Managing forest for carbon offsets—opportunities, risks and [is there a] way forward

Dr. Lilli Kaarakka

SAF Learning Exchange Series, June 2024

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Why are we here to today?

- Understanding forest carbon dynamics
- Land management and nature-based solutions
- Offset markets in the US (and findings so far)
- Way forward?

SAF Learning Exchange Series, June 2024

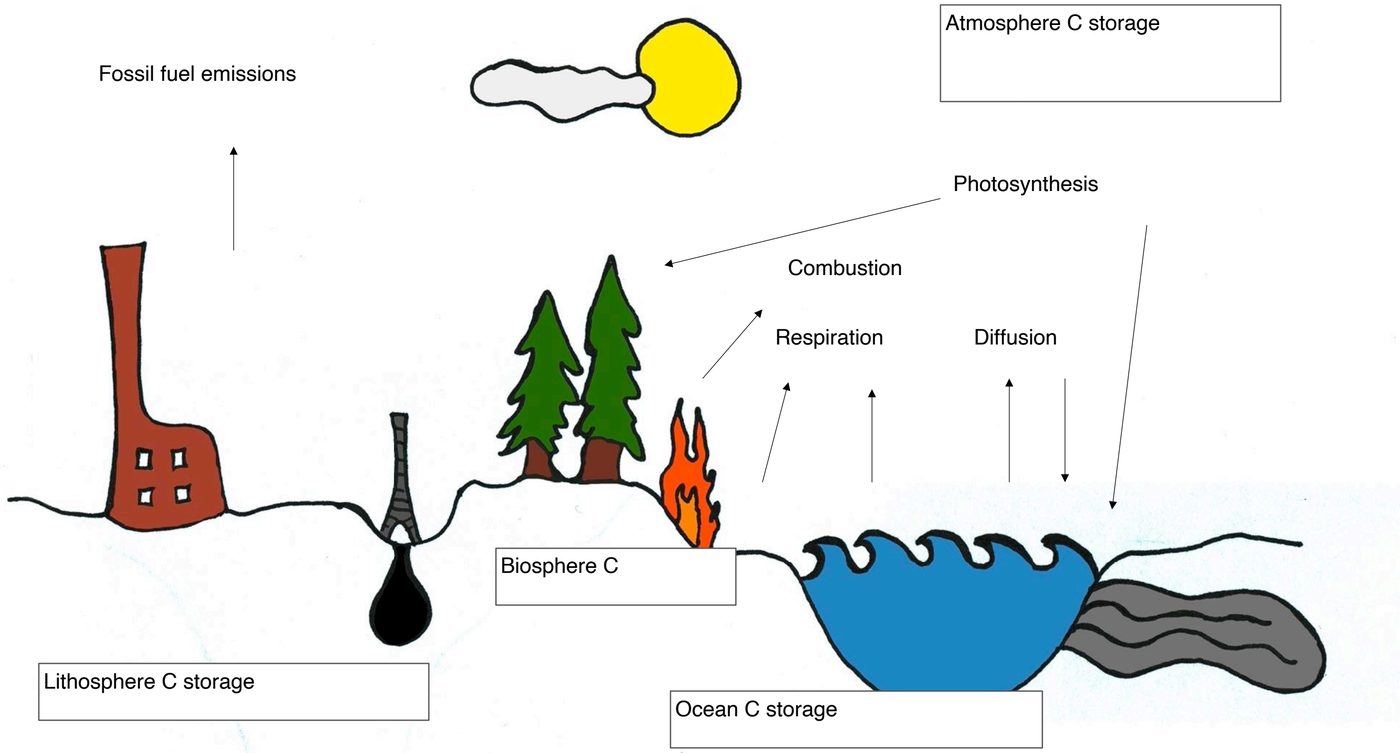
Quick carbon recap — where, how, why

SLOW C

- C takes between 100-200 million years to move between rocks, soil, ocean, and atmosphere in the slow carbon cycle
- The slow cycle returns carbon to the atmosphere through volcanoes*

FAST C

- Movement of carbon through life forms in the the biosphere
- Decadal/annual



(*HUMANS EMIT 100-300 times for carbon than volcanoes)

Fate of anthropogenic CO_2 emissions (2009—2018)

Sources = **Sinks**

34.7 $GtCO_2/yr$

86%

14%

5.5 $GtCO_2/yr$

17.9 $GtCO_2/yr$

44%

29%

11.5 $GtCO_2/yr$

23%

9.2 $GtCO_2/yr$

Budget Imbalance:
(the difference between estimated sources & sinks)

4%
1.6 $GtCO_2/yr$

Global C Budget 2019
https://www.globalcarbonproject.org/carbonbudget/

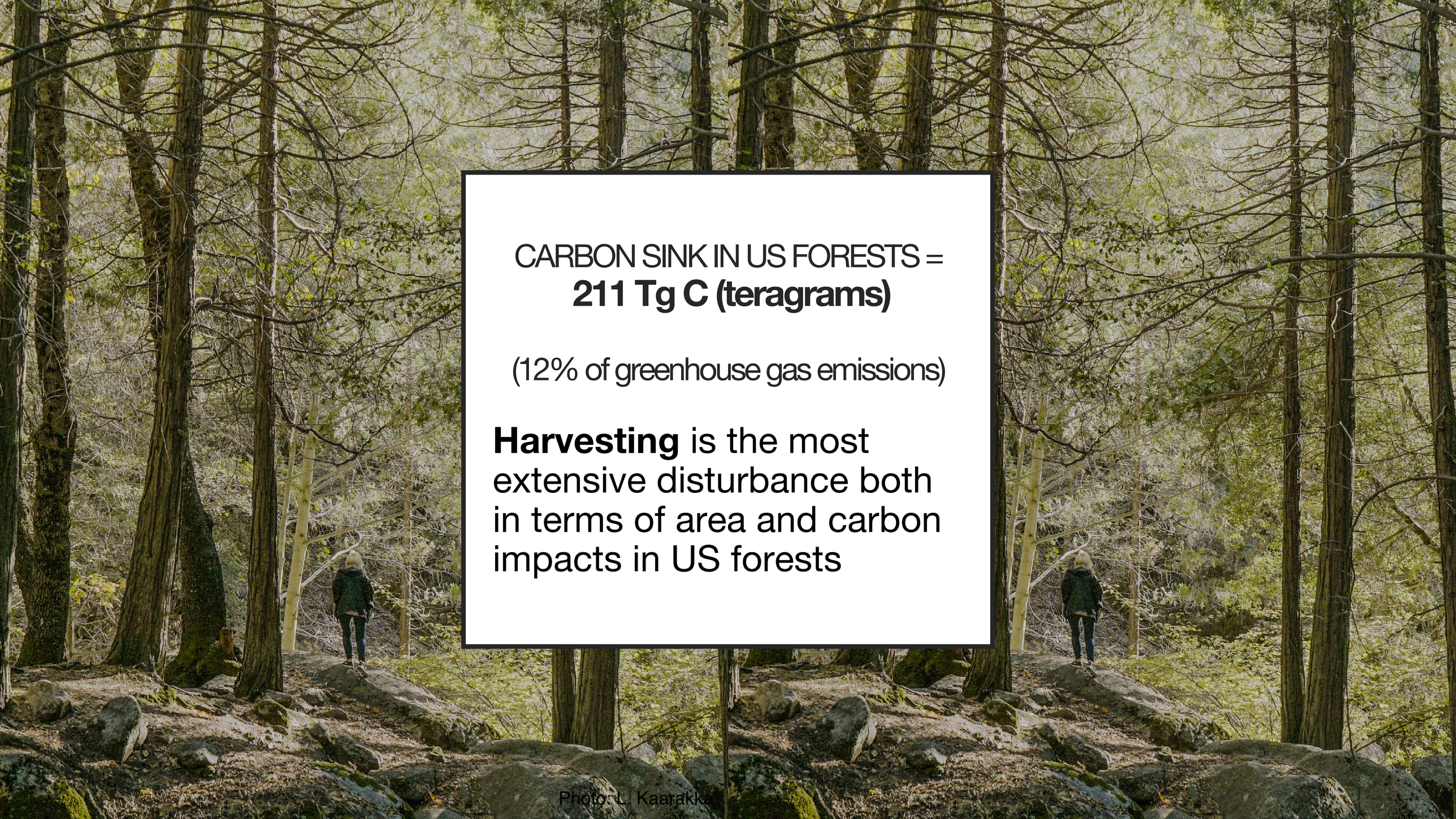
Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Friedlingstein et al 2019; Global Carbon Budget 2019

The fate of sequestered carbon.

Uptake of atmospheric CO_2 by vegetation and soils in the United States, partitioned according to the ultimate fate of the sequestered carbon in the environment [adapted from (**6**)]. The total uptake of carbon in the continental United States is between 0.3 and 0.6 Pg C per year, equivalent to 20 to 40 percent of fossil fuel emissions worldwide.

….more than 75 % of the C sequestered in the United States is found in organic matter that is not inventoried

Image from Wofsy (2001) Science, adapted from Pacala et al. 2001



CARBON SINK IN US FORESTS =
211 Tg C (teragrams)

(12% of greenhouse gas emissions)

Harvesting is the most extensive disturbance both in terms of area and carbon impacts in US forests

