Role of soil C sequestration in reducing the C intensity of bioenergy systems

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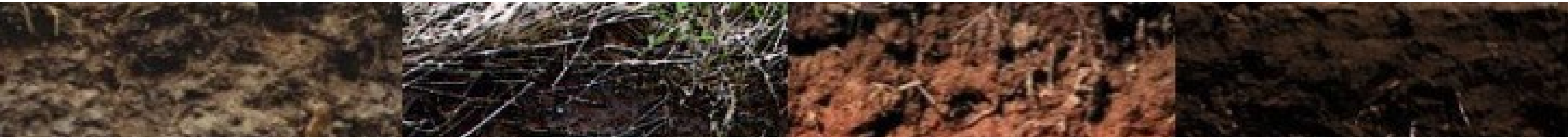


Berhe Soil Biogeochemistry lab

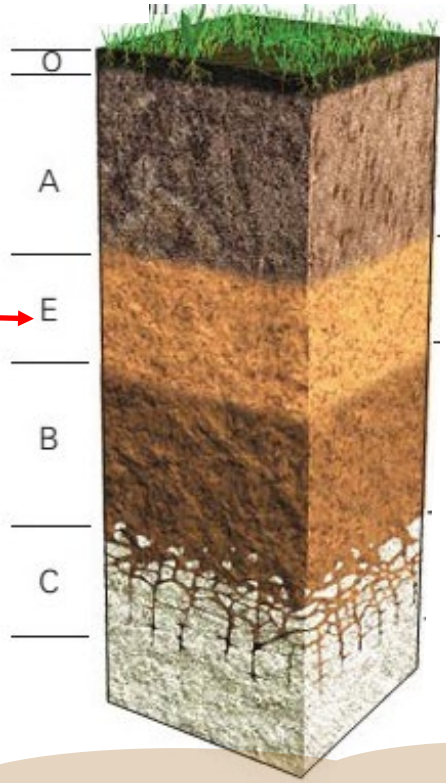
aaberhe.com

Spatial scales: nano to catchment

Temporal scales: <minutes to >1000s of years

Forcings

$$\frac{d}{dt}$$



Responses

- (Nano)(Bio)Geochemistry
  - C, N, P cycling
  - Soil health
  - Climate change impacts & mitigation
- Political ecology.
  - Soil and human security

