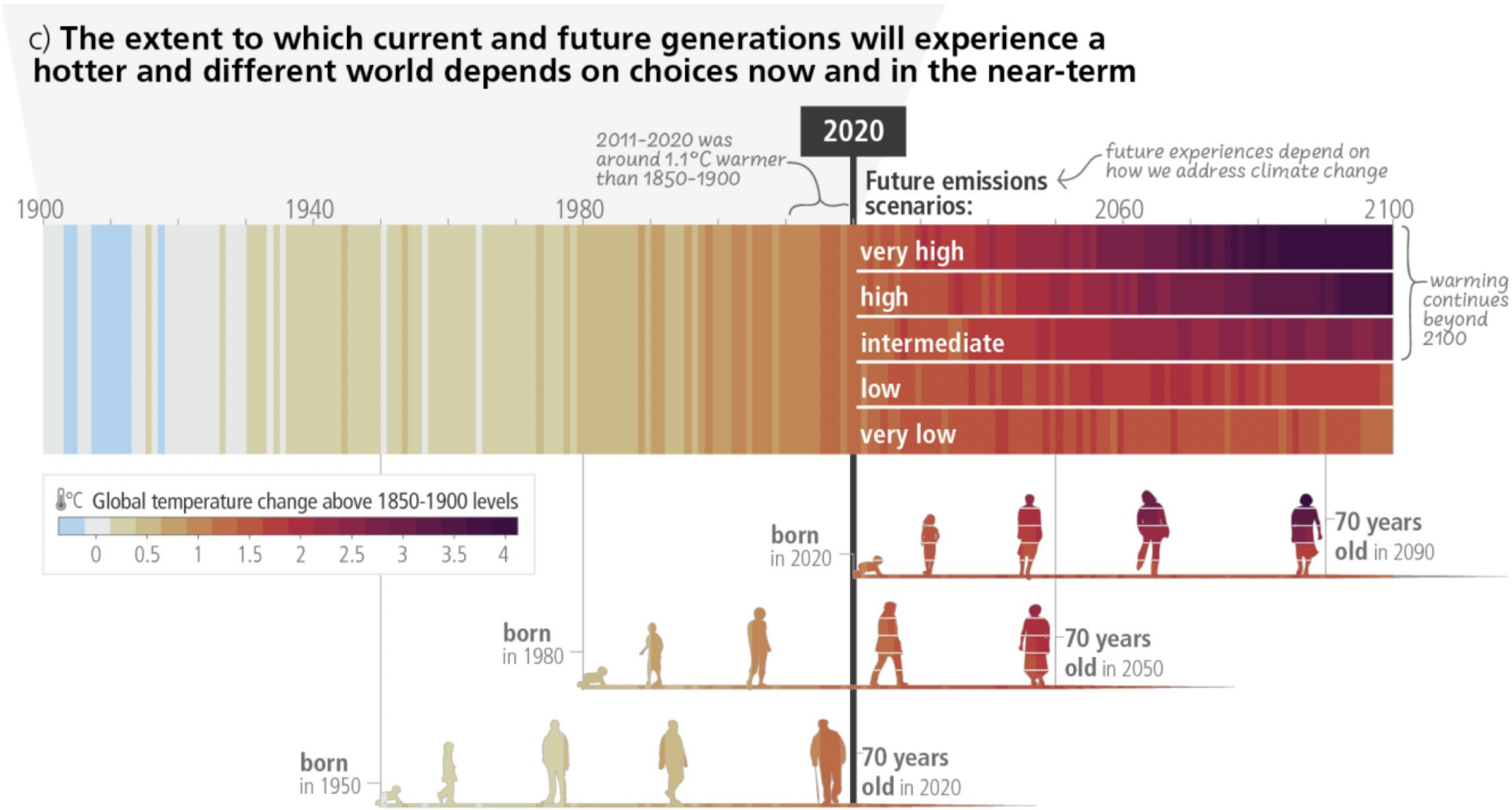
Outline

- IPCC 2023 summary report - key takeaways
- Observed and Projected Trends
  - Temperature
  - Precipitation
  - Extreme events
  - Snowpack
- Agricultural Impacts
  - Yield declines
  - Chill accumulations
  - Growing season shifts
  - Impacts due to pests
- UC ANR Resources on Climate and Ag
- Summary

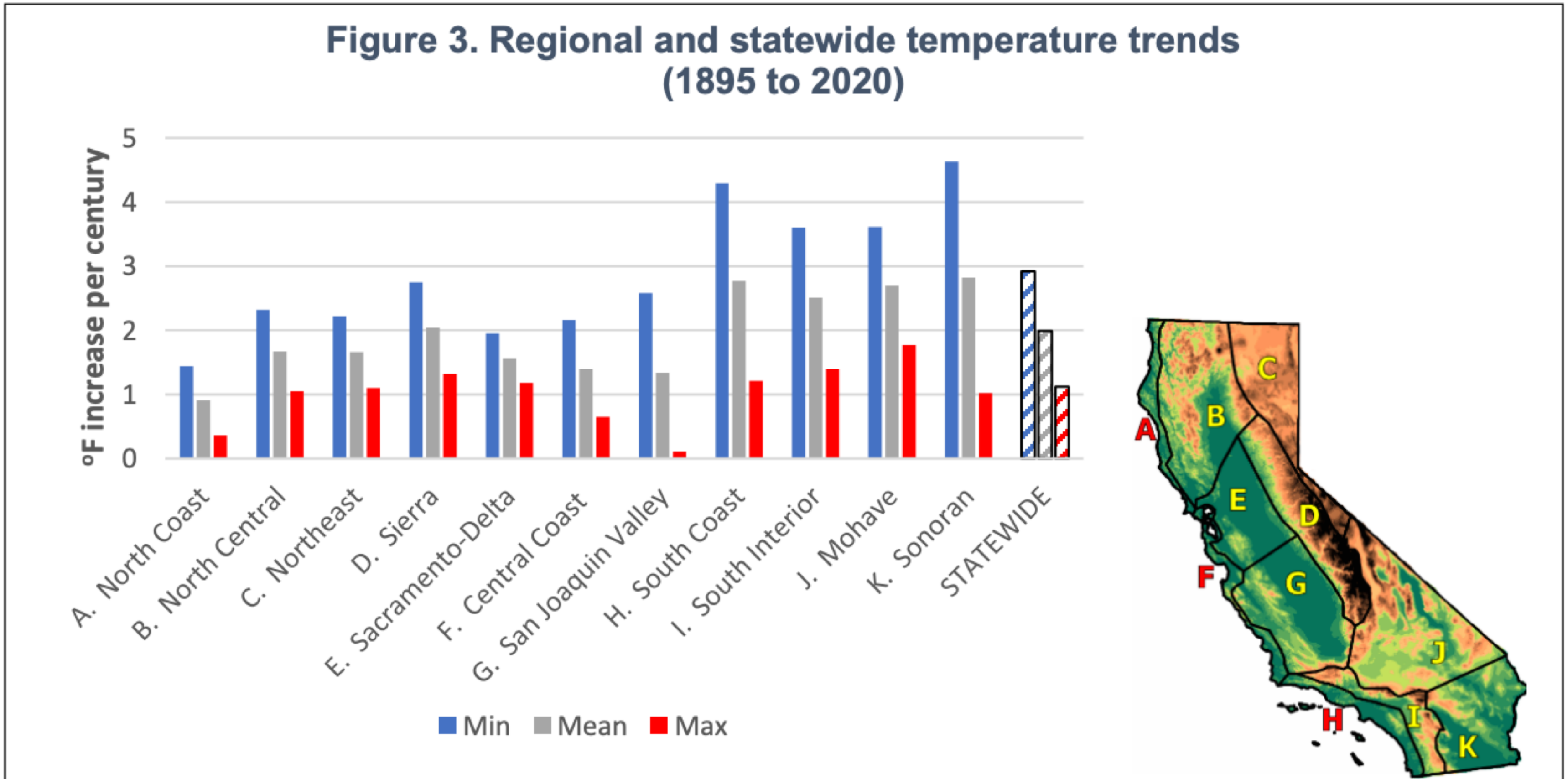
IPCC Summary Report, 2023

- Every increment of warming will intensify multiple and concurrent hazards (*high confidence*)
- Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected
- Adaptation planning and implementation has progressed across all sectors and regions. Despite progress, adaptation gaps and maladaptation exist
- Adaptation options that are feasible and effective today will become constrained and less effective with increasing warming. Holistic approaches with co-benefits is a key
- Accelerated implementation of adaptation actions in this decade would reduce projected losses and damages for humans and ecosystems (*very high confidence*)

