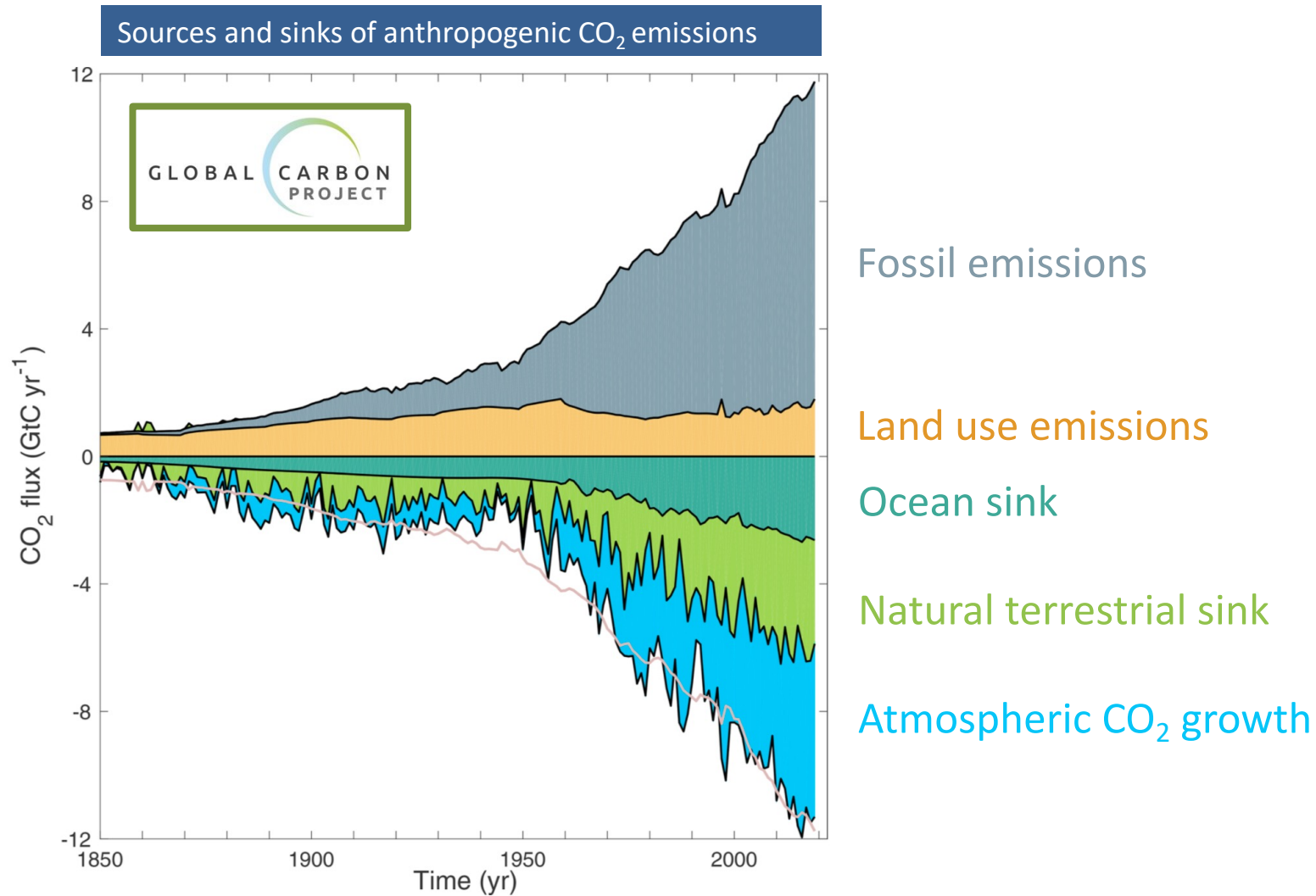


# Land use change and carbon fluxes

