Terrestrial Wetlands – Chapter 13

2nd State of Carbon Cycle Report

R. Kolka, C. Trettin, W. Tang, K. Krauss, S. Bansal, J. Drexler, K. Wickland, R. Chimner, D. Hogan, E. Pindilli, B. Benscoter, B. Tangen, E. Kane, S. Bridgham and C. Richardson

Wetlands :

- Hydrophytic vegetation
- Hydric soil
- Saturated soils near surface during growing season

C Stocks: f(wetland type, climate, vegetation hydrogeomorphic setting)

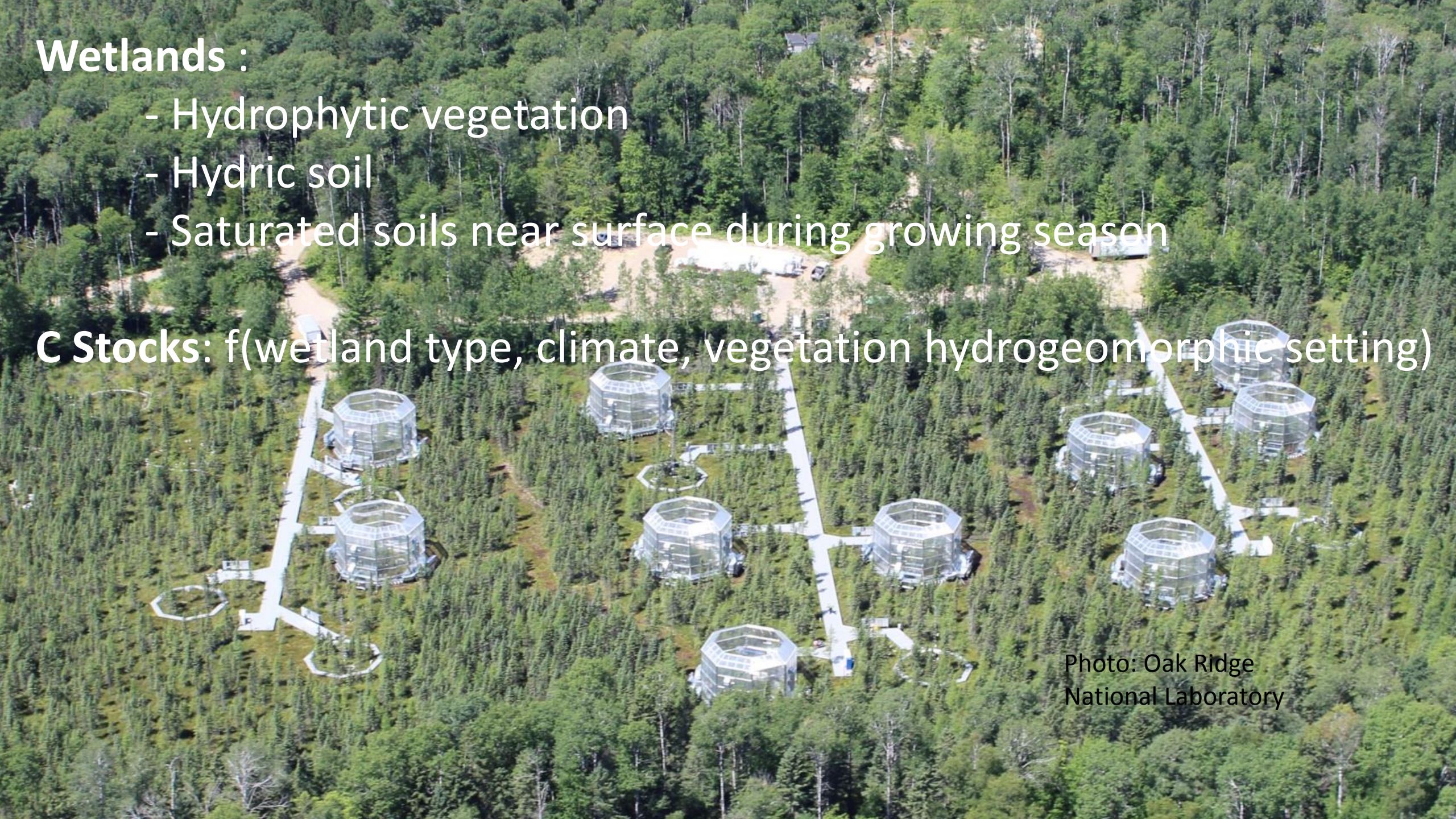


Photo: Oak Ridge National Laboratory

Organic Soil vs Mineral Soil Wetlands: Definition

Organic Soils :

- Peatlands (Bogs and Fens)
- Soil Order Histosols
- >18% Organic C in the Upper 40 cm

Mineral Soils:

- Don’t Meet the Definition of Organic Soils but still Hydric
- Prairie Potholes, Marshes, Black Ash Wetlands
- In Many of the Soil Orders – Wet End
- <18% Organic C in the Upper 40 cm

