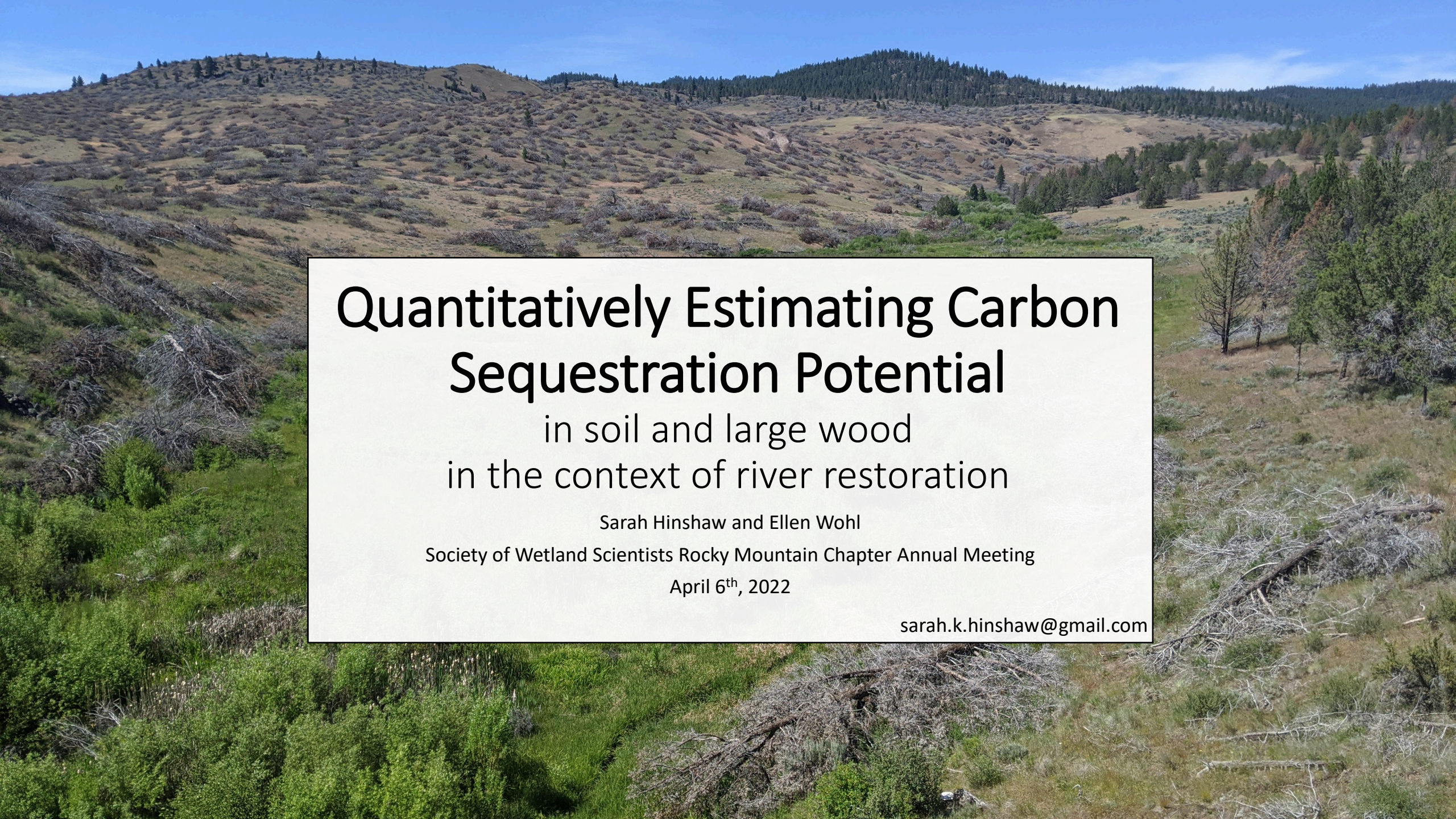


Quantitatively Estimating Carbon Sequestration Potential

in soil and large wood in the context of river restoration

Sarah Hinshaw and Ellen Wohl

Society of Wetland Scientists Rocky Mountain Chapter Annual Meeting

April 6th, 2022

sarah.k.hinshaw@gmail.com

Acknowledgements

patagonia®

COLORADO OPEN LANDS

EcoMetrics
Stream and Riparian Monitoring, Assessment and Restoration

SAGELAND COLLABORATIVE
FORMERLY WILD UTAH PROJECT

DESCHUTES LAND TRUST

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

Colorado State University

UPPER DESCHUTES WATERSHED COUNCIL