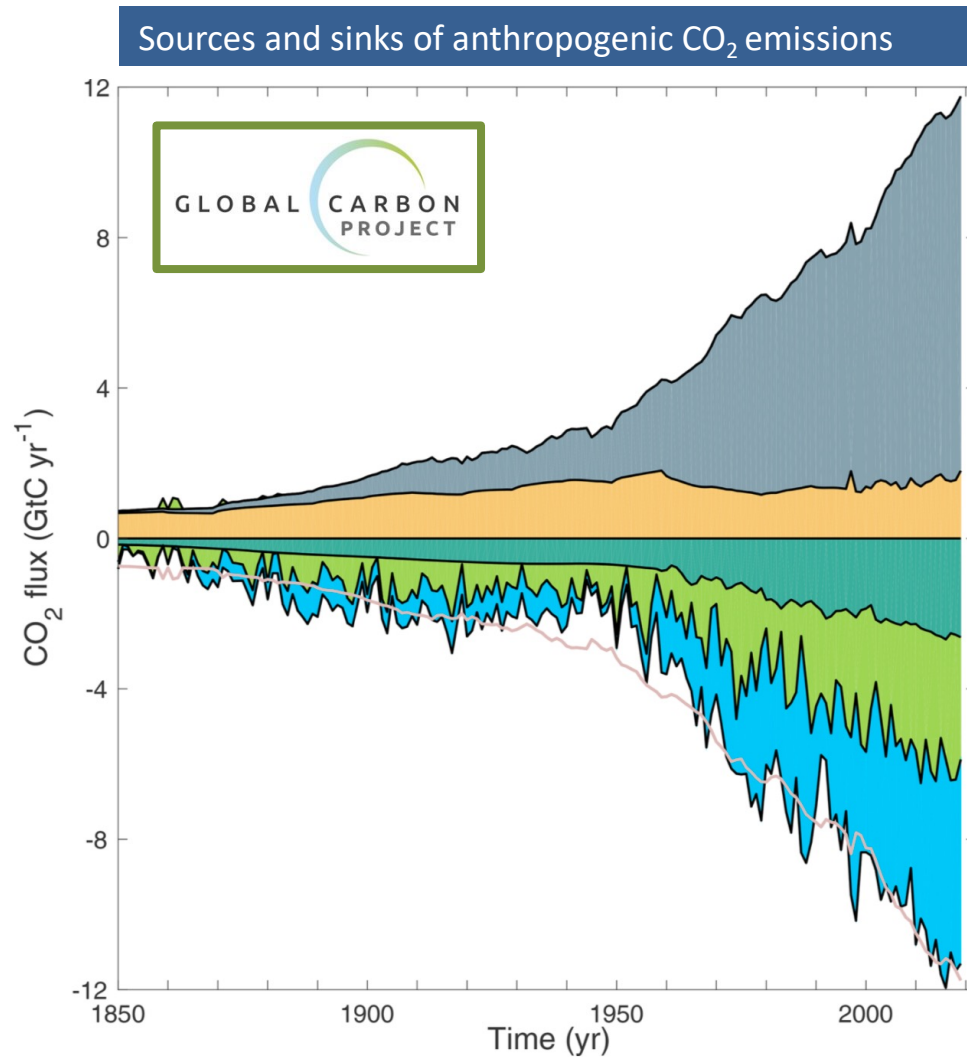
Julia Pongratz, LMU München  
julia.pongratz@lmu.de



