International Center for Tropical Agriculture
Since 1967 / Science to cultivate change

The soils advantage for transforming agriculture

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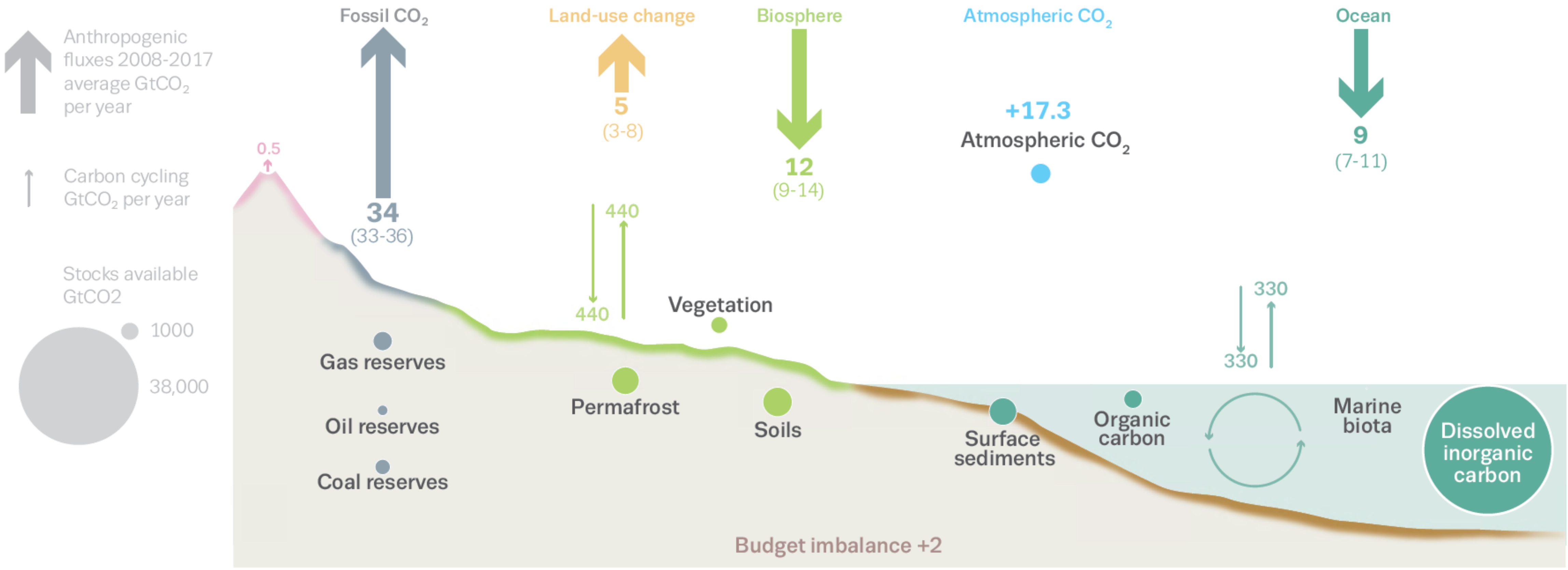
Anthropogenic perturbation of the global carbon cycle

Perturbation of the global carbon cycle caused by anthropogenic activities, averaged globally for the decade 2008–2017 ($GtCO_2$/yr)



Agricultural Non-CO_2:
6 Gt CO_2e (CH_4 & N_2O)