SWANER PRESERVE AND ECOCENTER
UtahStateUniversity

BIOPHILIAFOUNDATION


Ellen Wohl


Juli Scamardo


Anna Marshall


Taylor Kenyon


John Kemper

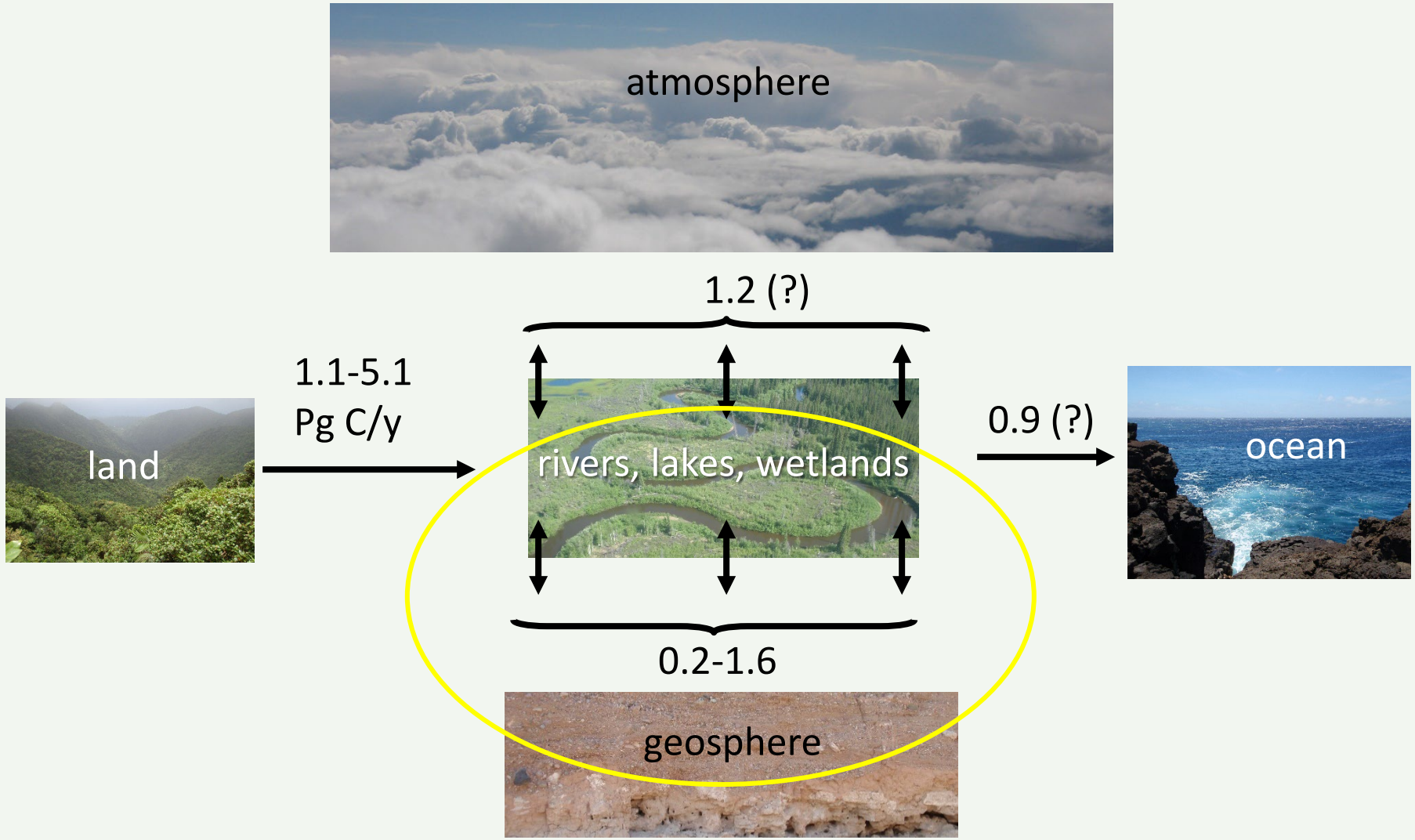

Regi Johnson


Anders Eckert


Shea Slonkosky

Others: Paul Powers, Paul Burns, Lauren Mork, Kate Meyer, Lisa Kurian, Johan Hogervorst, and more!

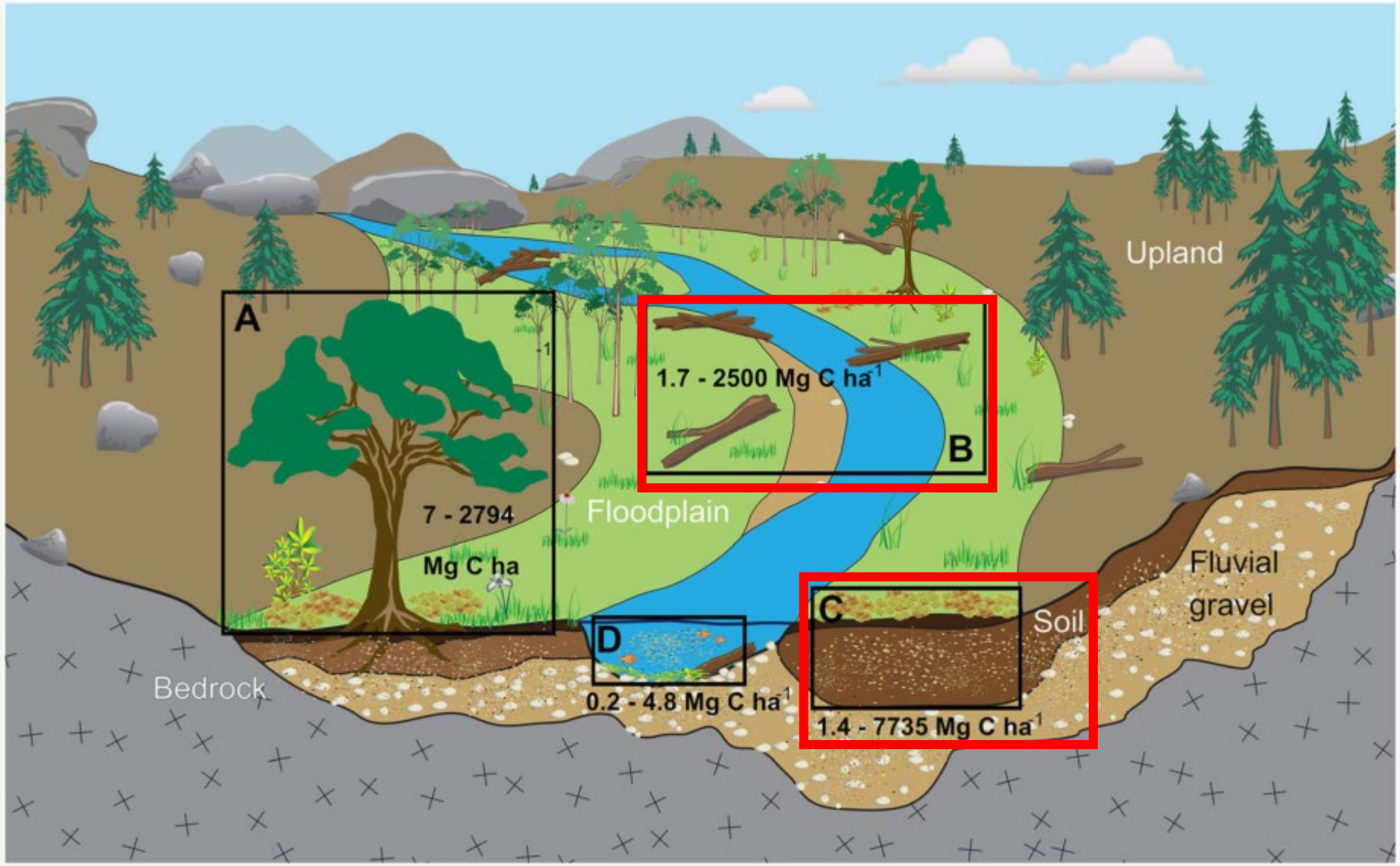
Amount of OC rivers deliver to oceans is a fraction of that entering rivers from terrestrial ecosystems



1 Pg = 10^{12} kg

Aufdenkampe et al., 2011, Frontiers Ecol.; Drake et al., 2017, Limnol. Oceanogr.