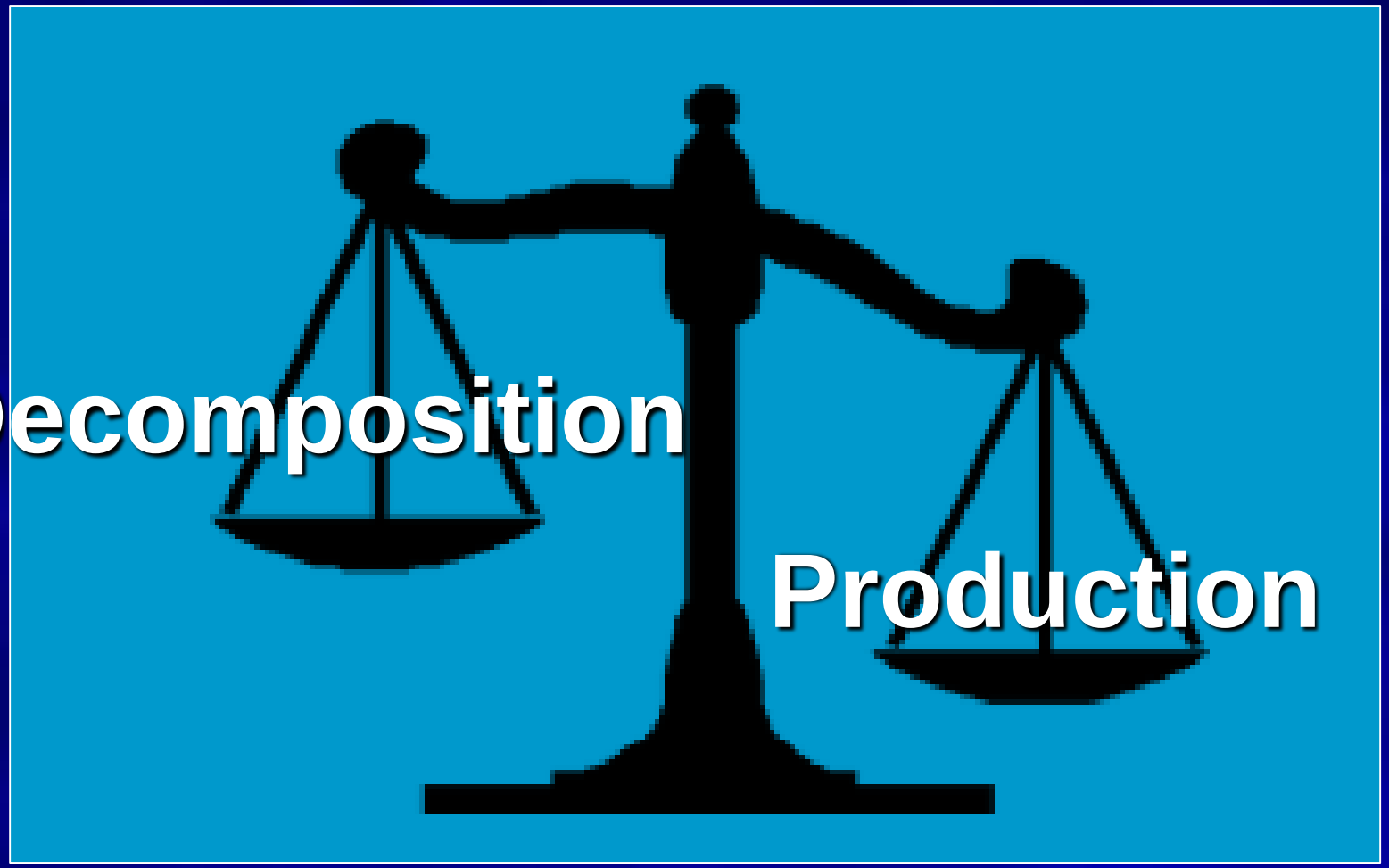
Wetland Functions

- Carbon Sink
- Hydrology/Water Quality
- Habitat

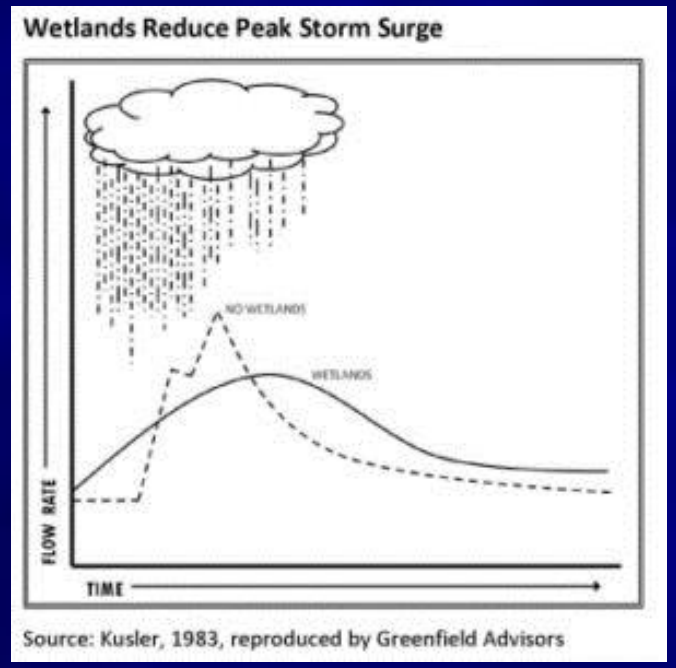
Wetland Functions

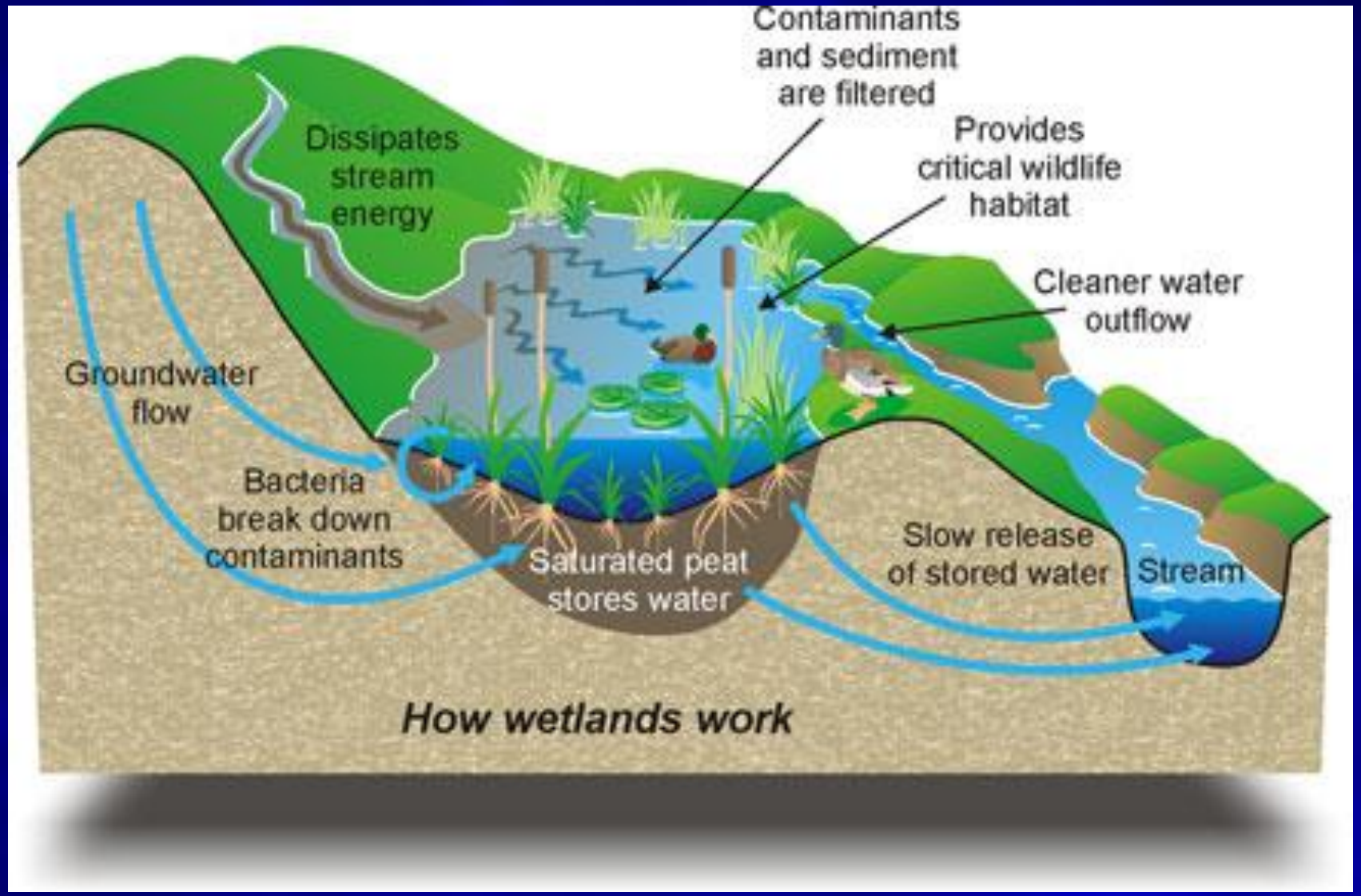
- Carbon Sink
  - Peatlands = 3% of terrestrial area, 30% of soil C
  - Numerous studies indicate that wetlands continue to be sinks for C
  - Some studies and models indicate that wetlands are/will soon become sources of C

