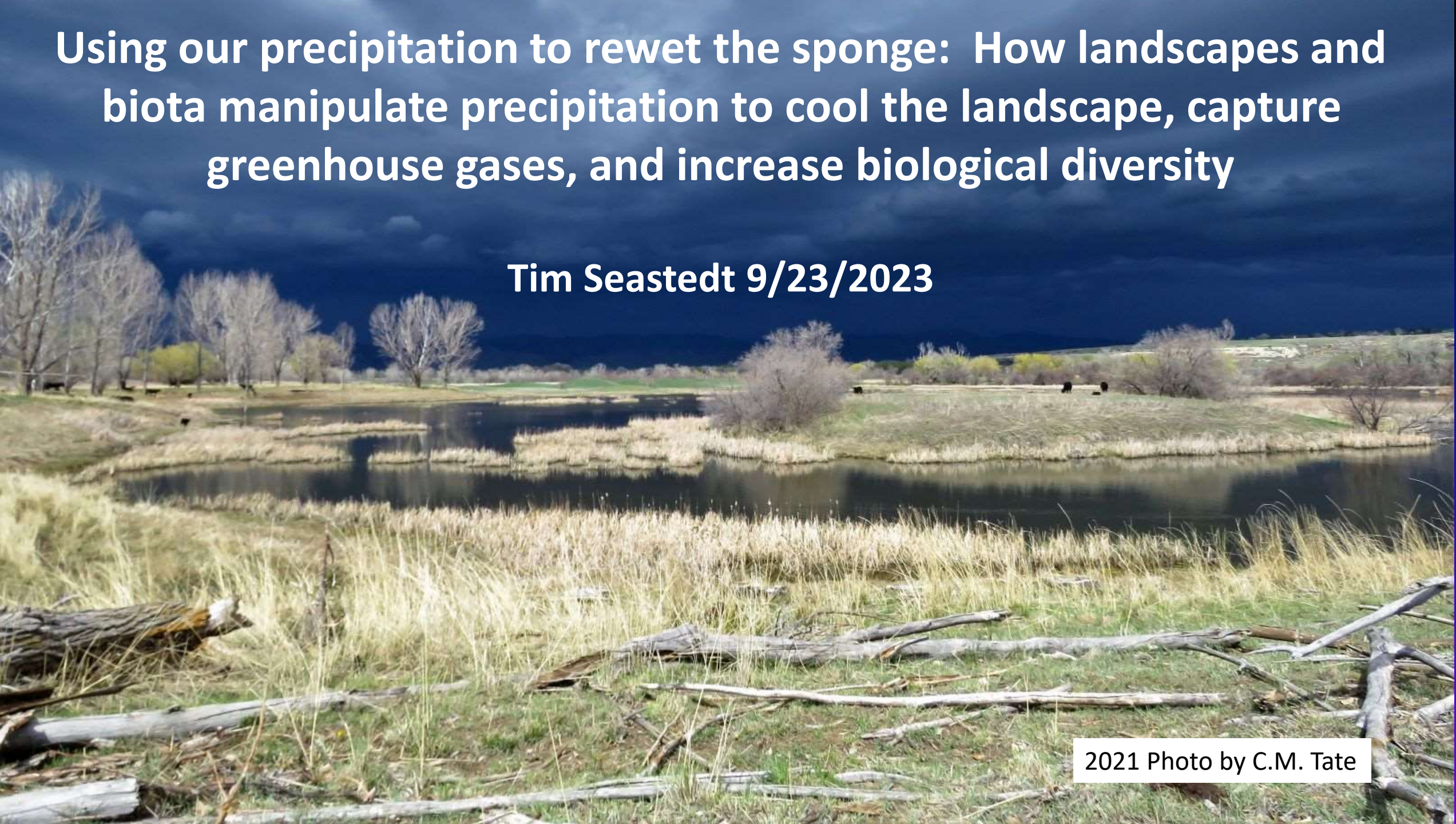
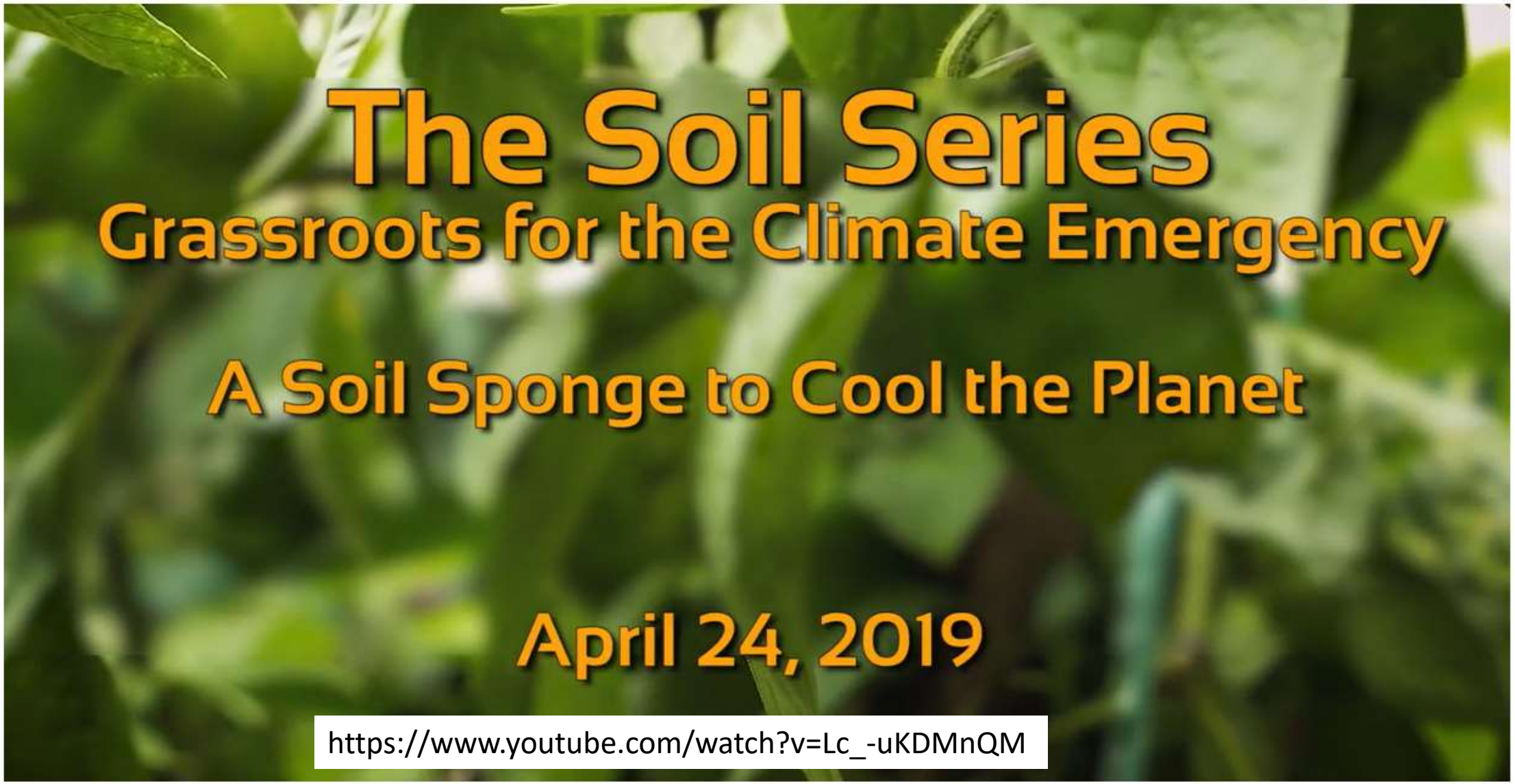
Using our precipitation to rewet the sponge: How landscapes and biota manipulate precipitation to cool the landscape, capture greenhouse gases, and increase biological diversity