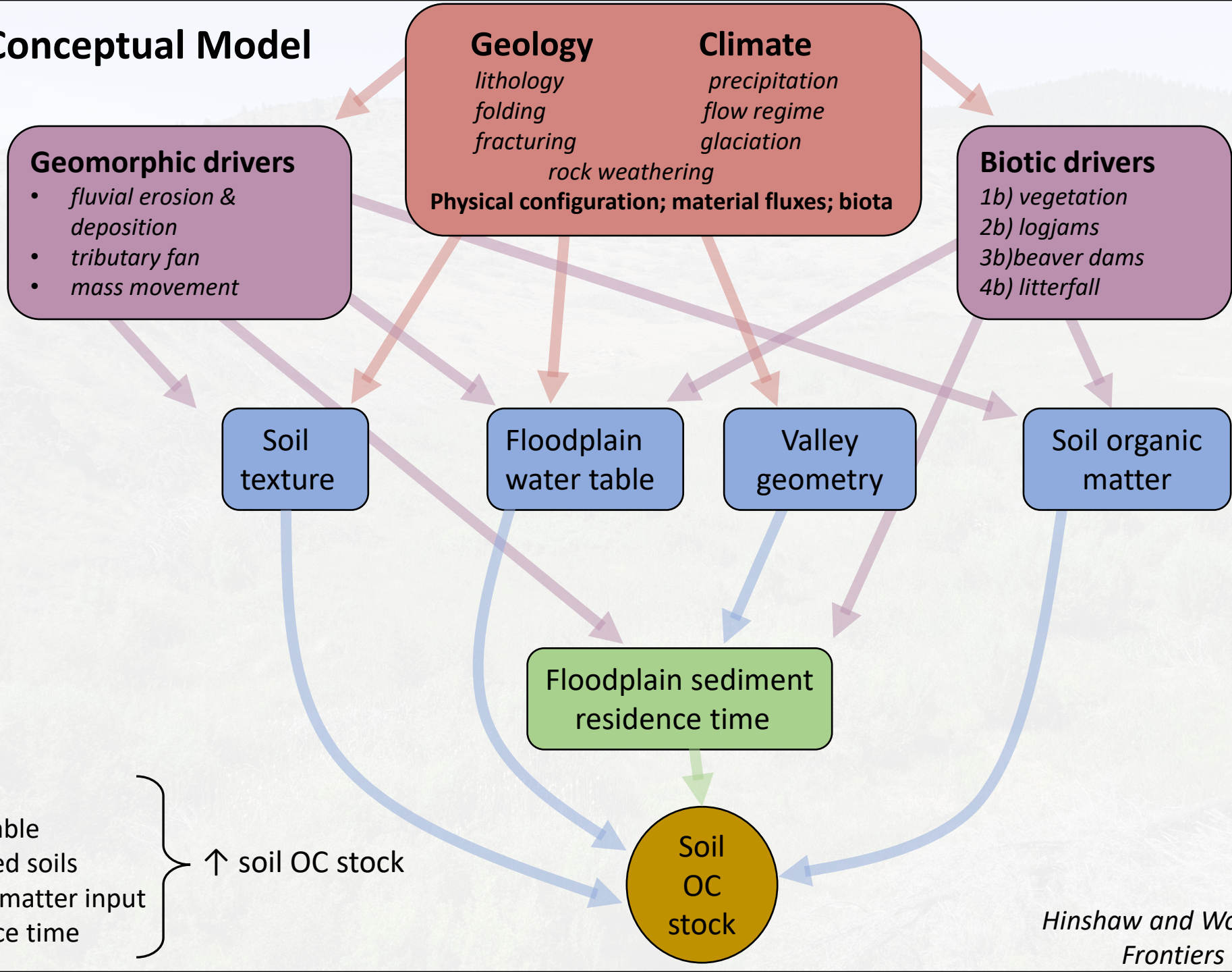
Figure courtesy of Nick Sutfin



OC pools: above & below ground riparian veg (A), dead wood (B), sediment (C), &
& aquatic organisms, FPOM + CPOM

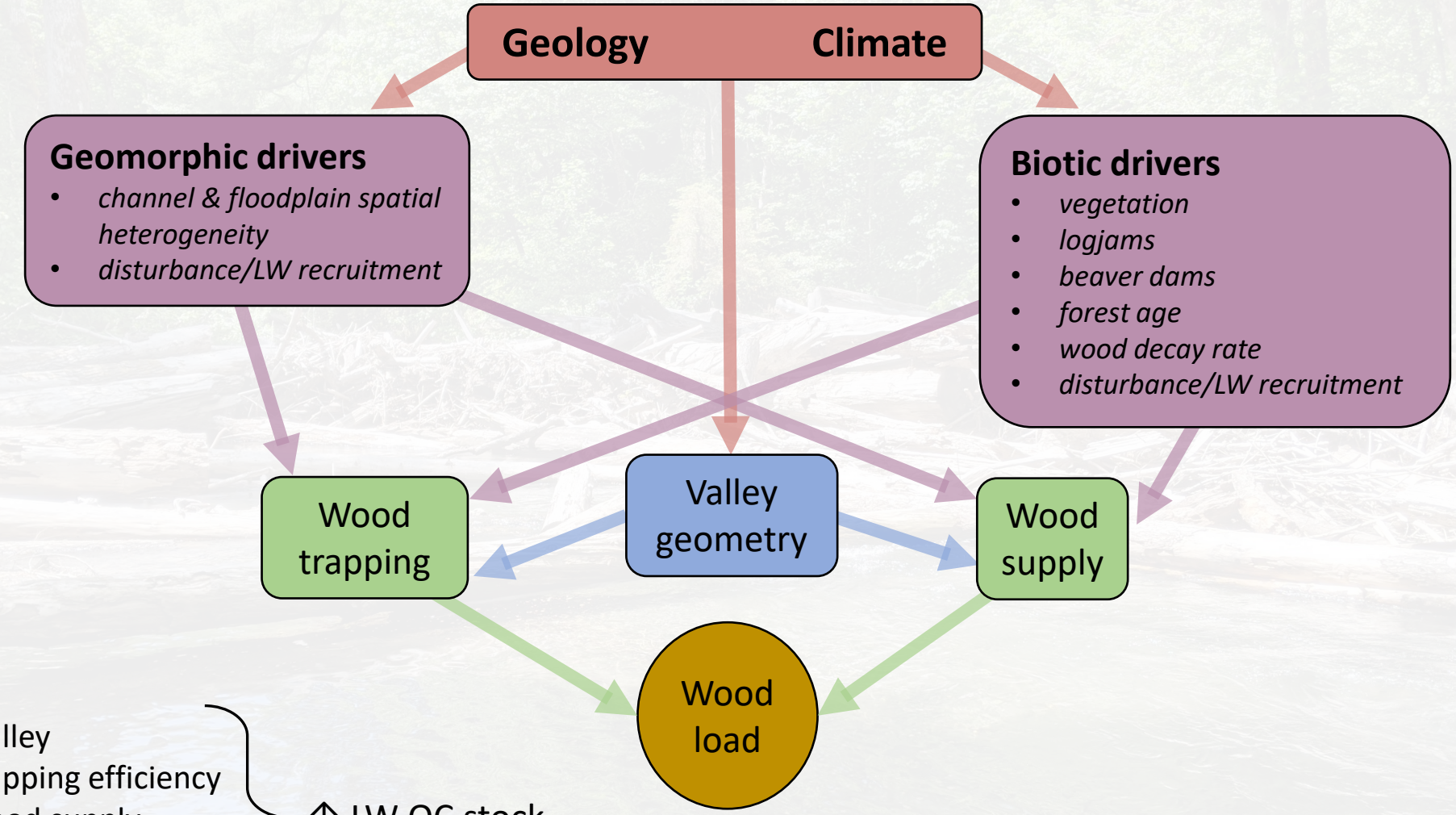
Sutfin et al., 2016, Earth Surface Processes & Landforms

Soil OC Conceptual Model



Hinshaw and Wohl, 2021, Frontiers Earth Sci.

