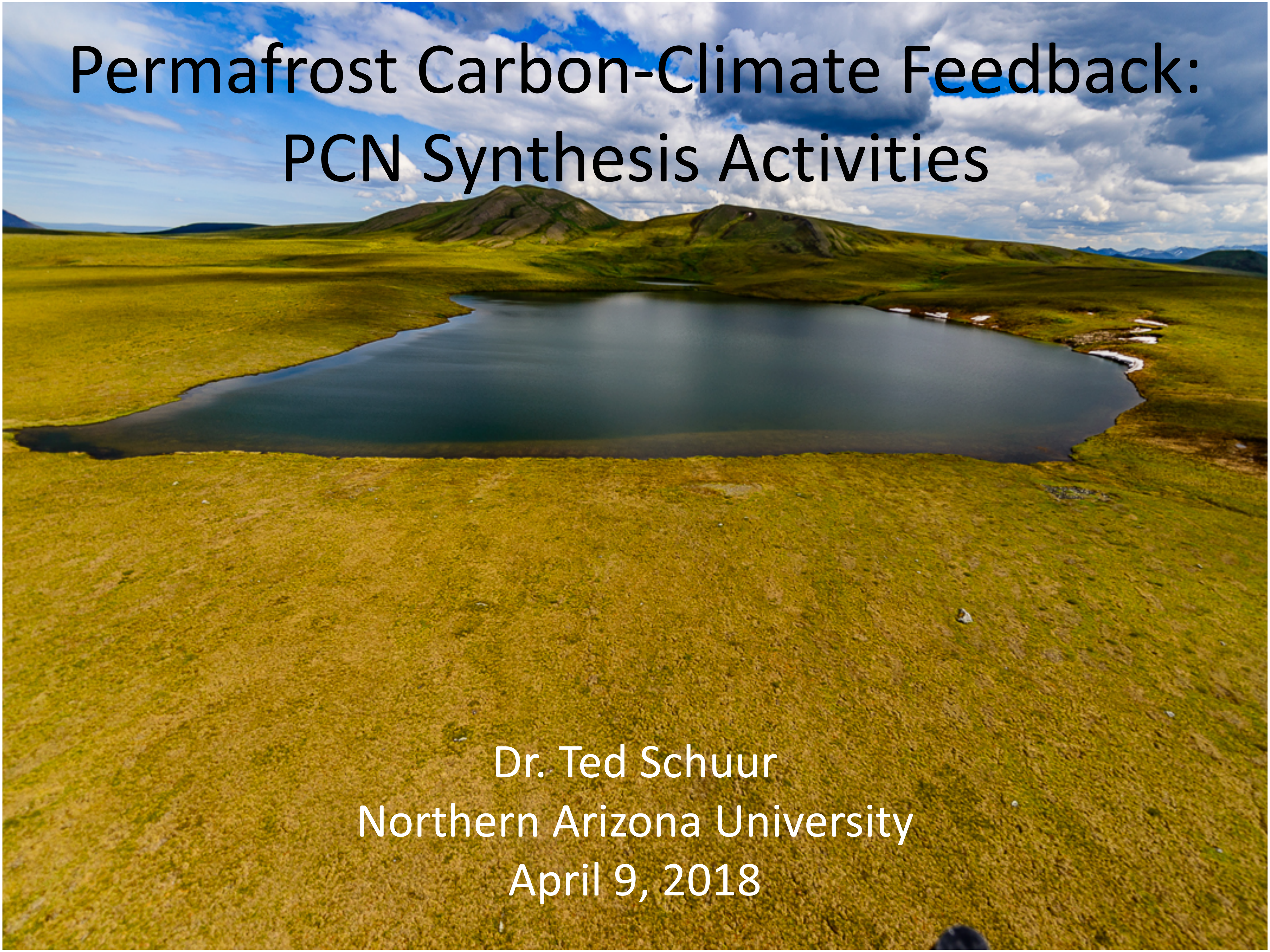
Permafrost Carbon-Climate Feedback: PCN Synthesis Activities



Dr. Ted Schuur
Northern Arizona University
April 9, 2018

Permafrost Carbon Network

Part of the Study for Environmental Arctic Change Program

OBJECTIVE: Produce knowledge through **research synthesis** to quantify the role of permafrost carbon in driving future climate change

BUILT NETWORK: Poised to ingest new observations and deliver synthesis science and outreach products on timeframe needed by decision makers

LEADERSHIP:

PI: Ted Schuur, Dave McGuire, Christina Schädel

Logistics: Brit Myers, ARCUS

Contributors: Steering committee, synthesis leads, the permafrost carbon community, SEARCH executive director & Action Team leads