Starting to Change?



Wetland Functions



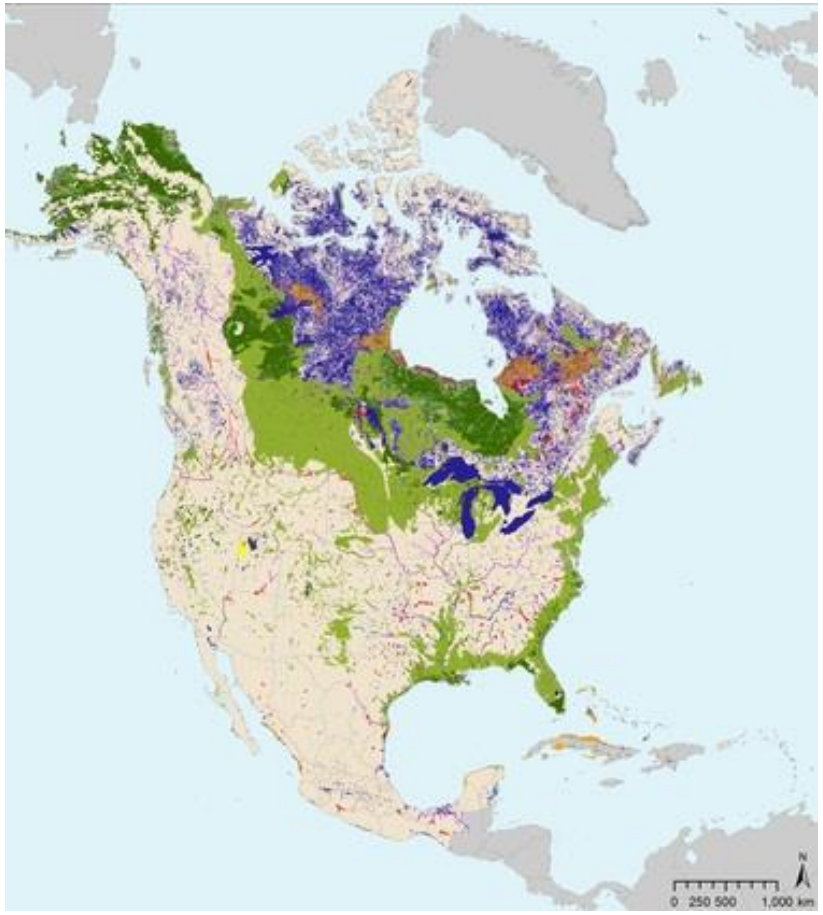


Wetland Functions

- Habitat
  - Animals and Endangered Plants

Terrestrial Wetlands Chapter Scope

- Geography
  - Alaska
  - Canada
  - Conterminous U.S.
  - Mexico
  - Puerto Rico (Hawaii not reported)
- Wetlands
  - Included
    - Terrestrial freshwater wetlands
  - Not included
    - Tidal, marine wetlands → Chap. 15
    - Tidal, freshwater wetlands → Chap. 15
    - Open water bodies (lakes, streams) → Chap. 14
    - Arctic wetlands → Chap. 11
    - Converted wetlands → Chap. 5



(from Commission on Environmental Cooperation, based on Lehner and Döll 2004)

