

Soils and Environmental Quality

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ARB

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Short Outline

- What do soils do for us?
- Soils and environmental quality.
- What are soils?
- What is a “California soil”?
- What is soil quality?
- Conclusions

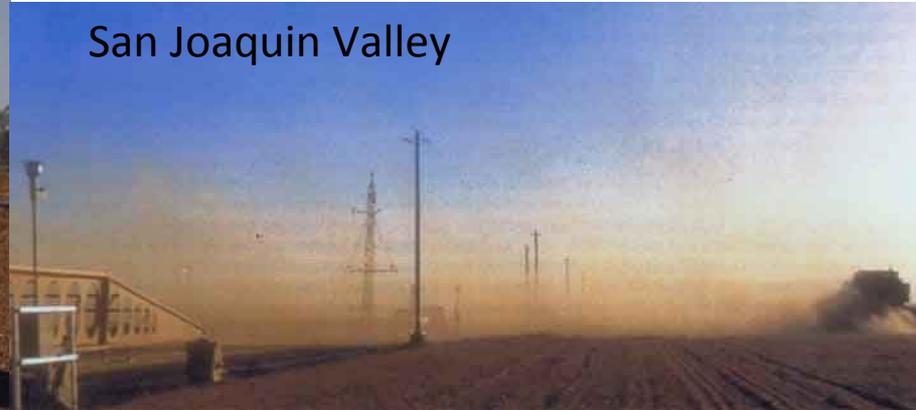
What do soils do for us?

- Grow food, fiber, biofuel (maybe)
- Substrate for waste disposal
- Filters water
- Substrate for building structures
- Basis for all natural terrestrial ecosystems--ecosystem services

What are the “environmental services” soils provide?

- Water
- Air
- Nutrients
- Support for plants
- Biological community (good and bad)

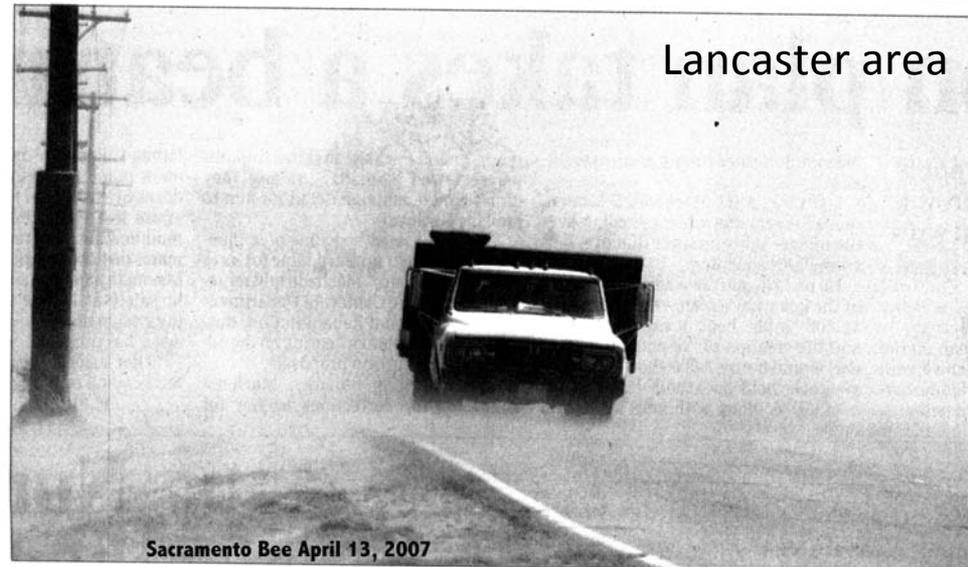
Soils and Environmental Quality?



Mali, West Africa

South state sandstorms impaired visibility Thursday on roadways, including this one in Lancaster. The storms caused a multi-vehicle pileup on Interstate 40 that killed two people and injured six, the California Highway Patrol said.

Associated Press/
Jeff Goldwater



Soils and Environmental Quality?

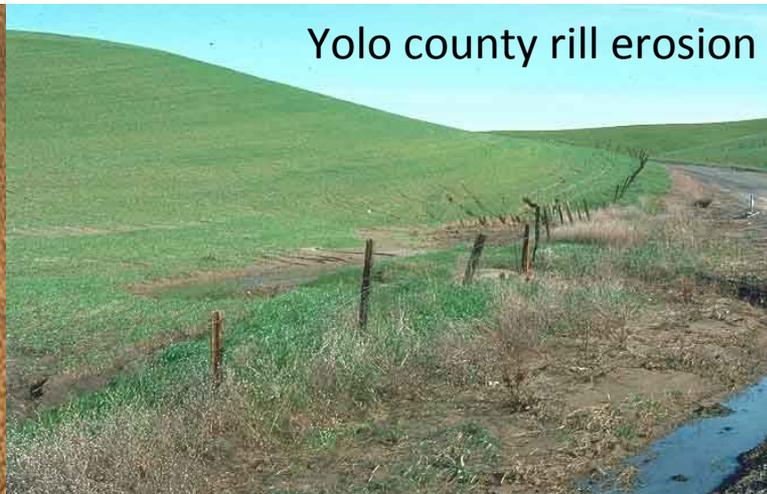


Owens Valley

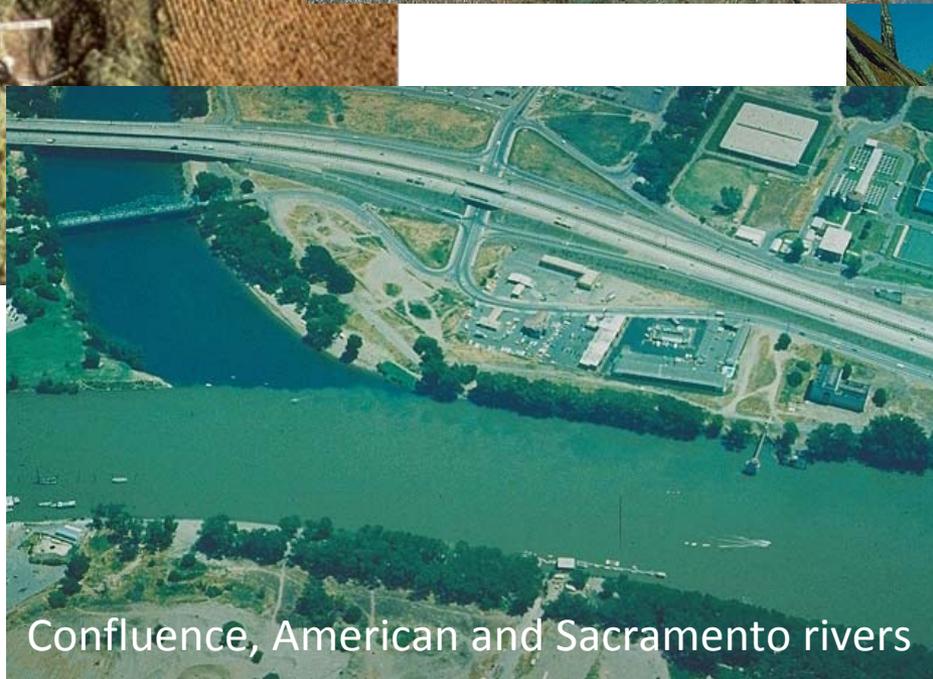
Soils and Environmental Quality?



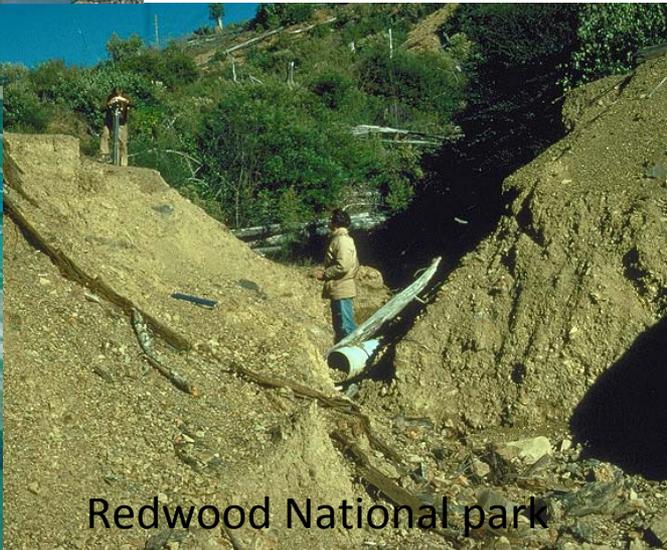
Iowa gully



Yolo county rill erosion



Confluence, American and Sacramento rivers



Redwood National park

Soils and Environmental Quality?

