Soil-Carbon Sequestration Science & Solutions

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SOIL AND CROP SCIENCES
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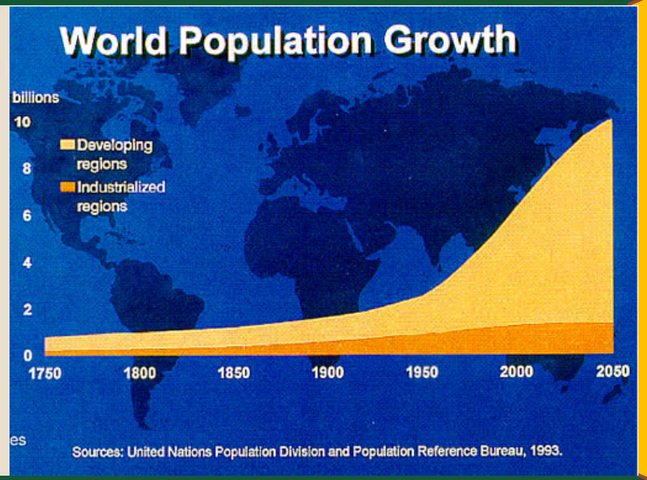
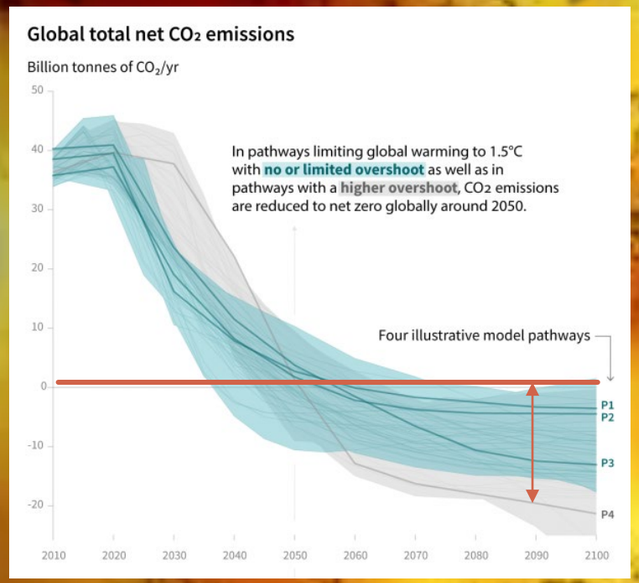
Our wicked challenges



Energy

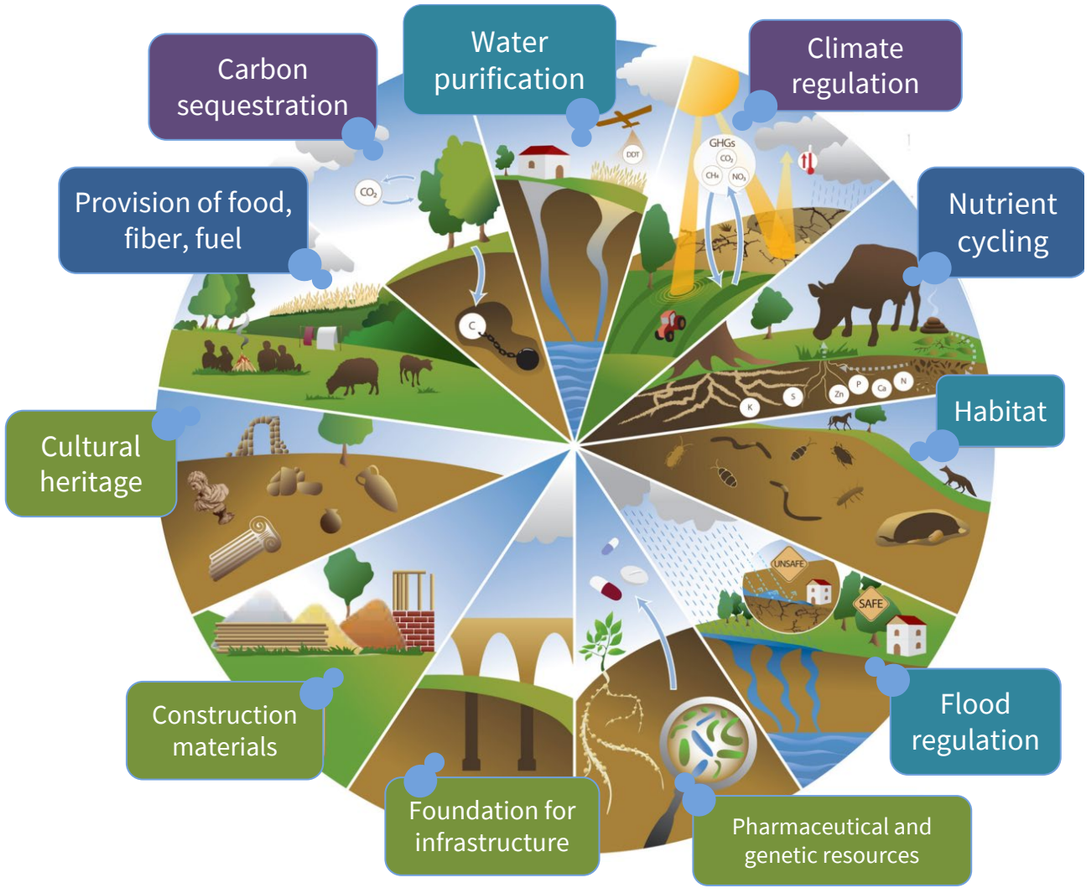
Water

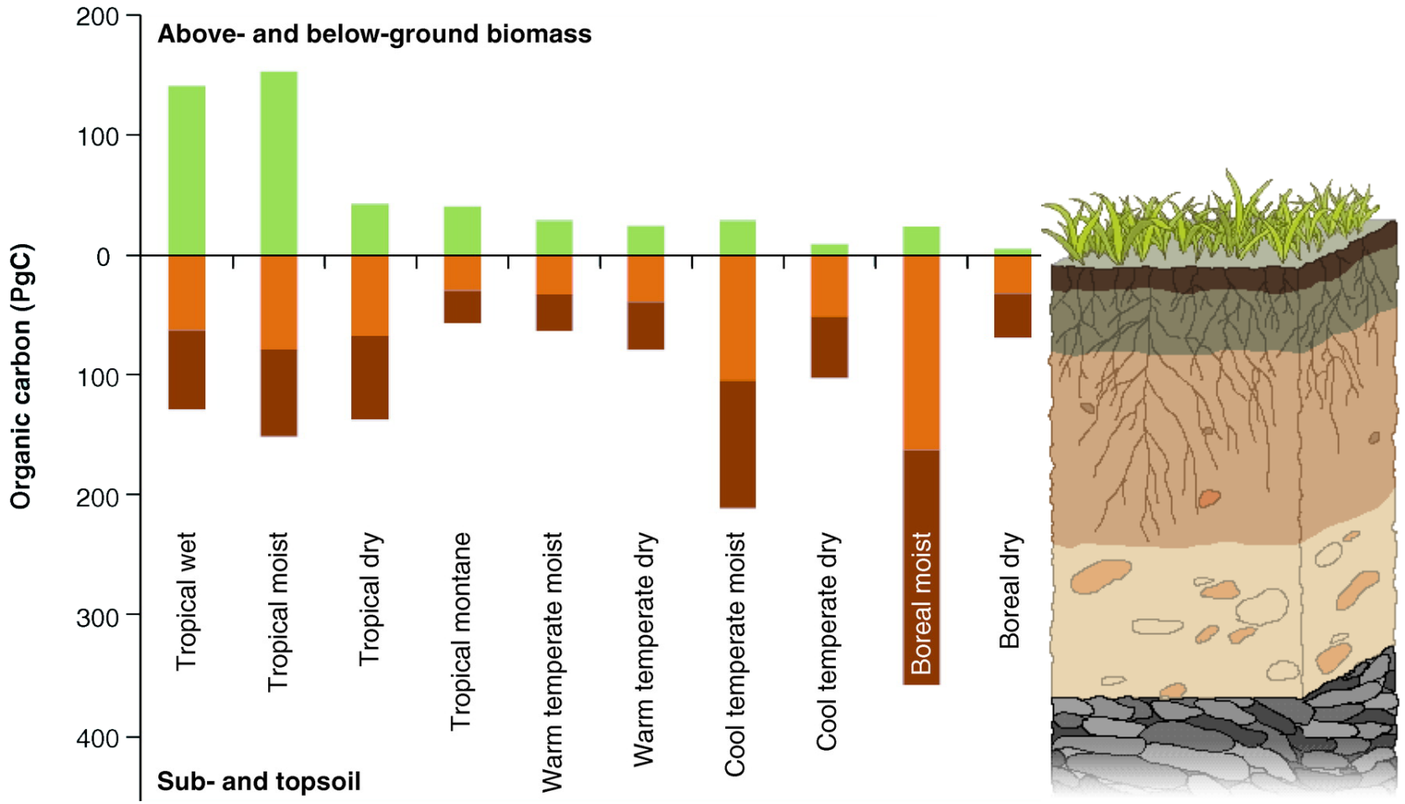


Land

Food

Soil is at the nexus of our challenges underpinning many ecosystem services and storing more C than vegetation and atmosphere combined





