

The Carbon Dilemma

Can soils solve our climate crisis?

Rachel Zweig

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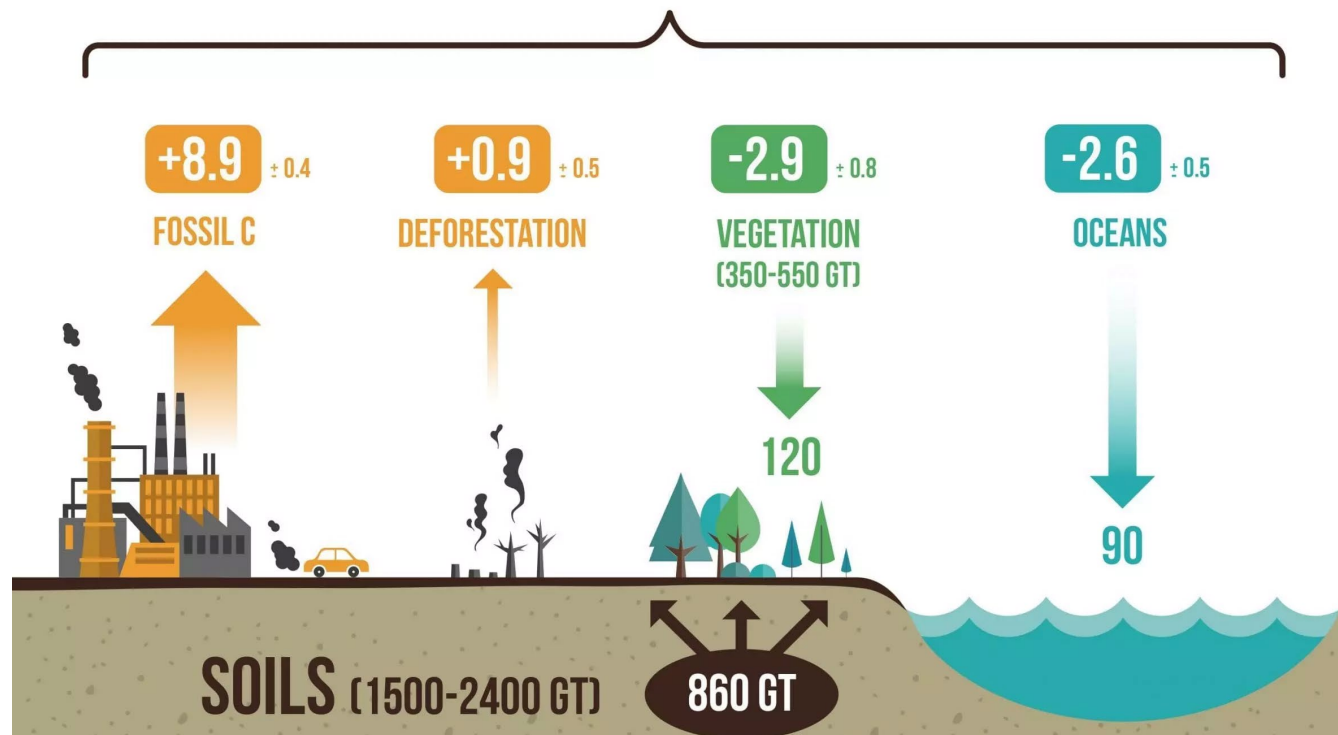
4 PER 1000

WHERE DOES IT COME FROM ?