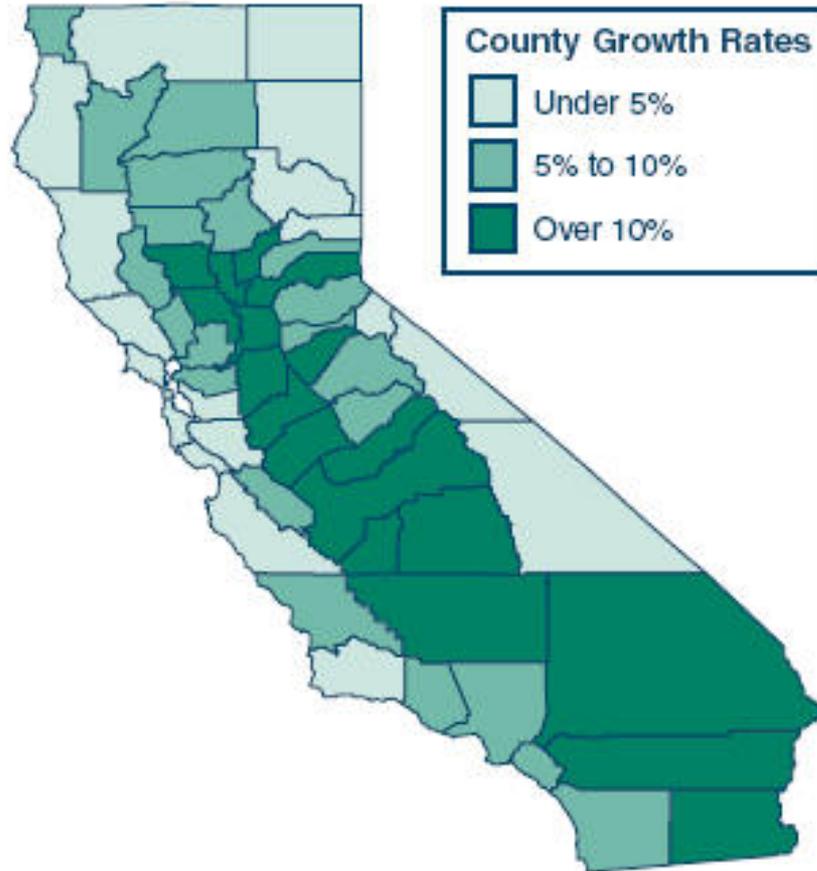


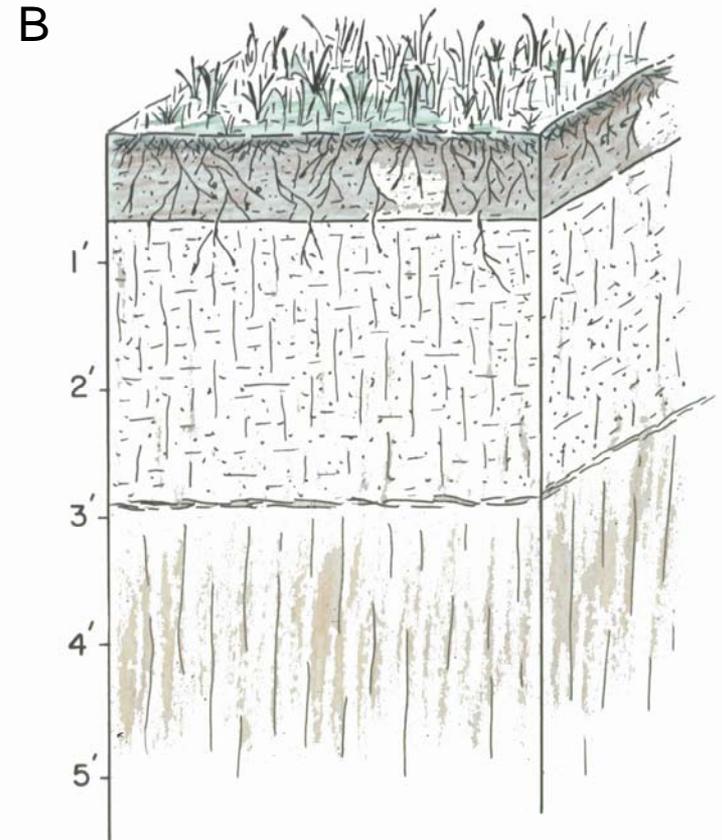
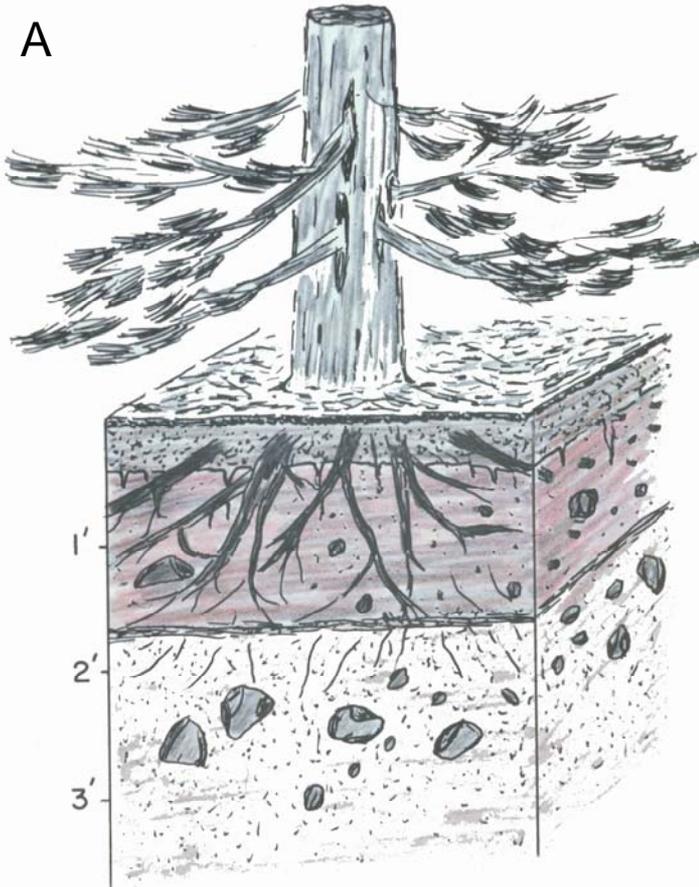
Image from the California Legislative Analyst's Office

What are Soils?

“A three dimensional, porous,
environmental buffer”

The excited skin of the earth!

Pedons--the three-dimensional soil individual

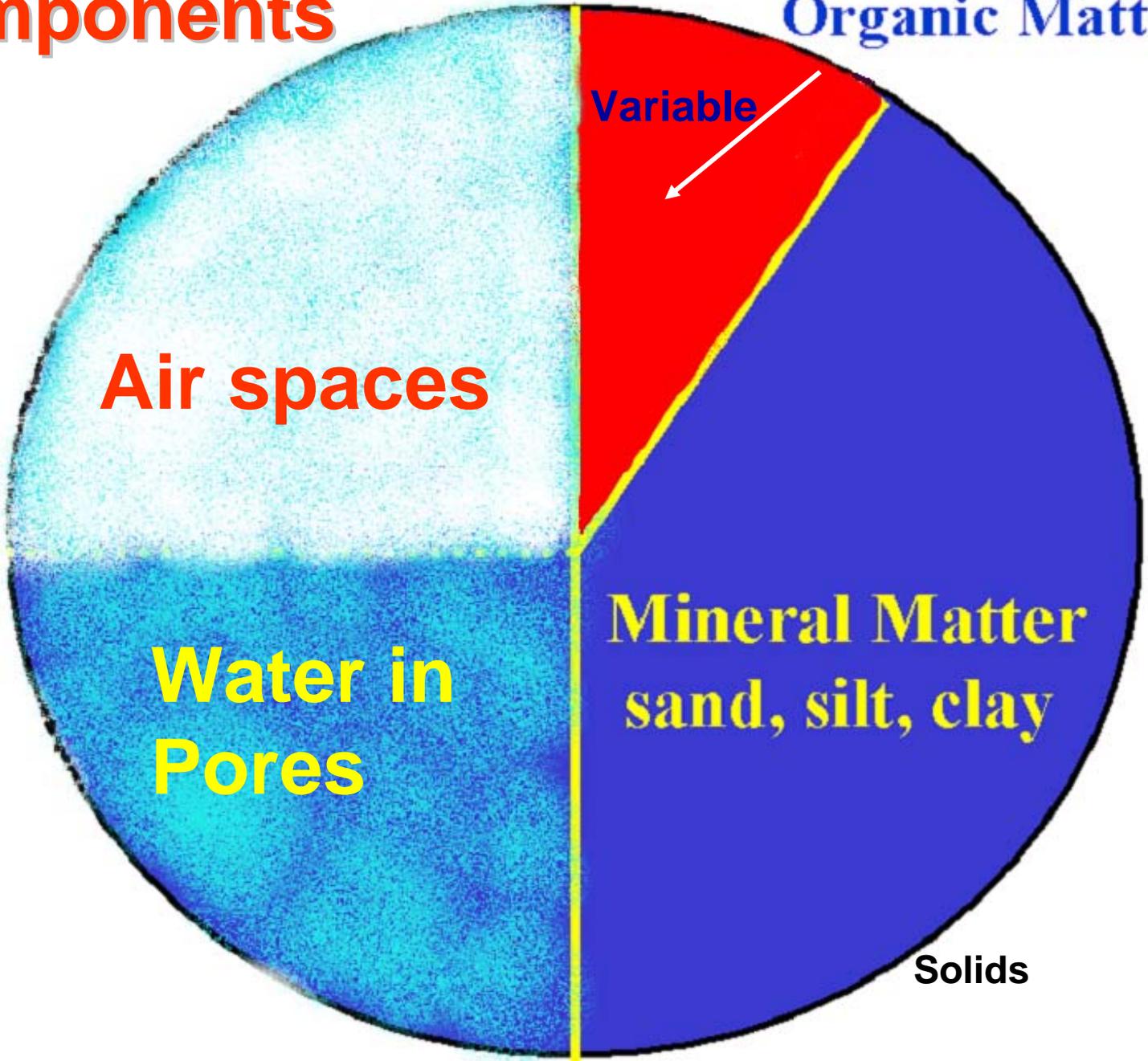


Soil characteristics

- Three phase system
 - Solids
 - Inorganic
 - Organic (living and dead)
 - Liquids
 - Soil solution
 - Gases
 - Nitrogen, oxygen and carbon dioxide

Soil Components

Organic Matter



Air spaces

Variable

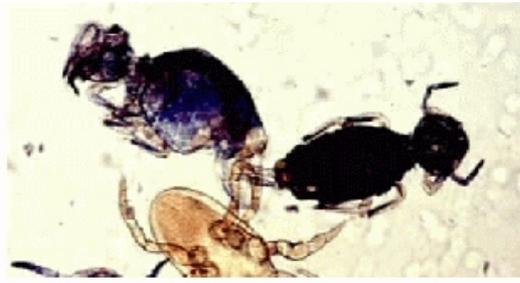
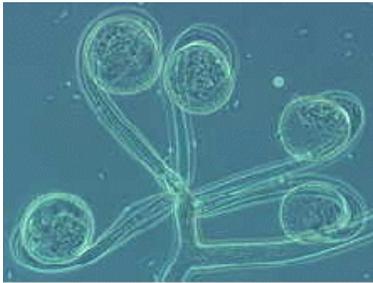
Water in Pores