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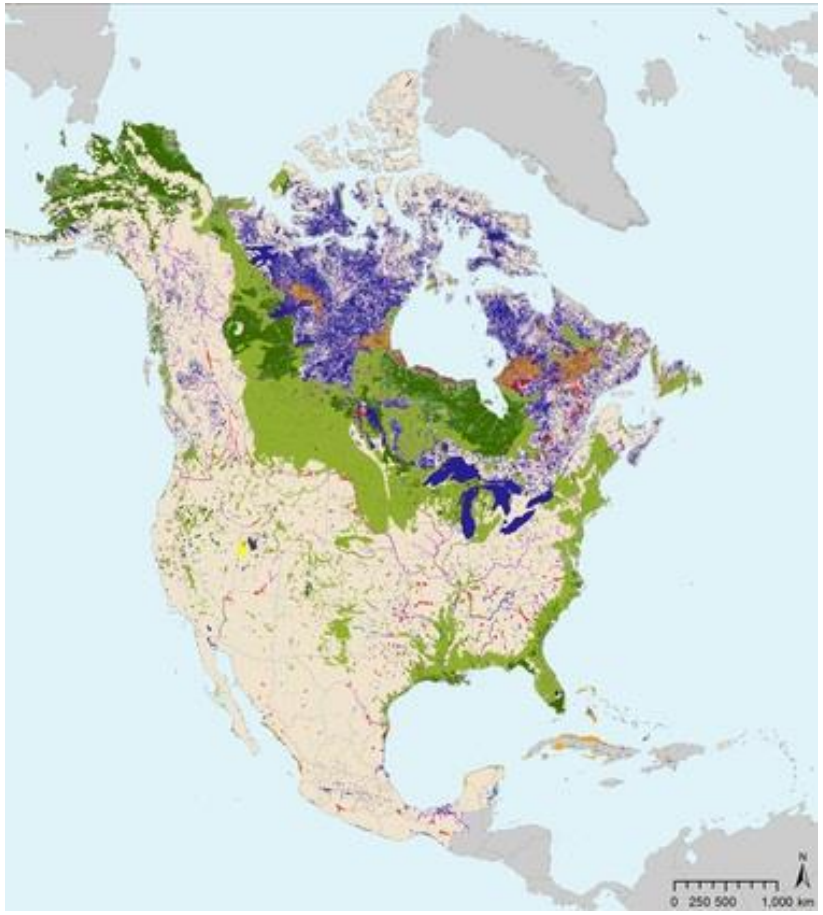
[Carbon Cycling in North America's Land-Ocean Aquatic Continuum, by Ray Najjar, Penn State]



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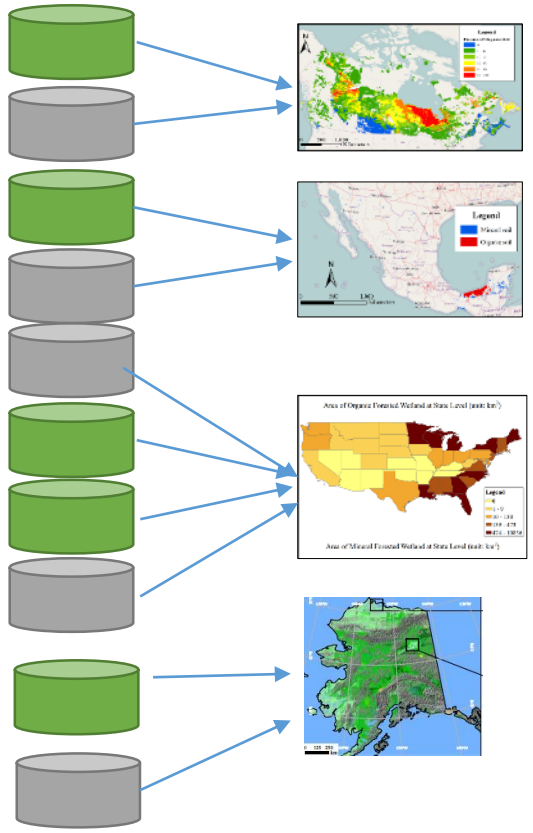
Approach

- Carbon Stocks
  - **Soil type** – mineral soils, organic soils (i.e. peat)
    Vegetation type – forested, non-forested
- Assessment
  - Wetland inventory – incorporate new assessments of wetland area (Mexico, Canada, Alaska)
  - Carbon stocks – incorporate C stock inventory (soils, vegetation) where feasible
  - Update C Stock and emission factors utilizing IPCC and literature

Basis for the Assessment

Area	Data Sources	Spatial Data Types
Canada	Peatland inventory	Vector (1:7.5million)
	Soil Landscape of Canada	Vector (1:1million)
Mexico	Wetland inventory	Vector (1:250,000)
	North America Land Cover data	Raster (250mx250m)
United States	gSSURGO (soil)	Raster (10mx10m)
	National Wetland Inventory (NWI)	Vector (1:12,000)
	FIA Forest Biomass	Raster (250mx250m)
	State boundary	Vector (1:50,000)
Alaska	Vegetated Wetlands of Alaska (Clewey et al. 2015)	Raster (50 x 50 m)
	STATSGO2	Vector (1:1million)

