Carbon in forests and harvested wood products in the United States

Grant Domke, grant.m.domke@usda.gov

National Press Foundation – 14 Oct. 2021

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Forest Service cooperators: Brian Walters (NRS), John Coulston (SRS), Jim Smith (NRS), Mike Nichols (NRS), Chris Woodall (NRS), Lara Murray (WO), Sean Healey (RMRS), Andrew Gray (PNW), Chris Oswalt (SRS), James Westfall (NRS), Chris Swanston (NRS), Greg Liknes (NRS), Andy Hudak (RMRS), Matt Reeves (RMRS), among many others

University and Agency cooperators: Matthew Russell (UMN), Anthony D'Amato (UVM), Steve Ogle (CSU), Chad Babcock (UMN), Chris Edgar (UMN), Eric Marland (App. State), Mark Harmon (OSU), Lucas Nave (UMichigan), Songlin Fei (Purdue U), Andy Finley (MSU), Sassan Saatchi (NASA JPL), Phil Radtke (VPI), Rodrigo Vargas (UDelaware), Jeremy Lichstein, among many others

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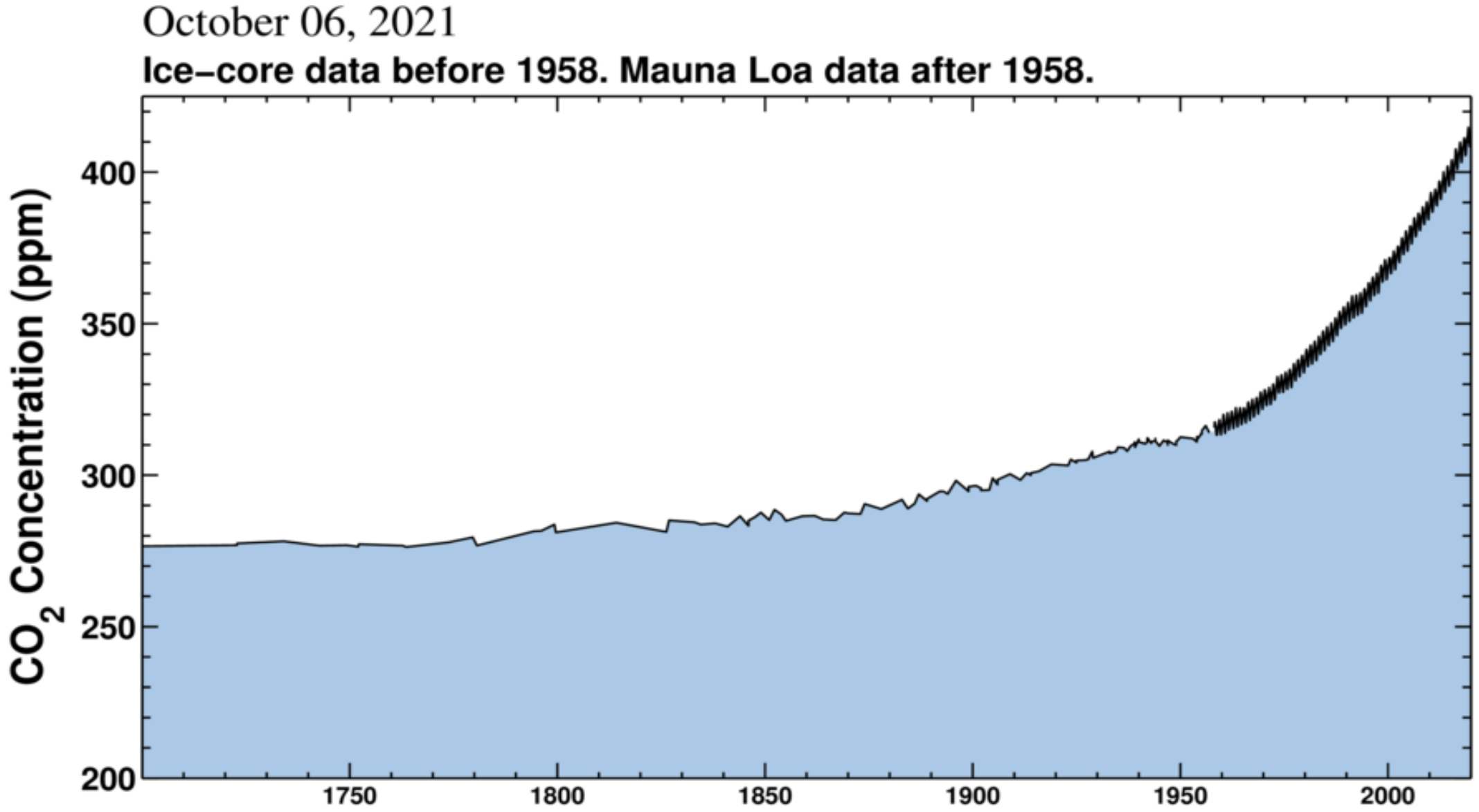
Why is this important?



C. D. Keeling, S. C. Piper, R. B. Bacastow, M. Wahlen, T. P. Whorf, M. Heimann, and H. A. Meijer, Exchanges of atmospheric CO2 and 13CO2 with the terrestrial biosphere and oceans from 1978 to 2000. I. Global aspects, SIO Reference Series, No. 01-06, Scripps Institution of Oceanography, San Diego, 88 pages, 2001. http://escholarship.org/uc/item/09v319r9

Why is this important?

- Entered into force in 1994
- US is a (Annex 1) Party to the UNFCCC
- 197 countries have ratified the Convention
- ‘’…act in the interests of human safety even in the face of scientific uncertainty.”
- Stabilize GHG concentrations "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system.“