Photo: L. Kaarakka


IMAGE
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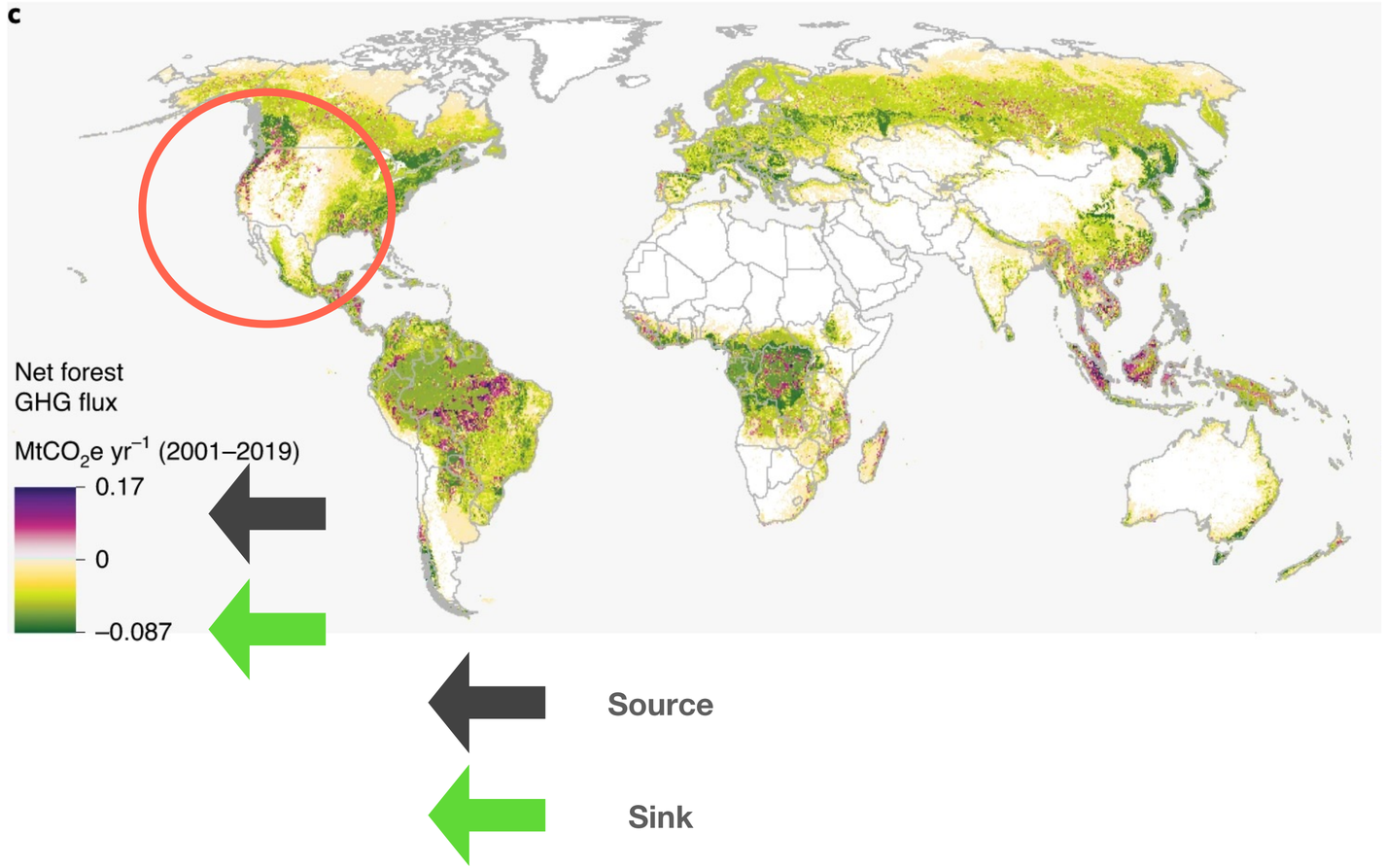
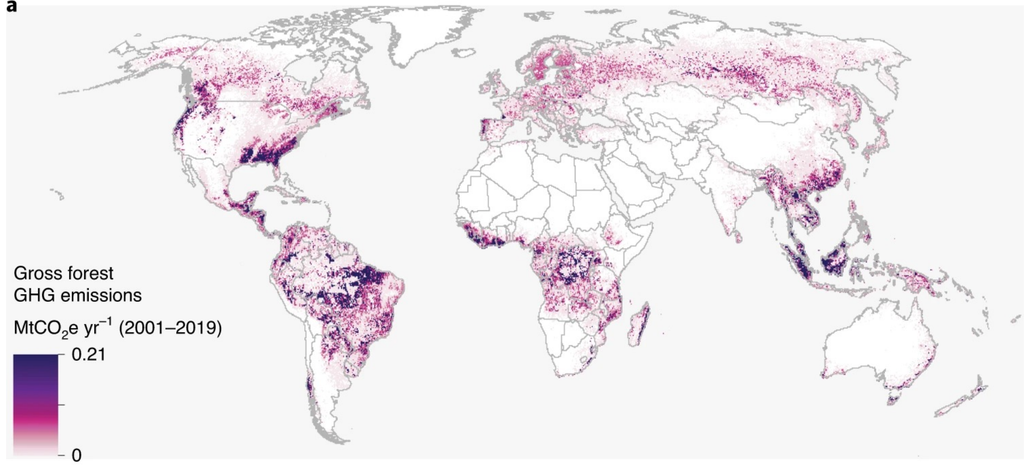
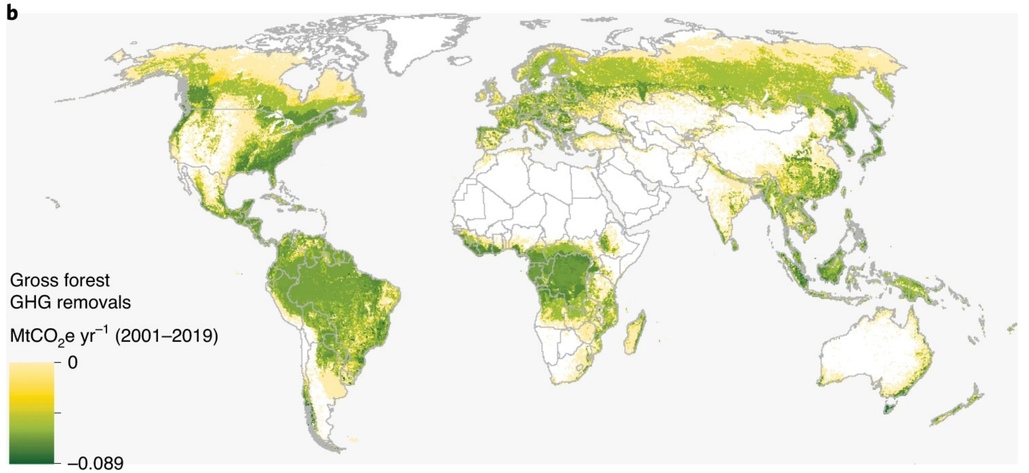
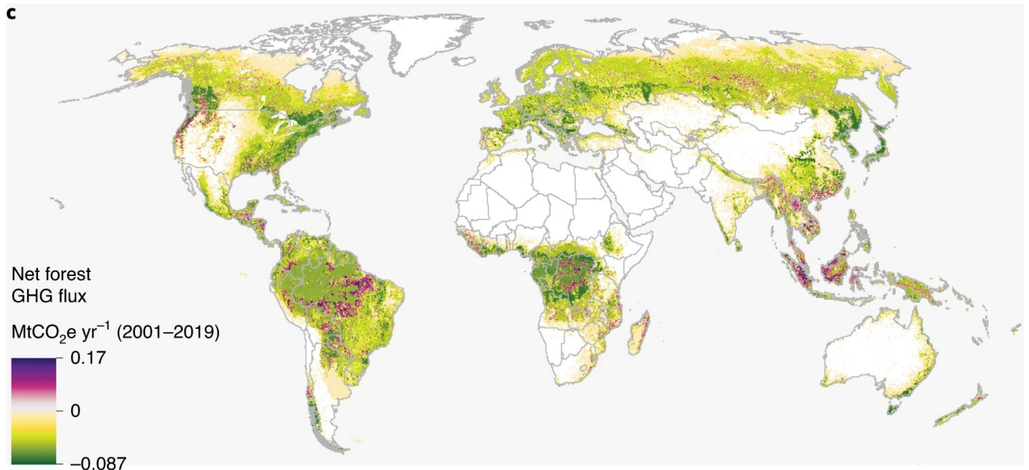
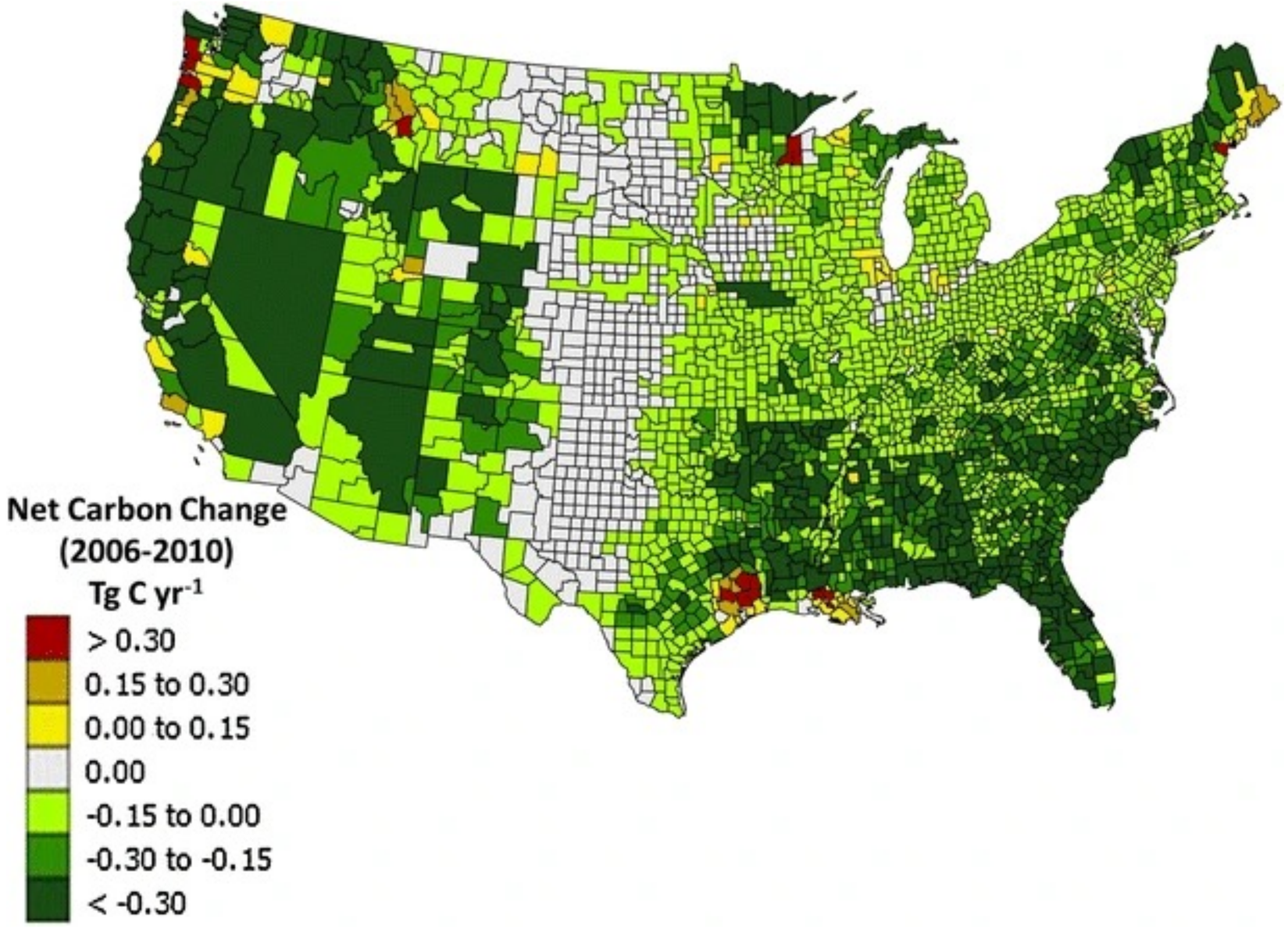








