California Dept. Food and Agriculture
Office of Environmental Farming and Innovation

Development of Soil Organic Carbon Map for California

May 5 & 6, 2020

Introductions/Agenda/Logistics

Casey Walsh Cady, Sr. Environmental Scientist

CDFA Office of Environmental Farming & Innovation Team

Casey Walsh Cady, MS,
Biodiversity Coordinator

Geetika Joshi, PhD,
Program Supervisor

Carolyn Cook, MS, Program Supervisor

Amrith Gunasekara, PhD, Science Advisor & Program Manager

Steph Jamis, MS,
Env. Scientist SWEEP

Agenda

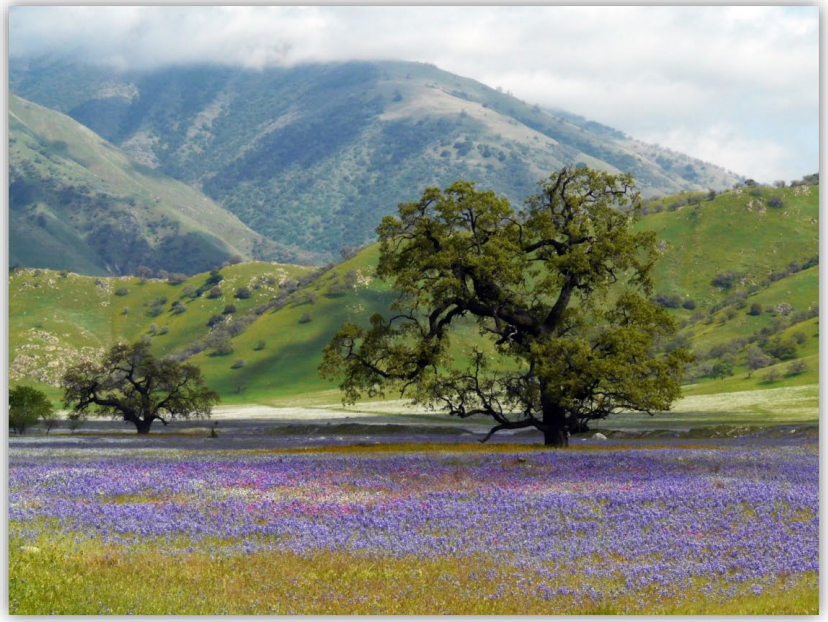
- Introductions/Webinar Logistics
- Background/Purpose – Casey Walsh Cady
- USDA NRCS – Tony Rolfes
- Comments and Feedback-Casey Walsh Cady
- Wrap up and Next Steps – Casey Walsh Cady

California Biodiversity Roadmap

- In 2018 – Governor Brown launched the California Biodiversity Initiative
- Preserving native species
- Protecting and restoring all types of California ecosystems, and improving ecosystem functions.
- Completing vegetation maps for the entire state
- Updating a statewide habitat connectivity assessment
- Seedbanking California's plants.

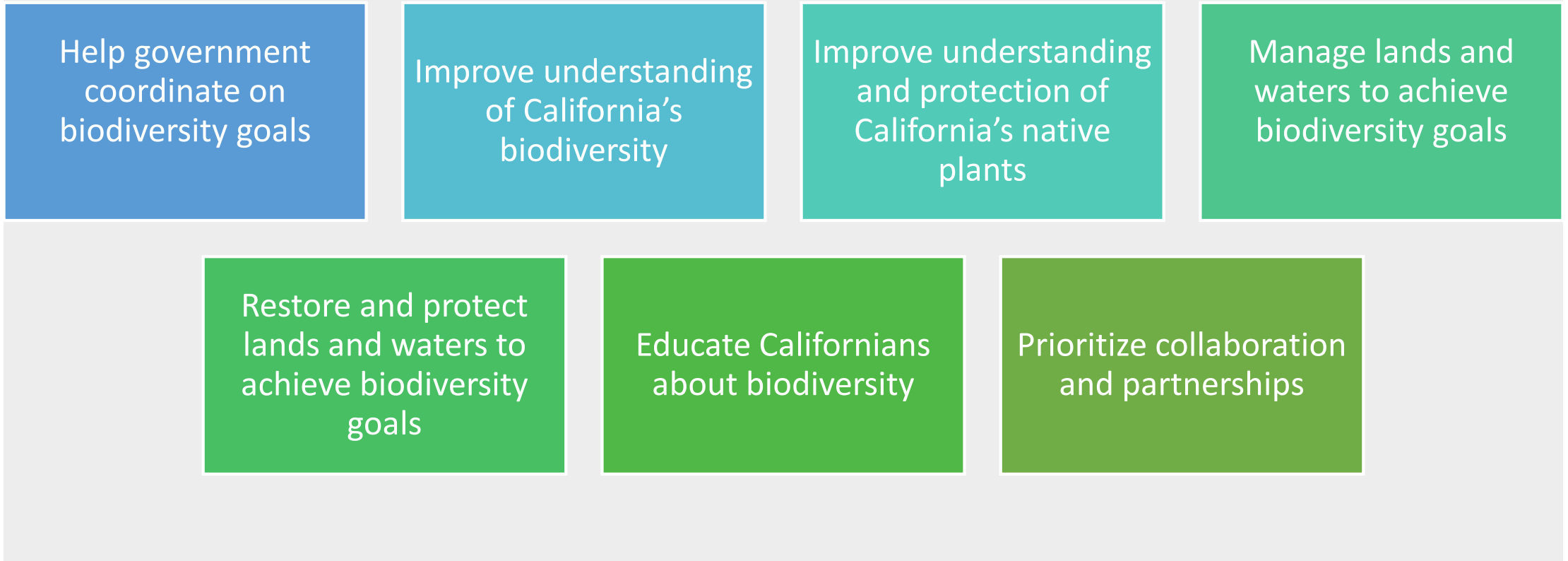
- https://www.californiabiodiversityinitiative.org/pdf/california-biodiversity-action-plan.pdf

California Biodiversity Initiative
A Roadmap for Protecting the State's Natural Heritage



September 2018

Focal Areas of the CA Biodiversity Roadmap



California Biodiversity Initiative: A Roadmap for Protecting the State's Natural Heritage

CDFA Key Actions

- Establishment of a soil carbon map of California to serve as an indicator of soil health.
- Potential development of soil health data repository system for CDFA Healthy Soils Program.
- Legislative Mandate: CDFA will collaborate with various groups to establish and maintain a Soil Carbon Map, Budget Act of 2019, Item 8570-001-0001

The Importance of Soil Organic Carbon (SOC)

Main component of soil organic matter (SOM) and is a crucial contributor to food production, mitigation and adaption to climate change.