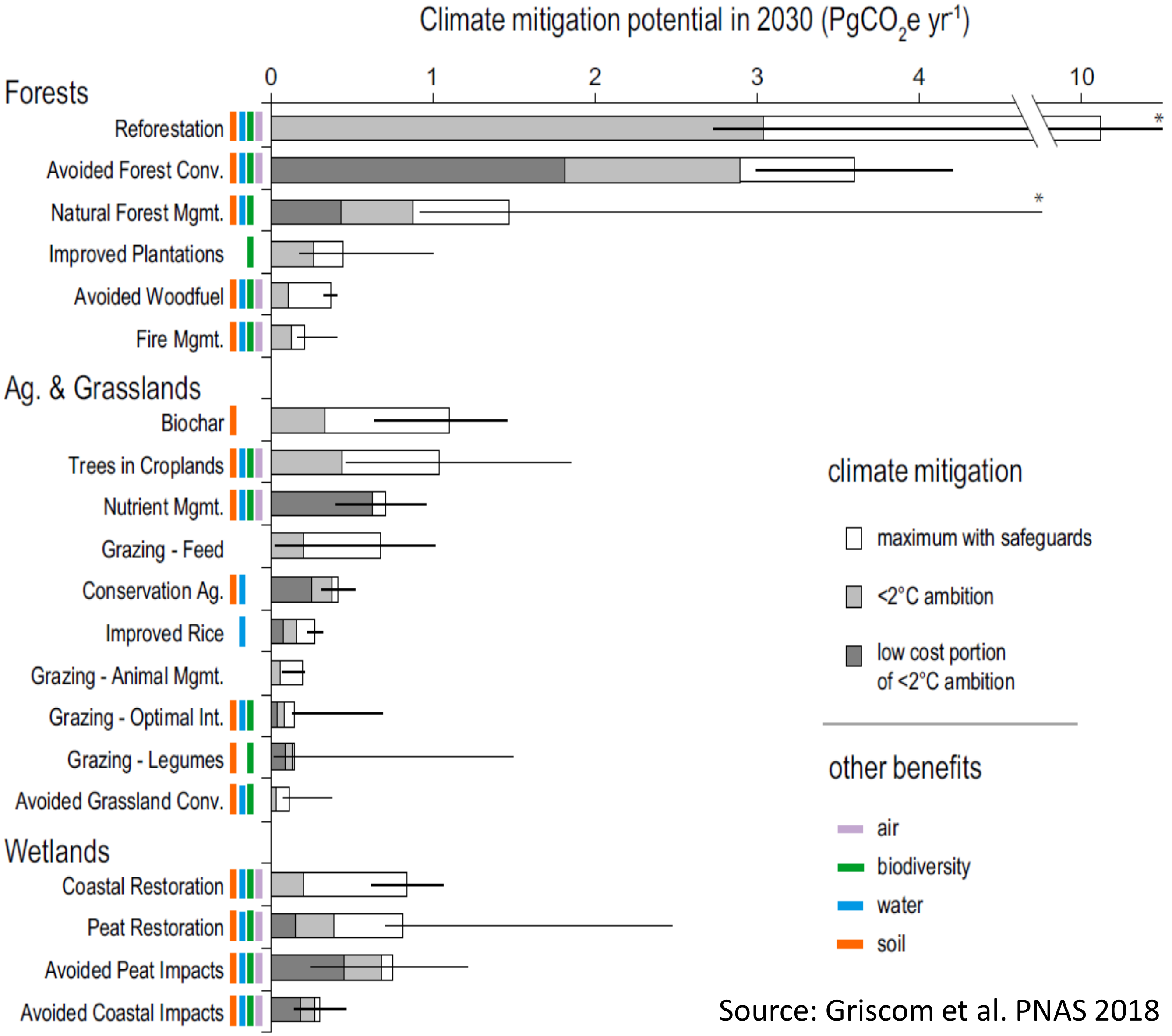
The budget imbalance is the difference between the estimated emissions and sinks.
Source: CDIAC; NOAA-ESRL; Le Quéré et al 2018; Ciais et al. 2013; Global Carbon Budget 2018

20 conservation, restoration, and improved land management actions to increase C storage/avoid GHG emissions across forests, wetlands, grasslands, and agricultural lands

- 23.8 Gt of CO_2 equivalent per year
- About half of this is cost-effective

- Natural climate solutions:
  - 37% mitigation needed through 2030
  - >66% chance of warming to below 2°C if combined with aggressive fossil fuel emissions limits