BAJEDI in the academy

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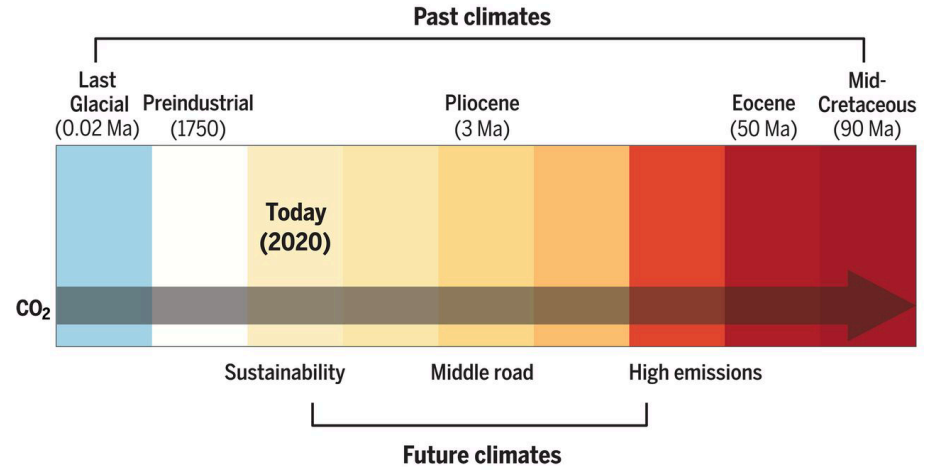
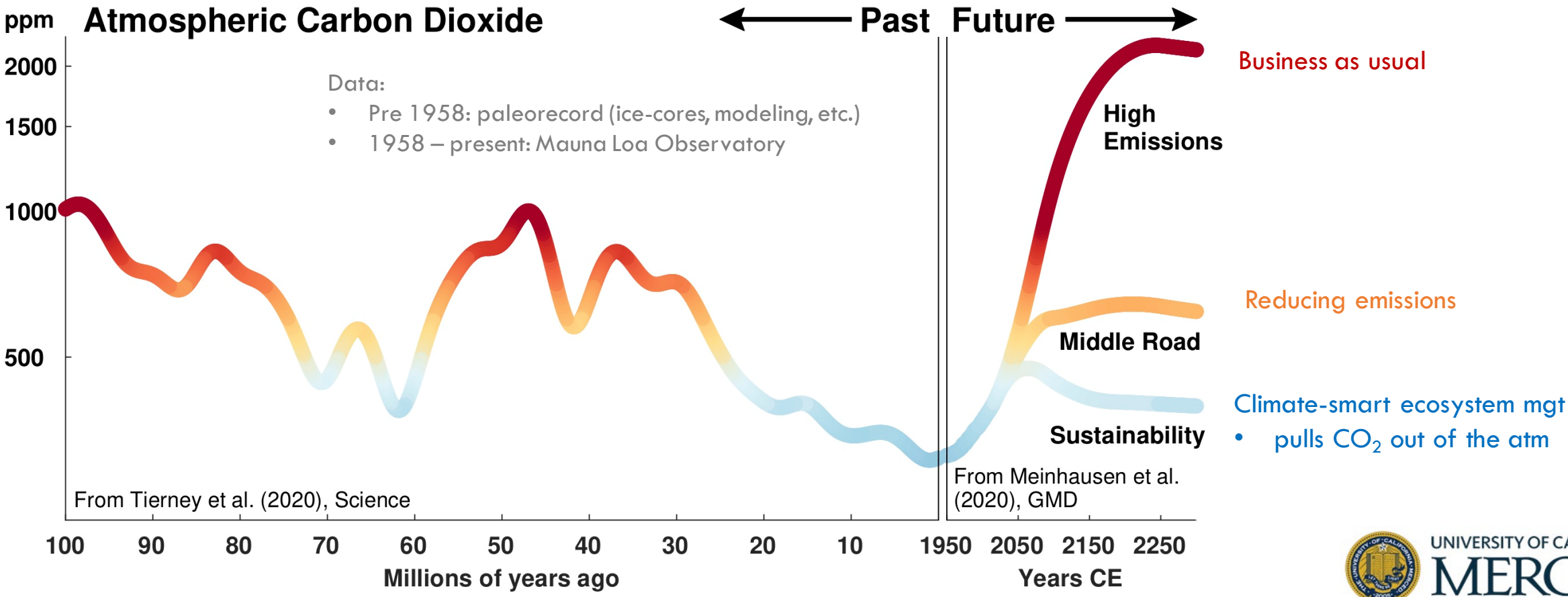
The future we choose …

- Mitigating & adapting to climate △ requires diverse solutions
- Limiting warming to 1.5°C requires reduction of emissions AND negative emissions





Business as usual

Reducing emissions

Climate-smart ecosystem mgt
- pulls CO_2 out of the atm

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Opportunities for soil C sequestration