SOC affects most of the processes relevant to soil functions and food production.

SOC often used as an indicator of soil health, due to its capacity to improve soil structural stability, which affects porosity, aeration and water filtration capacities to supply clean water. FAO, 2018

Project Scoping

- Soil Organic Carbon Map
- Healthy Soils Program Soil Health Data System?

Soil Carbon Map for State of California

Purpose - to serve as an indicator of soil health as California takes multiple actions to sequester carbon in agricultural soils.

CDFA endeavors to develop a resource that will be broadly useful for the state.

CDFA Healthy Soils Program

Incentive Program - funds conservation management practices that sequester carbon, reduce GHGs and improve soil health

- Soil sampling requirements – data is submitted to CDFA prior to implementation of practices and then annually after the practices are implemented, for up to 3 years.

CDFA is considering the development of a data repository system for soils data.

USDA NRCS – Tony Rolfes

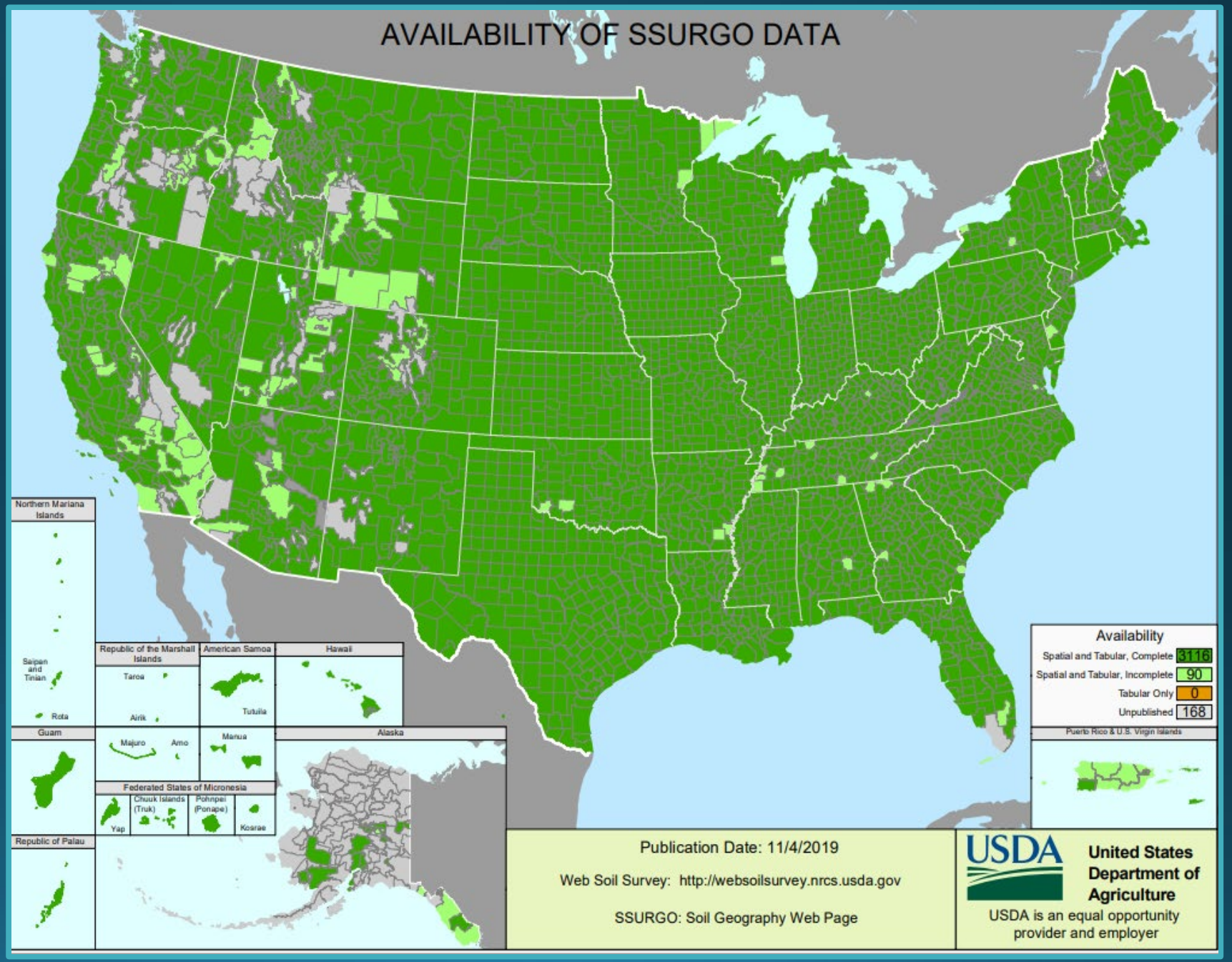
NRCS Soil Surveys

Tony Rolfes

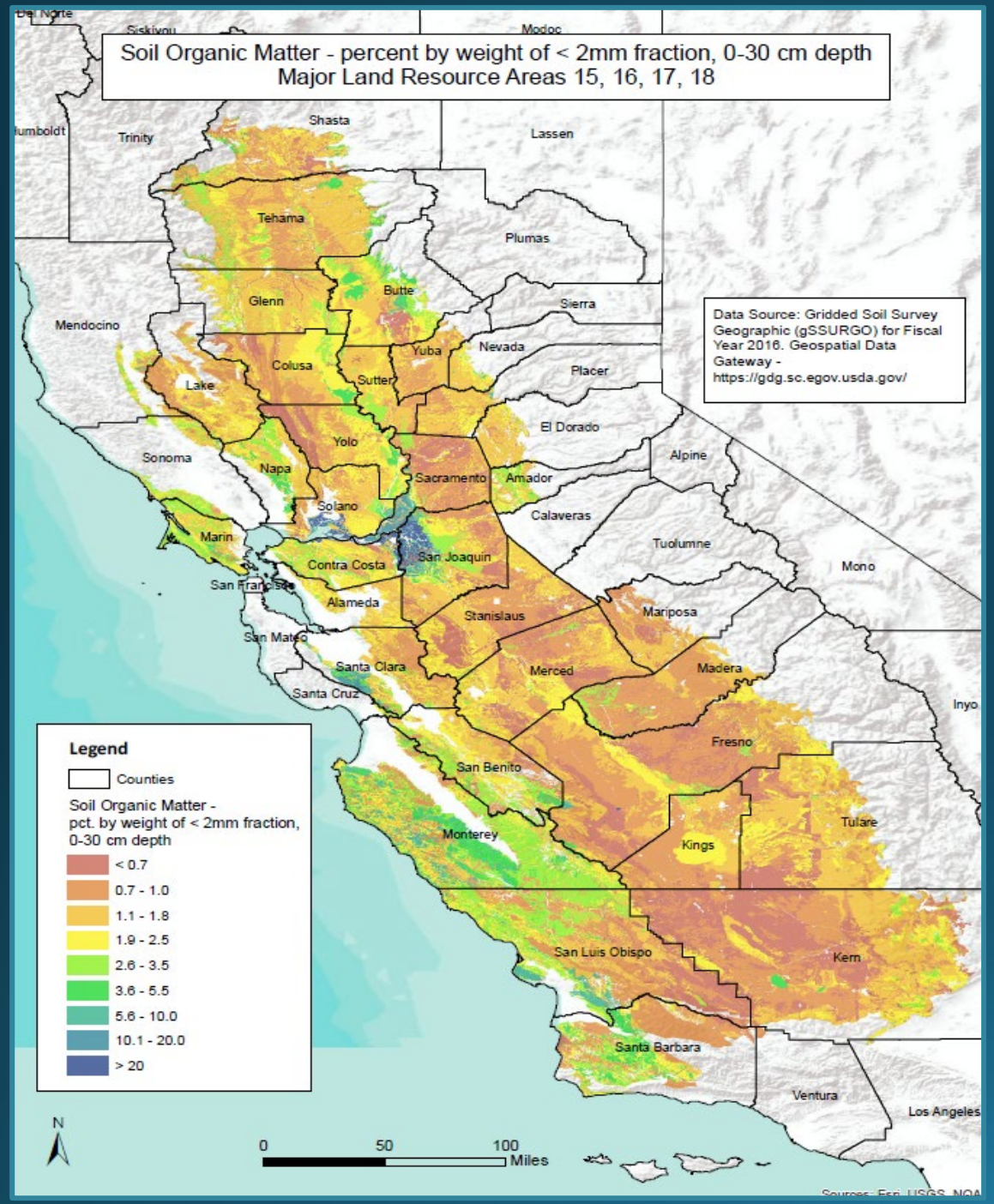
CA State Soil Scientist

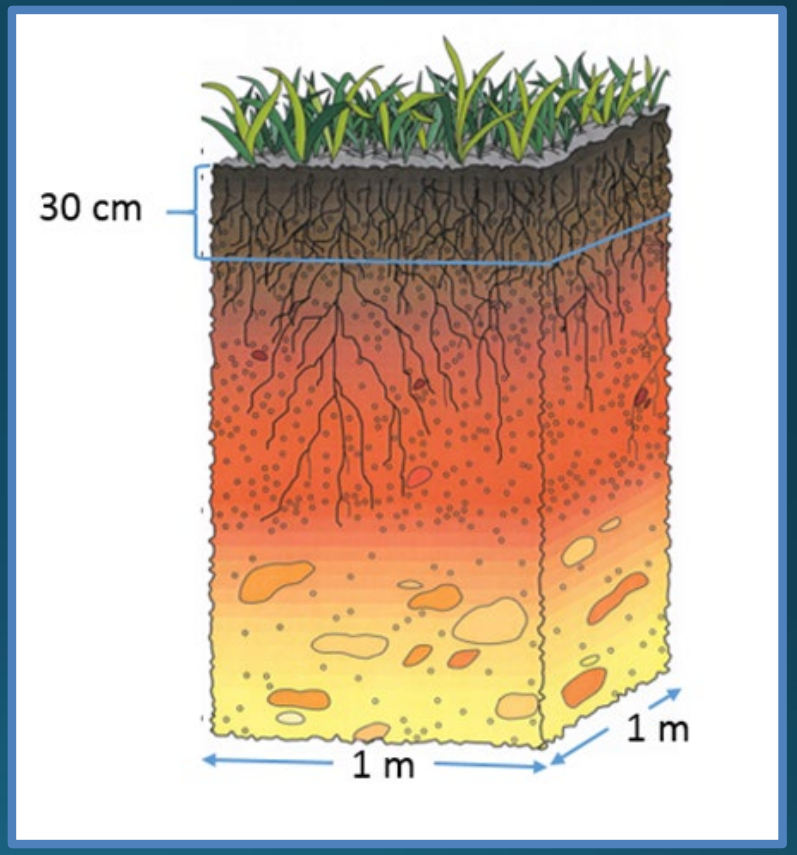
NRCS USDA Cooperative Soil Survey Program 1899 to 2016

- 3265 surveys nation
- 120 Surveys in CA



Baseline Soil Organic Matter





Organic carbon (kilograms / square meter) for the horizon =

((om r * 0.58) / 100) * dbthirdbar r * ((100 - ∑ fragvol r) / 100) * (hzdepb r - hzdept r) * 10

