

The Carbon Dilemma

Can soils solve our climate crisis?

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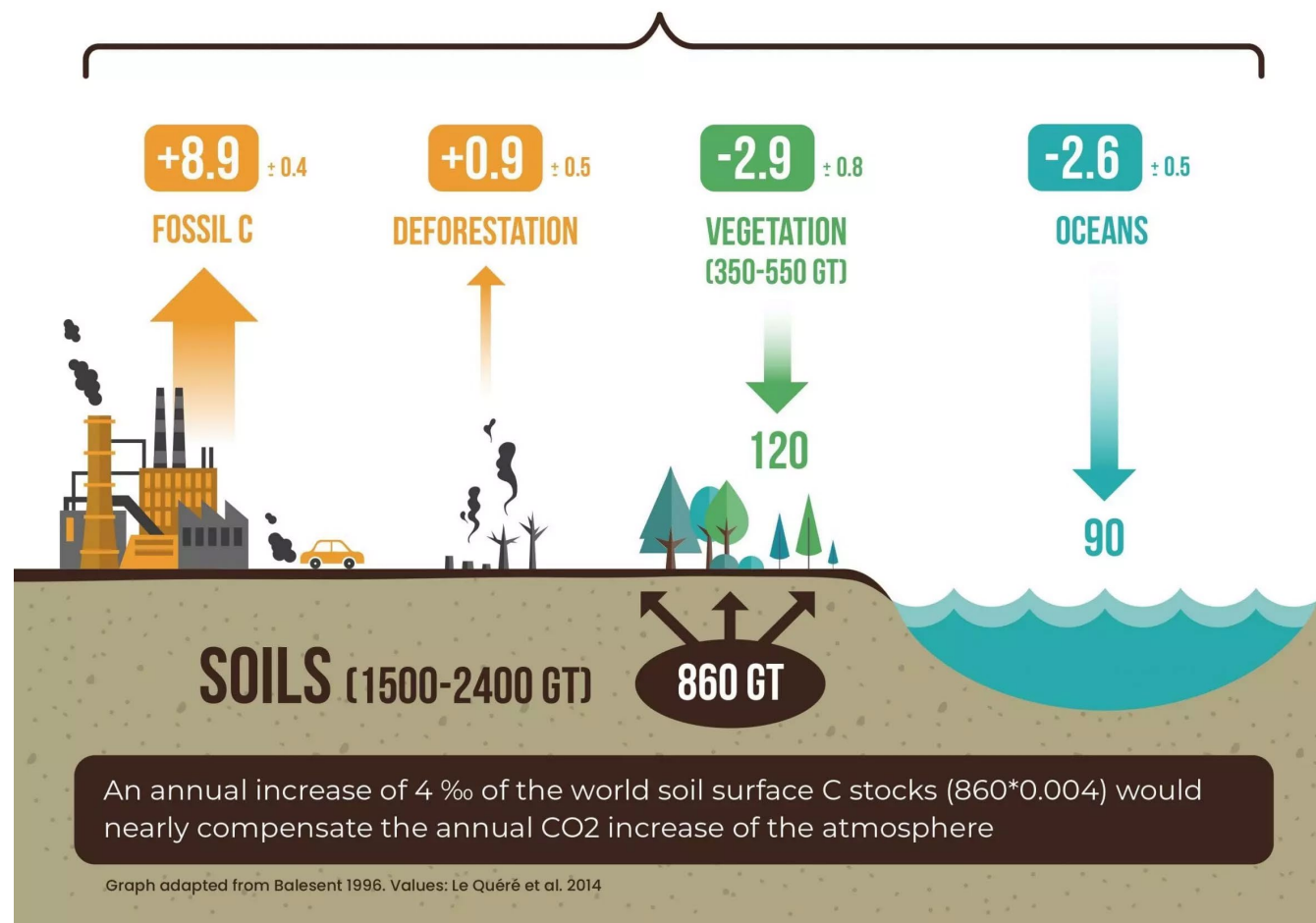
4 PER 1000

WHERE DOES IT COME FROM ?