Current number of

Members: 380+

Institutions: 177

Countries: 24

Permafrost Action Team

Study of Environmental Arctic Change

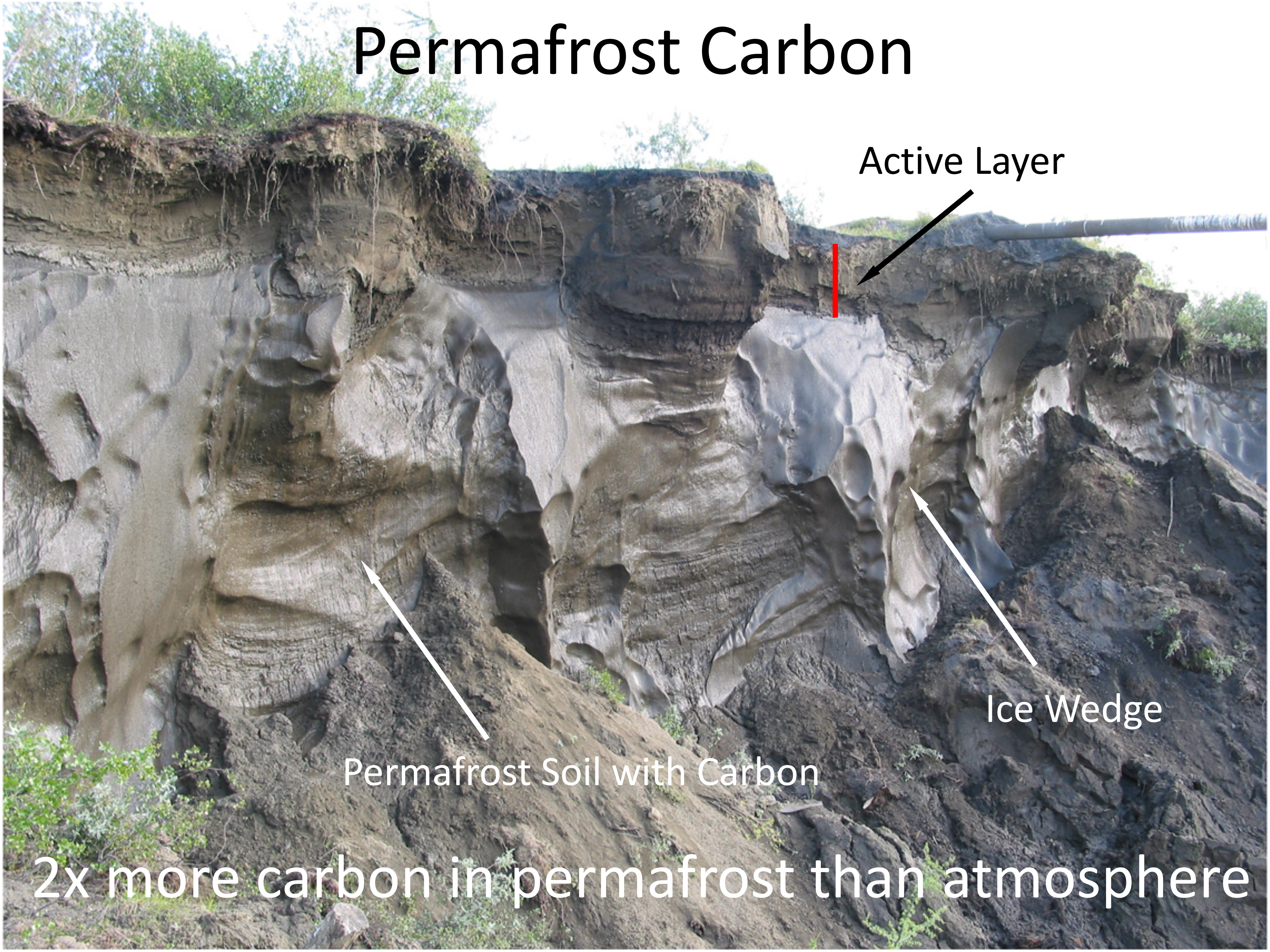
SEARCH

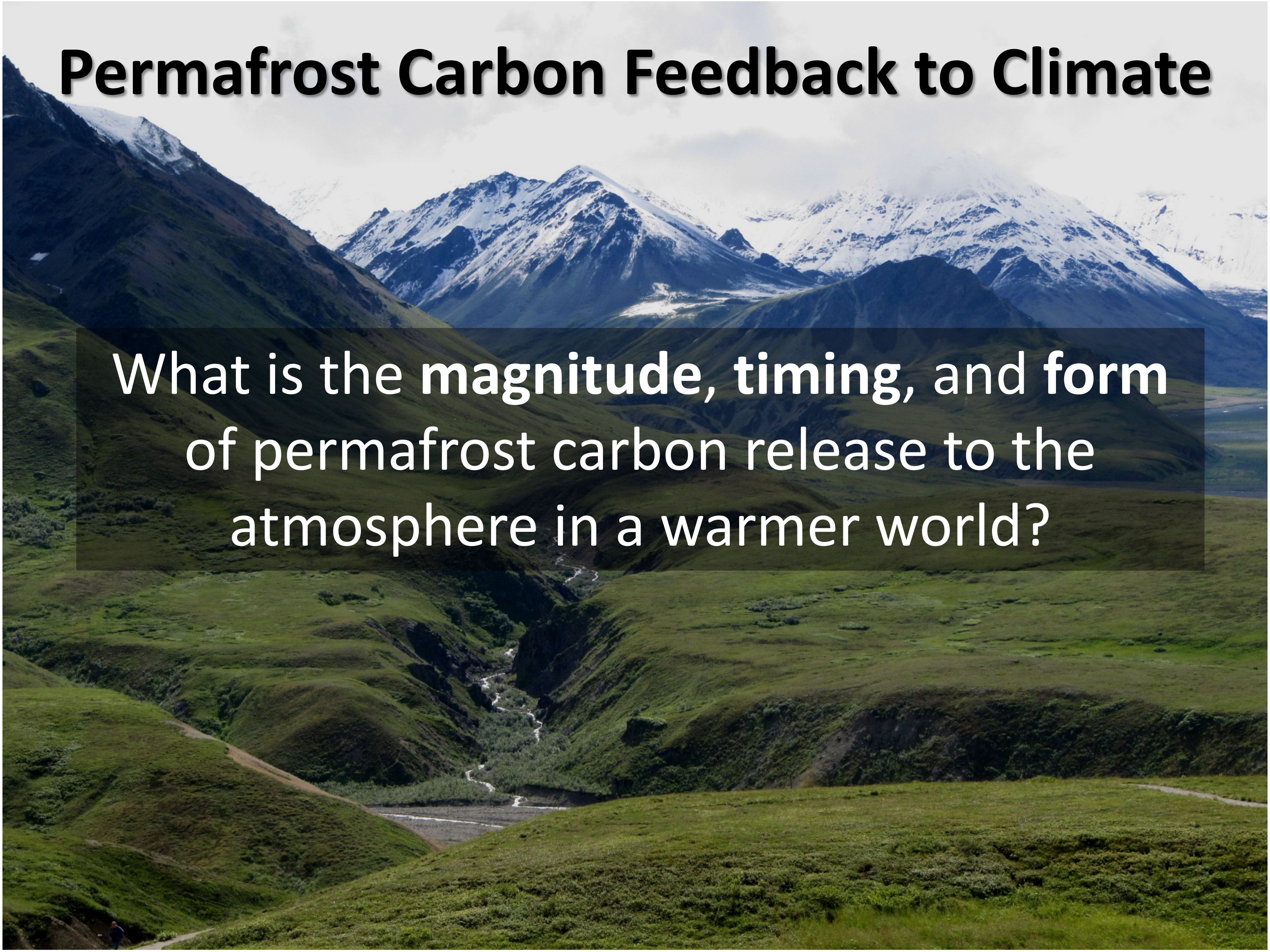
Sea Ice Action Team

Land Ice Action Team

Permafrost Action Team

Document and Communicate How Degradation of Near-Surface Permafrost Will Affect Arctic and Global Systems **USING SYNTHESIS SCIENCE**


Permafrost Carbon
Active Layer
Ice Wedge
Permafrost Soil with Carbon
2x more carbon in permafrost than atmosphere


Permafrost Carbon Feedback to Climate
What is the magnitude, timing, and form of permafrost carbon release to the atmosphere in a warmer world?