IPCC Summary Report, 2023

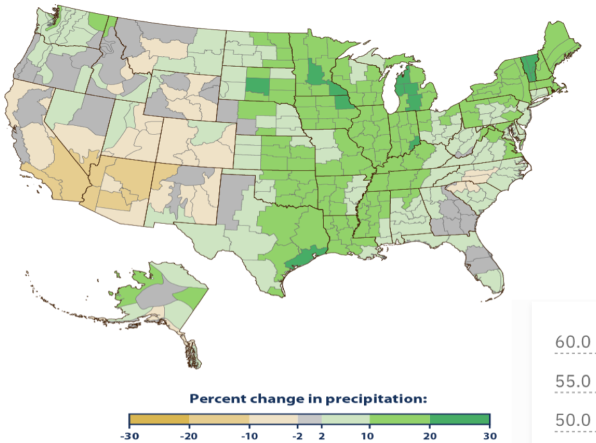


Changes in California Temperatures

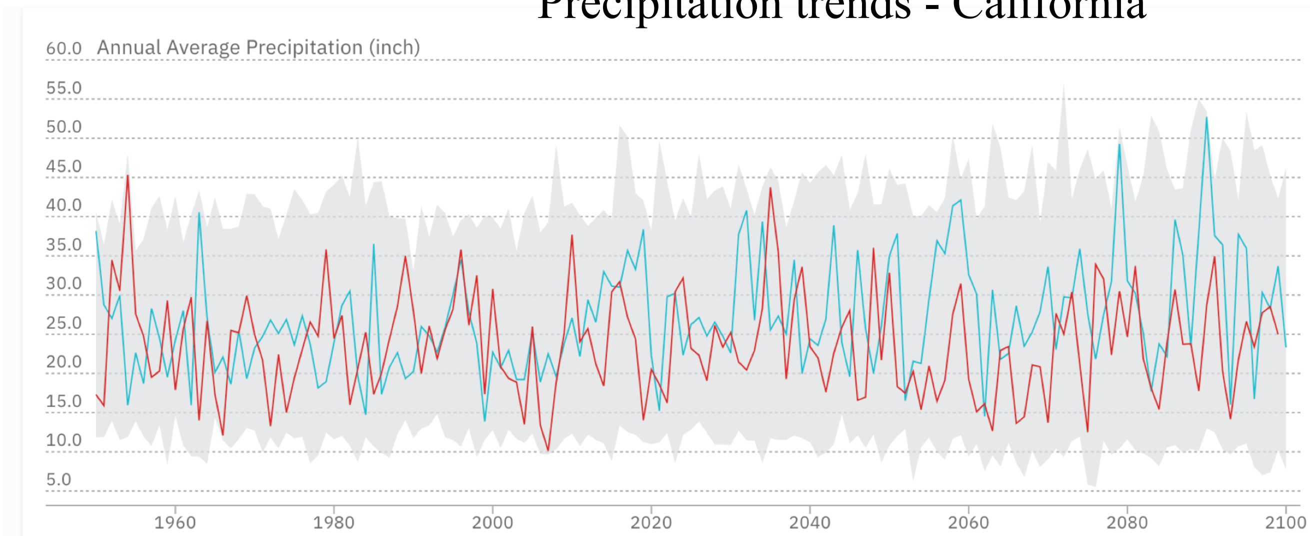


Source: WRCC, 2021

Precipitation Trends

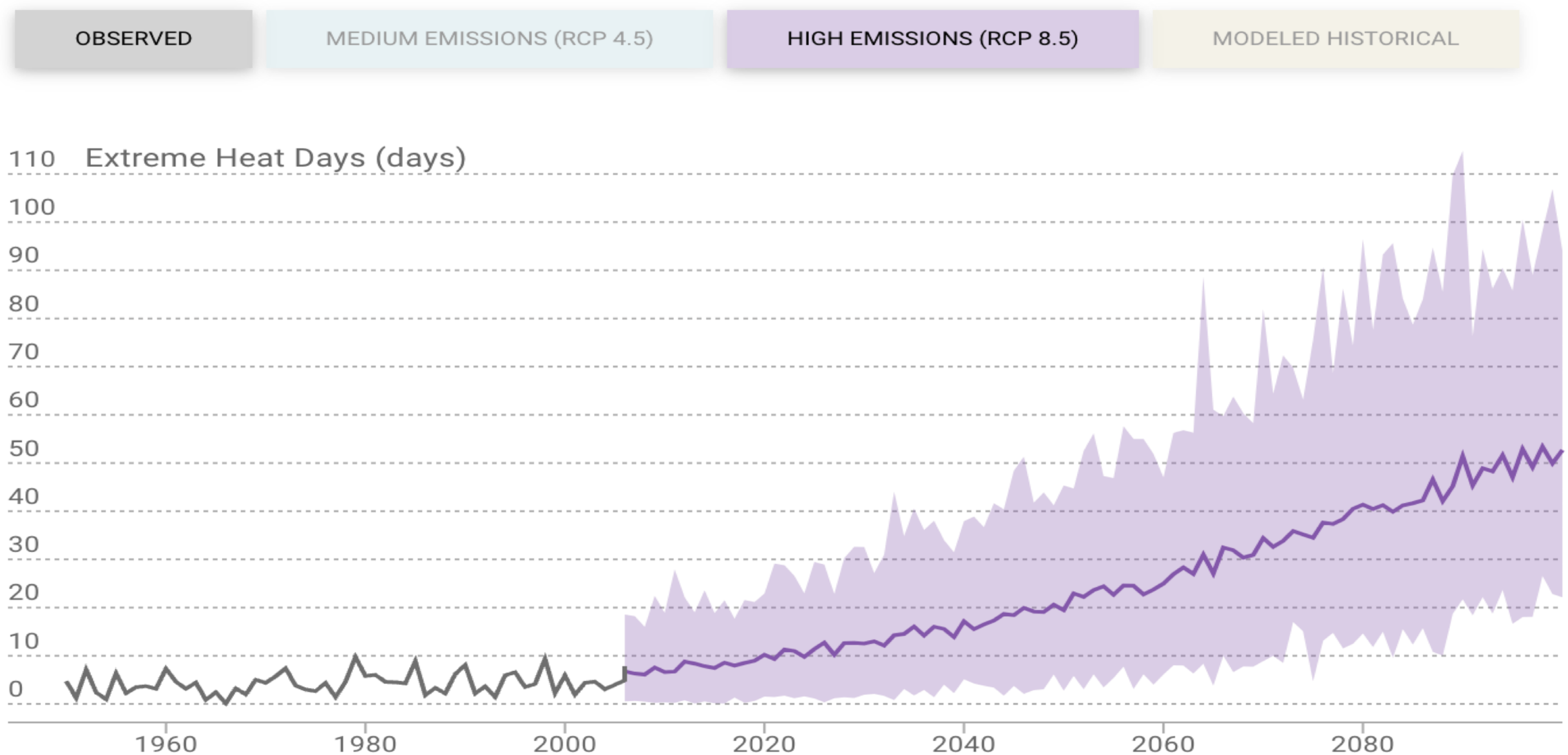


Precipitation trends - California



Ref: Cal-Adapt.Org

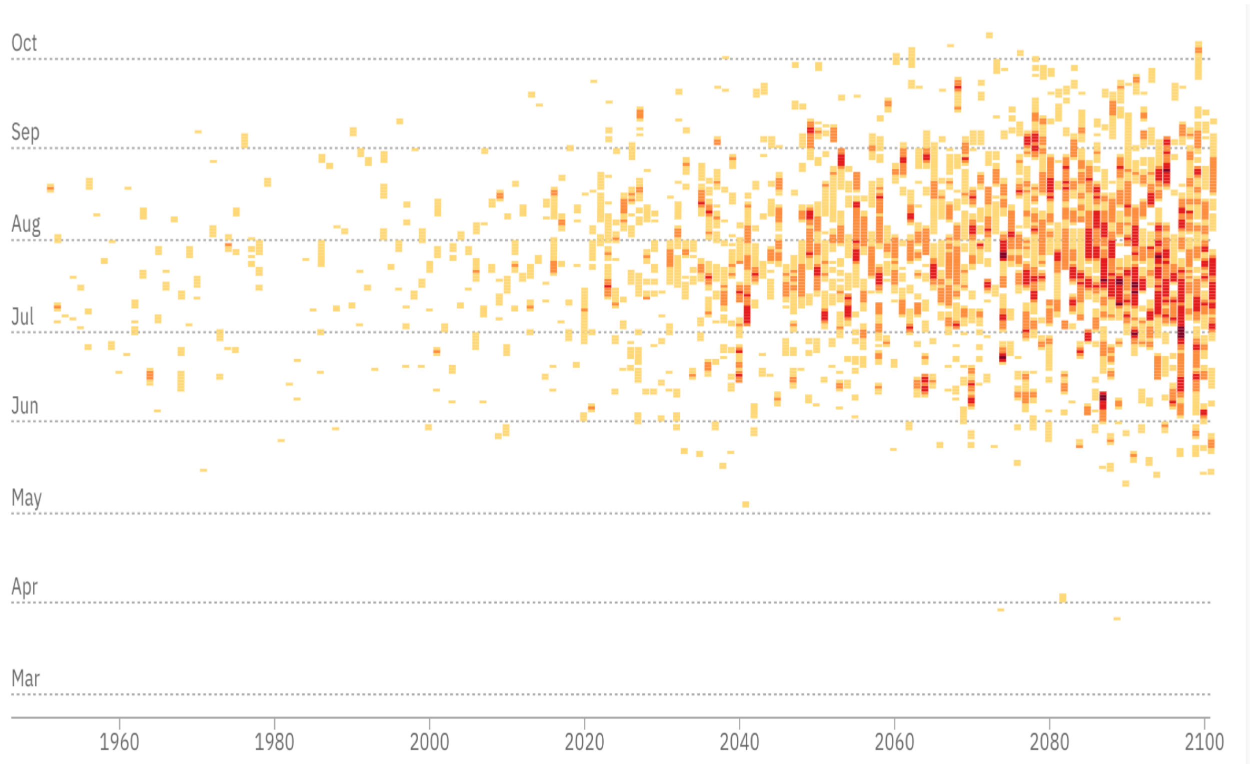
Frequency of Extreme Heat Days



Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+14 days	17 days	9 - 37 days
HIGH EMISSIONS (RCP 8.5)	+18 days	21 days	11 - 42 days
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+19 days	22 days	13 - 51 days
HIGH EMISSIONS (RCP 8.5)	+40 days	43 days	24 - 83 days