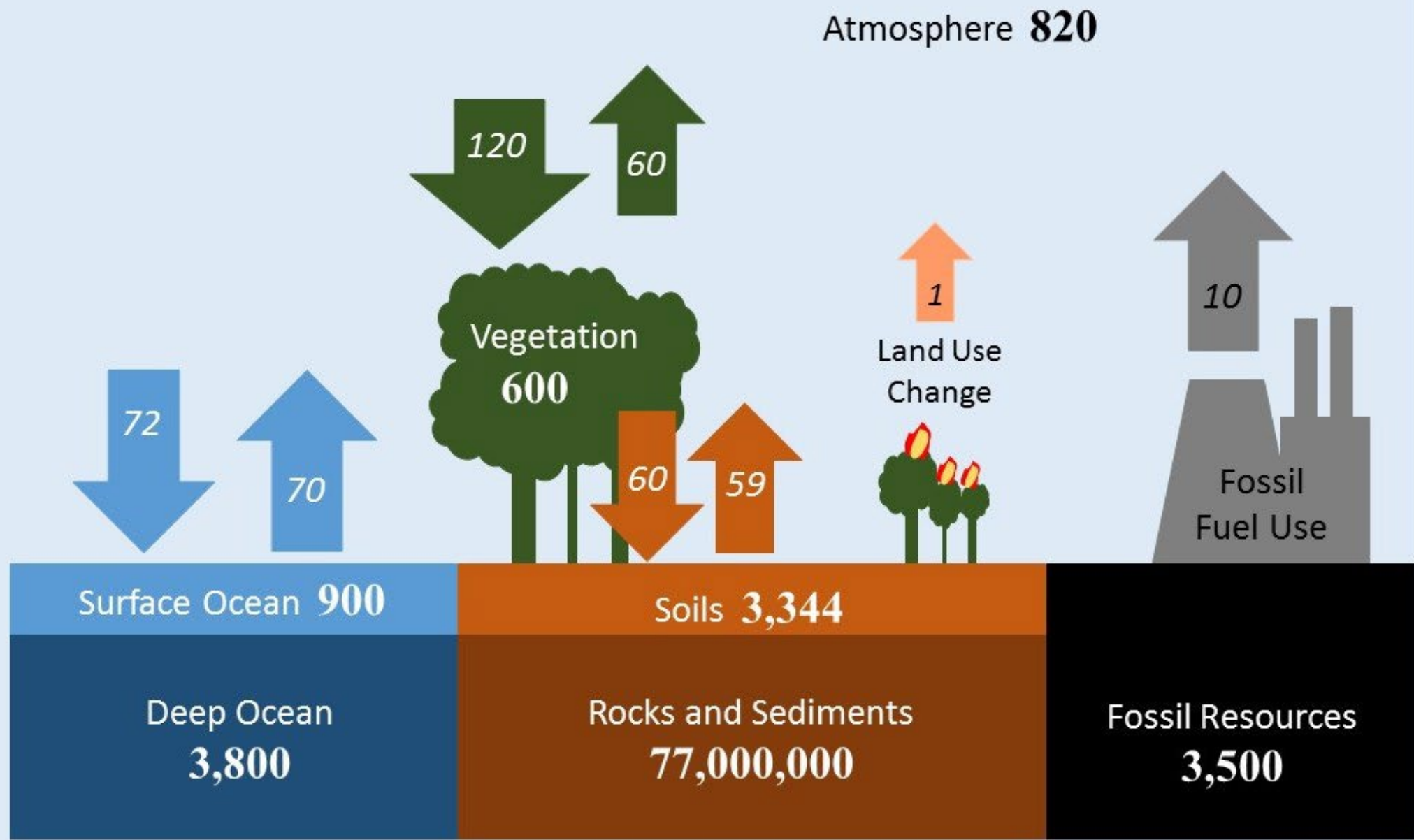
ATMOSPHERE (829 GT)