Tim Seastedt 9/23/2023



2021 Photo by C.M. Tate

This story has been told by many others in other places:



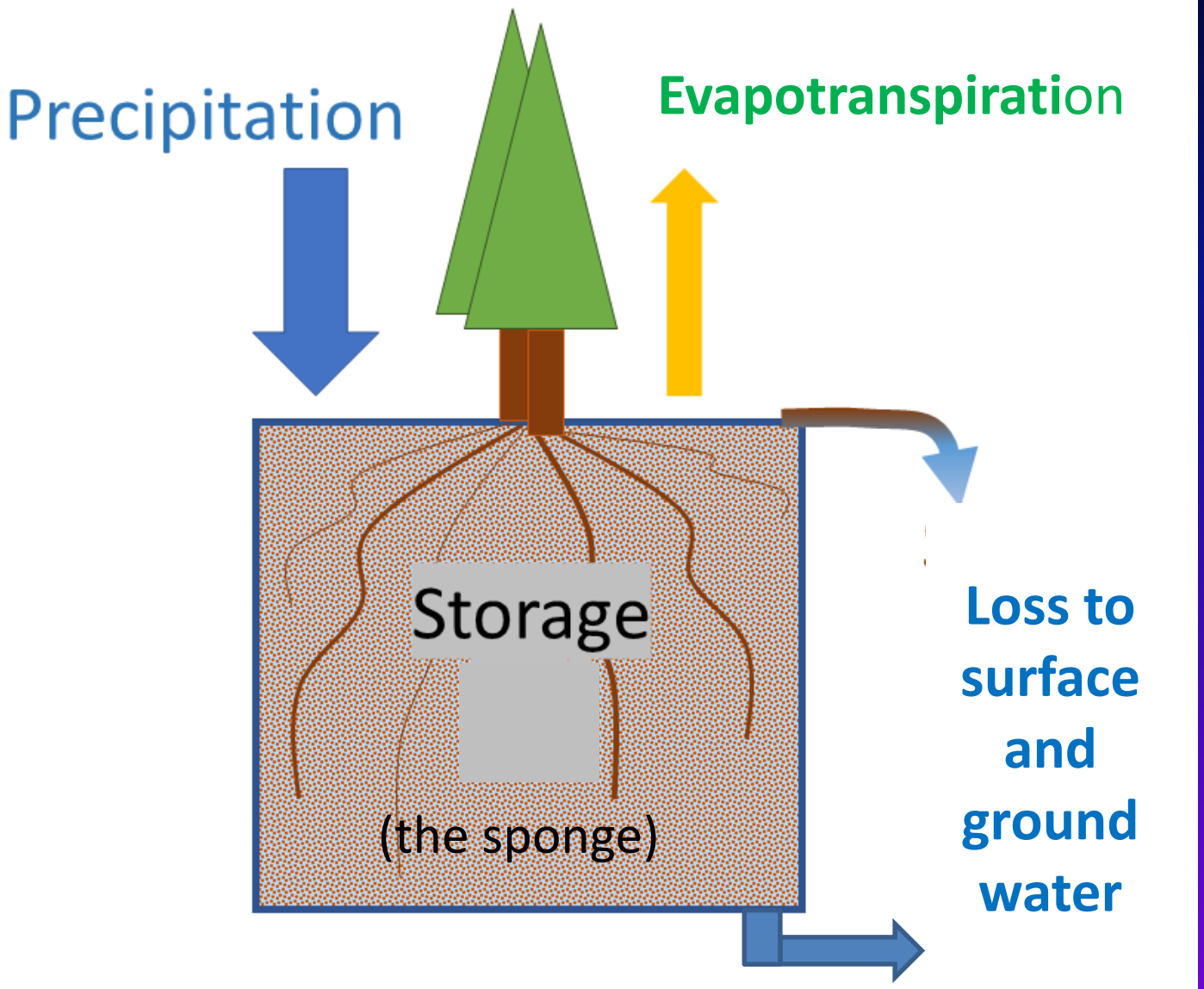
Why this is important:

Precipitation interacts with solar energy to affect our climate:

1. Incoming **precipitation** either is absorbed on the landscape (becomes '**green water**') or is removed ('**blue water'**).

2. Green water interacts more with solar radiation than blue water and can have a local 'cooling effect'.

The soil as a critical storage component, the sponge.



Inputs (precipitation) = **outputs**

Plus or minus the change in storage…

We have some control over the size of the sponge.