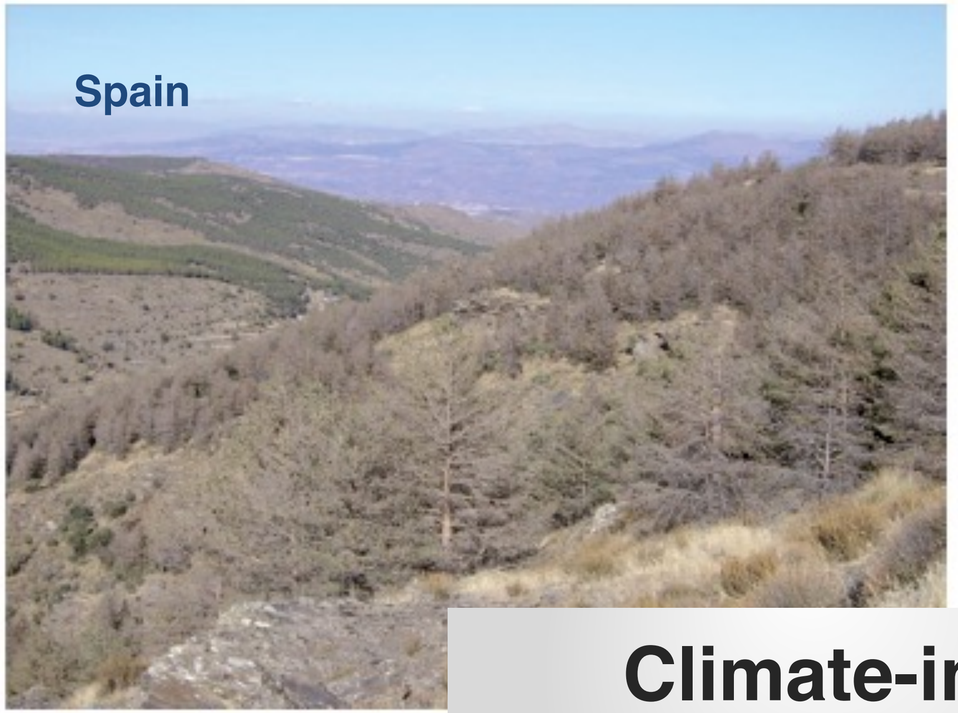
Harris, N. Et al. 2021 https://www.nature.com/articles/s41558-020-00976-6



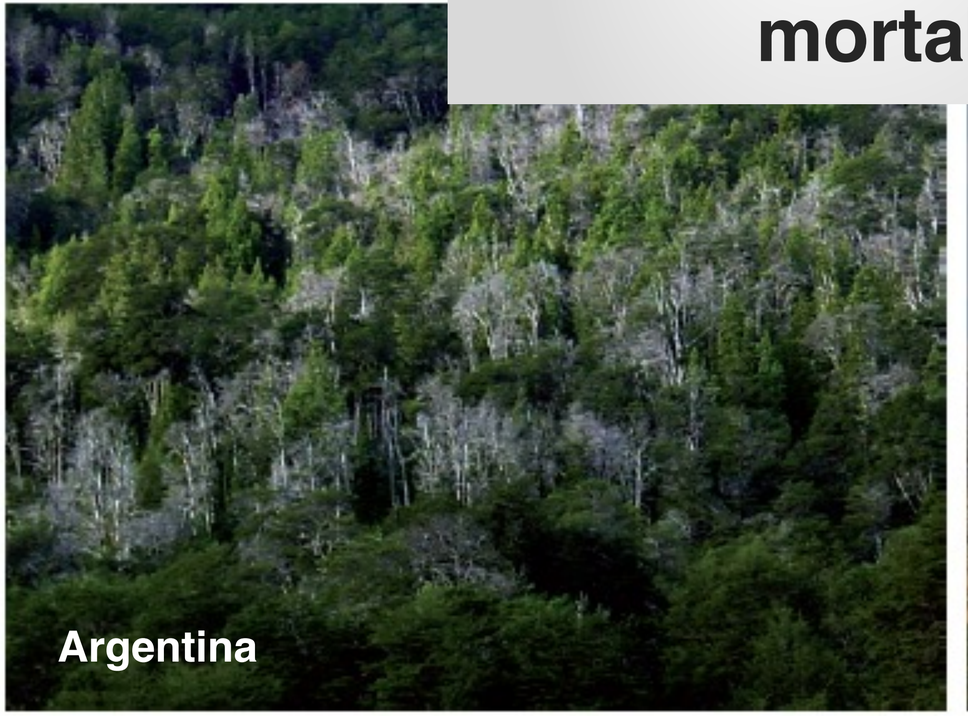
….these disturbances [harvest, fire, insects, storms] reduced the estimated potential C sink of US forests by 42%.

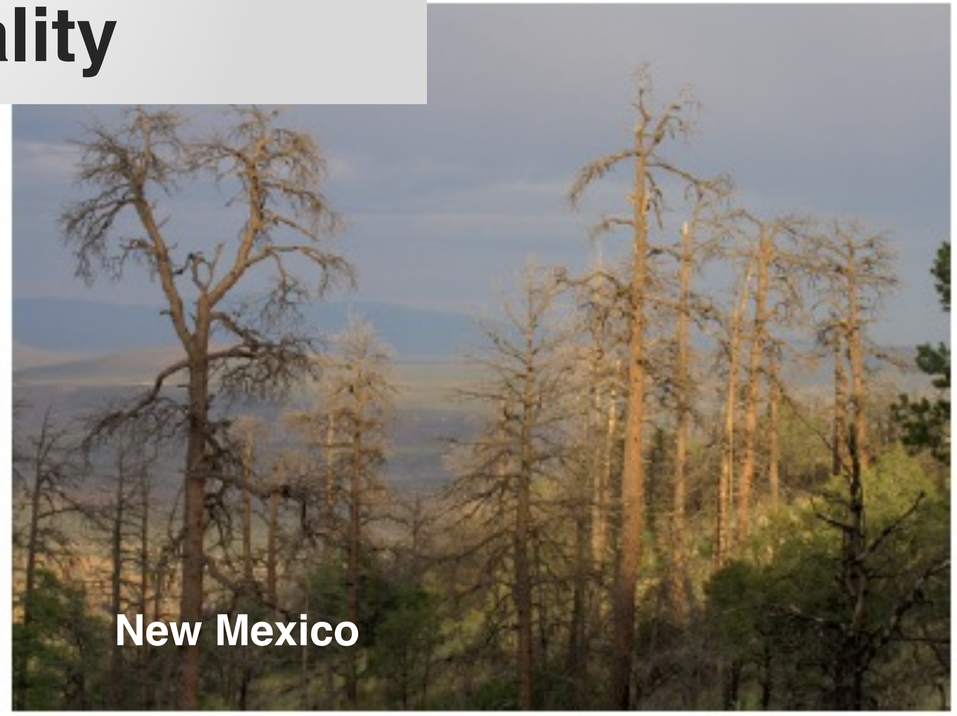
Harris, N.L., Hagen, S.C., Saatchi, S.S. *et al.* Attribution of net carbon change by disturbance type across forest lands of the conterminous United States. *Carbon Balance Manage* 11, 24 (2016). https://doi.org/10.1186/s13021-016-0066-5

Bark beetles have ravaged 85,000 square miles of forest in the western United States since 2000, including this area in California as seen in 2016. U.S. FOREST SERVICE



Climate-induced mortality





Why talk about carbon and changing conditions?!

Land management and nature-based solutions

- Land management key component in climate change mitigation
- Nature-based solutions→ forest pathways
- US forests = C sink (12% of emissions)
- Improved forest management (IFM)

Photos: L. Kaarakka

Land management - IFM

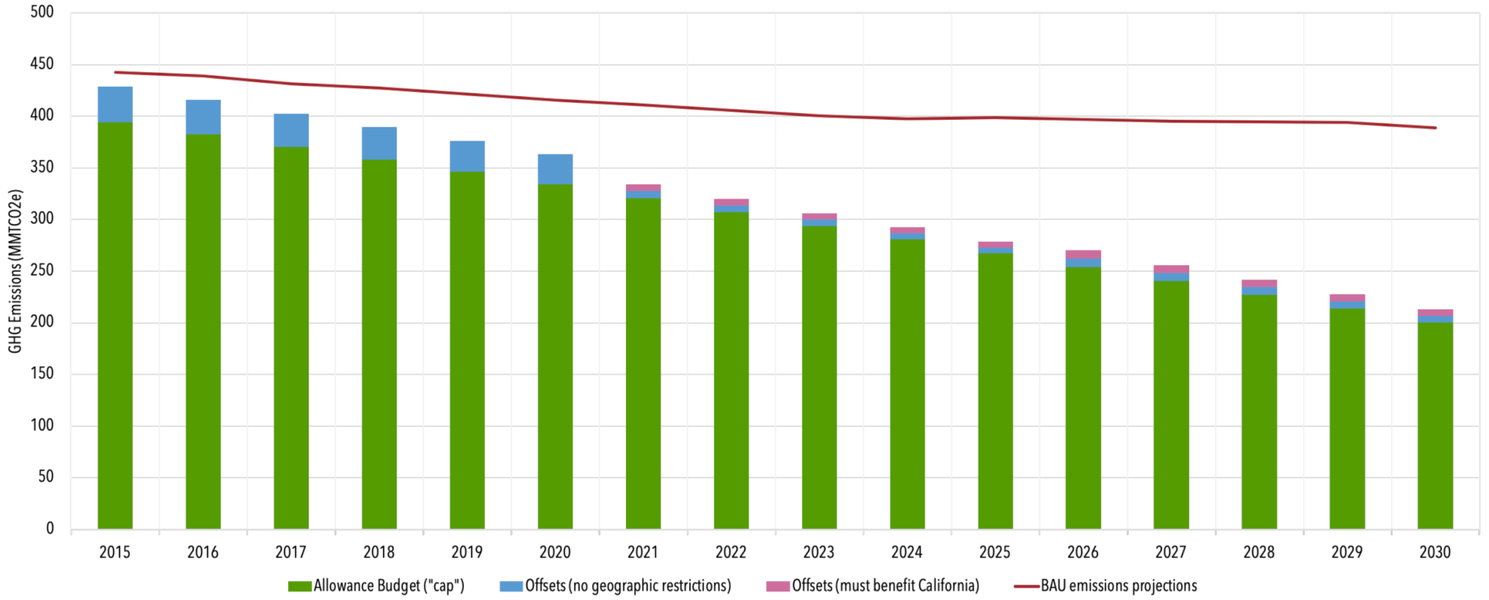
- Offsets in the market — 80% forestry projects
- 58% of all credits, 96% of forestry sector credits
- **OFFSETS?**

…now to C offset markets here in US

Offsets

Offsets are real, quantifiable, enforceable, permanent, additional, and verified reductions of GHGs generated from projects in economic sectors – like forestry or agriculture – that are not covered by the Cap-and-Trade Program (California)

Unit?