# The global carbon budget and its anthropogenic disturbances



# The global carbon budget and its anthropogenic disturbances



Fossil emissions

Land use emissions

Ocean sink

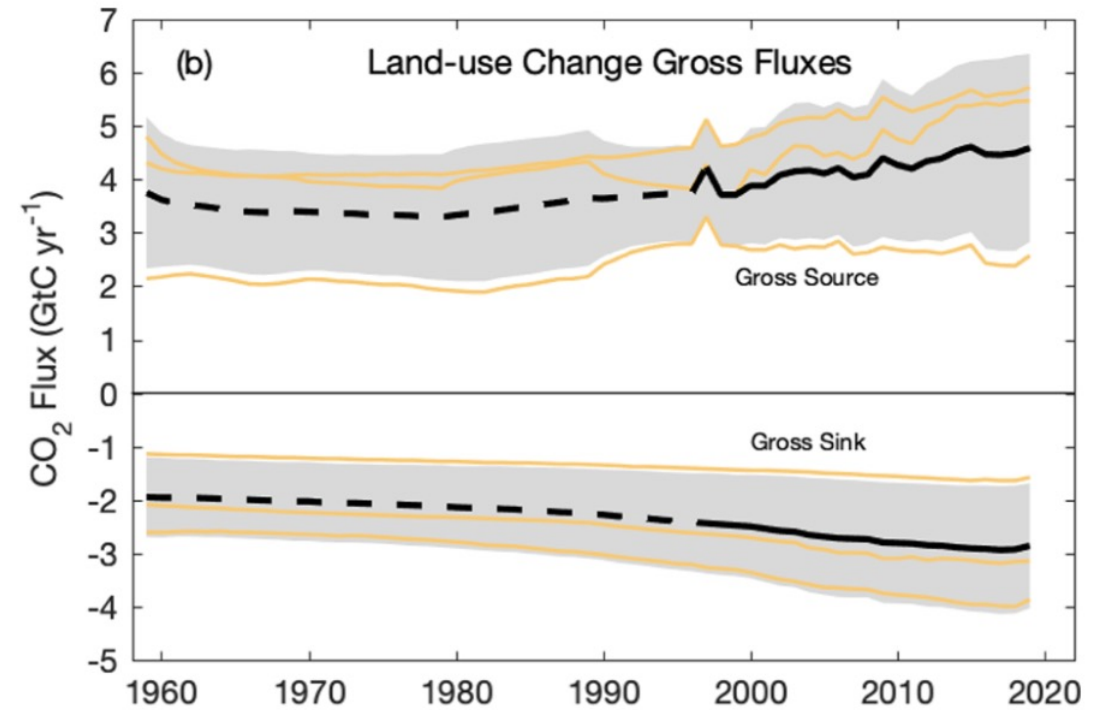
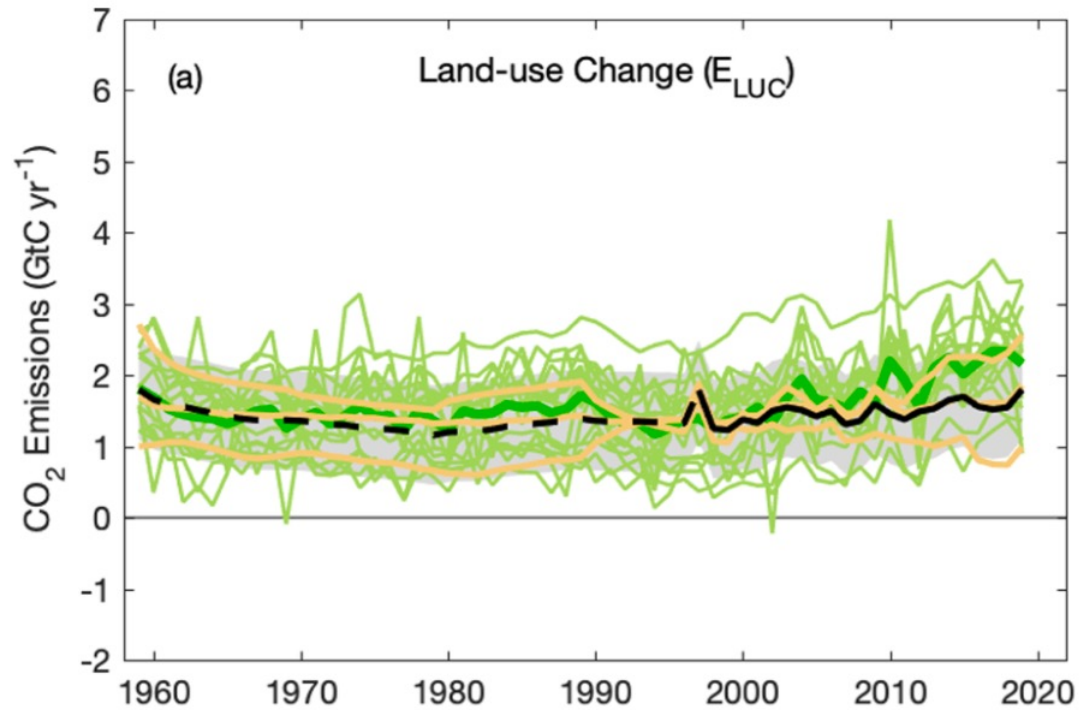
Natural terrestrial sink