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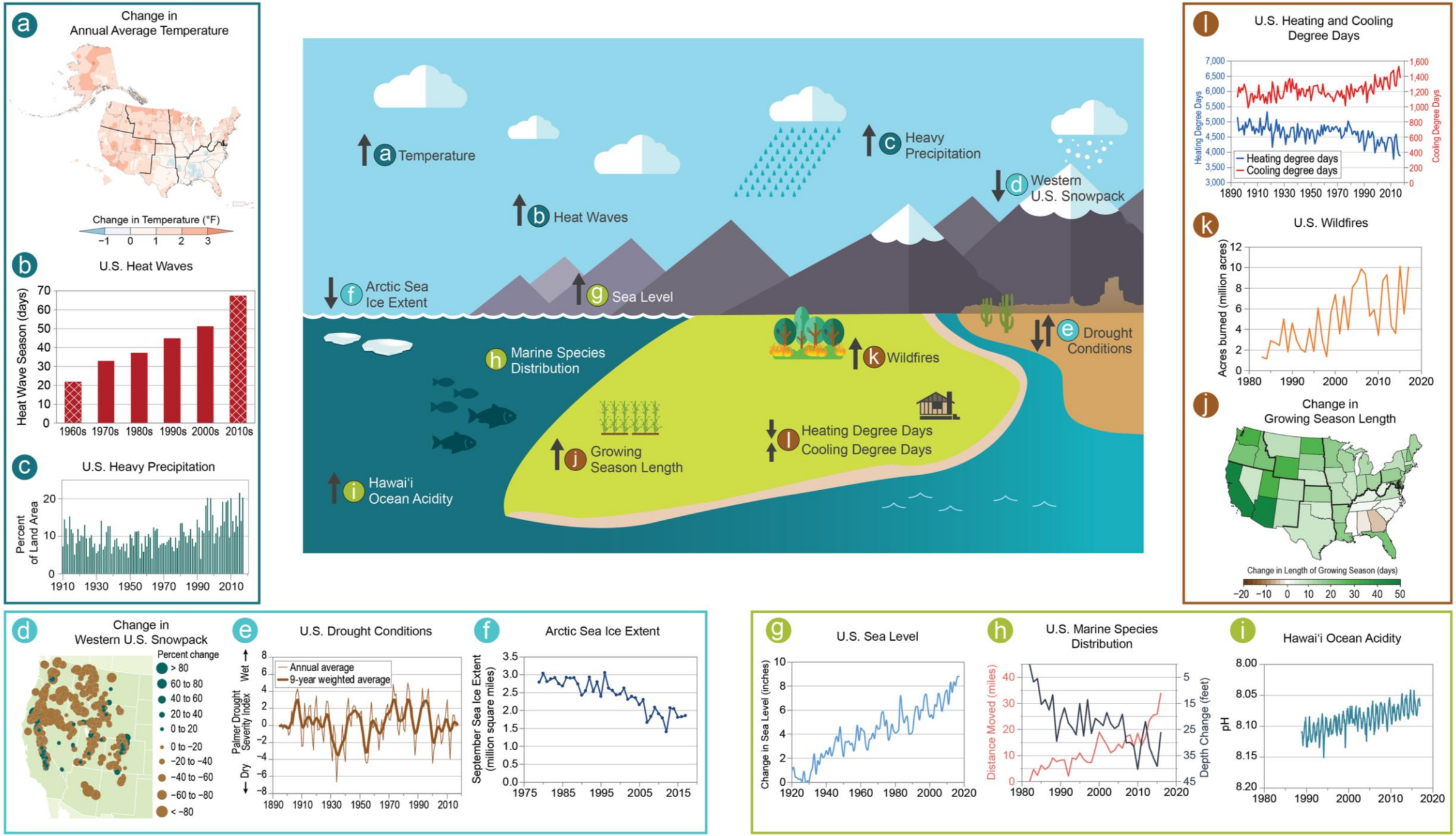
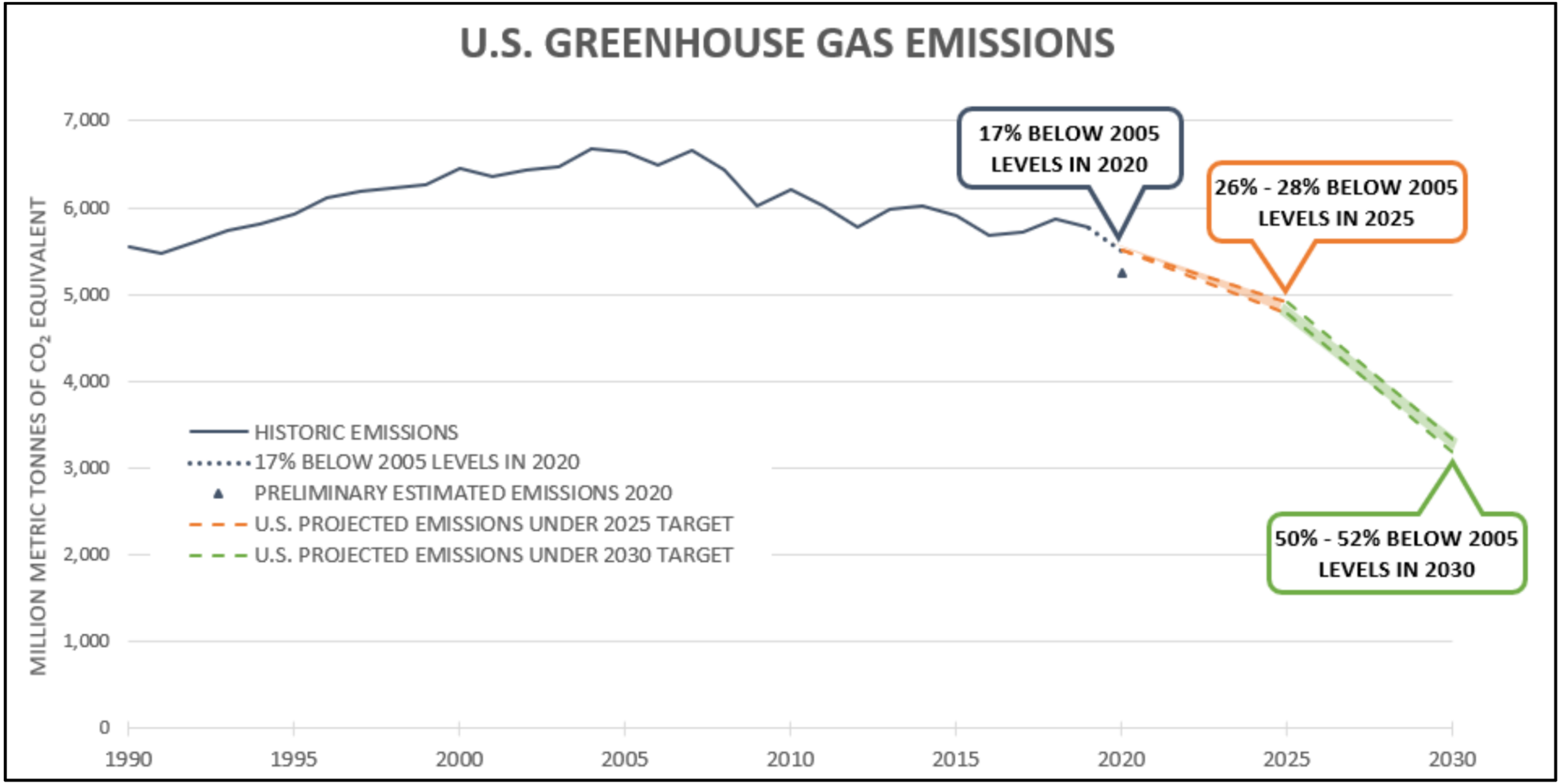


Jay, A., et al. 2018: Overview. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 33–71. doi: 10.7930/NCA4.2018.CH1

Relevance to recent commitments



https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/United%20States%20of%20America%20First/United%20States%20NDC%20April%2021%202021%20Final.pdf

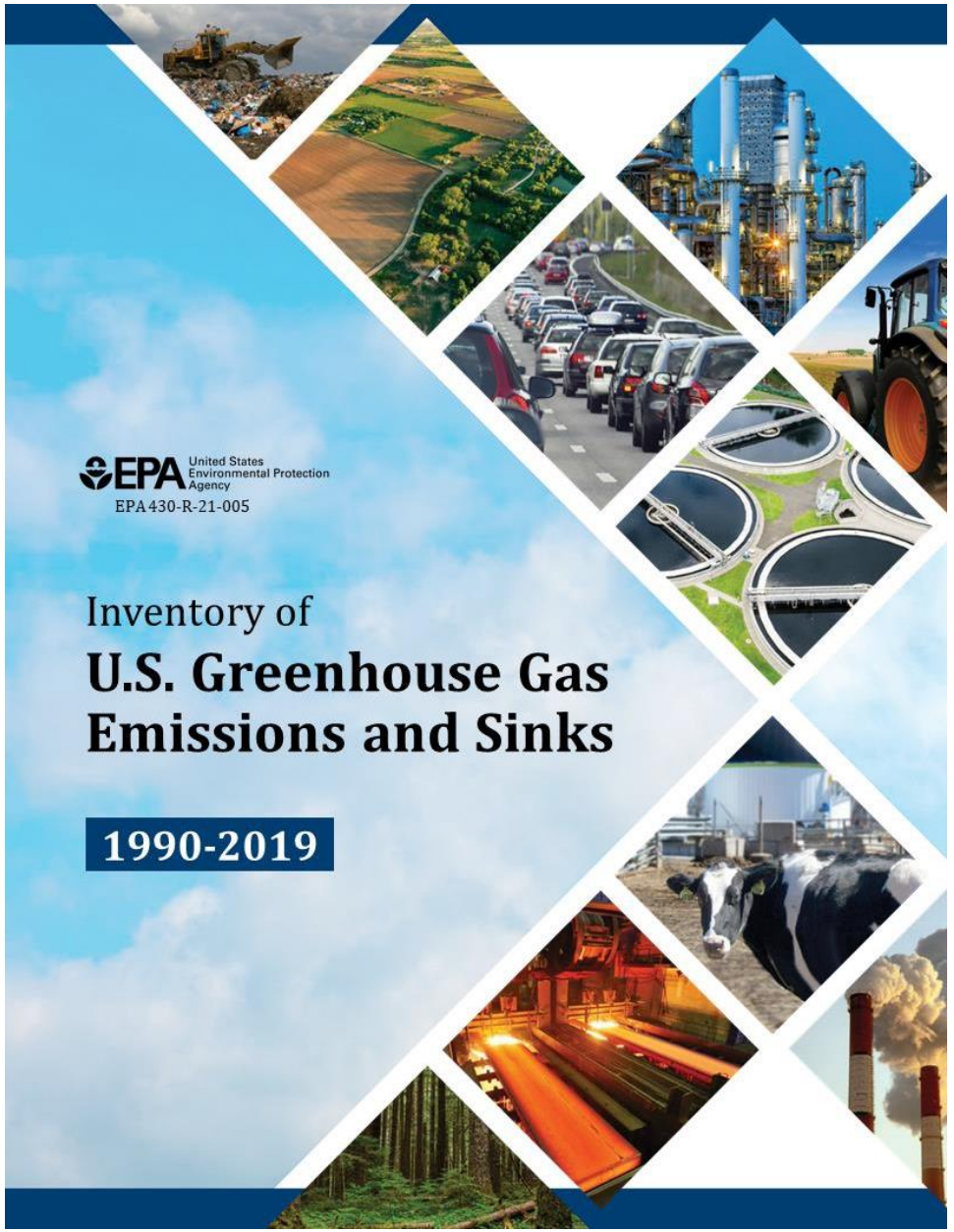
Relevance to recent commitments

- Include all categories of emissions and removals as reported in the NIR
- Account for the land sector using a net-net approach with the base year (2005)
- Use a “production approach” to account for HWPs consistent with IPCC guidance
- May exclude emissions from natural disturbances, consistent with IPCC guidance

