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CARBON 4 SOIL QUALITY

Cover Cropping

Mechanisms and Rates of Carbon Sequestration

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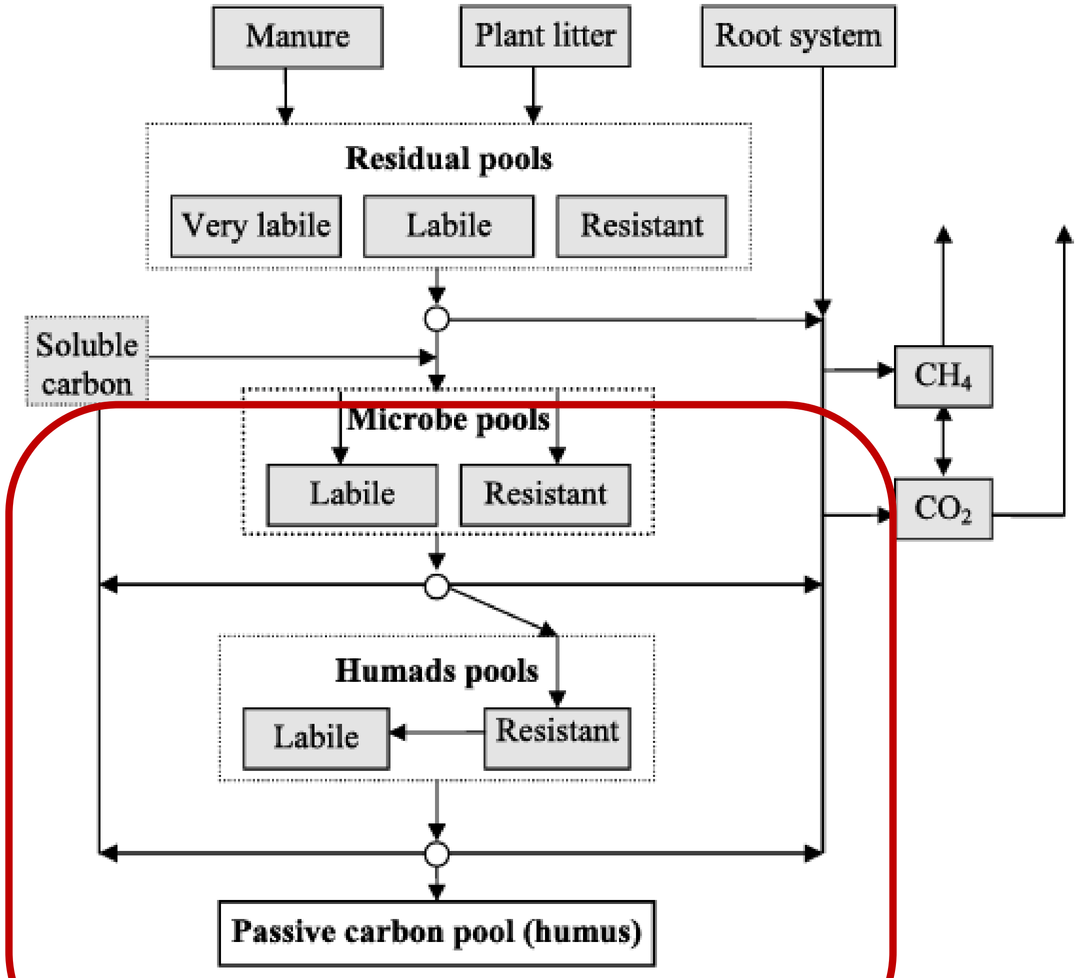
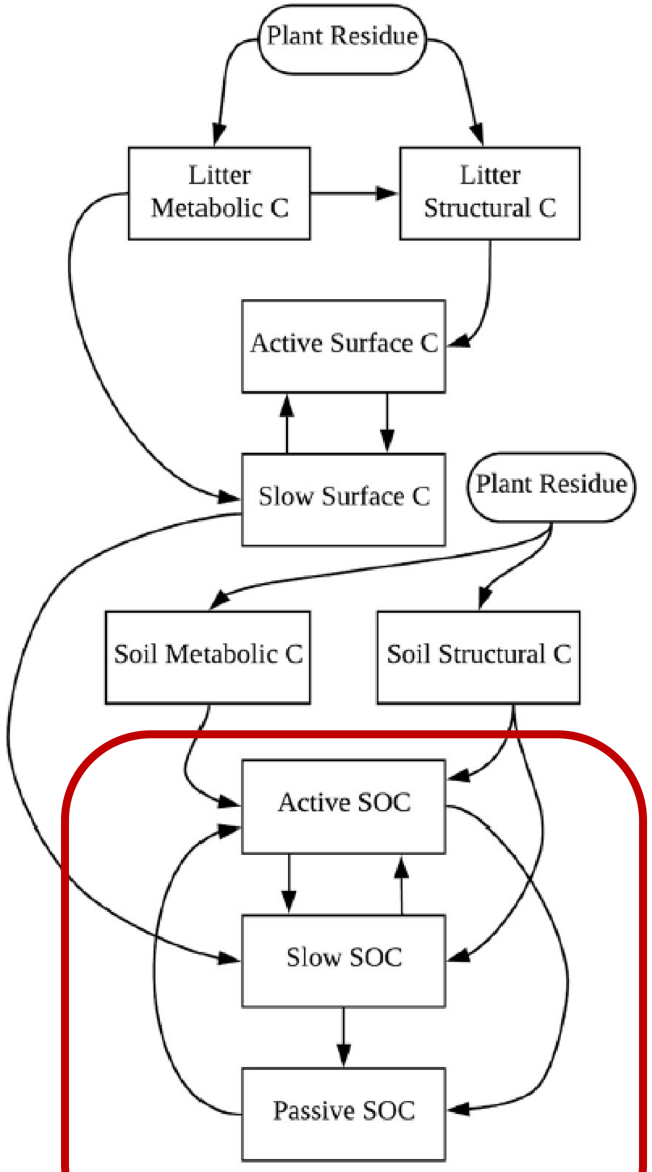
Mechanisms of Carbon Sequestration