Scharlemann et al., 2013

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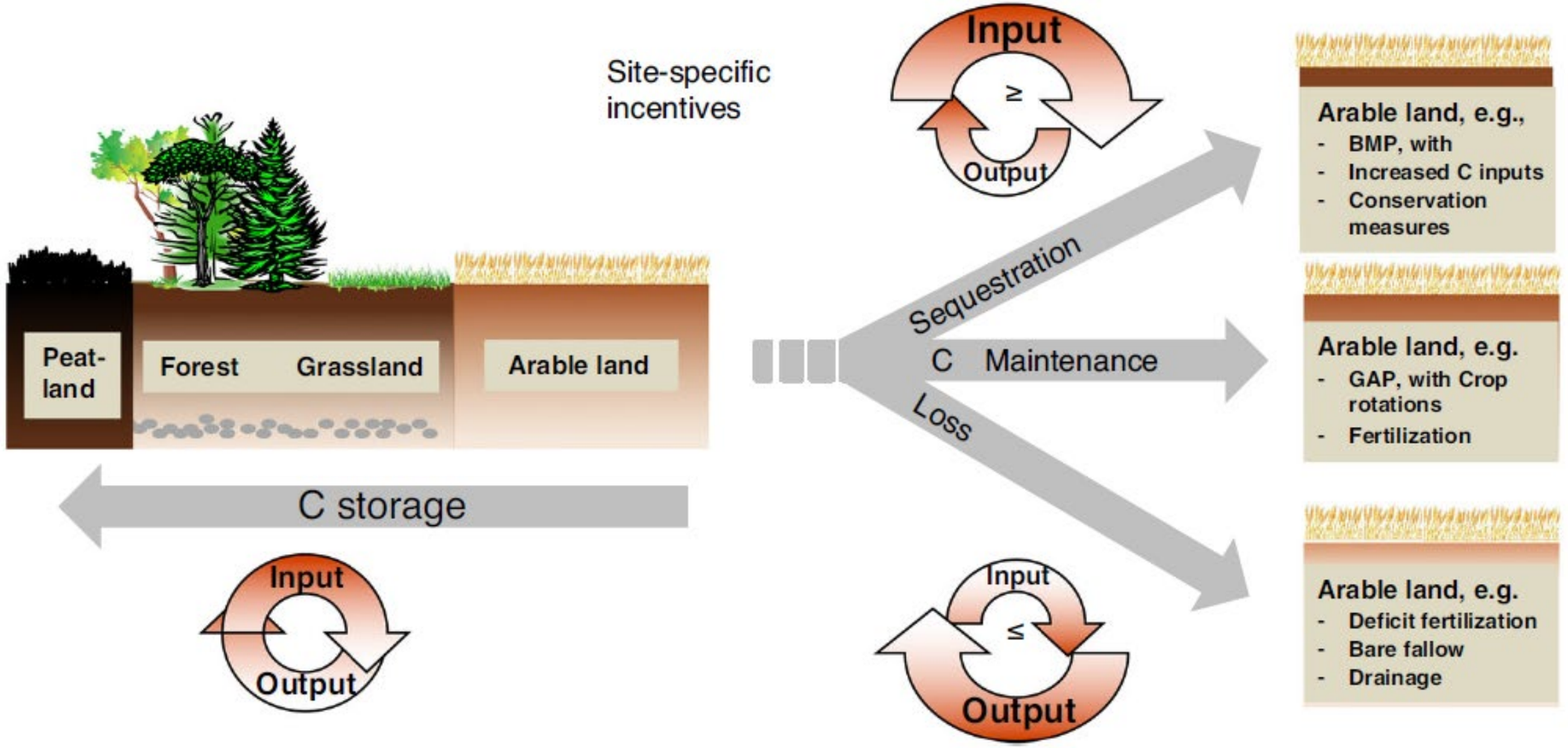
Management choices



Amelung et al., 2020

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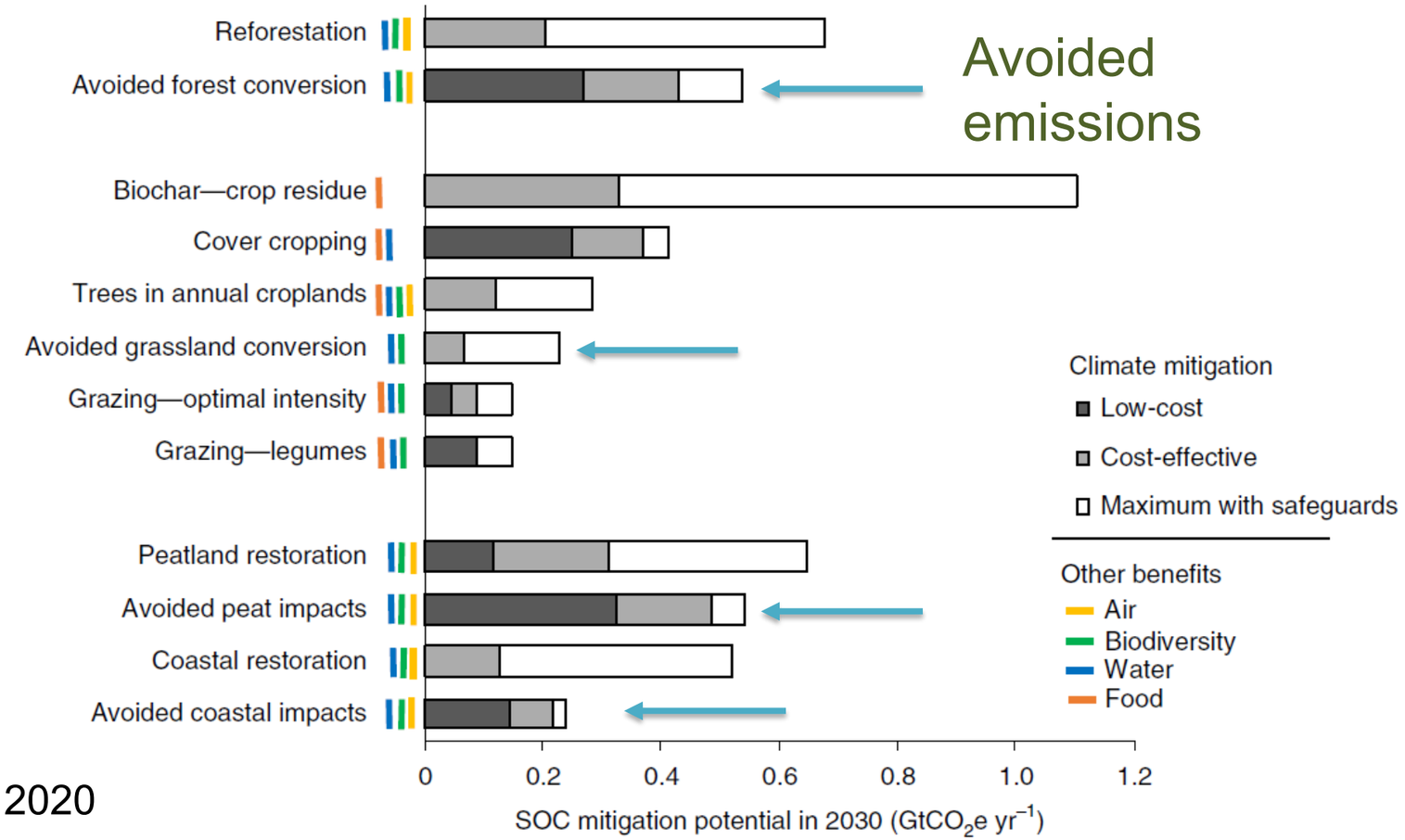
Soil carbon sequestration potentials: A win-win strategy