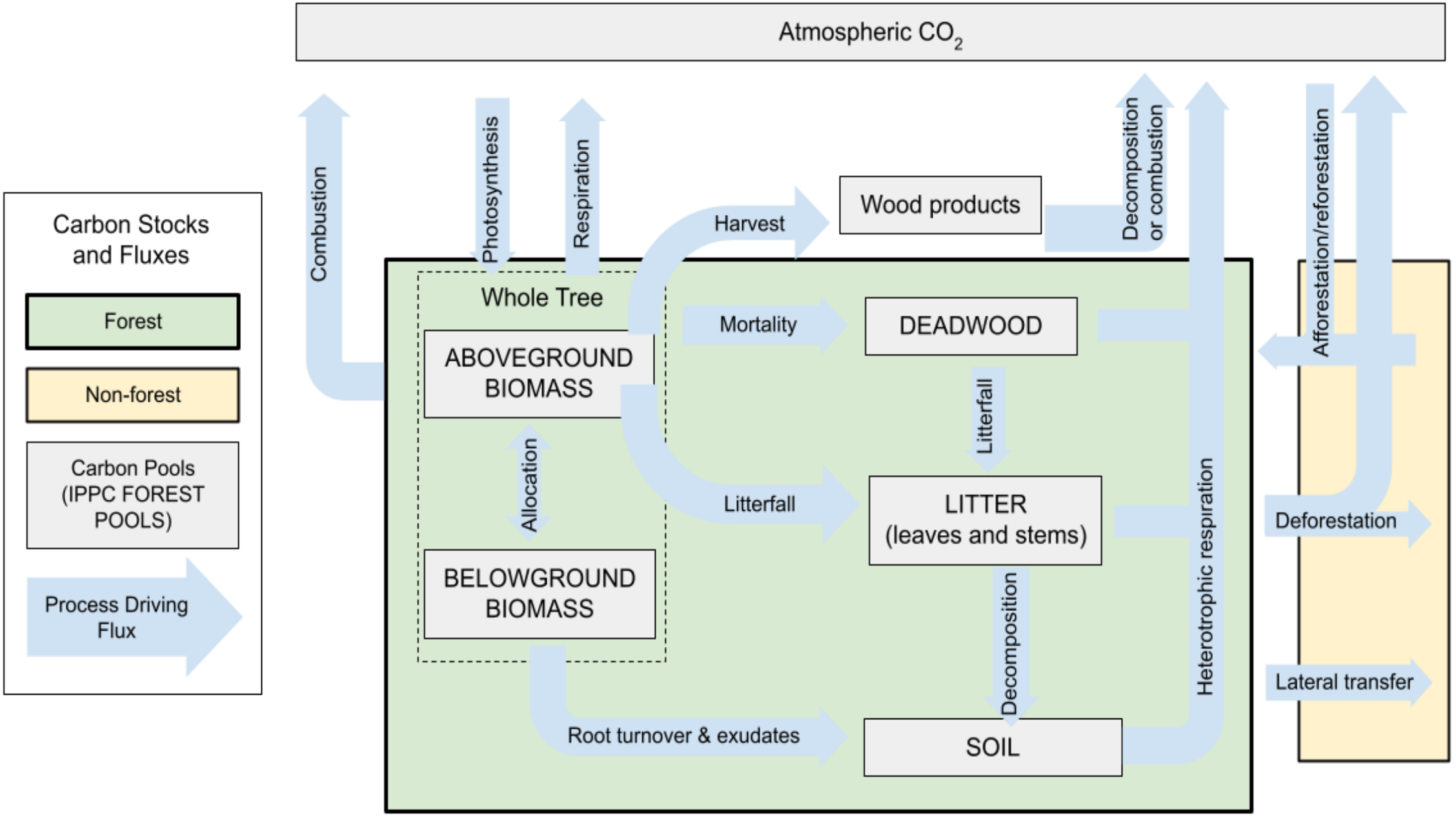
https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/United%20States%20of%20America%20First/United%20States%20NDC%20April%2021%202021%20Final.pdf

Annual reporting responsibilities

- Land Representation
- Forest Land Remaining Forest Land
  - Forest ecosystem carbon
  - Forest fire emissions
  - Emissions from drained organic soils and N additions to soils
- Land Converted to Forest Land
  - Forest ecosystem carbon
  - Emissions from drained organic soils
- Forest Land Converted to Land
  - Cropland, Grasslands, Settlement, Wetland, Other Land
- Woodlands in the Grassland category
- Harvested Wood Products
- Urban trees in Settlements

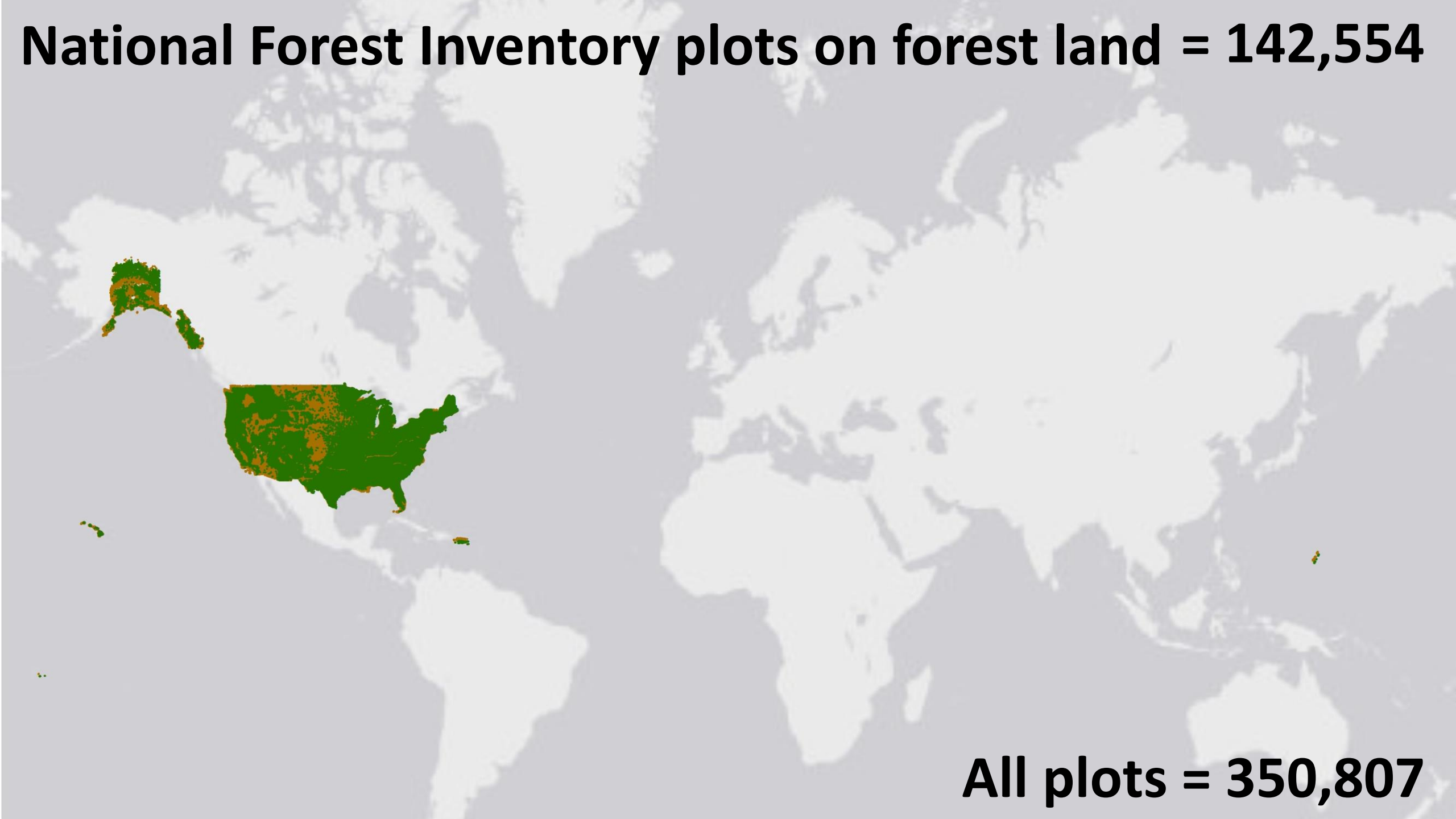


U.S. Environmental Protection Agency [U.S. EPA]. 2021. Inventory of U.S. greenhouse gas emissions and sinks: 1990–2019. EPA 430-R-21-005. Washington, DC: U.S. Environmental Protection Agency.
https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