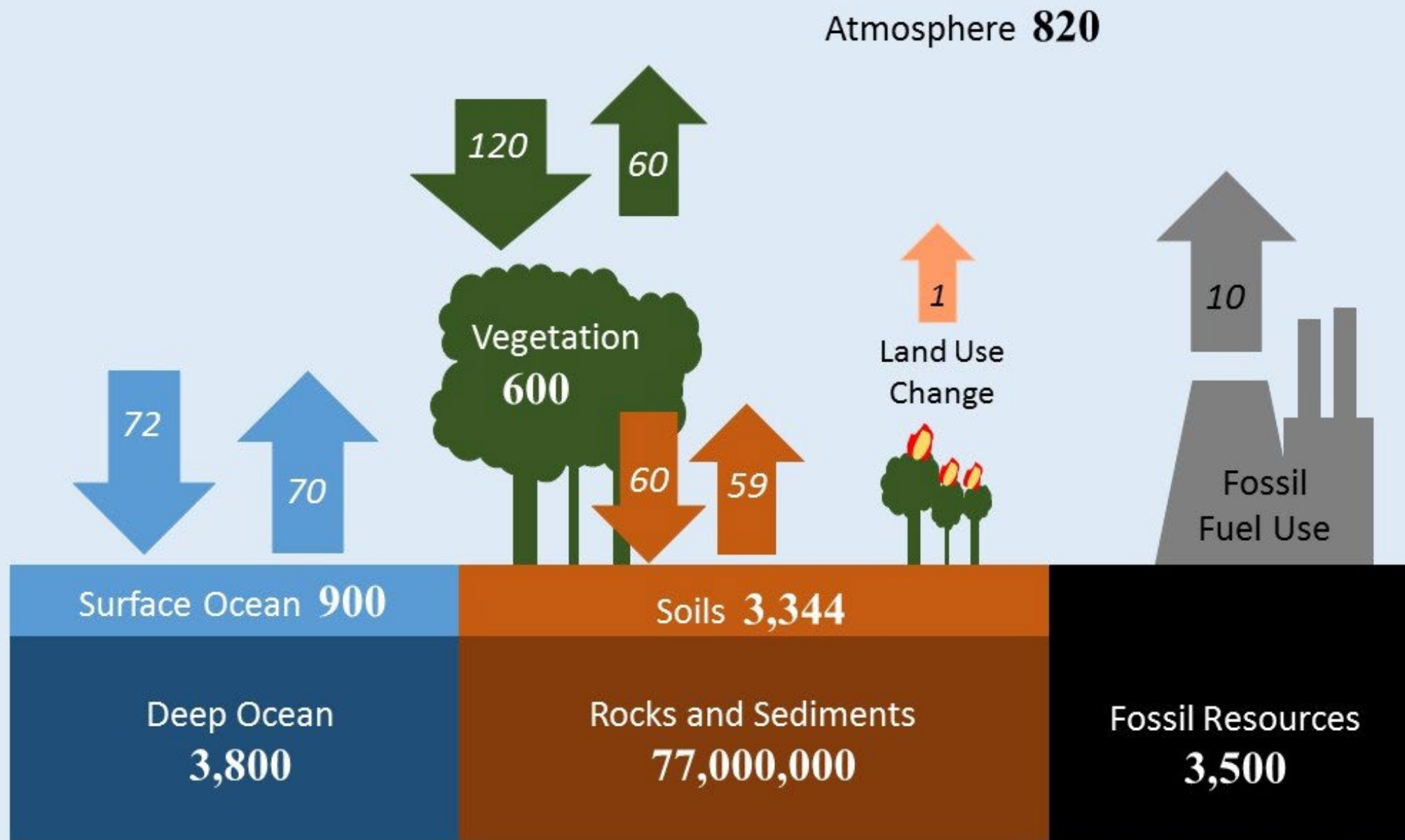
ATMOSPHERE (829 GT)

NET FLUXES EARTH/ATMOSPHERE (GT CY⁻¹ = PG CY⁻¹)

+4.3 ± 0.1



An annual increase of 4 % of the world soil surface C stocks (860*0.004) would nearly compensate the annual CO₂ increase of the atmosphere



Stocks in petagrams (10^{15} g) of carbon (PgC) in **bold serif**, flows in PgC/year in *italic sans serif*
 Sources: Churkina (2013) as updated by GCP (2015); illustration by Angelika Kurthen

What is Soil Organic Matter (SOM)?