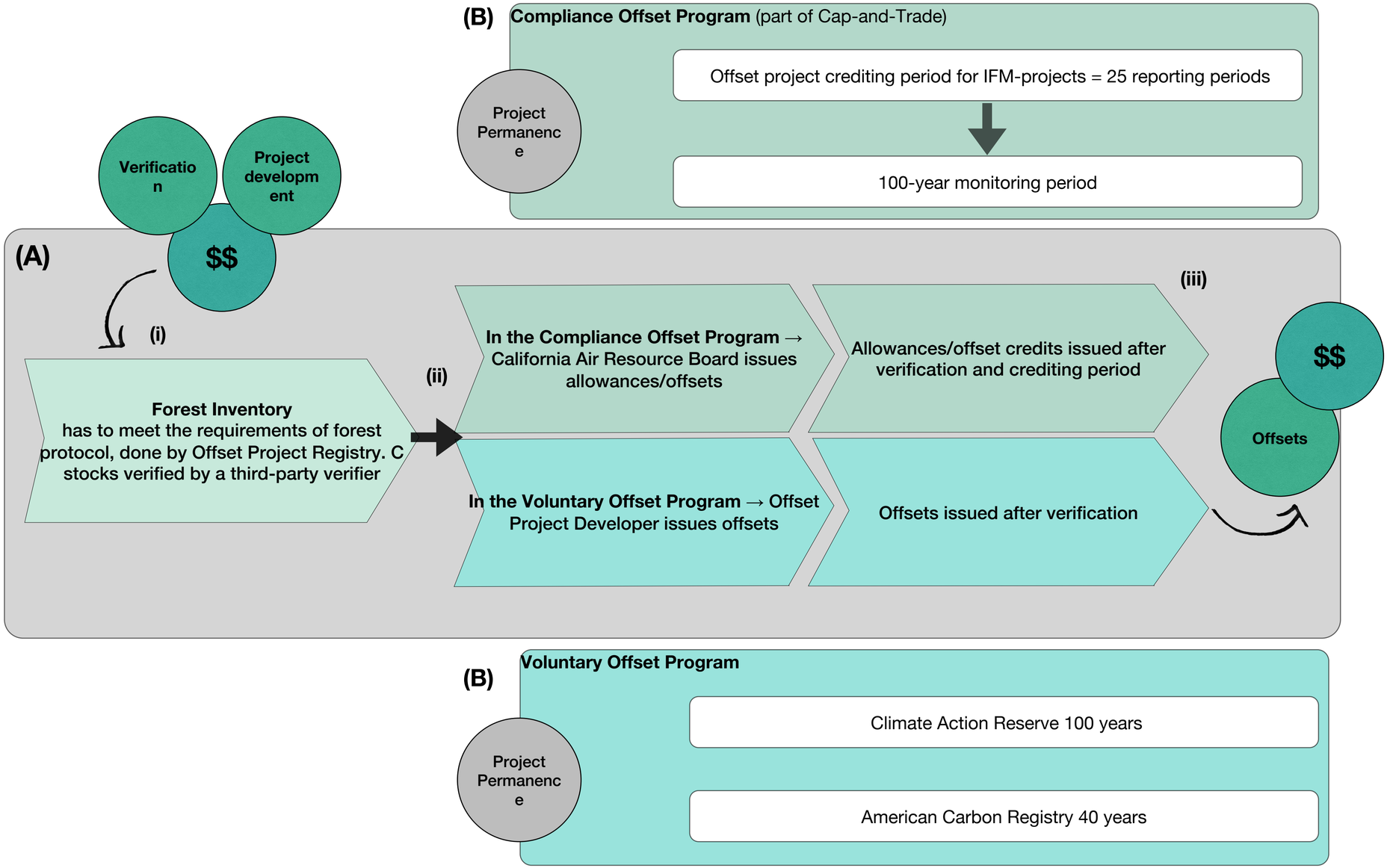


Carbon market in California

	Voluntary Market	Compliance Market
Participants	Any individual, business, nonprofit, municipality, or utility **voluntarily reducing emissions**	Large emitters and utilities **required to reduce emissions by law** (California, Quebec, EU)
Standard	**Climate Action Reserve** protocols, other carbon registries	**CA Air Resources Board (CARB)** approved protocols
Project Types	**18** project types	**6** project types; only Forest, MMC, ODS, Livestock used to date
Credit Prices	**50¢ - $50**, depending on project type, location, buyer needs, co-benefits, etc.	**$13-$15**, tracking close to current allowance prices
Costs	**Lower** than compliance, due to fewer review hurdles Variable; includes: project feasibility study, installation, on-going monitoring & reporting, verification, marketing and credit sales	**Higher** than voluntary, to comply with additional regulatory reviews Variable; includes: project feasibility study, installation, on-going monitoring & reporting, verification, marketing and credit sales
Risks	• **Finding buyers** • Price **uncertainty** over time	• **Limited timeline** for regulation • Credit **delays** • **Invalidation**
Buyers	ups, DELTA, AVIS Budget	TESORO, City of Glendale California, bp

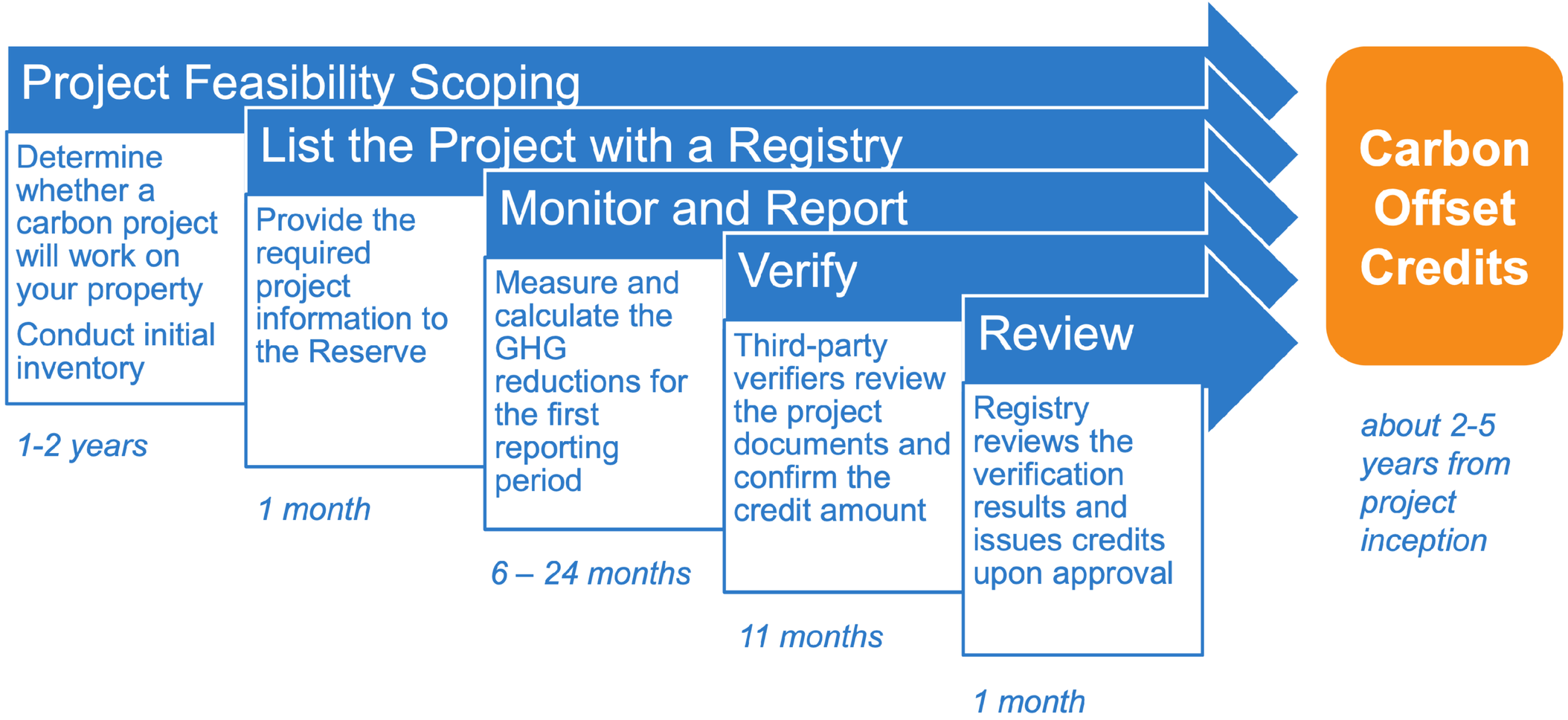
Slide credit: Sarah Wescott - Climate Action Reserve

CARB - Offset market



200 million offsets have been issued through the California Voluntary Offset Market

How Do Forest Projects Receive Credits?