Forests

Agricultural lands and grasslands

Wetlands



Bossio et al., 2020

Pros

- Relatively low cost
- Known technology
- Many co-benefits
- No need for new land (in agriculture)

Cons

- Hard to quantify
- Uncertain longevity

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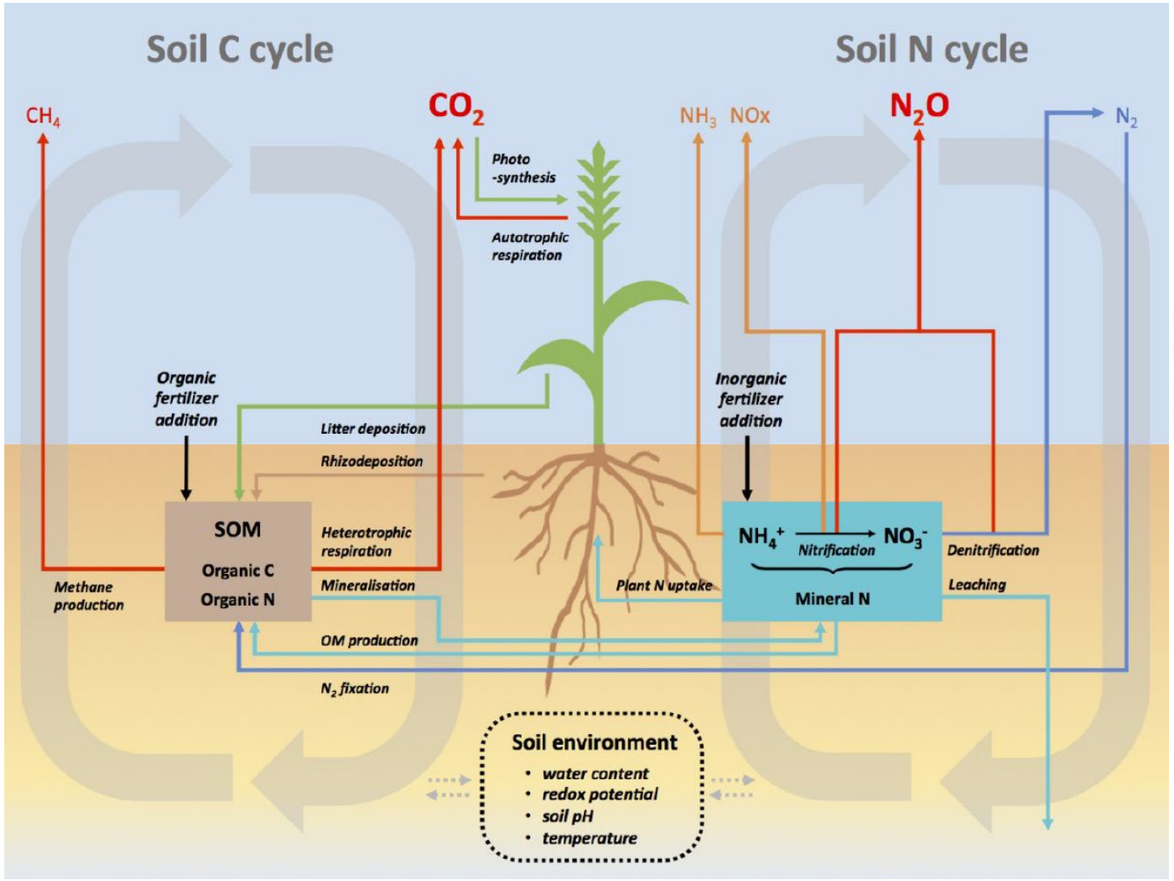
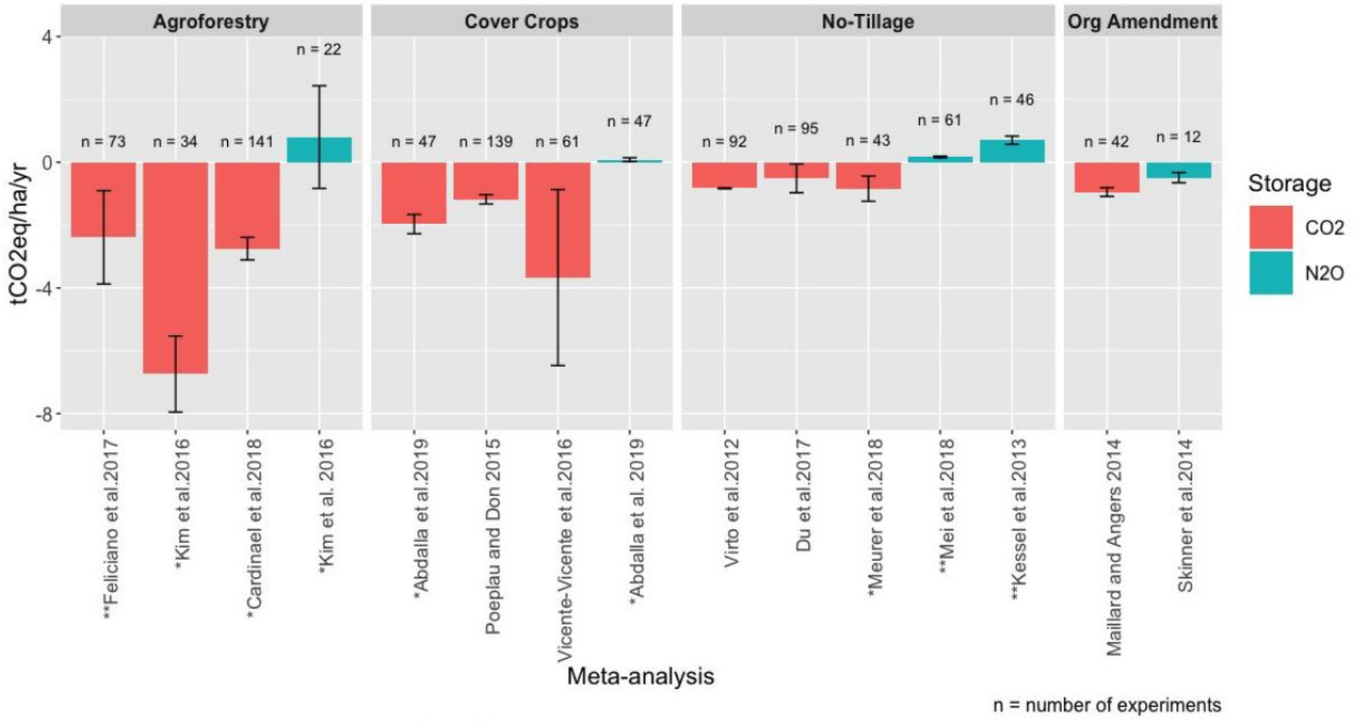
Carbon removal practices may result in N_2O emissions