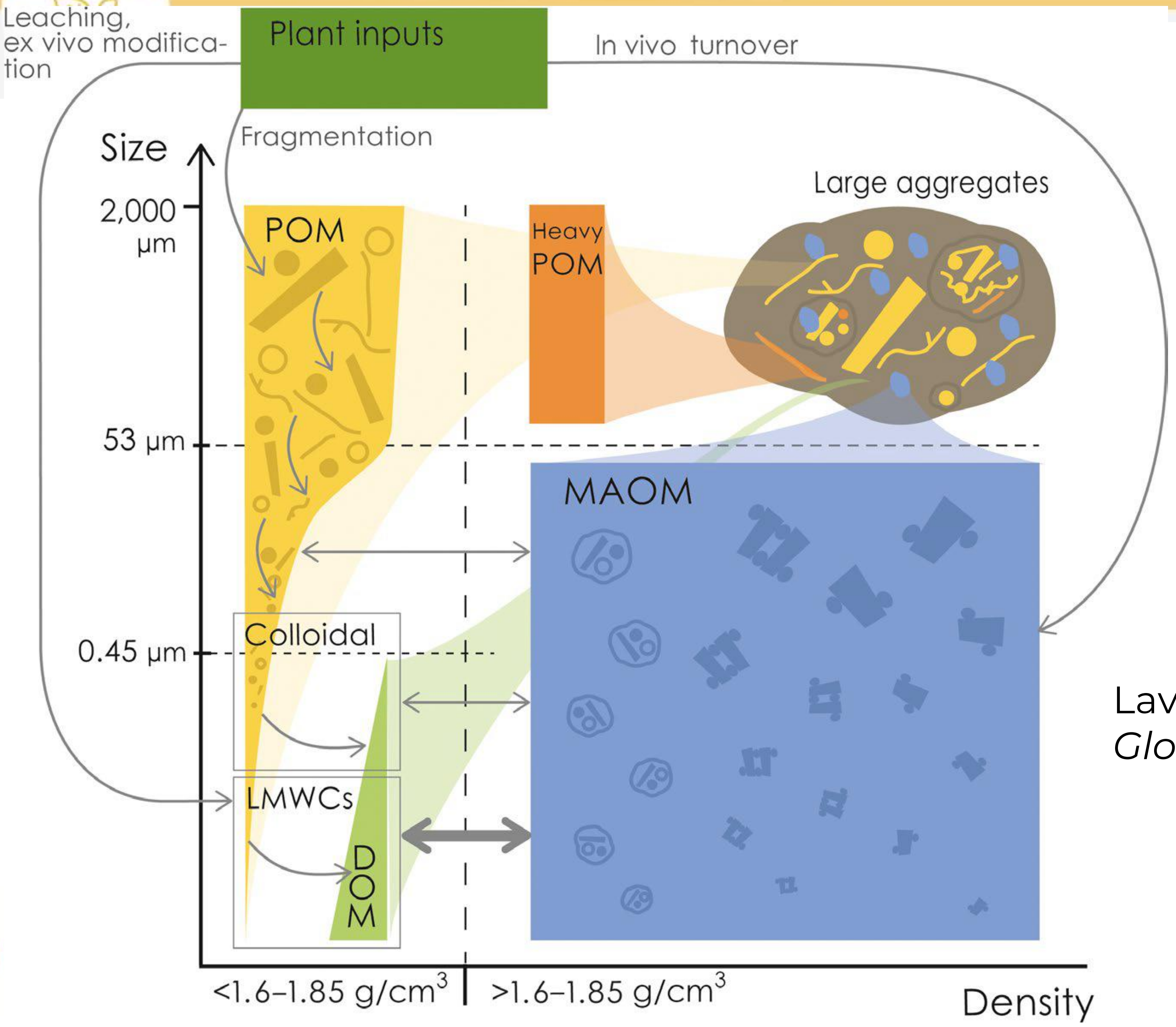


DNDC Model



Century Model

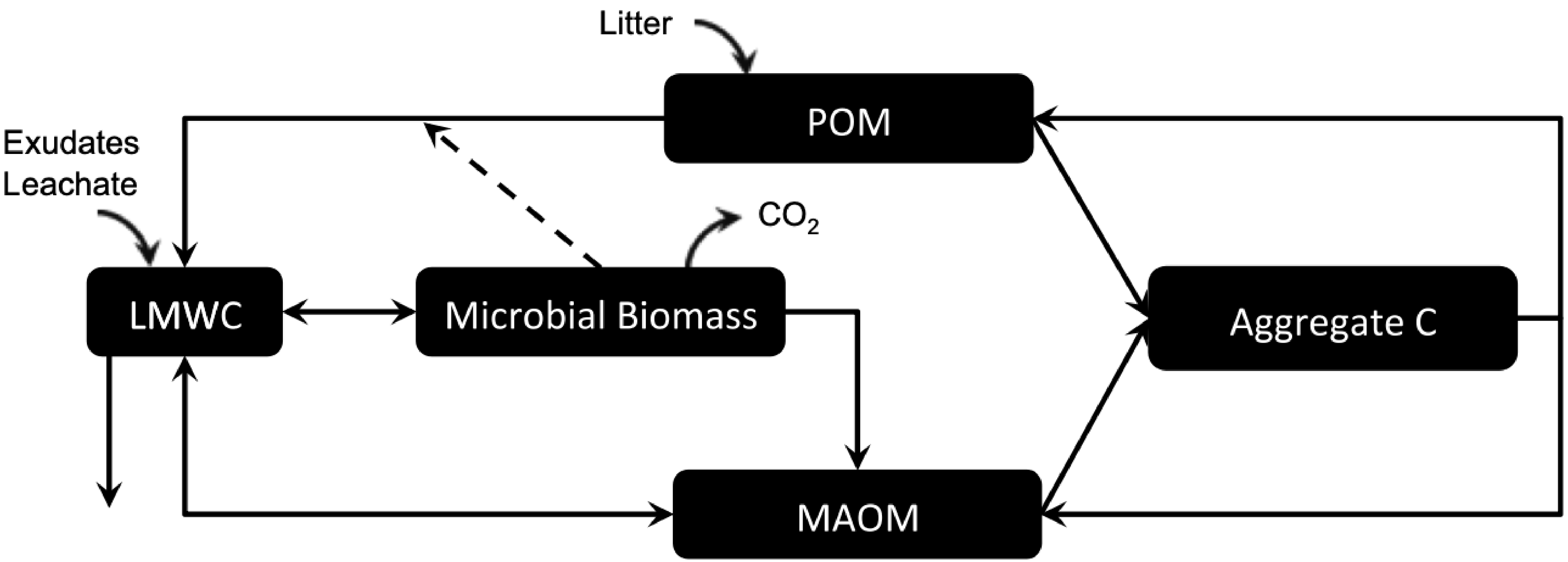
Mechanisms of Carbon Sequestration



Lavallee et al. (2020)
Global Change Biol. 2020;26:261–273

Mechanisms of Carbon Sequestration