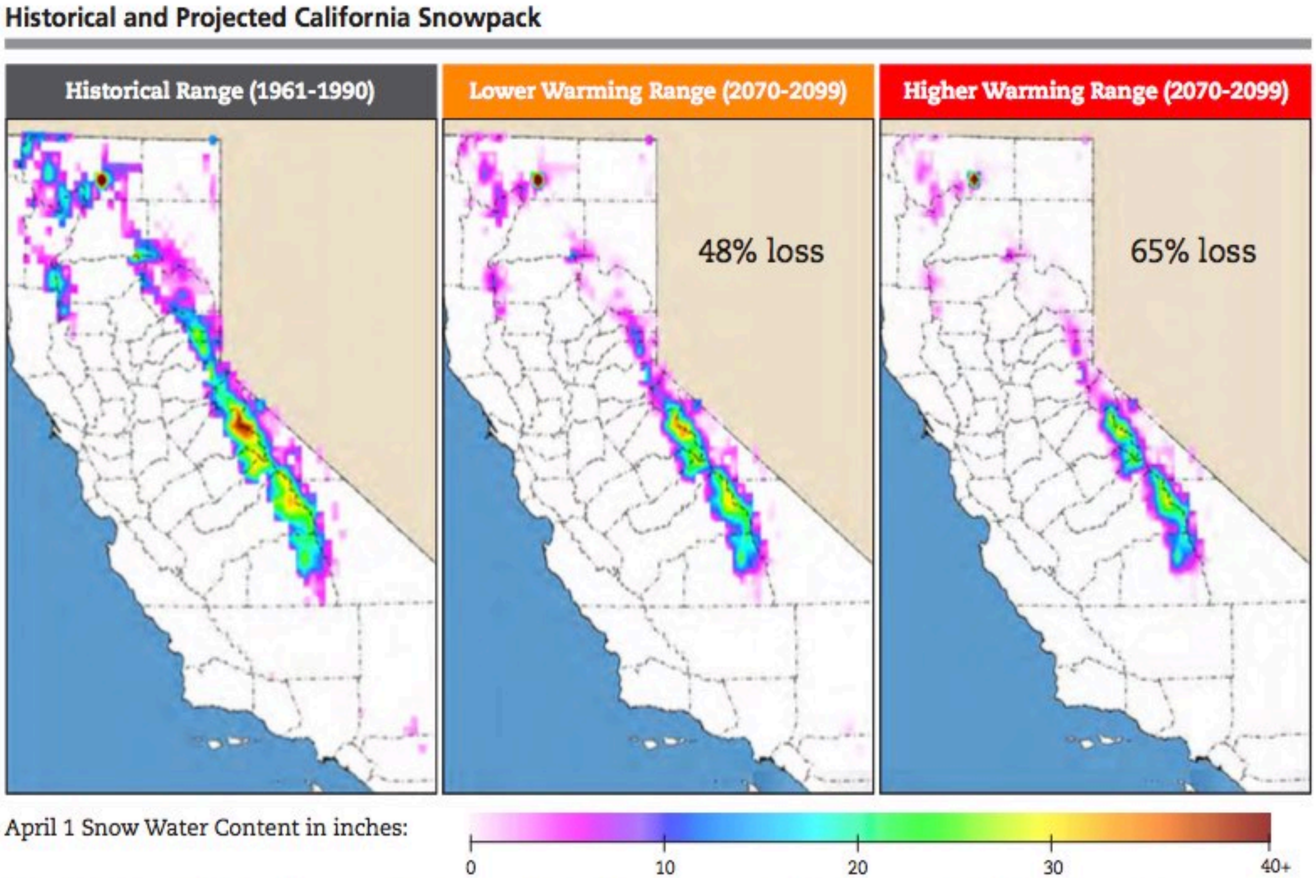
Ref: Cal-Adapt.org

Timing of Extreme Heat Days



Reference: cal-adapt.org

Snowpack



Source: CA DWR

- A loss of 48% and 65% of the snowpack is projected under low and high emission scenarios, respectively
- By 2081–2100, average temperatures in the Sierra Nevada are projected to increase by about 7–10 degrees F (UCLA study)

Impacts on Agriculture

Climate change impacts – Farmers views

"Our crops may have to change which also means that our markets may also change."

I feel water be feast or famine, more extremely wet or dry years

It's going to be hotter, already we harvest our crops much earlier than 30 years ago because of hotter summers

Yield losses

Due to these climate condition changes that are taking place, water districts are having to raise water rates.

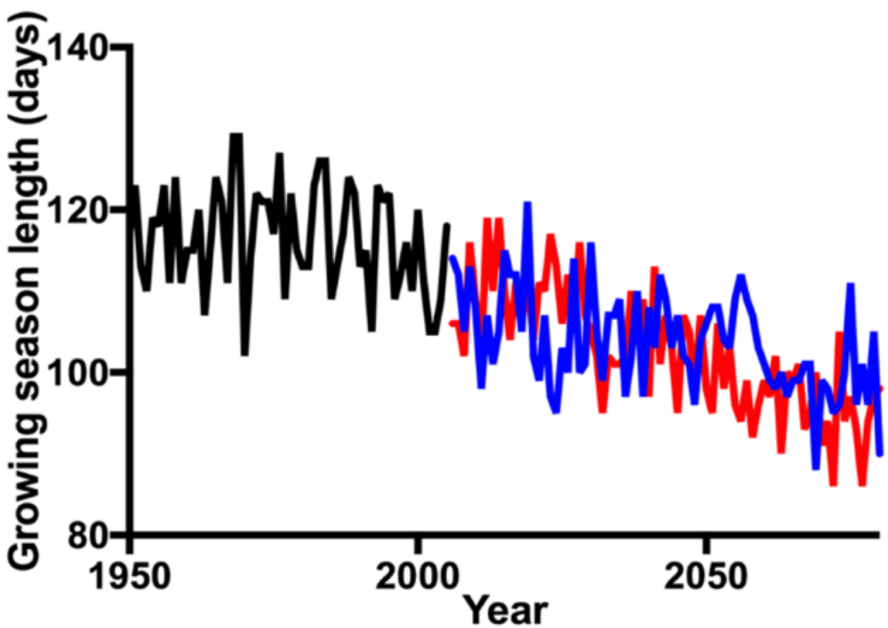
Too hot for too long during growing season

When you really see so much difference in a short amount of time …. we would have to look at that and say, well, we're going to have to adopt varieties because this is a 20- or 25-year planning and we're going to have to find crops or varieties that will adapt

Impacts on Crop Yield

- Expected yield reductions by 2097: cotton (≈ 29%) > sunflower (≈ 26%) > wheat (≈ 15%) > maize (12%) > rice (≈ 10%) > tomato (≈ 9%)
- These yield decreases were mainly because high temperatures under climate change shorten the duration of phenological phases
- Limitations related to water supply to irrigated croplands
- Adaptation measures such as management practices and improved cultivars may alleviate some of the impacts

Impacts on Crop Growing Season



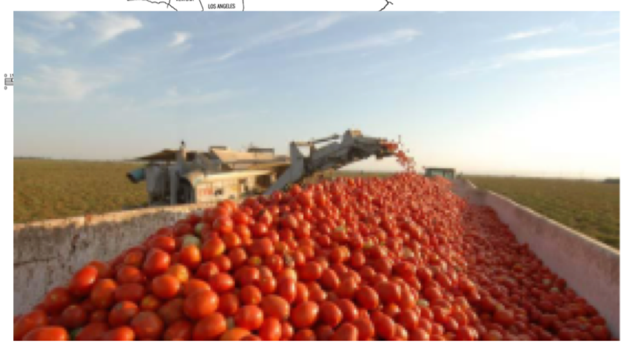
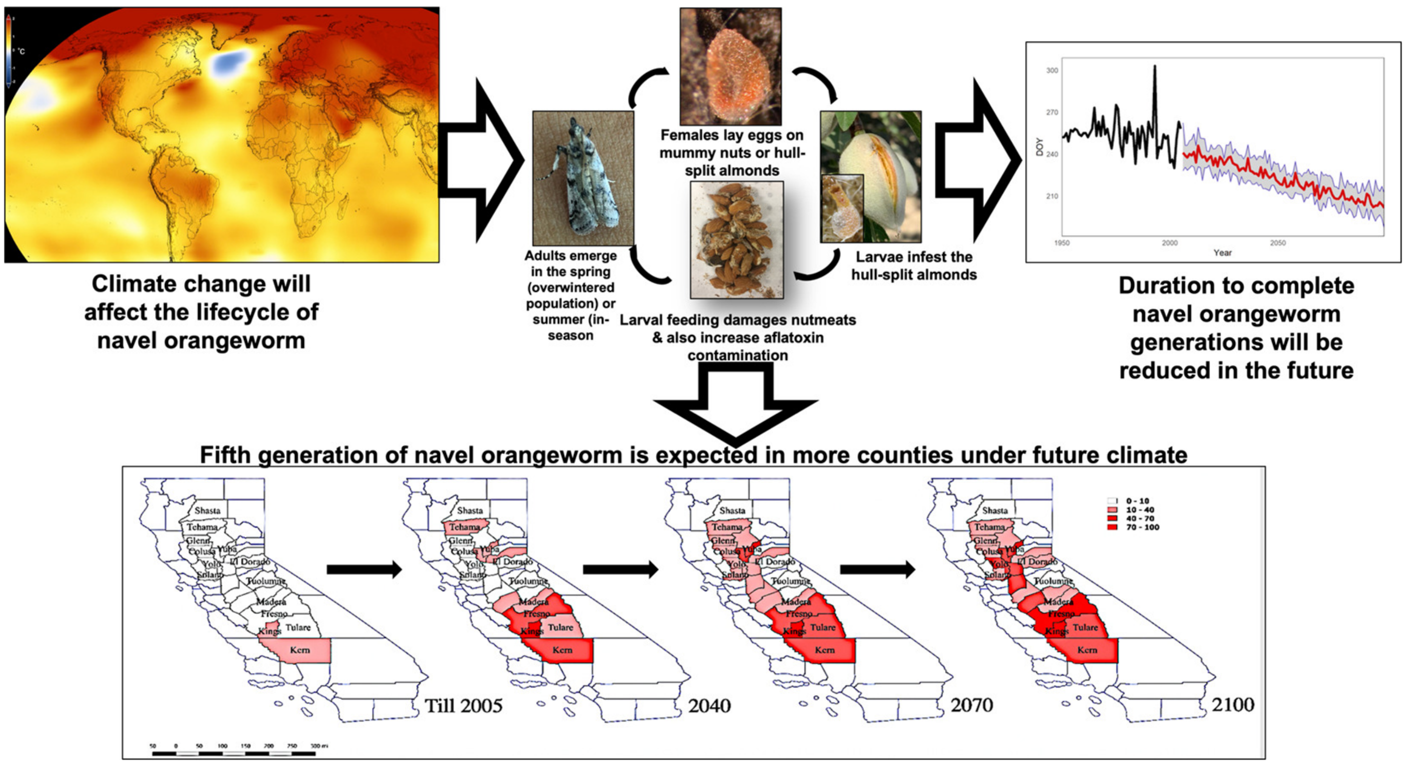