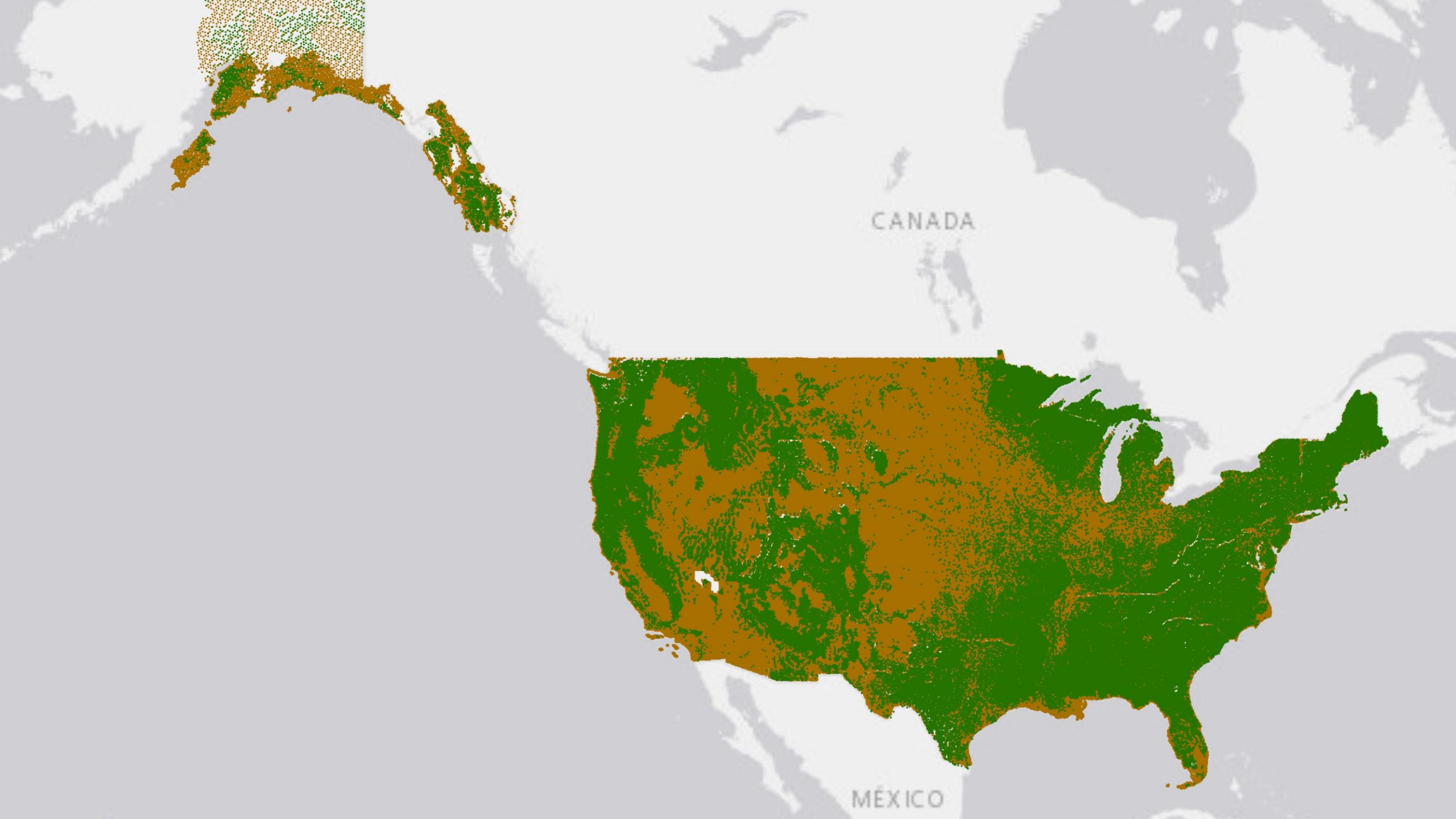


Giebink et al. Accepted. The policy and ecology of forest-based climate mitigation: challenges, needs, and opportunities. Intended outlet: *Plant and Soil.*

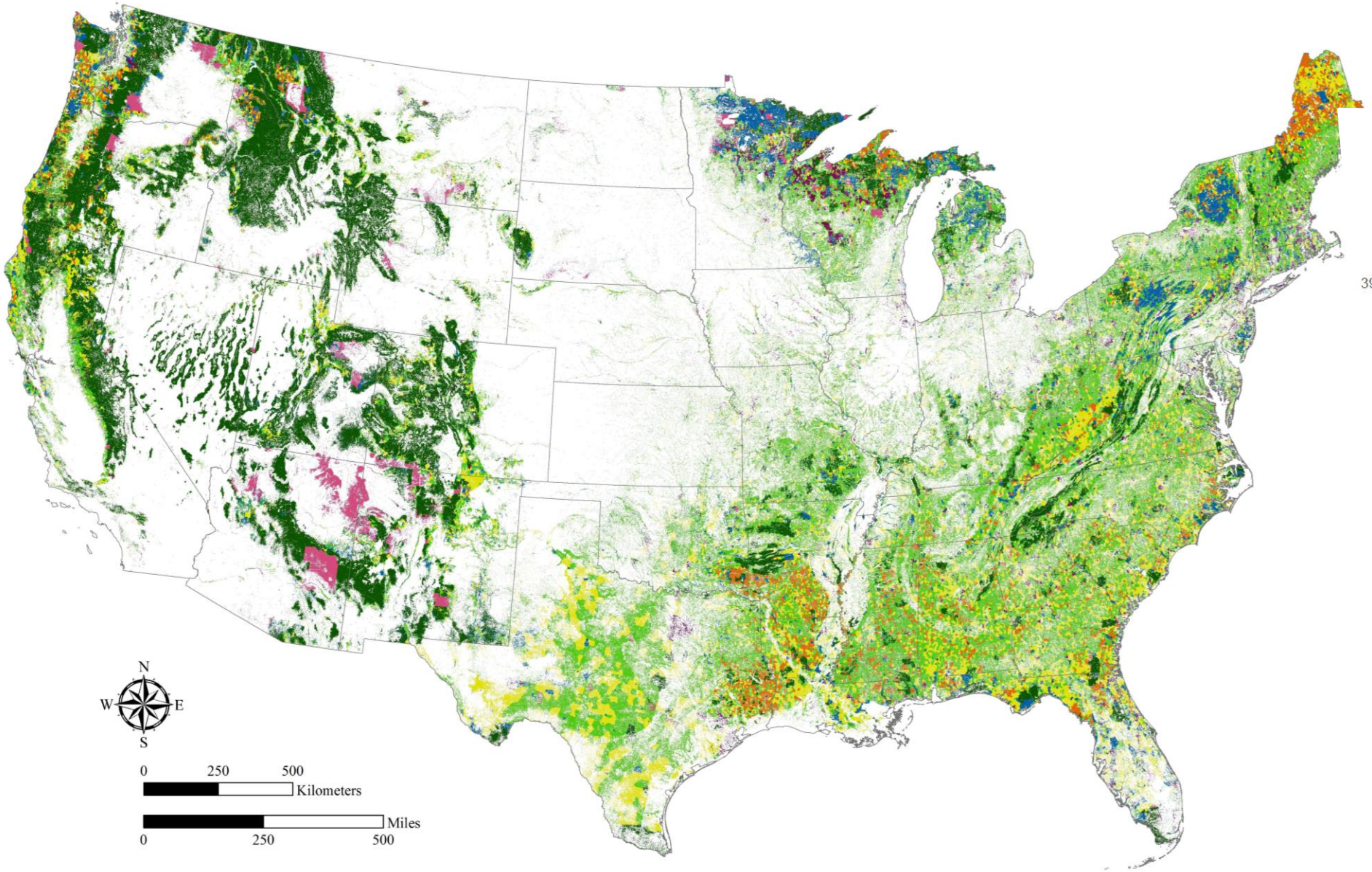
National Forest Inventory plots on forest land = 142,554

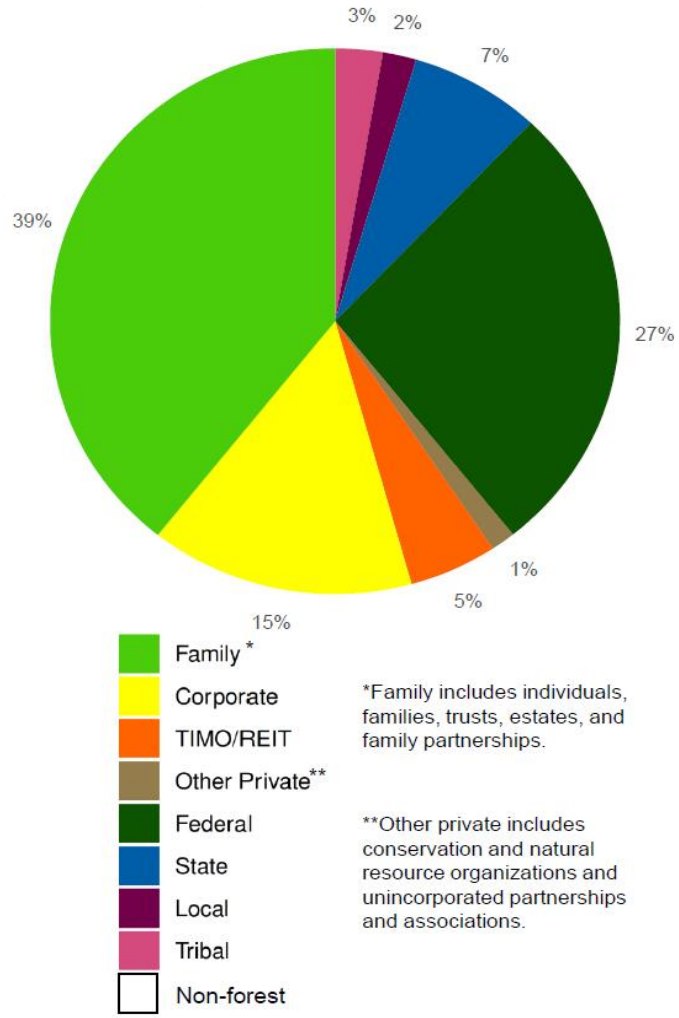


All plots = 350,807


CANADA
MÉXICO

Where is the forest in the US and who owns it?