Mineral Matter
sand, silt, clay

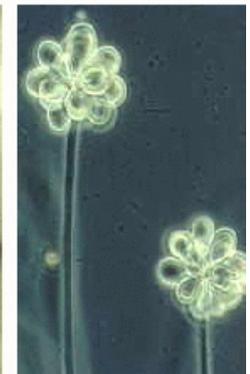
Liquids and Gases ~50%

Solids

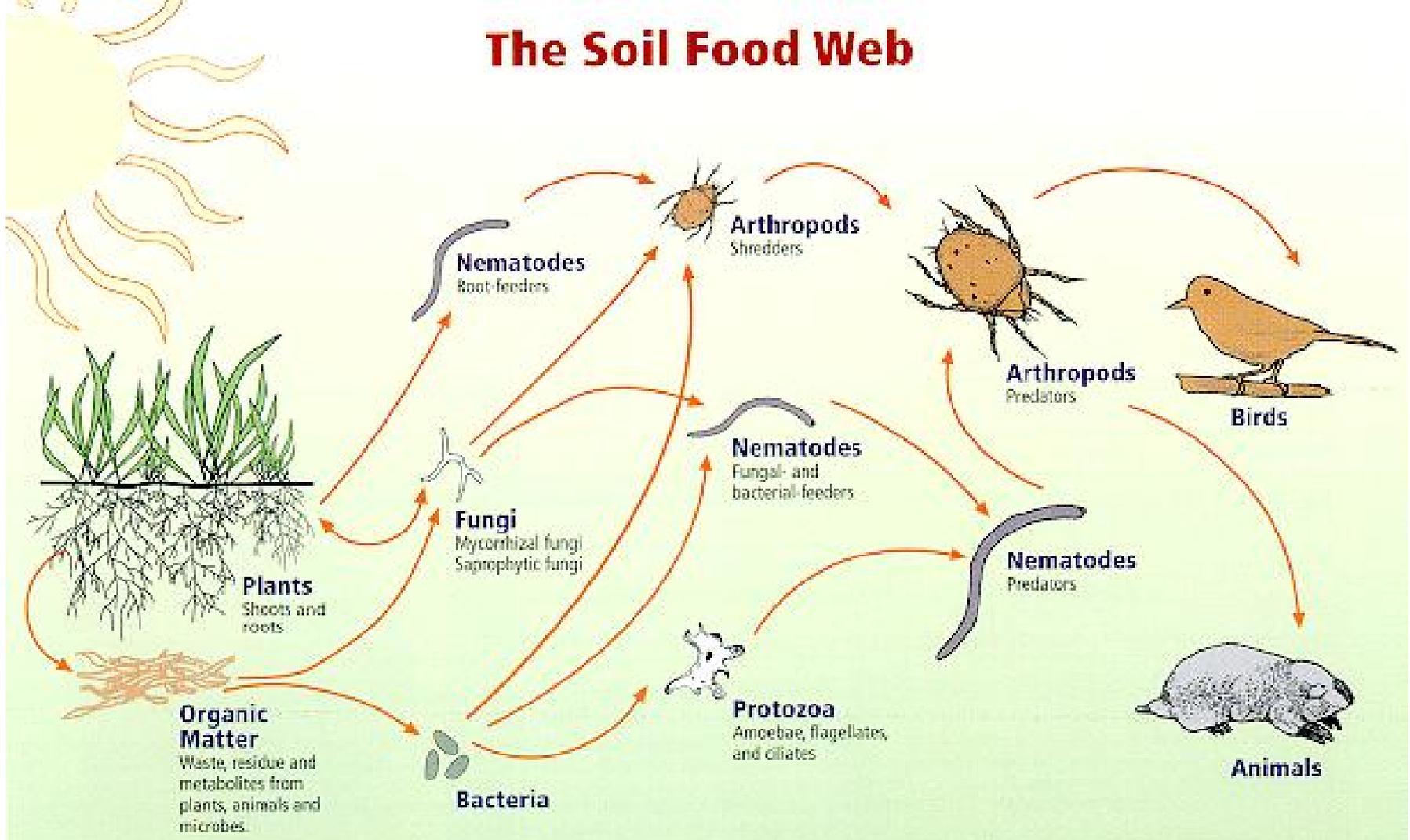
Biodiversity



1 m² soil
>10000 bacterial
and fungal types
100-1000
invertebrate species



The Soil Food Web



First trophic level:
Photosynthesizers

Second trophic level:
Decomposers
Mutualists
Pathogens, parasites
Root-feeders

Third trophic level:
Shredders
Predators
Grazers

Fourth trophic level:
Higher level predators

Fifth and higher trophic levels:
Higher level predators

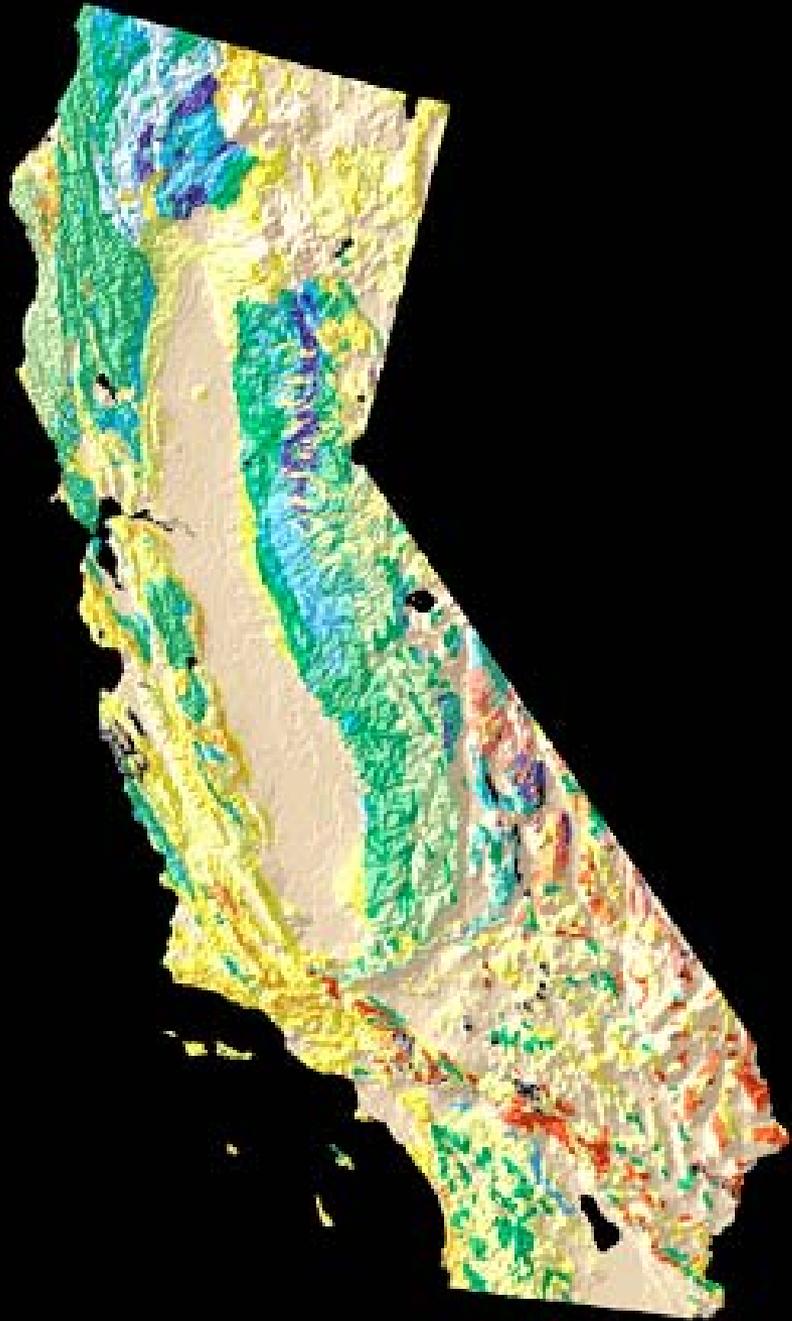
What is a “California” soil?

- Before defining soil quality, we need to answer this question.
- Trick question---no such thing exists.



California is a land of great contrasts.