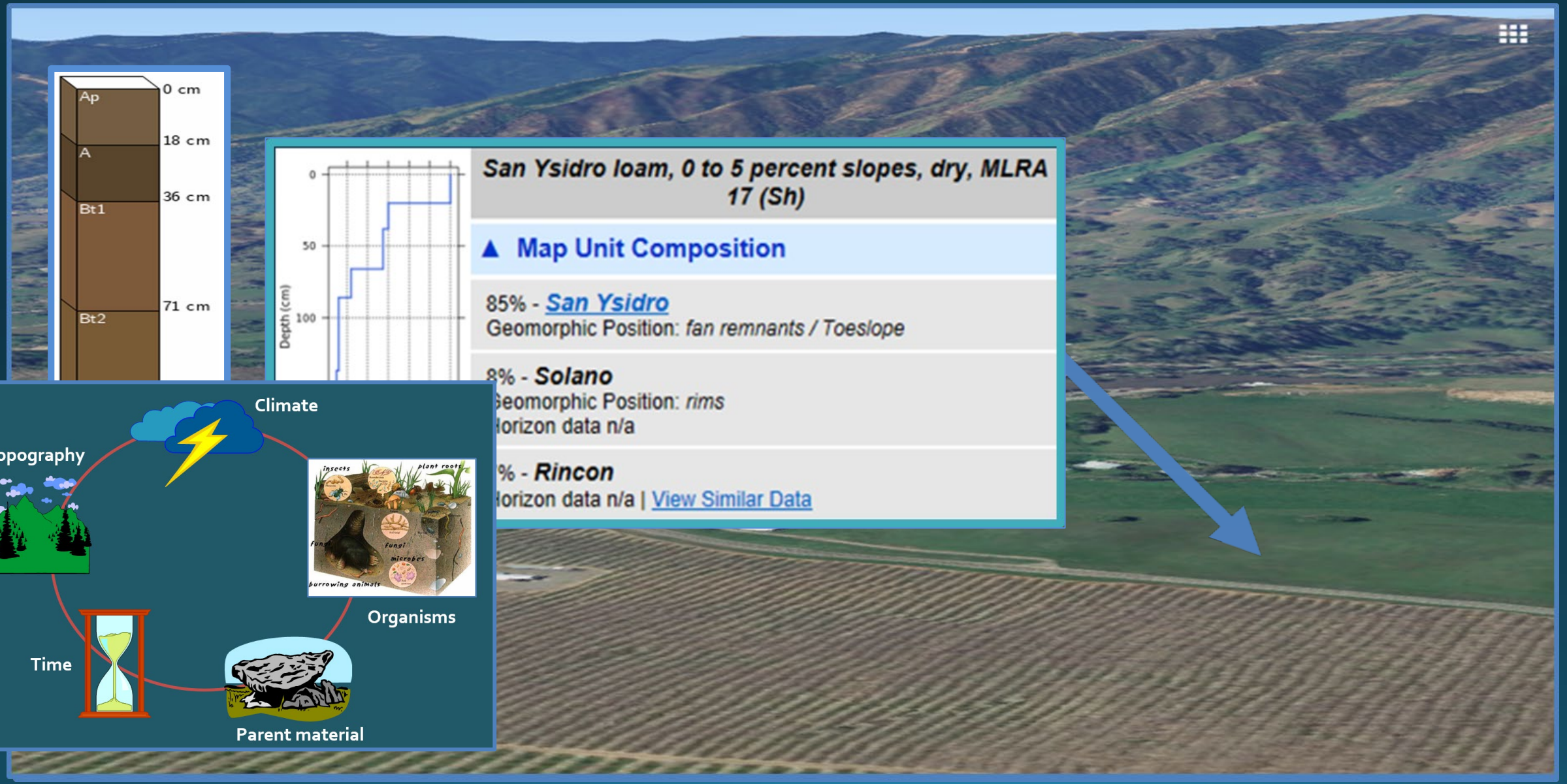
Collecting the Soil Information

The Field Work
How many holes do you dig?

Key Soil Properties Observed and Documented

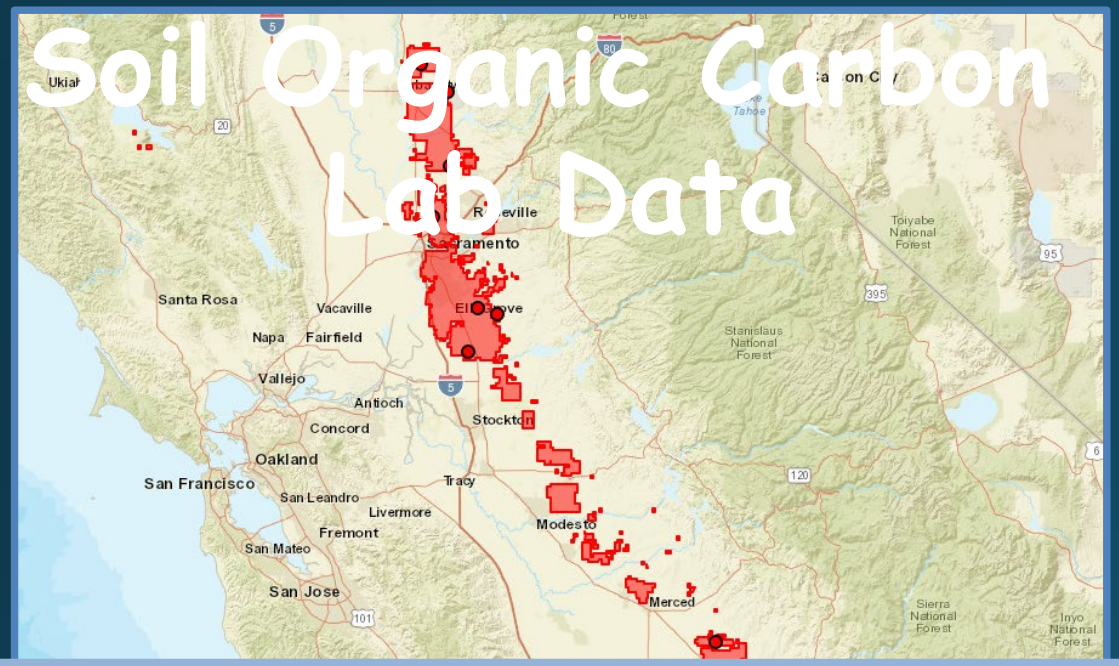
- Horizons
- Color
- Texture
- Depth
- Rock Fragments
- Organic Matter
- Chemistry – pH, Salts, SAR