The Millennial Model



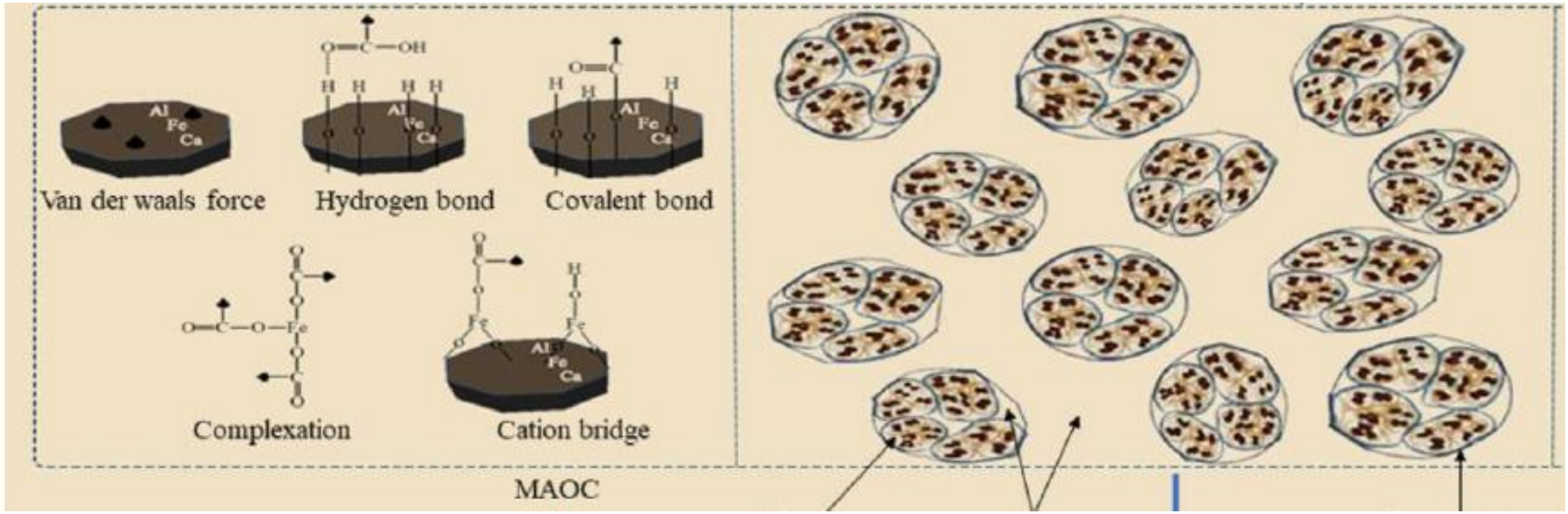
Abramoff et al. (2018-Biochem. 137:51-71; 2022-Soil Biol. Biochem. 164 108466)

Mechanisms of Carbon Sequestration

Plant Residue (free Particulate OM – **fPOM**)