Review facts: plants control not only the fate of precipitation but the fate of solar energy

The three ways landscapes affect climate:

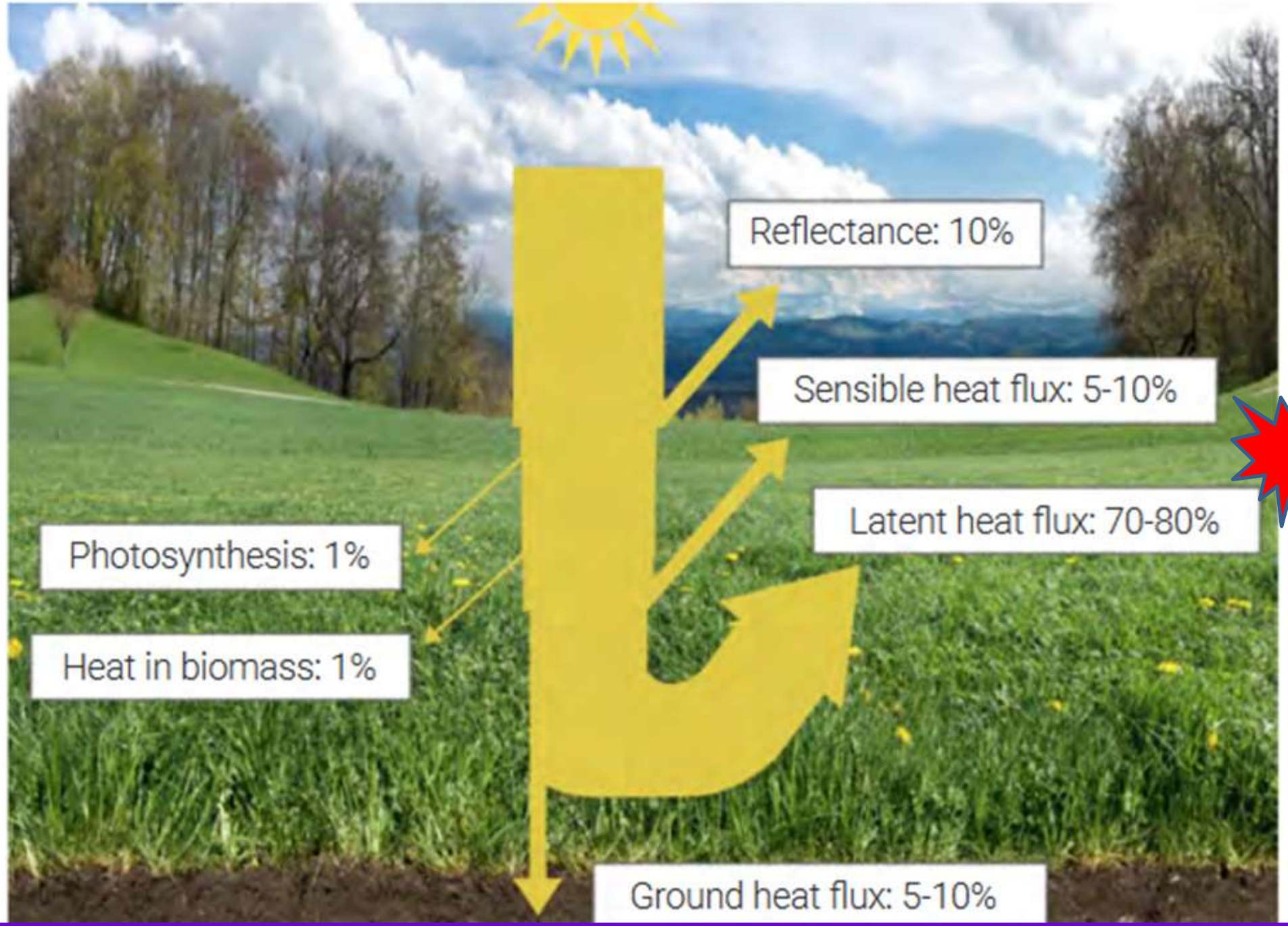
1. remove greenhouse gases.
2. Reflect (rather than absorb) sunlight.
3. Use solar radiation to evaporate water rather than convert to forms of energy that cause rapid surface heating.

…the presence of plants are ‘free” ways to maximize 1. and 3.

Thus…the plants are the pumps that need the sponge.
The combined size of the plants + sponge controls green water.

Storage matters, and we are often WATER LIMITED due to size of sponge.

Bigger sponge = bigger plants!

