Keynote Speaker Presentation:
Changing Climate, Extreme Weather and Water Scarcity: What It All Means for the Future of Farming

Steven Ostoja, United States Department of Agriculture, California Climate Hub
Changing Climate, Extreme Weather and Water Scarcity: What It All Means for the Future of Farming

2022 United Wine & Grape Symposium

Steven Ostoja, PhD
Director, USDA California Climate Hub
We develop and deliver science-based, region-specific information and technologies to enable climate-informed decision-making...
Food and Wine are Part of our Social Fabric
Global Change

![Graph showing atmospheric CO₂ at Mauna Loa Observatory from 1960 to 2020. The graph indicates a steady increase in CO₂ levels over time.](image)

Atmospheric CO₂ at Mauna Loa Observatory

Scripps Institution of Oceanography
NOAA Global Monitoring Laboratory

Year


parts per million (ppm)

320 340 360 380 400 420
Increase in Annual Average Temperature

Source: 4th National Climate Assessment
Hotter Summers and Warmer Winters

Source: 4th National Climate Assessment

Source: NOAA
Snowpack – our Natural Reservoir is in Decline

Source: Cal Adapt
Drought is Rule Rather than the Exception

West Palmer Hydrological Drought Index (PHDI) December

1895-2021 Trend
(-0.13/Decade)

1895-2021 Mean: 0.39

Source: NOAA
Drought Promotes Greater Reliance on Groundwater

Source: NOAA

Credit: Stanford University
Mismatch Between Water Supply and Demand

Historical Water Supply and Use
Colorado River Basin

- Water Supply (10-year Running Average)
- Water Use (10-year Running Average)

Projected Supply and Demand

Projected Water Demand
Projected Water Supply (10-year Running Average)

Source: 4th National Climate Assessment
Heat Waves can Stress Winegrapes

Source: Cal Adapt
Heat Waves can Stress Winegrapes

Source: Parker et al. 2020 Plant Science

Credit: Washington State University
Extreme Precipitation has Negative Impacts

Credit: Climate Toolbox

Source: Bloomberg News
A Word About Extreme Events

Severe Drought

Extreme Heat

Extreme Precipitation
Spring is Starting Earlier Across the Country

Source: 4th National Climate Assessment
Frost Exposure and Spring Phenology

<table>
<thead>
<tr>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><img src="snowflake.png" alt="Snowflakes" /></td>
<td></td>
<td><img src="flower.png" alt="Flowers" /></td>
<td></td>
</tr>
</tbody>
</table>

Approx. frost and bloom window **today**.

Possible frost and bloom window **2050s**.

Parker, Pathak & Ostoja (2021)
Impacts of Pathogens, Pests and Diseases

Pierce’s Disease

Credit: UC Davis IPM

Powdery Mildew

Credit: Washington State University

Vine Mealybug

Credit: M. Battany courtesy Univ. California
Wildfire and Smoke Damage

Credit: Cal Fire
Understanding Wildfire and Smoke Impacts

Understanding the impacts of wildland fire and smoke on California’s winegrape industry

A statewide survey to assess industry impacts is being conducted by researchers at the USDA Agricultural Research Service, USDA California Climate Hub, and Farm Foundation’s Young Agri-Food Leaders Network.

With an improved understanding of the breadth and nature of these impacts, we will be better able to assist the industry to prepare, anticipate, and adapt to the effects of wildfires. This understanding can also inform appropriate allocation of resources and support tied directly to the industry’s needs.

SCAN TO COMPLETE SURVEY

Takes less than 5 mins.

For more info: [link to survey](https://example.com/survey)
Wildfire and Smoke Impacts Vary Regionally

Understanding the impacts of wildland fire and smoke on California's winegrape industry

A statewide survey to assess industry impacts is being conducted by researchers at the USDA Agricultural Research Service, USDA California Climate Hub, and Farm Foundation’s Young Agri-Food Leaders Network.

With an improved understanding of the breadth and nature of these impacts, we will be better able to assist the industry to prepare, accommodate, and adapt to the effects of wildfire. This understanding can also inform appropriate allocation of resources and support to diversity in the industry's needs.

SCAN TO COMPLETE SURVEY

Takes less than 5 mins.

For more info contact: info@ccacalifornia.org

Impact to Grapes Exposed to Wildfire Smoke

<table>
<thead>
<tr>
<th>Production Region</th>
<th>Quality loss</th>
<th>Grapes under contract were discounted by buyer</th>
<th>Grapes under contract went unsold</th>
<th>Uncontracted grapes, as of August 1, went unsold</th>
<th>Financial loss for my operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Coast</td>
<td>33%</td>
<td>33%</td>
<td>33%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Coast</td>
<td>44%</td>
<td>5%</td>
<td>23%</td>
<td>4%</td>
<td>24%</td>
</tr>
<tr>
<td>Foothill/Mountain</td>
<td>47%</td>
<td>7%</td>
<td>13%</td>
<td></td>
<td>33%</td>
</tr>
<tr>
<td>Central Coast</td>
<td>50%</td>
<td>7%</td>
<td>11%</td>
<td></td>
<td>26%</td>
</tr>
</tbody>
</table>

Source: Zakowski et al. in prep.
Wildfire and Climate Change

Credit: Cal Fire
Climate Change has Amplified Wildfire Activity

Credit: Cal Fire

Source: Abatzoglou and Williams 2016
Responding to Climate Change

Navigating data and resources for appropriate responses to climate change and extreme events can be challenging...

*But it doesn’t have to be*
California Agriculture Adaptation Resources (Coming soon)

Adaptation Workbook

1
2
3
4
5

Strategies & Approaches

Menu of adaptation actions

Cover Crops

- Build soil organic matter
- Protect against erosion
- Improve mineral fertility
- Minimizes chemical use
- Habitat for beneficial insects
- Aesthetically pleasing
Cultivar Diversity

Credit: UC Davis

Morales-Castilla et al. 2020 PNAS
Soil Amendments

Build soil organic matter
Adds both macro- and micronutrients
Greater water holding capacity and retention
Drought resilience
Suppression of soilborne disease
Drones or UAVs

NDVI in real time

- Plant Stress and Disease
- Evapotranspiration and Soil Moisture
- Spatially Explicit Crop Water Use
- Aids in Modelling Soil Characteristics
- Estimation of Nitrogen Content
Develop an operationally applied multi-scale remote sensing evapotranspiration (ET) toolkit for **mapping vineyard water use and stress for improved irrigation scheduling and water management** in vineyards across California.

- **Modeling Domains (Colored Squares) & Tower Locations (Black Dots)**
- **Daily ET at field scale derived via satellite remote sensing**
- **Ingestion of Daily ET into grower dashboard for irrigation management decision making**
Develop an operationally applied multi-scale remote sensing evapotranspiration (ET) toolkit for mapping vineyard water use and stress for improved irrigation scheduling and water management in vineyards across California.
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Adaptation will be Required to Adjust to a Changing World
Thank you
We are here to help

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@climatehubs