Soil Map - How is it Made



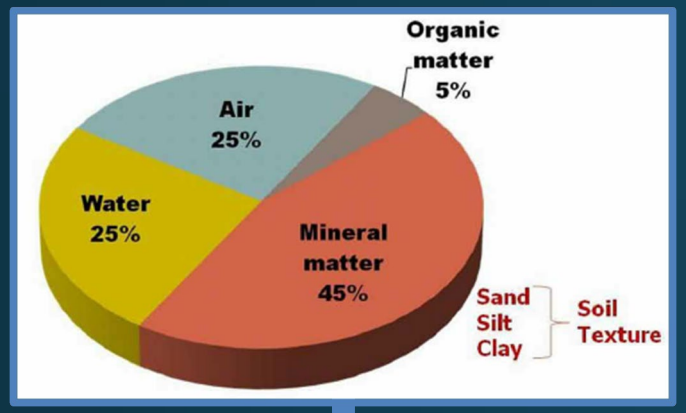
Extent of State Soil

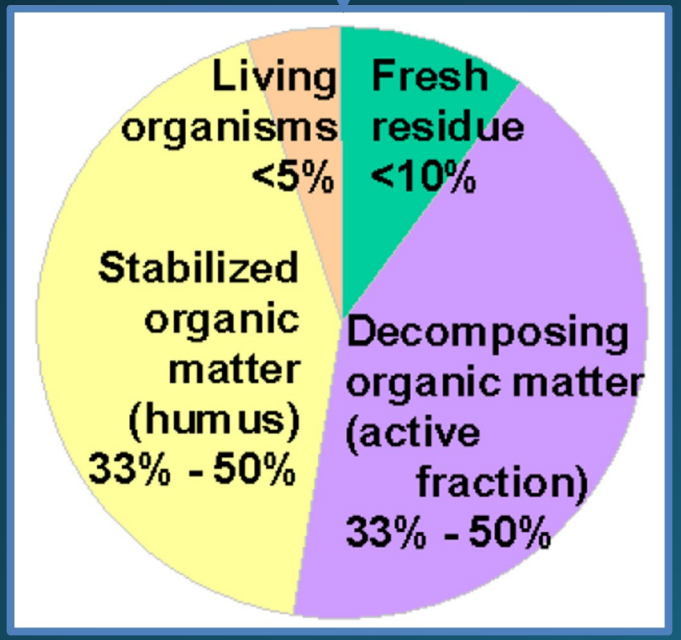
San Joaquin



Soil Series	Horizon	Top	Bottom	SOC
San Joaquin	A1	0	8	<Null>
San Joaquin	A1	0	9	2.1
San Joaquin	A	0	10	0.72
San Joaquin	Ap	0	15	0.84
SAN JOAQUIN	Ap	0	19	0.52
San Joaquin	Ap	0	20	0.41
San Joaquin	Ap	0	23	0.45
<Null>	Ap	0	23	0.87
SAN JOAQUIN-LIKE	Ap	0	28	0.3

Soil Organic Matter Pools





Mulch

Cover Crop

No Till

Figure 1: Organic carbon is made up of four different pools that decompose at different rates (adapted from Bell and Lawrence, 2009).

A 60 Year History of California Soil Quality Using Paired Samples

Department of Land, Air and Water Resources, University of California

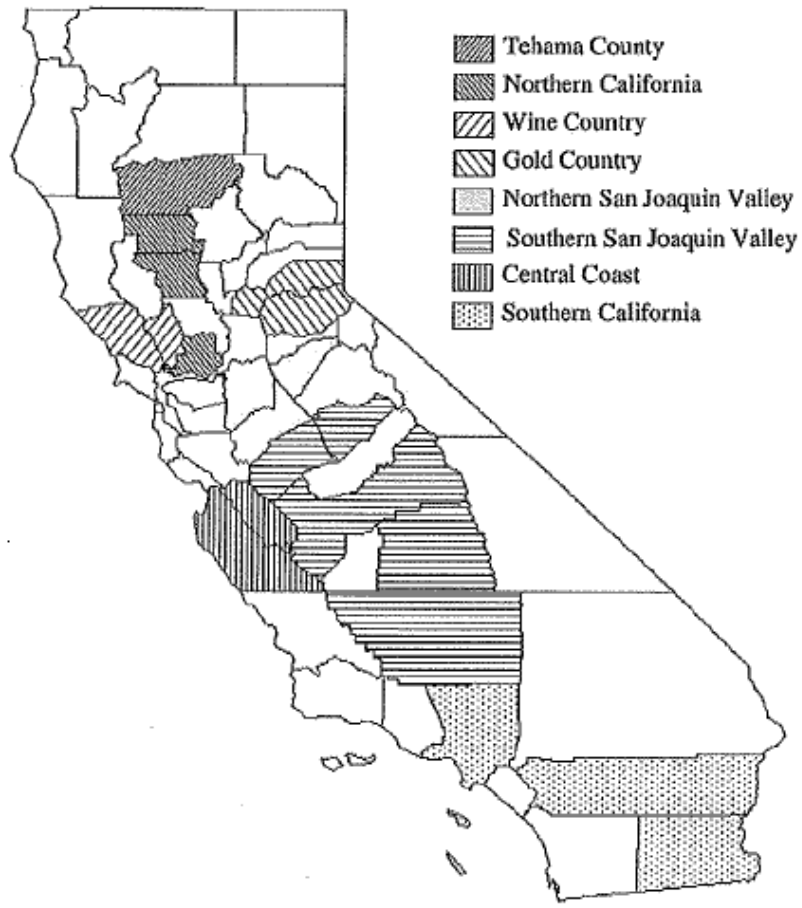


Fig. 1. Geographic regions where 1945 and 2001 samples were collected.

125 samples in 1945 and 2001 analyzed for Soil Carbon

Table 2
Mean values of soil properties for geographic regions in California for 1945 and 2001 sample dates

Indicator	Year	California	Southern California	Central Coast	Southern San J.	Northern San J.	Gold country	Wine country	Northern California	Tehama county
N	1945	0.09	0.06	0.10	0.11	0.07	0.06	0.09	0.09	0.11
	2001	0.11	0.06	0.09	0.21	1.34	0.15	0.81	0.13	0.13
C	1945	1.05	1.17	1.14	0.95	0.94	0.83	1.20	0.90	2.03
	2001	1.35	1.06	1.01	1.18	1.52	1.79	2.47	1.32	1.80

Table 3
Mean values of soil properties for land use categories in California for 1945 and 2001 sample dates

Indicator	Year	Row crops	Tree crops	Viticulture	Pasture	California
N	1945	0.13	0.08	0.09	0.07	0.09
	2001	0.24	0.73	0.13	0.13	0.29
C	1945	1.27	0.99	1.11	0.91	1.05
	2001	1.26	1.02	1.82	1.56	1.35