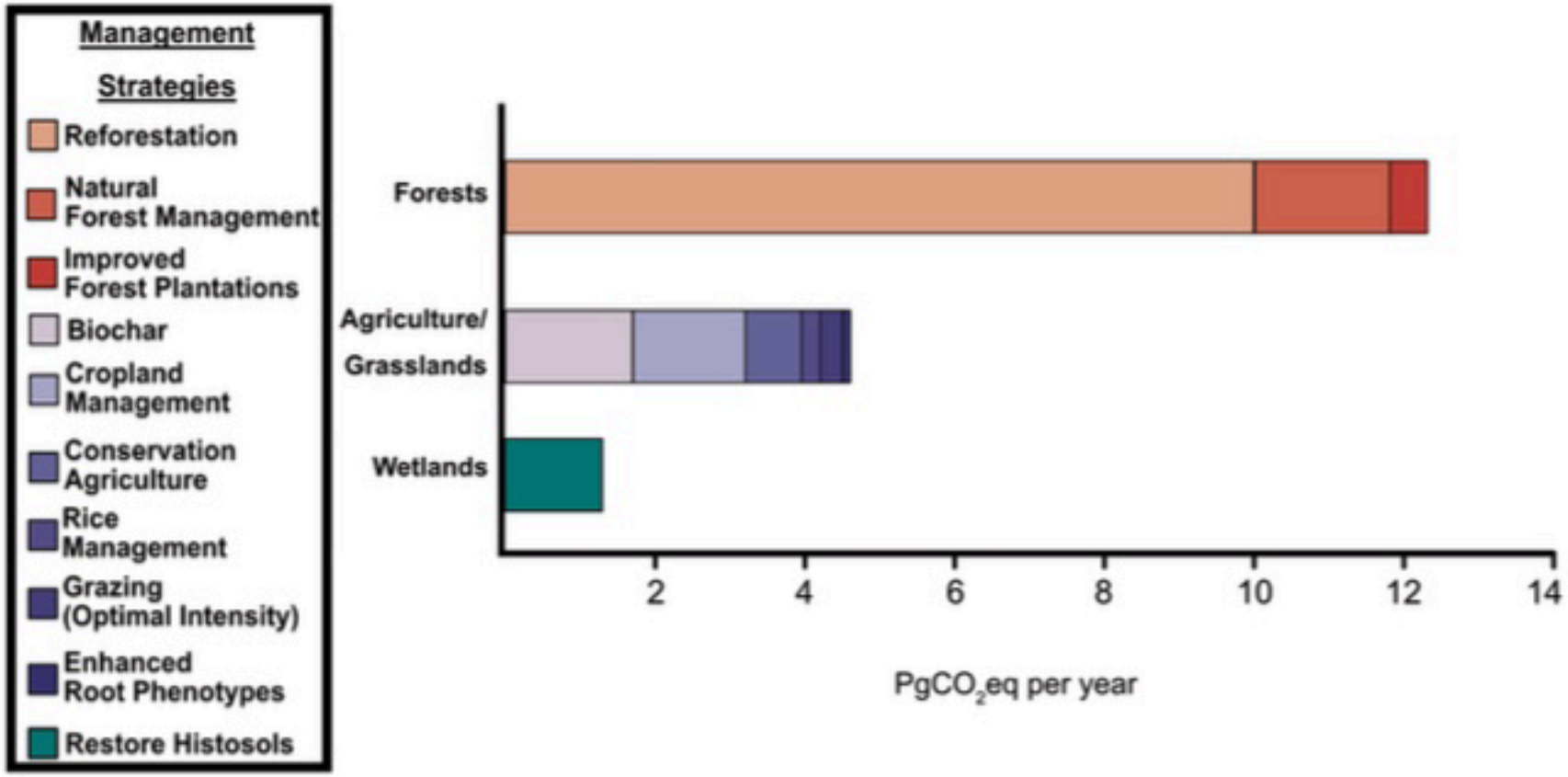

Figure 2. Various management strategies in forested, agriculture/grassland, and wetland ecosystems exhibit differing propensities to take up CO_2. Overall, these strategies represent a way to expand terrestrial ecosystem uptake of carbon (Friedlingstein et al., 2020; Paustian et al., 2016; Griscom et al., 2017).

Longbottom … Berhe. 2022 GSA Today (in Press)

