What controls organic carbon persistence? – Timescales in afrotropical soils





EGU, 26.05.2022, Session: BG3.22 – Dynamic soil landscapes and climate change

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Large-scale controls of SOC persistence

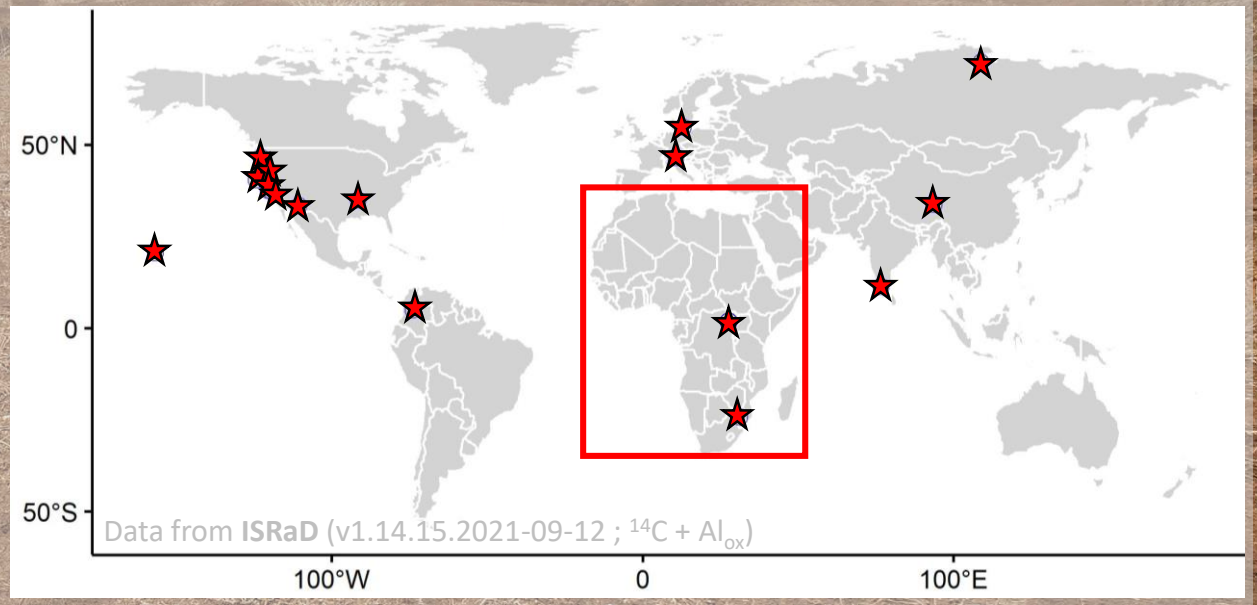
Soil organic carbon dynamics

Climate & mineralogy

C age: Good proxy for C persistence

Local vs. continental studies

Soil ^{14}C studies globally



Systematic continental-scale approach to study SOC persistence

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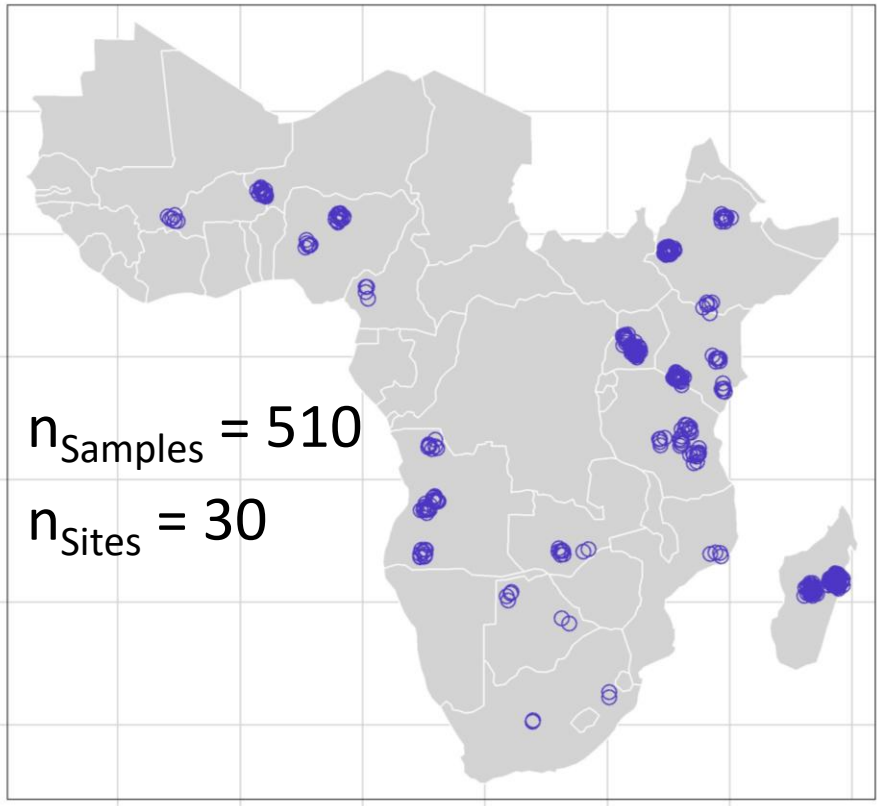
Sampling locations and measurements