Photo credit: California Tomato Growers Association

Pathak and Stoddard, 2018
https://link.springer.com/article/10.1007/s40808-018-0460-y

Climate change impacts on pests

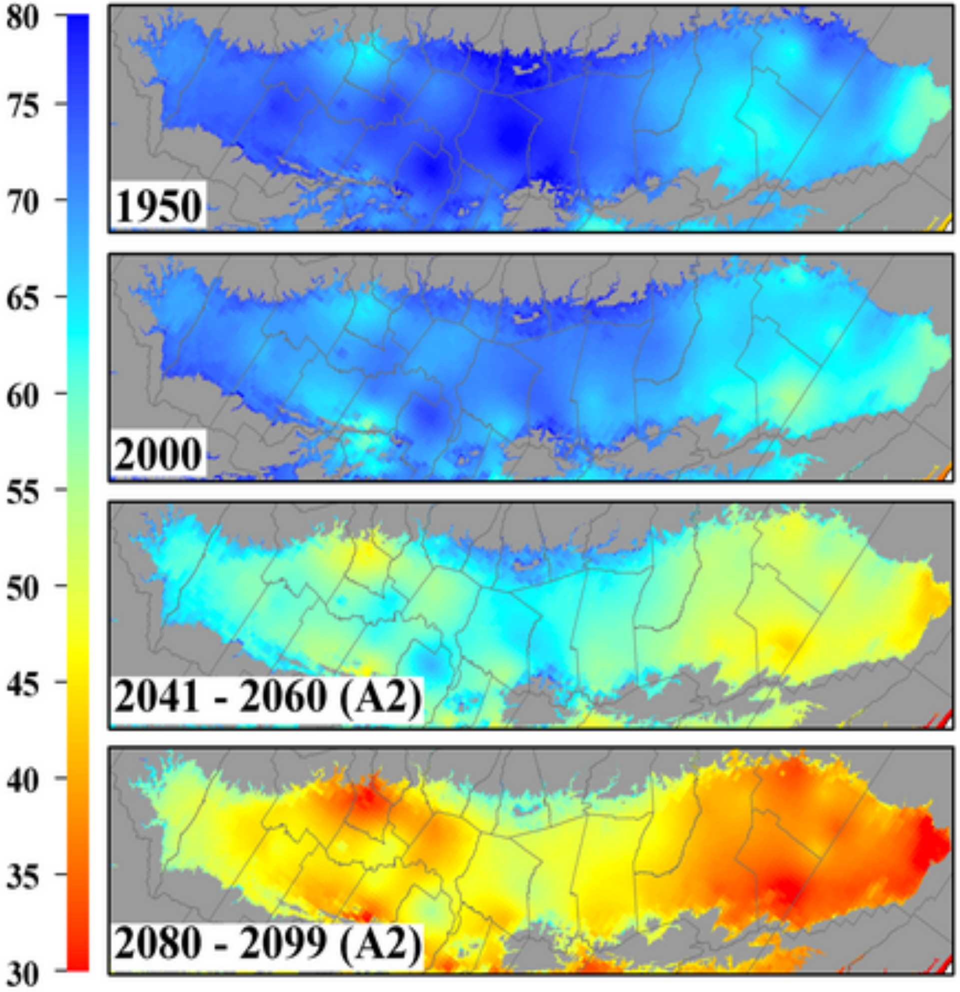


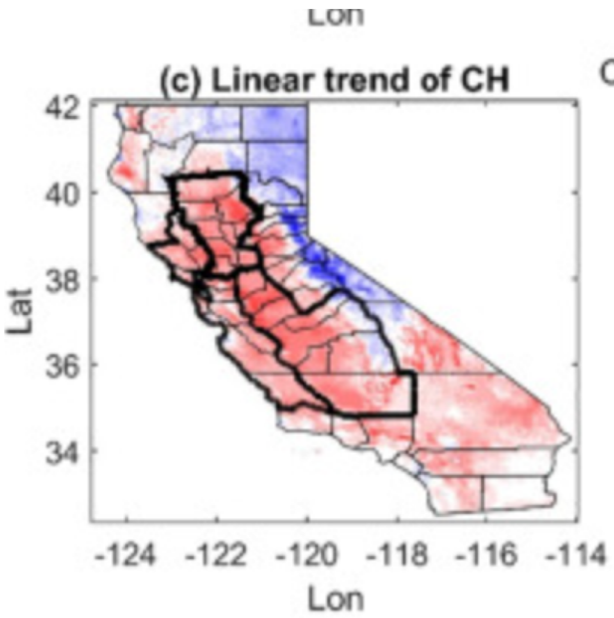
Pathak et al., 2021 https://www.sciencedirect.com/science/article/pii/S0048969720361866

Potential impacts – Weeds Pests and Diseases

- Declines in crop due to weeds, diseases, pests, and other climate change induced stresses
- Frost sensitive pests may survive due to reduced frost risks
- Increased rate of development and potentially northward migration of pests
- Increased weed biomass due to elevated temperature and CO_2, competing with crops for water and nutrients