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

+4.3 ± 0.1

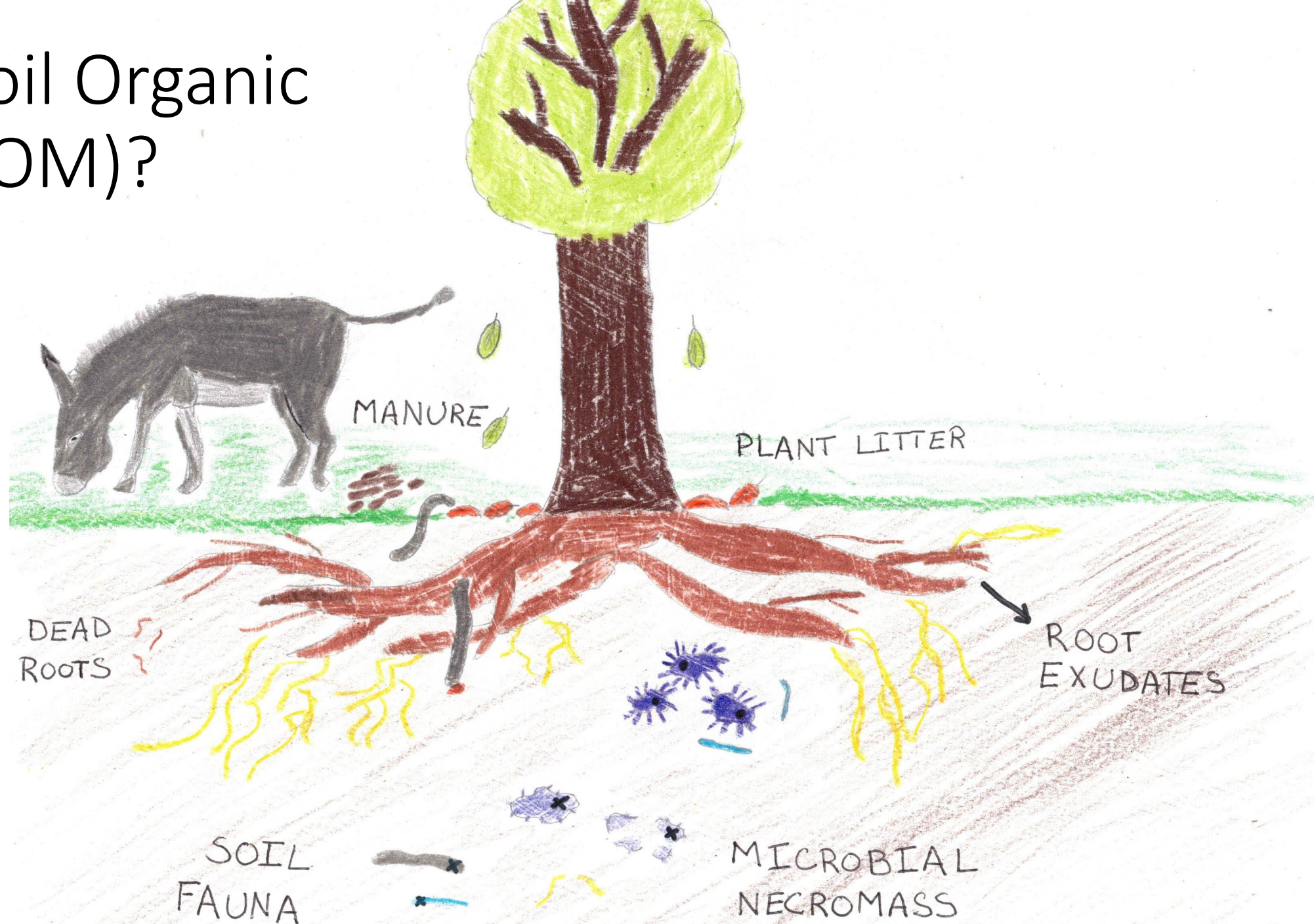


An annual increase of 4 % of the world soil surface C stocks (860*0.004) would nearly compensate the annual CO₂ increase of the atmosphere



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)?



Benefits of SOM

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



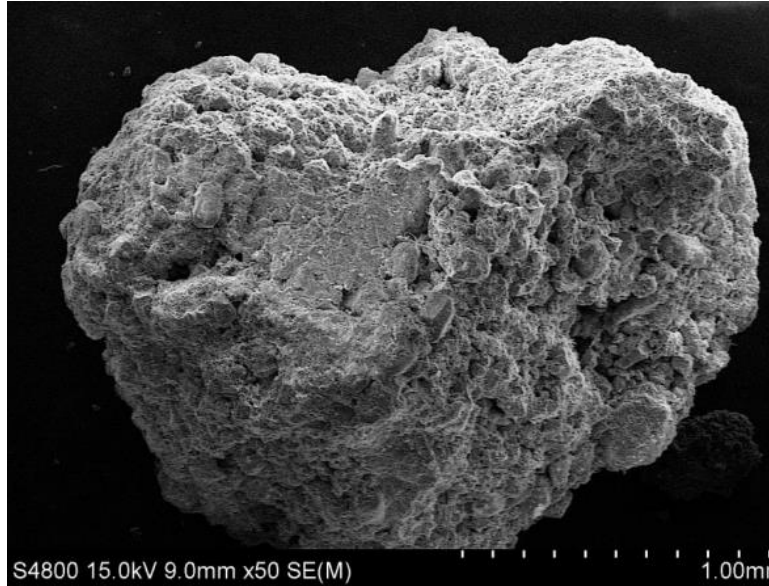
Photo: USDA

What happens to SOM in the soil?



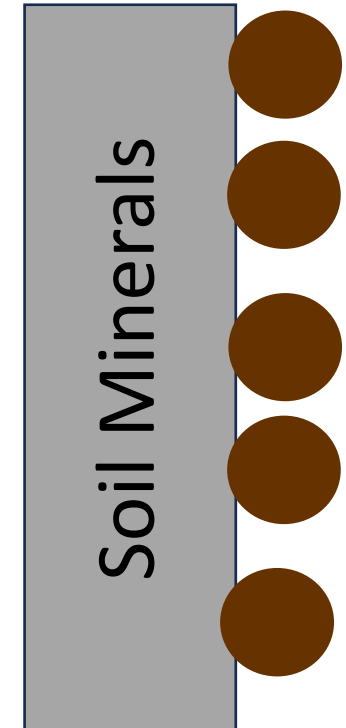
Figure 1. Particulate organic matter from no-till soil. From Cambardella and Elliot, 1992.

Particulate Organic
Matter (POM)