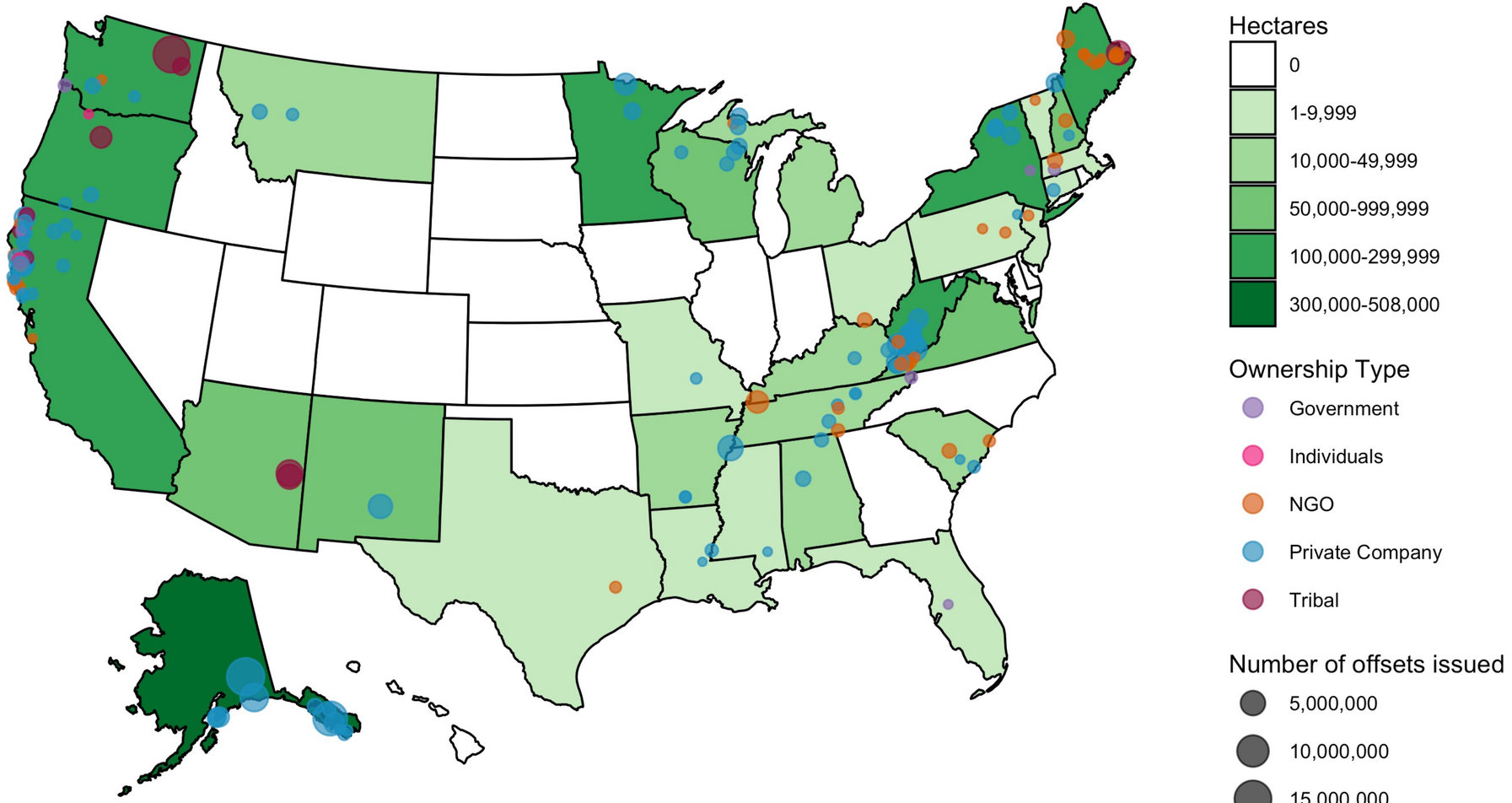
Slide credit: Sarah Wescott - Climate Action Reserve

Land management - IFM

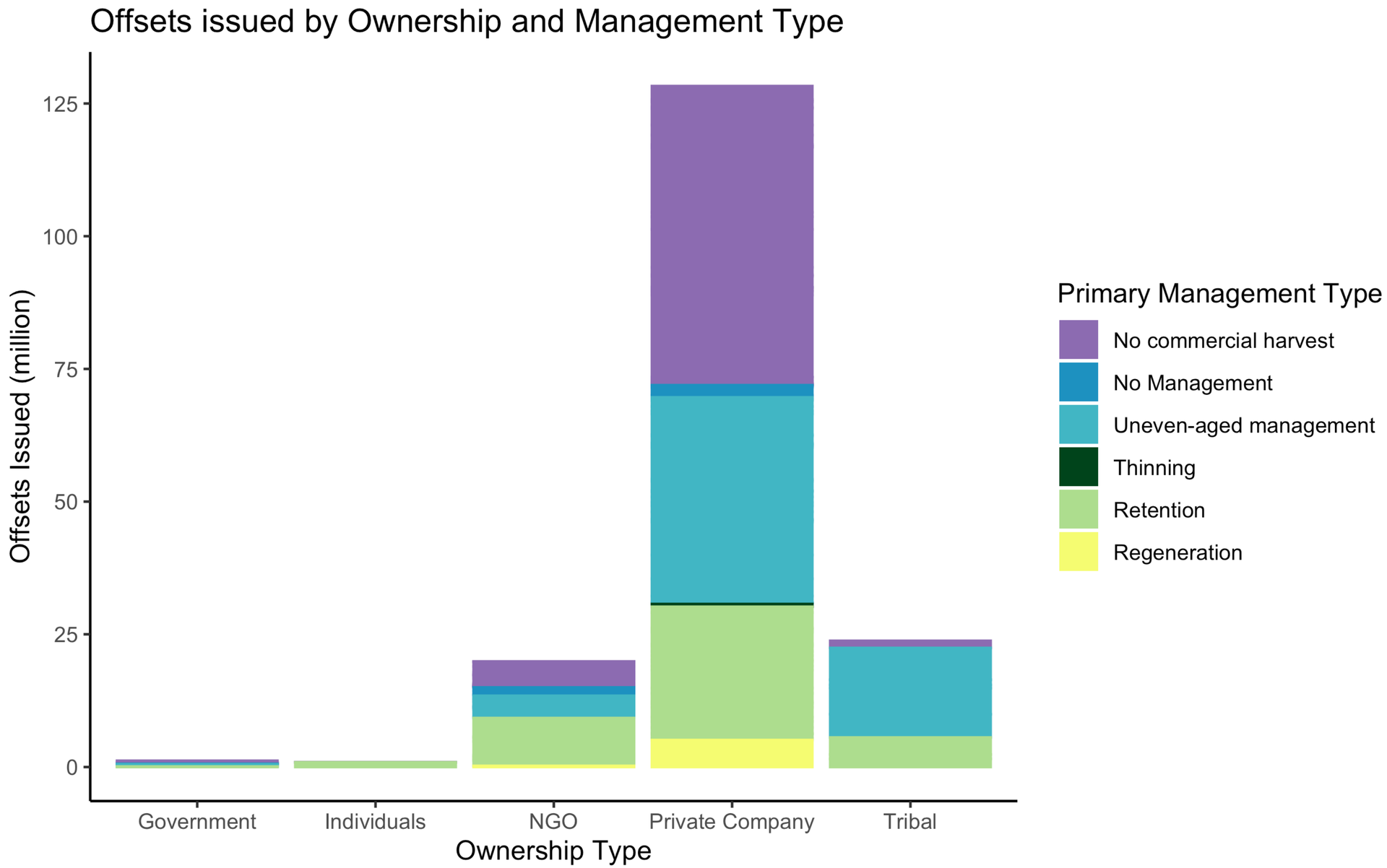
- What exactly is meant by IFM?
- Connection to practical forest management
- Extended rotation?
- Where are the projects located?

Assessing forest carbon offset projects in the silvicultural context

Project areas



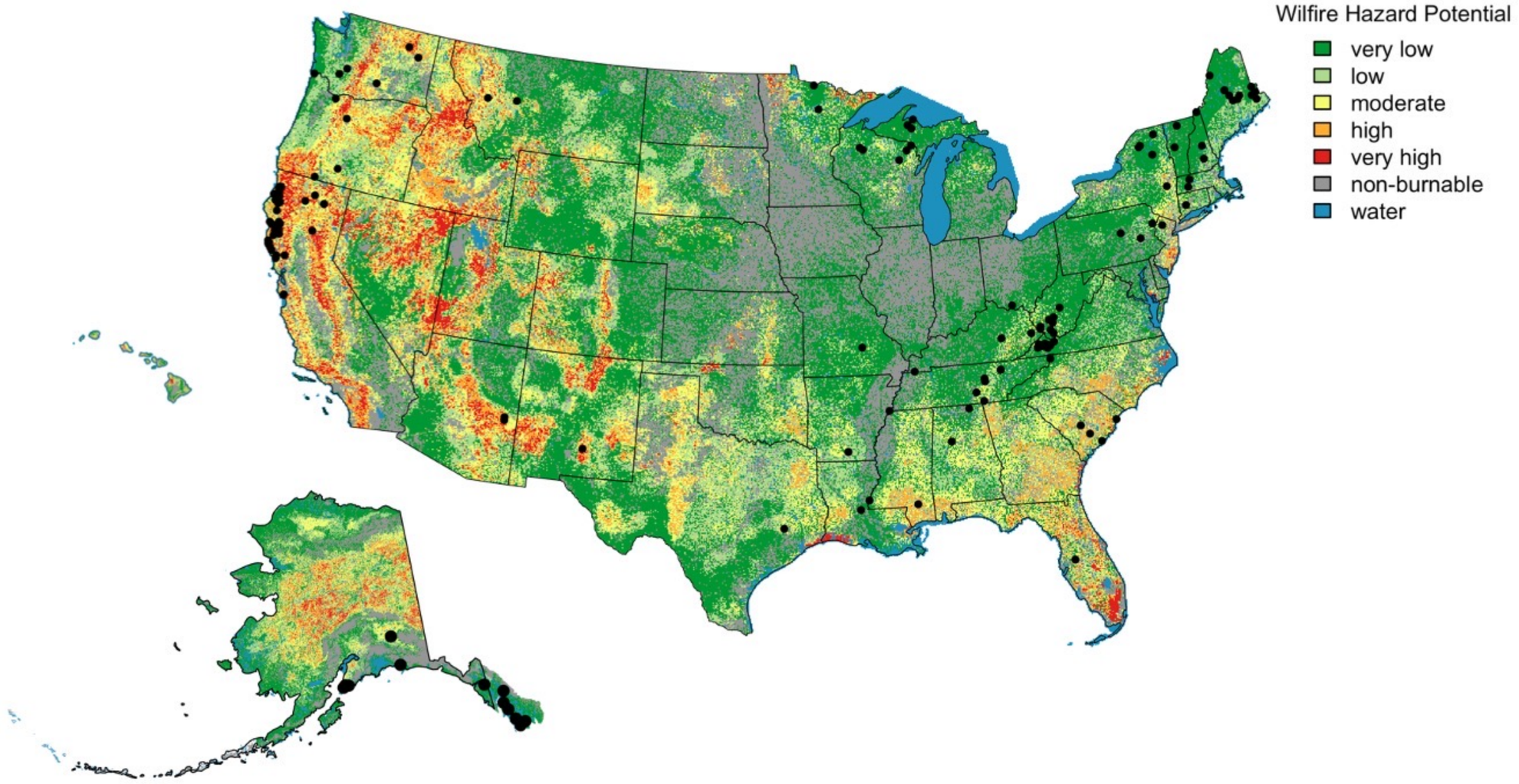
Ownership and forest management



Results

- California, Alaska, Washington ➡️ largest projects and most offsets
- Private companies largest ownership group (70% of offsets)
- Forest management: uneven-aged management (36% of offsets), no management (34%)
- **Retention?**