Sampling locations:



Measurements:

- Radiocarbon ($\Delta^{14}C$)
- Soil organic carbon
- Type of clay minerals
- …

Mean SOC age by depth:

Topsoil (0–20 cm): **182 ± 62 years**

Subsoil (20–50 cm): **563 ± 227 years**

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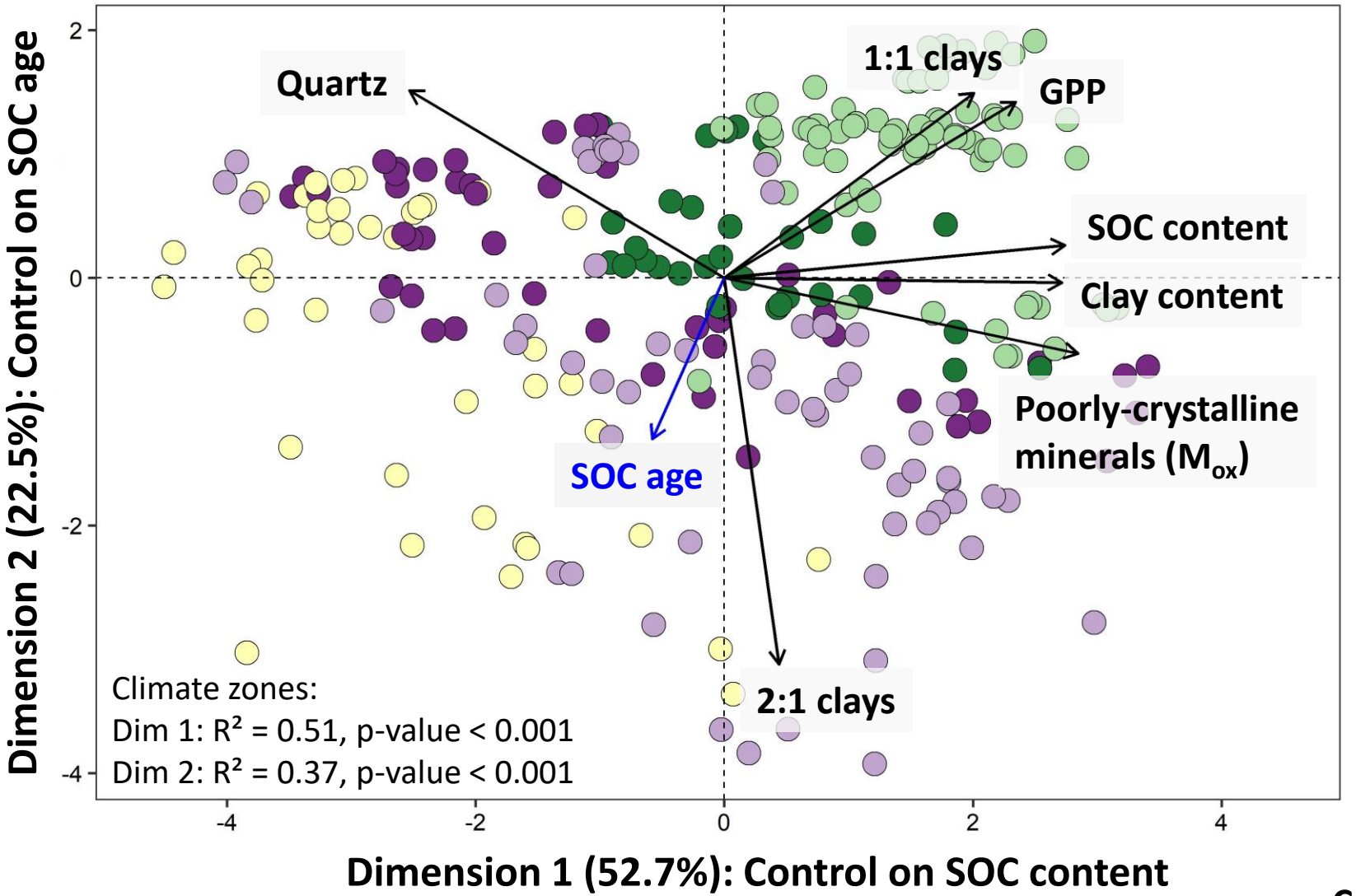
Mean SOC ages in sub-Saharan Africa