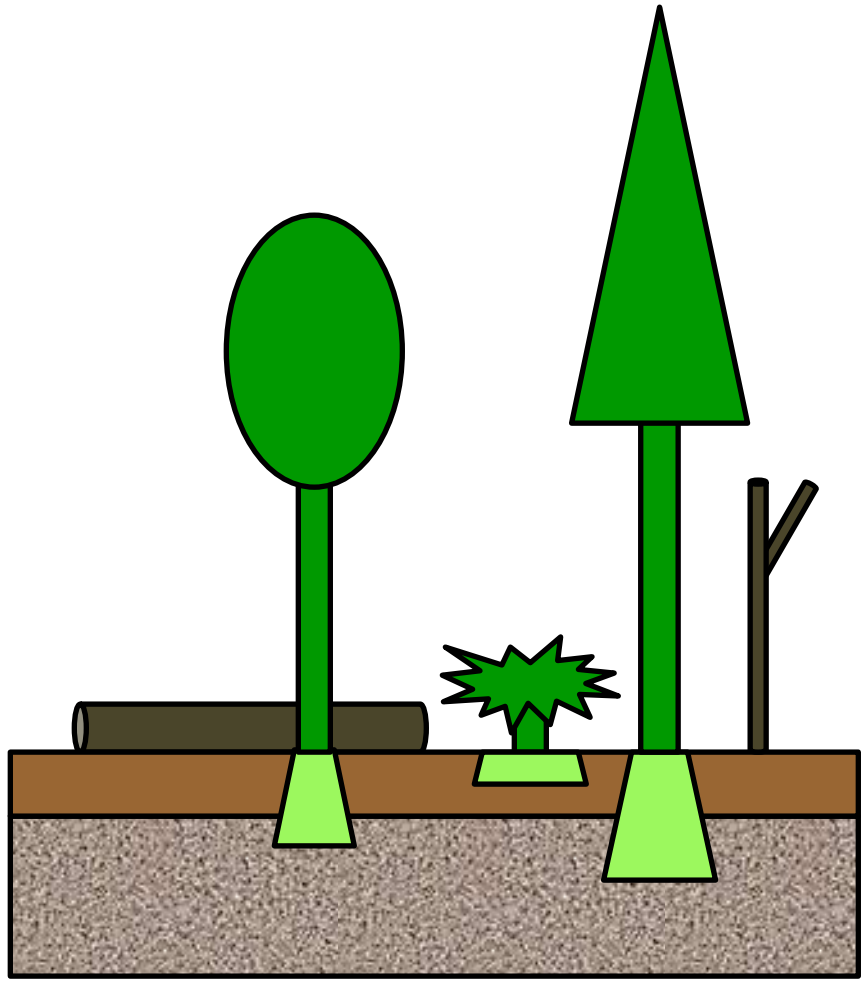




Sass, Emma M.; Butler, Brett J.; Markowski-Lindsay, Marla. 2020. Distribution of forest ownerships across the conterminous United States, 2017. Res. Map NRS-11. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. https://doi.org/10.2737/NRS-RMAP-11

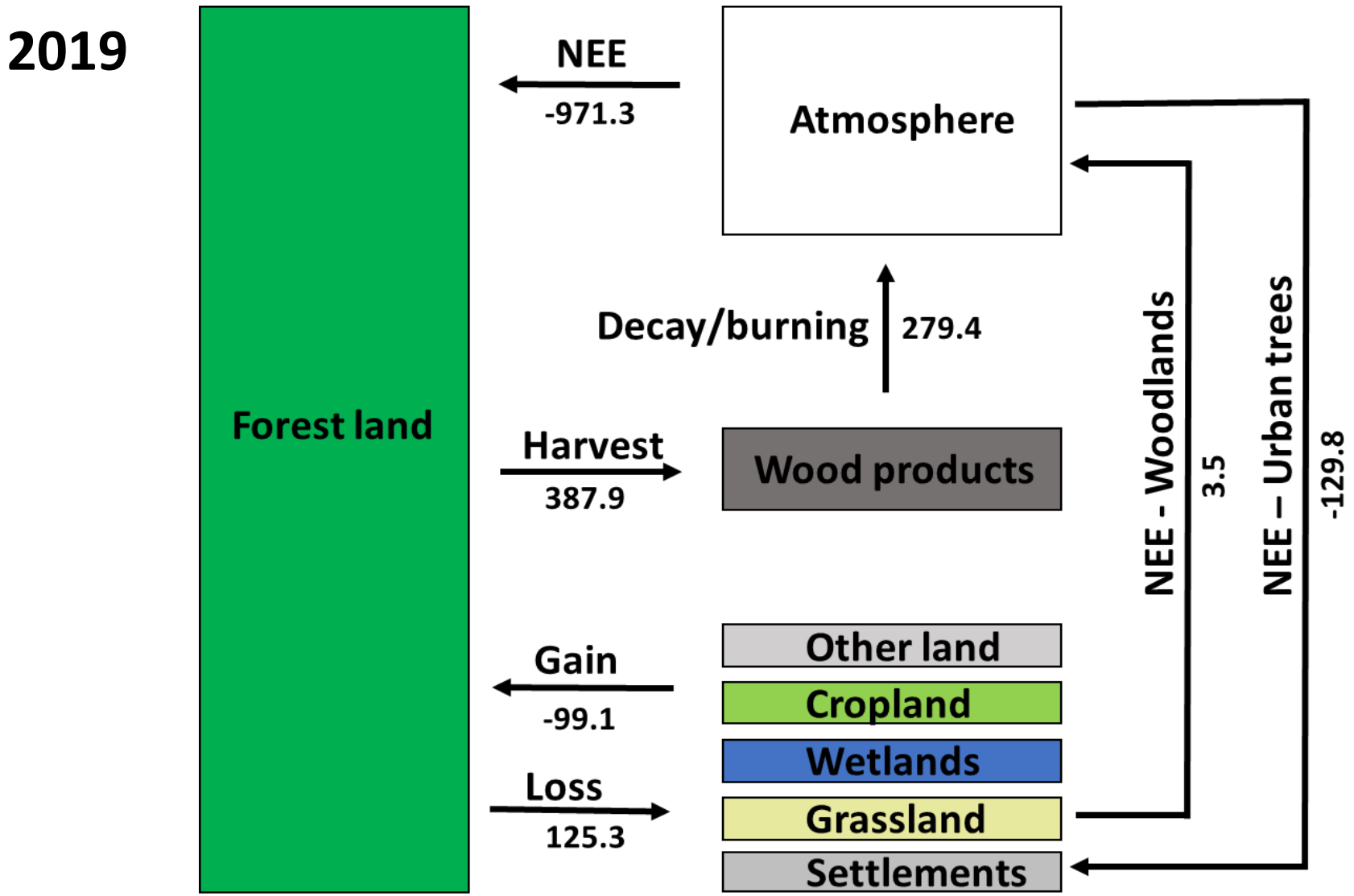
Ecosystem carbon pools

- Aboveground live biomass
- Belowground live biomass
- Dead wood
- Litter
- Soil organic matter



Intergovernmental Panel on Climate Change 2006. IPCC guidelines for national greenhouse gas inventories. http://www. ipcc-nggip. iges

Forest land carbon cycling (MMT CO_2 eq.)