Bertrand et al., Global Change Biology, 2020

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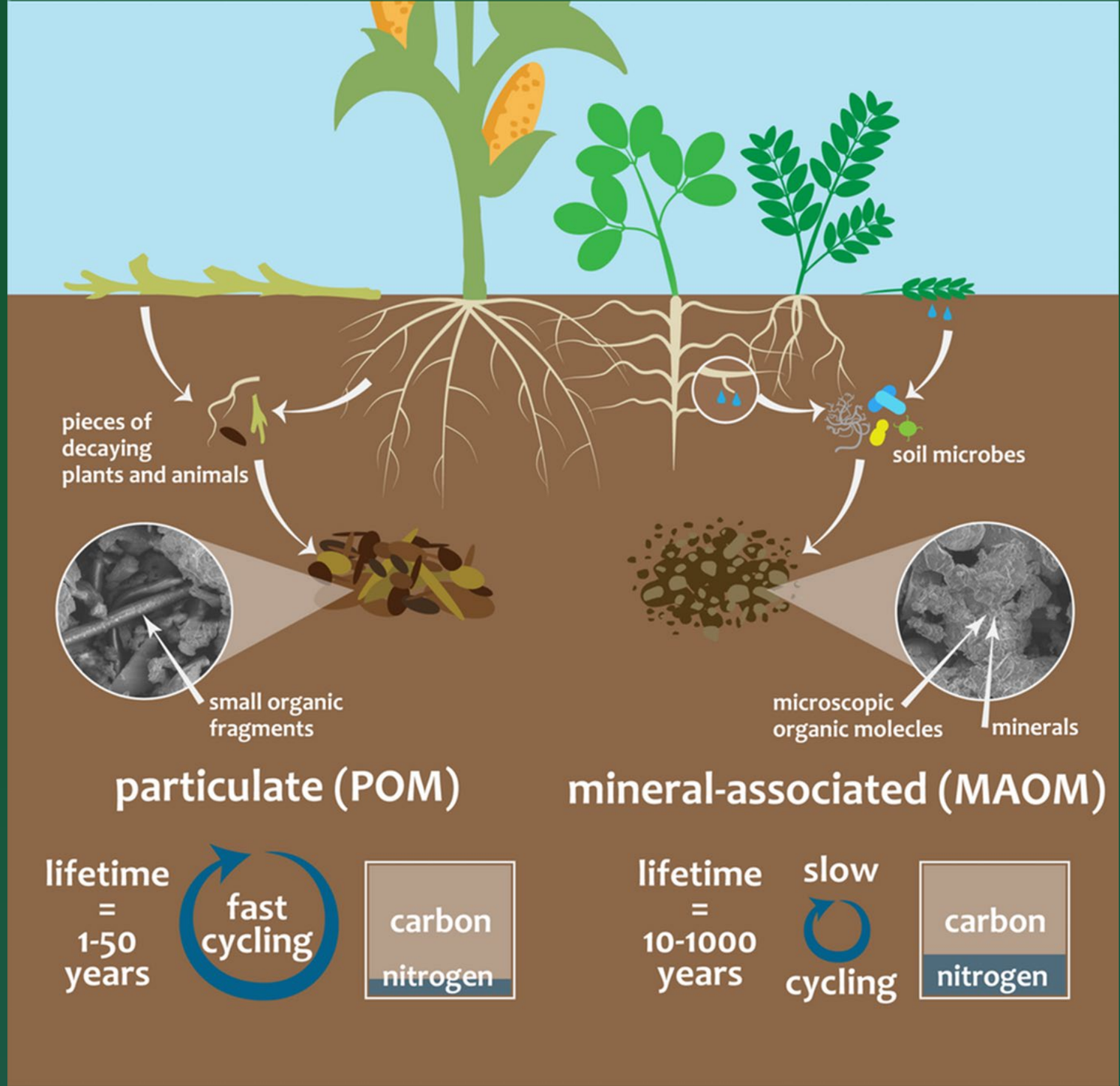
Not all soil carbon is made equal

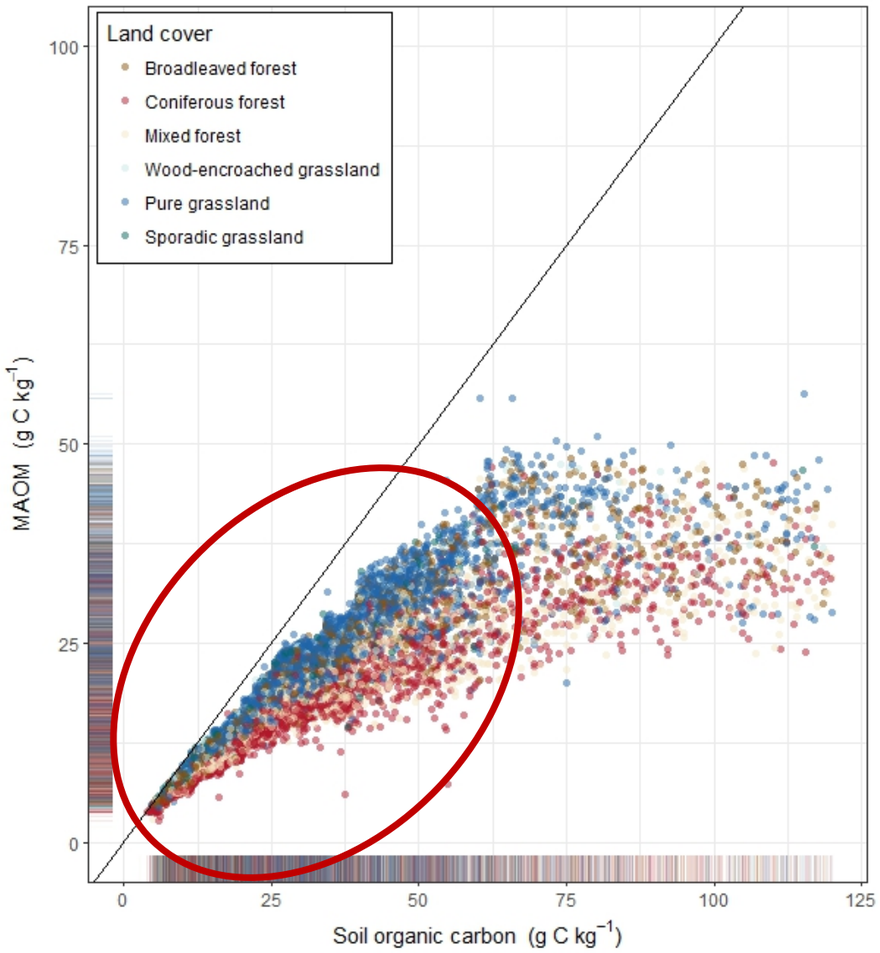
Separating carbon in POM from MAOM is important to assess:

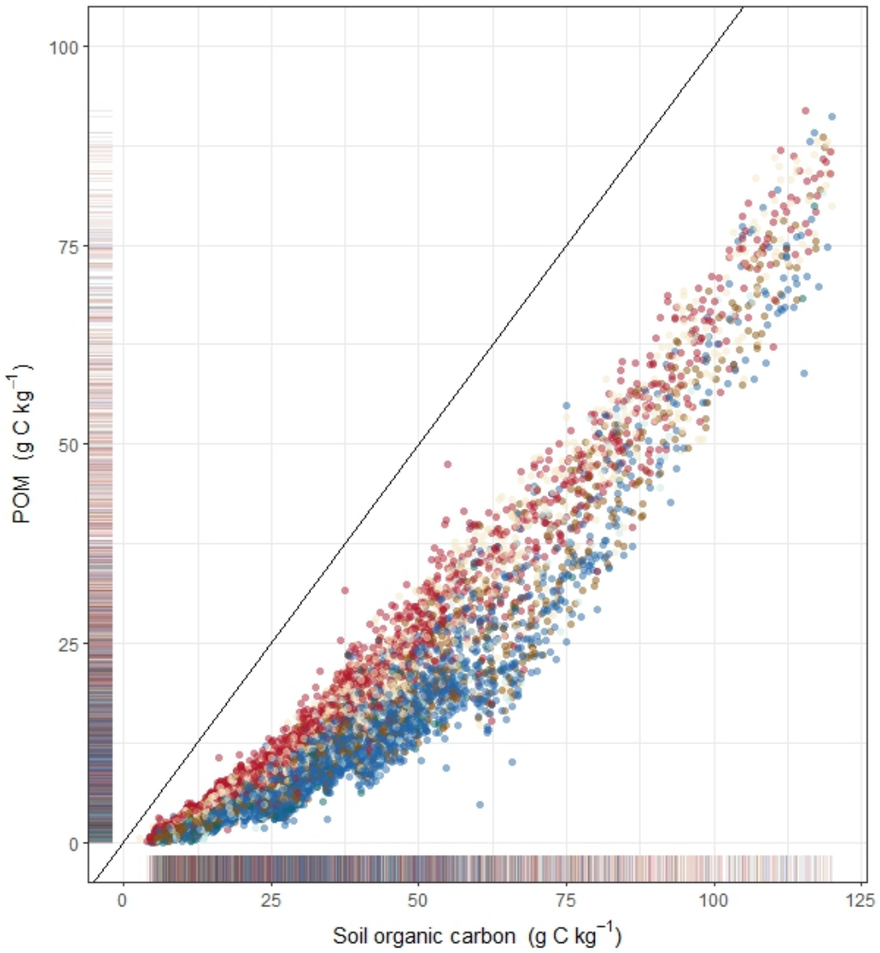
- ✓ Vulnerability to disturbance
- ✓ Potentials for C sequestration
- ✓ Management strategies to accrue more and persistent carbon

Lavallee, Soong & Cotrufo, 2020, *GCB*
Lavallee & Cotrufo, 2020, *The Conversation*
Cotrufo et al, 2019, *Nature geosciences*



Soils do not have the same potential to sequester C





MAOM saturates while POM does not

Most soils are below saturation, in particular in deeper horizons.
Does saturation is not a significant constrains to C accrual