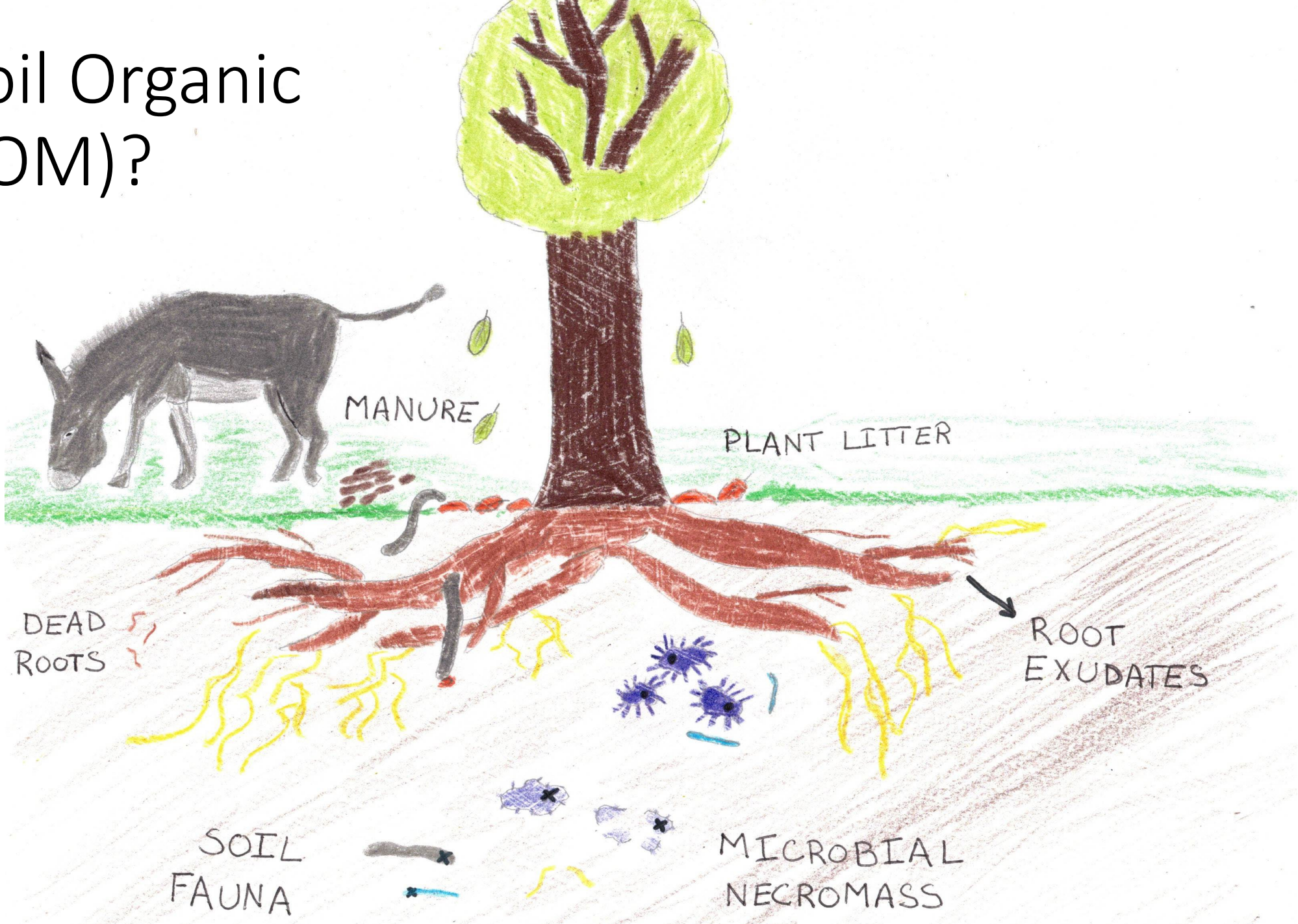


Image: Rachel Zweig

Benefits of SOM

- Improved water quality
- Better water infiltration and retention
- Increased nutrient retention
- Decreased erosion
- Enhanced microbial diversity



Photo: USDA

What happens to SOM in the soil?

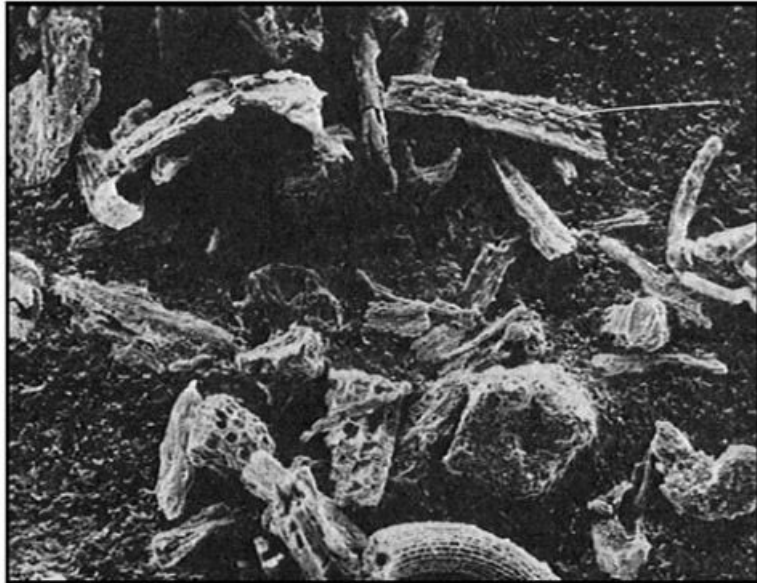
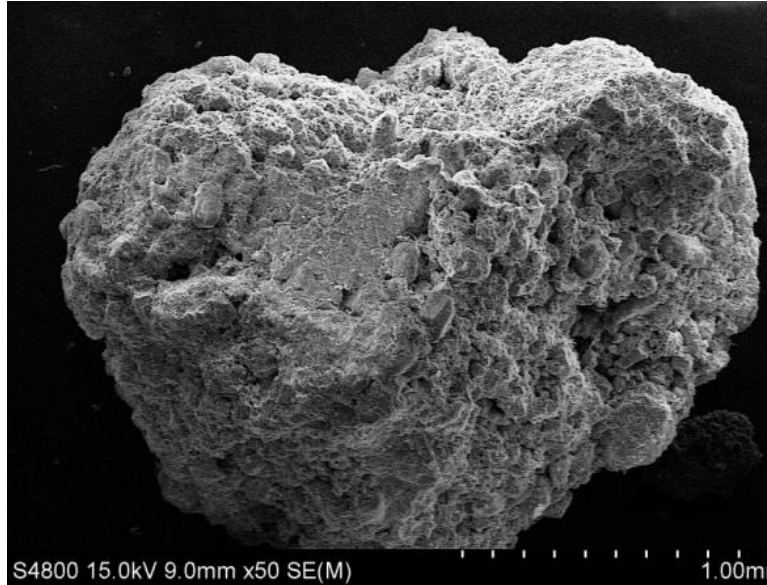


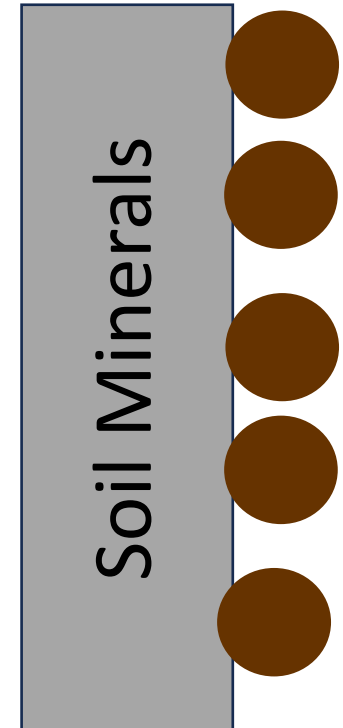
Figure 1. Particulate organic matter from no-till soil. From Cambardella and Elliot, 1992.