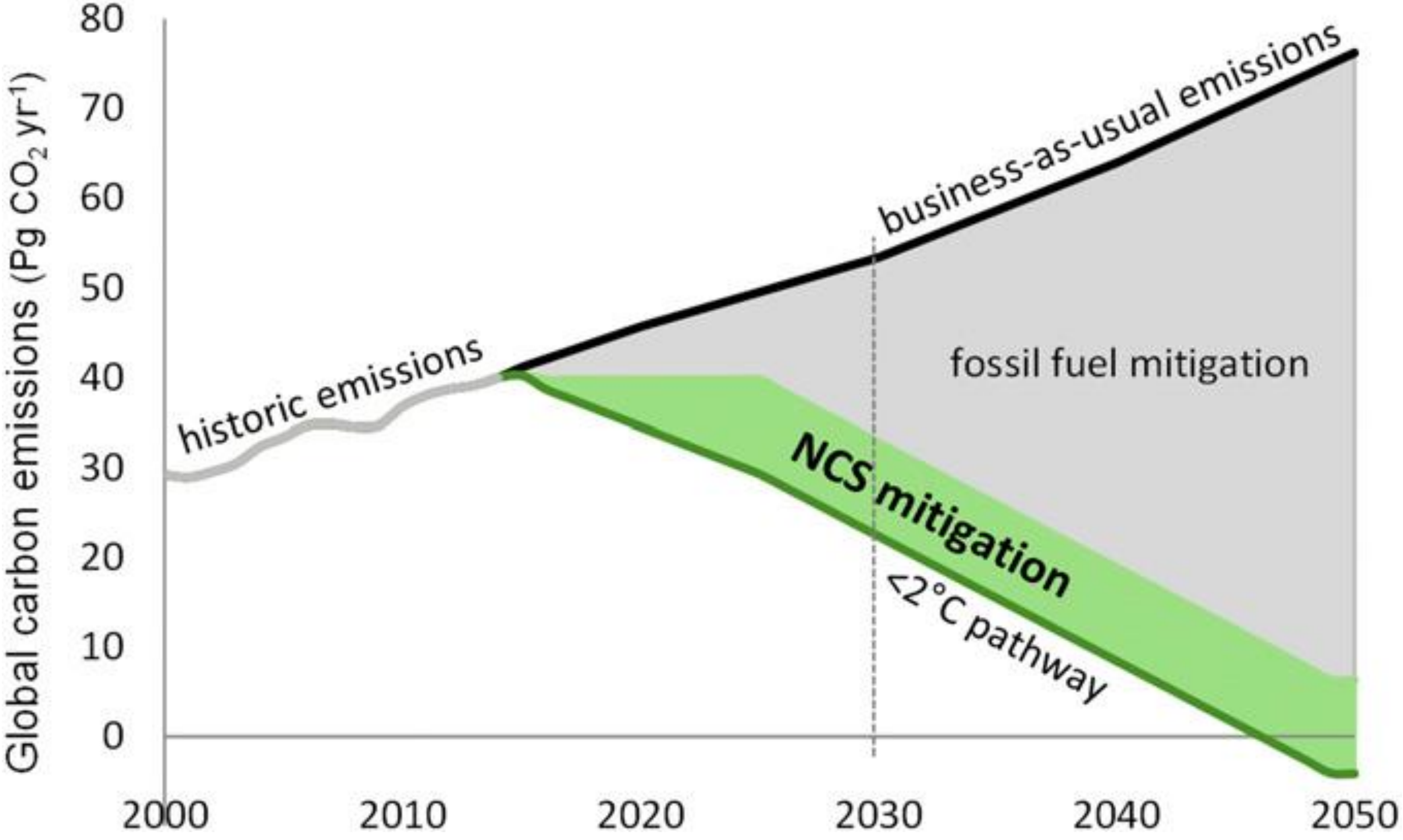
- Co benefits
  - water filtration
  - flood buffering
  - soil health
  - biodiversity habitat
  - enhanced climate resilience



Source: Griscom et al. PNAS 2018

The contribution of natural climate solutions decreases over time and the proportion depends on the baseline

- RCP 8.5 trajectory (black line)
- The green area:cost effective NCS (aggregate of 20 pathways)
- % of needed mitigation
  - 37% through 2030,
  - 29% at year 2030,
  - 20% through 2050,
  - 9%through 2100