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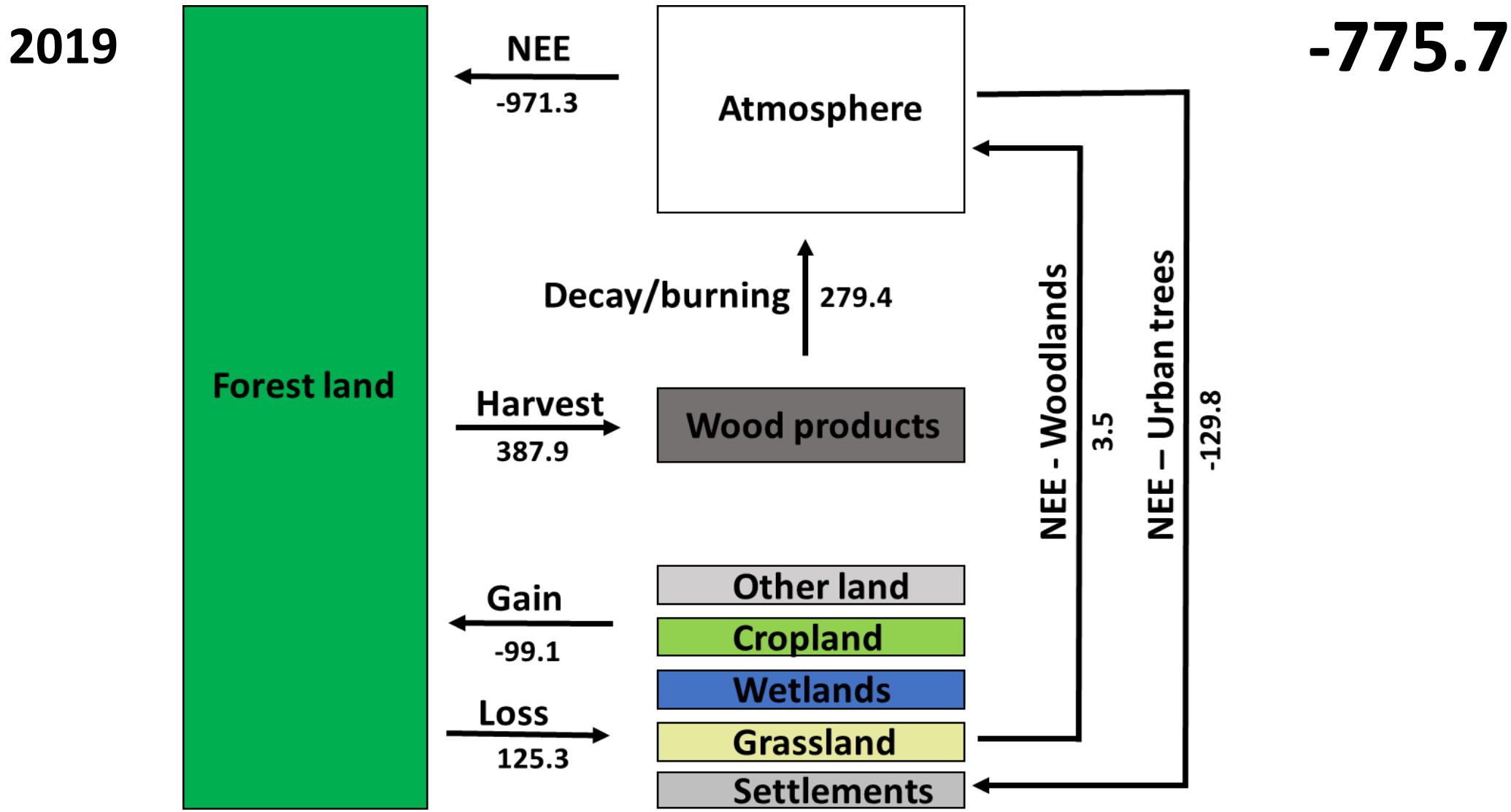

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Greenhouse gas emissions from

168,699,168

Passenger vehicles driven for one year

-or-

1,949,487,588,44

Miles driven by an average passenger vehicle

CO_2 emissions from

87,284,798,020

gallons of gasoline consumed

-or-

76,198,428,291

gallons of diesel consumed

-or-

857,368,405,701

Pounds of coal burned

-or-

10,268,800

tanker trucks' worth of gasoline

-or-

93,412,264

homes' energy use for one year

-or-

140,900,218

homes' electricity use for one year

-or-

4,278,796

railcars' worth of coal burned

-or-

1,795,909,484

barrels of oil consumed

-or-

31,710,391,128

propane cylinders used for home barbeques

-or-

196

coal-fired power plants in one year

-or-

https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Forest land carbon cycling (MMT CO_2 eq.)

Emissions and Removals Category[a]	1990	1995	2000	2005	2010	2017	2018	2019
Forest land remaining forest land[b]	(663.8)	(647.1)	(624.5)	(555.5)	(611.8)	(564.0)	(599.8)	(583.3)
Non-CO_2 emissions from fire	1.5	0.5	2.9	8.2	4.7	18.3	15.7	15.7
N_2O emissions from forest soils	0.1	0.3	0.5	0.5	0.5	0.5	0.5	0.5
Non-CO_2 emissions from drained organic soils	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Forest land converted to non-forest land[b]	117.3	119.0	121.0	122.9	124.5	125.3	125.3	125.3
Non-forest land converted to forest land[b]	(98.2)	(98.3)	(98.4)	(98.7)	(98.8)	(99.1)	(99.1)	(99.1)
Harvested wood products	(123.8)	(112.2)	(93.4)	(106.0)	(69.1)	(95.7)	(98.8)	(108.5)
Woodlands remaining woodlands[c]	4.1	4.1	4.0	3.9	3.8	3.5	3.5	3.5
Urban trees in settlements[d]	(96.4)	(103.3)	(110.4)	(117.4)	(124.6)	(129.8)	(129.8)	(129.8)
Total Emissions and Removals	**(859.1)**	**(837.0)**	**(798.3)**	**(742.0)**	**(770.8)**	**(740.9)**	**(782.4)**	**(775.7)**

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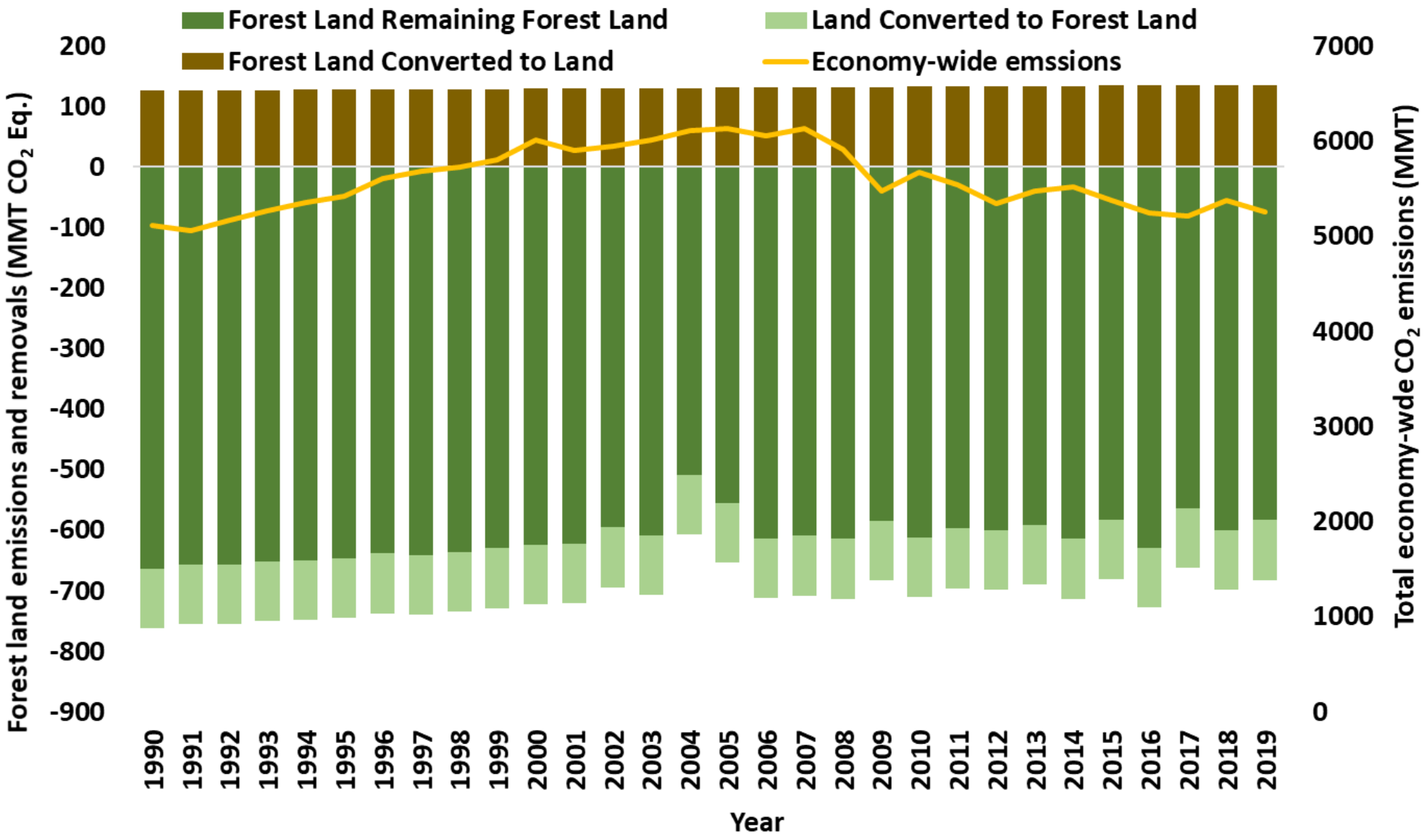