Mineral Assoc. OM - **MAOM**

Occluded particulate OM - **oPOM**

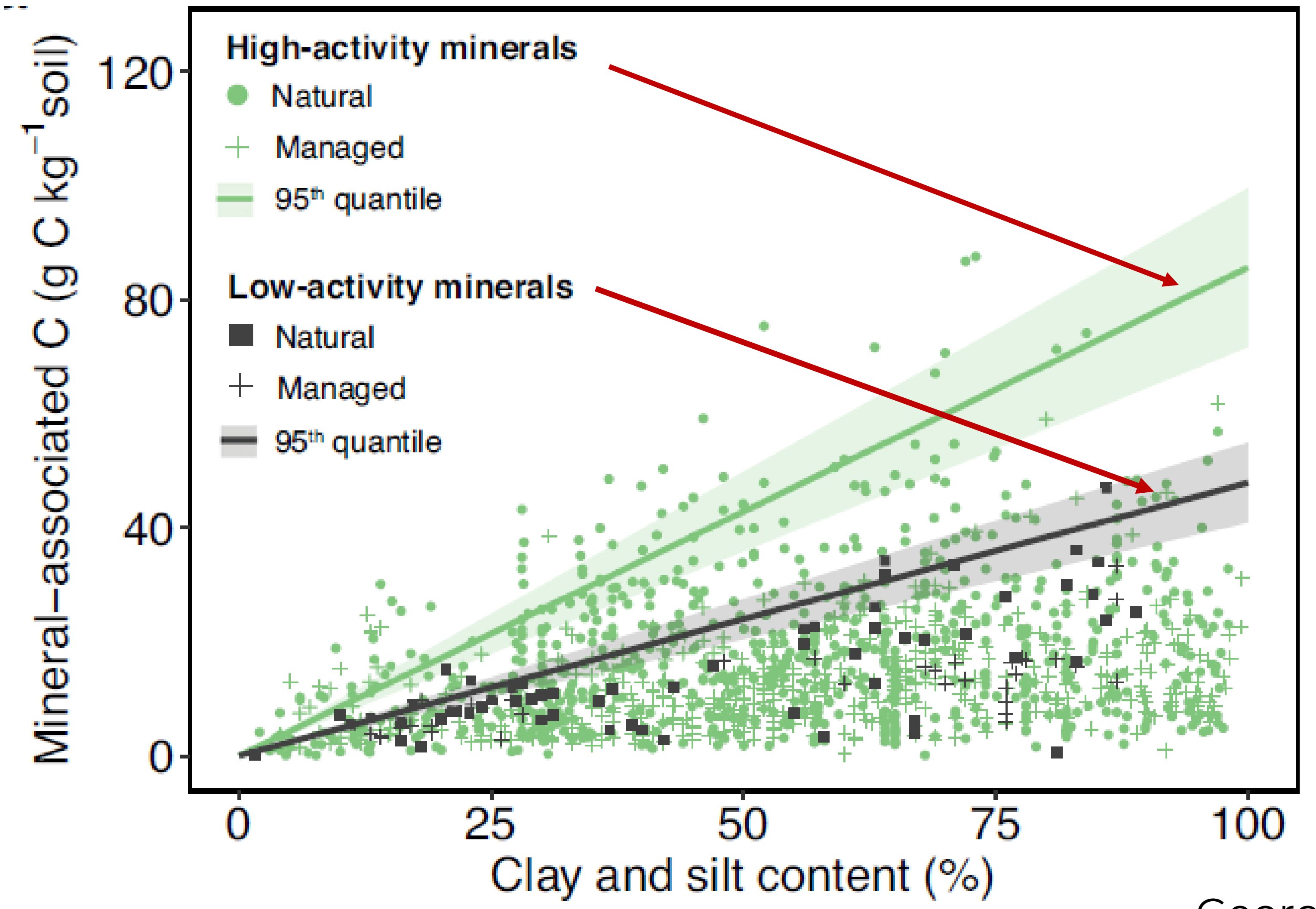


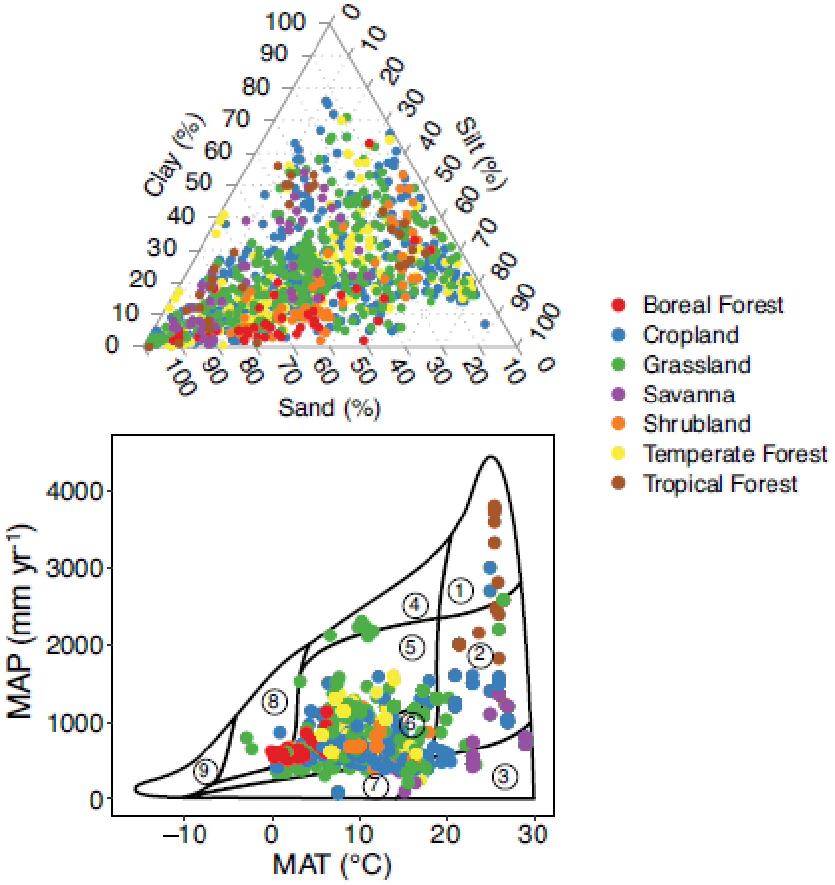
Microaggregate

Macroaggregate

Mechanisms of Carbon Sequestration