Particulate Organic Matter (POM)



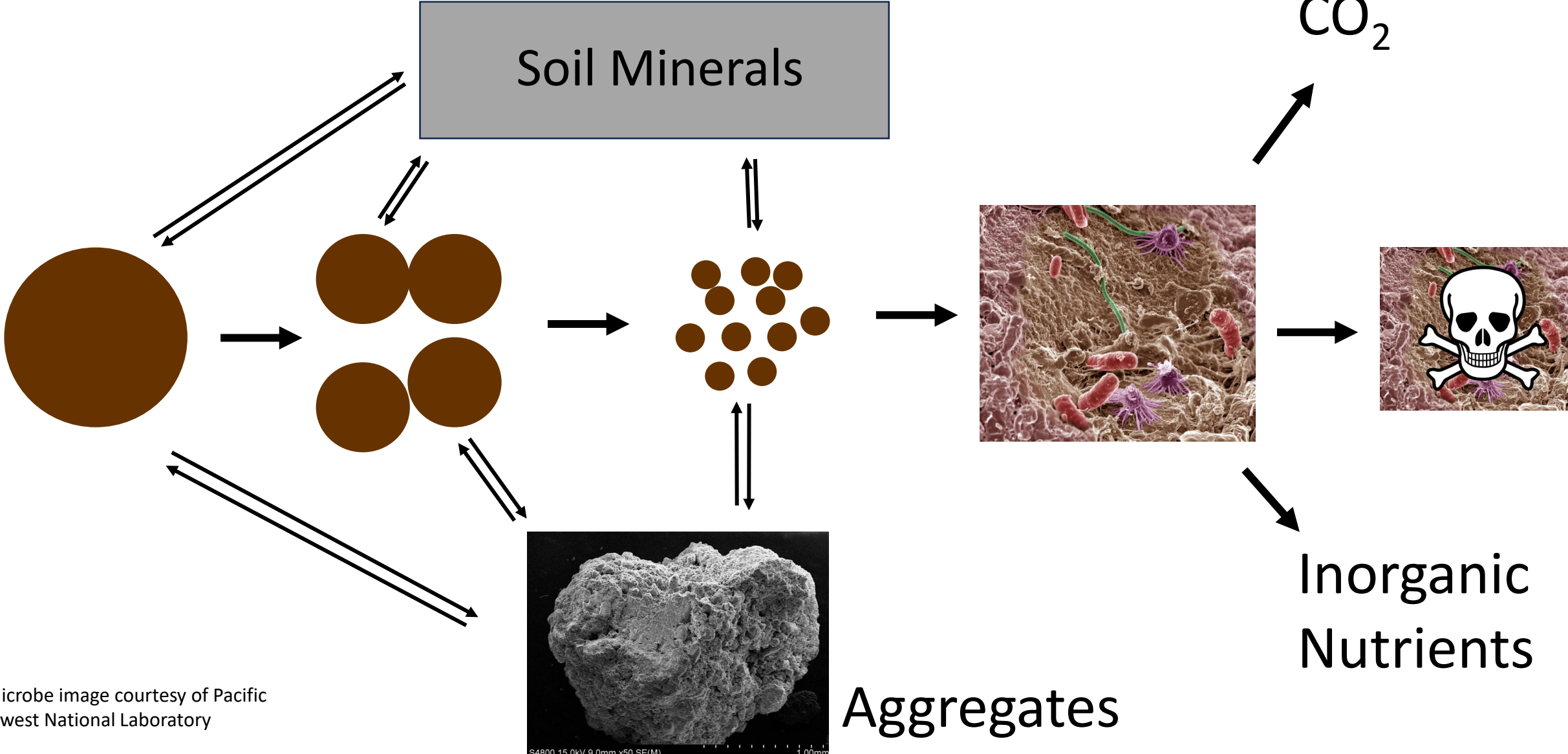
Brevik et al., 2015; <https://doi.org/10.5194/soil-1-117-2015>

Soil Aggregates



Mineral-Associated Organic Matter (MAOM)

What happens to SOM in the soil?