Cotrufo et al., Nature Geoscience, 2019

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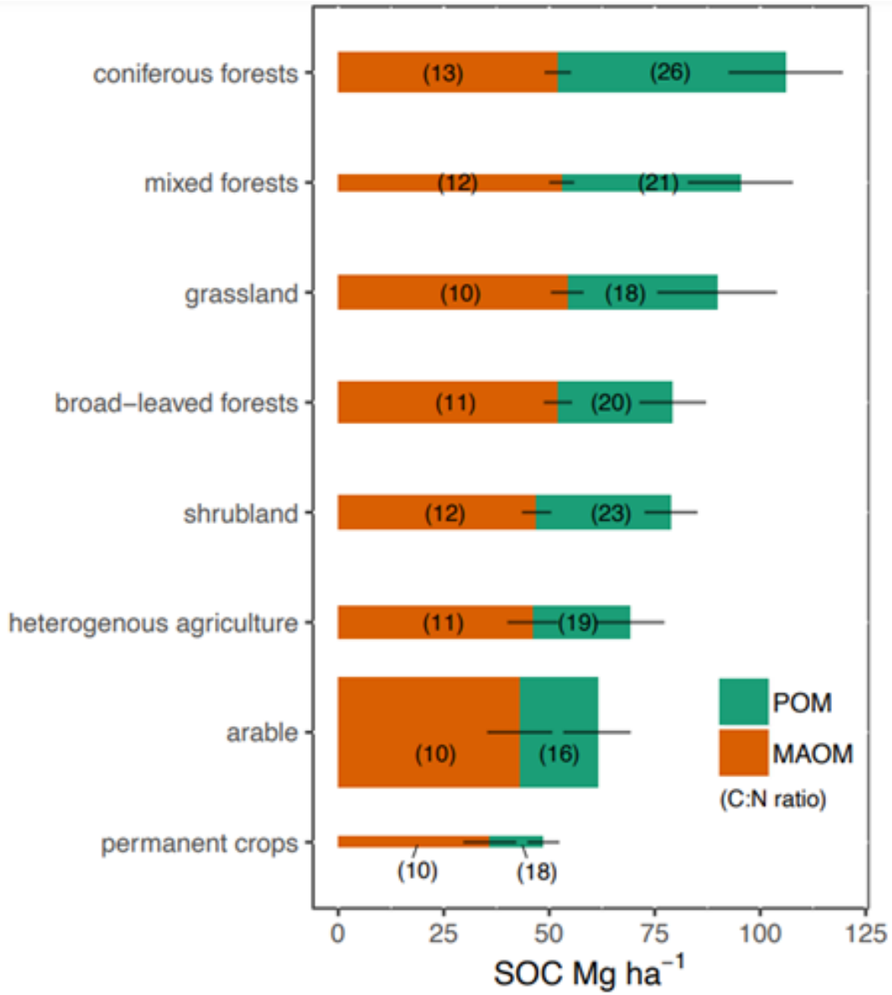
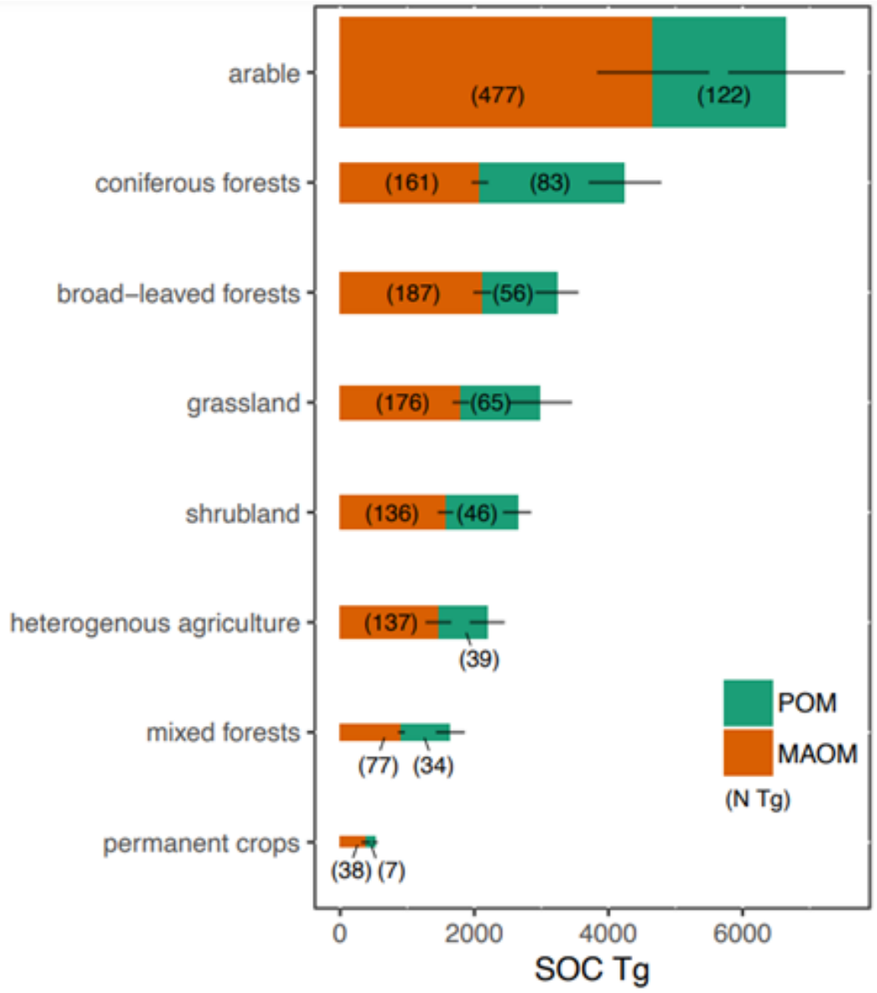
Soil Carbon Stocks distribution in Europe