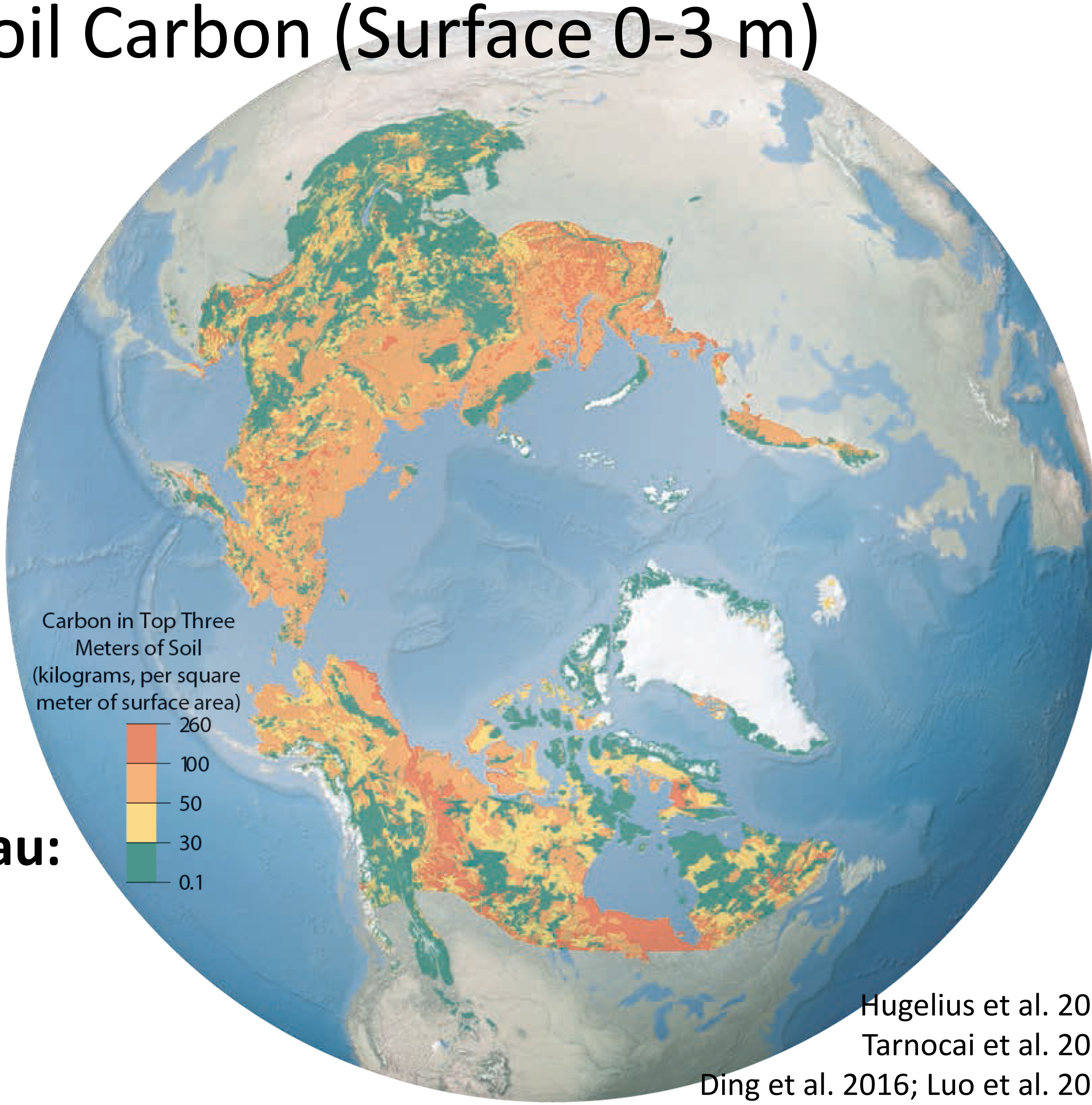
Soil Carbon (Surface 0-3 m)

1035

±150 Pg C

33% of Global soil carbon (0-3m)

Tibetan Plateau:
15.3 Pg C
N. China:
20.4 Pg C



Hugelius et al. 2014
Tarnocai et al. 2009
Ding et al. 2016; Luo et al. 2000

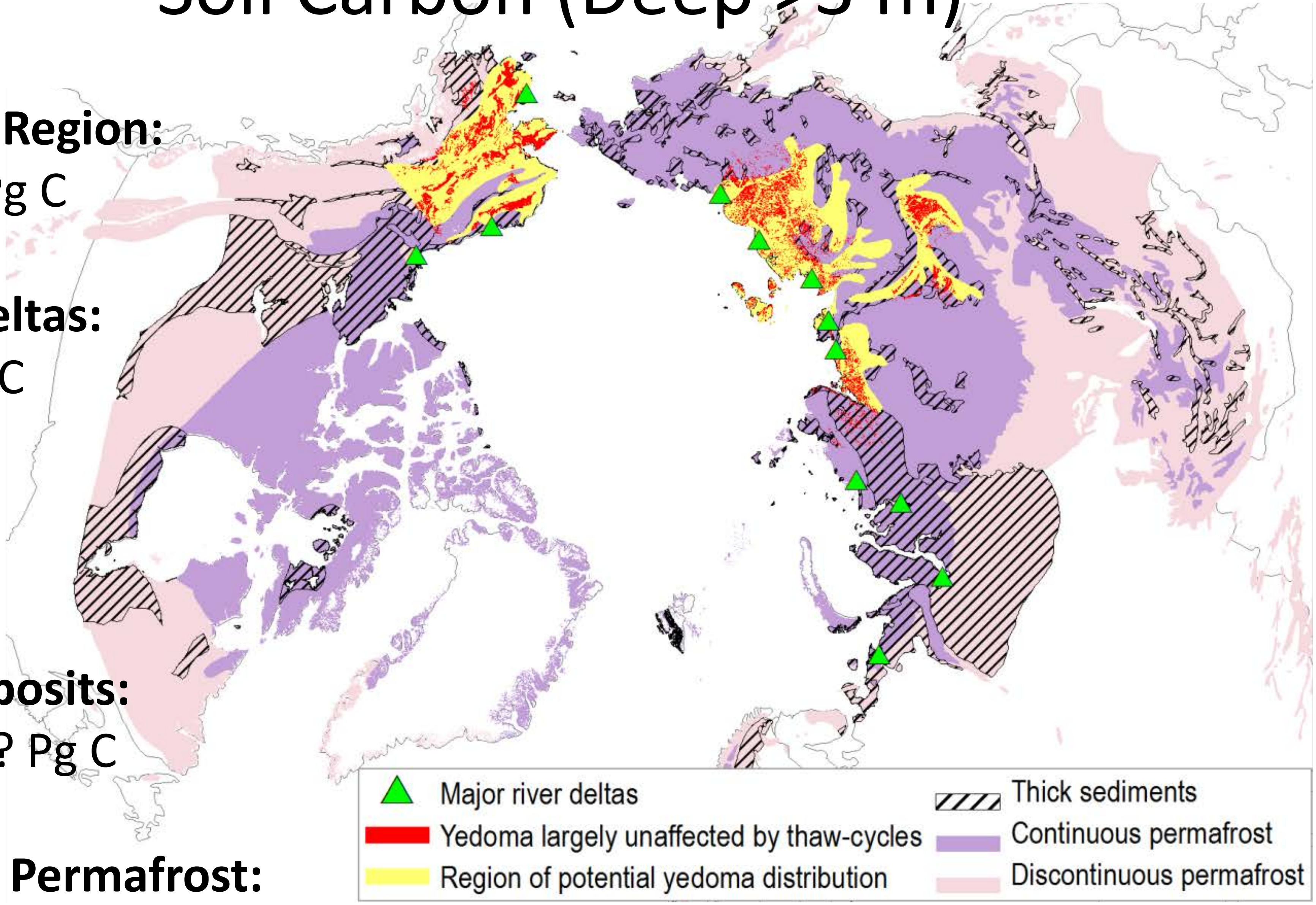
Soil Carbon (Deep >3 m)