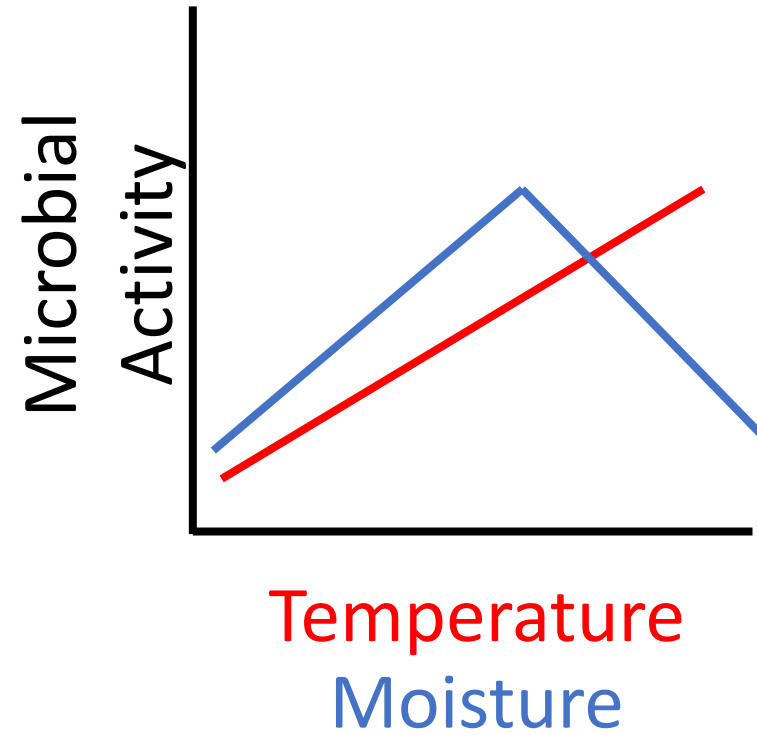
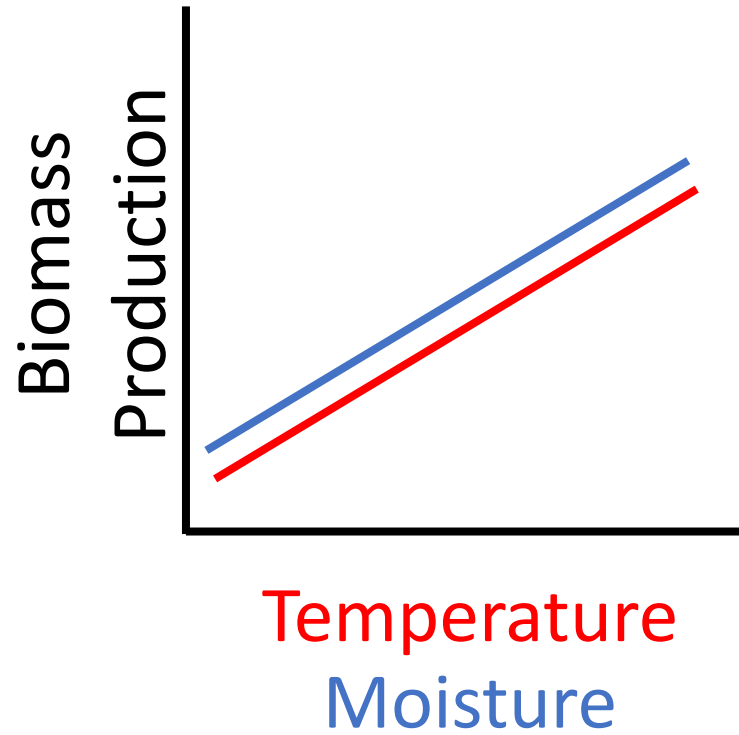
Soil microbe image courtesy of Pacific Northwest National Laboratory

S4800 15.0kV 9.0mm x50 SE(M) 1.00mm

What affects soil carbon sequestration?