Maximum Mineral-Associated Carbon

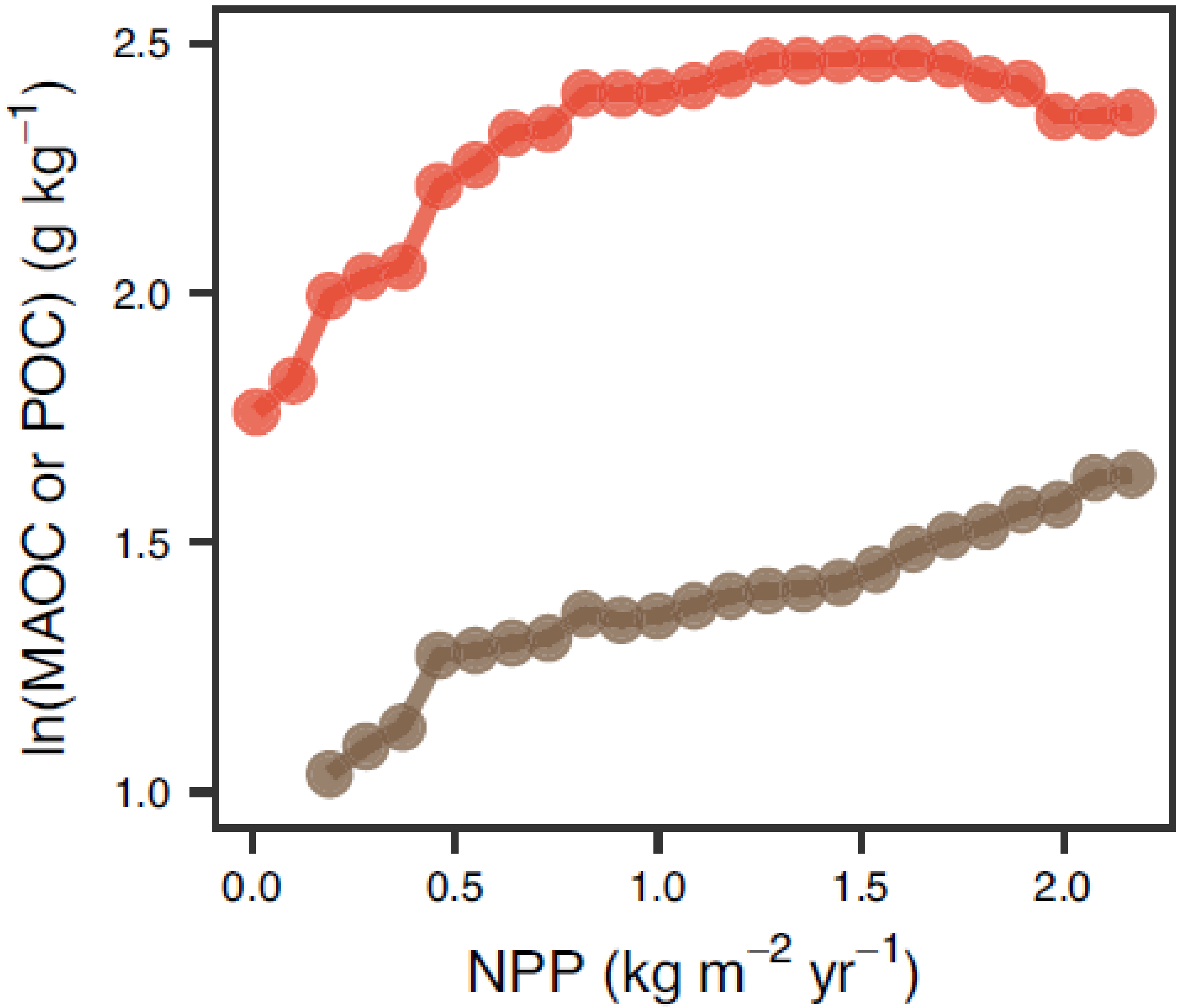




- Data from 1144 profiles

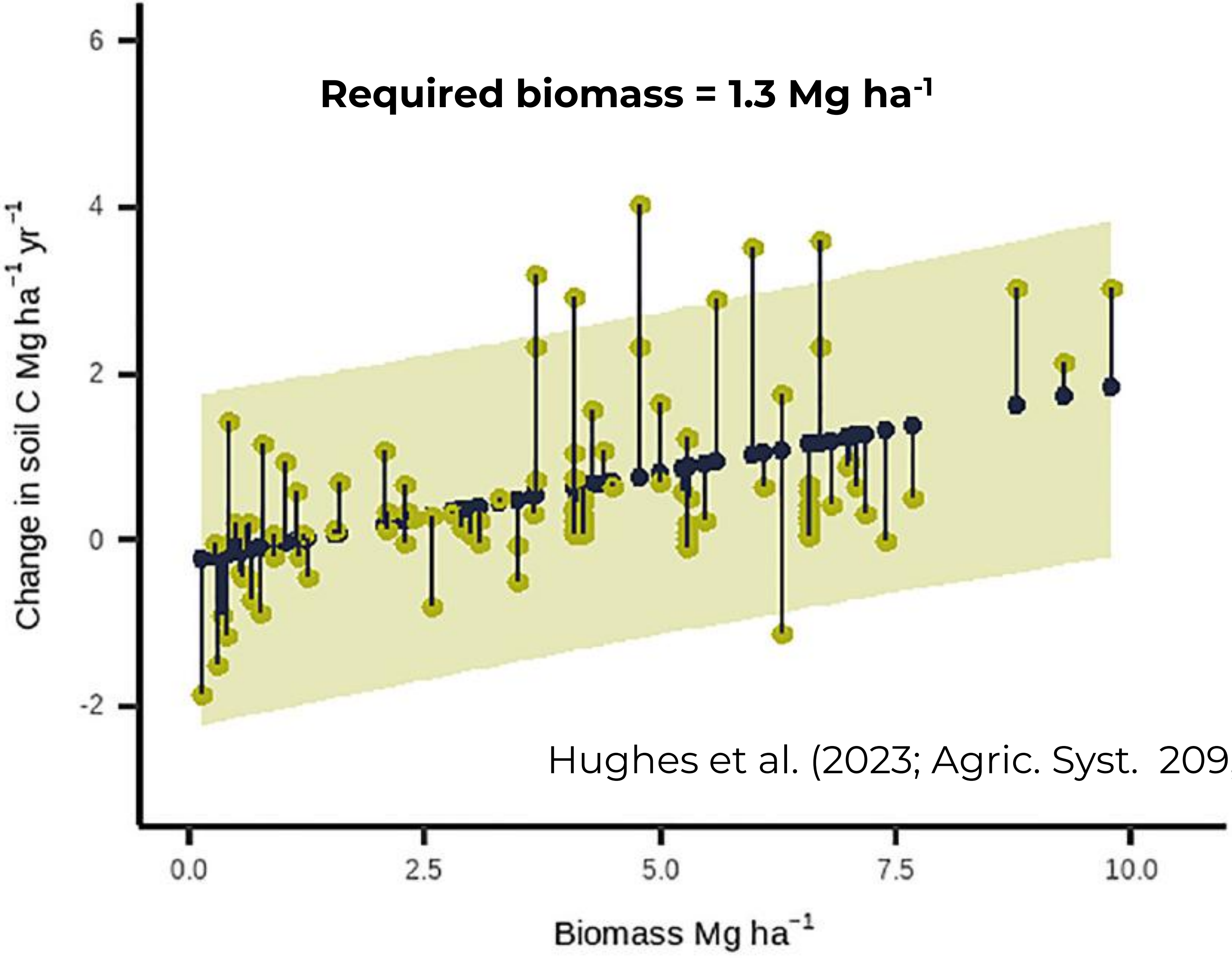
Georgiou et al. (2025; Nature Comm. 13:3797)