Source: Griscom et al. PNAS 2018

Soil solutions

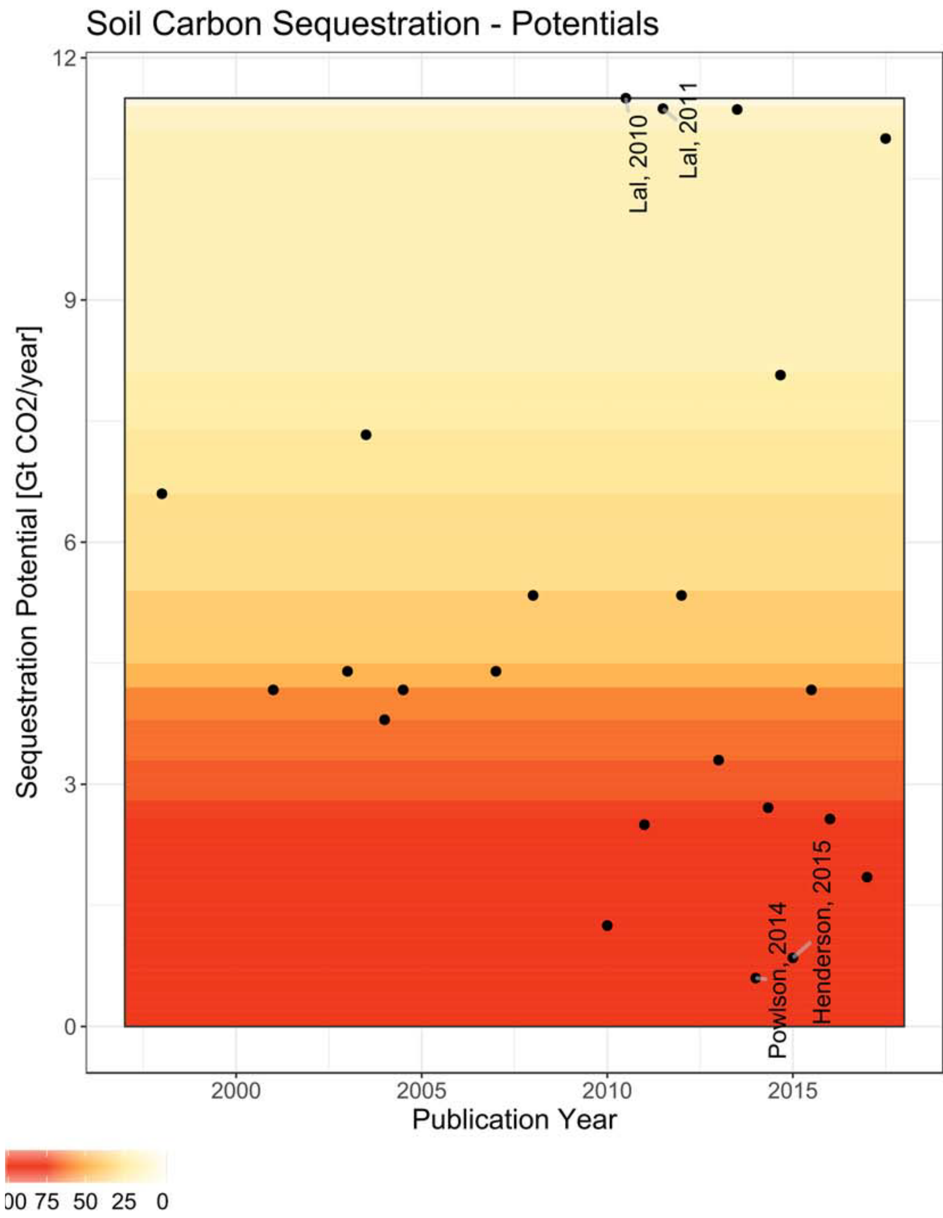
Biochar

- 0.6 to 6 Gt CO_2 y^{-1}
- Requires available biomass
- 3 Gt if all forest slash and 50% crop residue used
- 6 Gt if 80 % of all harvested biomass is used.
- US$30 and 50/$tCO_2$
- Meta analysis: Crop productivity increases by 10% (high variability)
- Lower N_2O and CH_4 emissions
- Albedo
- Changes in soil microbial community?