- Environment
- Agriculture
- *In-situ* factors

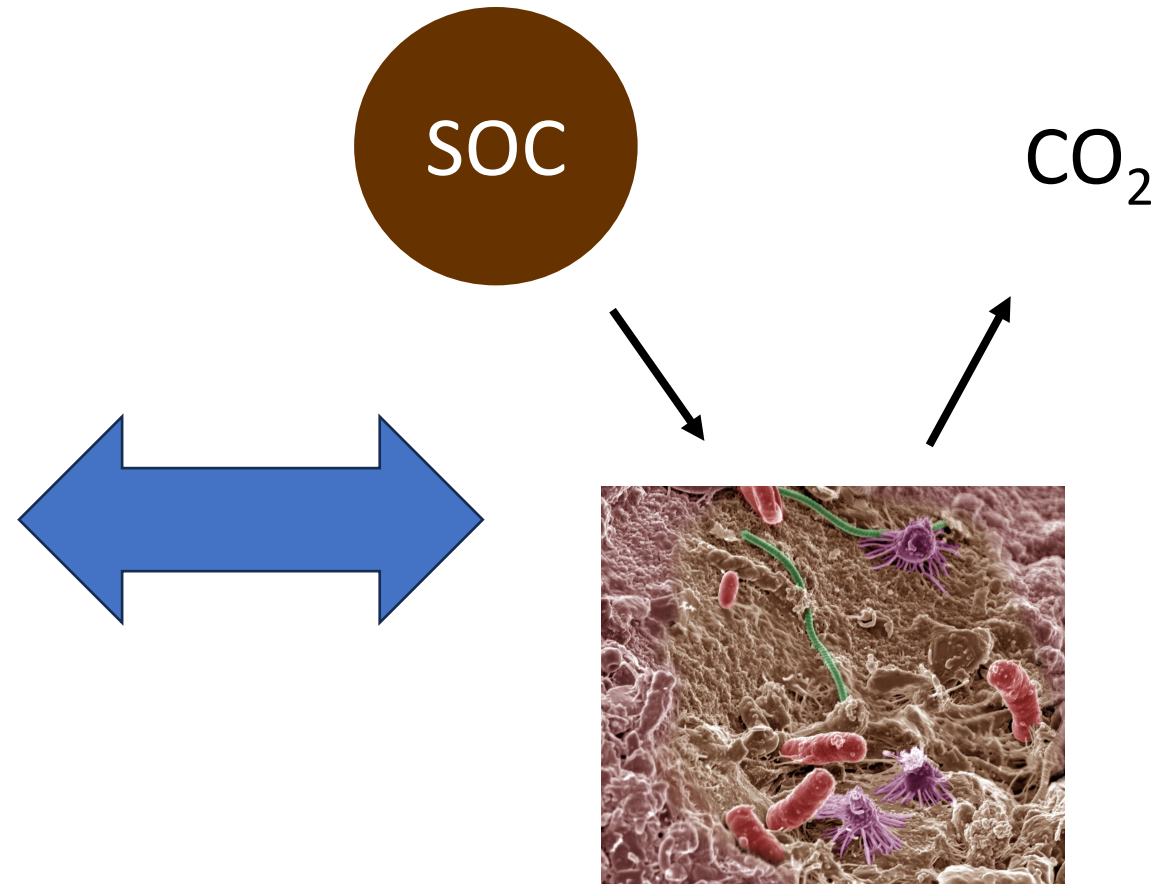
Environment



Environment

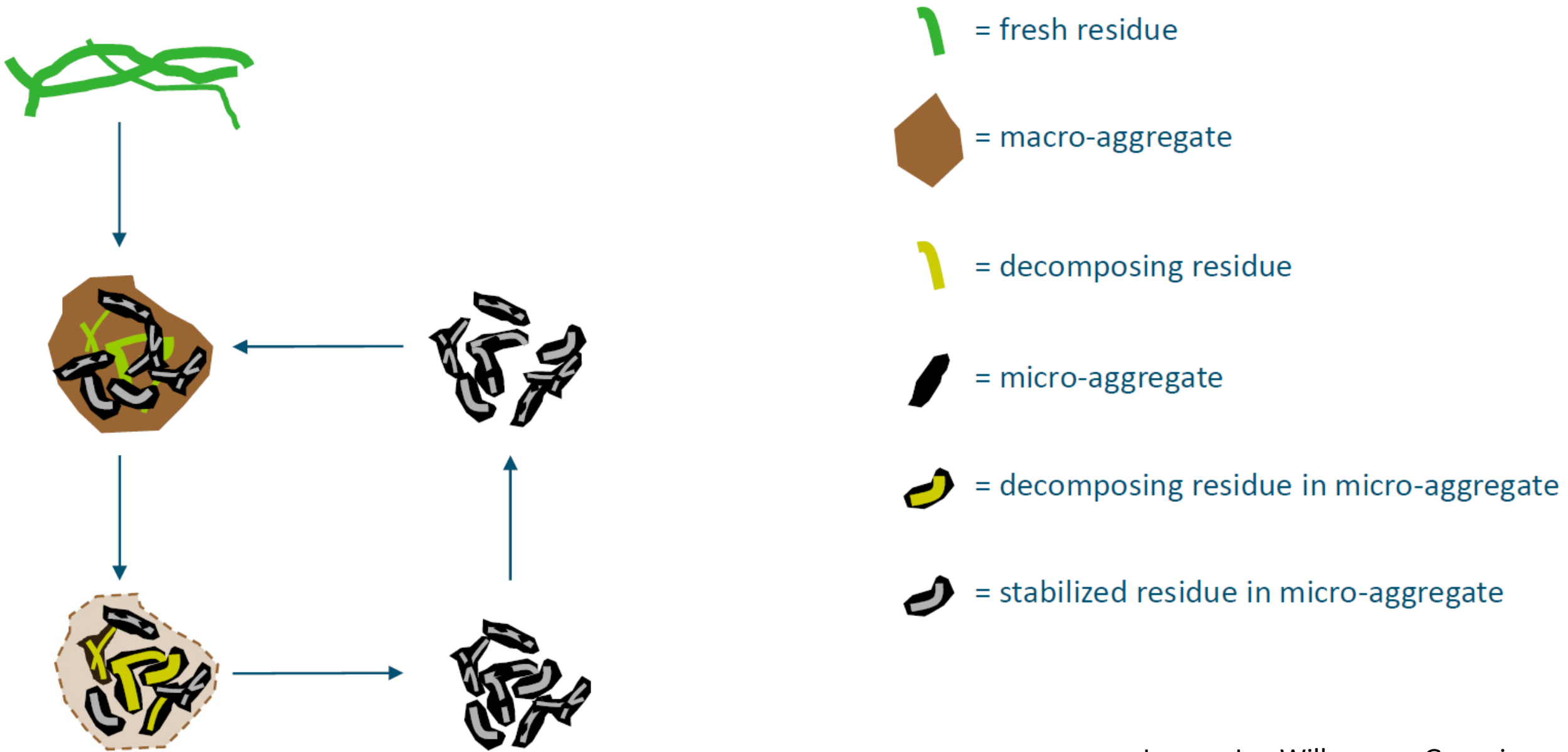


Photo: Arild Vågen



Agriculture

Tillage



Agriculture

Tillage



Agriculture

Crops



Photo: The Land Institute

Fertilizer and Water Management



Photo: Mark Cain

In-situ factors

Surface Area



Photo: Dave Lanovaz



Soil Biota

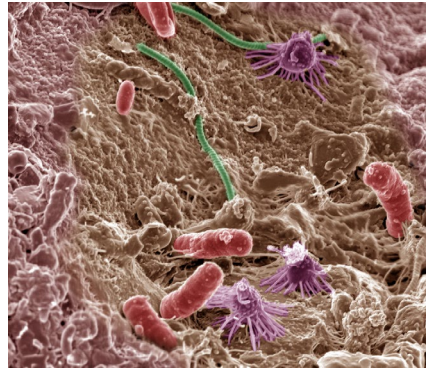


Photo: Cristina Menta

Soil Nutrients



So, what's the dilemma?