Atmospheric CO<sub>2</sub> growth

Land use emissions/sources,  
e.g. deforestation;  
theoretically: erosion

Land use removals/sinks,  
e.g. regrowth;  
theoretically: sedimentation

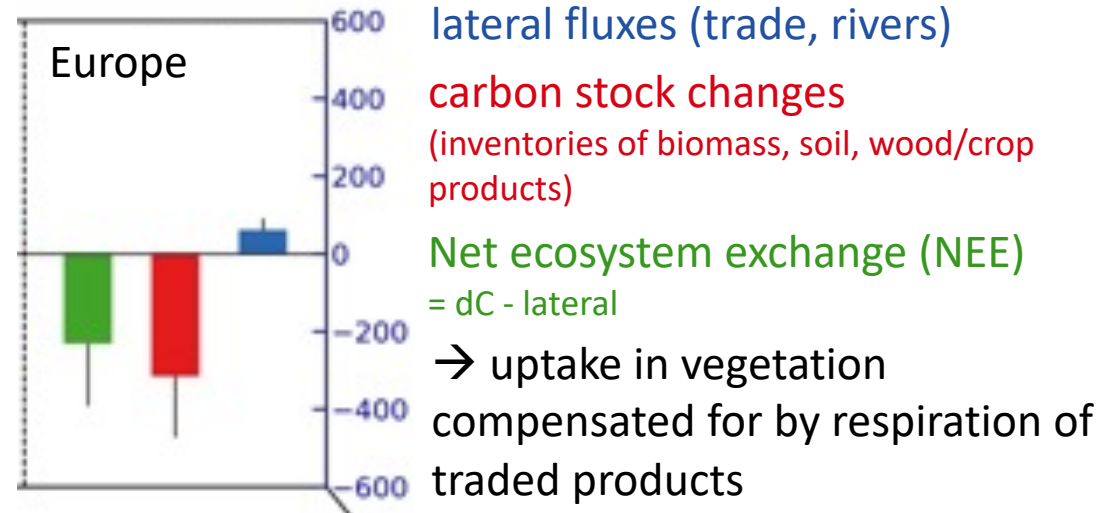
# The global carbon budget and its anthropogenic disturbances



- Gross land use emissions and removals are 2-3 times larger than the resulting net flux
- Huge potential for managing for mitigation

# Relevance of lateral fluxes for the terrestrial carbon cycle

Terrestrial carbon budget (TgC/yr) for Europe compiled from multitude of observational data



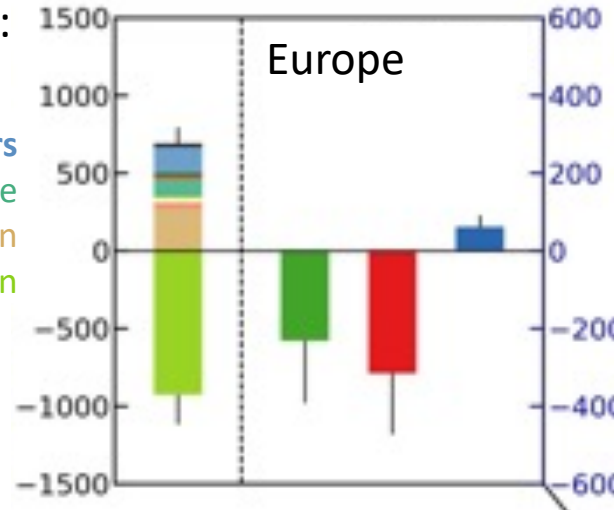
# Relevance of lateral fluxes for the terrestrial carbon cycle

Terrestrial carbon budget (TgC/yr) for Europe compiled from multitude of observational data

bottom-up estimate of NEE:

- lakes, rivers
- grazing, manure
- crop consumption
- NPP + soil heterotrophic respiration

- sources show large relevance of management
- soil respiration can be derived as NPP – sources



lateral fluxes (trade, rivers)