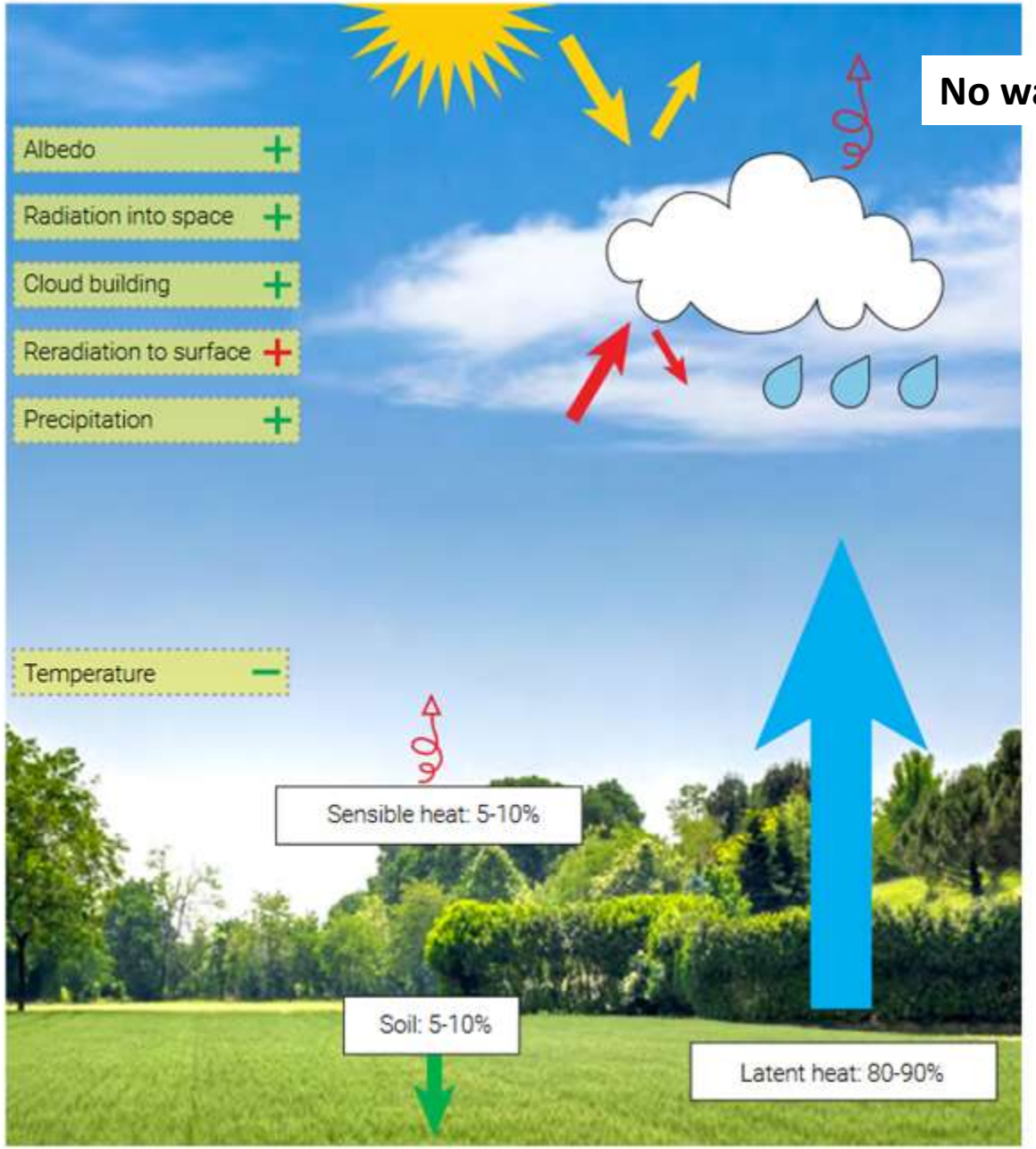


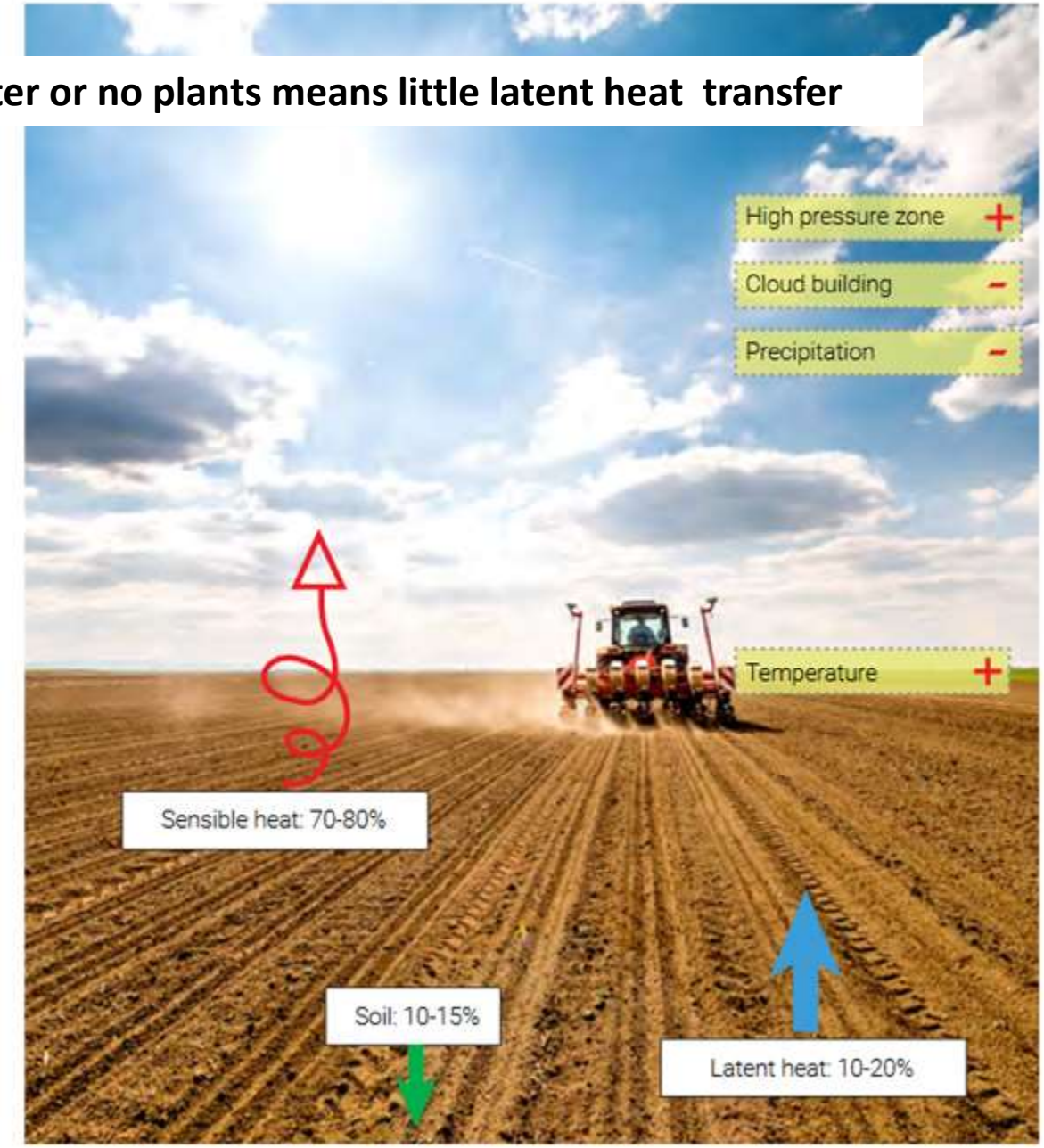
If there is no soil water, there is **little** latent heat flux

(latent heat = energy eqiv. of evapo-transpiration)

from.
Schwartzer, 2021

No water or no plants means little latent heat transfer





We have damaged our sponge:

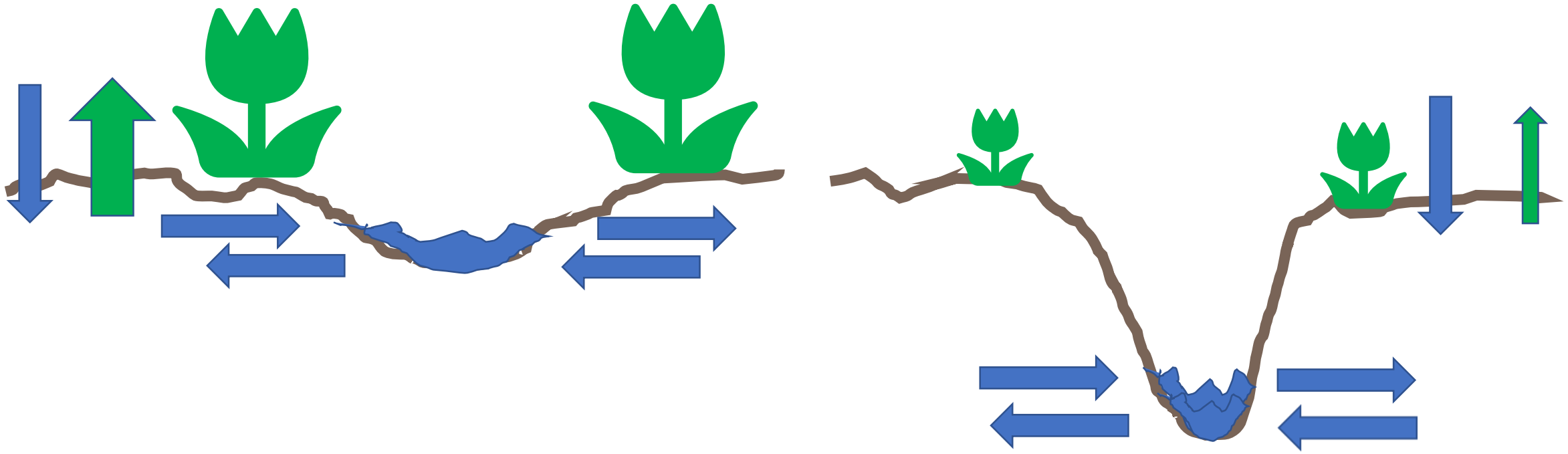
1) We have allowed a portion of the sponge to **wind/water erode**.
2) We have created **impermeable surfaces (things that do not absorb water) or compacted the surface that reduces storage.**

These can be a significant percentage of area in:

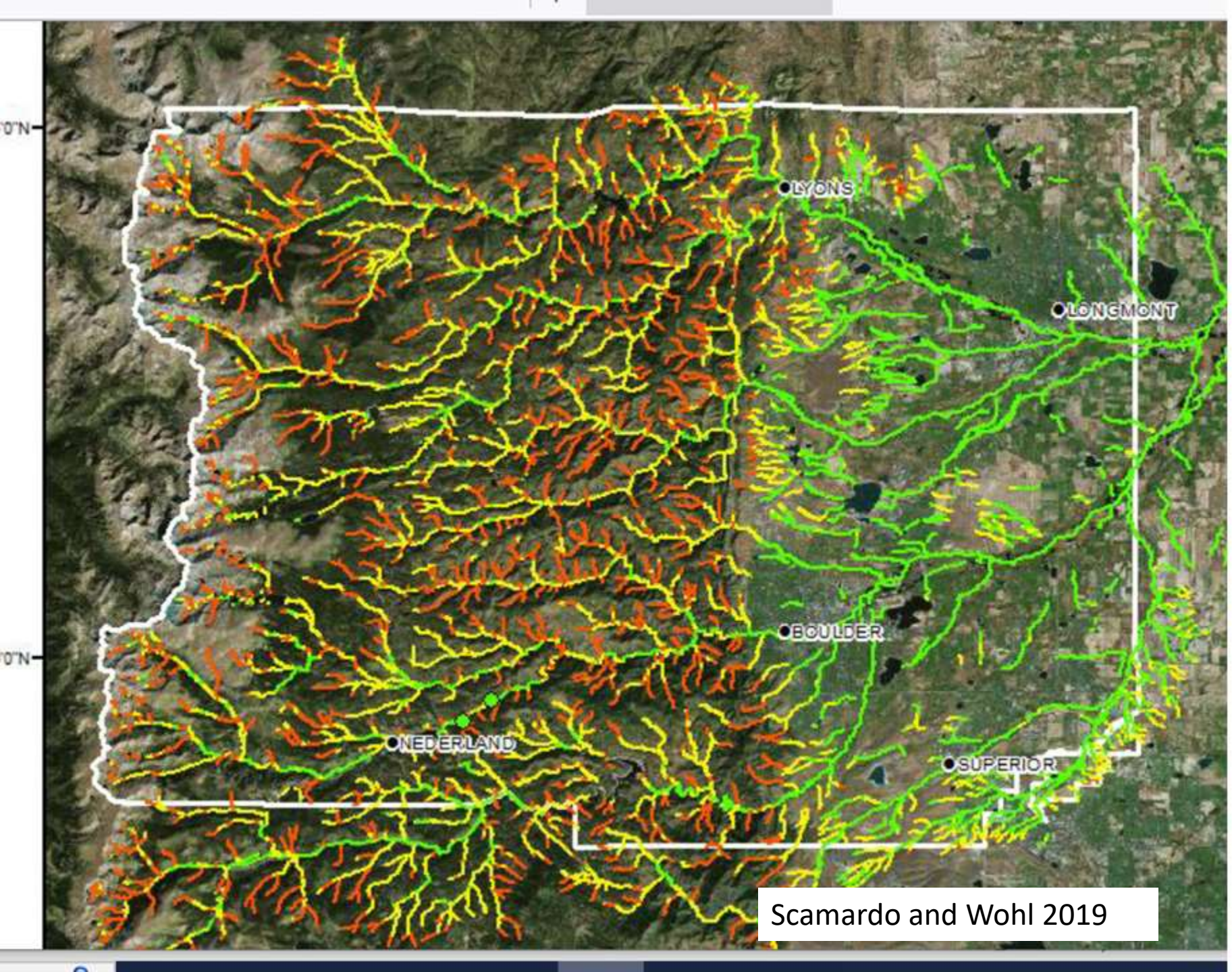
- Built environments
- Agricultural systems
- Grazing systems and natural areas

There is less green water now than ~ 140 years ago… in some areas a lot less!

Excess erosion/ditches steal water from the sponge:



Erosion is both a natural and human-induced process. Downcutting results in less water available to surface soils



Watersheds and stream gradients

The precipitation from Foothills and prairie/agriculture drainages can have a different fate than our precipitation in high elevation systems.