Courtesy of Pacific Northwest National Laboratory



Photo: Mark Cain

CO₂

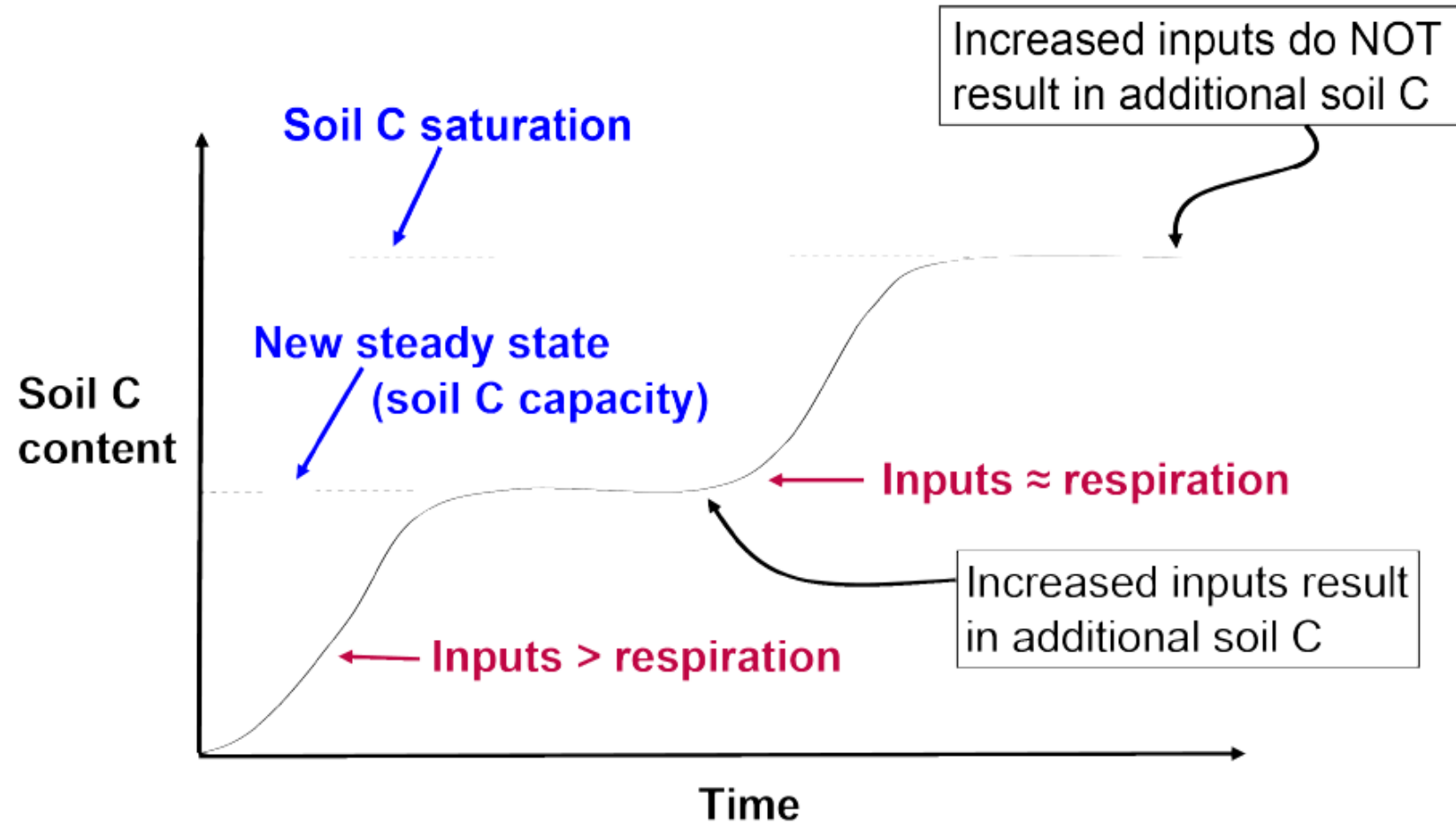


Inorganic
Nutrients



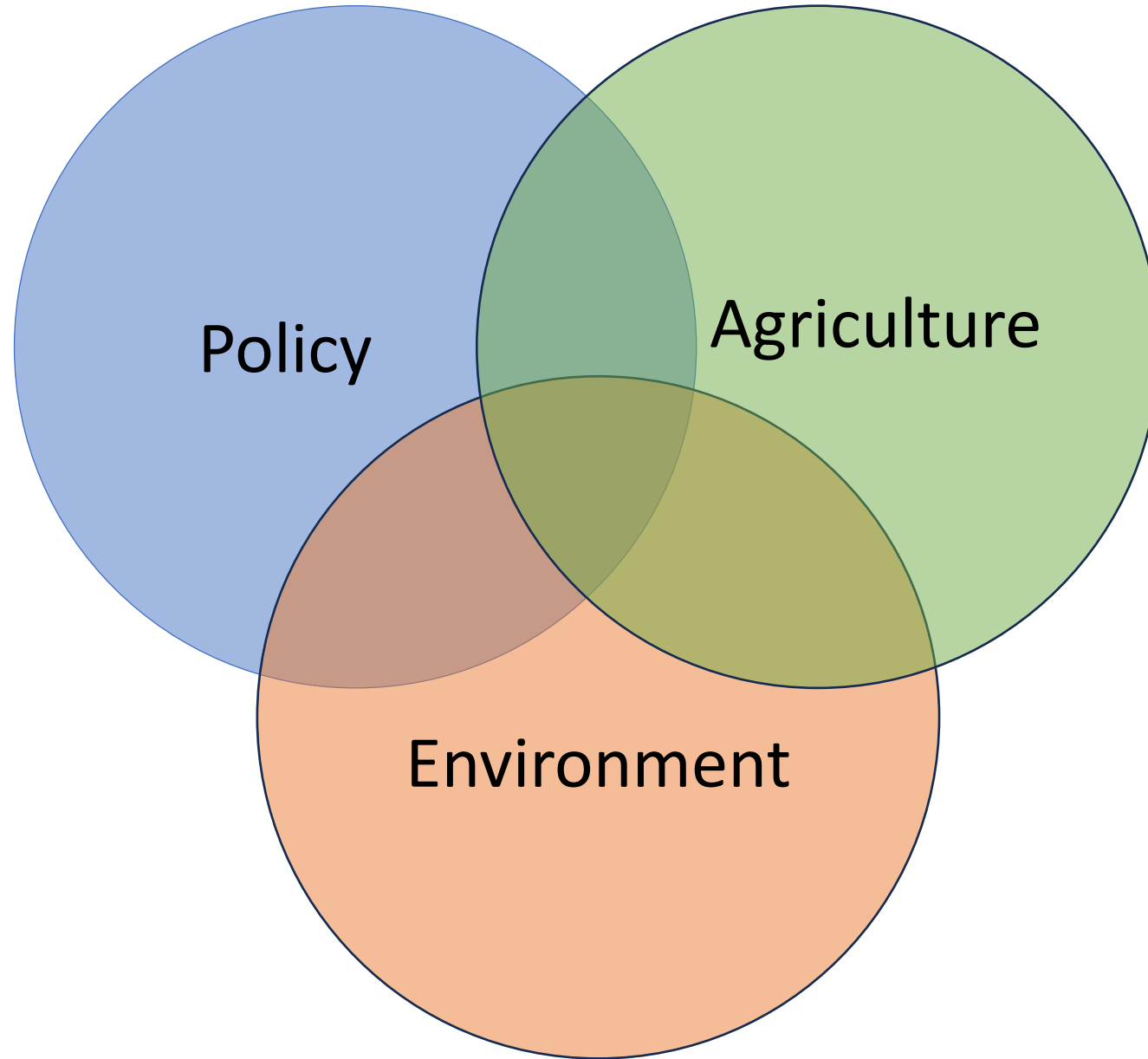
Topics of debate

- Saturation
- NO₂ emissions
- Changing temperature
- Priming effect