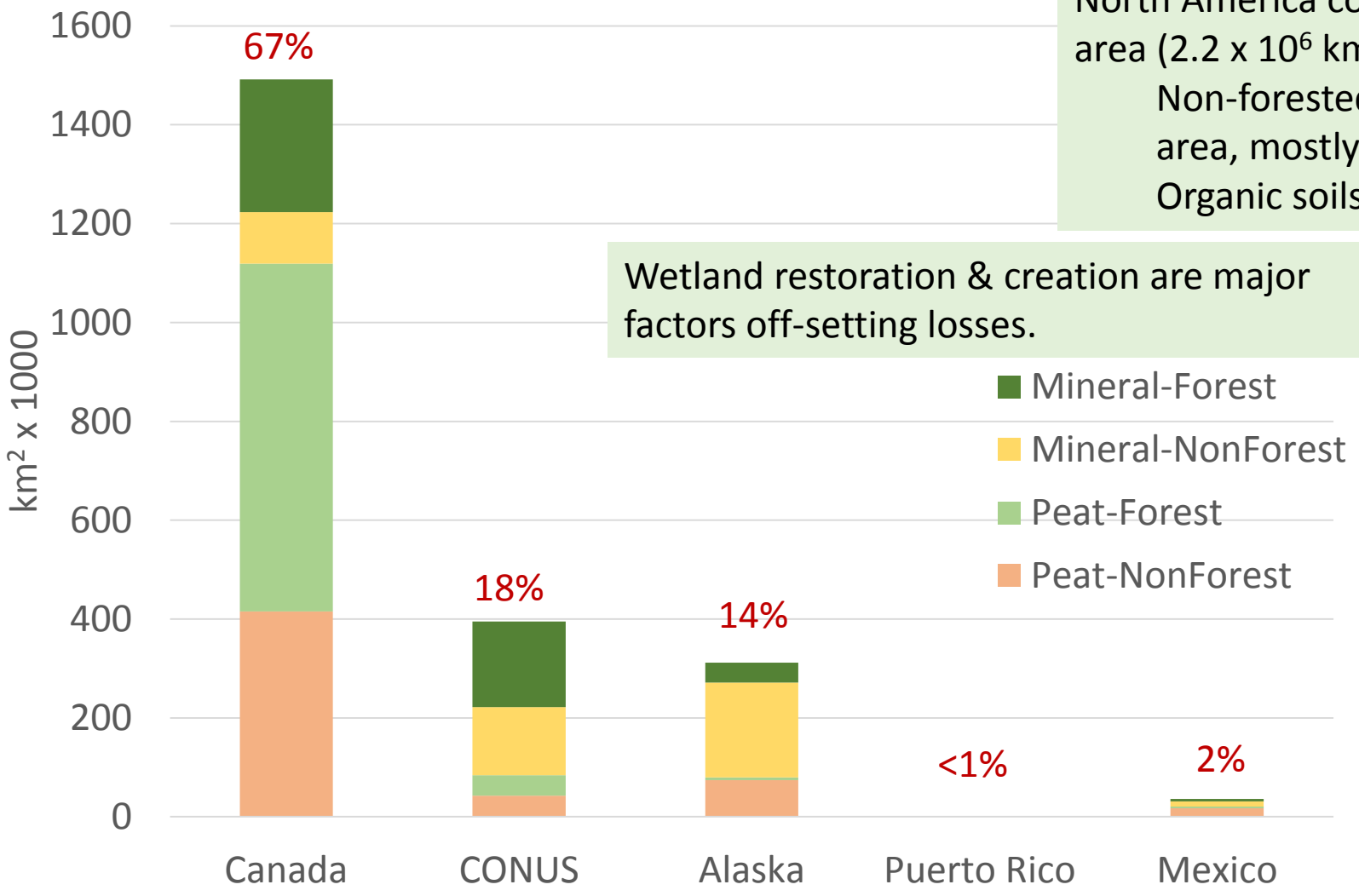


Terrestrial Wetland Area

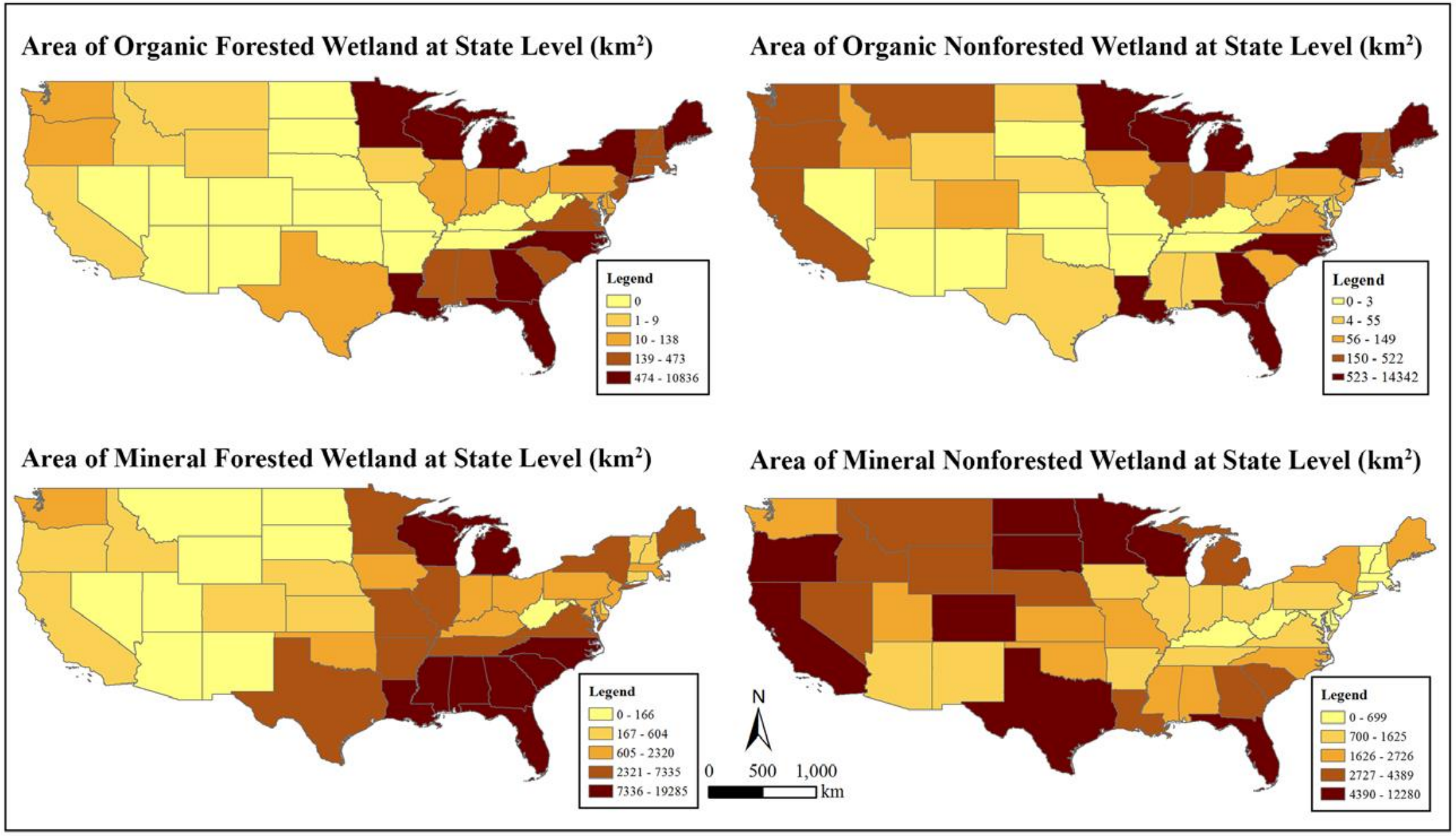
North America contains ~37% of global wetland area (2.2 x 10^6 km^2)

- Non-forested wetlands comprise ~44% of the area, mostly in Canada & Alaska
- Organic soils comprise ~58% of the area