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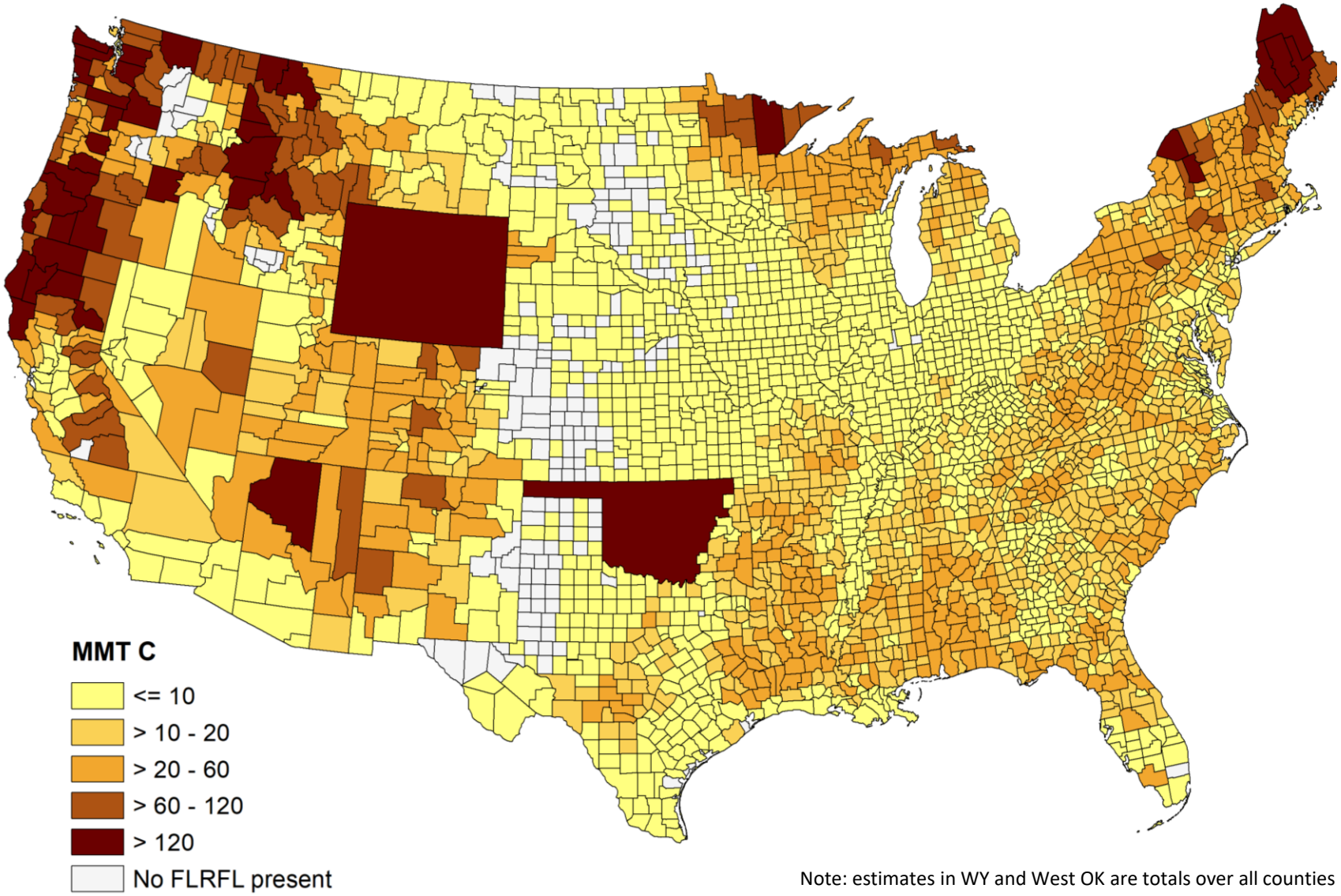
Where is the carbon in forest land in the CONUS?



Note: estimates in WY and West OK are totals over all counties

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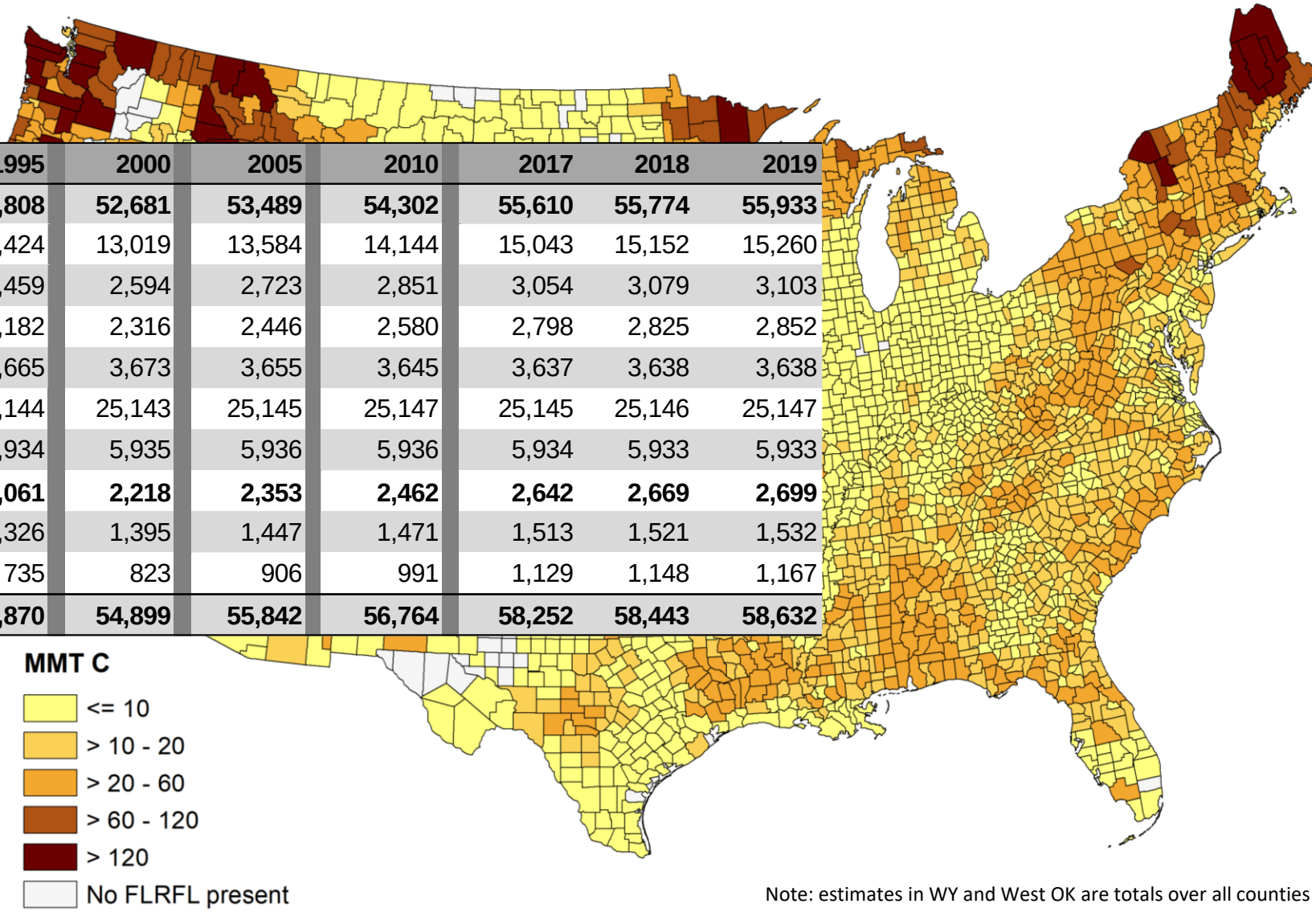
Where is the carbon in forest land in the CONUS?