***Yedoma Region:**
327-466 Pg C

***Arctic Deltas:**
96±55 Pg C

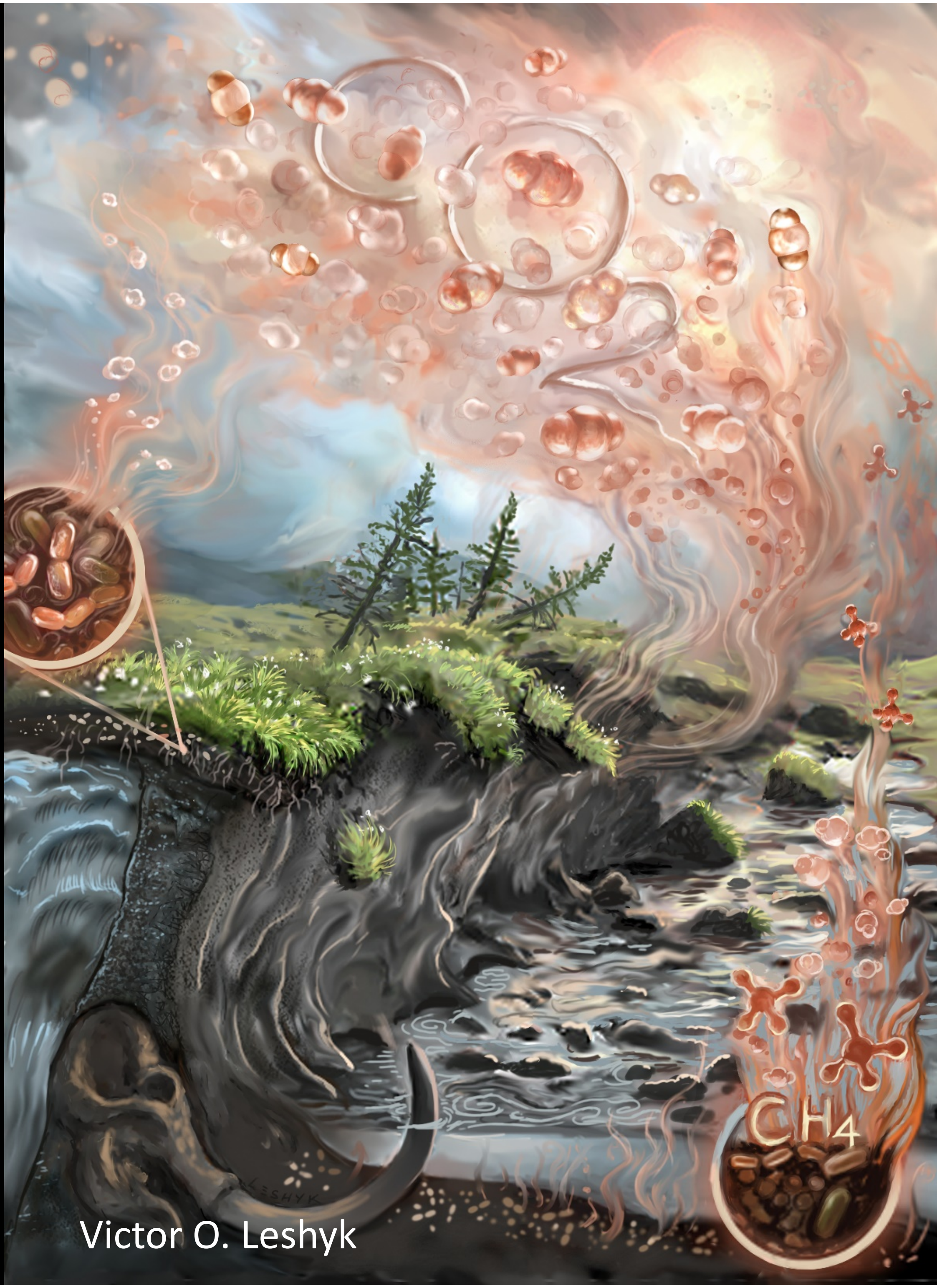
Other Deposits:
~350-465? Pg C

Undersea Permafrost:
? Pg C



Zimov et al. 2006
Hugelius et al. 2014
Strauss et al. 2017
Schuur et al. 2018

Known Permafrost Carbon = 1460-1600* Pg C



Carbon Decomposability

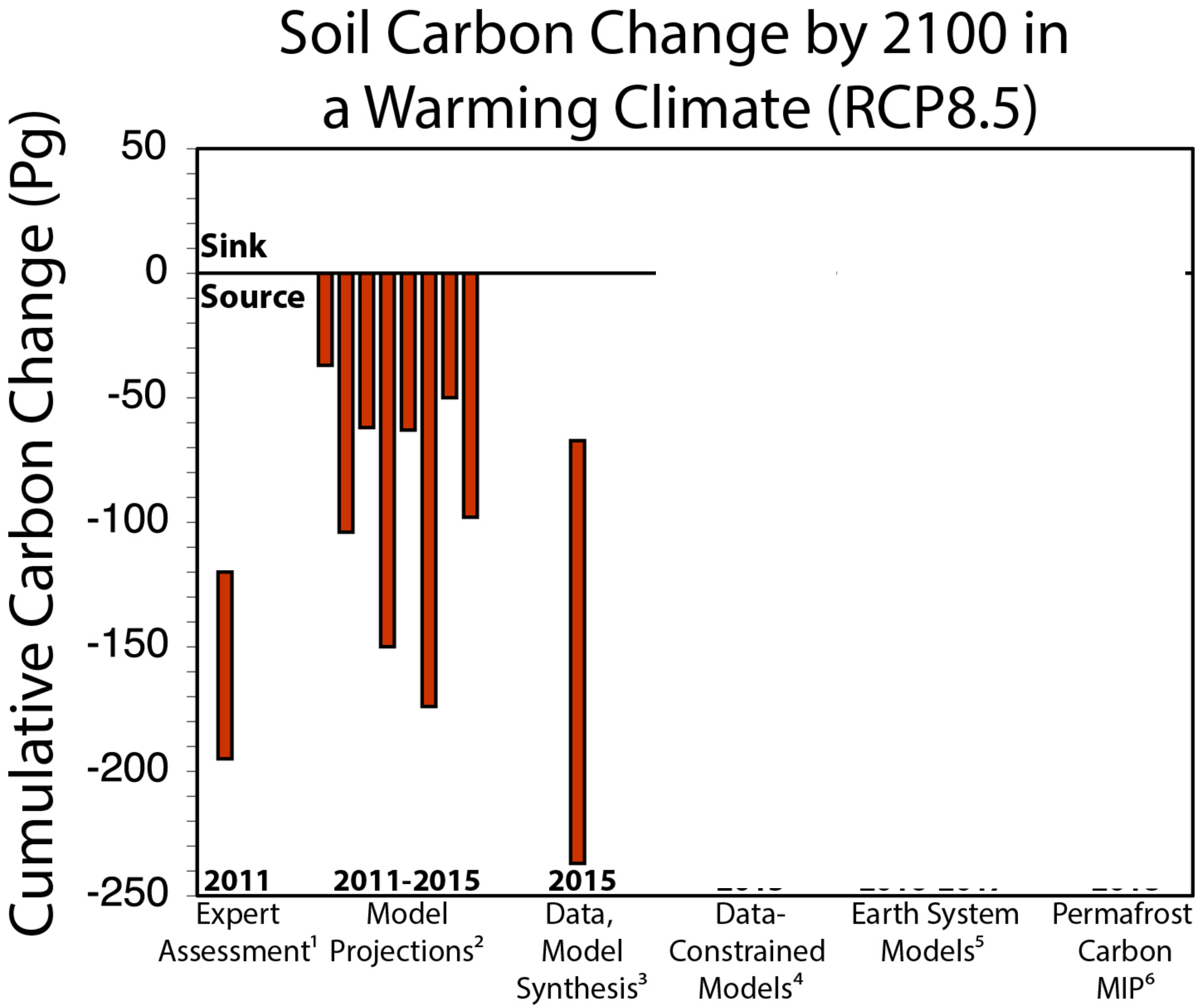
2.1x more carbon with temperature increase of 10°C