Impacts on chill accumulations

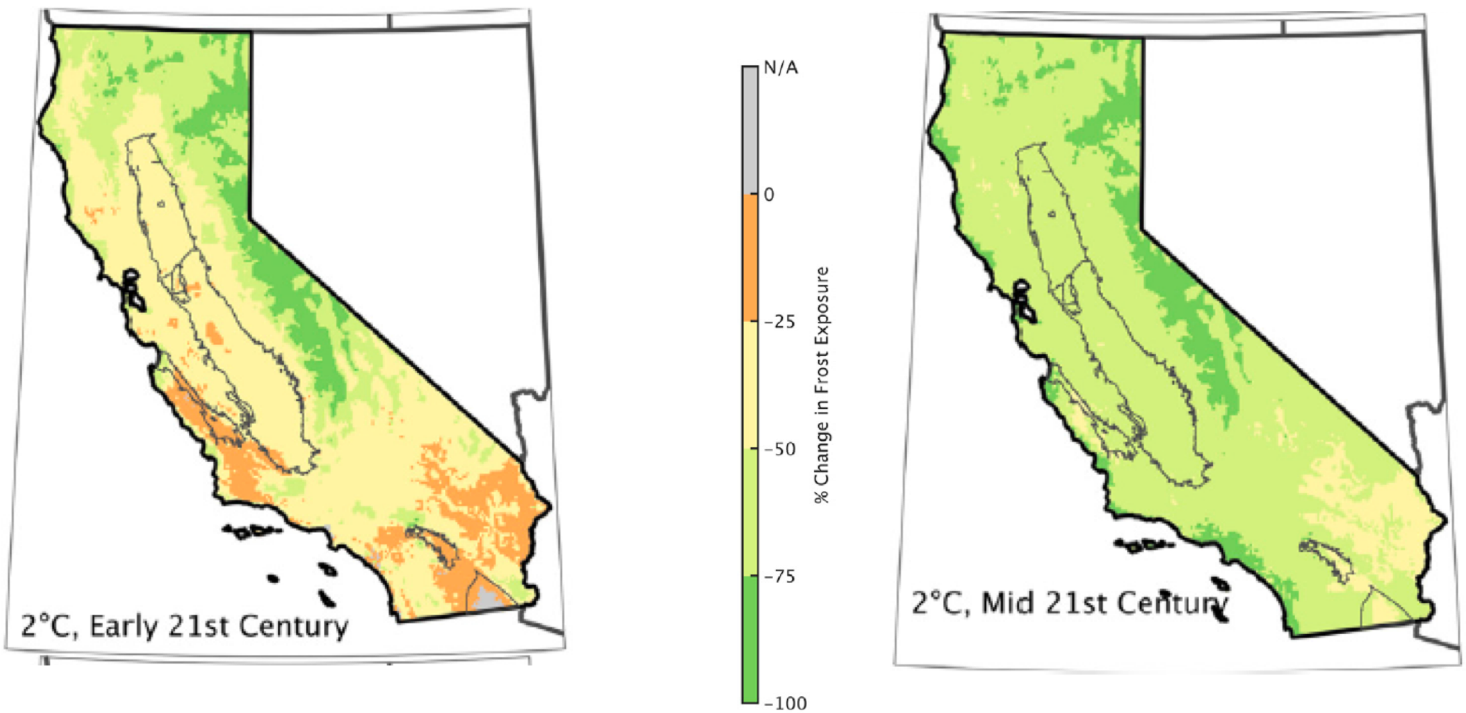




Zhang; Pathak et al., 2021

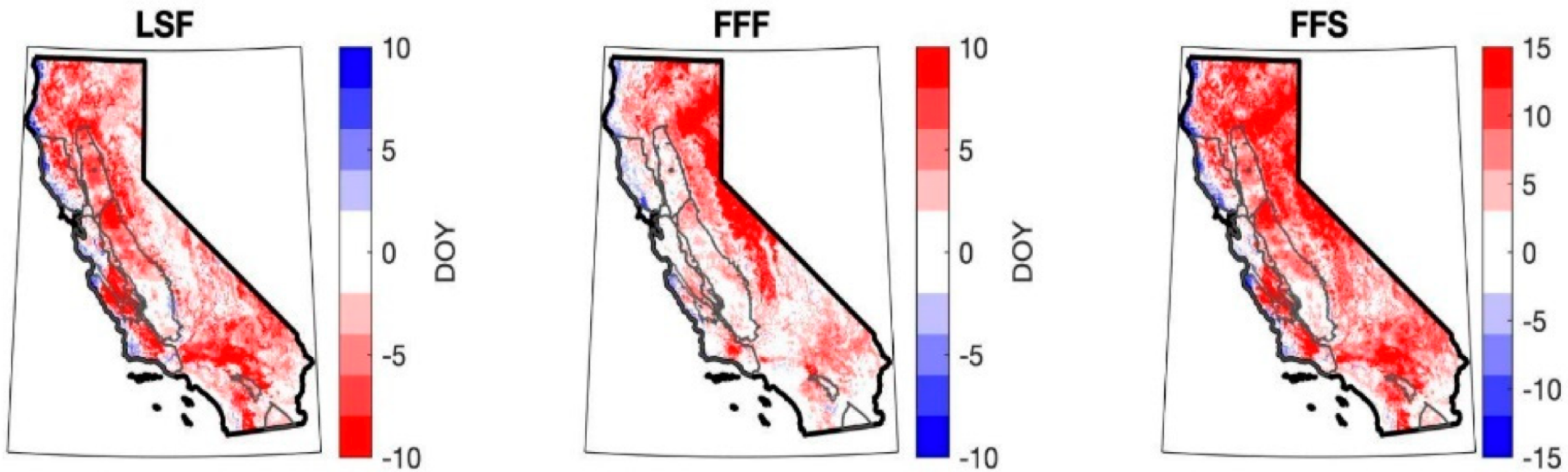
Reduced frost risk under future climate

Lauren Parker; Tapan Pathak, Steven Ostoja,



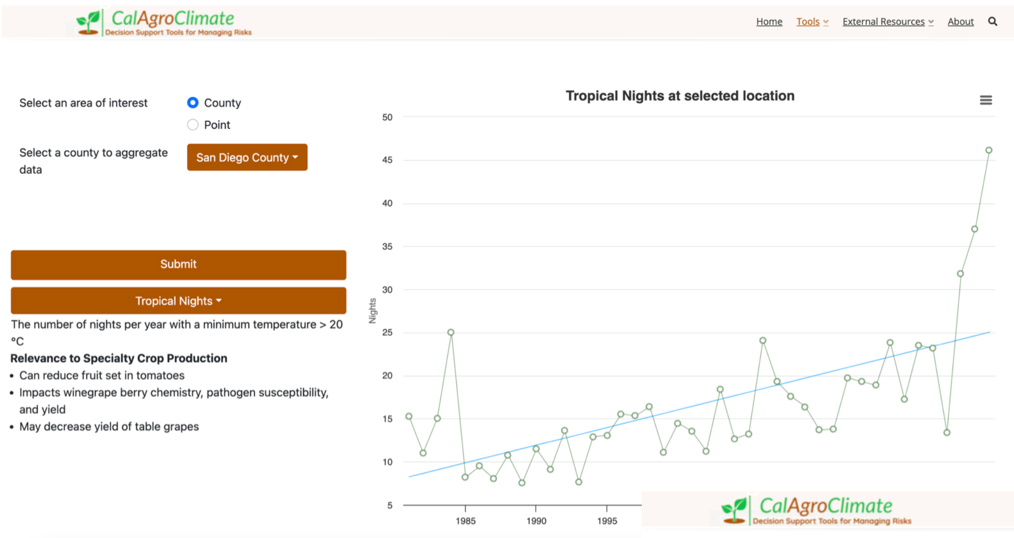
https://doi.org/10.1016/j.scitotenv.2020.143971

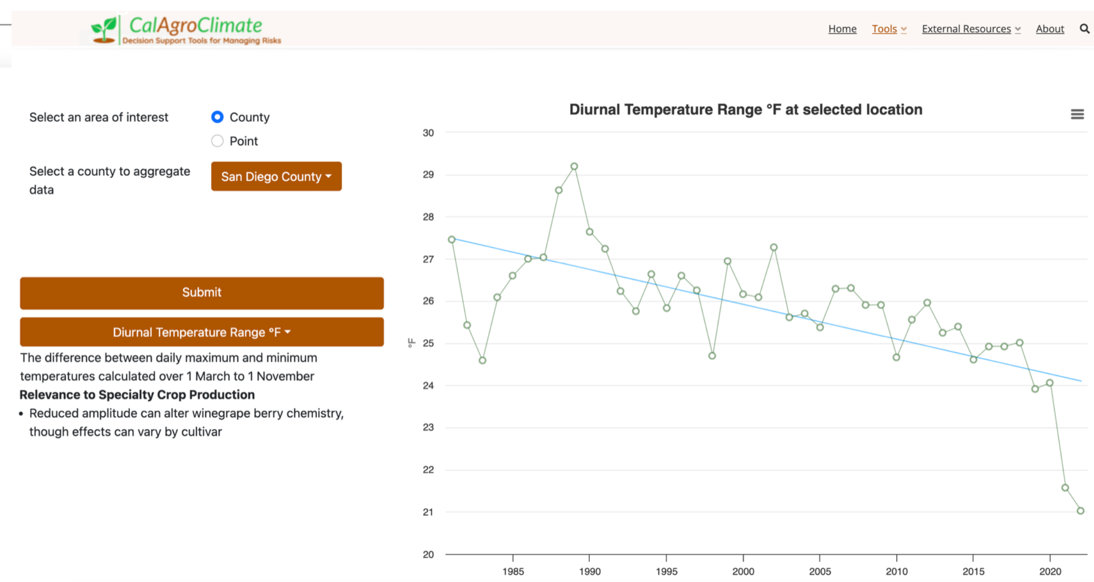
Length of the growing season



Lauren E. Parker; Ning Zhang; John T. Abatzoglou; Steven M. Ostoja; Tapan B. Pathak. 2022.

Agroclimatic Indicators





UC ANR Resources

CalAgroClimate

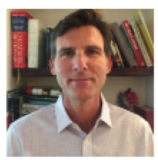
Decision Support Tools for Managing Risks

TOOLS

Heat Advisory	Frost Advisory	Crop Phenology	Pest Advisory
Maximum temperature forecast	Minimum temperature forecast.	Calculate growing degree days	Tool to predict crop pest life stage.