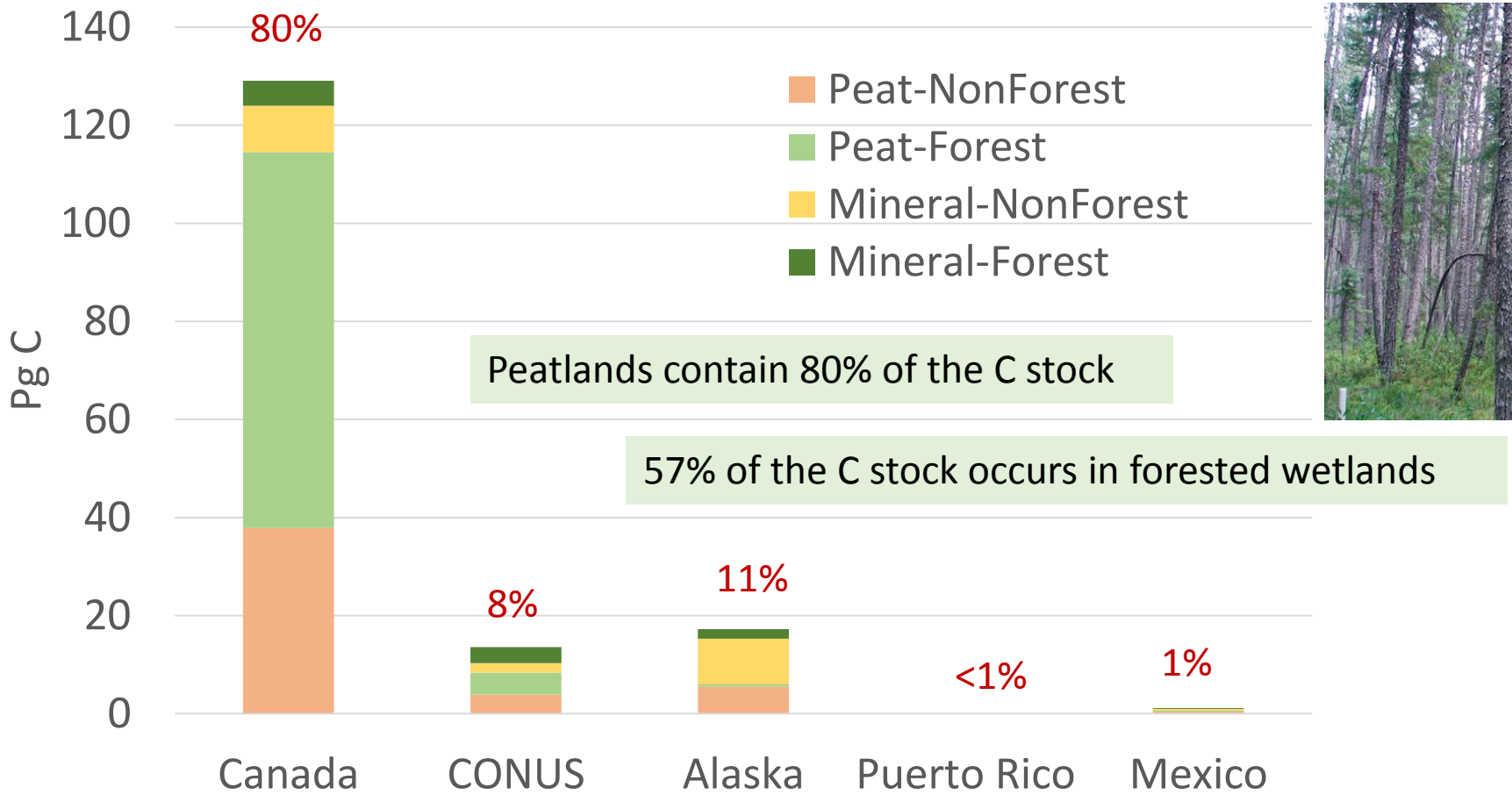
Wetland restoration & creation are major factors off-setting losses.



Terrestrial Wetland Area - CONUS



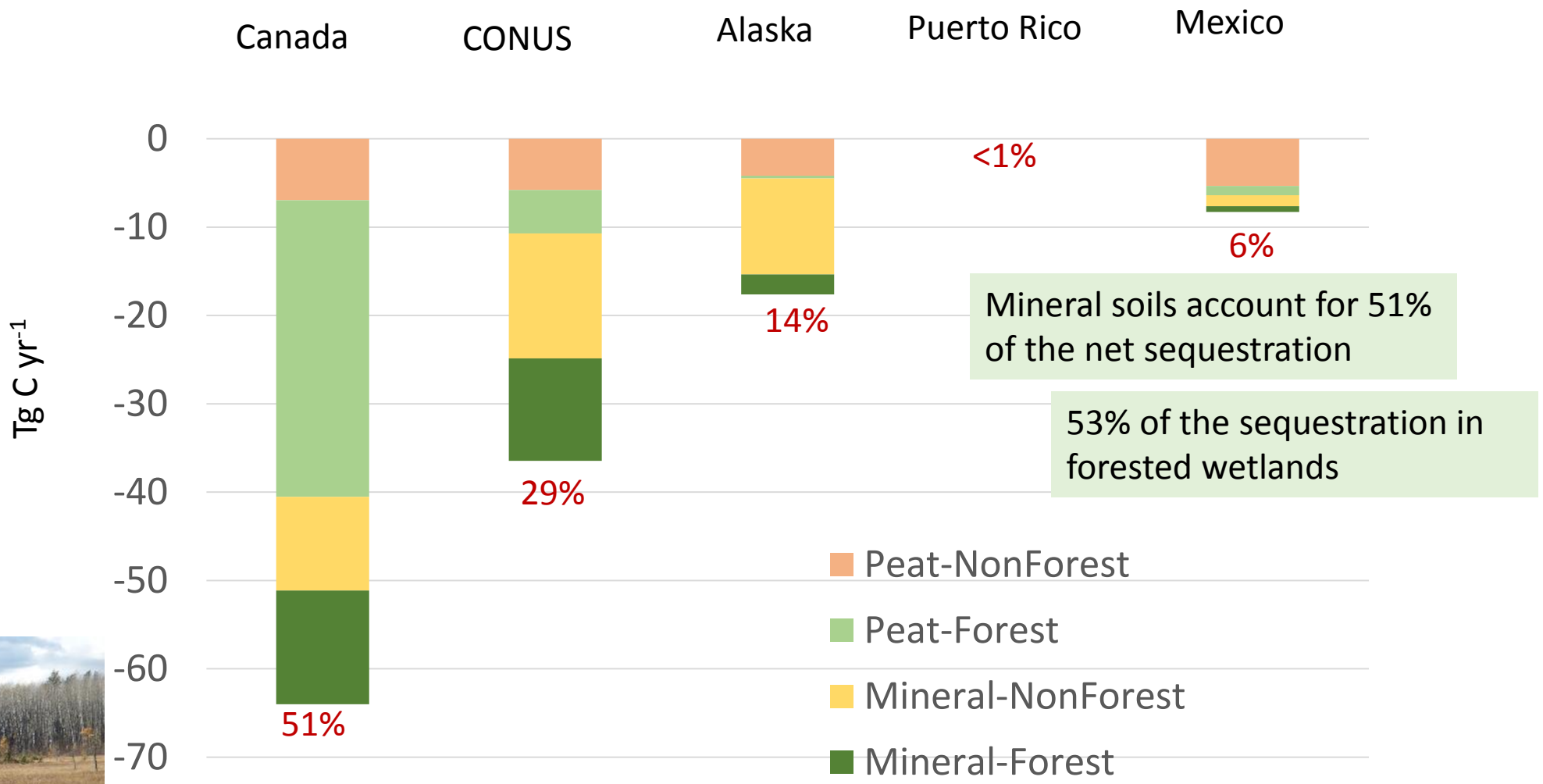
Terrestrial Wetland C Stock (Vegetation + Soil)