Wildfire hazard potential

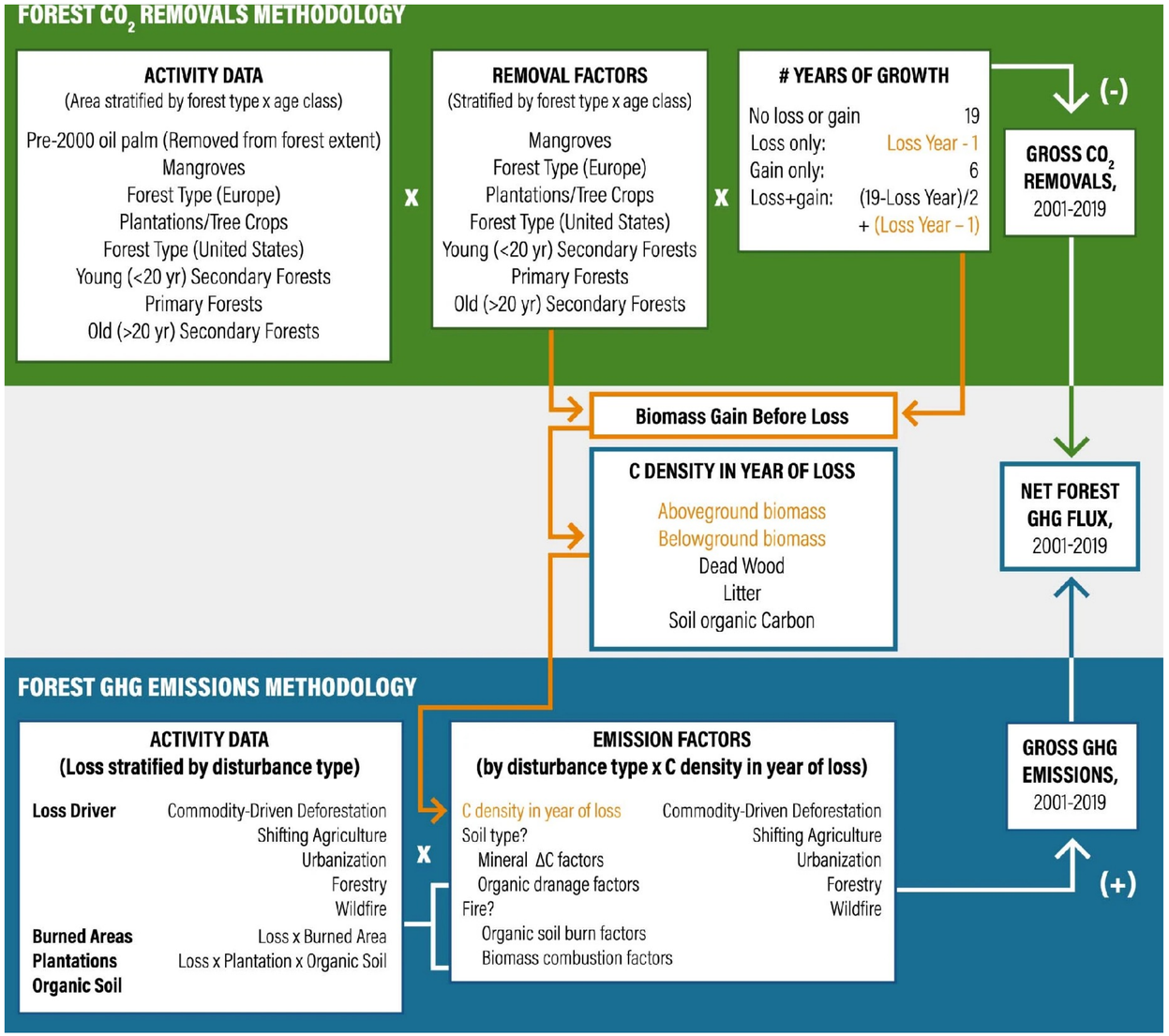


Solutions?

Thinking of solutions - data?

"The geospatial monitoring framework introduced here supports climate policy development by promoting alignment and transparency in setting priorities and tracking collective progress towards forest-specific climate mitigation goals with both local detail and global consistency."

~27% of the global net forest GHG sink occurred within protected areas



Thinking of solutions - management?

ASSESSING FOREST CARBON IN THE LANDSCAPE CONTEXT

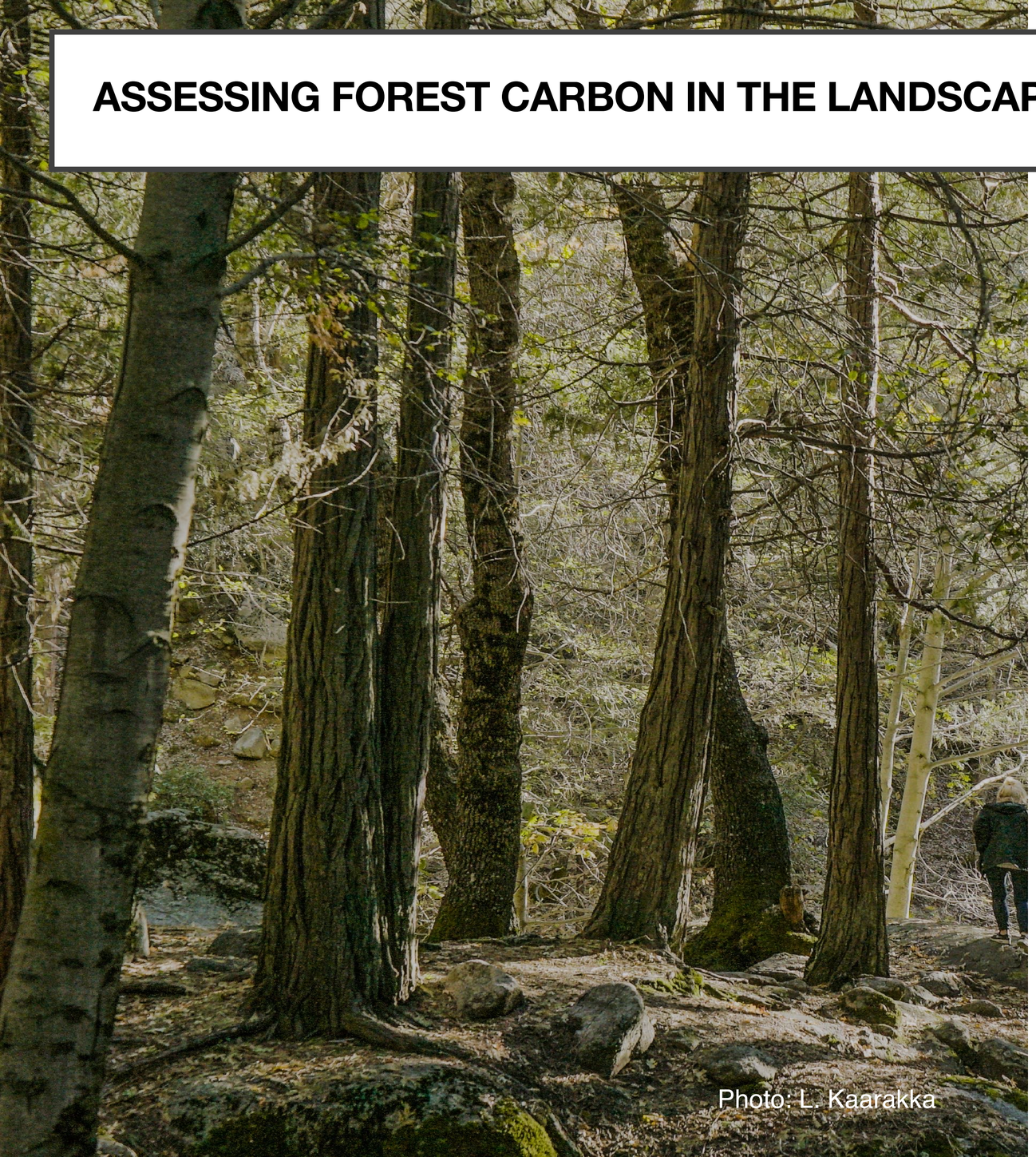


Photo: L. Kaarakka

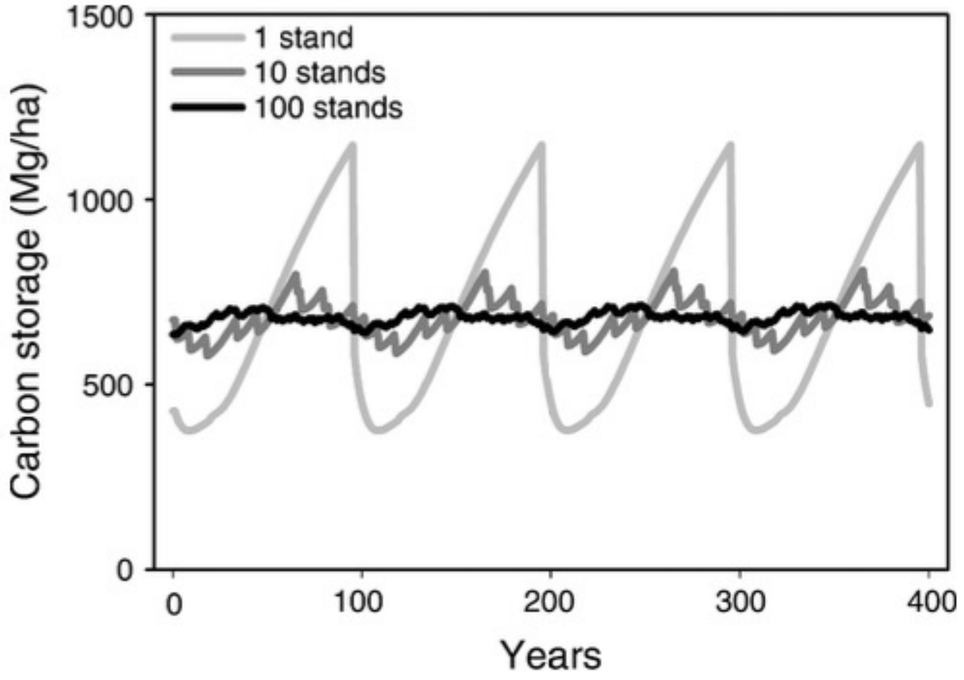


Figure: Harmon (2009)