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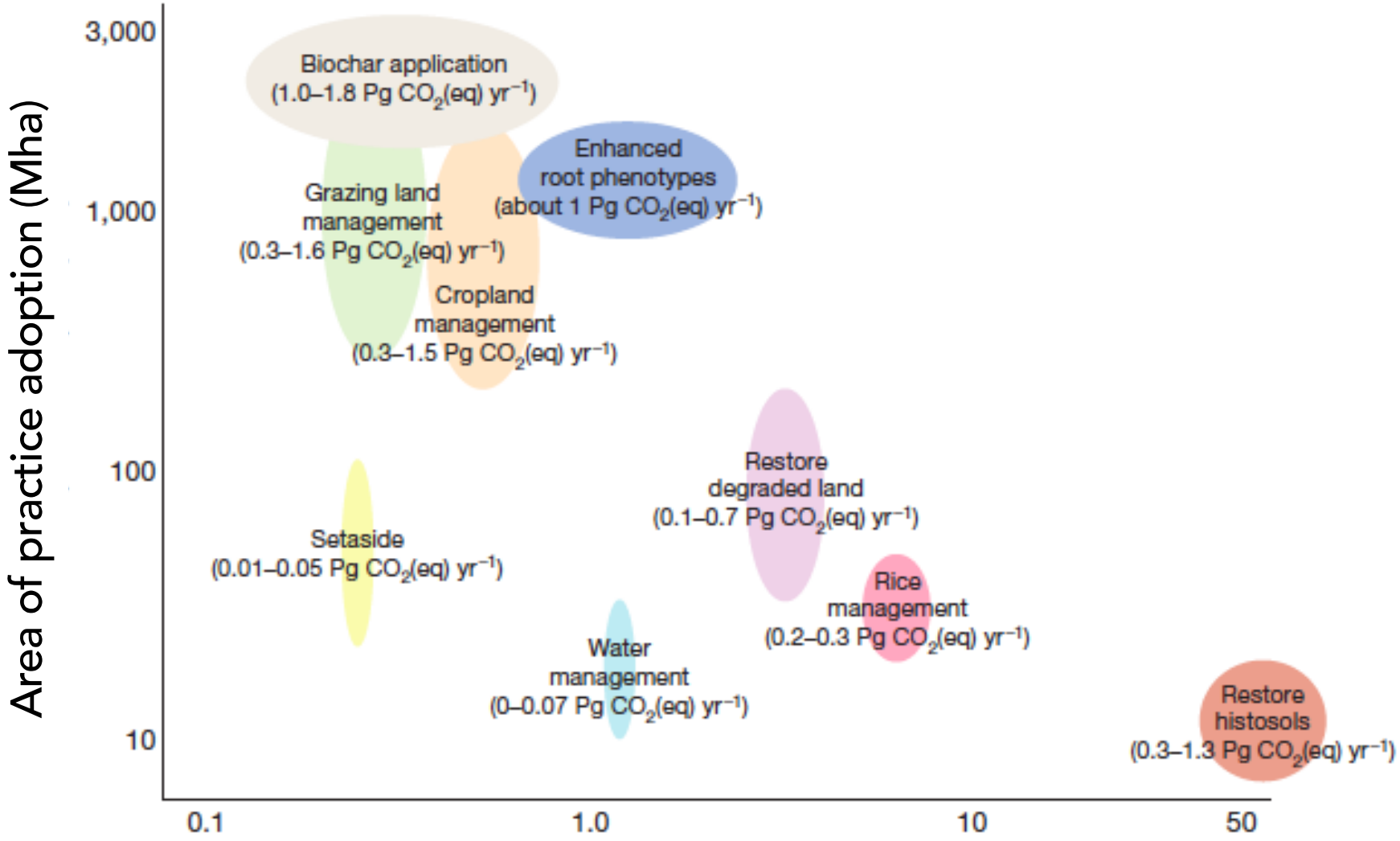
Spatially constrained potential for soil C sequestration