Credits: Michael J Singer, Fabrice De Clerck and Peter Lindert

Farm Demonstration in Turlock CA

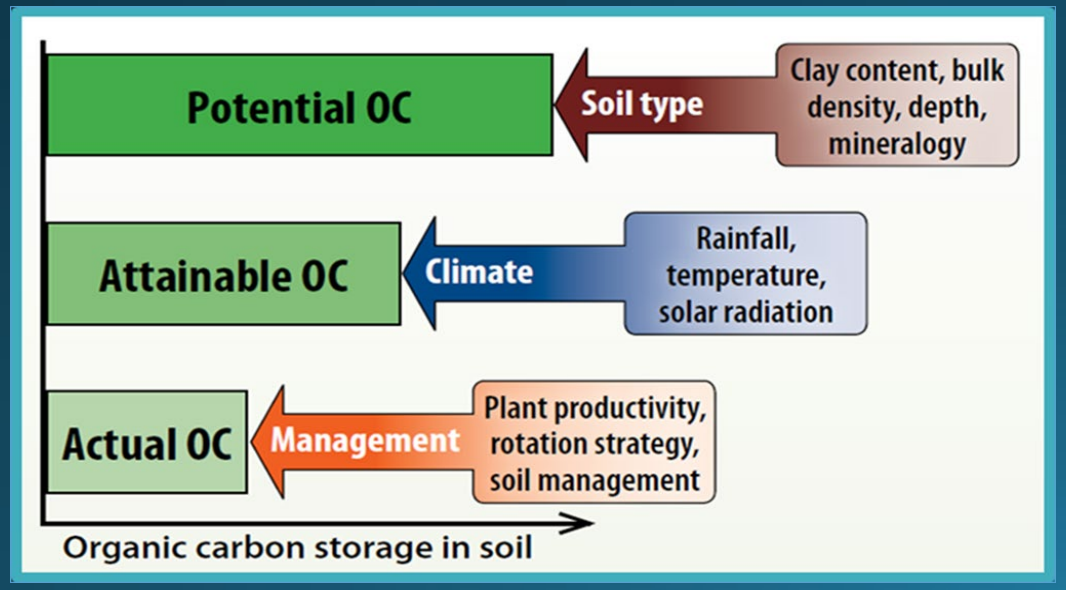
Soils are the Delhi sandy loam series.

About ½ percent organic matter, soil on the right.

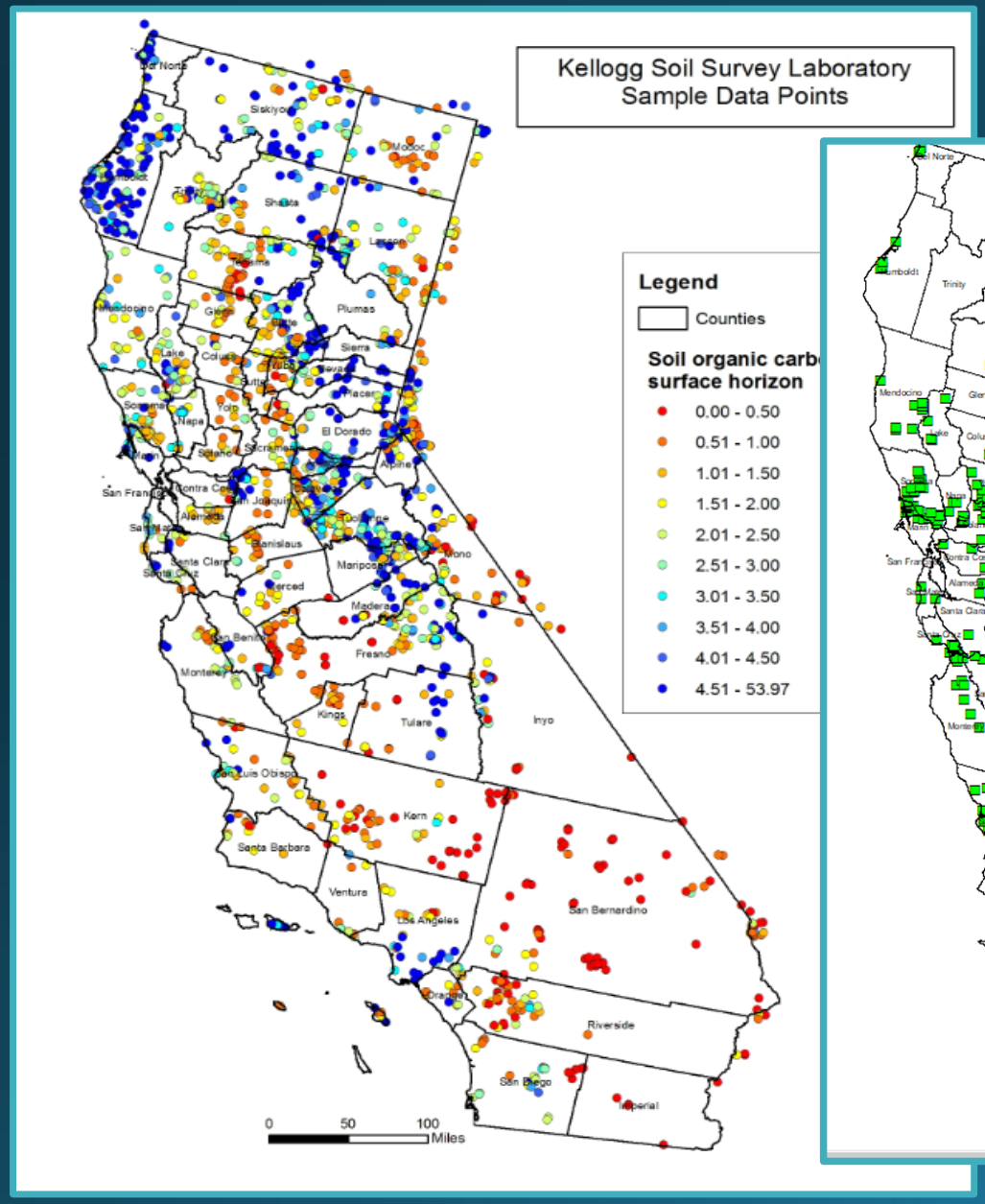
About 3 percent soil organic matter, soil on the left.