https://calagroclimate.org/

Tapan Pathak
Applied climate in agriculture



Steve Ostoja
USDA California Climate Hub

Lauren Parker
USDA California Climate Hub

Shane Feirer
GIS analyses with emphasis on natural resource related topics

Robert Johnson
GIS/Web Development

Prakash Jha
Project Scientist

USDA California Climate Hub
U.S. DEPARTMENT OF AGRICULTURE

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IGIS

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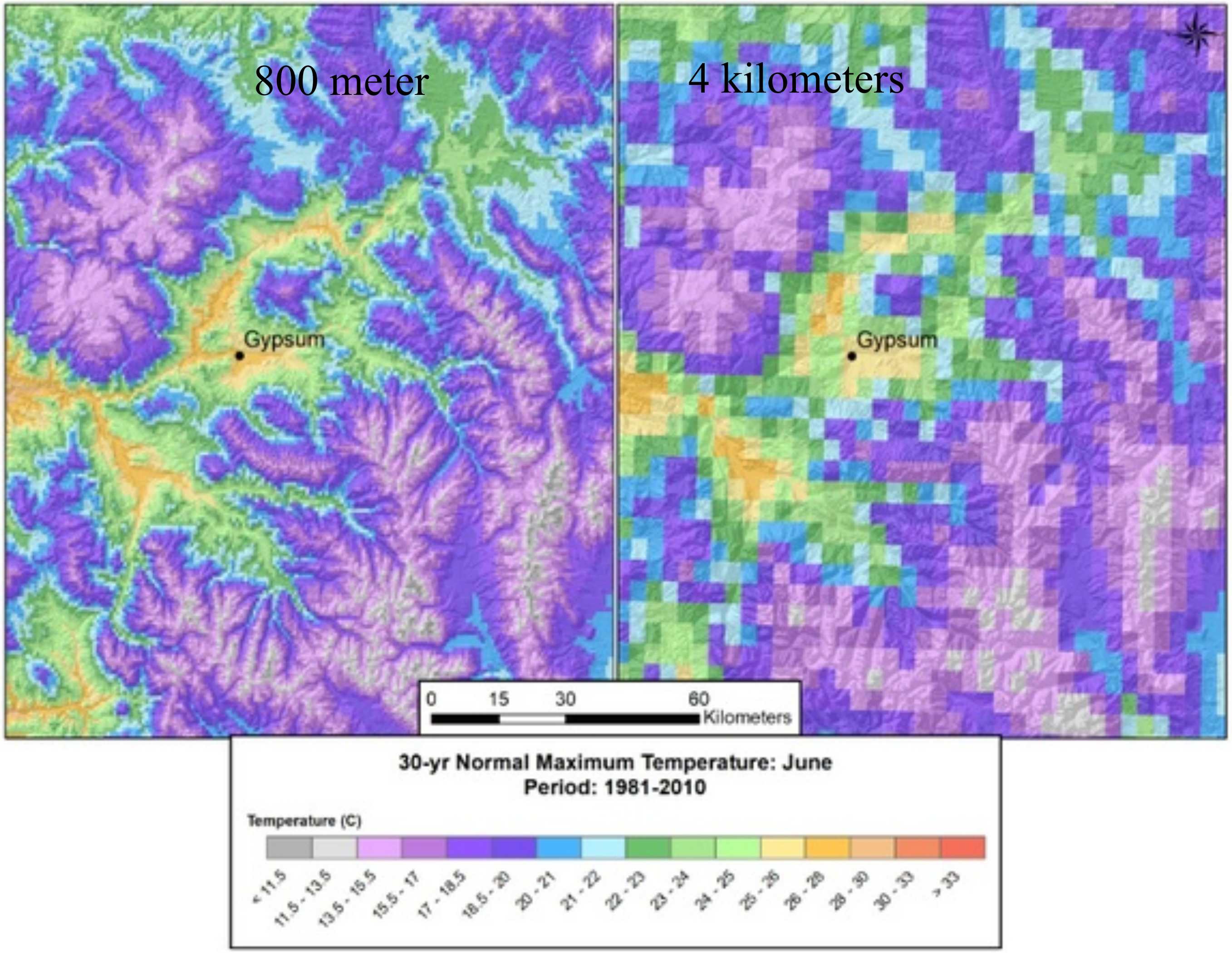
USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

High-Resolution PRISM Data



Crop Phenology Tool

CalAgroClimate
Decision Support Tools for Managing Risks

Home | Tools | External Resources | About

① Select a commodity — **Commodity**

② Select a variety — **Variety**

③ Select a date to start GDD accumulation — Start Date: 03/01/2022

④ Select the number of years used to caculate the historical average — Historic Average (Years): 5

⑤ Launch the map to specify your location — **Launch map**

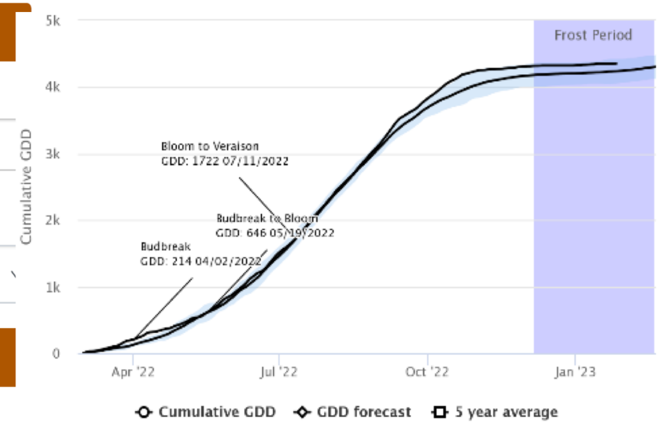
⑥ Select minimum temperature for GDD accumulation — Min Temp

⑦ Select maximum temperature for GDD accumulation (if applicable) — Max Temp

⑧ Select temperature units — Unit: F / C

⑨ Select threshold type for GDD calculation — **Threshold**

Submit



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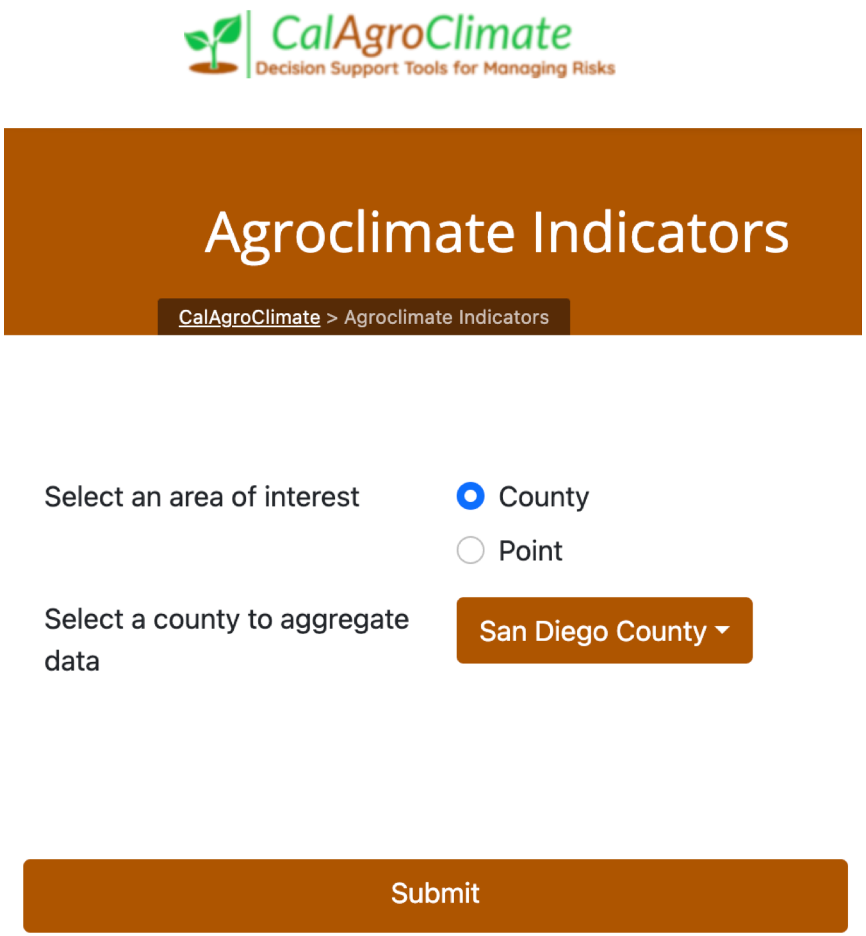
CalAgroClimate
Decision Support Tools for Managing Risks

https://calagroclimate.org/

Agroclimatic Indicators



Frost Days

Last Spring Freeze

First Fall Freeze

Freeze-Free Season

Tropical Nights

Hot Days

Extreme Heat Days

Heatwaves

Diurnal Temperature Range °F

Diurnal Temperature Range °C

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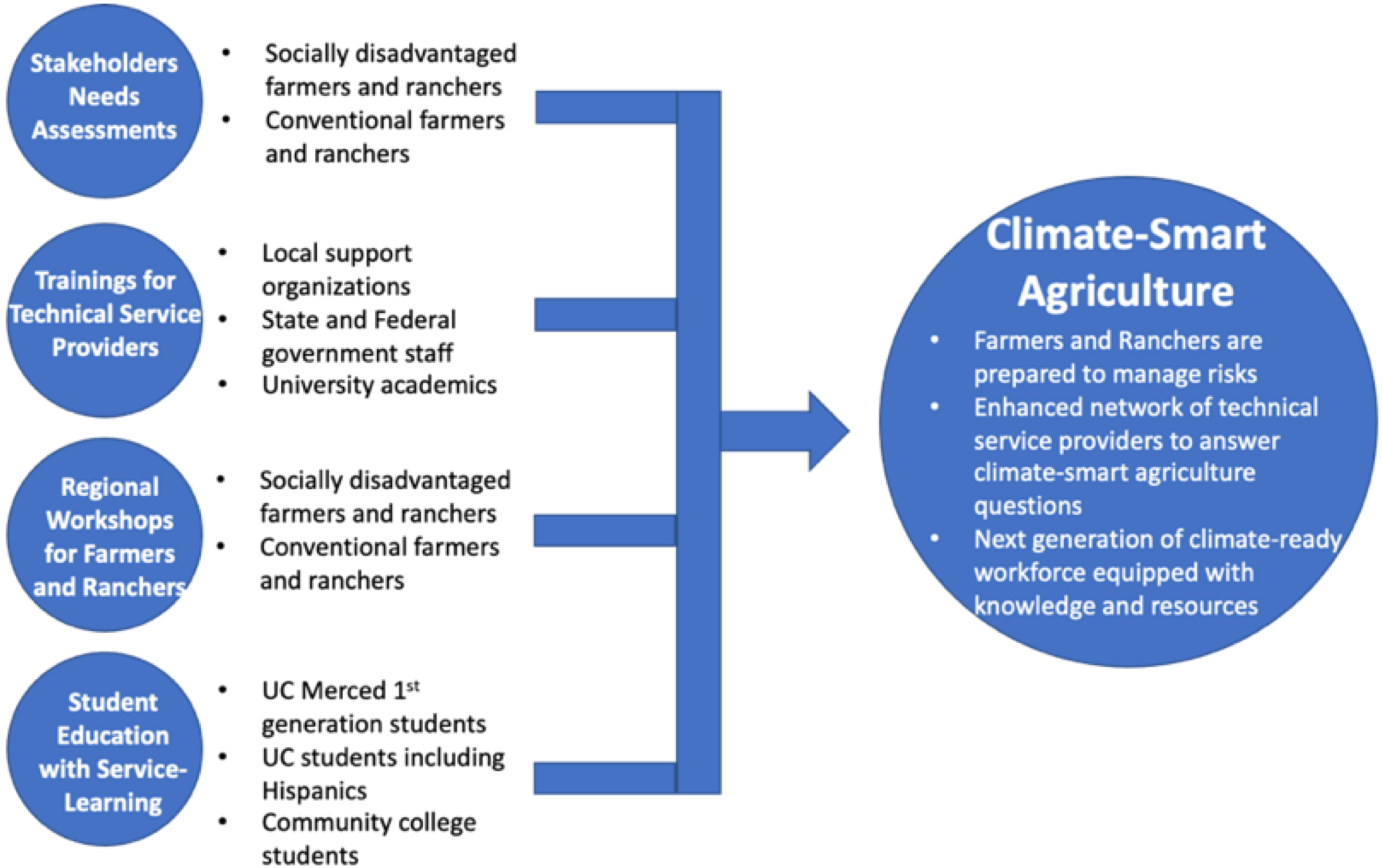
https://calagroclimate.org/