Paustian et al. 2016. Nature

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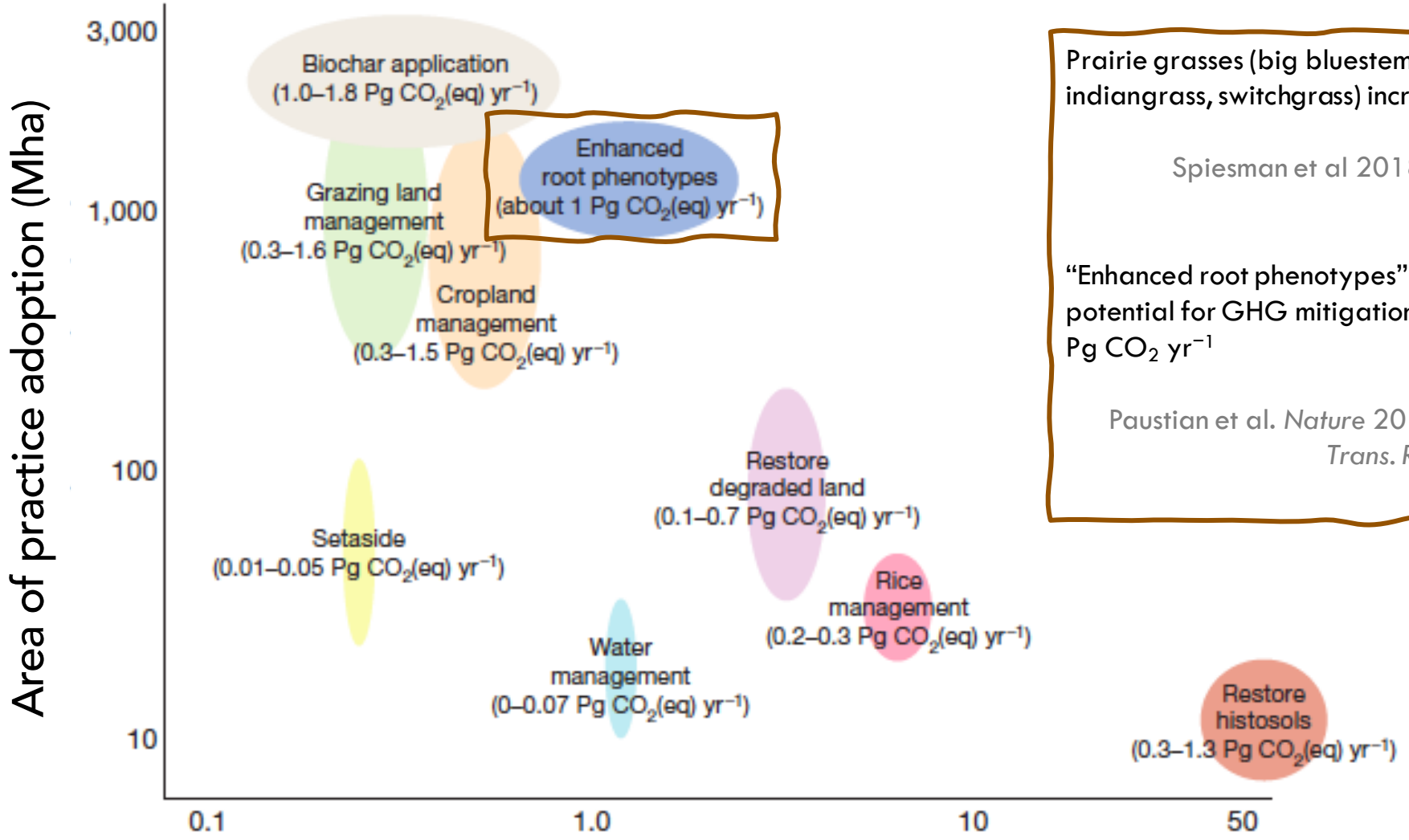
Bioenergy crops:

- deep soil carbon storage
- potential to restore degraded soils

Contribution of bioenergy crops to soil C sequestration



Prairie grasses (big bluestem, indiangrass, switchgrass) increase soil C

Spiesman et al 2018 *Oecologia*

"Enhanced root phenotypes" have global potential for GHG mitigation, up to ~1 Pg CO_2 yr^{-1}