Wood Conceptual Model



wide valley
high trapping efficiency
high wood supply
slow decay
long residence time

↑ LW OC stock

Hinshaw and Wohl, 2021, Frontiers Earth Sci.

Carbon Sequestration Potential

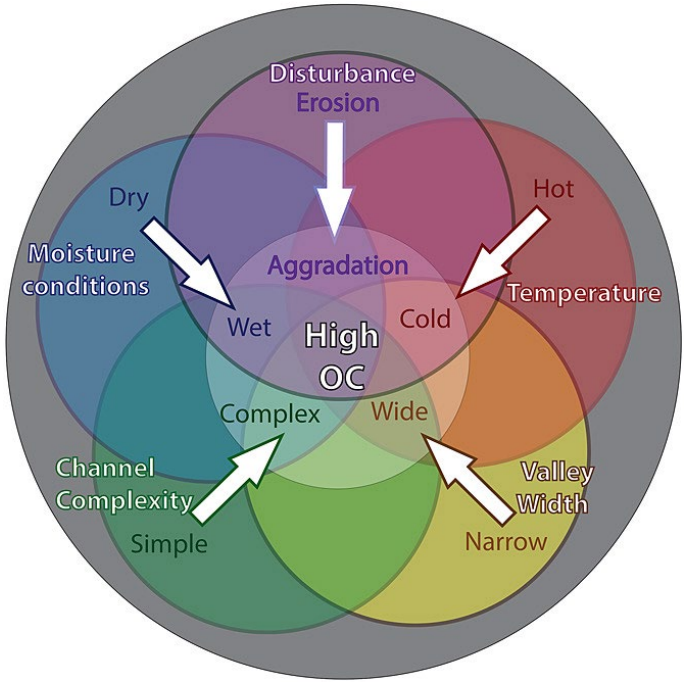
Restoration can potentially sequester carbon.

- Rewetting valley bottom
- Creating a depositional environment

Do floodplain "states" show differences in C stocks?

Is there measurable change in C after restoration?