CalAgroClimate
Decision Support Tools for Managing Risks

Multifaceted pathways to climate-smart agriculture

Tapan Pathak, Project Director

USDA NIFA



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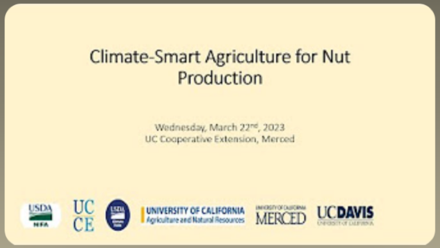
Climate-smart regional workshop



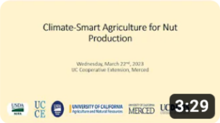
2023 Climate-Smart Nut Production Workshop Series (USDA/NIFA)

UCANR

11 videos 56 views Last updated on Apr 5, 2023

Play all Shuffle

A series of videos produced for the workshop held at UCCE Merced on March 22, 2023, which provides a number of perspectives on climate-smart agriculture processes, risk management, resources, incentives, and other considerations that may be of interest to California nut producers.

1 

An Introduction to the 2023 USDA/NIFA Climate-Smart Nut Production Workshop with Tapan Pathak, Ph.D.

UCANR • 34 views • 1 month ago

2 

#1: Climate Change Trends & Impacts on California Agriculture with Tapan Pathak, Ph.D.

UCANR • 52 views • 1 month ago

3 

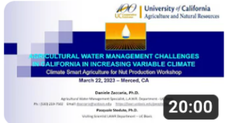
#2: How Will a Changing Climate Affect Orchard Crops? with Phoebe Gordon, Ph.D.

UCANR • 38 views • 1 month ago

4 

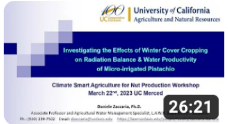
#3: Effect of Climate Change on Ag Pests and Future Management Implications w/Jhalendra Rijal, Ph.D.

UCANR • 21 views • 1 month ago

5 

#4: Ag Water Management Challenges in CA in Increasing Variable Climate with Pasquale Steduto, Ph.D.

UCANR • 34 views • 1 month ago

6 

#5: Investigating the Effects of Winter Cover Cropping with Daniele Zaccaria, Ph.D.

UCANR • 47 views • 1 month ago

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https://www.youtube.com/playlist?list=PLLjlfxpbNglYEOEhMN_Ic-TbkRCxAA7ML

UCANR/CDFA Climate-Smart Agriculture programs

Program Goals

The UCANR-CDFA program provides technical assistance that improves access for key statewide grant programs, including:

The State Water Efficiency and Enhancement Program (SWEEP) encourages farmers to install more efficient irrigation systems that decrease their water consumption as well as their greenhouse gas emissions. CDFA's SWEEP will fund grants up to $200,000.

The Healthy Soils Program (HSP) awards up to $100,000 per project for implementing conservation agriculture techniques that decrease erosion and greenhouse gas emissions, like cover cropping, compost, crop rotation, and mulching.

The Alternative Manure Management Program (AMMP) awards funds - up to $750,000 - to livestock producers who decrease their methane emissions by changing the way they manage manure.

https://ciwr.ucanr.edu/Programs/ClimateSmartAg/

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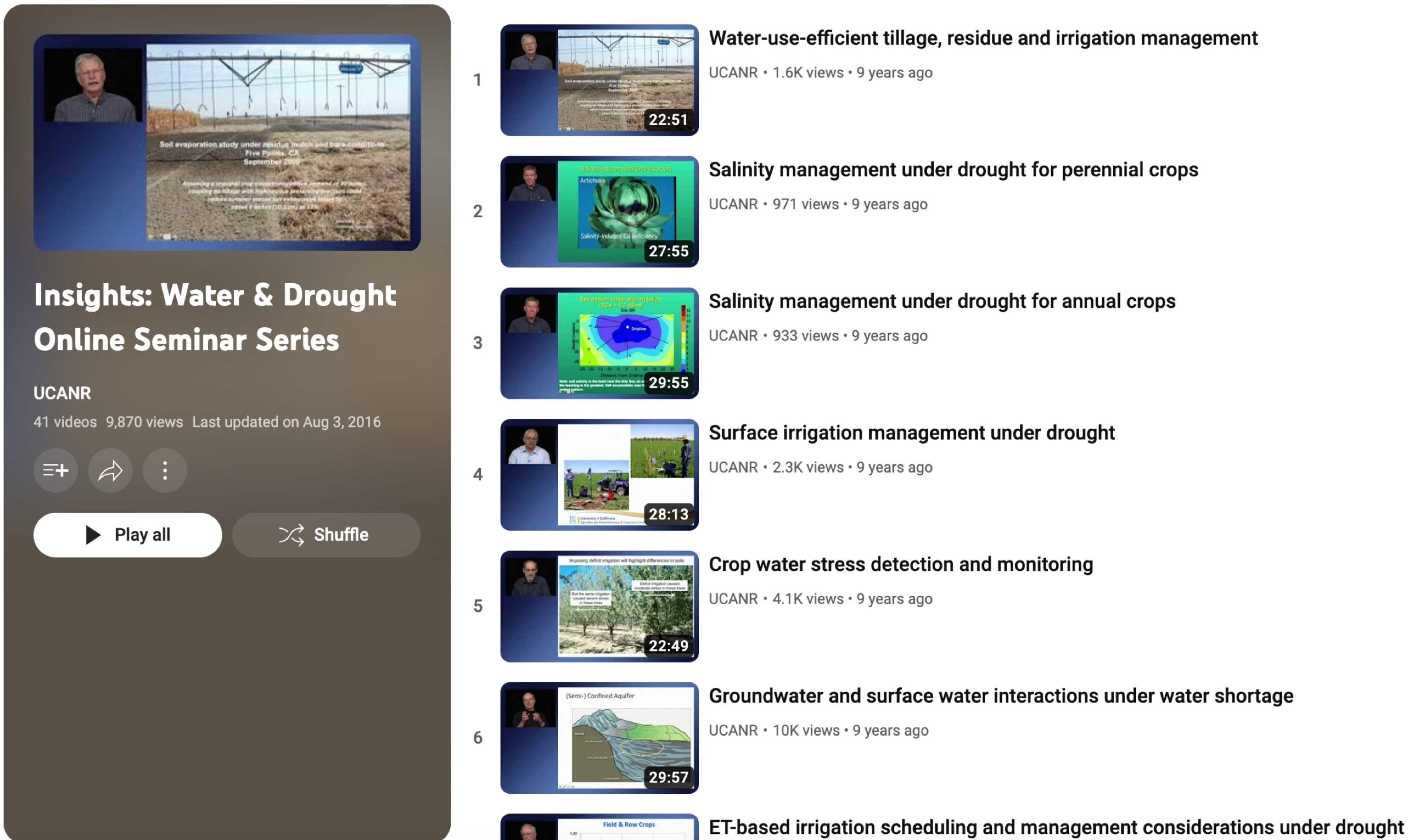
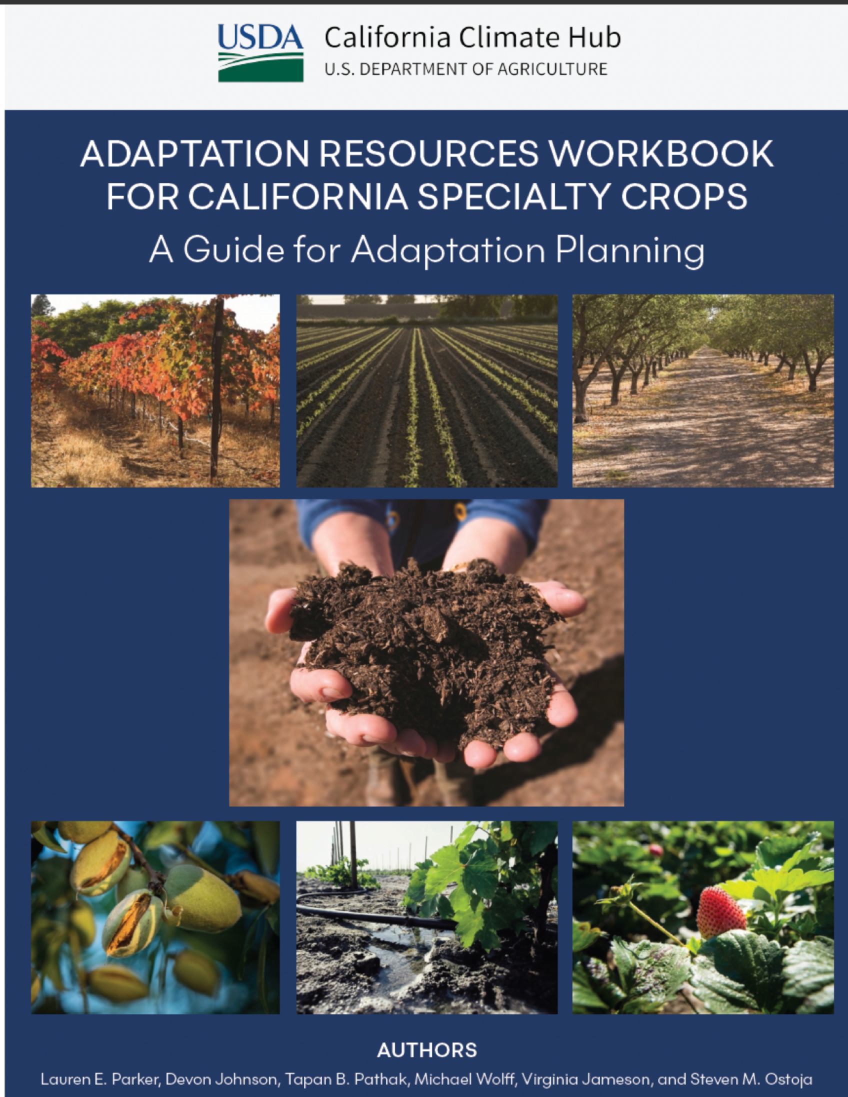
UC ANR Water and Drought Seminar