3.4x more carbon under aerobic vs anaerobic

2.1x more accounting for GWP of CH_4

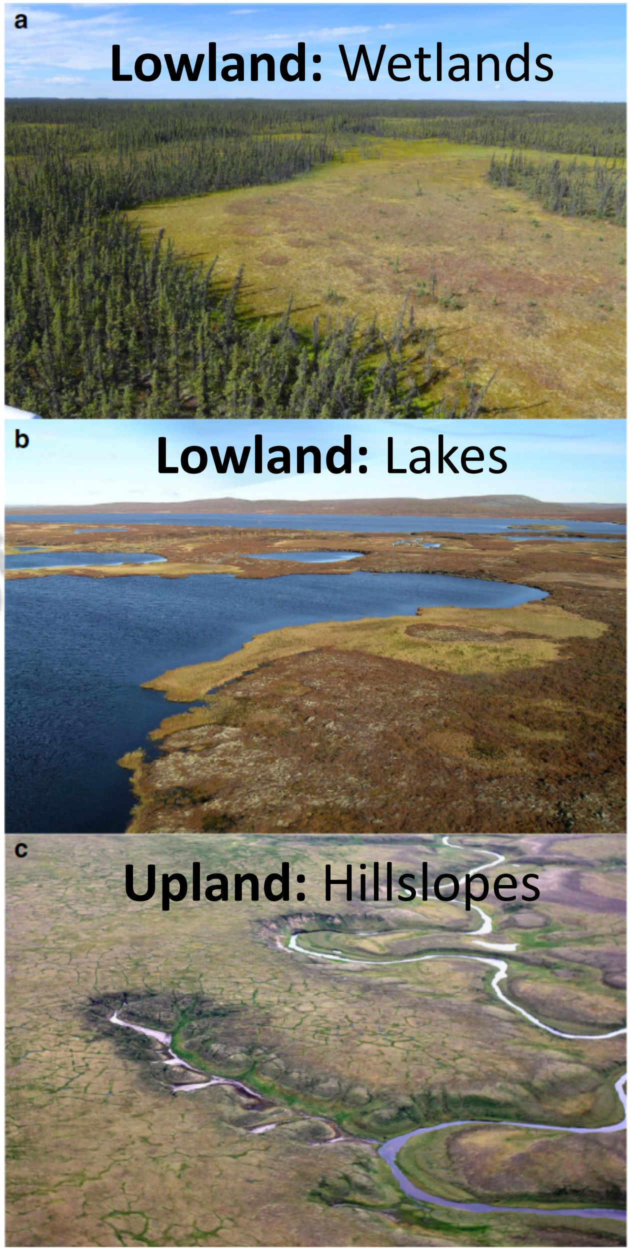
Schaedel et al. 2016

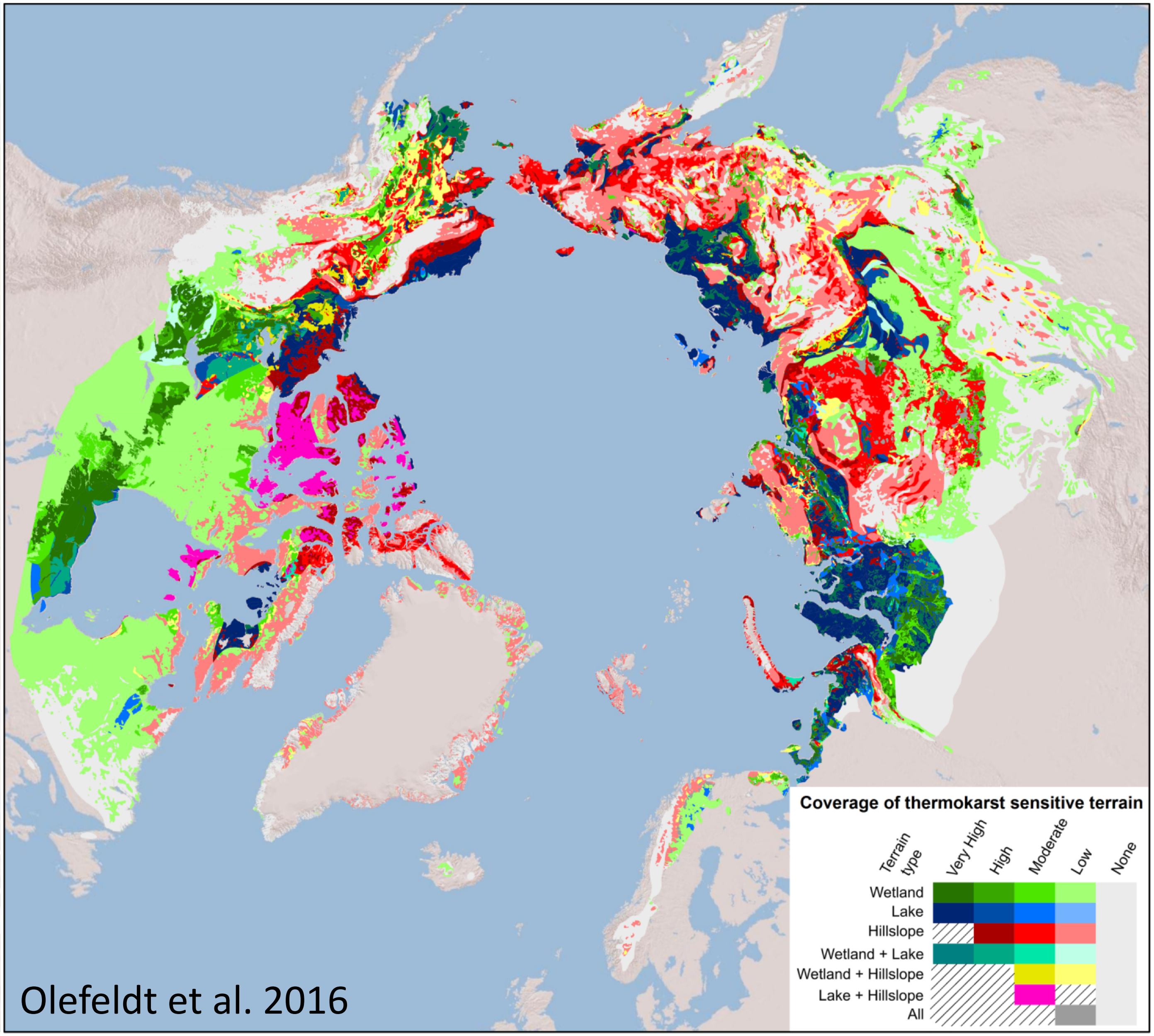
Permafrost Carbon Emissions Synthesis



[1]Schuur et al. 2011 Nature Comment; 2013 Climatic Change; [2]Schaefer et al. 2014 Environmental Research Letters [8 models];