Climate zones:

- Arid
- Temperate (seasonal)
- Tropical (seasonal)
- Temperate (humid)
- Tropical (humid)

Humid climates: Highly weathered, younger SOC ages

Arid and **seasonal** climate: Less weathered, older SOC ages

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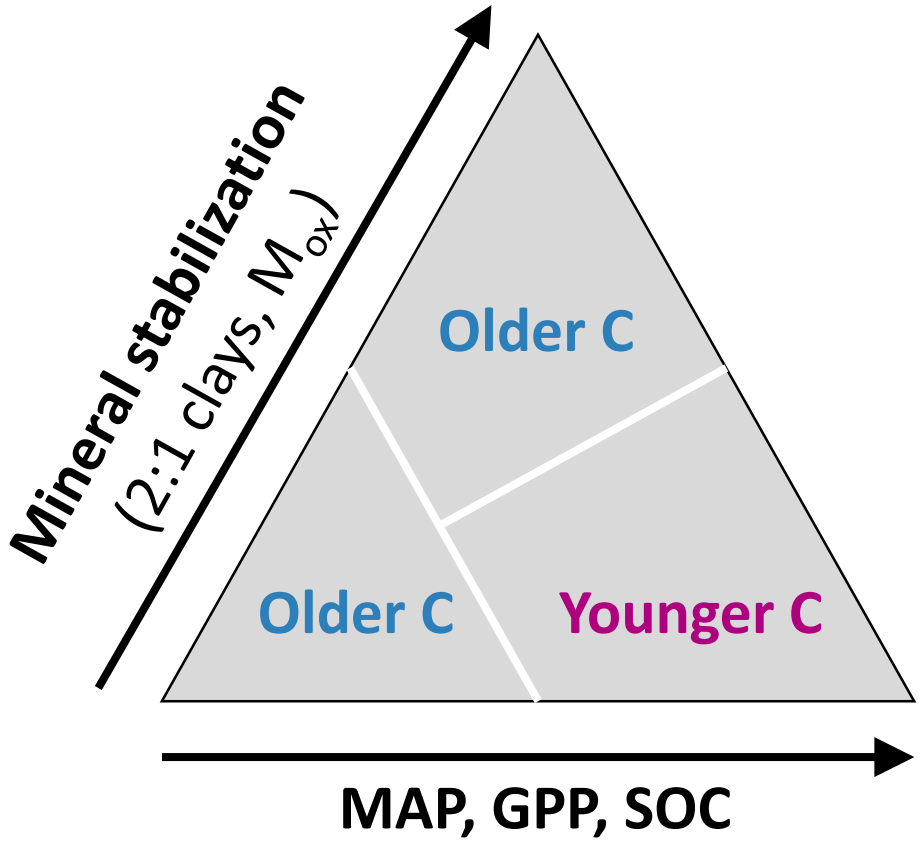
Summary – key findings



Younger C ages (most samples)

- **Humid climates**: High C inputs, **low mineral stabilization** (1:1 clay minerals)