Paustian et al. *Nature* 2016; Kell *Phil. Trans. R. Soc.* 2012

Paustian et al. 2016. Nature

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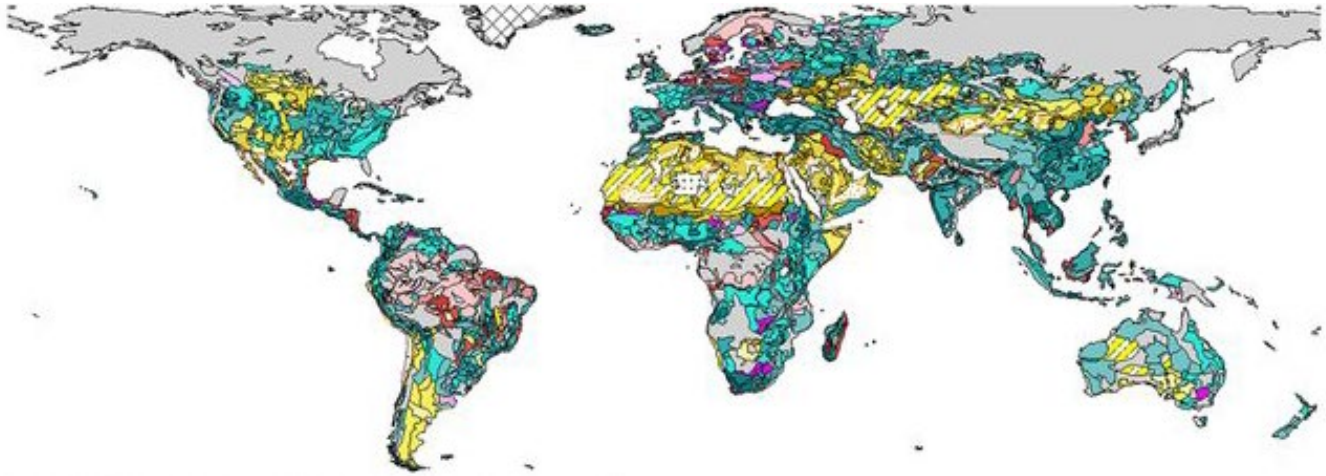
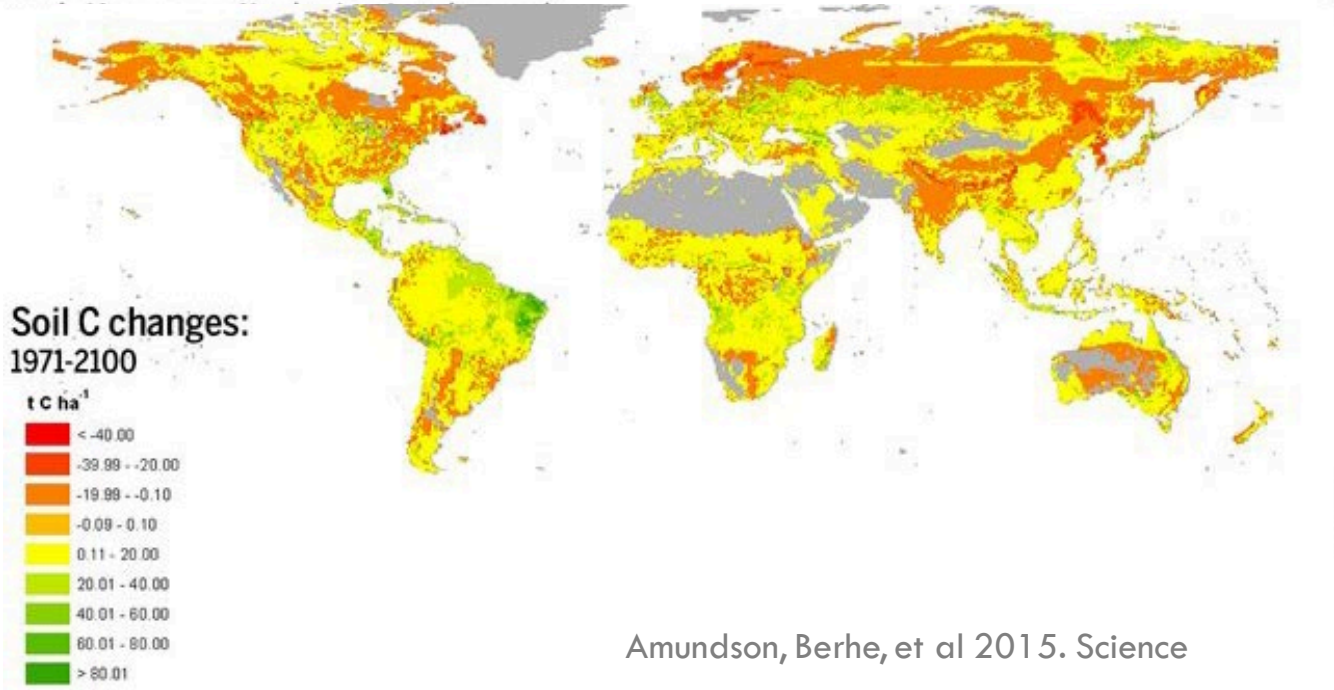
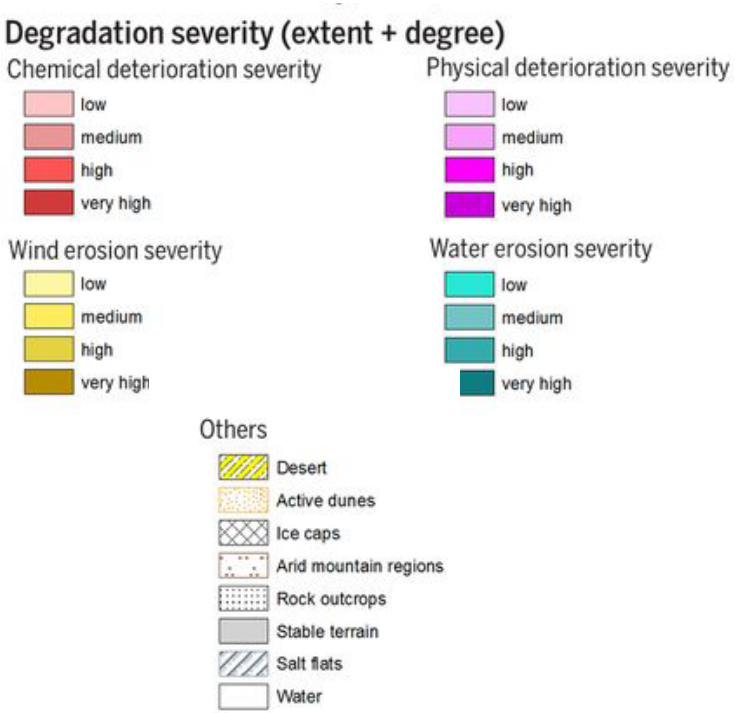
Global Land degradation and soil carbon