Global Meta-Analysis of MAOC and POC Concentrations (8,341 observations)



Zhou et al. (2024; Nature Comm. 15:5329)

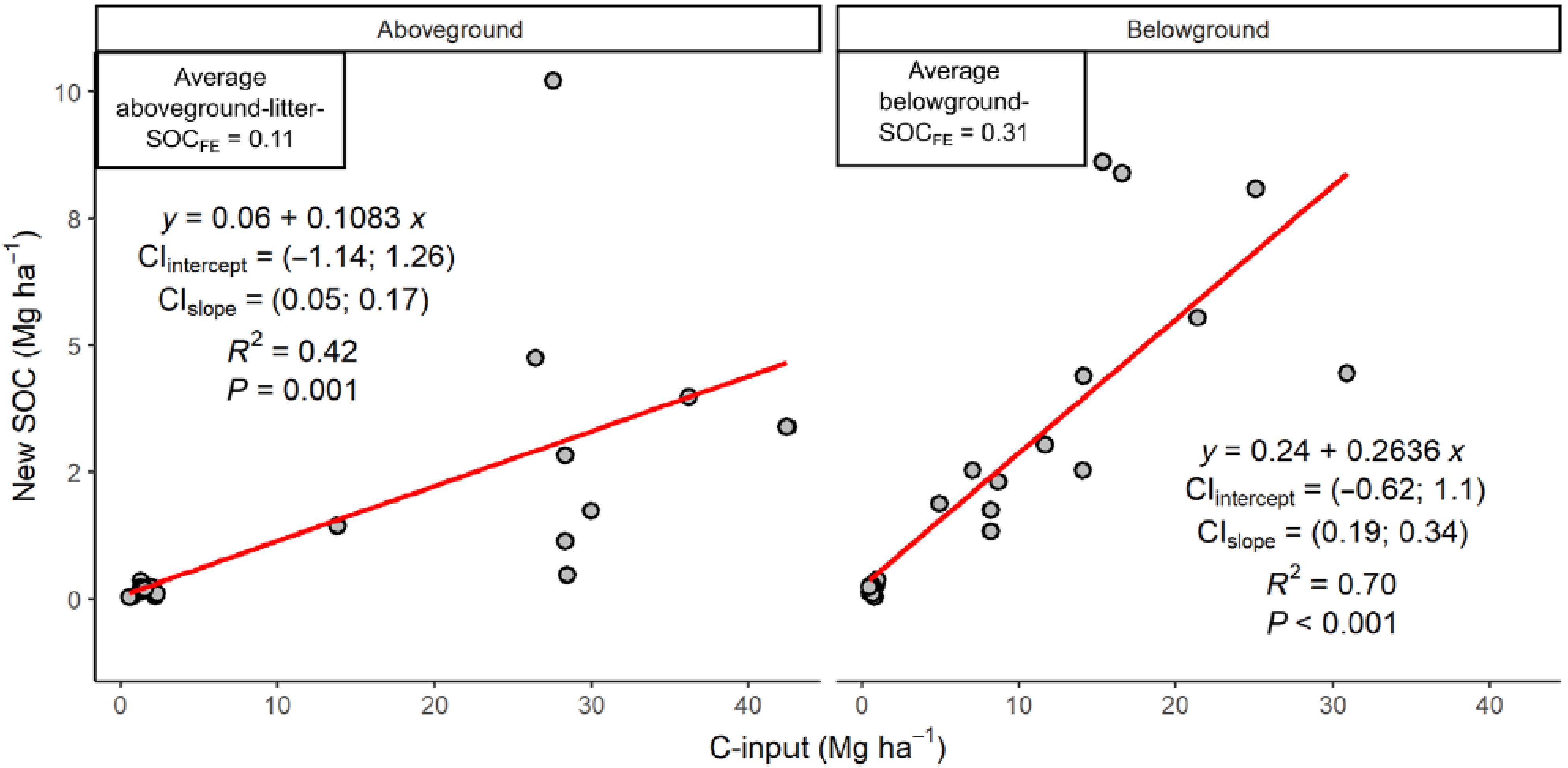
The Best Model to Predict C Sequestration was Based on Cover Crop Biomass (181 observations, Temperate regions)



Hughes et al. (2023; Agric. Syst. 209, 103663)