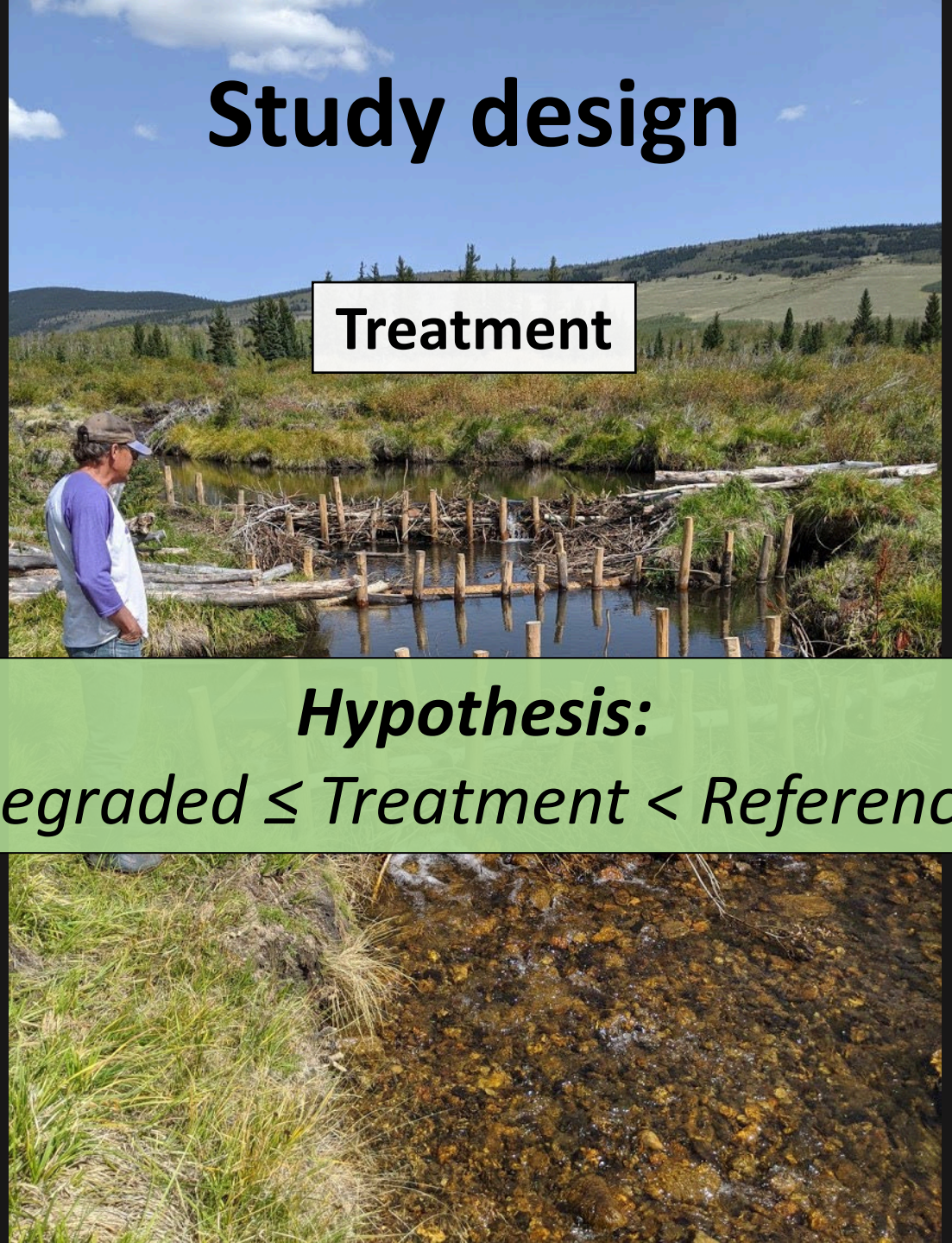
Optimal conditions for C storage

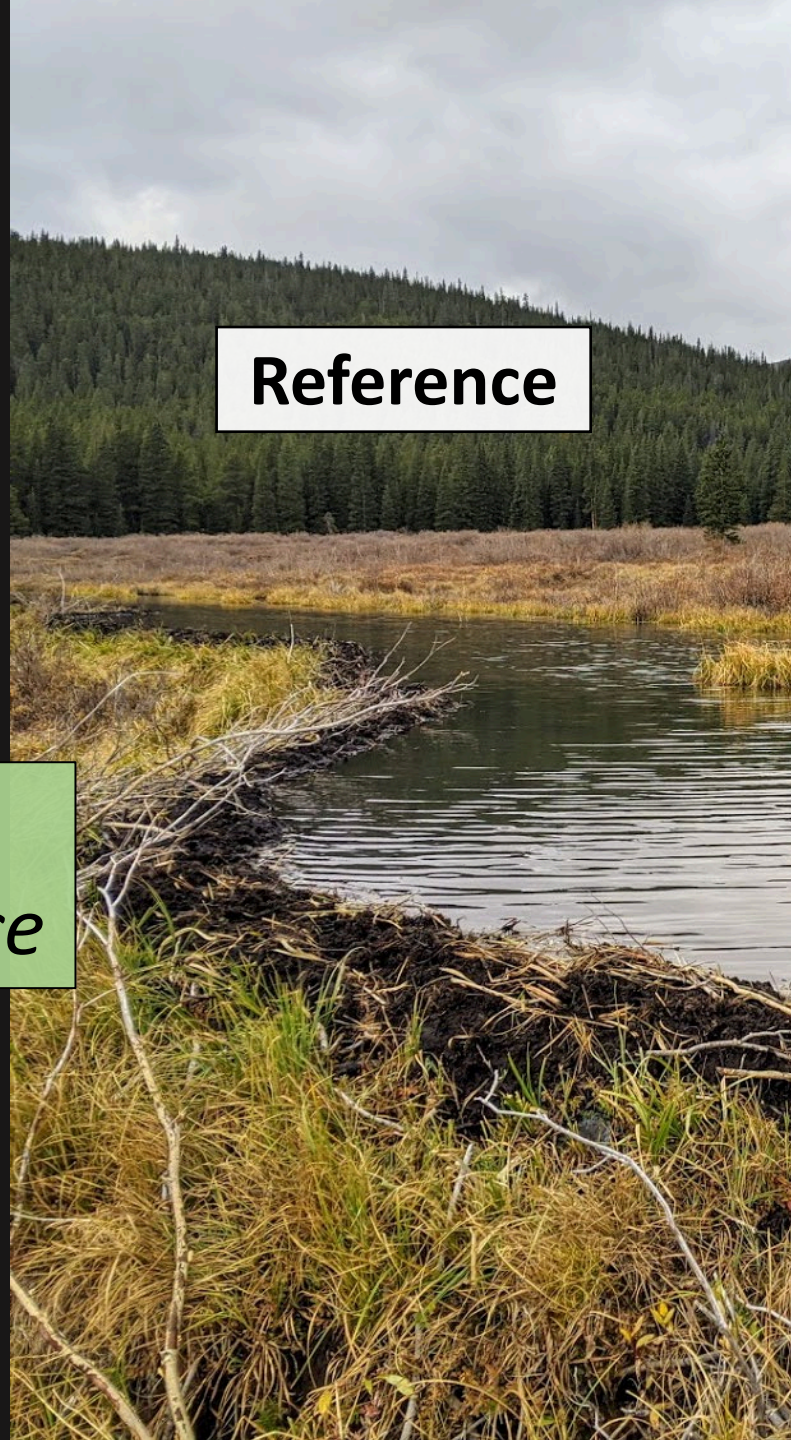


(Sutfin et al. 2016)

Fall at Sheep Creek

Study design

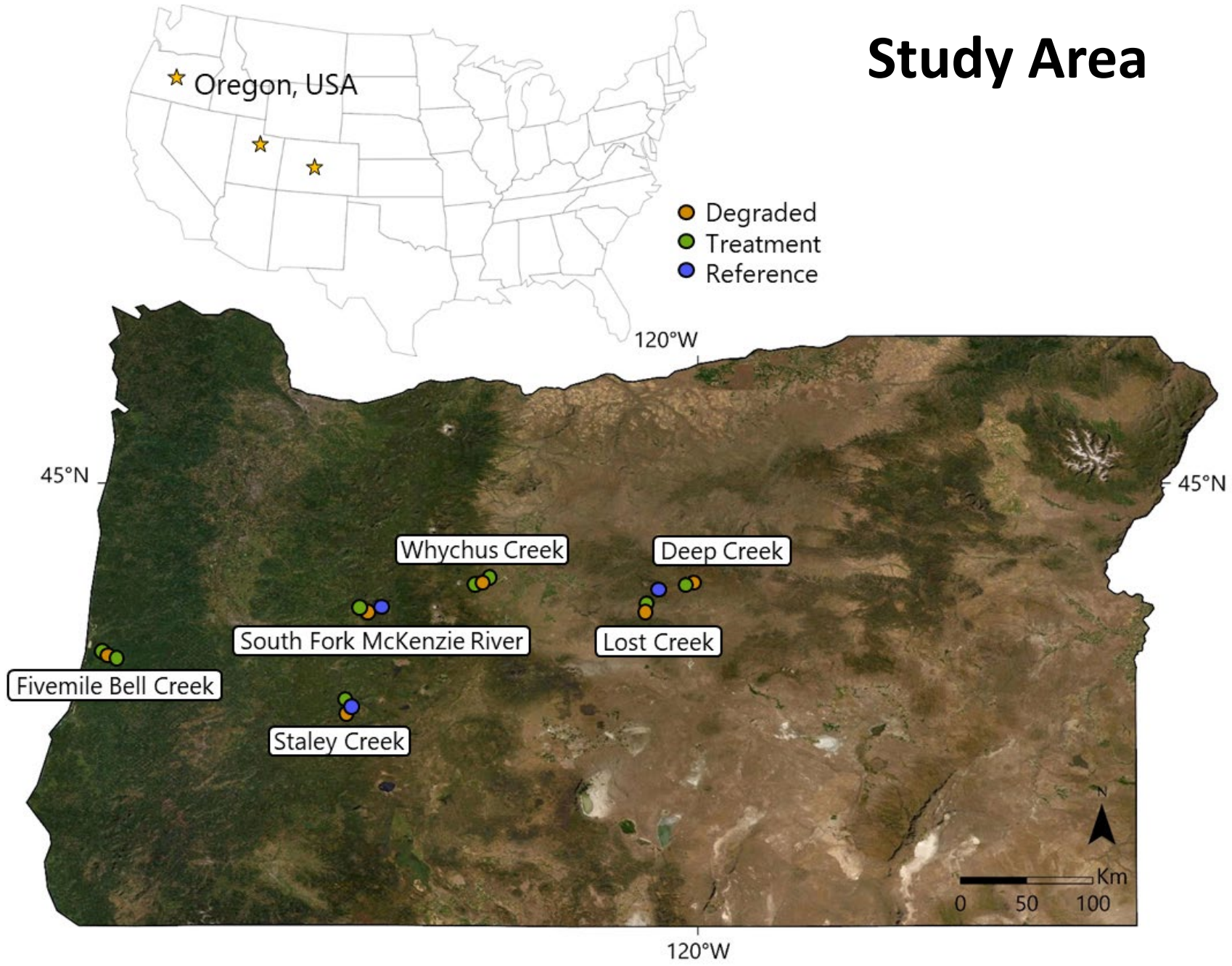




Hypothesis:

Degraded ≤ Treatment < Reference

Study Area



Hinshaw and Wohl, 2021, Frontiers Earth Sci.