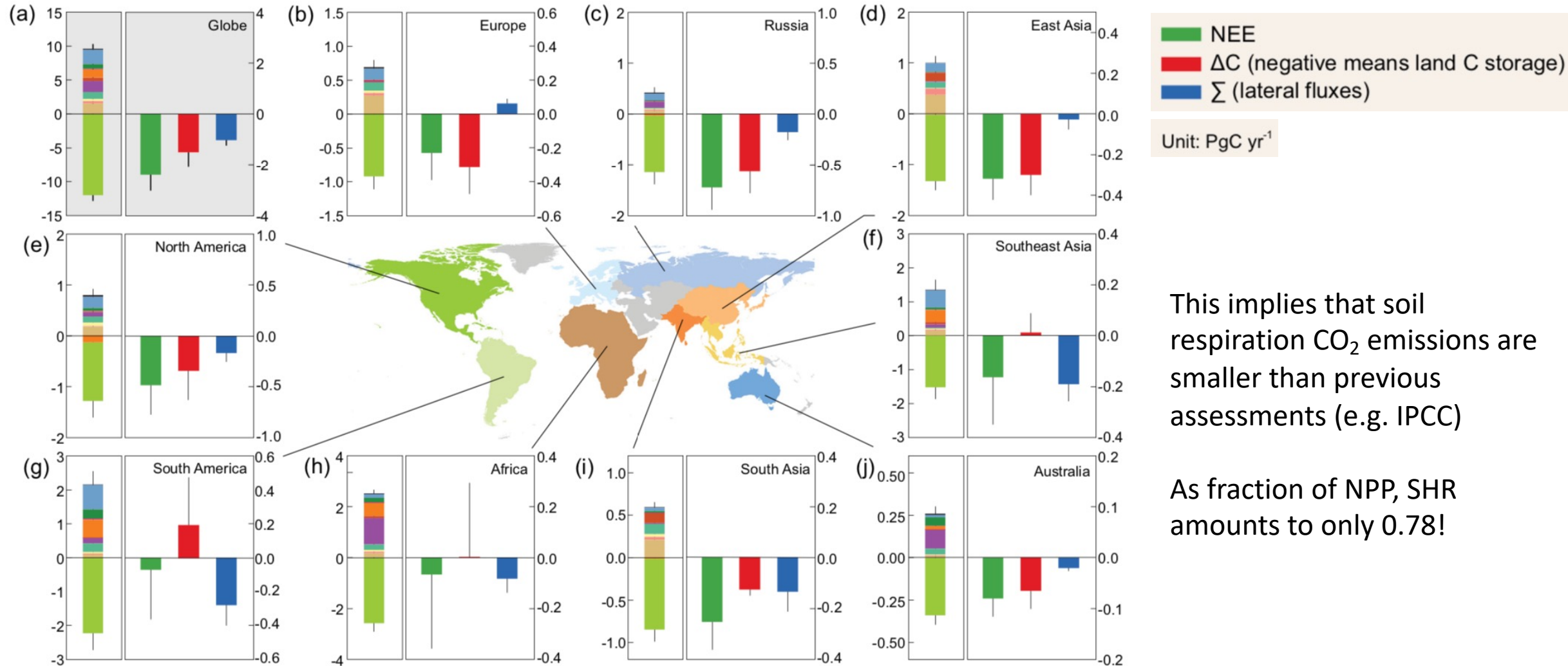
carbon stock changes  
(inventories of biomass, soil, wood/crop products)