Prescribed burning, restoration

Left Image: *Pre-treatment monitoring plot within the restoration unit at Mount Rushmore National Memorial. NPS*

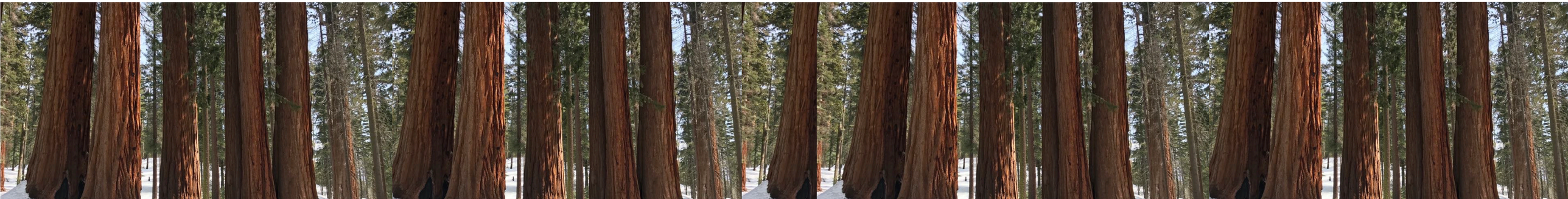
Right Image: *Post-treatment monitoring plot within the restoration unit at Mount Rushmore National Memorial. Pole-sized tree density was reduced by more than 95%. NPS*

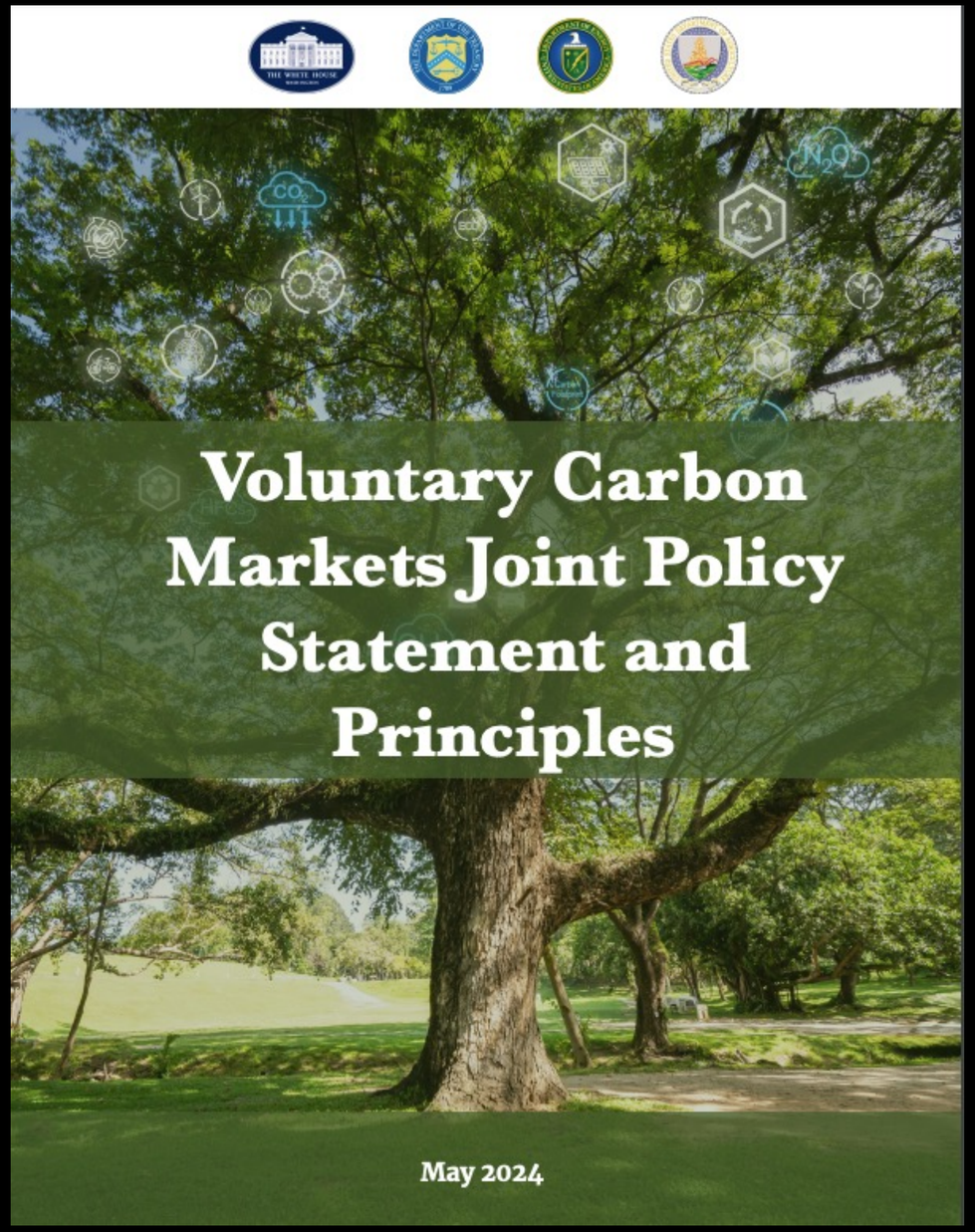
https://www.nps.gov/articles/wildland-fire-in-ponderosa-pine.htm

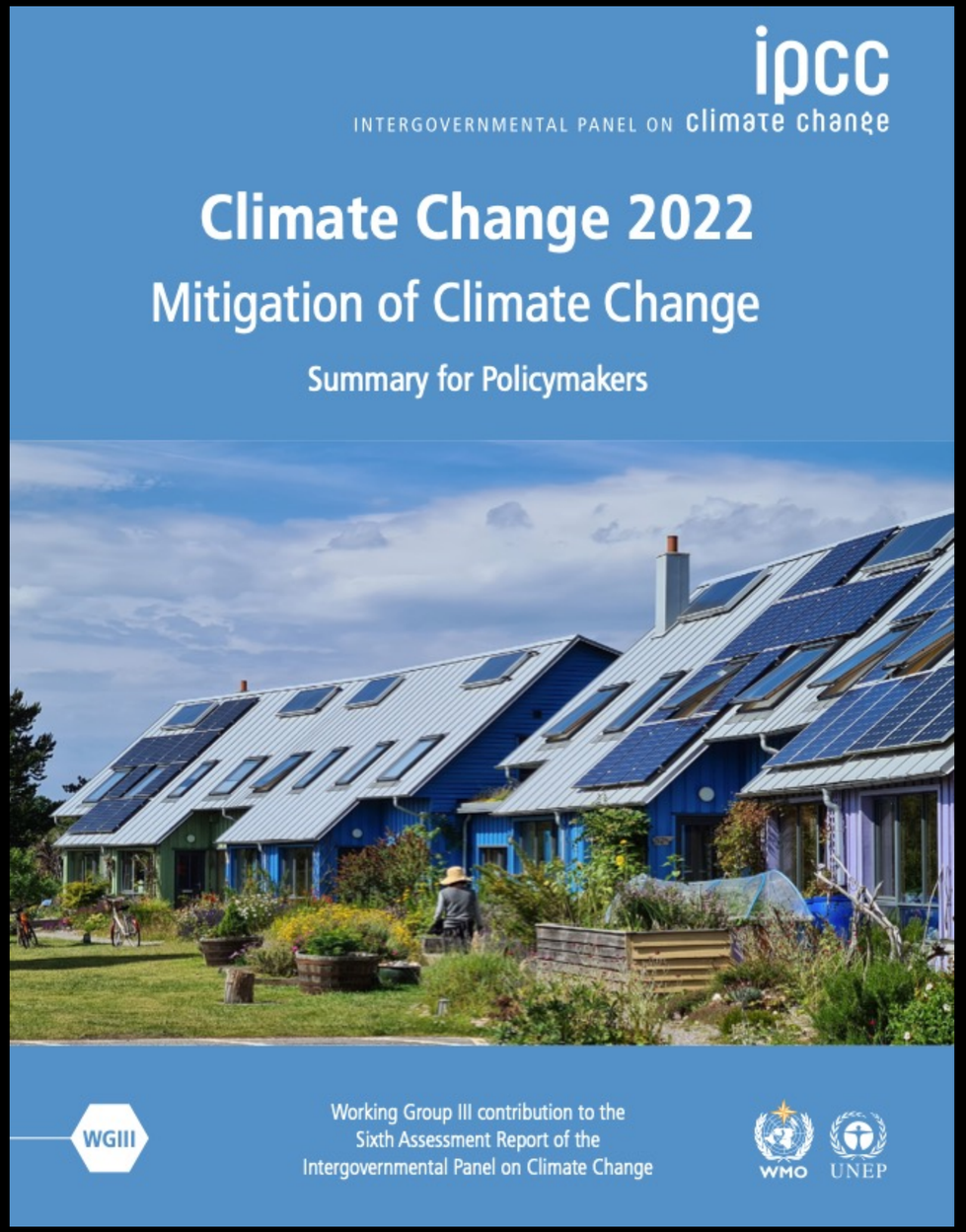
Silviculture and carbon?

Forest management practices that can **maintain** or **enhance** forest carbon storage include

- **Retain forests** (avoid deforestation/conversion) as forests
- **Actively regenerate forests after fire, reforest** areas that were historically forested
- **Protect and support soil productivity**
- **Reduce** wildfire risk (thinning, removing fuel ladders, pruning, etc.)
- **Manage forests for a variety of ecosystem services (NOT just C!)**
- **Substitute** forest biomass for fossil fuels, and long-lived forest products for carbon intensive materials like concrete and steel




Voluntary Carbon Markets Joint Policy Statement and Principles
May 2024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INTERGOVERNMENTAL PANEL ON climate change
Climate Change 2022
Mitigation of Climate Change
Summary for Policymakers
WGIII
Working Group III contribution to the
Sixth Assessment Report of the
Intergovernmental Panel on Climate Change
WMO
UNEP

ISSUE: “However, researchers, journalists, and other observers have found that several popular crediting methodologies and activities that rely on them have not produced the decarbonization outcomes they claim. Important questions have emerged about how to ensure that VCMs genuinely drive additional decarbonization action (rather than reward what would have happened anyway) that is sustained over time and does not simply shift emissions elsewhere. In addition, barriers to market participation have inhibited market efficiency and opportunity.”