Soil Sampling

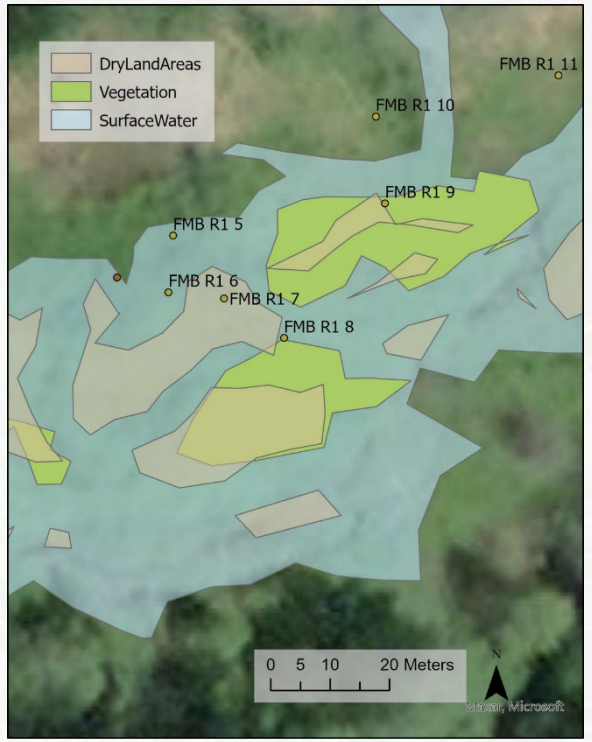
- Degraded, treatment, reference categories
- Stratify by moisture (wet, dry) based on vegetation
- 11 samples per moisture category *(Sutfin and Wohl 2017, JGR)*
- Sample up to 1 m depth
  - can sample multiple depths per location

Wood Sampling

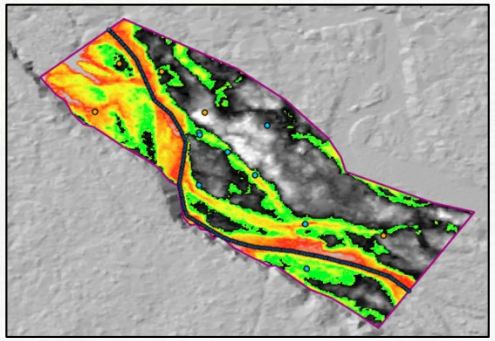
- Degraded, treatment, reference categories
- 5 transects *(Van Wagner 1968)*
  - Measure diameter of each piece crossed
- Timber sale and restoration project wood estimates
  - Compare to any existing monitoring data *(Hinshaw et al., Earth Surface Processes & Landforms 2022)*

Lab and Post Processing

- LECO Elemental Analyzer
- Grain size (% sand, silt, clay)
- Use bulk density and tree density to convert to C stocks
  - Results in Mg/ha
  - Assume 50% OC for wood
  - Average tree densities of dominant species
- Estimate proportion wet and dry area
  - Relative elevation, vegetation, monitoring data
  - Appropriate when significant differences between wet/dry OC



Existing monitoring data

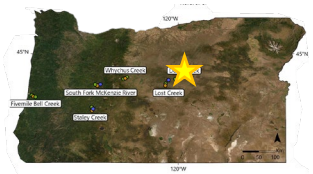

Relative elevation

NAIP Imagery for vegetation-based estimate of wet/dry area

Case Studies

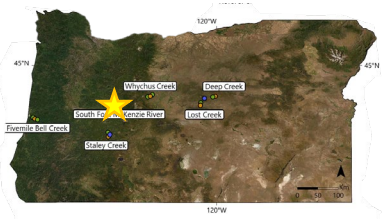
Oregon and Utah

Deep Creek, OR



Hinshaw and Wohl, 2021, Frontiers Earth Sci.

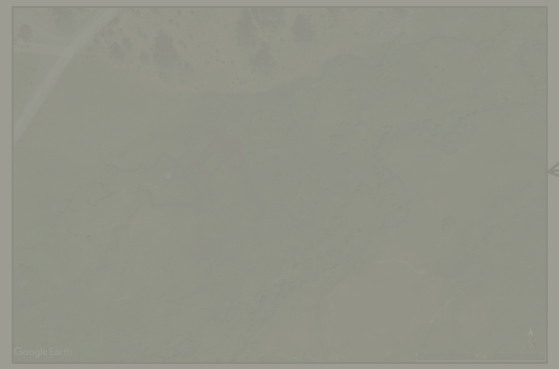
South Fork McKenzie River, OR



Hinshaw and Wohl, 2021, Frontiers Earth Sci.

floodplain jams in degraded

wood added to floodplain



beaver meadow (low large wood)

Wood Load

Now, soil!