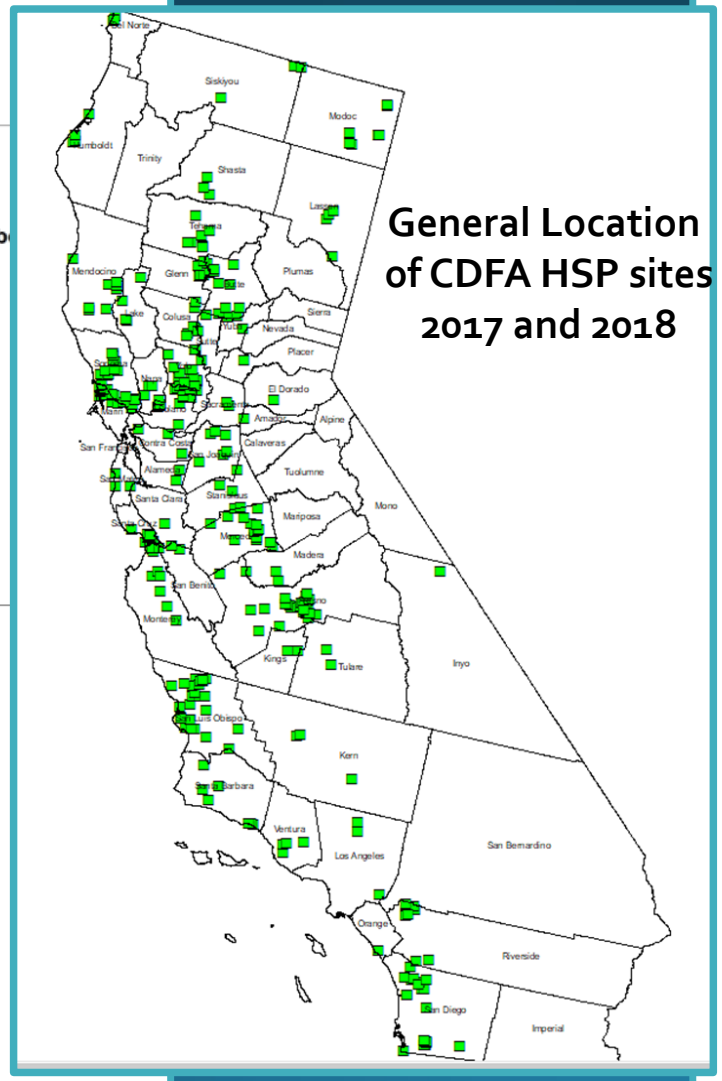
Soil on the left - Walnut orchard with reduced tillage, cover crop, livestock grazing, and compost added.