Sources: data Fuss et al. 2018; Image ETH Zurich

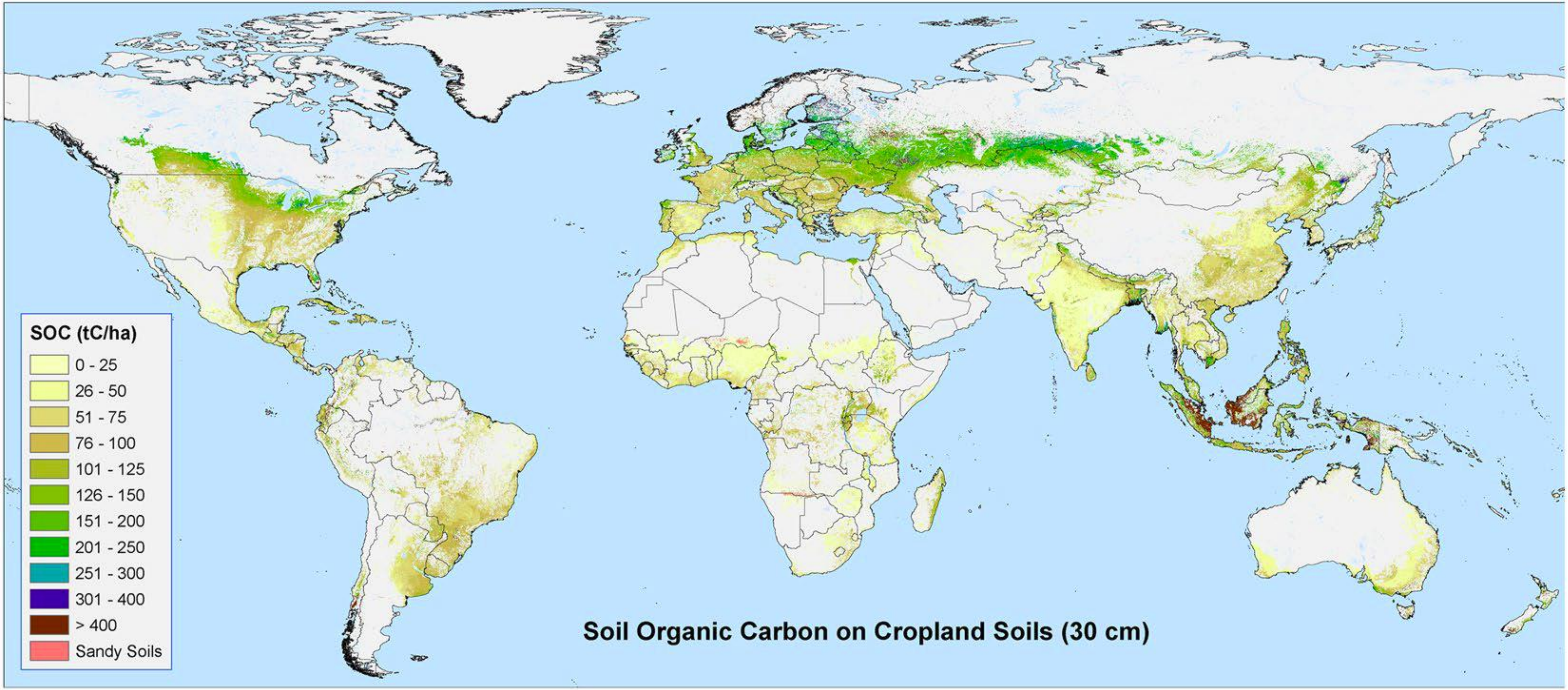
Soil solutions

- Review of 22 articles
- Shading shows the percentage of studies with max potential ≥ each value
- Technical potentials Gt CO_2 yr^{-1}
  - 1.3–2.9 for croplands,
  - 0.7–1.7 desertification control
  - 3.6 dryland ecosystems
  - 1. 5–3.7 reclamation of agricultural soils
  - 0.4–0.6 for no tillage in croplands
  - 0.5– 1.3 for degraded land restoration
  - 4–8 for agro-forestry
  - 1.1–2.5 through forestry and agriculture
  - 3.3–6.7 in croplands
  - 1.4–2.7 for croplands and pastures
  - 0.15 and 0.20G for grazing optimization and planting of legumes in grazing land