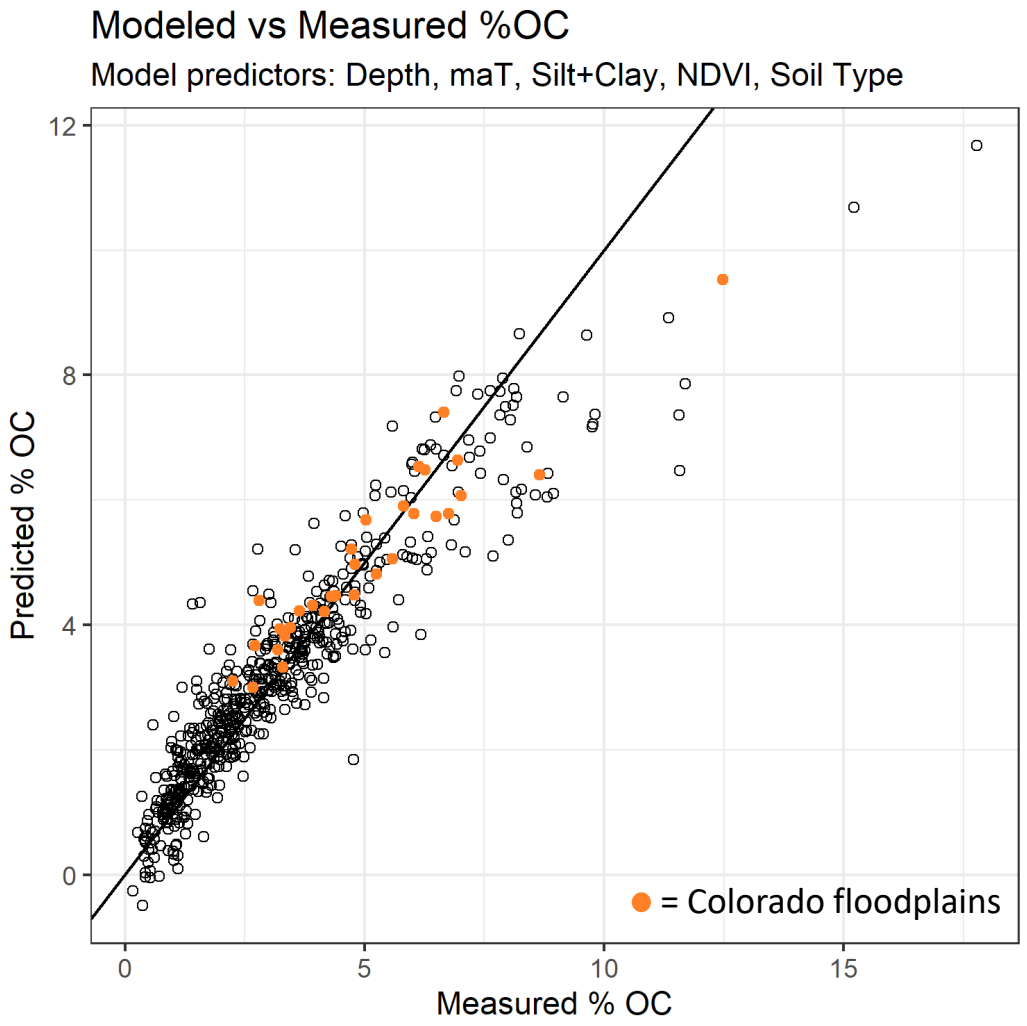
timber harvest effects

LW covers floodplain

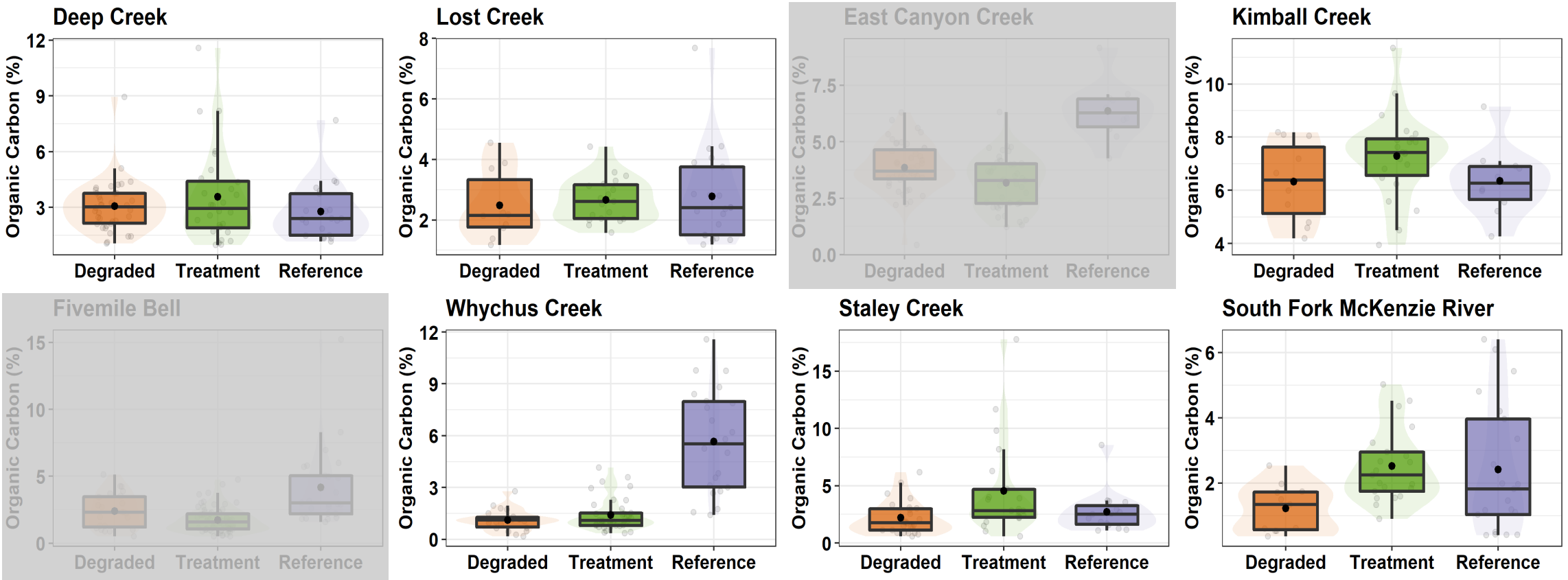
thickly vegetated

All Sites

- Reference Stocks > Treatment and Degraded
- Treatment ≈ Degraded
- Working on model to estimate SOC using novel dataset
  - Possible predictors:
    - Mean annual temperature, precip
    - Elevation
    - NDVI
    - Grain size
    - Sample characteristics (depth, moisture)