… growing demand for food, fiber, feed + natural climate change solution







We've lost 120 Pg C from top 2 m, mostly in the past 200 years (Sanderman et al. 2017 PNAS)

Amundson, Berhe, et al 2015. Science

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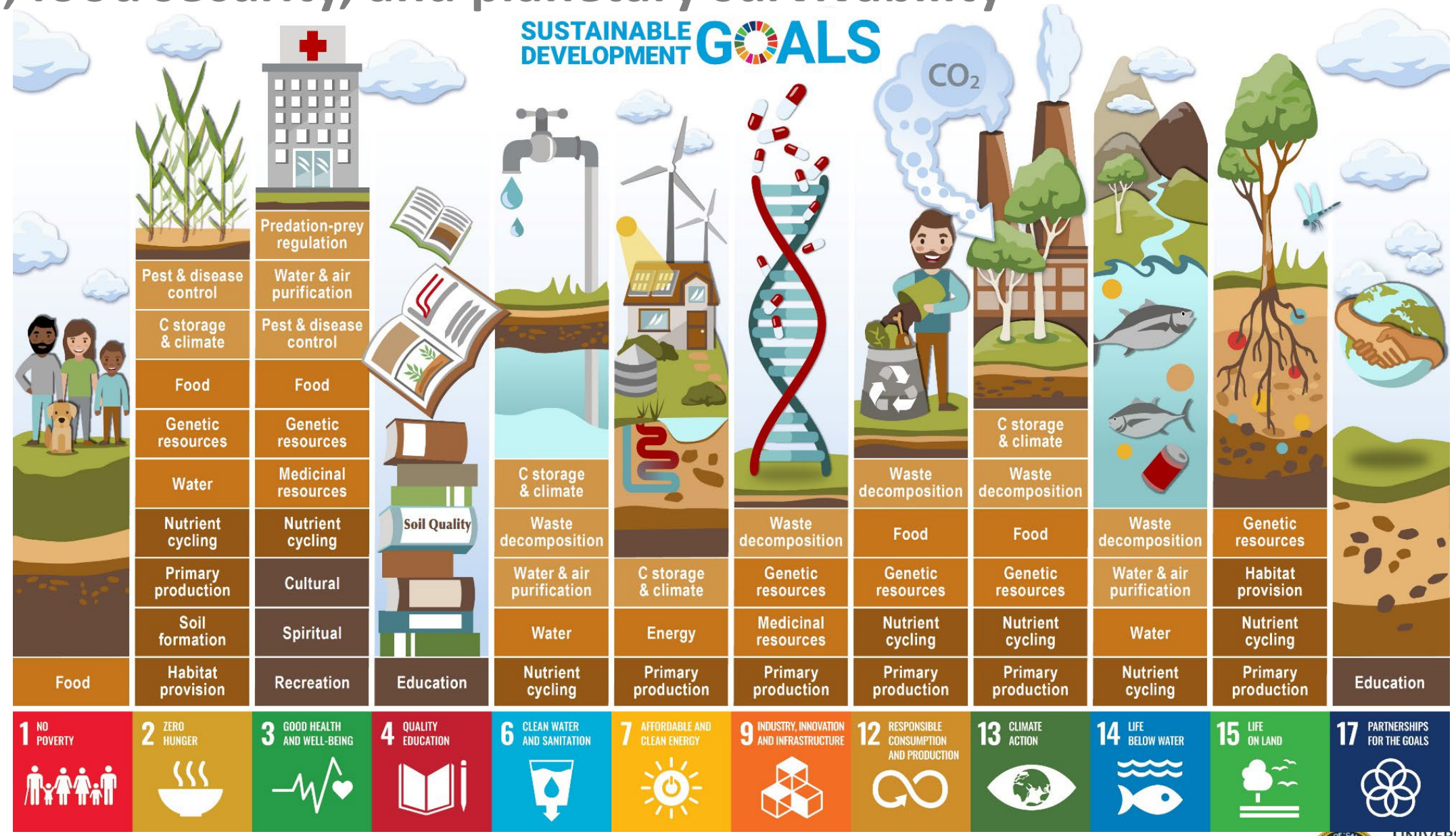
Soil, food security, and planetary survivability