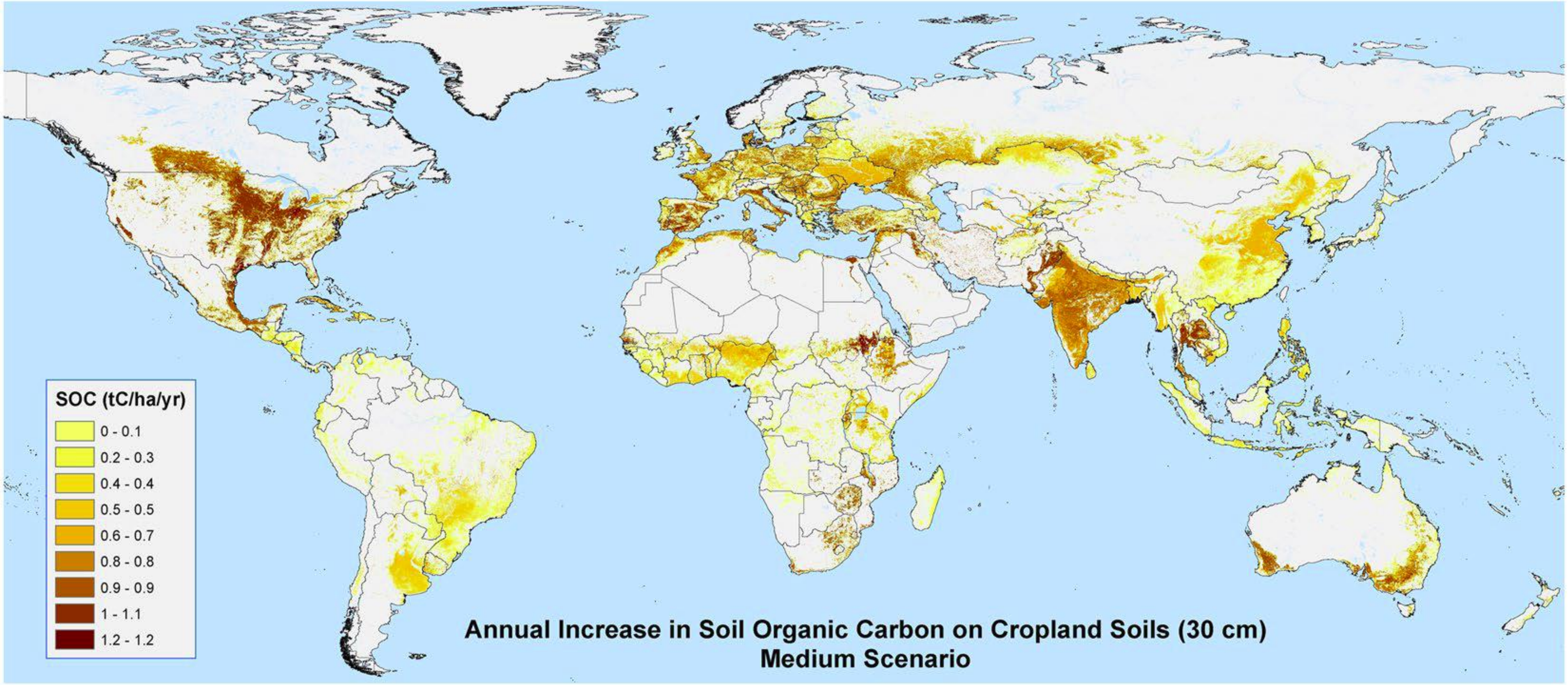
Sources: data Fuss et al. 2018

Where in the world is soil carbon?