[3]Schuur et al. 2015 Nature; [4]Koven et al. Philosophical Transactions of the Royal Society A 2015; Schneider von Deimling et al. 2015;
[5]MacDougall al. 2016; Burke et al. 2017; [6]McGuire et al. 2018

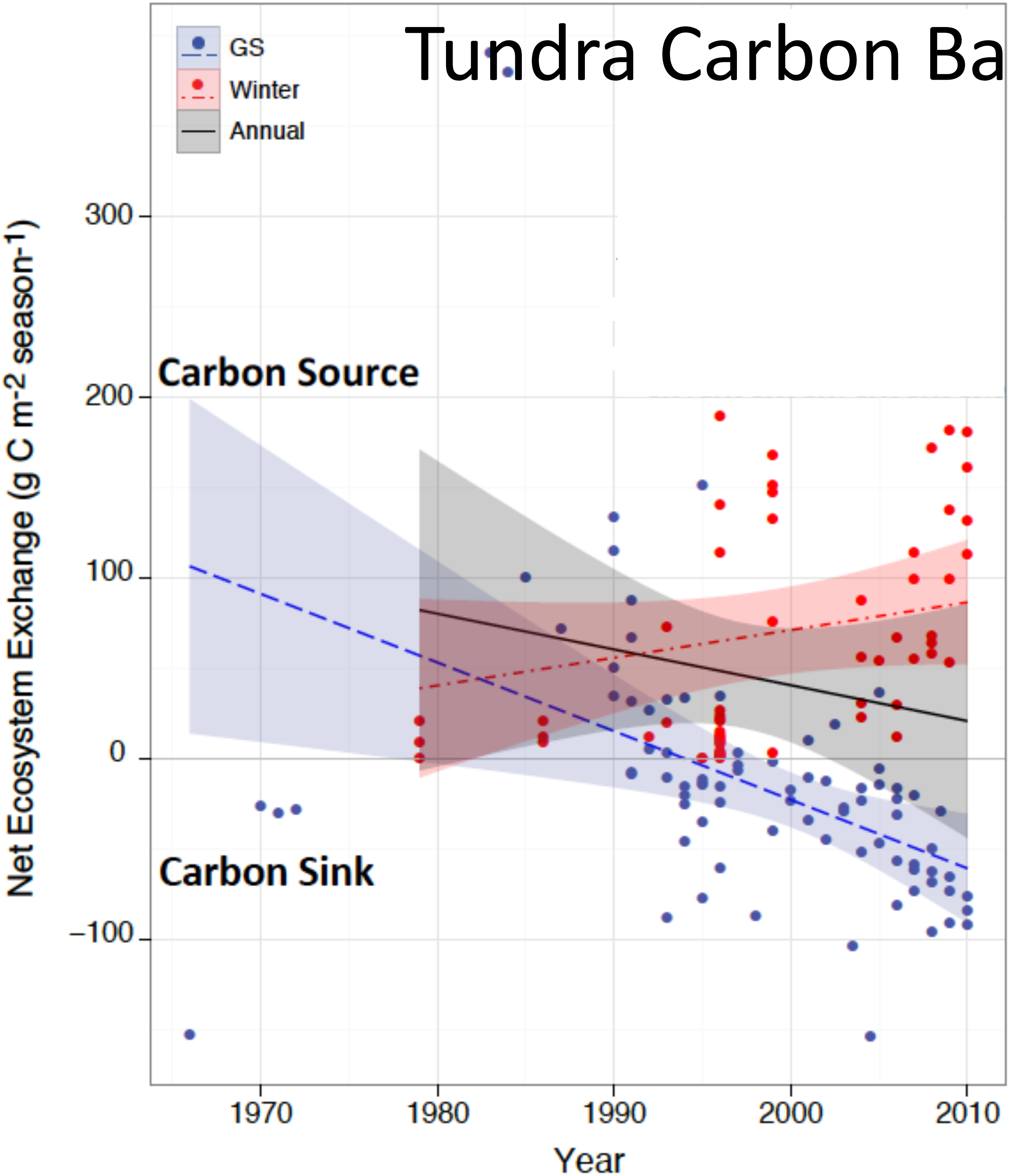
Abrupt Thaw Landscape Distribution





Sensitive terrain = 20% of land area; 50% of soil carbon pool

Tundra Carbon Balance



Growing Season:

- Increasing carbon uptake by plants over time

Winter:

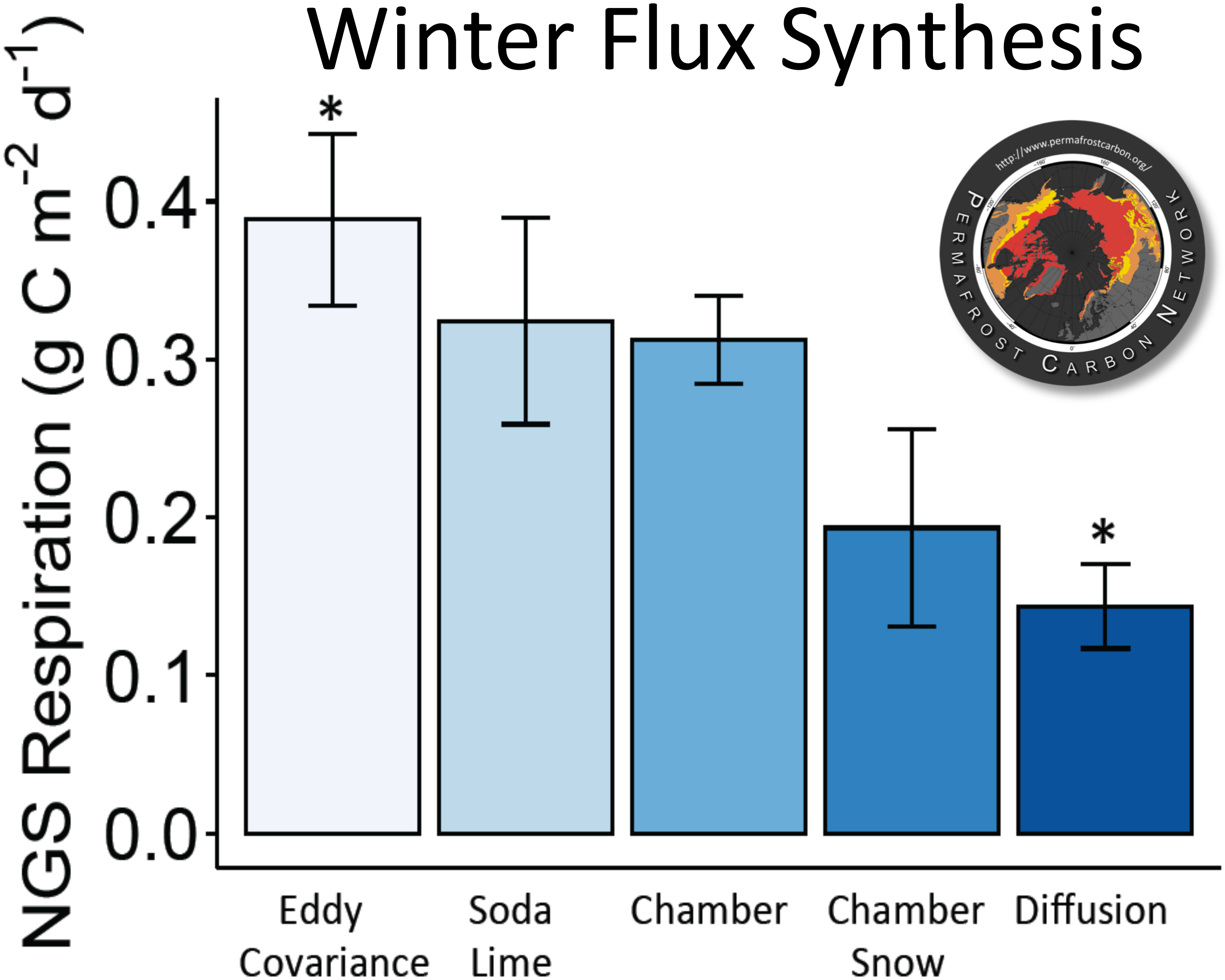
- Increasing carbon release (sensitive to obs period)

Annual:

- Mean carbon source over several decades

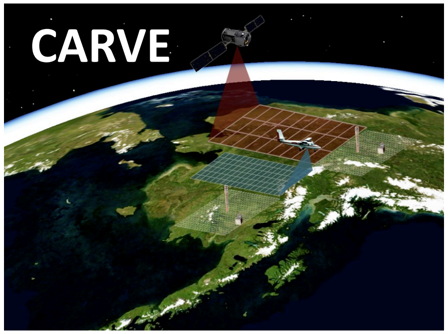
Belshe et al. 2013

Winter Flux Synthesis

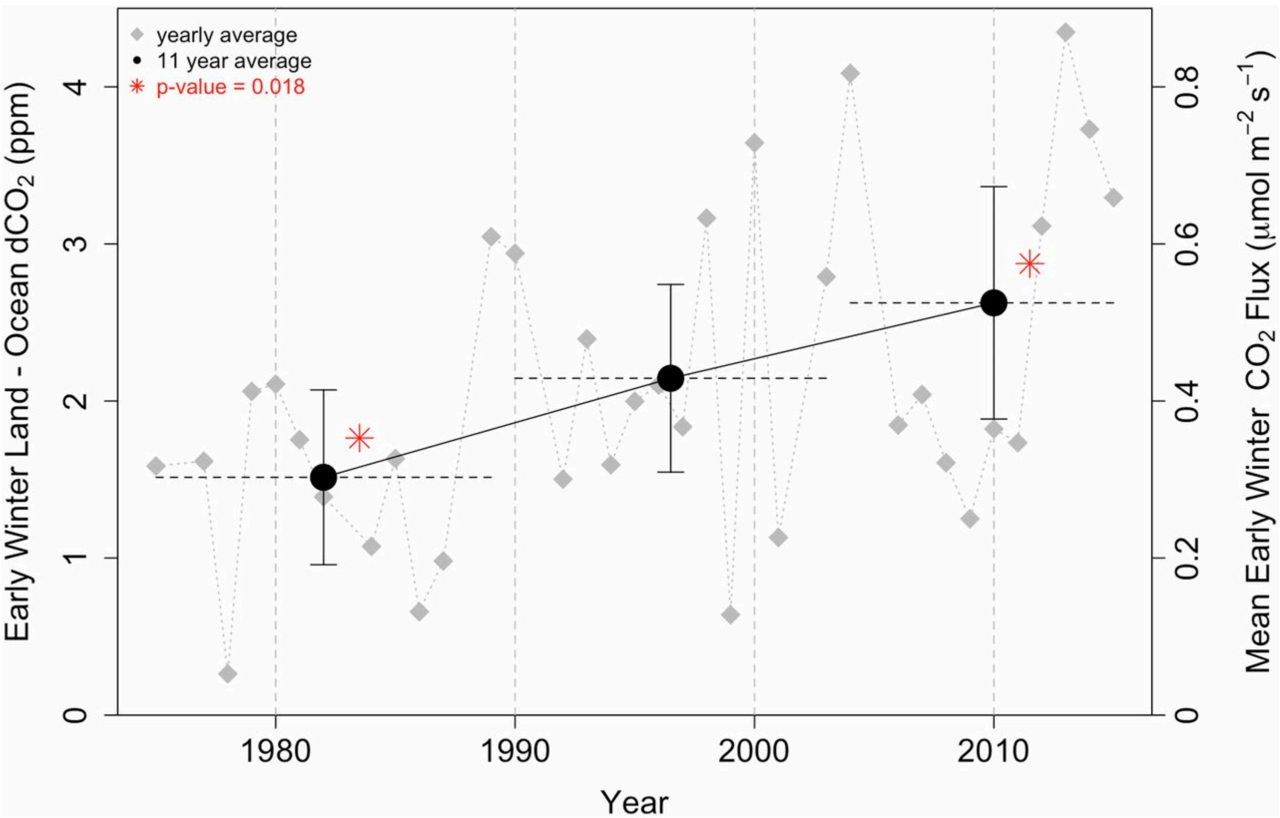


Winter C loss > previously thought

Pulse releases
(fall ‘zero curtain’, winter/spring ‘burps’)



2012-2014 Regional (Alaska) Carbon Loss



Tundra:

- Consistent annual C source

Boreal:

- Neutral to net C sink, but fires offset in part

Regional/Alaska:

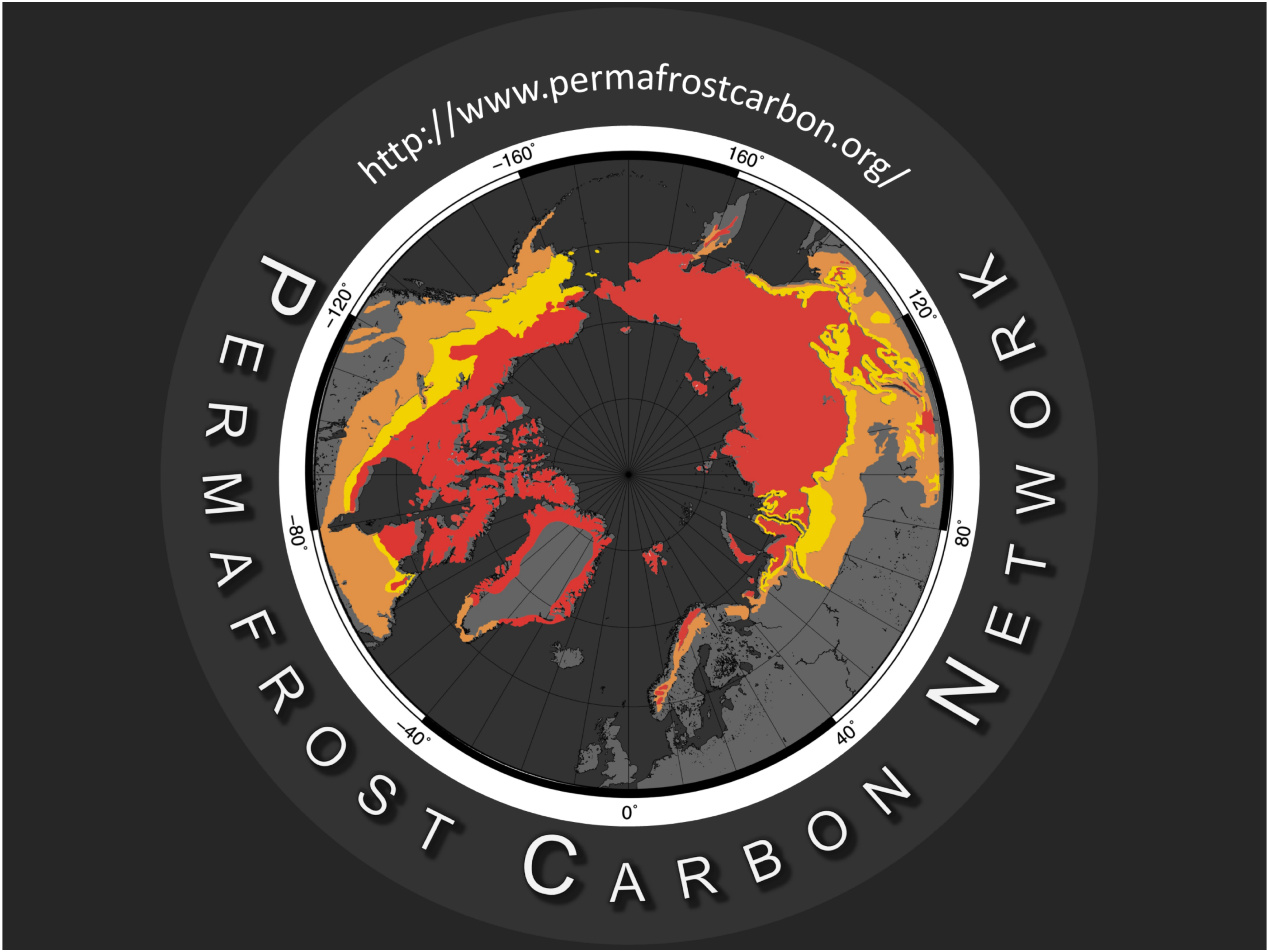
- 25±14 Tg C yr^{-1} source

If Alaska represents the permafrost zone = ~0.3 Pg C yr^{-1} source

Commane et al. 2017 PNAS

Permafrost Carbon Key Findings

- Soil carbon pools are an order of magnitude larger than plant carbon, and are climate stabilized
- Soil carbon vulnerable fraction 5-15% by 2100; 10% of pool = 130 Pg C
- Plant carbon uptake will offset, in part, soil carbon loss, but major uncertainty about timing and magnitude between models and measurements
- IPCC special report (SROCC) opportunity to report high level findings to policymakers (cutoff Oct 15, 2018)


http://www.permafrostcarbon.org/
PERMAFROST CARBON NETWORK
-160°
160°
-120°
120°
-80°
80°
-40°
40°
0°