Lugato et al., Nature Geoscience , in review

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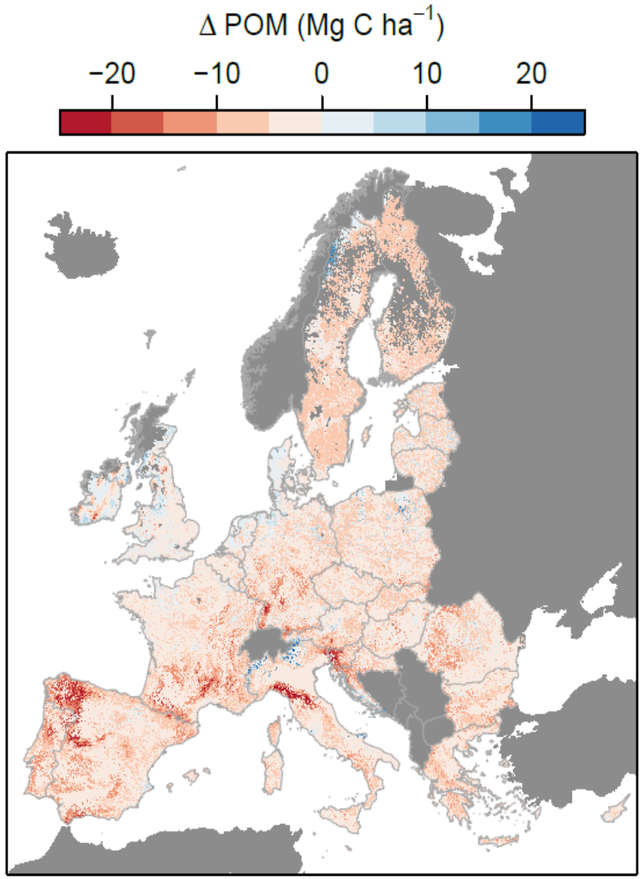
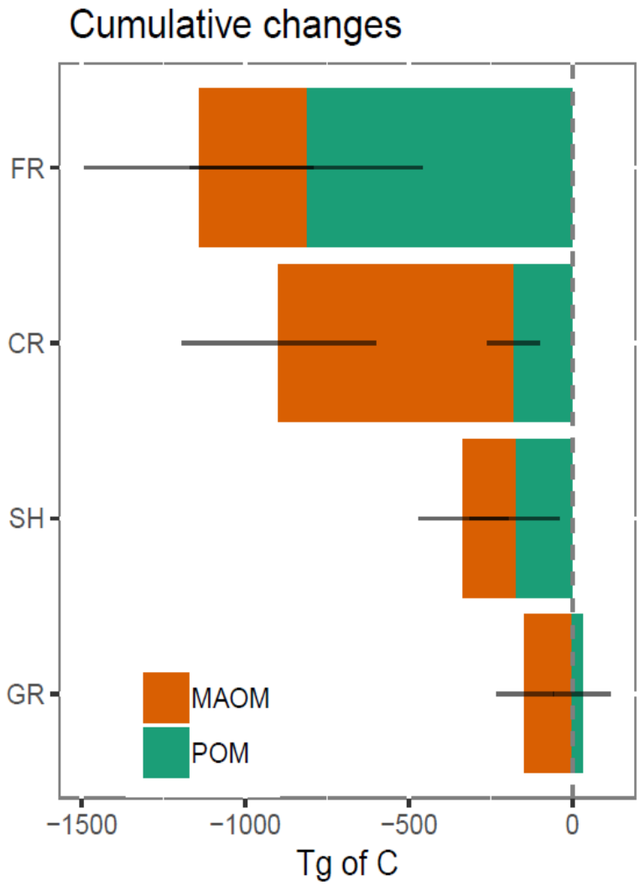
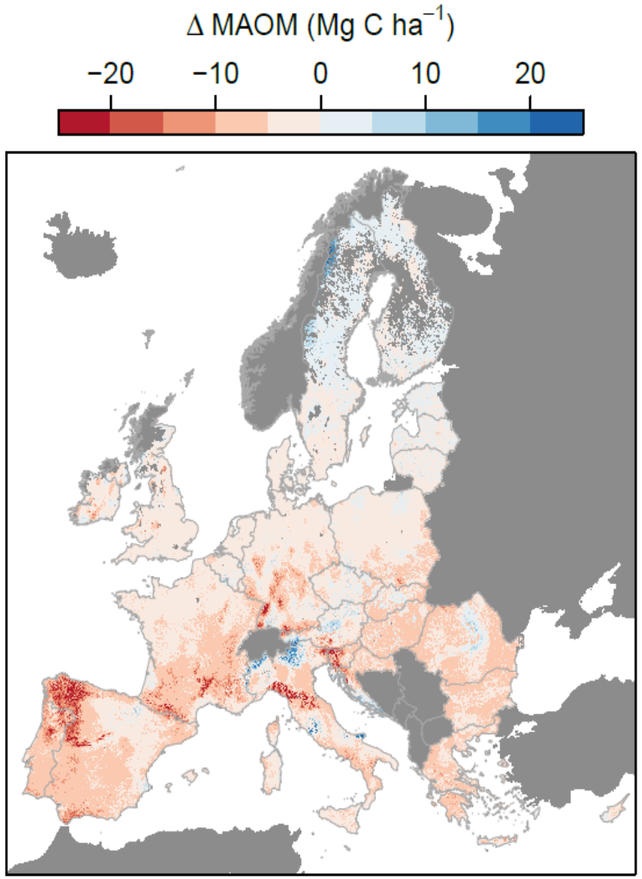
Soil Carbon vulnerability to Climate Change







Lugato et al., Nature Geoscience , in press

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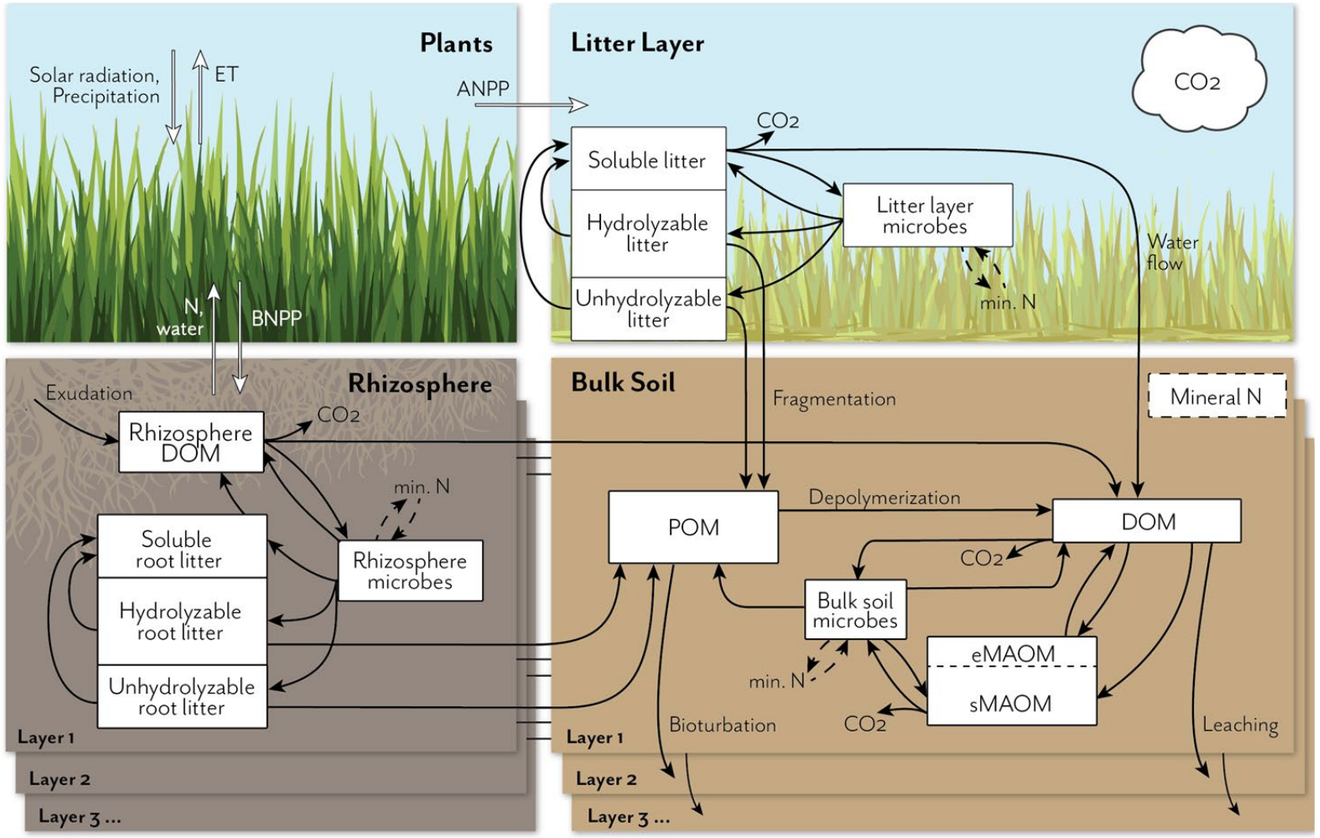
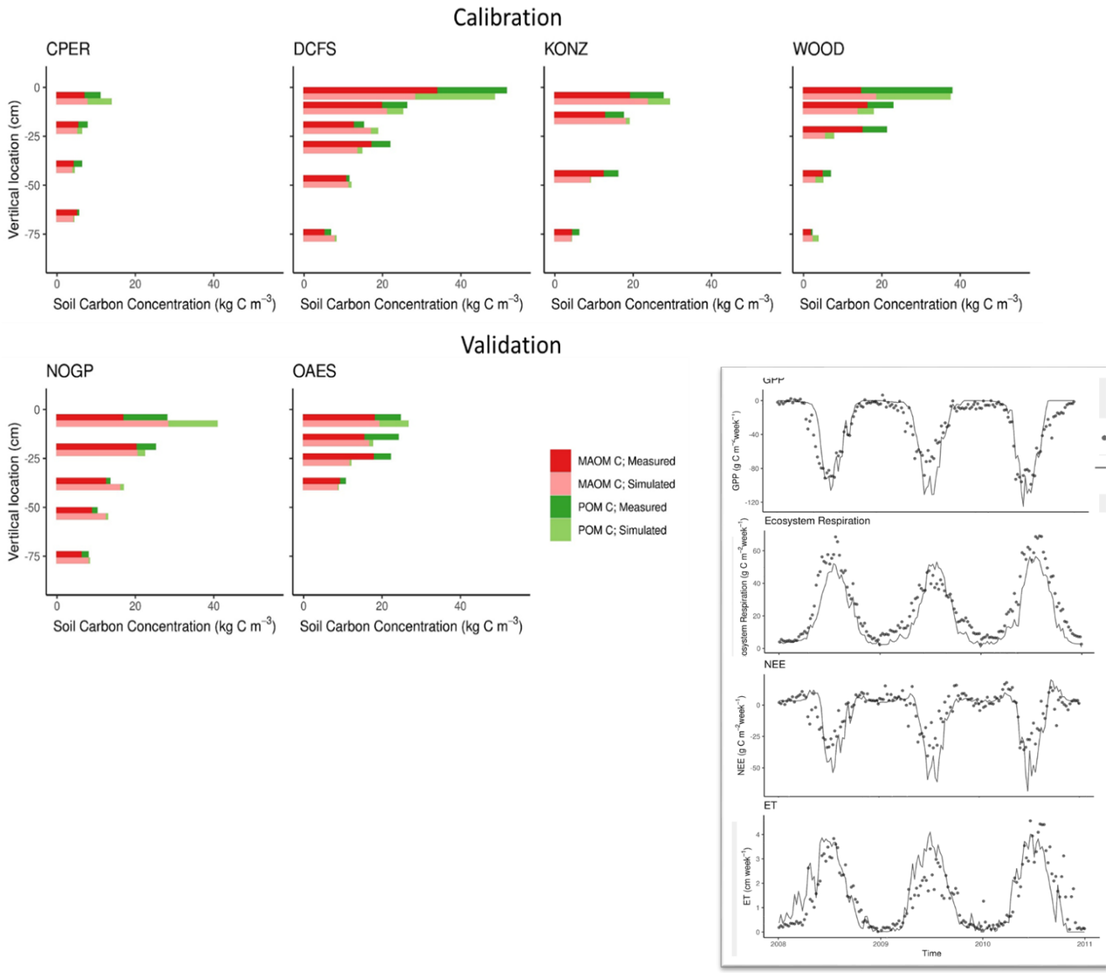
New generation models are required that enable accurate calibration and verification with measured and sensed data: **THE MEMS 2.0**