Peatlands contain 80% of the C stock

57% of the C stock occurs in forested wetlands

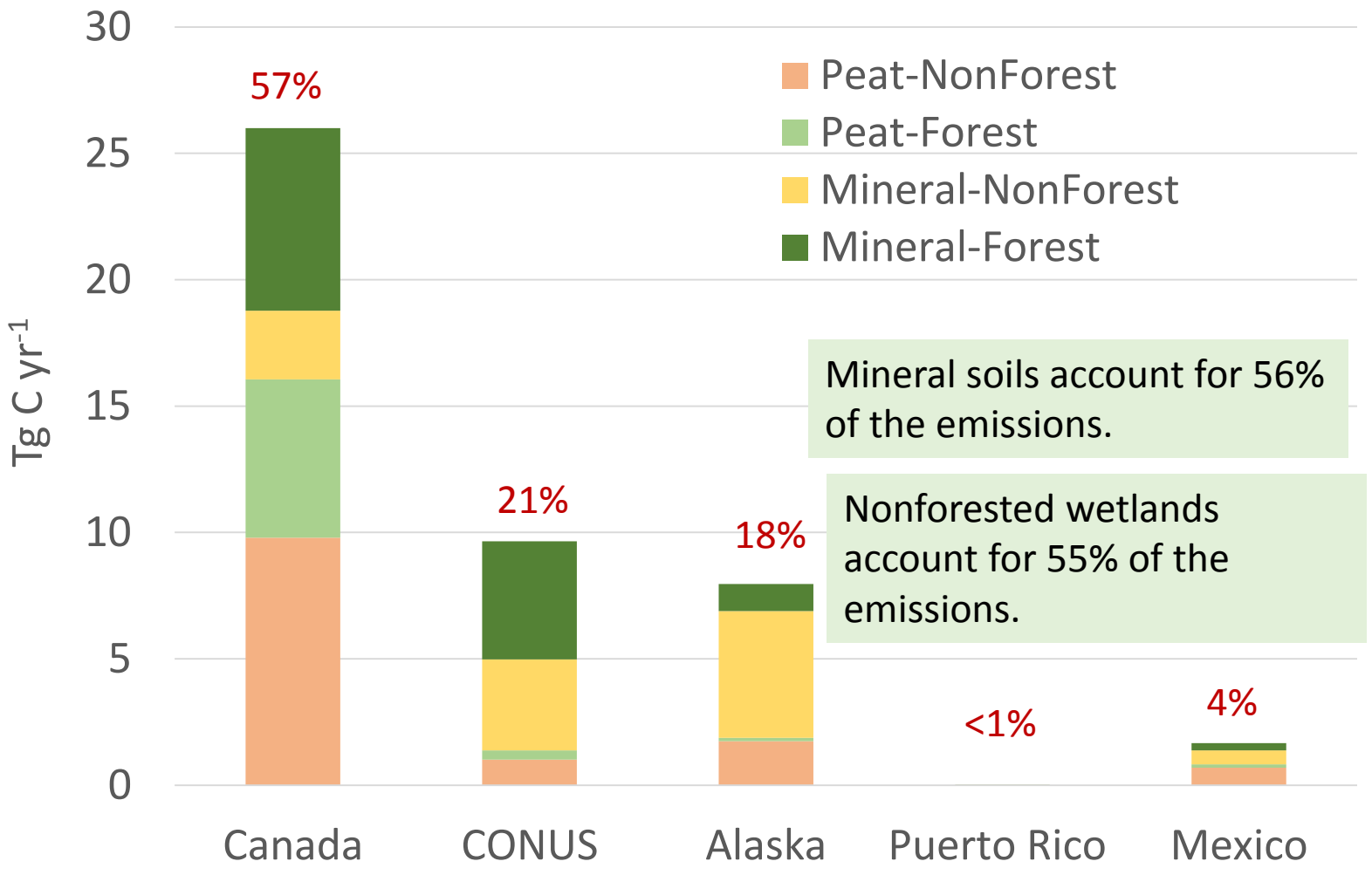
Terrestrial Wetland Net C Flux



Mineral soils account for 51% of the net sequestration

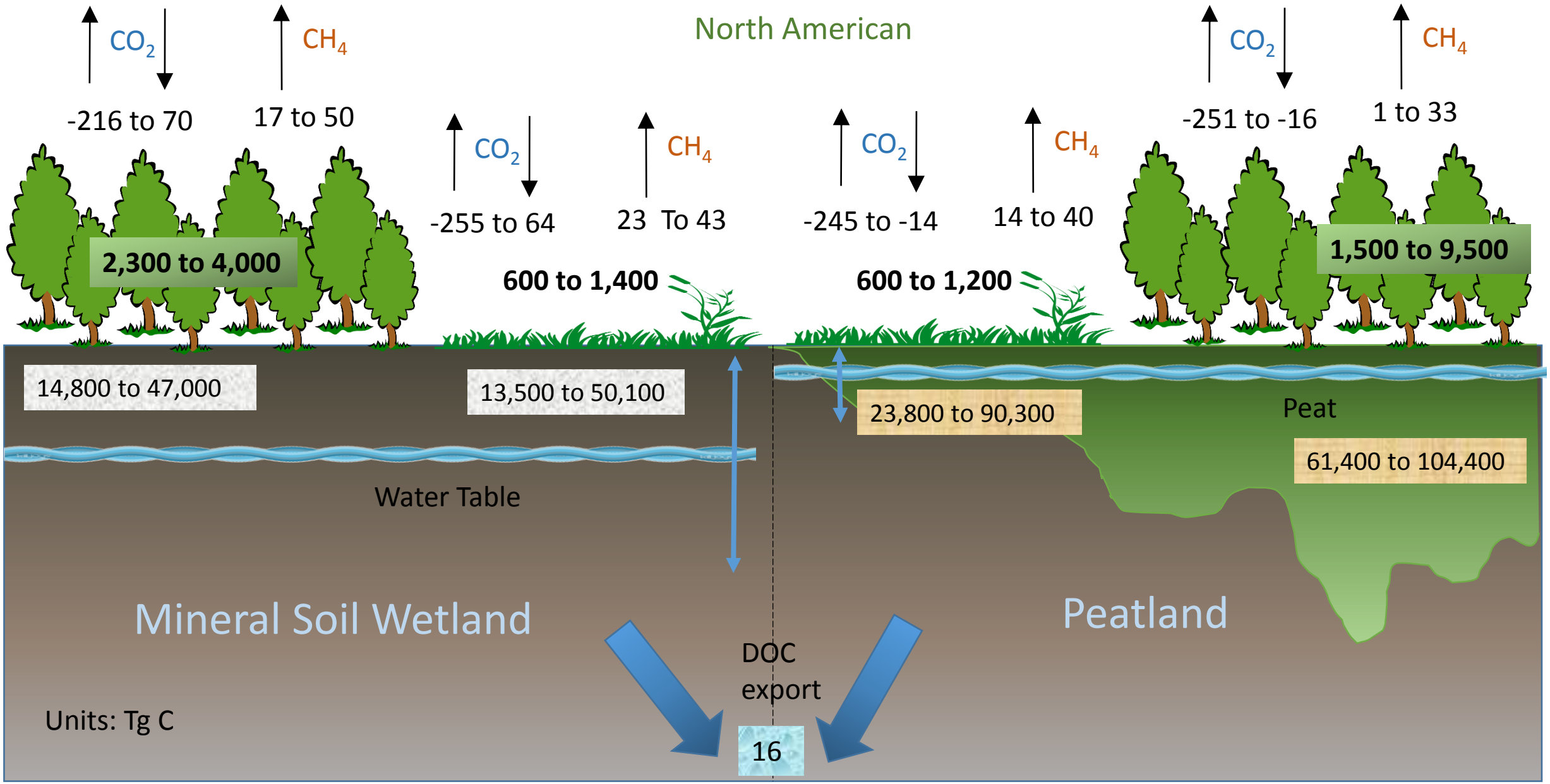
53% of the sequestration in forested wetlands

Terrestrial Wetland Net CH_4 Flux



Mineral soils account for 56% of the emissions.

Nonforested wetlands account for 55% of the emissions.


Wetland Carbon Stocks & Fluxes in North American
CO_2
CH_4
-216 to 70
17 to 50
CO_2
CH_4
-255 to 64
23 To 43
CO_2
CH_4
-245 to -14
14 to 40
CO_2
CH_4
-251 to -16
1 to 33
2,300 to 4,000
600 to 1,400
600 to 1,200
1,500 to 9,500
14,800 to 47,000
13,500 to 50,100
23,800 to 90,300
Peat
61,400 to 104,400
Water Table
Mineral Soil Wetland
Peatland
DOC export
16
Units: Tg C

Freshwater Wetland C Balance

Ecosystem Fluxes

	Tg C yr^{-1}
Net sequestration	-126.4
CH_4 emissions	44.8
DOC leaching	16.3
Balance	-65.3

Key Findings

- Wetland Area
  - Comprise ~ 37% of the global wetland area (2.2×10^6 km^2)
  - The rate of wetland loss is much lower than historical rates
    - 53% of wetland area lost from 1870-1980 (>85% in Midwest, 95% in CA)
    - ~0.06% of the wetland area from 2004 to 2009
    - restoration and creation nearly offset losses of natural wetlands
  - Considerable uncertainty about the functional equivalence of disturbed, created, and restored wetlands as compared to undisturbed wetlands