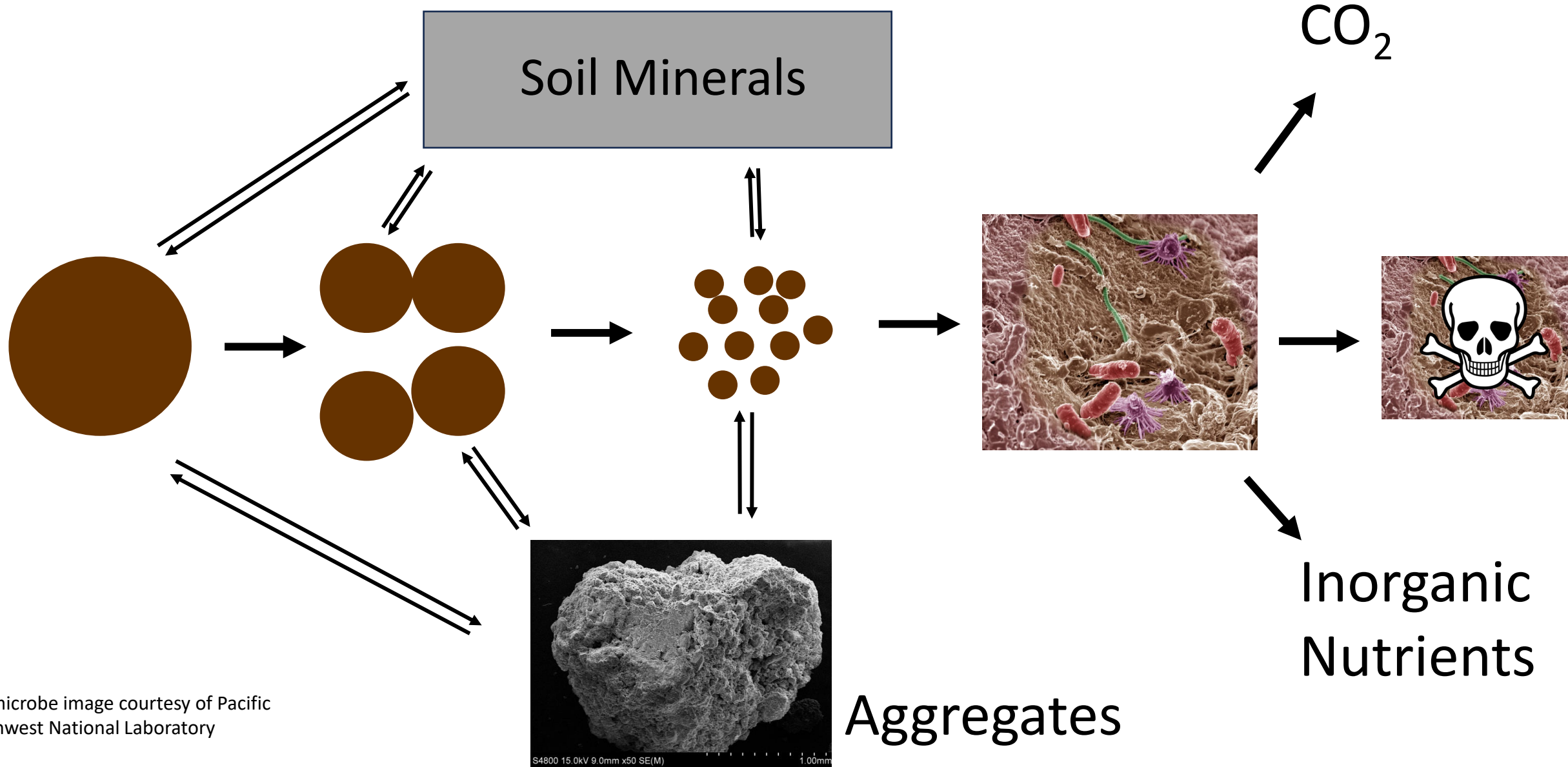
Brevik et al., 2015; <https://doi.org/10.5194/soil-1-117-2015>

Soil Aggregates



Mineral-Associated
Organic Matter
(MAOM)

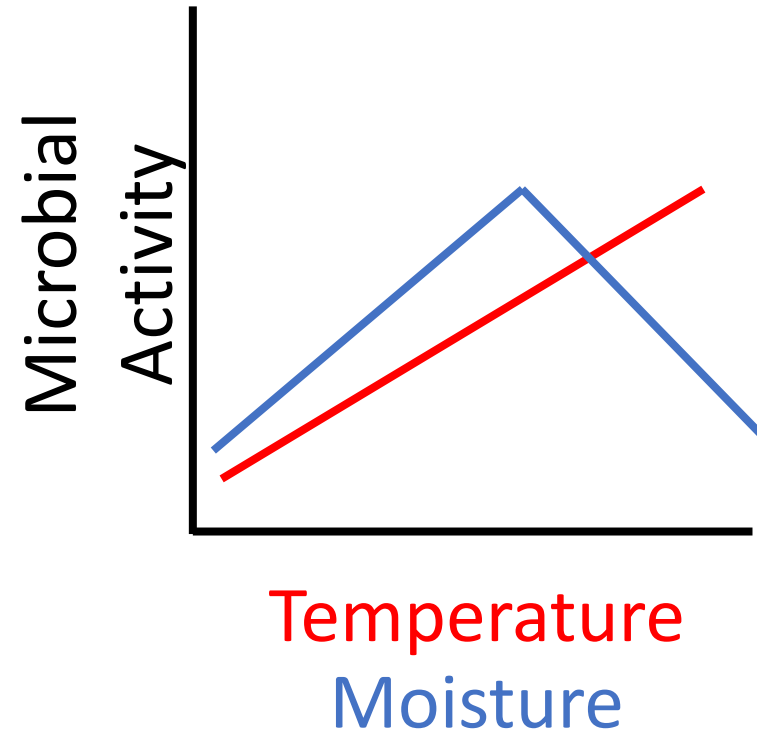
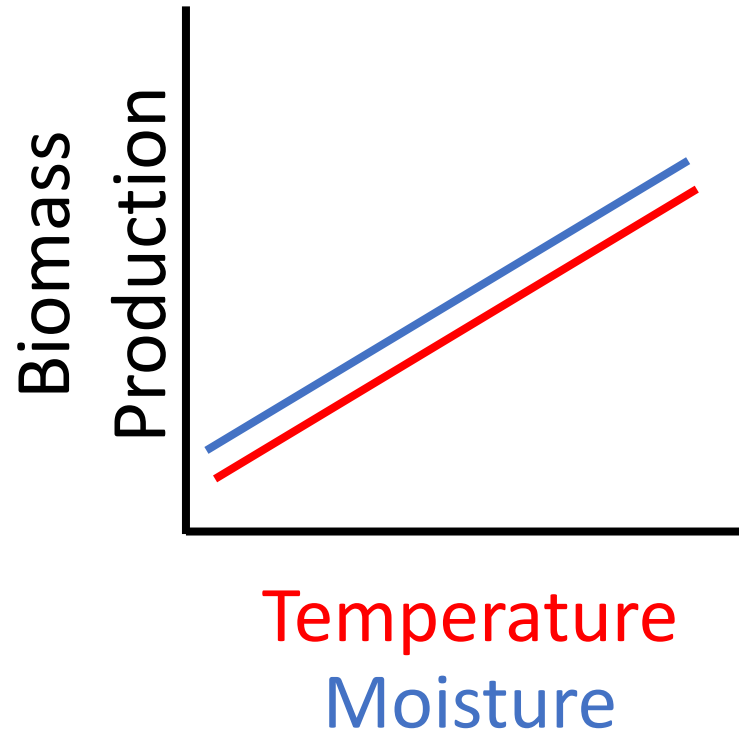
What happens to SOM in the soil?