https://www.youtube.com/playlist?list=PLLjlfxpbNglYQxsSCr0TFtk2hUr_p1LDv

Adaptation Resource Workbook



Strategy 1: Support and Maintain Soil Health, Soil Biological Services, and Water Quality
- Approach 1.1: Maintain and Improve Soil Structure
- Approach 1.2: Enhance soil biology and nutrient availability with organic amendments
- Approach 1.3: Manage for soil and water salinization
- Approach 1.4: Manage fertilizer application to protect groundwater quality and soil health

Strategy 2: Cope with Uncertain Water Availability
- Approach 2.1: Improve or Alter Water Systems to Meet Current and Expected Demands
- Approach 2.2: Manage for the Effects of Drought
- Approach 2.3: Prepare for Changing Patterns and Intensity of Precipitation

Strategy 3: Manage Biological Stressors
- Approach 3.1: Reduce Pest Pressure
- Approach 3.2: Reduce Disease Risk from Pathogens
- Approach 3.3: Reduce Weed and Invasive Plant Pressure

Strategy 4: Prepare for Temperature Change
- Approach 4.1: Adapt to Warmer Conditions
- Approach 4.2: Manage for Changing Seasonality
- Approach 4.3: Prepare for Longer-Magnitude Temperature Change

Strategy 5: Enhance Preparedness to Extreme Events
- Approach 5.1: Prepare for Extreme Heat Events
- Approach 5.2: Manage for Extreme Precipitation and Flooding
- Approach 5.3: Enhance Resilience to Extreme Wind
- Approach 5.4: Prepare for and Respond to Wildland Fire and Smoke Impacts

Strategy 6: Manage Farms and Fields as Part of a Larger Landscape
- Approach 6.1: Integrate, Improve, or Maintain Natural Ecosystems on Agricultural Operations
- Approach 6.2: Promote Biological Diversity Across the Landscape
- Approach 6.3: Conserve Individual Farms

Strategy 7: Develop or Expand Co-Benefit Efforts to Mitigate Climate Change
- Approach 7.1: Reduce On-Farm Greenhouse Gas Emissions
- Approach 7.2: Increase On-Farm Soil Carbon Sequestration

SAREP Cover Crops Database

Sustainable Agriculture Research & Education Program

A program of UC Agriculture & Natural Resources

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Cover Crops Database

Sustainable Agriculture Research & Education Program • Resources • Tools & Databases • Cover Crops Database

Cover Crops Database

Click on a cover crop name to learn more about that crop.

Search in table

Crop	Growing Period	Type	Annual or Perennial	Drought Tolerance	Shade Tolerance	Salinity Tolerance
Annual Fescue	Cool Season	Grass	Annual	High	Low	Low
Annual Ryegrass	Cool Season	Grass	Annual	High	Intolerant	High
Barley	Cool Season	Grass	Annual	Moderate	Intolerant	High
Barrel Medic	Cool Season	Legume	Annual			Moderate
Bell Bean	Cool Season	Legume	Annual	Intolerant		Low
Berseem Clover	Cool Season	Legume	Annual	Low	Intolerant	Moderate
Birdsfoot Trefoil	Warm Season	Legume	Perennial	Moderate	Intolerant	Moderate

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https://sarep.ucdavis.edu/covercrop

SAREP other resources

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- Funding Opportunities
- SAREP Publications
- Tools & Databases
- Trainings & Videos

Teaching Soil Healt

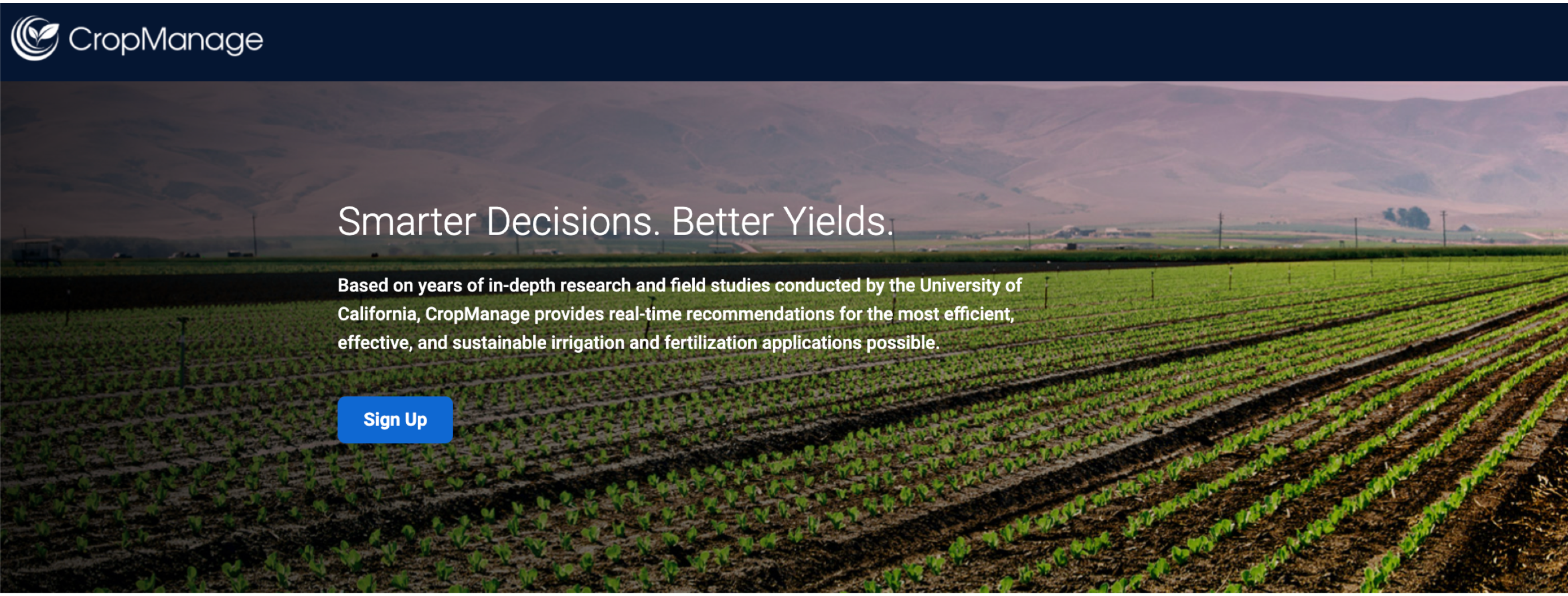
Sustainable Agriculture Research & Education Program • … y & Organic • Teaching Soil Health

Principles and Practices to Build Soil Health Workshop Curriculum

Who this curriculum is for:

This curriculum outline is geared toward agricultural extension professionals to lead workshops for agricultural producers for assessing and developing healthy soils on their farms. It presumes a moderate to strong knowledge basis in soils and farm management practices on the part of the workshop leaders.

Crop Manage



Benefits to Growers

Based on a few simple inputs, CropManage can provide any level of irrigation and fertilization decision support in order to validate or improve your existing operation' production—and increase your overall confidence.

20% to 40% Reduction in Water and Fertilizer With Same Yields

CropManage is ground-truthed in more than 30 field trials and has produced consistent, or in many cases, improved crop yields.

Supports Irrigation AND Fertilization Recommendations

CropManage combines irrigation and fertilization recommendations that, when used together, significantly improve yields while reducing costs.

https://cropmanage.ucanr.edu/

Thank You!

Contact Information

Tapan Pathak
Email: **tpathak@ucmerced.edu**

Twitter: @Ag_Climate

Phone: (209) 228-2520

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