Kopittke, Berhe, et al. 2022 (Critical Reviews in Environmental Science and Technology).

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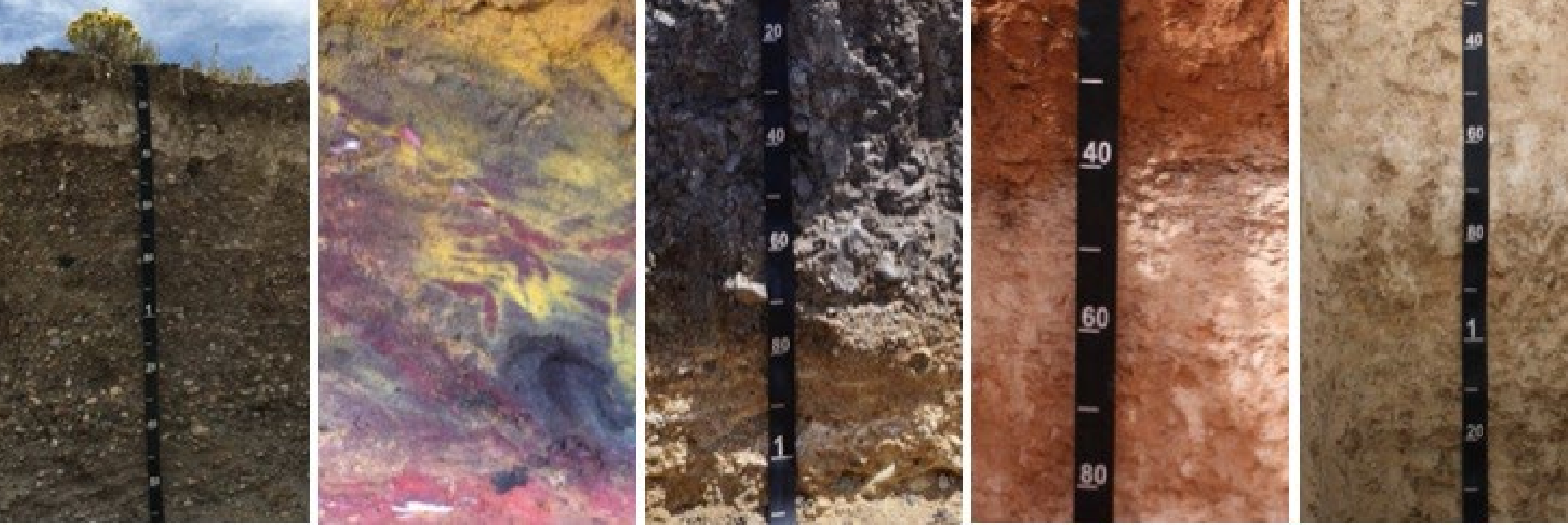

Photo source: Karen Vaughn

Acknowledgements: The work presented here was result of collaborations with numerous scholars and was primarily supported by :