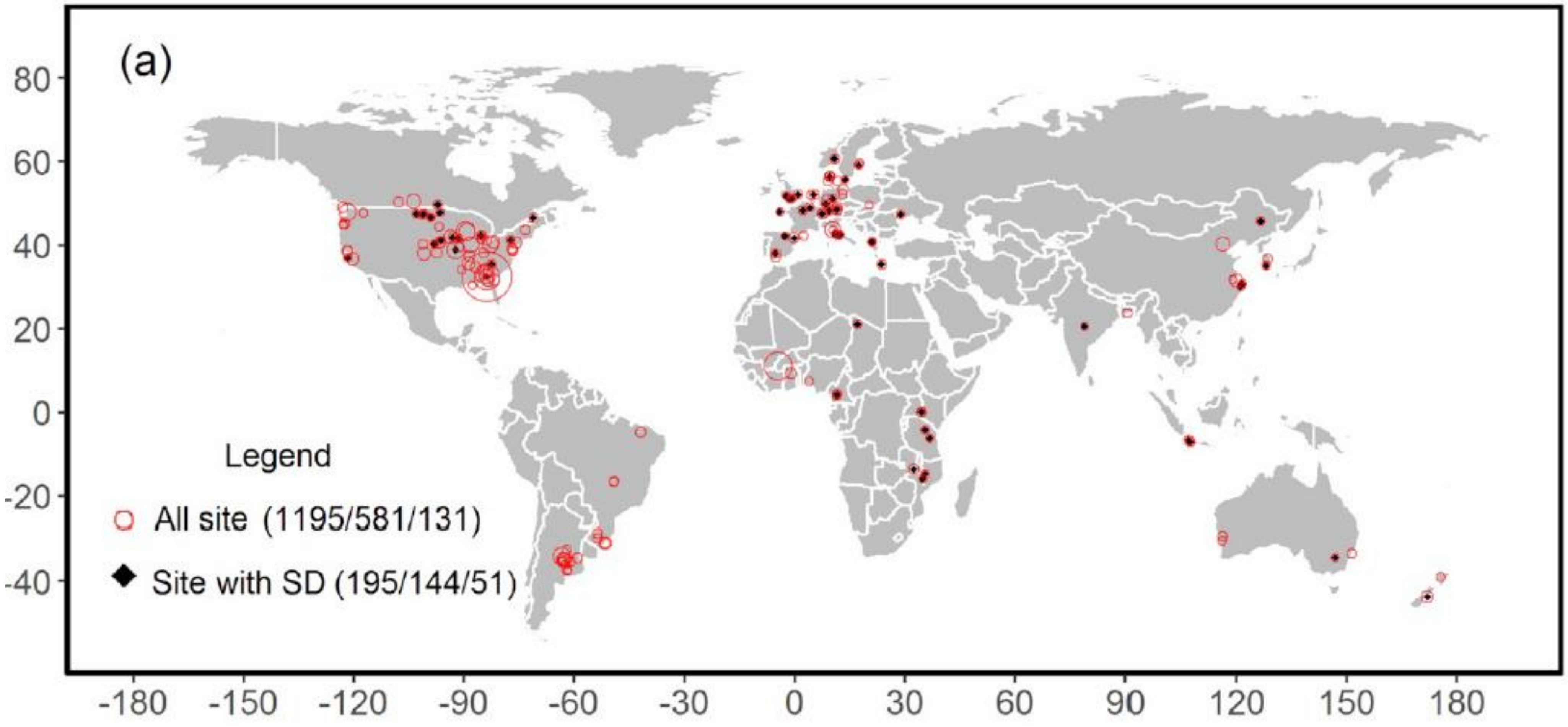
CARBON SOIL QUALIT

Efficiency of Aboveground and Belowground litter (roots+rhizodeposition)



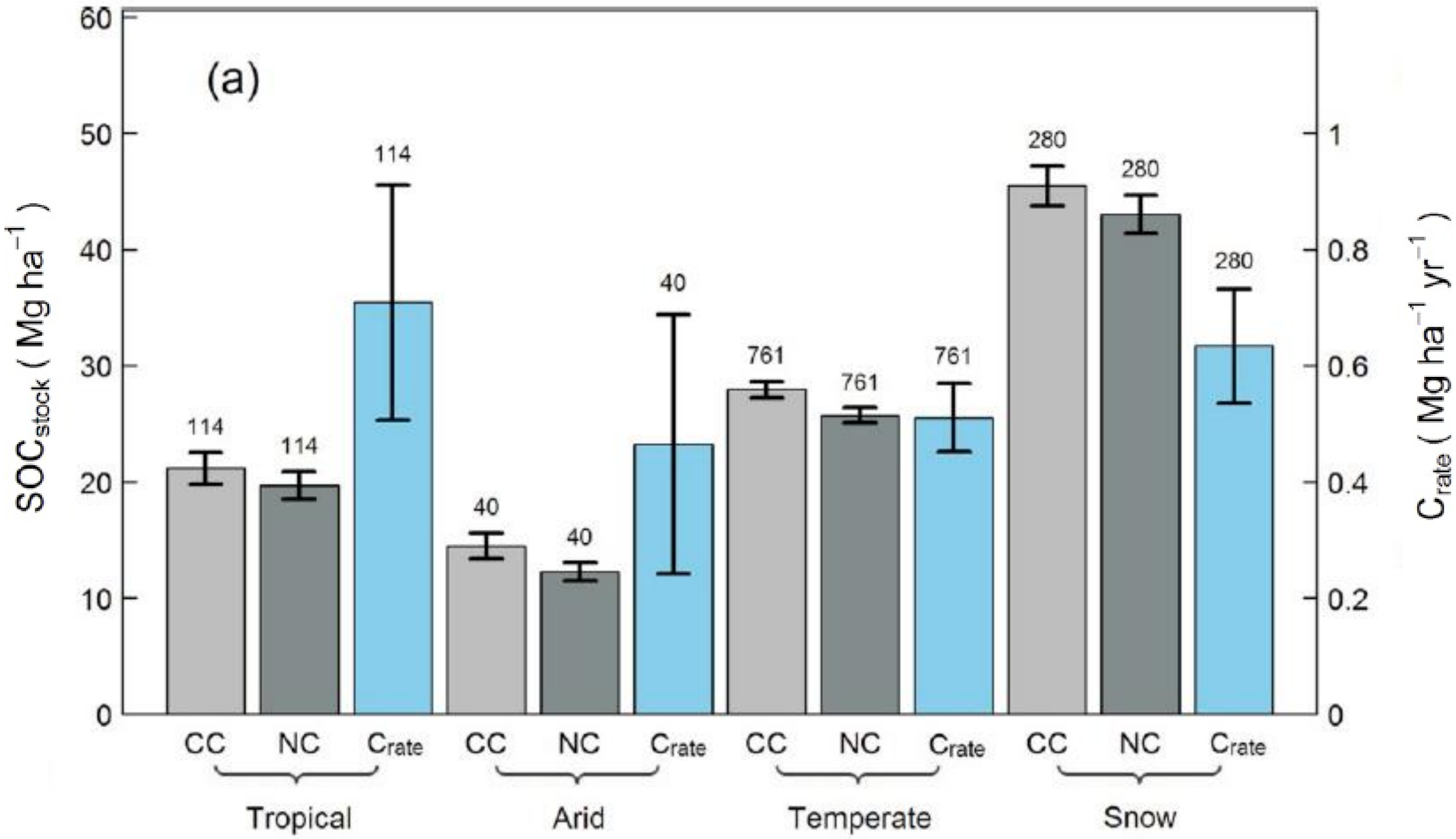
Villarino et al. (2021; *Sci. Adv.* 2021; **7** : eabd3176109411)