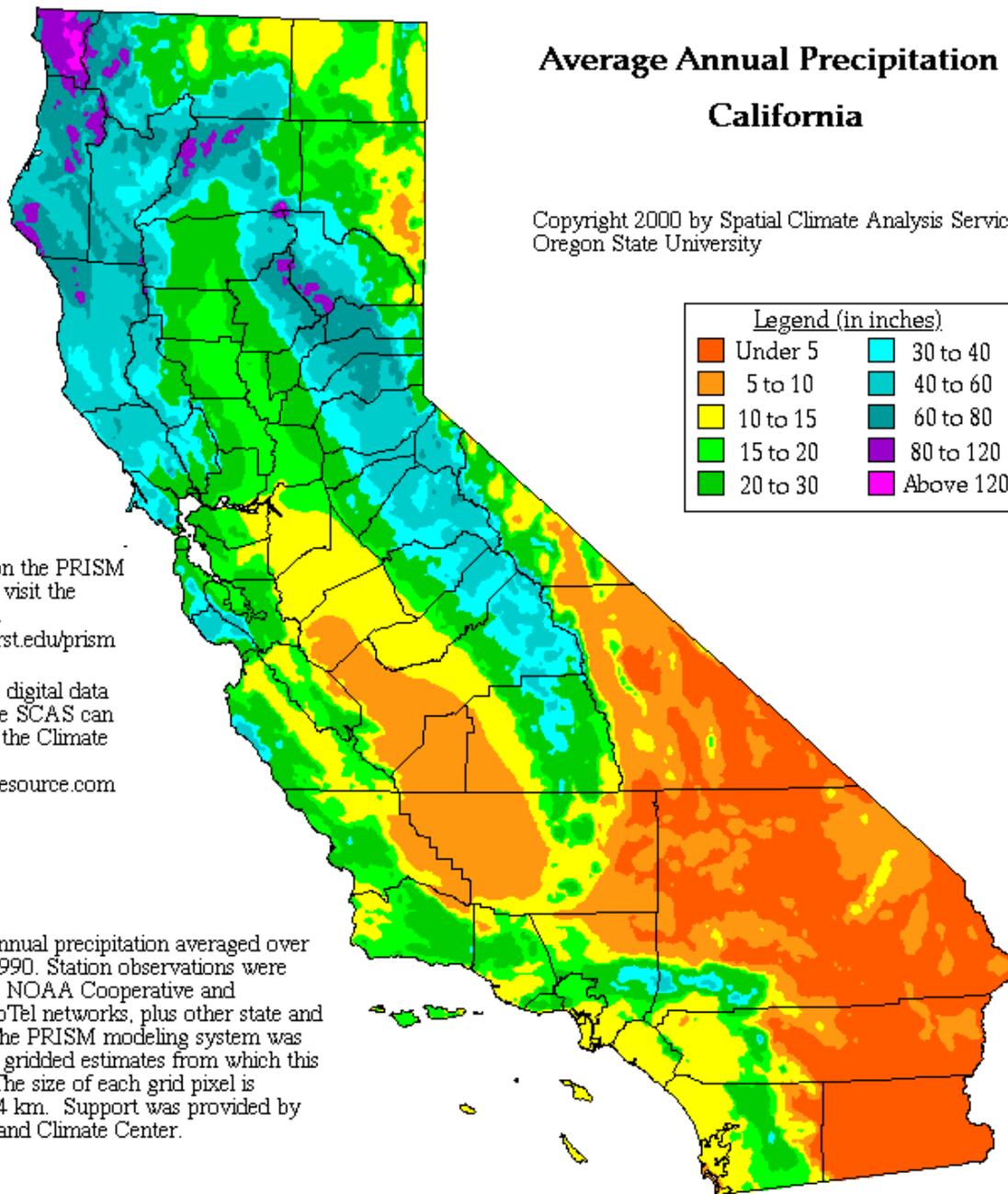
- Geology
- Landscapes
- Climate
- Plants
- Agriculture
- Cities
- People



Diverse parent material because California is at the edge of a continent and the continents are moving.

Average Annual Precipitation California

Copyright 2000 by Spatial Climate Analysis Service,
Oregon State University



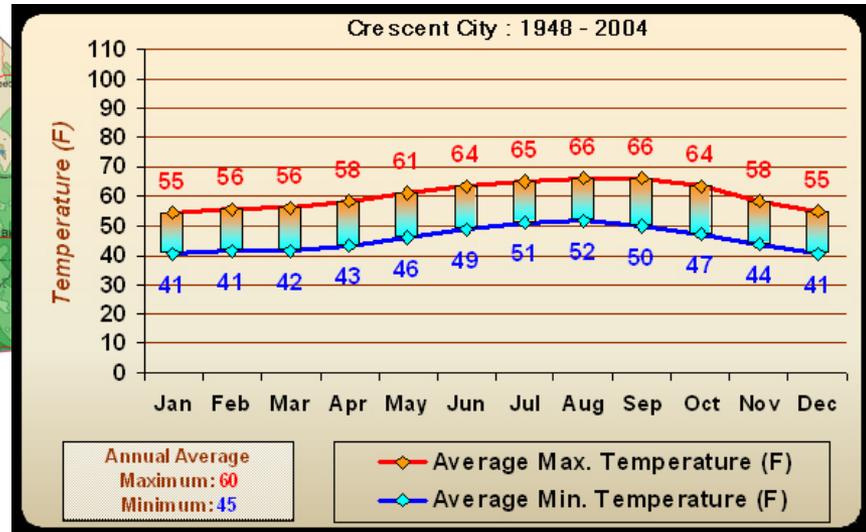
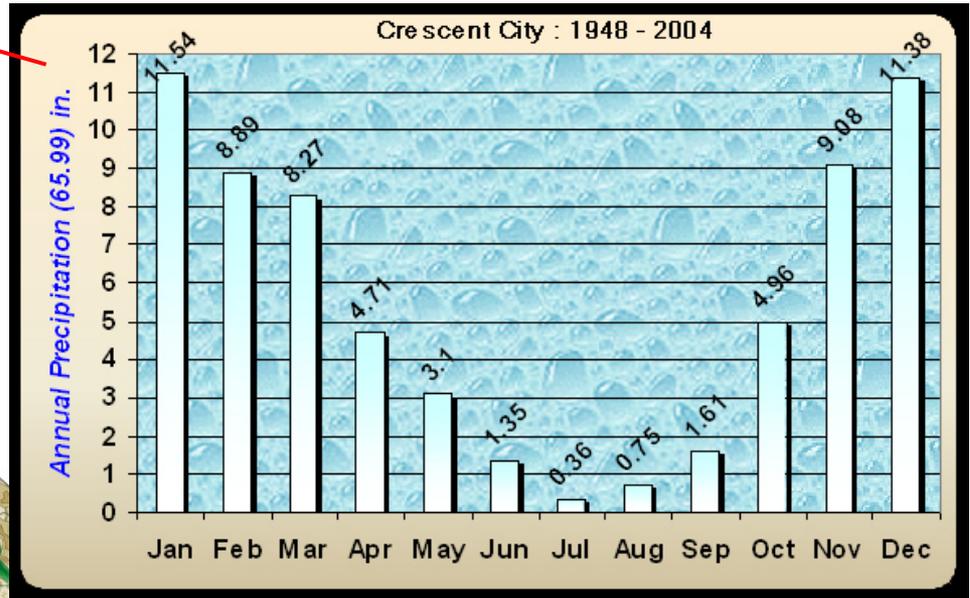
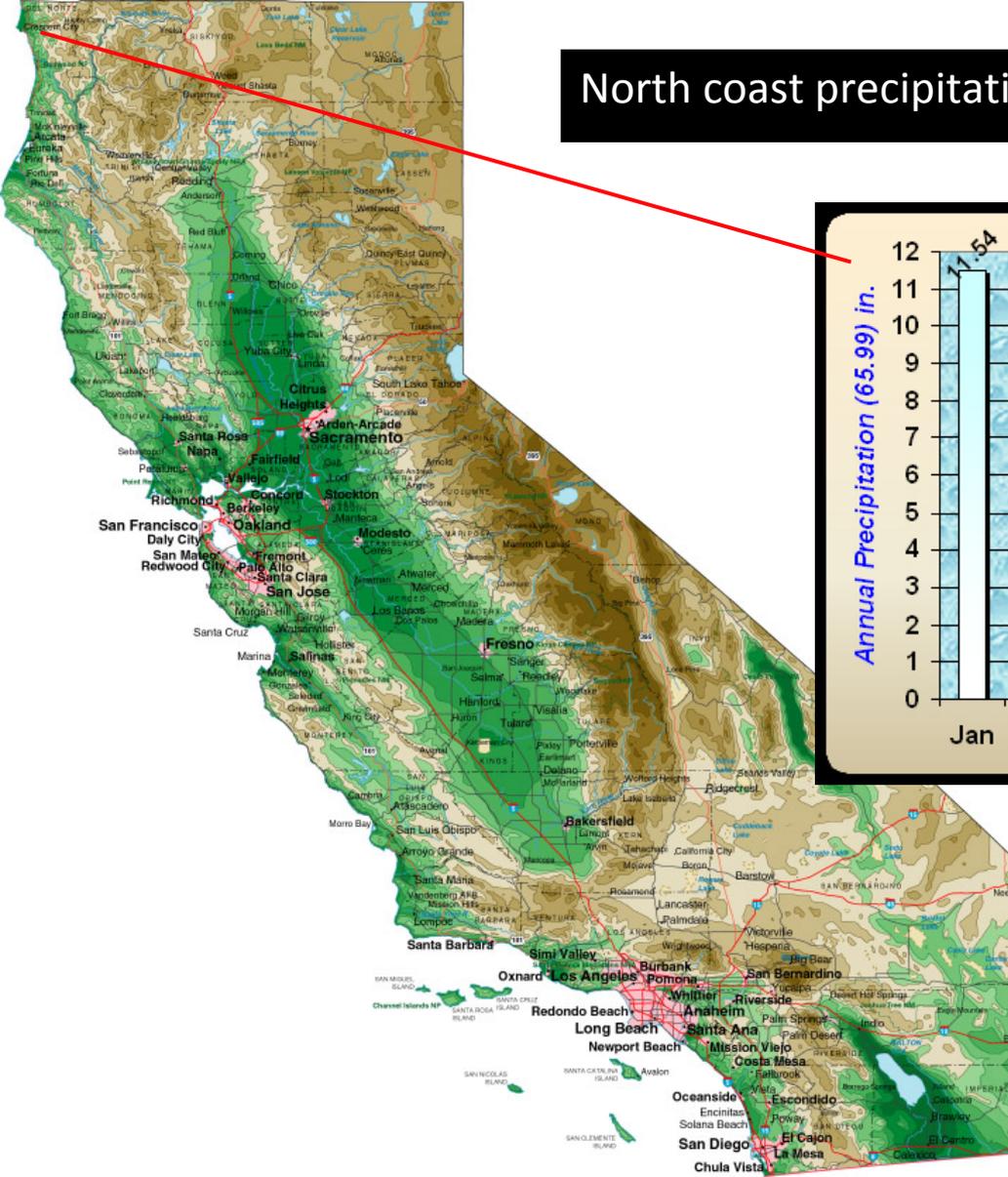
For information on the PRISM modeling system, visit the SCAS web site at <http://www.ocs.orst.edu/prism>

The latest PRISM digital data sets created by the SCAS can be obtained from the Climate Source at <http://www.climate-source.com>