The fate of low-elevation precipitation in the Front Range:

Low elevation watersheds contribute “runoff” and “intermittent flow”. A large but variable percentage is absorbed by the surface.

Green water….

Is greatly enhanced by surface wetlands….

These wetlands can be composed of….water or saturated soils adjacent to water.

The science literature is replete with information showing benefits to biological diversity, to carbon storage, and to temperature moderation.

Evidence for the Multiple Benefits of Wetland Conservation in North America

Carbon, Biodiversity, and Beyond

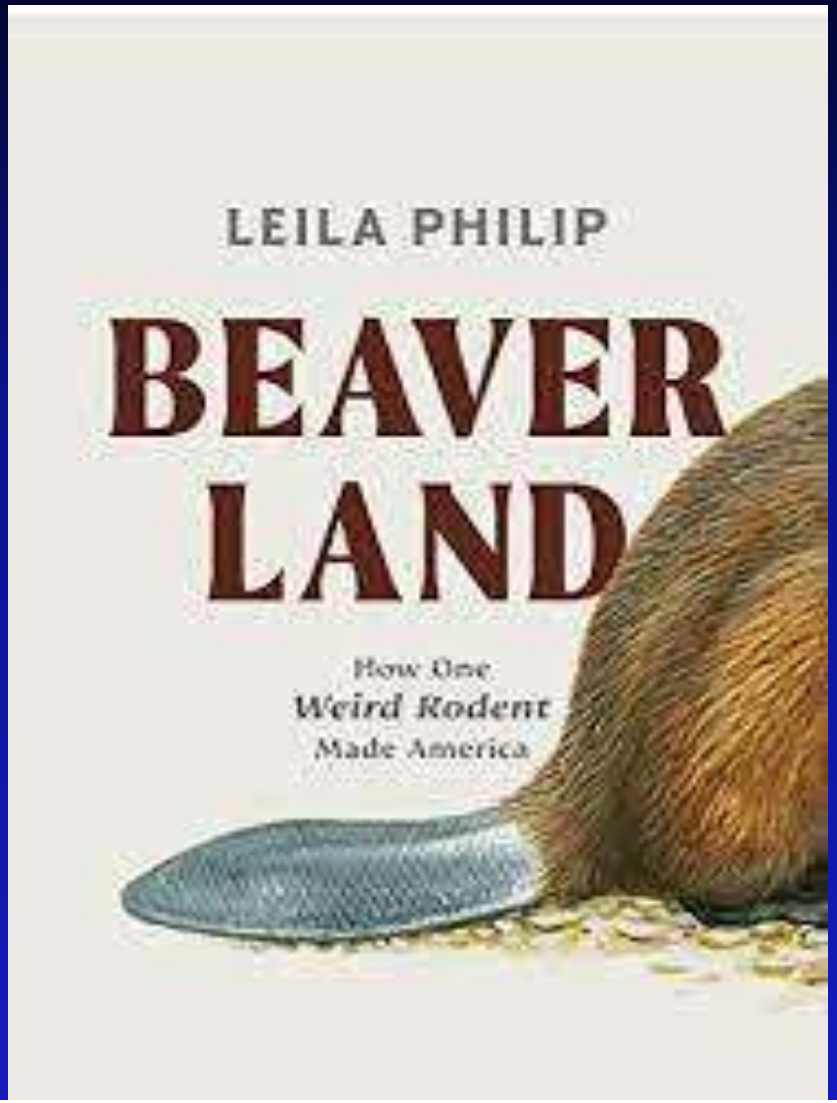
Point Blue Conservation Science 2022
Erin Conlisk, Liz Chamberlin, Marian Vernon, Kristen E. Dybala

Restoring Western Headwater Streams with Low-Tech Process-Based Methods: A Review of the Science and Case Study Results, Challenges, and Opportunities

Version 1.0, November 2022

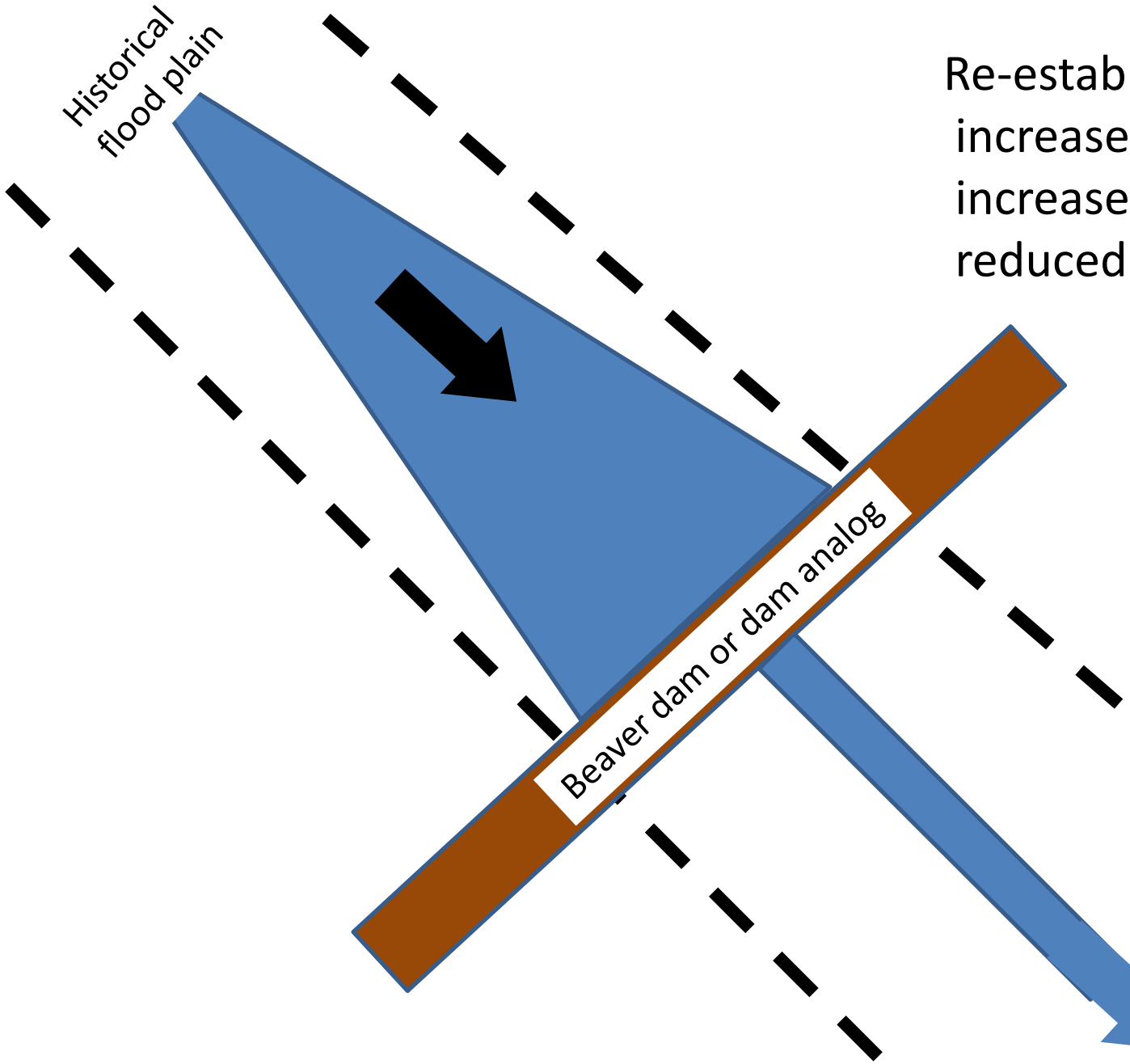
Jackie Corday, with support from a Colorado Water Conservation Board