Older C ages

- **Dry climates**: Low C inputs, **low mineral stabilization** (quartz)
- **Humid climates**: High C inputs, **high mineral stabilization** (2:1 clay minerals, M_{ox}: Oxalate-extractable metals)

Anthropogenic factors (erosion, cultivation) **do not show a consistent pattern** at this large scale

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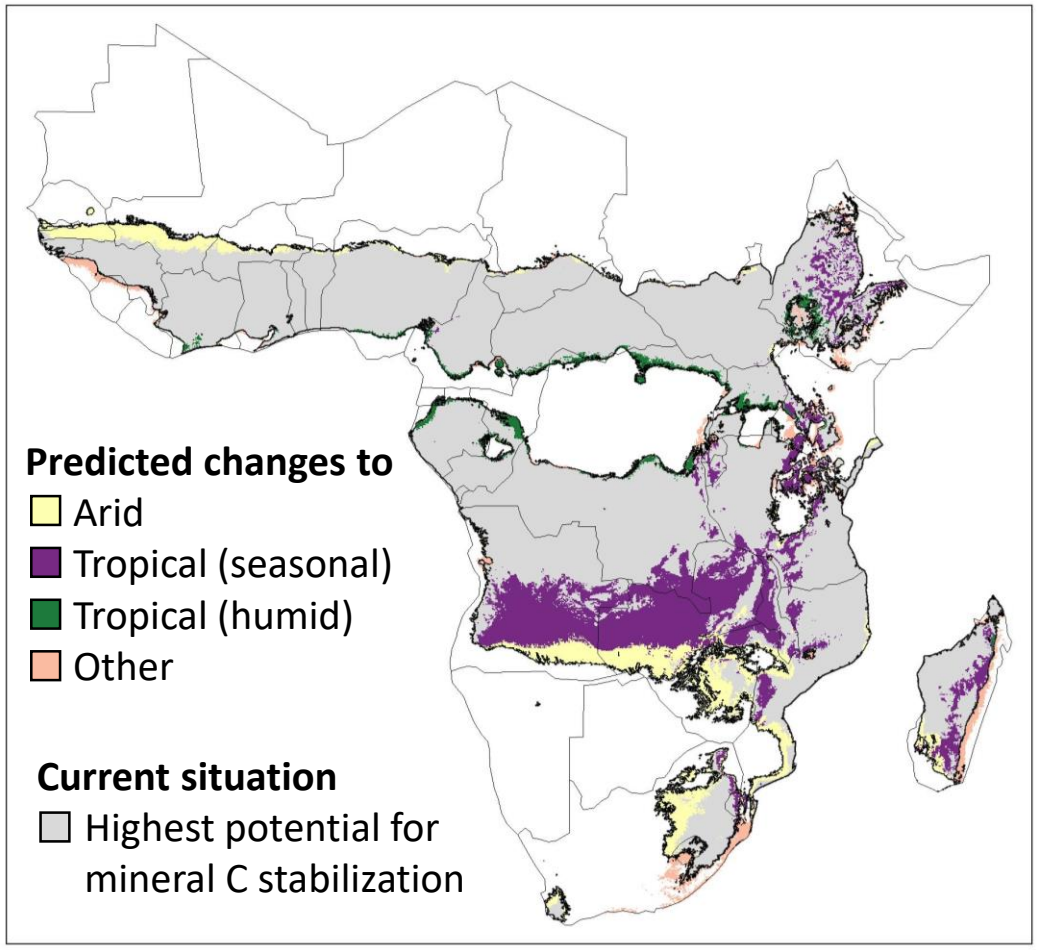
Outlook – future pathways of mineral C stabilization

Predicted changes in climate zones



Data from Beck et al. 2018 (RCP8.5 Scenario)

Predicted changes are highest for temperate and tropical (seasonal) climate zones

- Currently highest potential for mineral C stabilization
- Store highest amount of C across sub-Saharan Africa

Regions with highest potential for mineral C stabilization

- Short term: C input ↓
  Long term: Mineral C stabilization ↔
- Short term: C input ↑
  Long term: Mineral C stabilization ?
- Short term: C input ↑
  Long term: Mineral C stabilization ↓