SOLUTION (in the US forestry sector)?

PLOS CLIMATE

REVIEW

Managing forests for carbon–Status of the forest carbon offset markets in the United States

Lilli Kaarakka[1☯*], Julia Rothey[2], Laura E. Dee[2☯]

‘..these findings underscore the need for a robust framework to monitor and evaluate cumulative and future carbon benefits of forest-based offset projects, and for assessing the risk of reversal associated with each project.’

CARBON OFFSETS

Action needed to make carbon offsets from forest conservation work for climate change mitigation

‘Methodologies used to construct deforestation baselines for carbon offset interventions need urgent revisions to correctly attribute reduced deforestation to the projects, thus maintaining both incentives for forest conservation and the integrity of global carbon accounting’

JOURNAL ARTICLE

Pitfalls of Tree Planting Show Why We Need People-Centered Natural Climate Solutions FREE

Forrest Fleischman ✉, Shishir Basant, Ashwini Chhatre, Eric A Coleman, Harry W Fischer, Divya Gupta, Burak Güneralp, Prakash Kashwan, Dil Khatri, Robert Muscarella ... Show more

RESEARCH

CARBON OFFSETS

Action needed to make carbon offsets from forest conservation work for climate change mitigation

Thales A. P. West[1,2]*, Sven Wunder[3,4], Erin O. Sills[5], Jan Börner[6,7], Sami W. Rifai[8], Alexandra N. Neidermeier[1], Gabriel P. Frey[6], Andreas Kontoleon[2,9]

Carbon offsets from voluntary avoided-deforestation projects are generated on the basis of performance in relation to ex ante deforestation baselines. We examined the effects of 26 such project sites in six countries on three continents using synthetic control methods for causal inference. We found that most projects have

Ecosystems, not tree planting campaigns, capture and store carbon

Received: 25 September 2020 | Revised: 24 December 2020 | Accepted: 27 December 2020
DOI: 10.1111/gcb.15513

GCB REVIEWS

Global Change Biology WILEY

Getting the message right on nature-based solutions to climate change

Nathalie Seddon[1] | Alison Smith[1,2] | Pete Smith[3] | Isabel Key[1] | Alexandre Chausson[1] | Cécile Girardin[1,2] | Jo House[4] | Shilpi Srivastava[5] | Beth Turner[1,6]

RESEARCH

DRYLAND FORESTATION

Limited climate change mitigation potential through forestation of the vast dryland regions

Shani Rohatyn[1]*, Dan Yakir[2]*, Eyal Rotenberg[2], Yohay Carmel[1]

Forestation of the vast global drylands has been considered a promising climate change mitigation strategy. However, its actual climatic benefits are uncertain because the forests' reduced albedo can produce large warming effects. Using high-resolution spatial analysis of global drylands, we found 448 million hectares suitable for afforestation. This area's carbon sequestration potential until 2100 is 32.3 billion tons of carbon (Gt C), but 22.6 Gt C of that is required to balance albedo effects. The net carbon equivalent would offset ~1% of projected medium-emissions and business-as-usual scenarios over the same period. Focusing forestation only on areas with net cooling effects would use half the area and double the emissions offset. Although such smart forestation is clearly important, its limited climatic benefits reinforce the need to reduce emissions rapidly.

https://www.nytimes.com/2022/07/13/magazine/planting-trees-climate-change.html

What to remember from this talk…

[New and existing] Forest carbon offsets/credits in the US need …

…to be vetted for actual C benefit (and to avoid double-counting)

…assessed for the REALISTIC disturbance risk

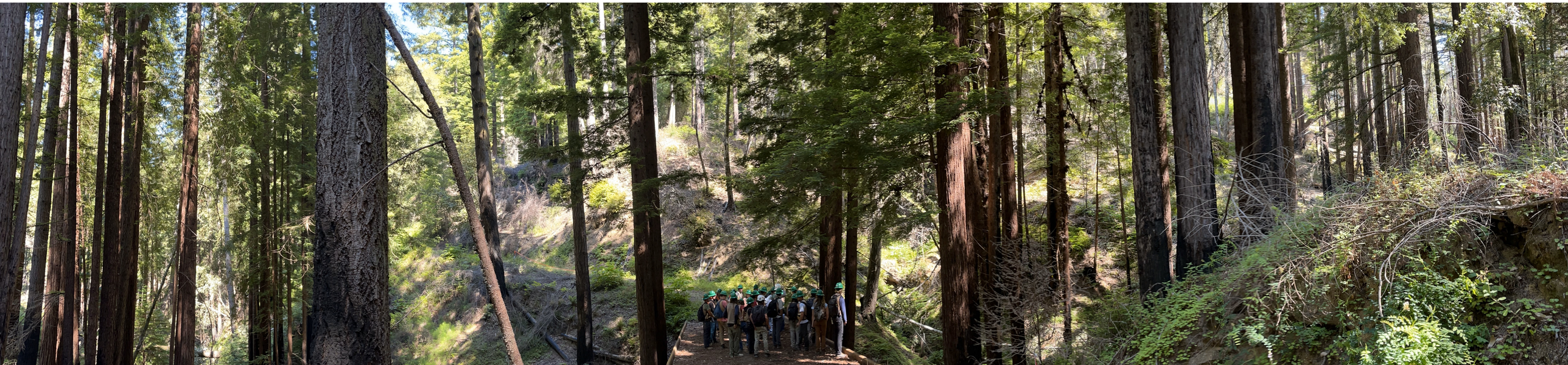
…[state] oversight (transparency, trust in process)

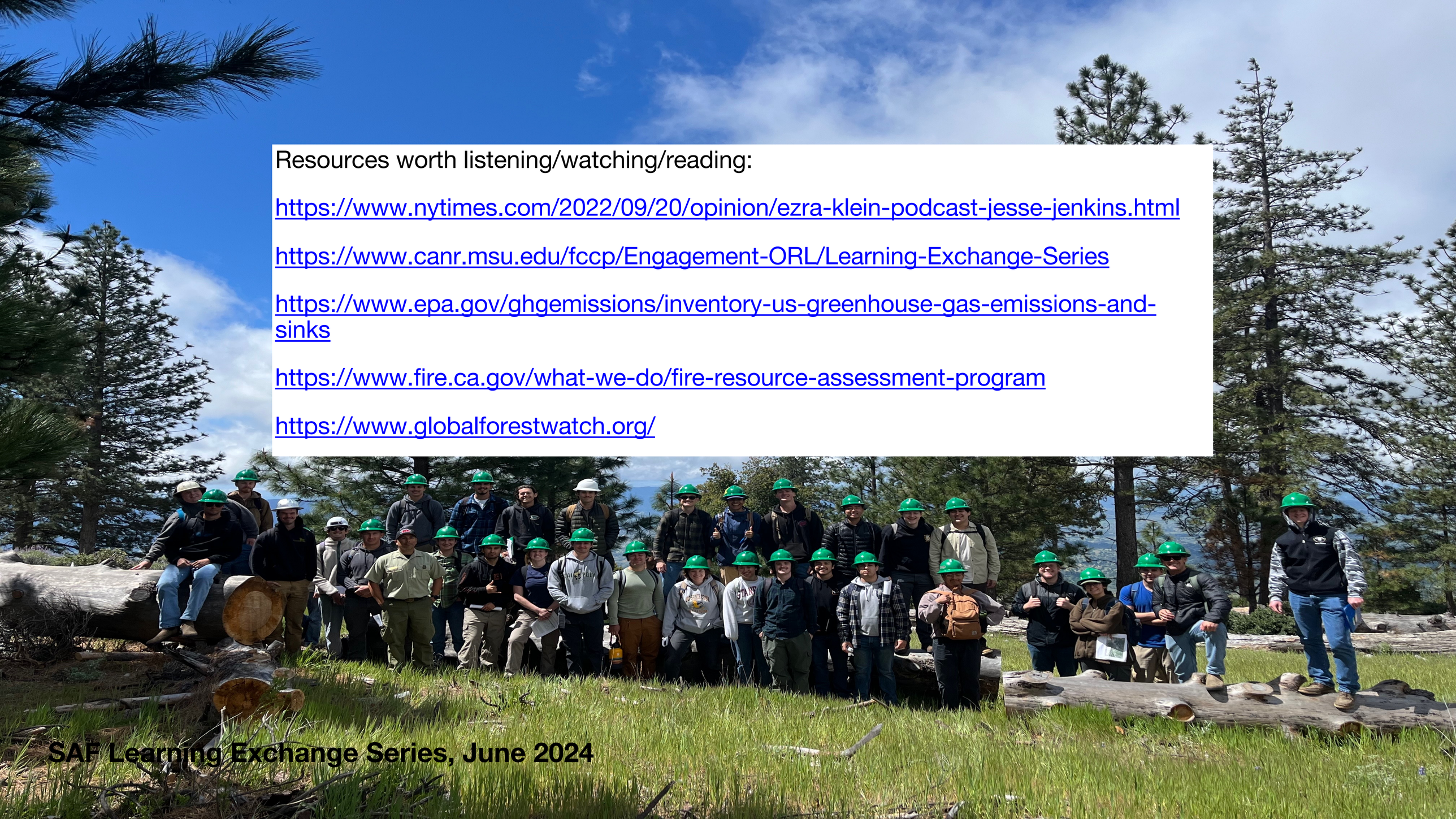
…<u>clarity in terms of forest management applied</u>

Contact:

LILLI KAARAKKA
lkaarakk@calpoly.edu

Thanks to Dr. Dee, Julia Rothey, Dr. Cornett, Dr. Domke, Dr. Ontl, Dr. Aislyn Keys, Dr. Katie Peterson, Jonathan Garcia, Audrey Rose, Assata Golash and **all the students who have and are currently carrying out amazing research projects!**





Resources worth listening/watching/reading:

https://www.nytimes.com/2022/09/20/opinion/ezra-klein-podcast-jesse-jenkins.html

https://www.canr.msu.edu/fccp/Engagement-ORL/Learning-Exchange-Series

https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

https://www.fire.ca.gov/what-we-do/fire-resource-assessment-program

https://www.globalforestwatch.org/