Beaver dams overshadow climate extremes in controlling riparian hydrology and water quality Dewey et al. 2022



Pre-European contact #s as high as 200 million? After massive reductions, #s have increased to 15 million.

Cameron Peak Fire burned everything around this beaver pond in 2020. Photo taken in June 2021 by Ev
Barrientos/Audubon Rockies [Beavers Offer Help for Western Waters | Audubon Rockies]



Re-establish historical flood plain
increased carbon deposition
increased biodiversity
reduced fire risk

Rewetting historically wet floodplains is unlikely to violate Colorado Water Law (**the beavers had ‘first use’, right?)**

goal is to spread and ‘detain’ water, not retain water.

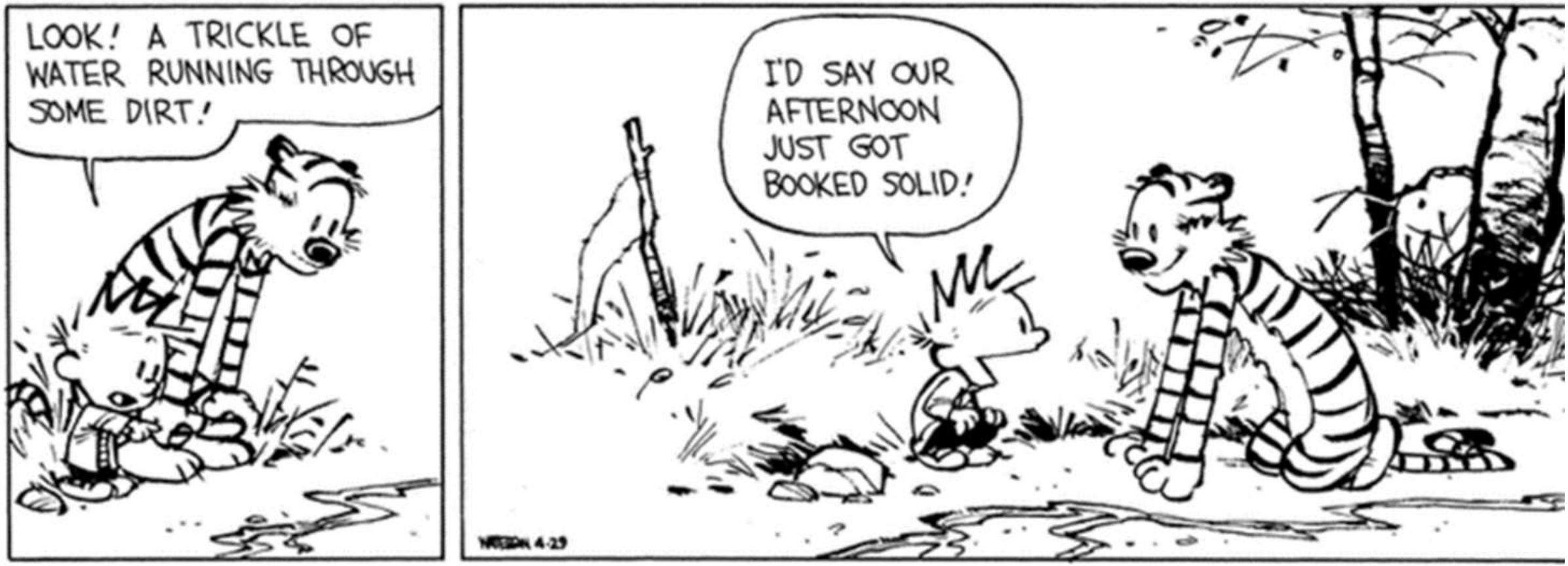
Can’t wait for the beaver’s food to be restored? Create beaver analog structures….

Here, a stream that was channelized 100+ years ago to remove water from hay meadow is now slowed and spread out.

WILDLANDS RESTORATION VOLUNTEERS

A beaver dam analog creates a wetland area (Boulder YSI, Wildlands Restoration Volunteers and CU-Outreach project)

Watterston, 1995



Rewetting Landscapes: How to increase biodiversity, remove carbon dioxide from the atmosphere, and cool the planet…

One watershed at a time!

Re-wetting the Sponge: Meadow restoration in the Upper Gunnison River Basin

A Collaborative Project of the Gunnison Climate Working Group

Andrew Breibart, Bureau of Land Management

Sustaining Watersheds Conference

A climate-smart project started in 2012 and funded by Gunnison sage grouse protection funds (TNC, Betsy Neely)


Fall, 2020


Fall, 2020


Summer,
2021


Summer,
2022

June 2023 – 3 growing seasons after structure was built

THE STUCTURE:

STOPPED EROSION FROM HEADCUT

INCREASED GRASS PRODUCTION

DURING EXTREME RUNOFF, TRAPPED SEDIMENT FROM EROSION BROUGHT DOWN FROM DAMAGED UPHILL SITE.

MADE ‘THE SPONGE’… THE SOIL STORAGE COMPONENT… BIGGER!