Zhang et al., *Biogeoscience Discussion*, 2021



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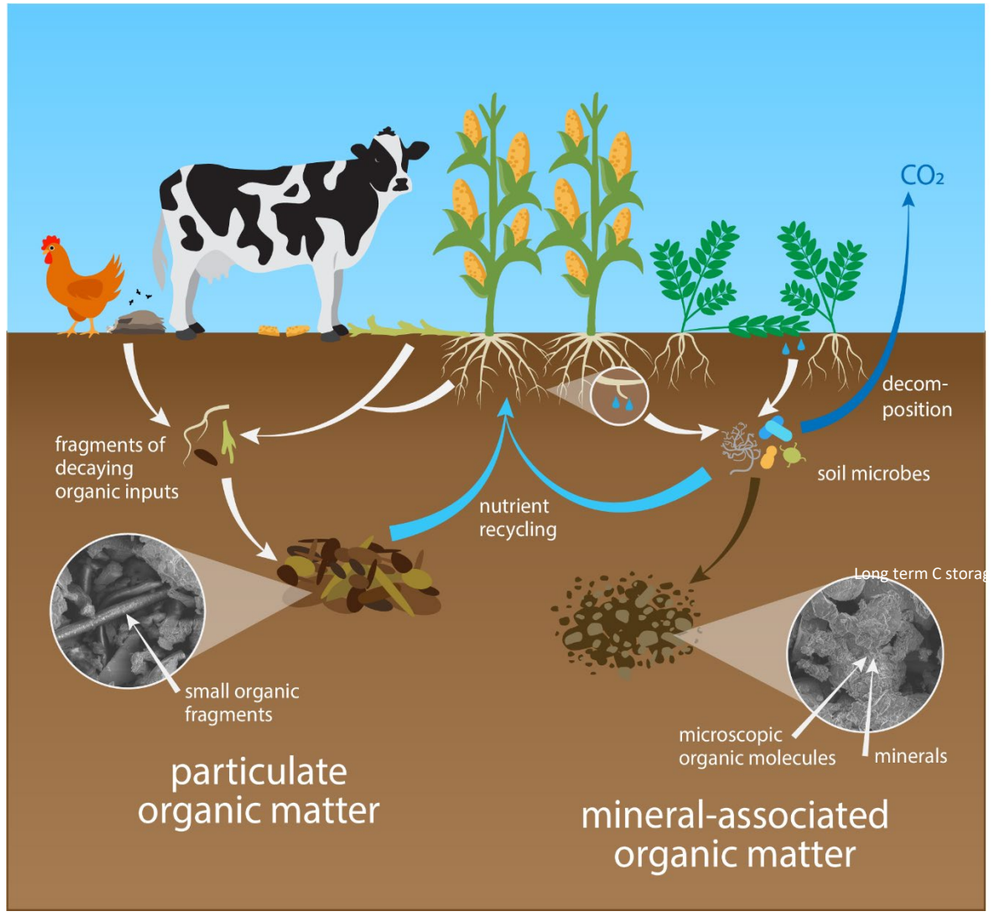
Regenerative agriculture

May have high potentials to sequester C while reducing chemical inputs



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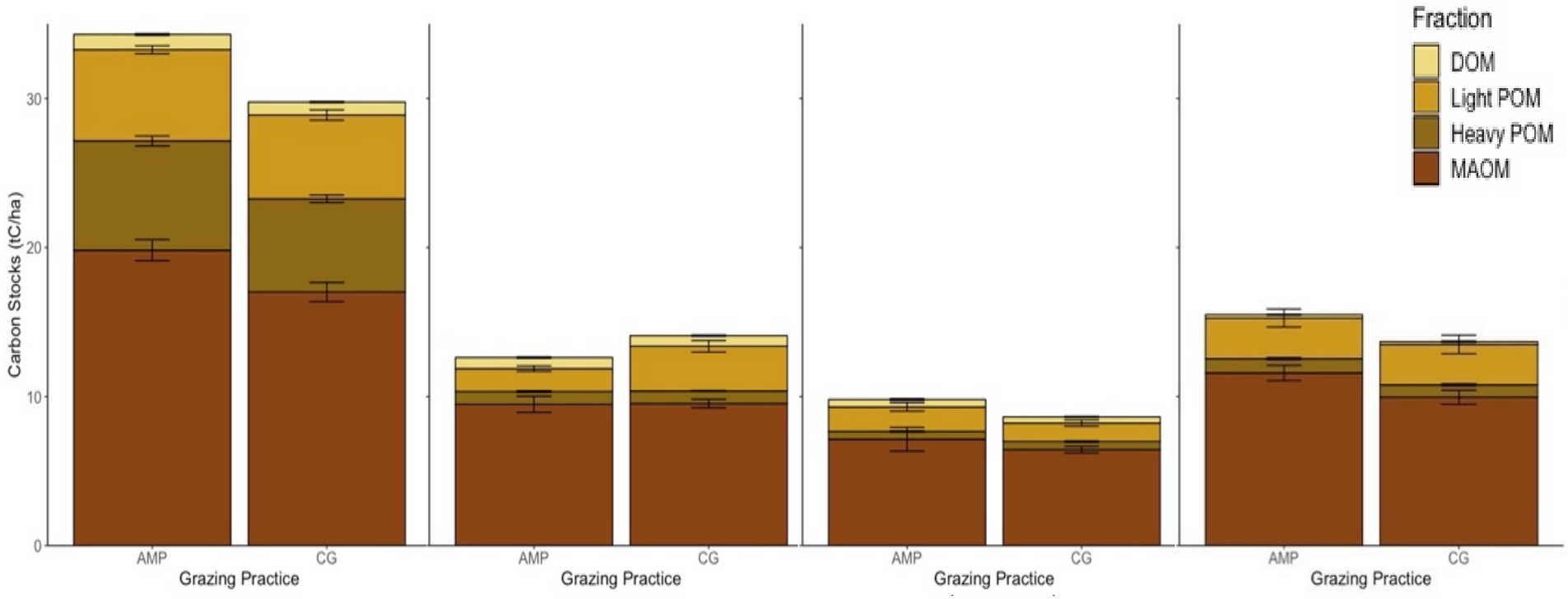
Adaptive Multi Paddock (AMP) Grazing

AMP grazing sites had on average 13% (i.e., 9 Mg C ha^{-1}) more soil C and 9% (i.e., 1 Mg N ha^{-1}) more soil N compared to the CG sites over a 1 meter depth.



