Climate Change, Soil Health, and Ecosystem Goods and Services

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Soil Health

Soil health is the capacity of a soil to contribute to ecosystem function and sustain producers and consumers.

Healthy soils provide a variety of ecosystem goods and services.
Soil health

Components of Soil Health

**Chemical**
- pH
- Salinity
- Soil organic matter

**Physical**
- Texture
- Aggregate stability
- Structure

**Biological**
- Microbial biomass
- Activity
- Macro- & microfauna

Components of Soil Health
Soil health

- **Chemical**
  - pH, salinity, soil organic matter

- **Biological**
  - Microbial biomass & activity, macro- & microfauna

- **Physical**
  - Texture, aggregate stability, structure

Components of Soil Health
Soil organic matter (SOM) is correlated with soil fertility: generally speaking, the higher the SOM, the “healthier” and more fertile the soil.

*In this presentation, I will also mention soil organic carbon (SOC), which is an indicator of soil organic matter.
## Soil Organic Matter and SOC

The amount of SOM, and therefore SOC, in the soil is affected primarily by:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Plant community structure</th>
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<tbody>
<tr>
<td>Soil moisture</td>
<td>Biomass production</td>
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<tr>
<td>Topography</td>
<td>Soil pH</td>
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- Soil pH
Climate Change and Soil Health

Given the direct and indirect effects of climate on soil, what do shifts in climate mean for long-term soil health and associated ecosystem services?
The Carbon Cycle

- Burning of fossil fuels
- Plant respiration
- Decomposer respiration
- Decomposing organic matter and decomposers
- Death, waste production
- Feeding
- Animal respiration
- Photosynthesis
- Fossilization
- Organic compounds in green plants
- Organic compounds in animals
- Fossil fuels

Carbon dioxide in the atmosphere

Death
Climate Change and Soil Organic Carbon

The rate of carbon cycling is partially dependent upon environmental conditions.
Generally:

Higher temperature and precipitation →

Higher production & higher rate of decomposition

The Carbon Cycle

- Burning of fossil fuels
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- Organic compounds in animals
- Feeding
- Organic compounds in green plants
- Fossilization
- Plant respiration
- Fossil fuels
- Death
Generally:

Higher temperature and precipitation $\rightarrow$ Higher production & higher rate of decomposition $\rightarrow$ Larger amount of carbon stored in the soil

The Carbon Cycle

- **Carbon dioxide in the atmosphere**
- **Burning of fossil fuels**
- **Decomposing organic matter and decomposers**
- **Decomposer respiration**
- **Death, waste production**
- **Animal respiration**
- **Death**
- **Feeding**
- **Photosynthesis**
- **Organic compounds in animals**
- **Organic compounds in green plants**
- **Fossil fuels**
- **Plant respiration**
- **Fossilization**

**Fossil fuels**
- **Burning of fossil fuels**

**Decomposing organic matter and decomposers**
- **Death, waste production**
- **Animal respiration**

**Animal respiration**
- **Death, waste production**

**Death**
- **Feeding**

**Feeding**
- **Photosynthesis**

**Photosynthesis**
- **Organic compounds in animals**

**Organic compounds in animals**
- **Death**
Soil organic matter (SOM) is correlated with soil fertility: *generally speaking, the higher the SOM, the more fertile the soil...*

...And more fertile soil tends to be healthier and more capable of providing ecosystem services.
Not all climates or changes are equal...
Climate Change, Soil Health, and Ecosystem Services

What does all of this mean for ecosystem services provided by healthy soils?
Climate Change, Soil Health, and Ecosystem Services

What does all of this mean for ecosystem services provided by healthy soils?

It depends on the soil, the ecosystem, the direction and type of change(s), and people.
Components of Soil Health

- **Chemical**
  - pH, salinity, soil organic matter

- **Biological**
  - Microbial biomass & activity, macro- & microfauna

- **Physical**
  - Texture, aggregate stability, structure

Soil health
Soil health

Components of Soil Health

Chemical
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Physical
- Texture, aggregate stability, structure
Conclusion

The extent to which climate change affects soil health and ecosystem services is contingent upon the type and magnitude of change, as well as other contributing factors.

The potential for mitigating or enhancing any negative effects of climate change on soils is heavily dependent on soil management.
Adapting to and mitigating the effects of climate change on ecosystem services will require management directed at improving and preserving soil health.
Questions?

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