Looking uphill to a one-rock dam, a very simple, low statured structure designed to slow the flow of runoff (fall, 2020)


Side view
Summer 2021


Looking uphill
Summer 2021


summer, 2022


June, 2023

Same one-rock dam three years after construction: Sediment trapped uphill now functions as a larger sponge.
(Once the grass roots become established, further erosion is unlikely. The structure buries itself!)

“Hurricane-force winds whip the Colorado Front Range”

Amanda Kresting, Nine news, March 31, 2023

Wind and water erosion removes topsoil….

Additional infrastructure needed to protect our soils from overgrazing

Soil deposited from the spring Boulder County Dust storm being eroded By spring runoff.

Photo: May 21, 2023

A series of one-rock dams could keep this soil in place to enhance grassland water retention.


An example of the sponge on OSMP in action!

The absence of vegetation is evidence of active erosion.

1) Water not retained in bare areas and facilitates *enhanced* erosion
2) The absence of plants implies the site is a carbon source.
3) The sponge needs to be restored before it can be rewetted!

Example of head cut:

Damage caused by management legacies, nonpermeable surfaces, (e.g., roads, trails, etc).

Foothill fires and 2013 flood scars also generate these.

A cow-trail turned into a drainage Ditch?

The culvert at the bottom of this photo attests to the fact that surface runoff on this clearly ‘mesic’ grassland is occurring. Why not spread that flow and put it into the soil?

Note that this action may NOT completely negate the increasingly aridity trends that exist for our region! (rewetting can maintain the status quo?)

Pre-fire or post-fire check dams can function into the future as rewetting structures

Building rewetting structures in the Front Range:

Provides a mechanism to ***enhance biodiversity****	Win
Provides a mechanism to ***enhance carbon drawdown***	Win
Provides a mechanism to ***reduce the seasonality of fires****	Win
Provides a mechanism for ***maintaining human health*** (exercise!)	Win

* Best with native reseeding or plantings and additional land management techniques

Restore and rewet the sponge: more water storage = more cooling, less greenhouse gases & more biodiversity. Let's exploit one very obvious nature-based climate solution for the Front Range!

Thanks for listening!

Acknowledgments:

A whole boat-load of people!

Oops… this logo belongs to the athletic dept.

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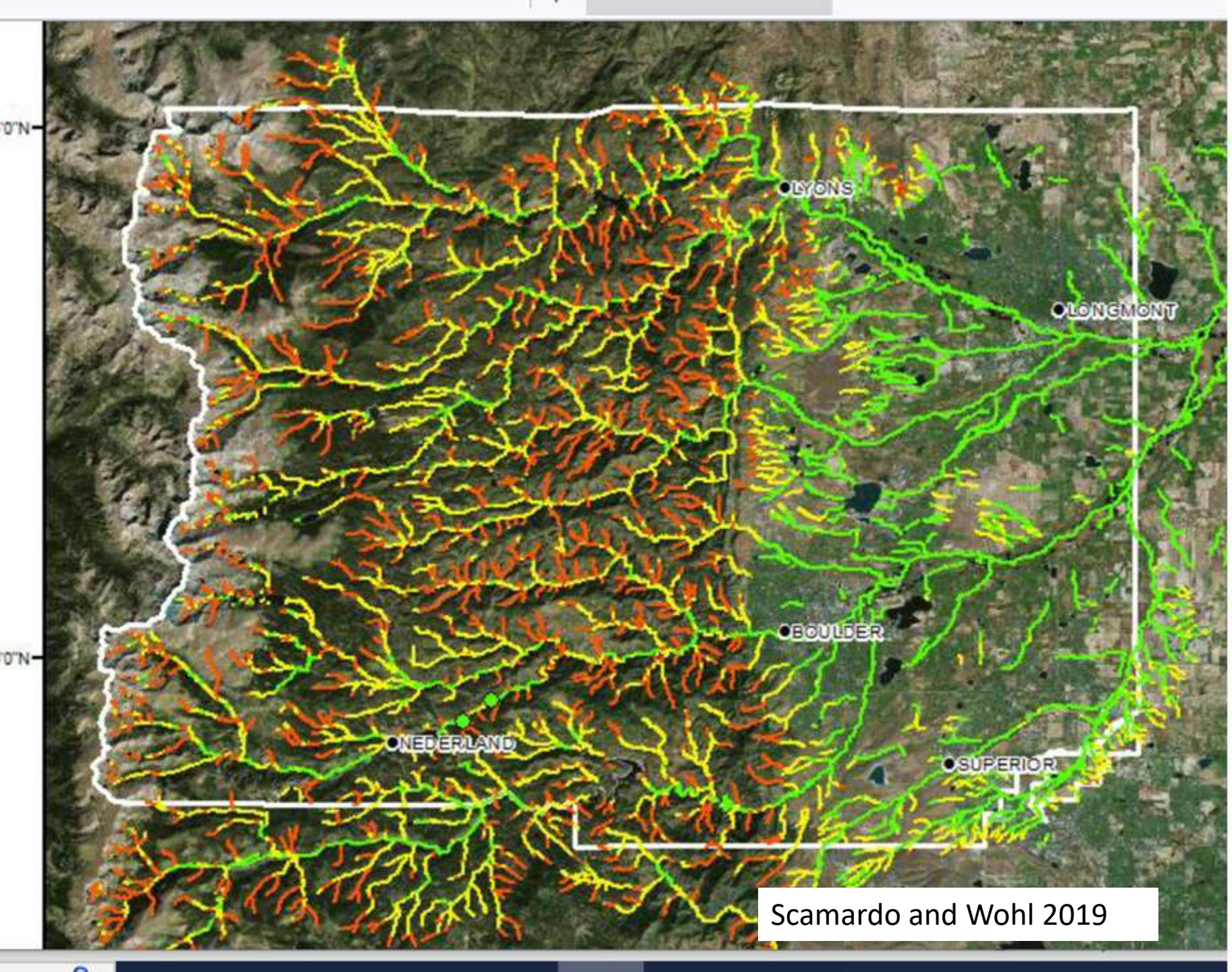

Scamardo and Wohl 2019

Watersheds and stream gradients

WE LIVE IN A SEMIARID LANDSCAPE, BUT WE COULD BE SOAKING WET (?)

“Let water do the work.” Bill Zeedyk