What affects soil carbon sequestration?

- Environment
- Agriculture
- *In-situ* factors

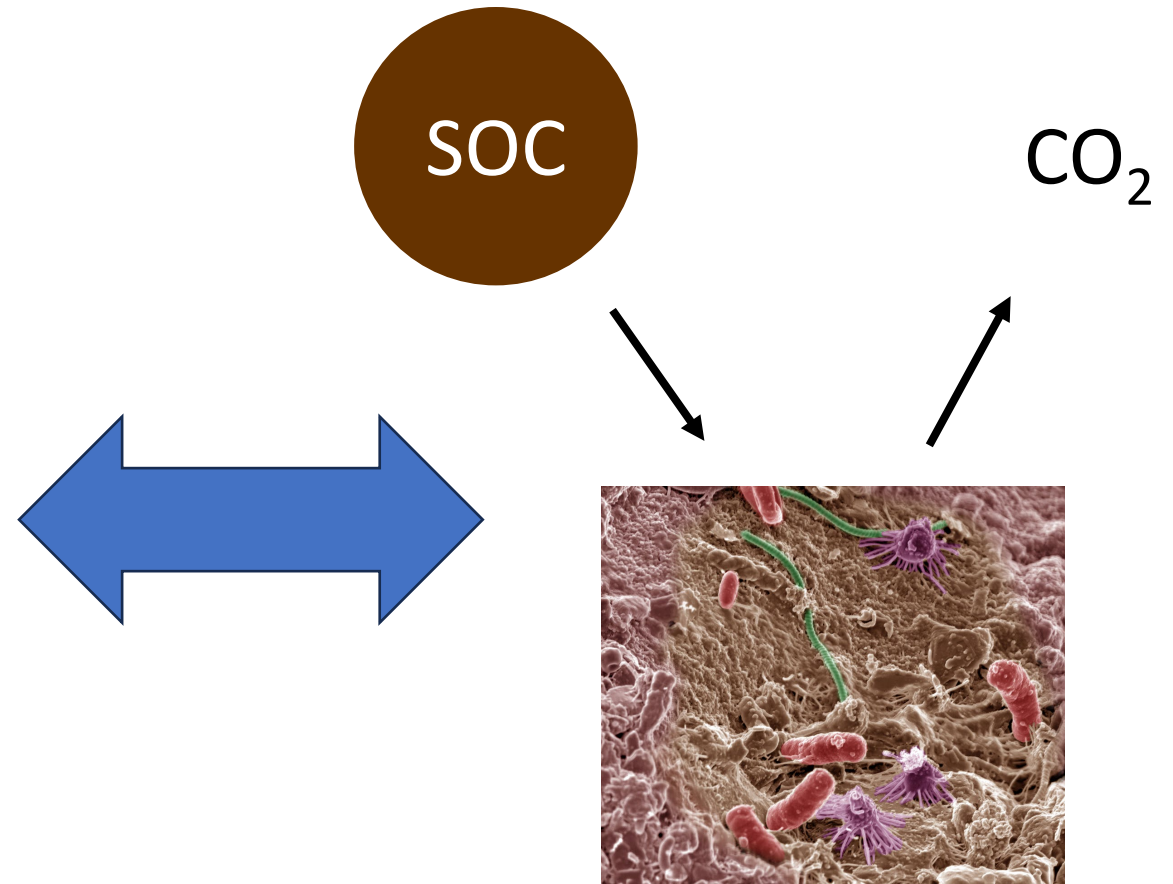
Environment



Environment

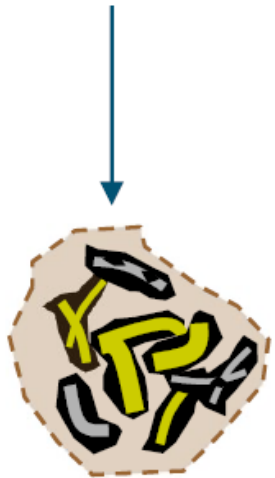
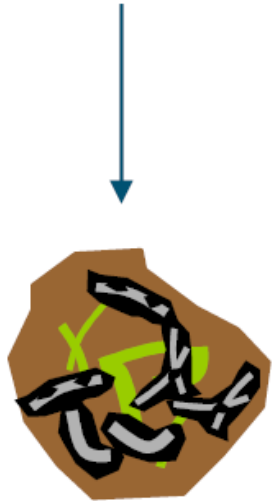