Net ecosystem exchange (NEE)  
= dC - lateral

→ uptake in vegetation  
compensated for by respiration of  
traded products

# Relevance of lateral fluxes for the terrestrial carbon cycle

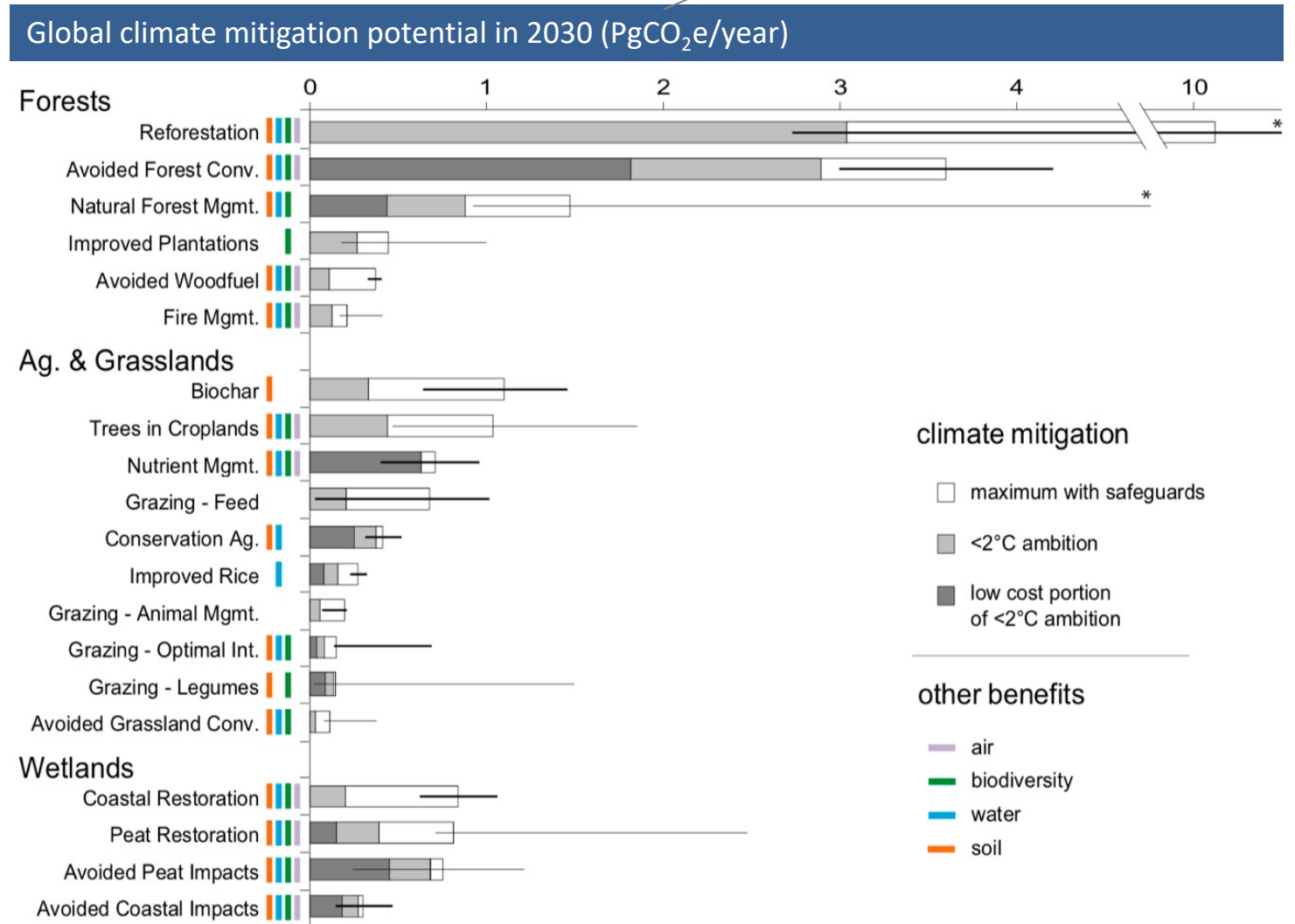
Terrestrial carbon budget (TgC/yr) for Europe compiled from multitude of observational data



# Erosion in the “natural climate solutions” context

1 PgCO<sub>2</sub> = 0.27 PgC 

- “NCS” → Protect, restore or sustainably manage ecosystems with the goal of mitigating climate change, while also addressing other societal challenges