Meta-Analysis of Cover Crop Studies



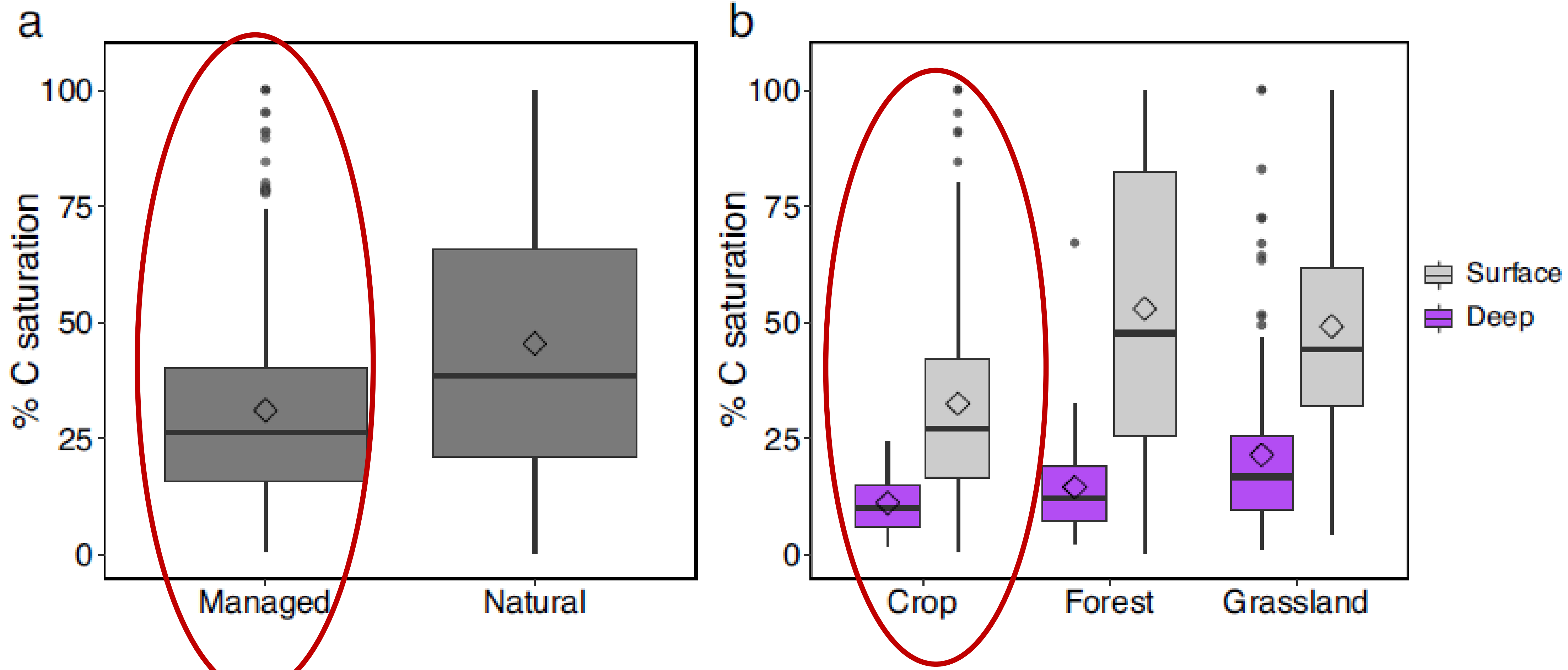
Jiang et al. (2020; Soil Biol. Biochem. 103:107735)

Rates of Carbon Sequestration



Jiang et al. (2020; Soil Biol. Biochem. 103:107735)

Carbon Saturation of World Soils



- Data from 1144 profiles

Georgiou et al. (2025; Nature Comm. 13:3797)

Cover Crop Selection in Mediterranean Regions

- **Before MAOM saturation**
  - Target species to increase POM and MAOM (fast-growing mixed species)
  - Legumes in the mix (more N, better microbial efficiency, CUE)
  - Species with root tissue chemical recalcitrance (MAOM formation)
  - Large root depth distribution (ex, alfalfa, faba bean, MAOM formation)

- **After MAOM saturation**
  - Target species to increase POM (ex., grasses, brassicas)
  - Species with shallow, fibrous roots (promote aggregation - POM)
  - Avoid MAOM priming due to high-quality residue

Moukanni et al. (2022; Front. Agron. 4:844166)

Cover Crop Management in Mediterranean Regions

- **Before MAOM saturation**
  - Terminate cover crops earlier(high litter quality, greater microbial efficiency)
  - Limit N and P during cover crop growth (promotes root formation and exudation)
  - Limited P in legumes maximizes exudates (favors MAOM)
  - Increase N and P during cash crop (greater microbial efficiency during decomposition)
  - Low intensity grazing increases dissolved C and N (increases MAOM)

- **After MAOM saturation**
  - Terminate cover crops later (low-quality litter forms POM)
  - Increase N during cover crop and cash crop (more biomass, slow lignin decomposition)
  - Slower aboveground residue input rates (avoids POM and MAOM priming)

Moukanni et al. (2022; Front. Agron. 4:844166)

Thank you!