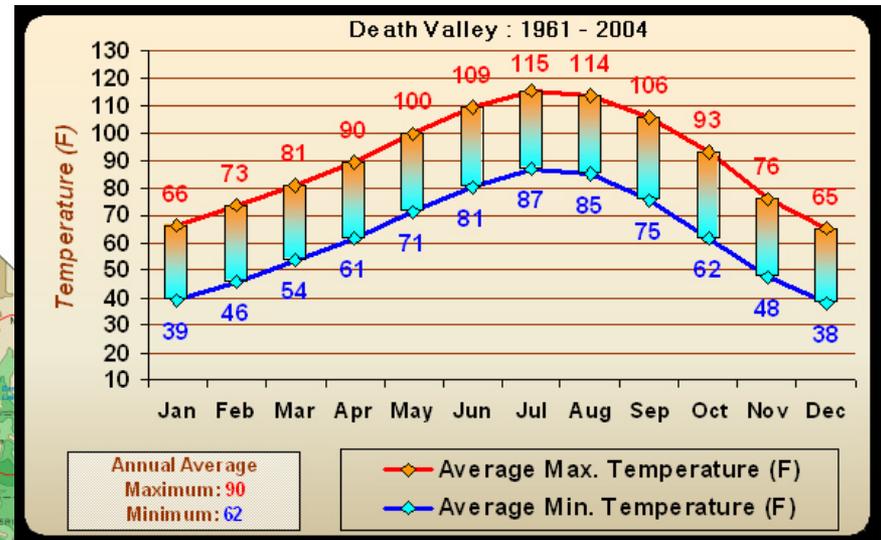
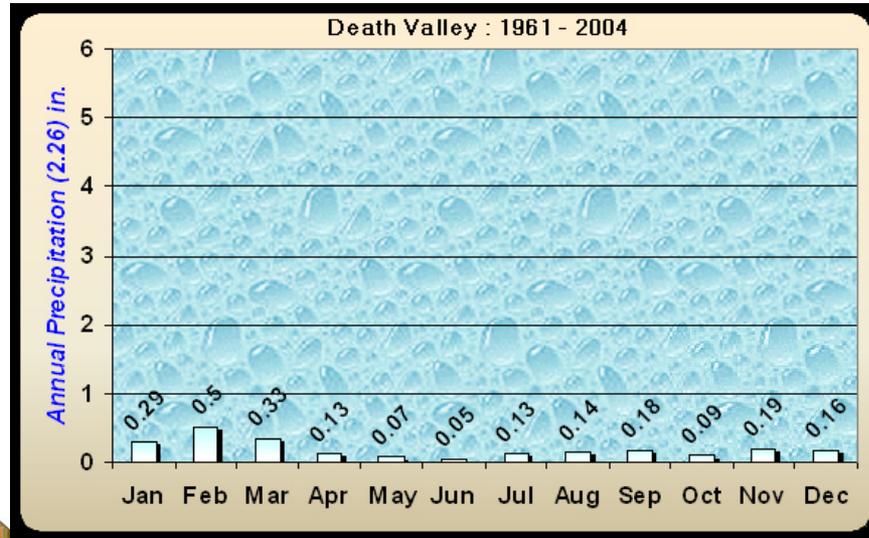
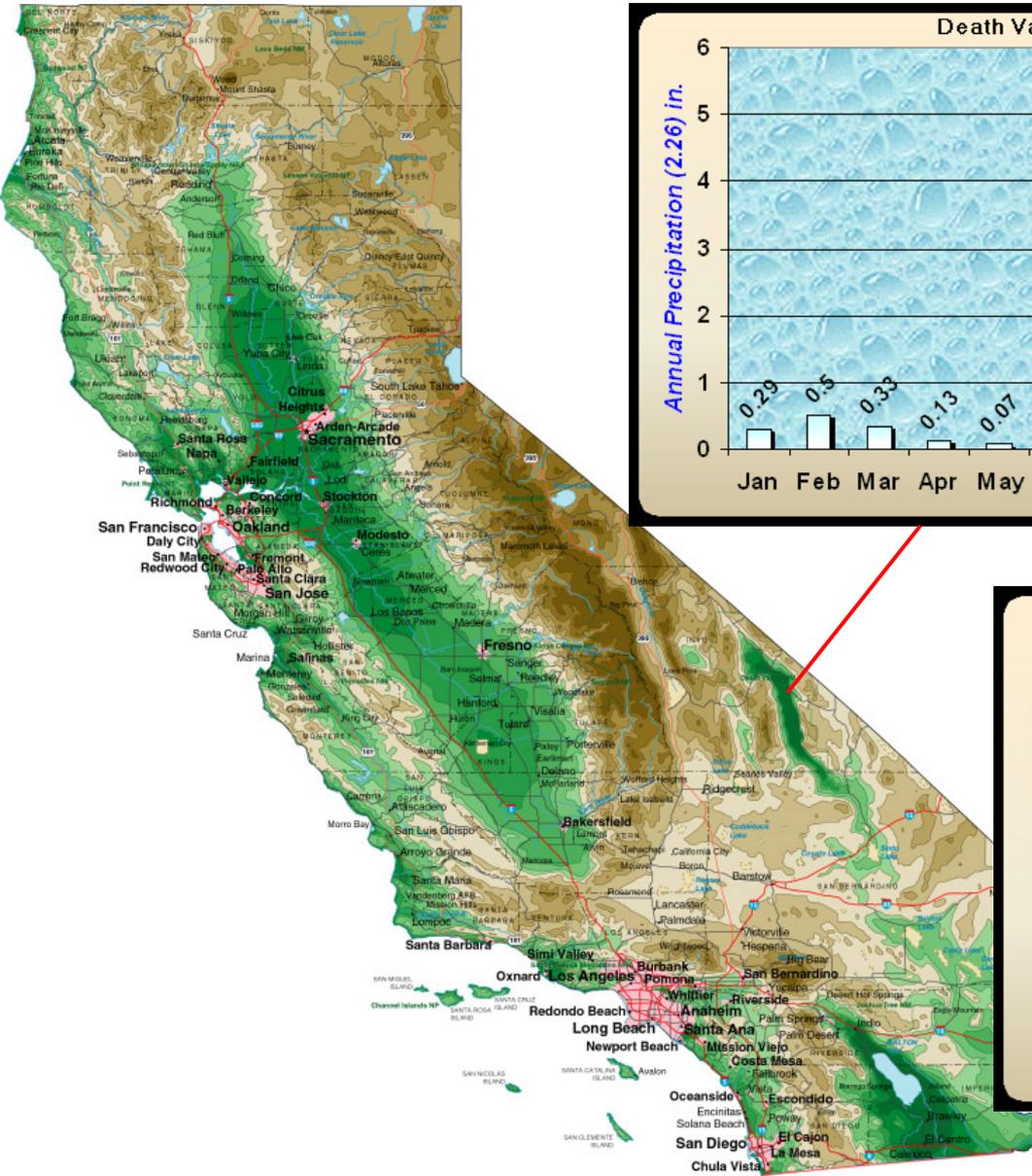
This is a map of annual precipitation averaged over the period 1961-1990. Station observations were collected from the NOAA Cooperative and USDA-NRCS Snotel networks, plus other state and local networks. The PRISM modeling system was used to create the gridded estimates from which this map was made. The size of each grid pixel is approximately 4x4 km. Support was provided by the NRCS Water and Climate Center.

Enormous climate variability.

North coast precipitation distribution example



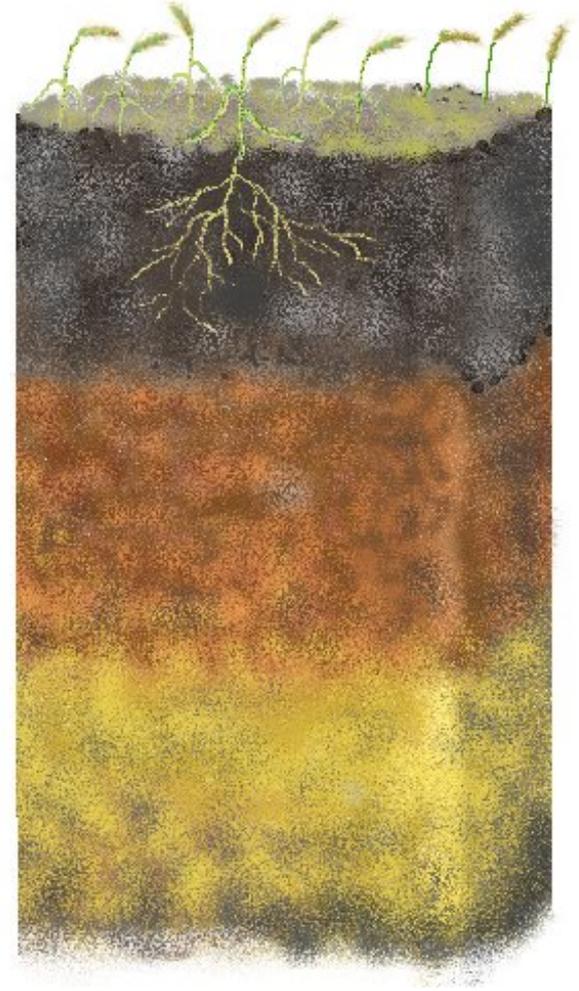
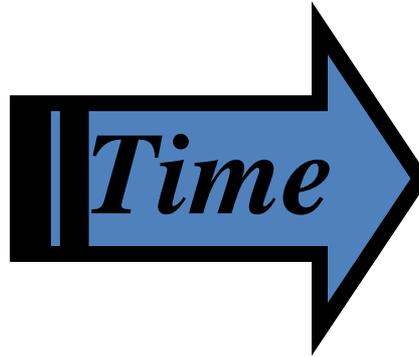
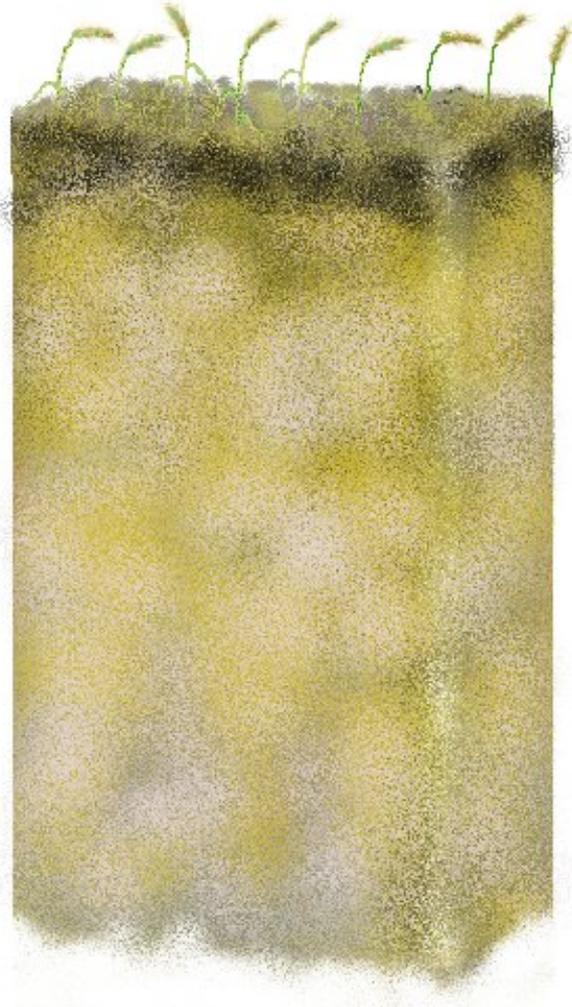
Desert precipitation distribution example





Vegetation reflects the diversity of geology, topography and climate.