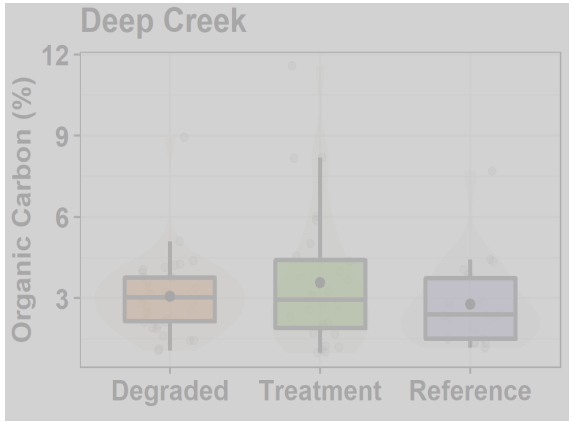


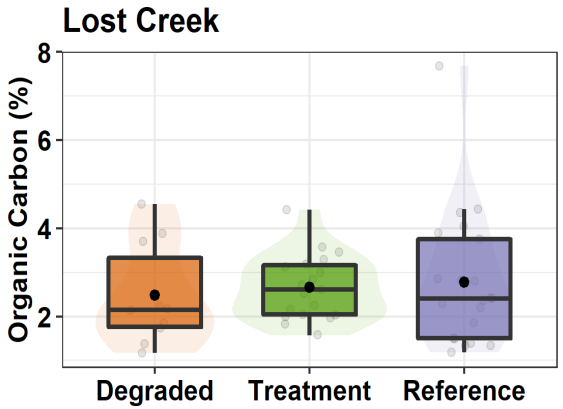
Individual site differences

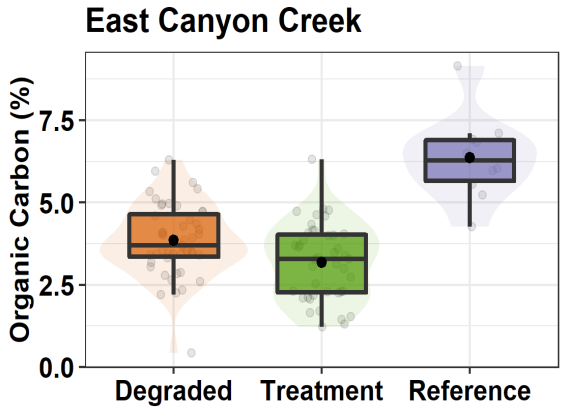


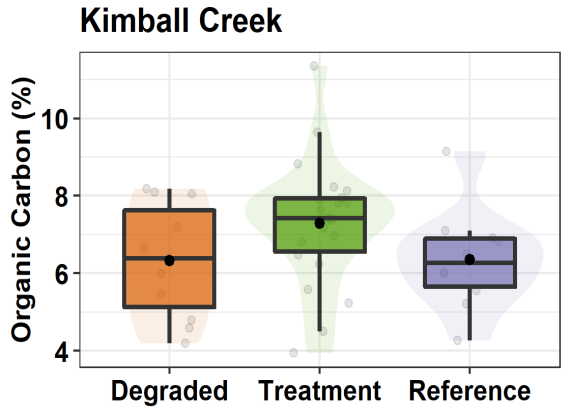
treatment > degraded in all but 2 sites

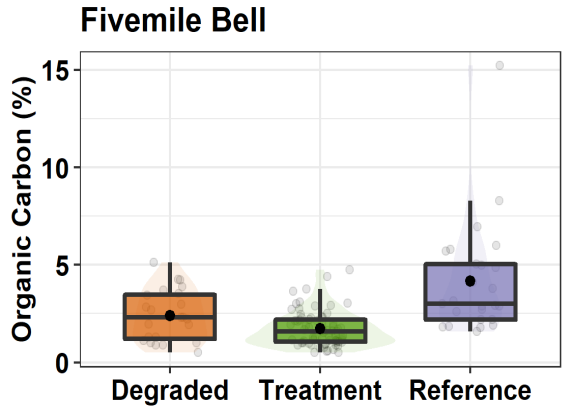
Individual site differences

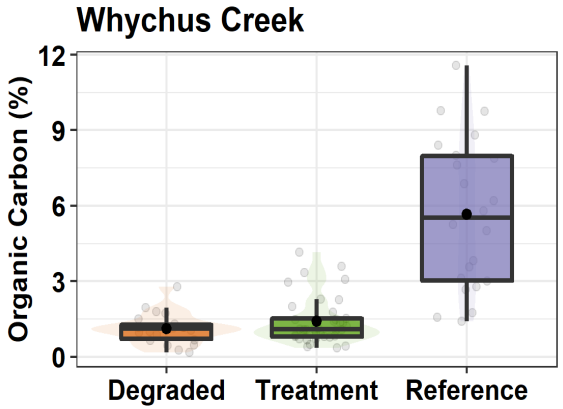


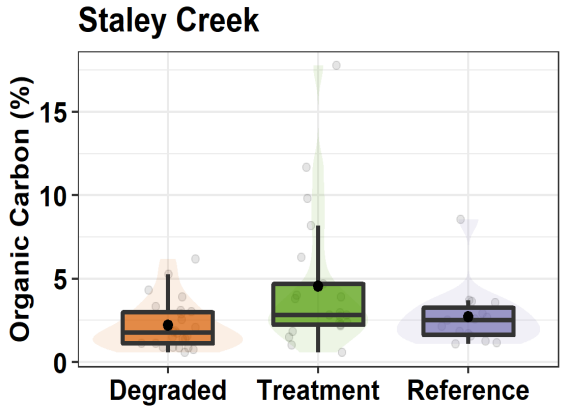


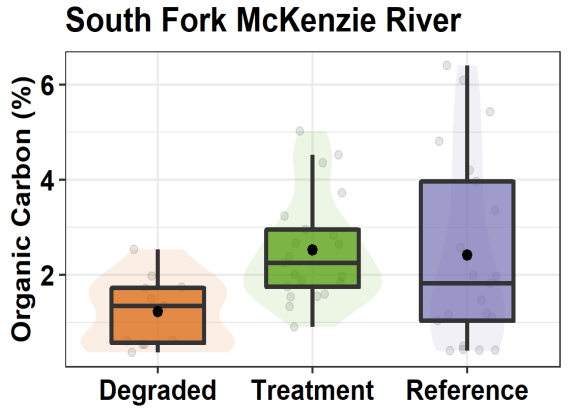












reference > degraded in all but 1 site

Nature Based Carbon Offset

$11.14 per ton on 4/4/2022

The nature/land based voluntary carbon market price varies and a conservative value can be found in the GEO price.

from carboncredits.com

If degraded is proxy for pre-restoration:

Treatment – Degraded Stocks ~ "Carbon stored"

Staley = **$85,000**

South Fork McKenzie = **$94,000**

Staley Creek

South Fork McKenzie

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Staley Creek

South Fork McKenzie

Bridging the gap between C sequestration and the C market?

C sequestration must be:

- Real – genuine
- Measurable – recognized methods
- Permanent – reversal risk is minimized
- Additional – more than background level
- Independently audited – verified by accredited body
- Unique – not duplicated
- Transparent – appropriate public disclosure
- Conservative – not over estimated

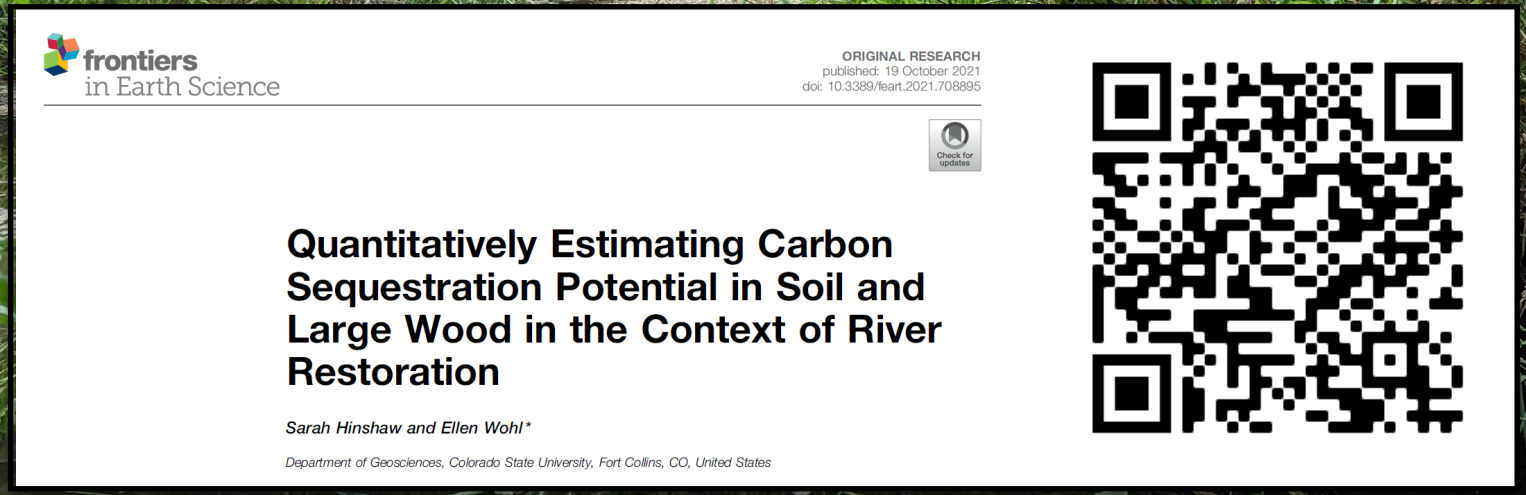
From VCS Program Guide v4.1

VERRA

Verified Carbon Standard

Conclusions

- Carbon is highly variable!
- Moderately fieldwork-intensive method to quantify C storage potential
  - Needs modification for official certification
- Floodplain restoration could be an untapped resource in the carbon offset market



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Quantitatively Estimating Carbon Sequestration Potential in Soil and Large Wood in the Context of River Restoration

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Thank you!
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