Mosier et al., JEM in press

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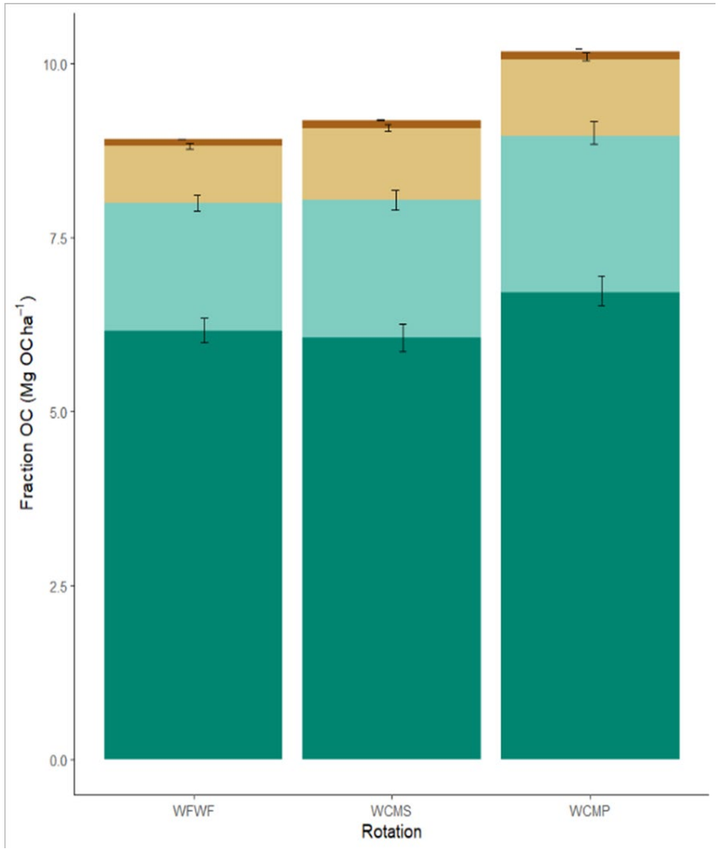
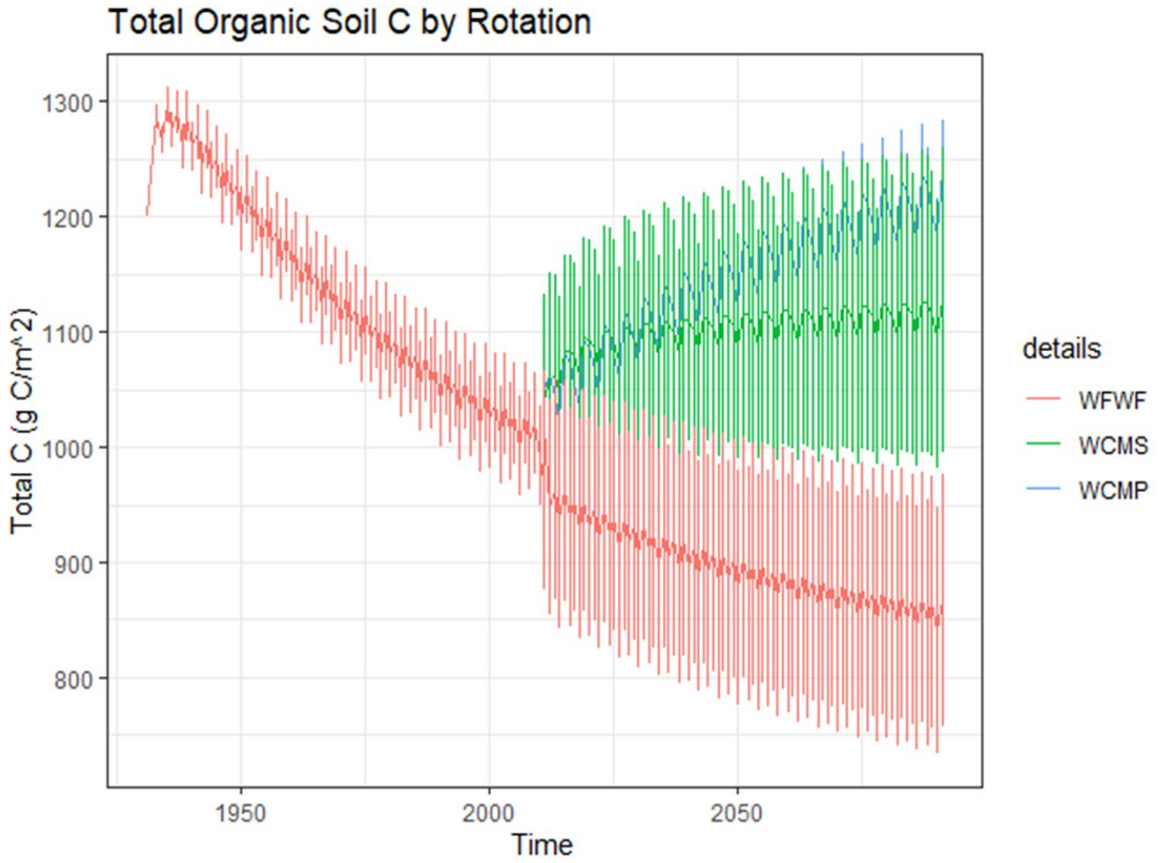
Continues and diversified crop rotations

WFWF=
wheat fallow

WCMS=
continues
grains

WCMP=
continues
grains with
legume





Van der Pol et al., in prep

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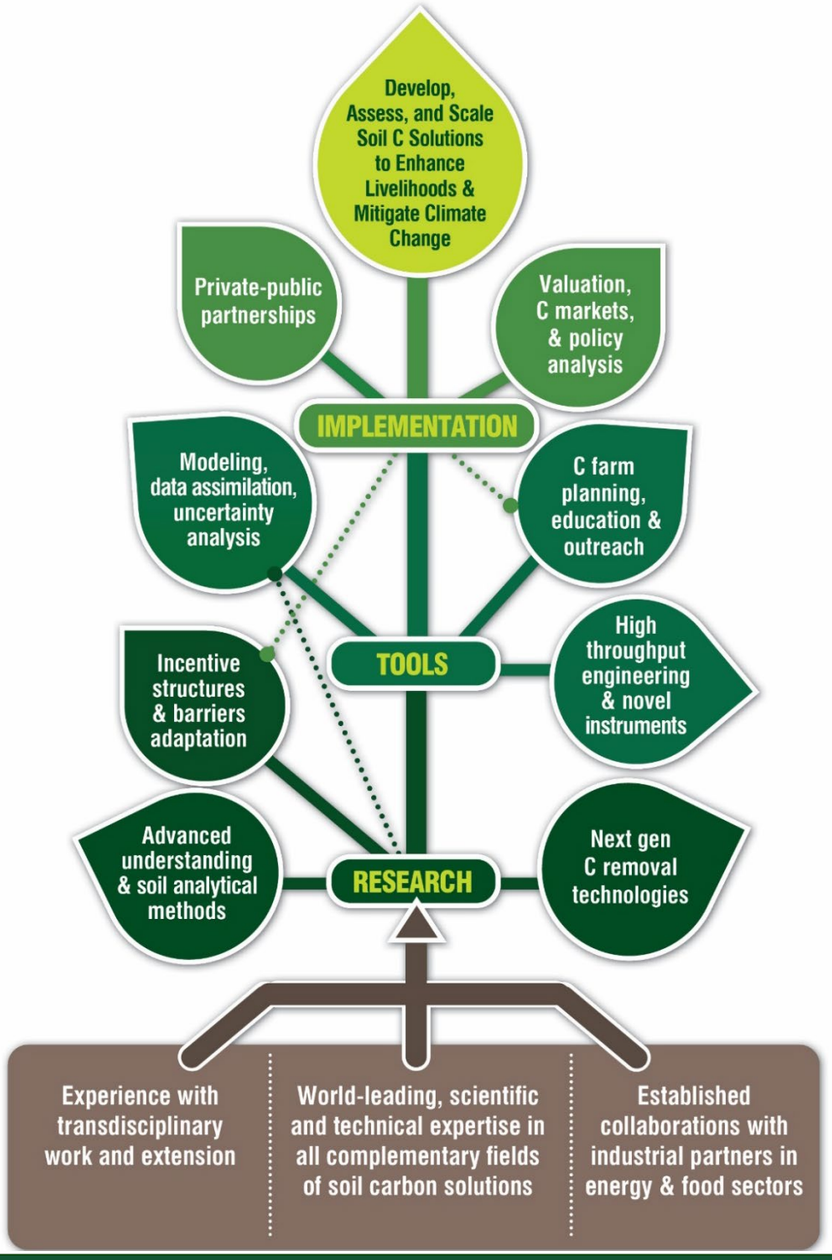

The **Soil Carbon Solutions Center**: https://www.research.colostate.edu/cip/scsc/

Enhancing livelihoods and mitigating climate change through cutting-edge research, tools, and implementation

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