Soil Development



California parent materials vary in age from recent to ancient.

Soil Quality?

“The capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation” Soil Science Society of America

An “unofficial” definition. Can a soil be managed to produce a product with minimum environmental damage? Is the land use sustainable?

Let’s look at some examples.

Defining Soil Quality

What soil properties define soil quality?

How does one quantify soil quality?

How does one combine quantitative measures of soil quality?

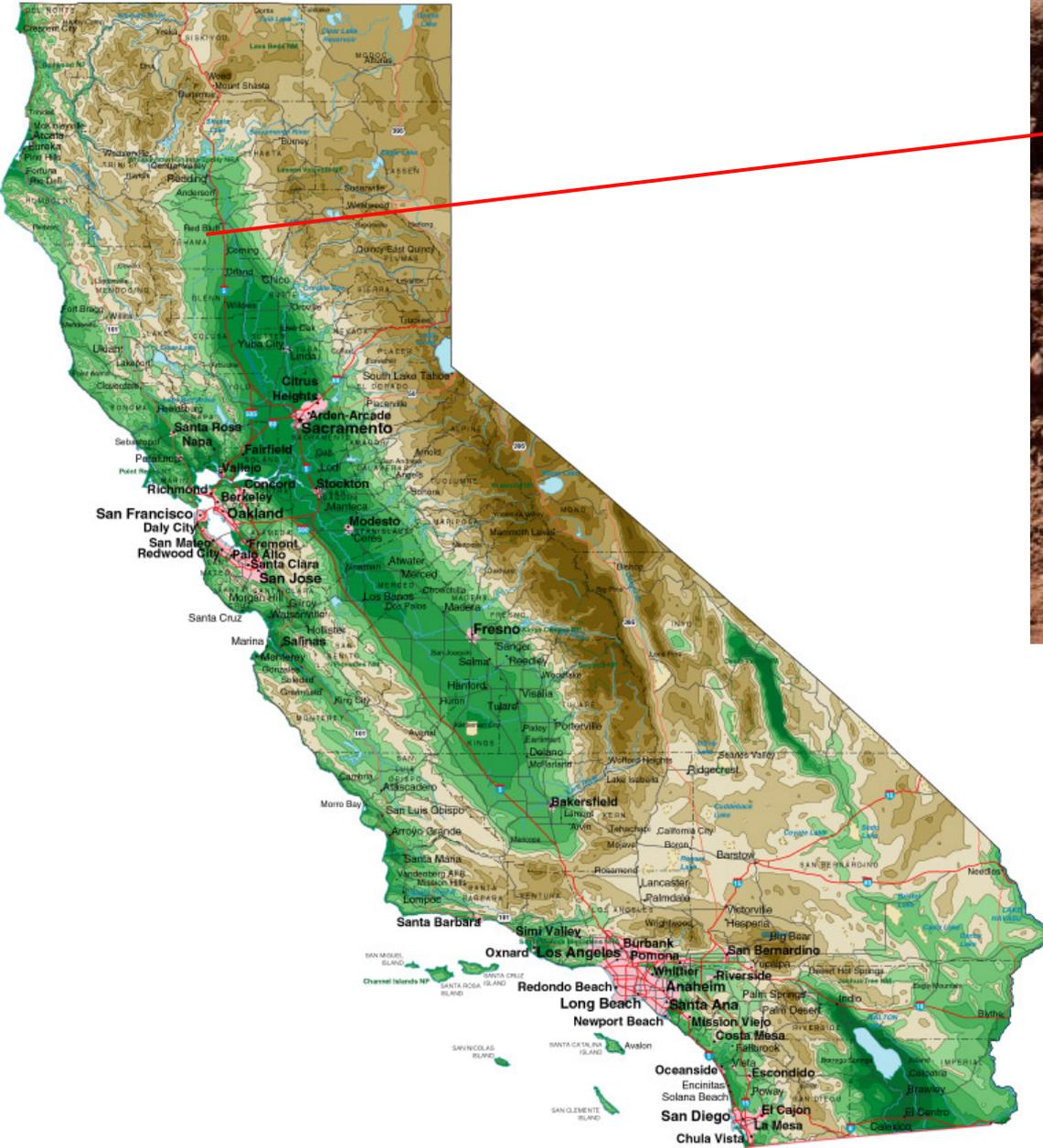
What is Soil Quality?



What is Soil Quality?