Photo: Arild Vågen



Agriculture

Tillage



 = fresh residue

 = macro-aggregate

 = decomposing residue

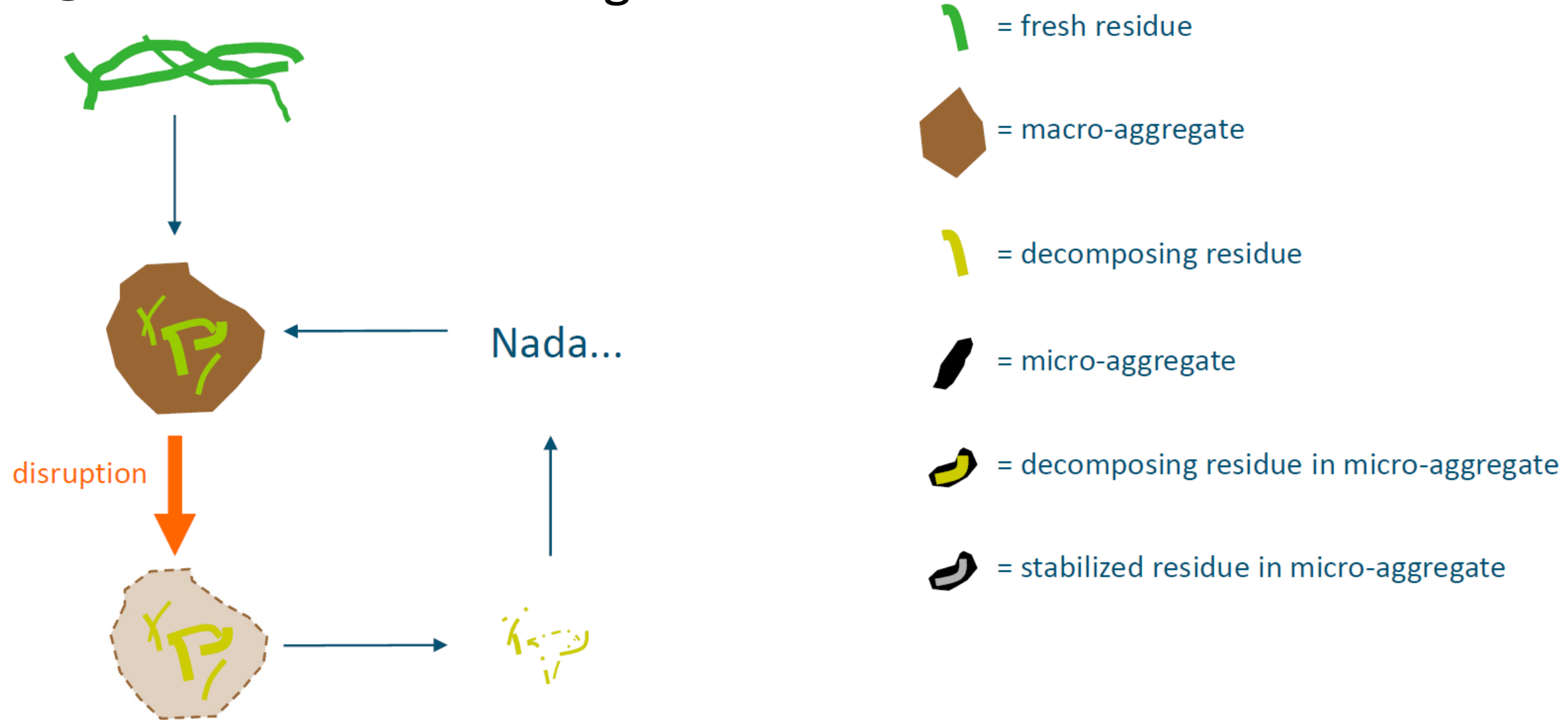
 = micro-aggregate

 = decomposing residue in micro-aggregate

 = stabilized residue in micro-aggregate

Agriculture

Tillage



Agriculture

Crops



Photo: The Land Institute

Fertilizer and Water Management



Photo: Mark Cain

In-situ factors

Surface Area

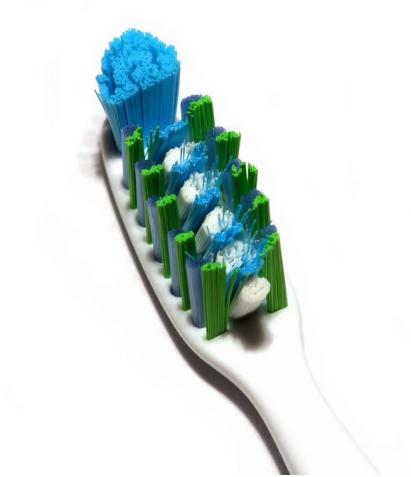


Photo: Dave Lanovaz



Soil Biota

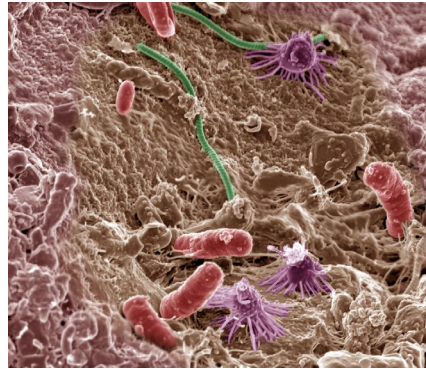


Photo: Cristina Menta

Soil Nutrients



So, what's the dilemma?