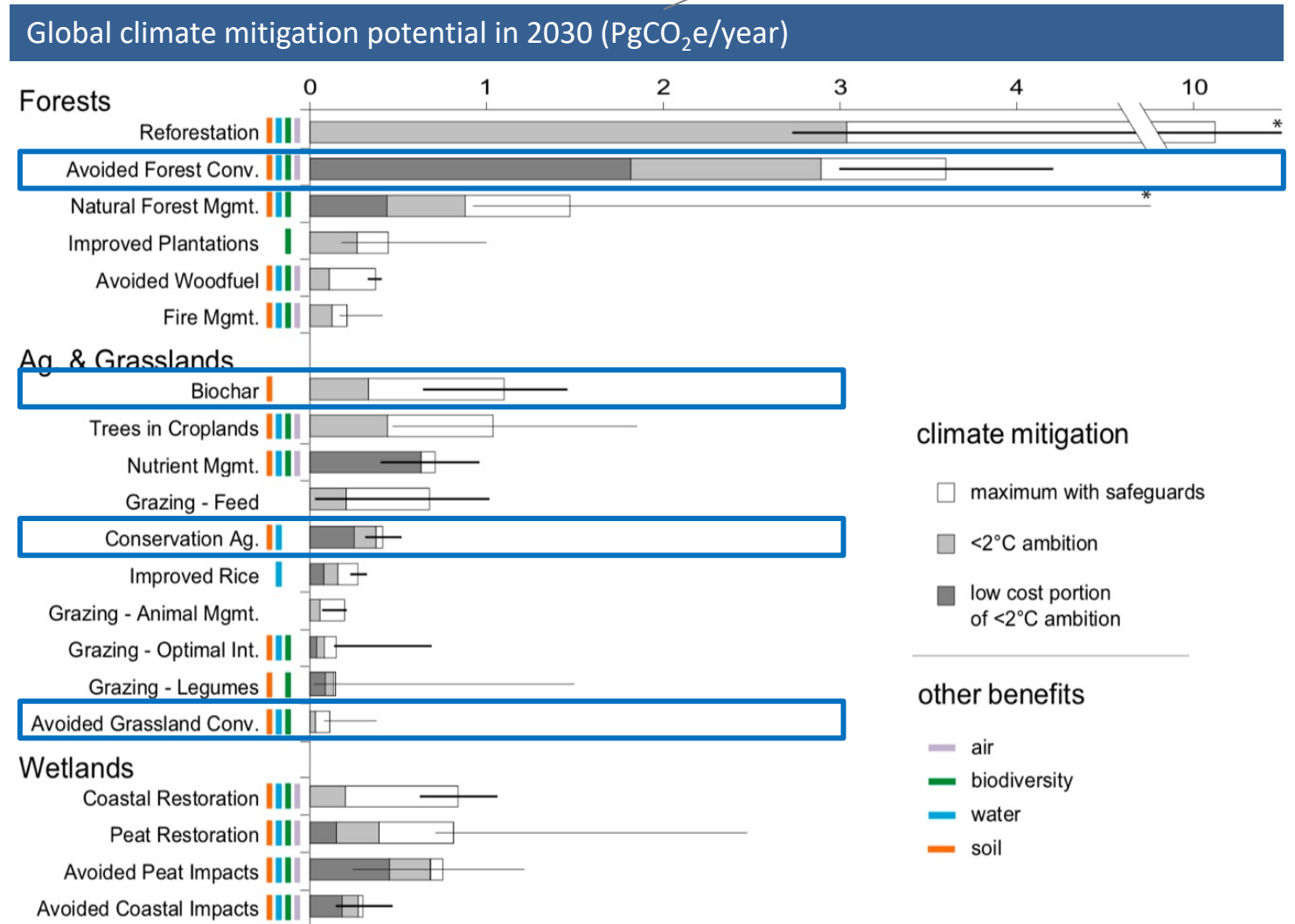




# Erosion in the “natural climate solutions” context

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- “NCS” → Protect, restore or sustainably manage ecosystems with the goal of mitigating climate change, while also addressing other societal challenges



+ enhanced weathering

# Way forward

- Accurate estimates with global coverage of erosion and sedimentation fluxes for the last century are of high relevance for carbon cycle assessments (Global Stocktake!)
  - Good progress on global erosion fluxes → see talk by P. Borrelli
  - Some progress on for the process-based C cycle models used in global budgeting

**Improving the global applicability of the RUSLE model –  
adjustment of the topographical and rainfall erosivity factors**

GMD, 2015

V. Naipal<sup>1</sup>, C. Reick<sup>1</sup>, J. Pongratz<sup>1</sup>, and K. Van Oost<sup>2</sup>

**Modeling long-term, large-scale sediment storage using  
a simple sediment budget approach**

ESD, 2016

Victoria Naipal<sup>1</sup>, Christian Reick<sup>1</sup>, Kristof Van Oost<sup>2</sup>, Thomas Hoffmann<sup>3</sup>, and Julia Pongratz<sup>1</sup>

**CE-DYNAM (v1): a spatially explicit process-based carbon erosion  
scheme for use in Earth system models**

GMD, 2020

Victoria Naipal<sup>1,2</sup>, Ronny Lauerwald<sup>3</sup>, Philippe Ciais<sup>1</sup>, Bertrand Guenet<sup>1</sup>, and Yilong Wang<sup>1</sup>

- (Reducing) erosion gains importance in the mitigation & CDR context; trade-offs/synergies with other CDR options need better understanding