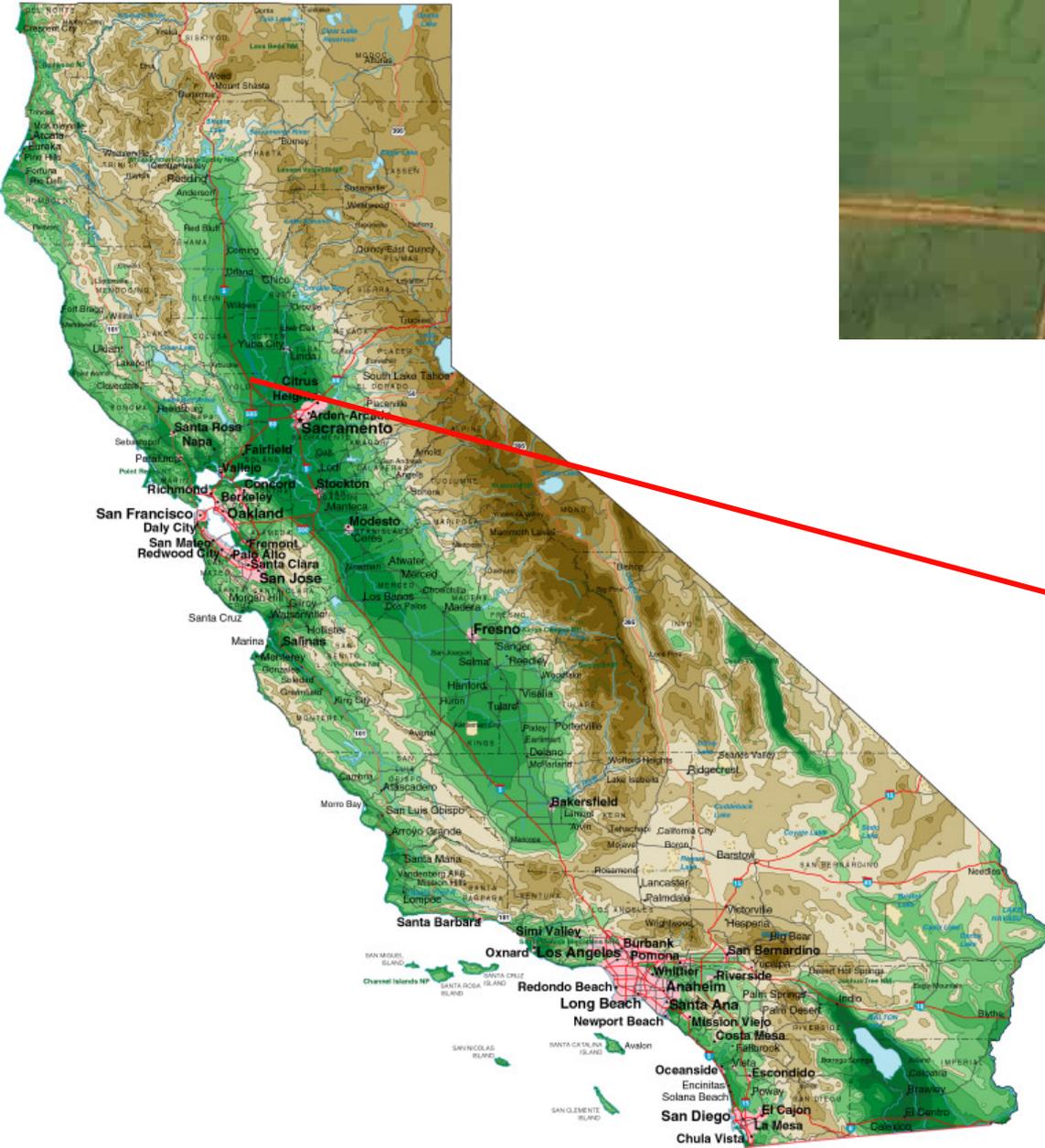
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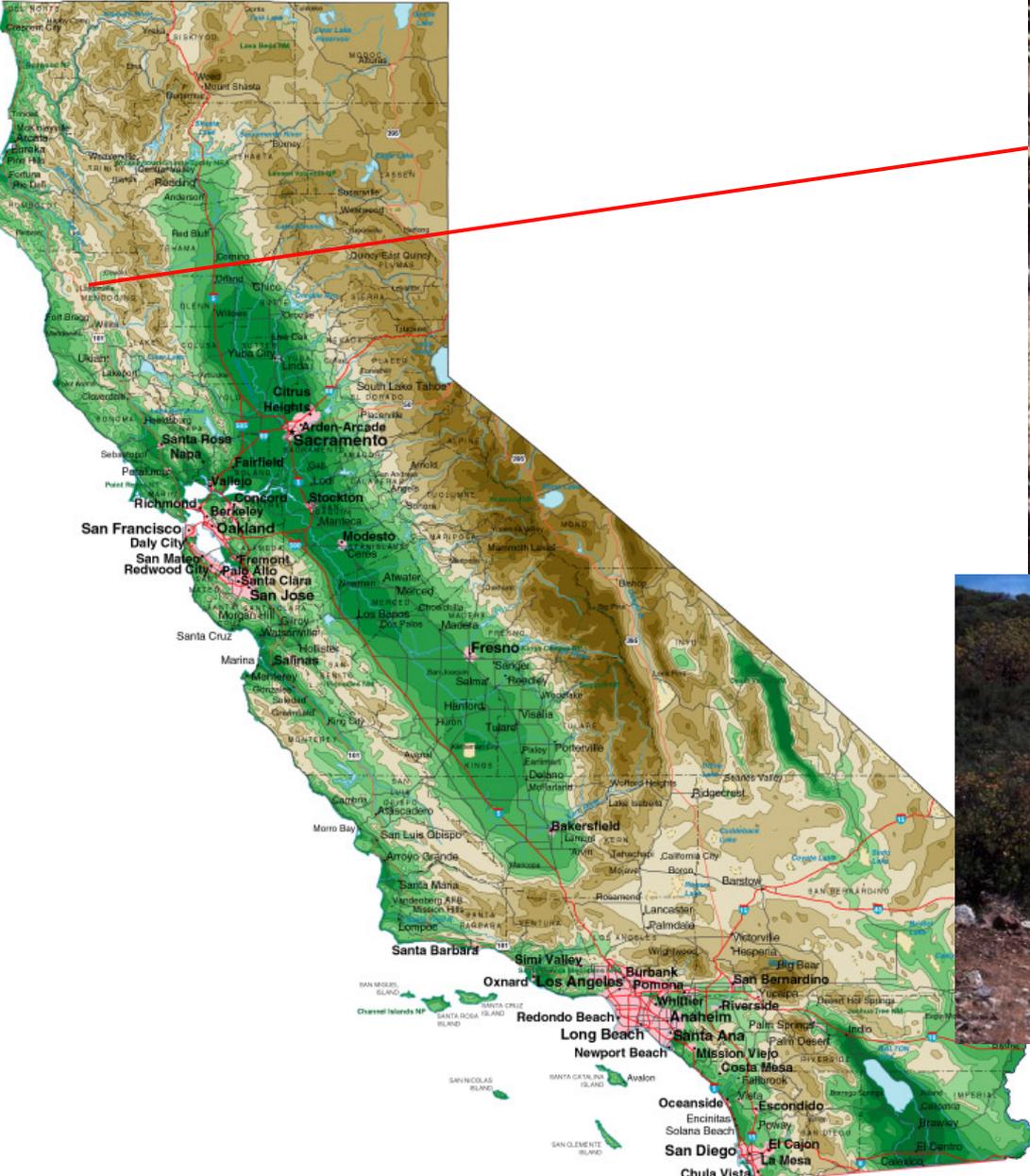
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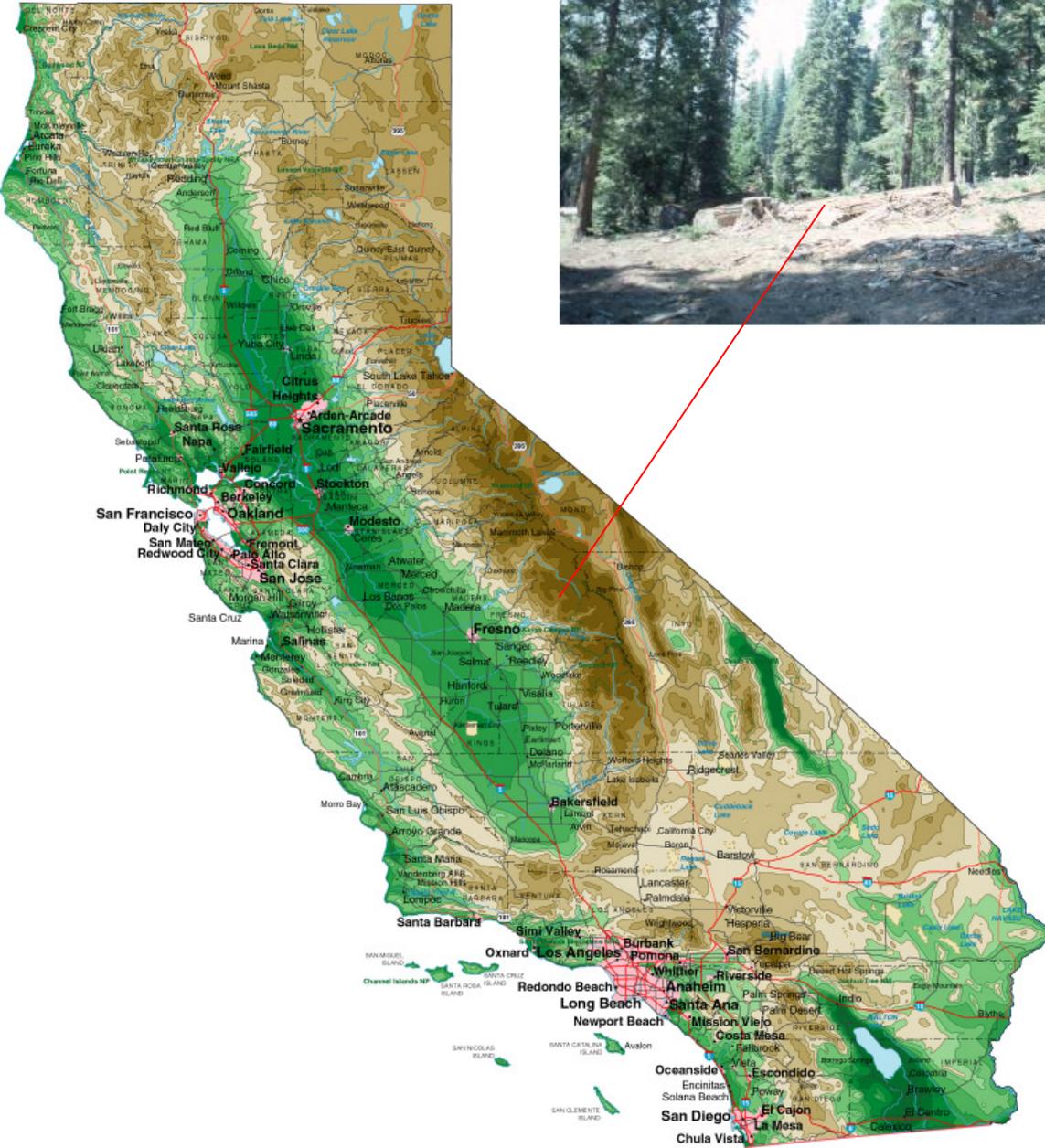
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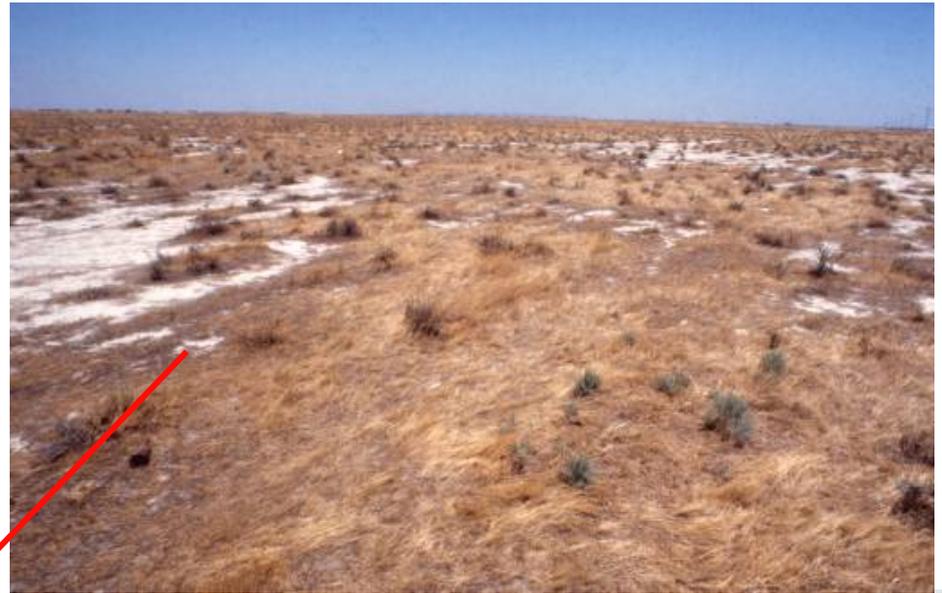
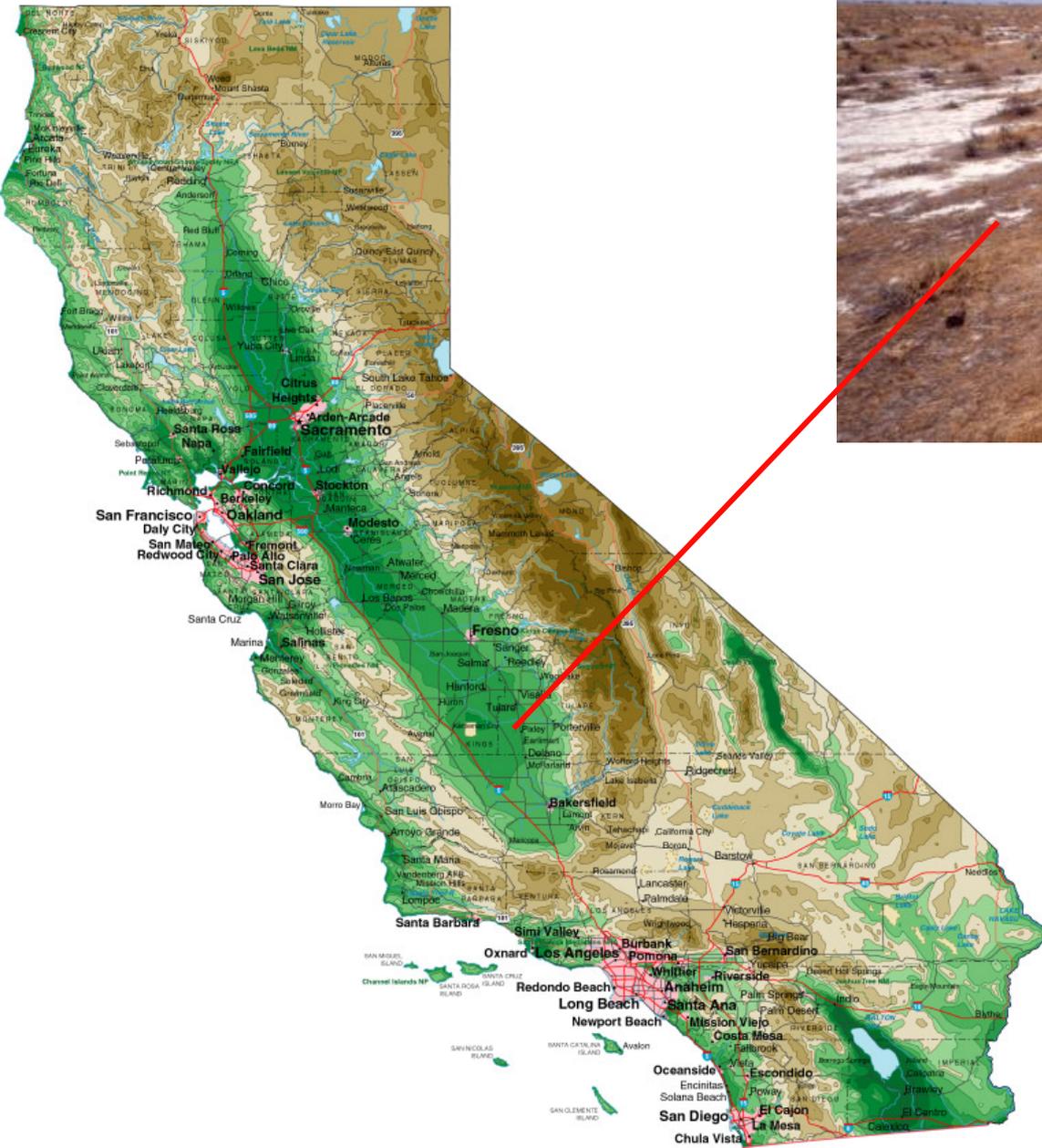
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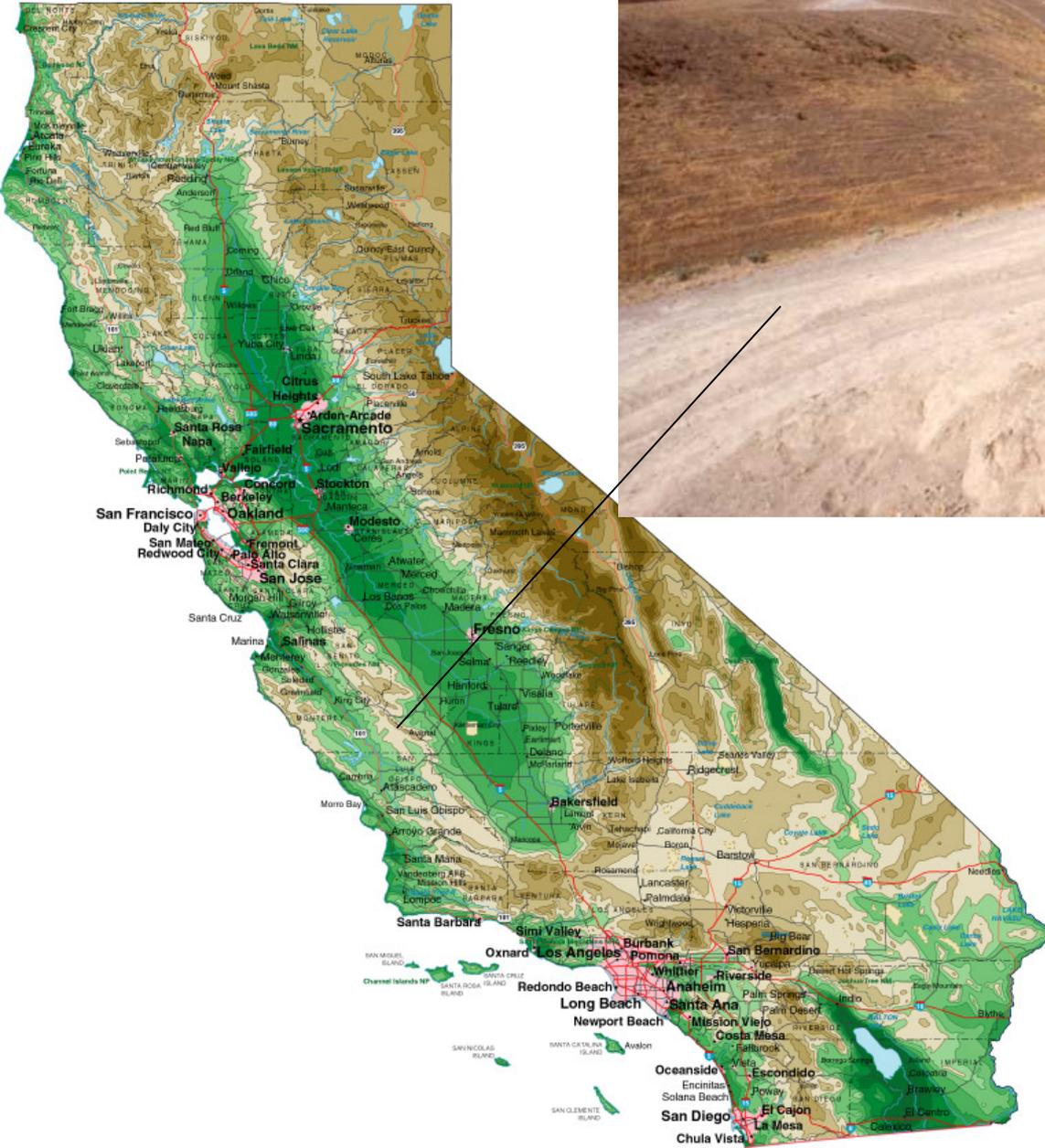
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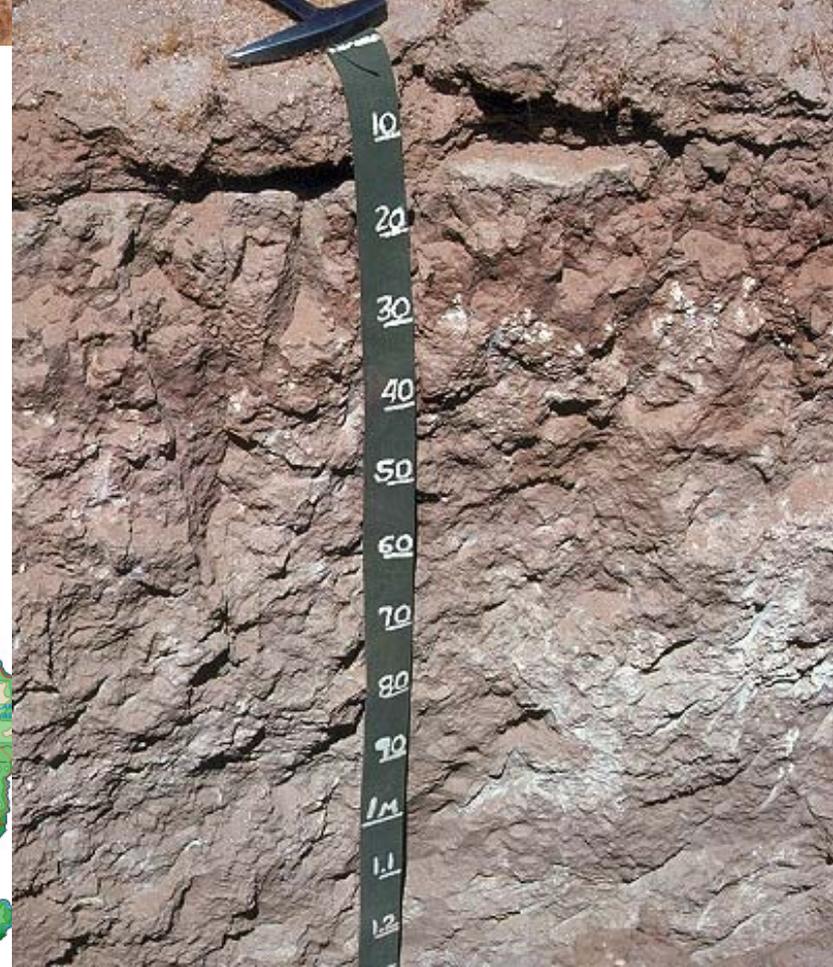
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What is Soil Quality?



What is Soil Quality?



Soil/Land Capability?

- Many measures of land capability exist to help land managers make land use decisions.
- USDA Land Capability Classification
- Storie Index
- Site Index for forests

Conclusions

- Soils are thin covering on the earth's surface that support life at varying scales.
- Soils are three phase systems, solids, liquids and gasses.
- Soils are highly variable because they form under different climates, vegetation, landscapes, on different parent materials and over different time periods.
- Soil quality is difficult to define and nearly impossible to quantify.
- Many systems exist for rating soils for agricultural capability that will work for helping to select areas for biofuels and for managing the soils that are selected.