- Nutrient stoichiometry



Adapted from: West and Six, Climatic Change, 2007; doi:10.1007/s10584-006-9173-8

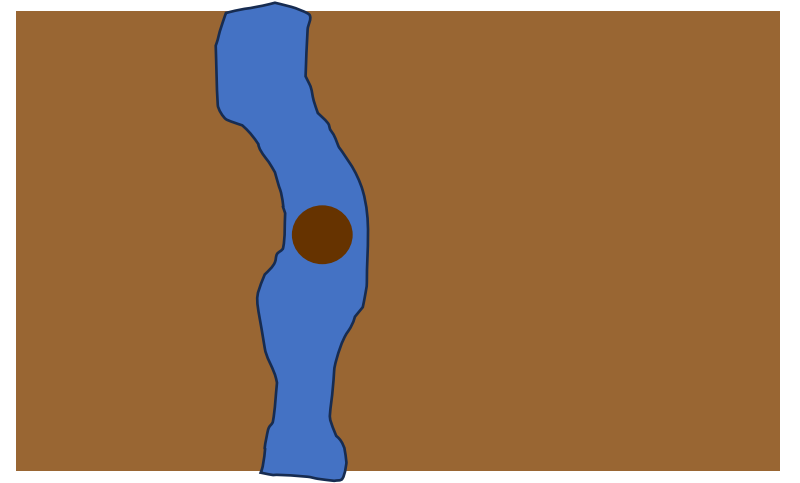
Can we sequester enough carbon?



Questions?

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Dissolved Organic
Matter (DOM)

Carbon Cycle