  - 2016 study by EPA assessed national (US) wetland health and found 48% of wetlands were in good condition, 20% in fair condition and 32% in poor condition
  - Wetlands tend to be disturbed on the edges or perimeter which then affects the water and nutrient balance of the entire ecosystem

Key Findings, Cont'd

- C stocks in Terrestrial Wetlands
  - Contain ~36% of the global wetland C stock (161 Pg)
  - Peatlands contain ~58% of the total area & ~ 80% of the carbon
  - Forest comprise ~55% of the area

Key Findings, Cont'd

- C Fluxes from Terrestrial Wetlands
  - CO_2 sink (~ 126 Tg C yr^{-1})
  - CH_4 source (~45 Tg C-CH_4 yr^{-1})
  - DOC source (~16 Tg C yr^{-1})
  - Overall net sink (~65Tg C yr^{-1})
  - Considerable uncertainty about the effects of disturbance regimes on carbon stocks and greenhouse gas (GHG) fluxes

Key Findings cont'd

- Studies and monitoring systems are needed that compare C pools, rates of C accumulation, and GHG fluxes across disturbance gradients, including restored and created wetlands.
  - Produce data that are needed for model applications. Really need to be able to better model wetland C cycles for application in Global Circulation Models.

Major Differences with SOCCR 1

- SOCCR 1 Wetlands Chapter included all wetlands.
- 320,000 km^2 more freshwater wetlands
  - Wetland area of Alaska 50% less (permafrost in Arctic chapter);
  - 619,000 km^2 more in Canada
- Net sequestration 4X greater;
- CH_4 emissions 6X greater.

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