Soil on the right – conventionally tilled sweet potatoes

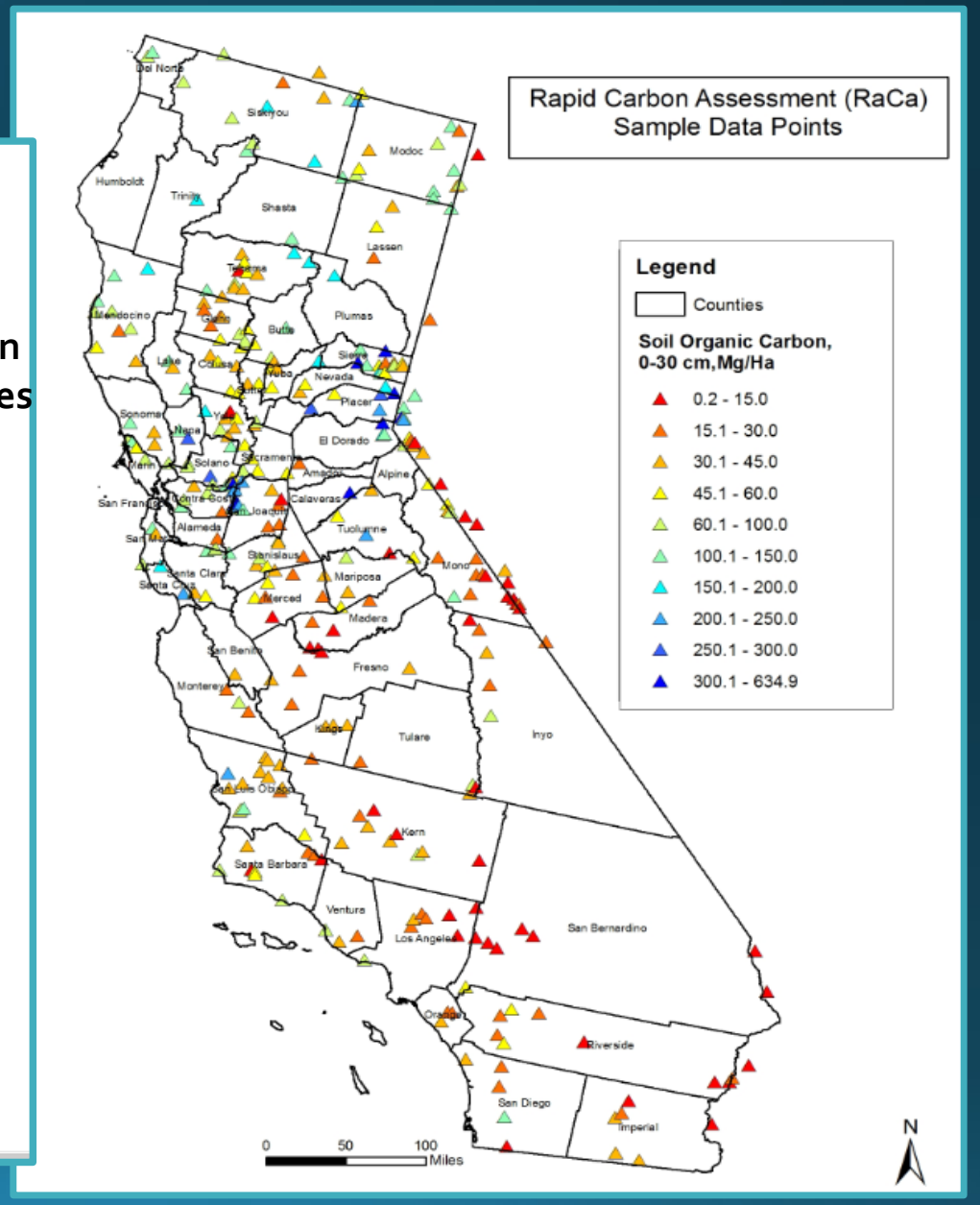


NRCS Soil Data - Organic Carbon

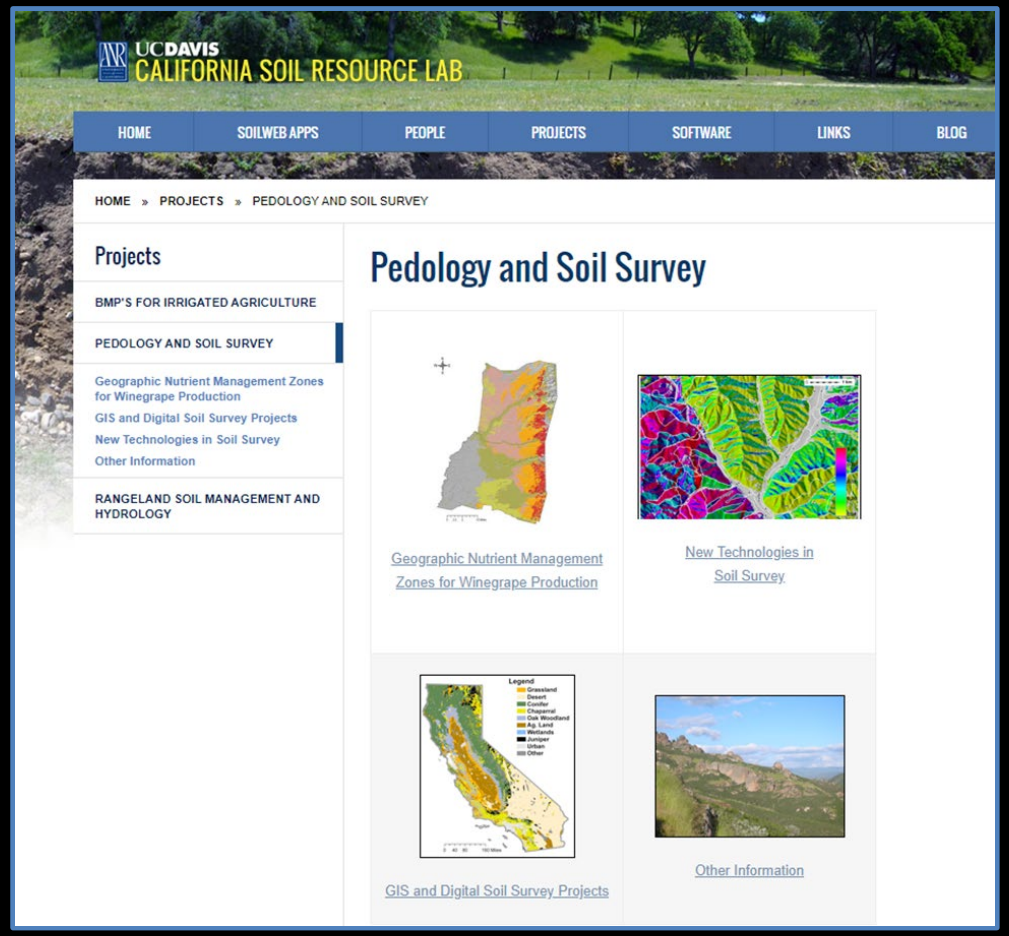


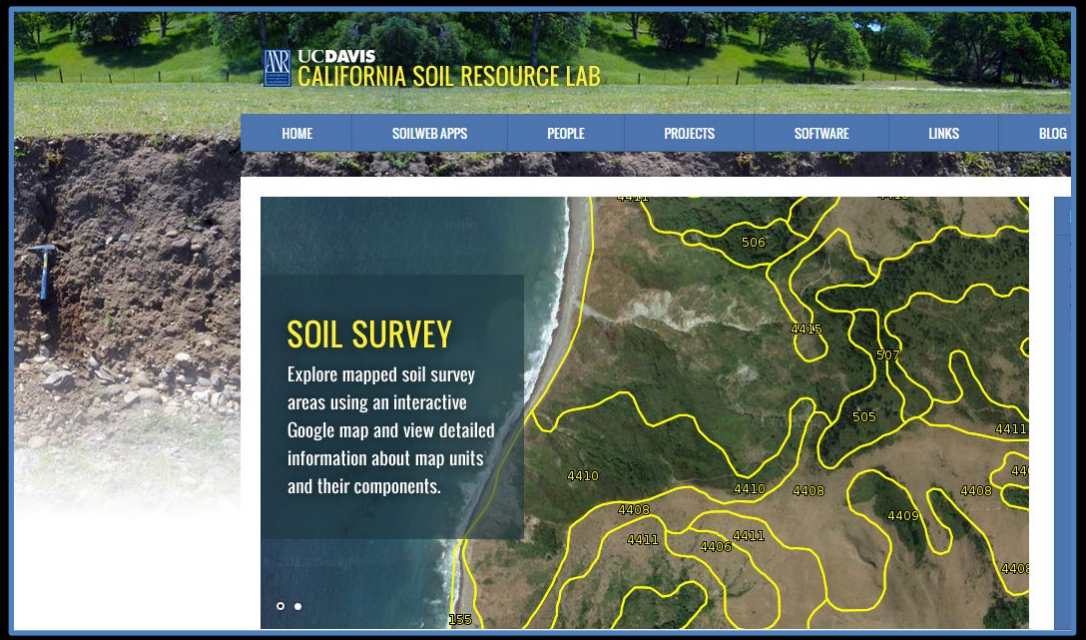


General Location of CDFA HSP sites 2017 and 2018



UC Davis CA Soil Resource Lab
Innovative Tools & Research - Using NRCS Soil Surveys





Credit: Dr Toby O'Geen, Scott Devine and Dr. Kerri Steenwerth

Questions for Stakeholder Input (1)

- Which existing maps/data sets can be used as baseline for soil organic carbon?
- USDA NRCS has developed several maps that may serve the purpose above; stakeholder feedback on the use of these is encouraged.
- What scale is needed for the map to meet its objective of serving as an indicator of soil health?
- Should CDFA develop a statewide map or focus on agricultural production areas?
- What components and layers should the map include?

Questions for Stakeholder Input (2)

7. What is appropriate soil depth for the map (ex: 30 cm)?

8. What are other issues and concerns?

9. Are there recommendations on data standards and quality assurance?

10. What would stakeholders like to use this map for?

11. What are the needs for this tool beyond its use by governmental agencies?

12. What can stakeholders contribute?

Wrap Up – Next Steps

Written Comment Period - May 7, 2020 – May 21, 2020

Comments should be submitted by e-mail to: cdfa.oefi@cdfa.ca.gov by 5:00 pm PDT, May 21, 2020.