Source: Zomer et al 2017, SoilGrids database

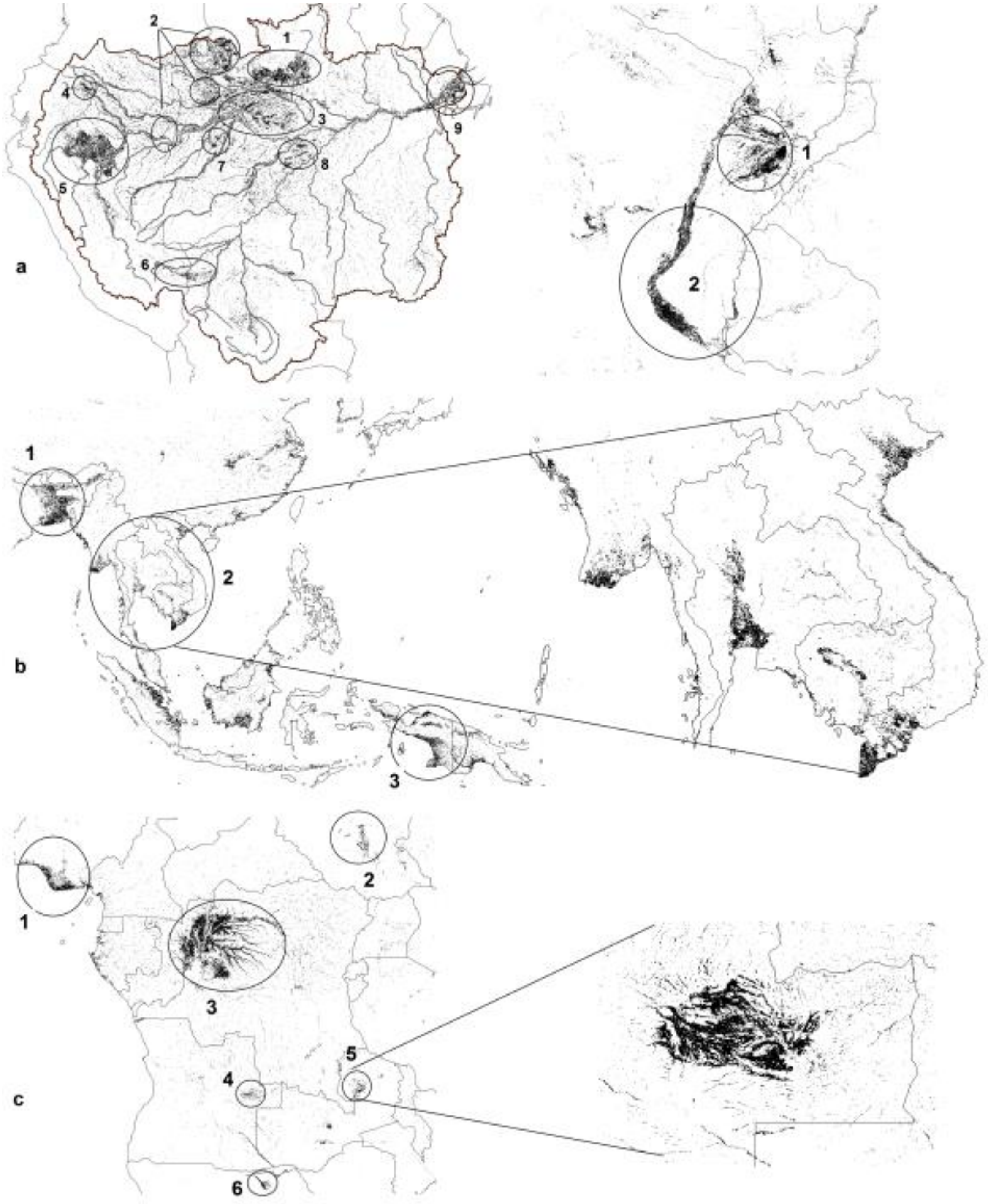
Where in the world’s croplands can you sequester soil C?



Tropical peatlands: some new understandings

- 3% of the global land area, 30% of the global soil carbon, 6% in the tropics
- Global drained and burned peatlands: $1GtCO_2e.yr^{-1}$ (10% of global GHG emissions in 2000-2009) (IPCC AR5)
- Transboundary haze effects
- Mitigation and adaptation synergies, and co-benefits (water, biodiversity, livelihoods, etc.)
- Transparency initiatives: TRASE. Connecting commodity producers, distributors and consumers.
- New data on histosols and peatlands.

Under-reported peatland hotspots



South America: Amazon Basin, Rio La Plata, Ibera Wetlands

Asia: Bangladesh,all river deltas, Indonesian Papua

Africa: Niger river delta, Angola, Zambia, South Sudan.

Gumbricht et al. (2017) Global Change Biology

Mitigation potential of tropical peatlands

	Total area Mkm²	Volume km³	Depth (m)	Stocks GtC
Estimates in Page et al., (2011)	0.44 (0.39-0.66)	1,758 (1,585-1,822)	2.3	89
Gumbricht et al. (study area of Page et al., (2011)	1.5	6,991 (5,765-7,079)	2.5	352

- **Tropical peat stocks:** Four-fold increase **(89 to 352 GtC)**

  Mitigation potential using conservative annual emissions**:** 0.3 $GtC.yr^{-1}$ (IPCC AR5)

Source: Gumbricht et al. 2017 Global Change Biology.


Thank you