Courtesy of Pacific Northwest
National Laboratory



Photo: Mark Cain

CO_2

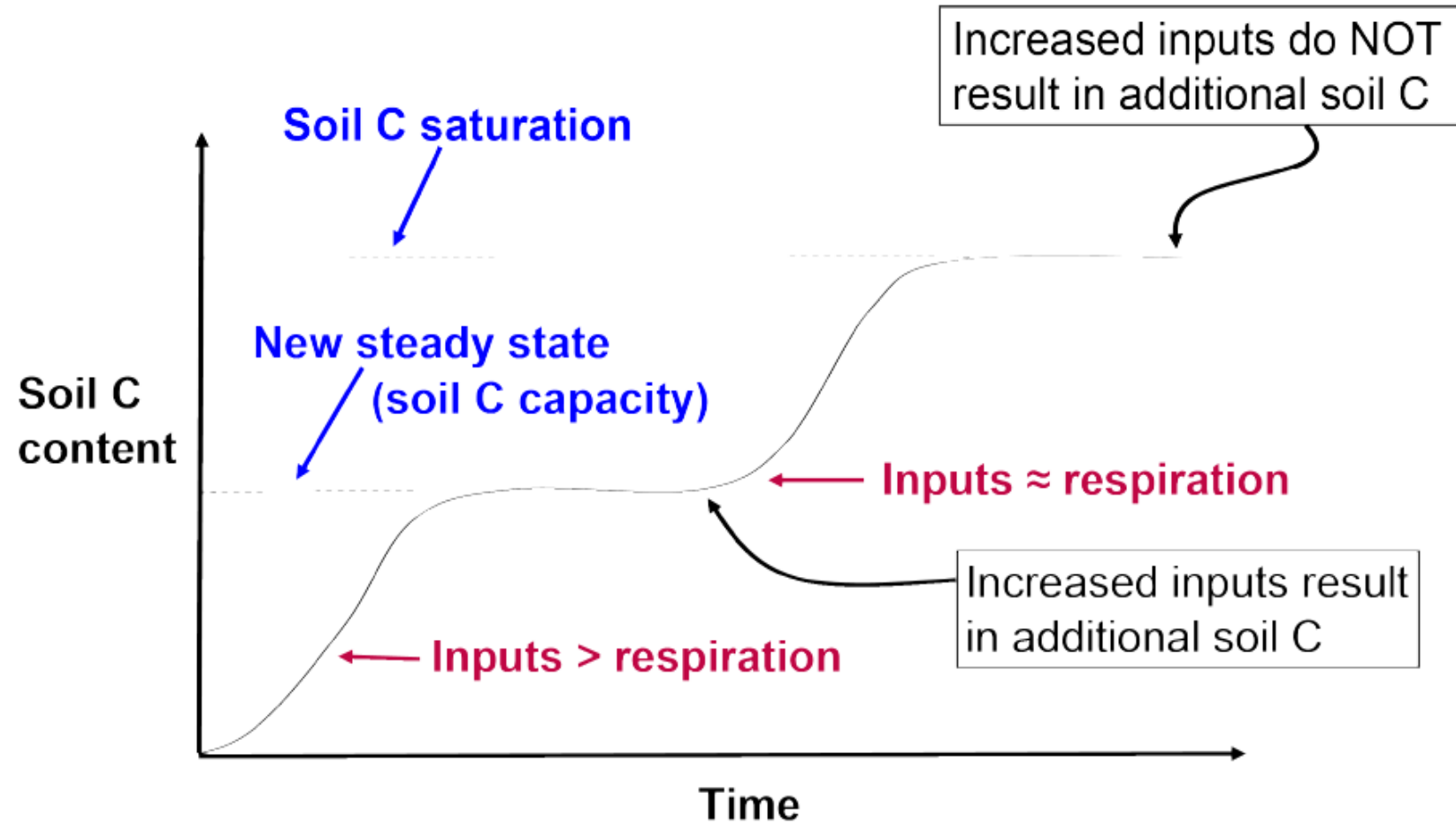


Inorganic
Nutrients



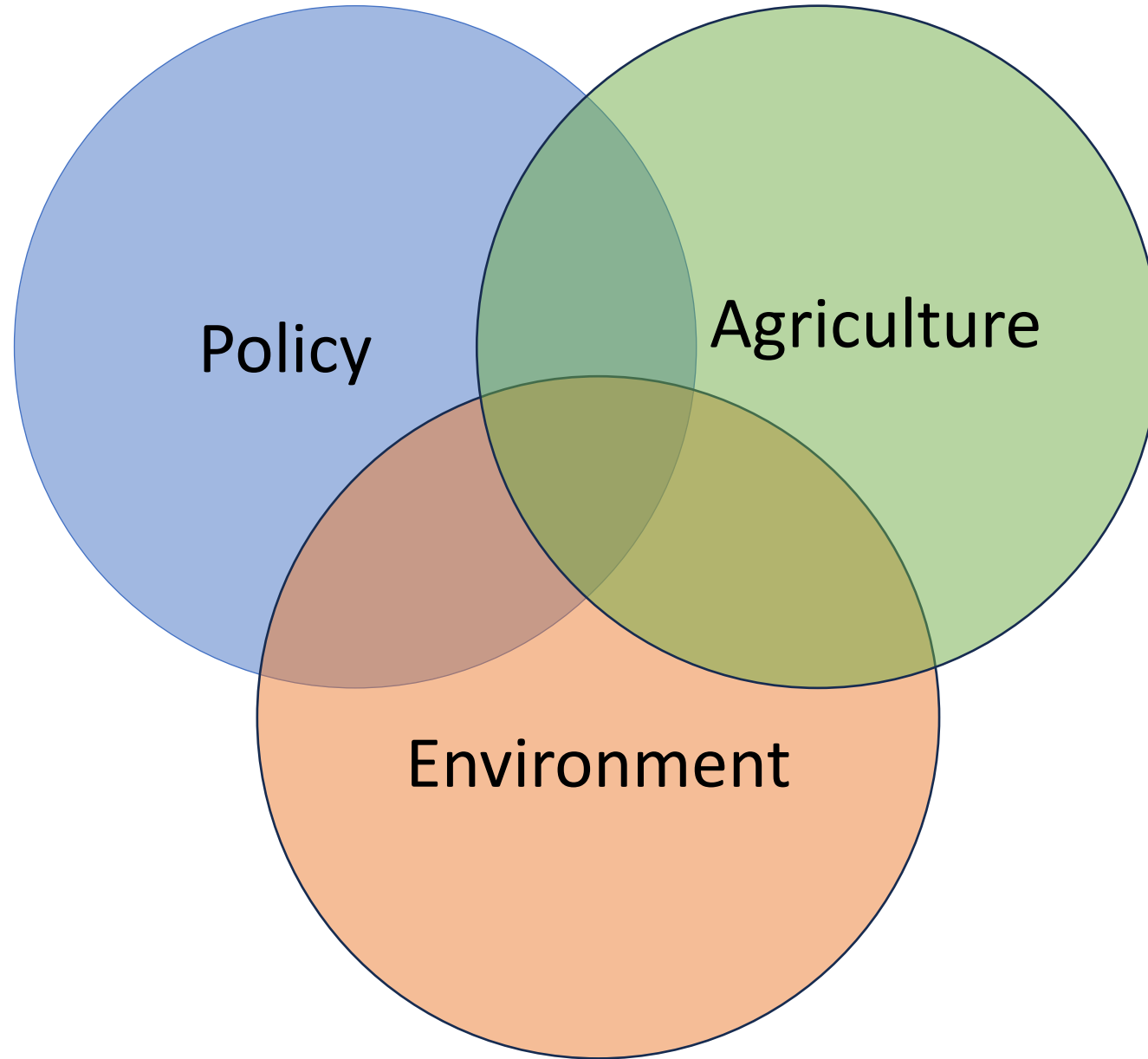
Topics of debate

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



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

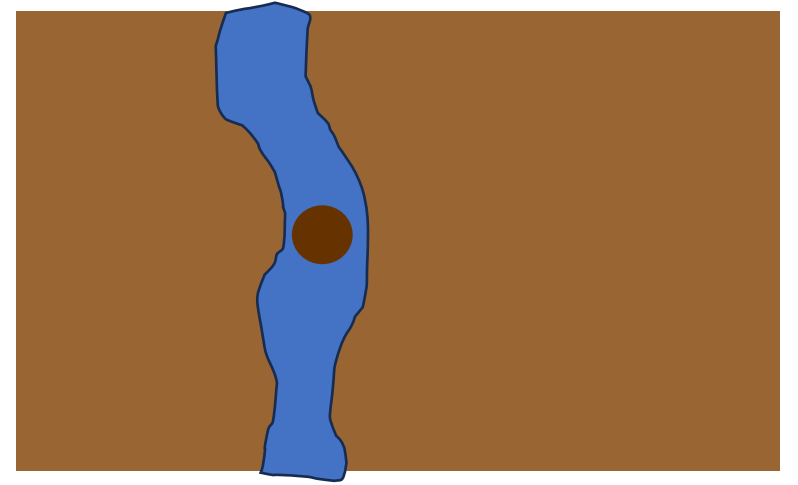
Can we sequester enough carbon?



Questions?

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Dissolved Organic
Matter (DOM)

Carbon Cycle