Carbon Pool[a]	1990	1995	2000	2005	2010	2017	2018	2019
Forest	**50,913**	**51,808**	**52,681**	**53,489**	**54,302**	**55,610**	**55,774**	**55,933**
Aboveground biomass	11,810	12,424	13,019	13,584	14,144	15,043	15,152	15,260
Belowground biomass	2,319	2,459	2,594	2,723	2,851	3,054	3,079	3,103
Dead wood	2,049	2,182	2,316	2,446	2,580	2,798	2,825	2,852
Litter	3,656	3,665	3,673	3,655	3,645	3,637	3,638	3,638
Soil (mineral)	25,145	25,144	25,143	25,145	25,147	25,145	25,146	25,147
Soil (organic)	5,934	5,934	5,935	5,936	5,936	5,934	5,933	5,933
Harvested wood	**1,895**	**2,061**	**2,218**	**2,353**	**2,462**	**2,642**	**2,669**	**2,699**
Products in use	1,249	1,326	1,395	1,447	1,471	1,513	1,521	1,532
SWDS	646	735	823	906	991	1,129	1,148	1,167
Total stocks	**52,808**	**53,870**	**54,899**	**55,842**	**56,764**	**58,252**	**58,443**	**58,632**



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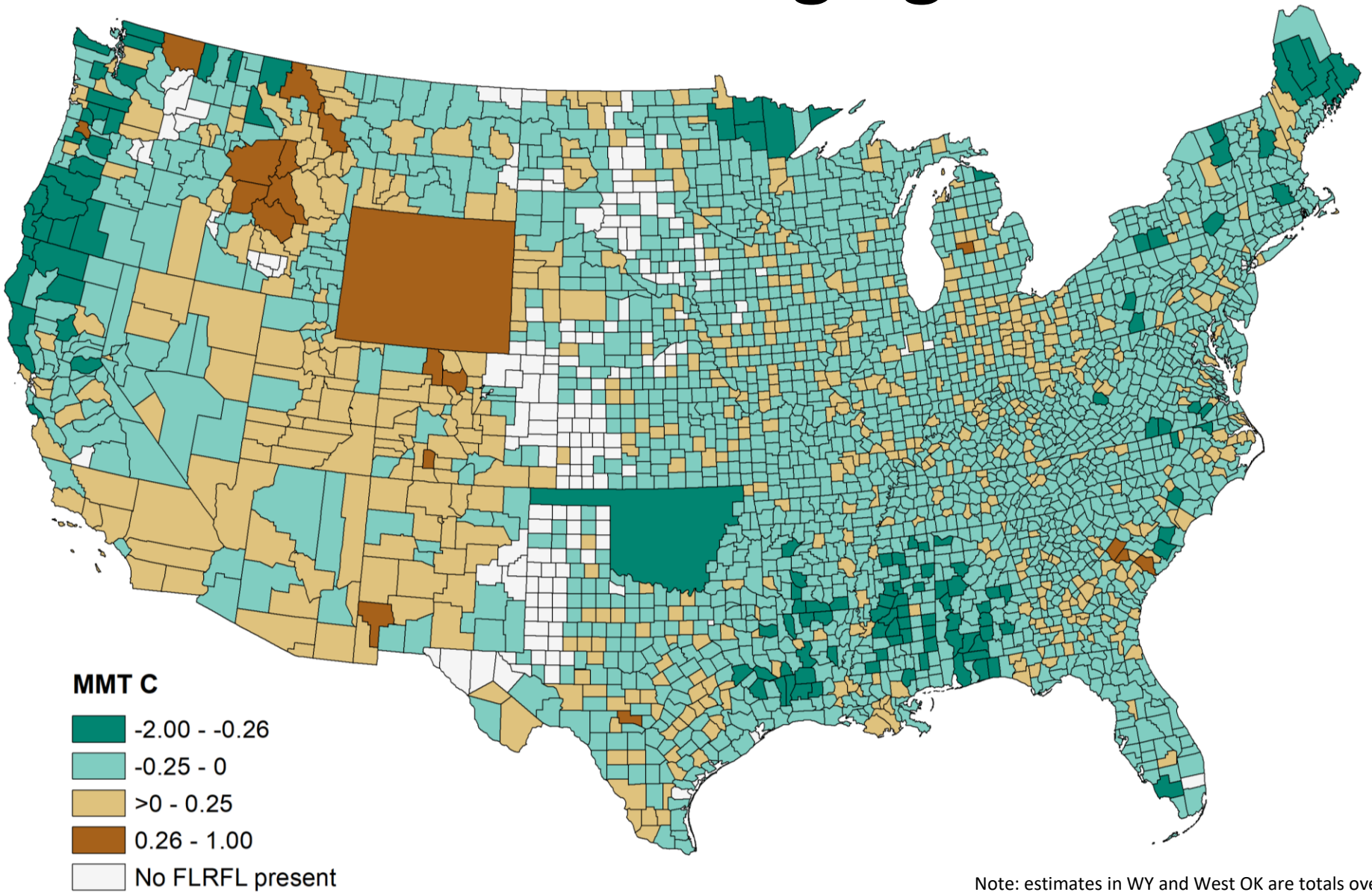
How are carbon stocks changing?



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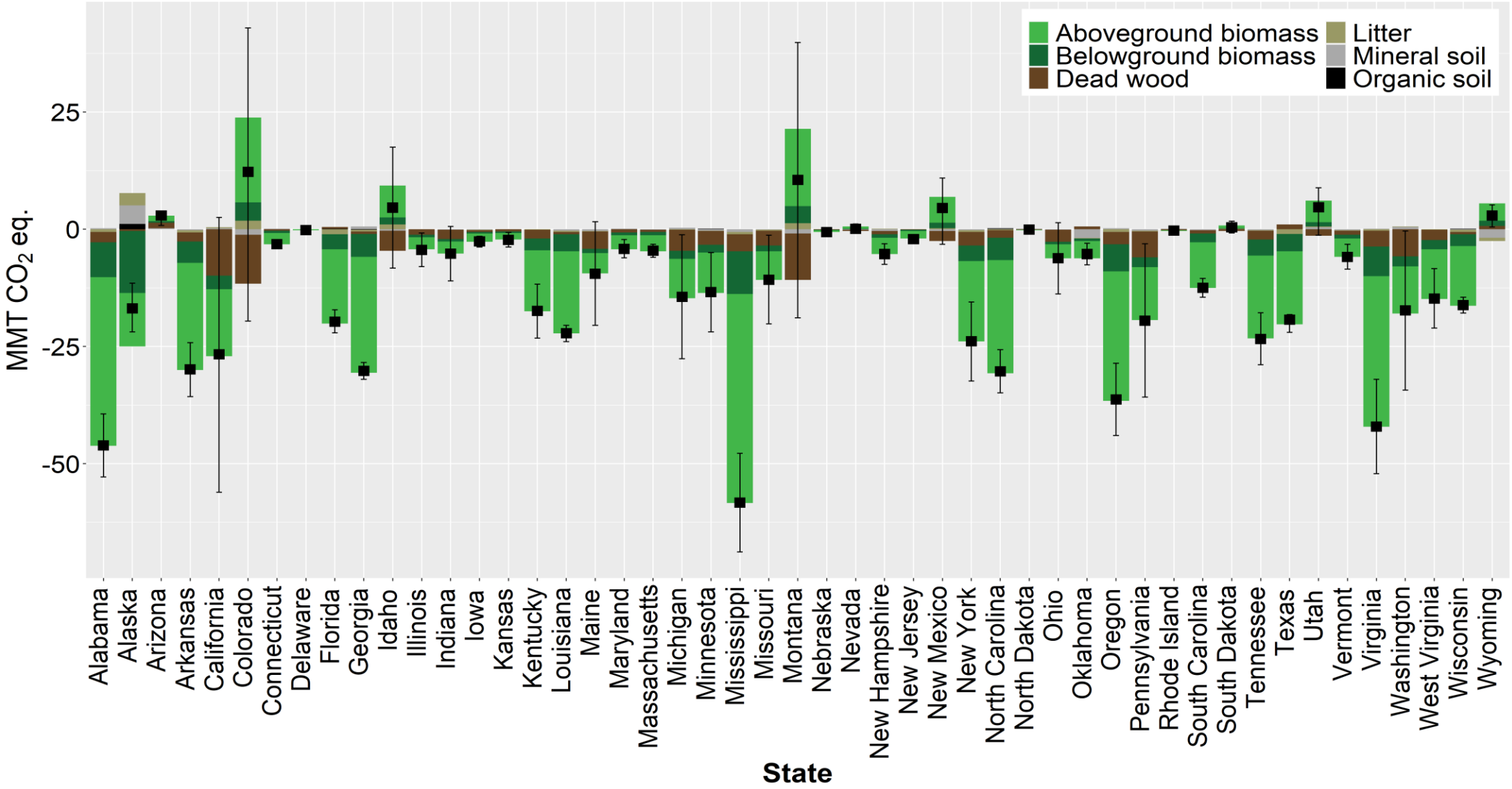

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Harvested Wood Products (HWP) approaches

1. Stock change methods
   - All HWP consumed in the area, regardless of origin
   - Imports are included, exports are excluded
2. Production methods
   - All HWP produced from timber harvested in the area
   - Exports are included, imports are excluded
3. Atmospheric flow methods
   - Direct estimation of annual atmospheric flux within domain boundaries
4. Combined methods

IPCC 2019, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds). Published: IPCC, Switzerland.

Biomass for energy

TABLE 12.5
REPORTING OF CO_2 EMISSIONS FROM WOOD BIOMASS BURNT BY PRODUCING AND CONSUMING COUNTRIES UNDER DIFFERENT HWP APPROACHES

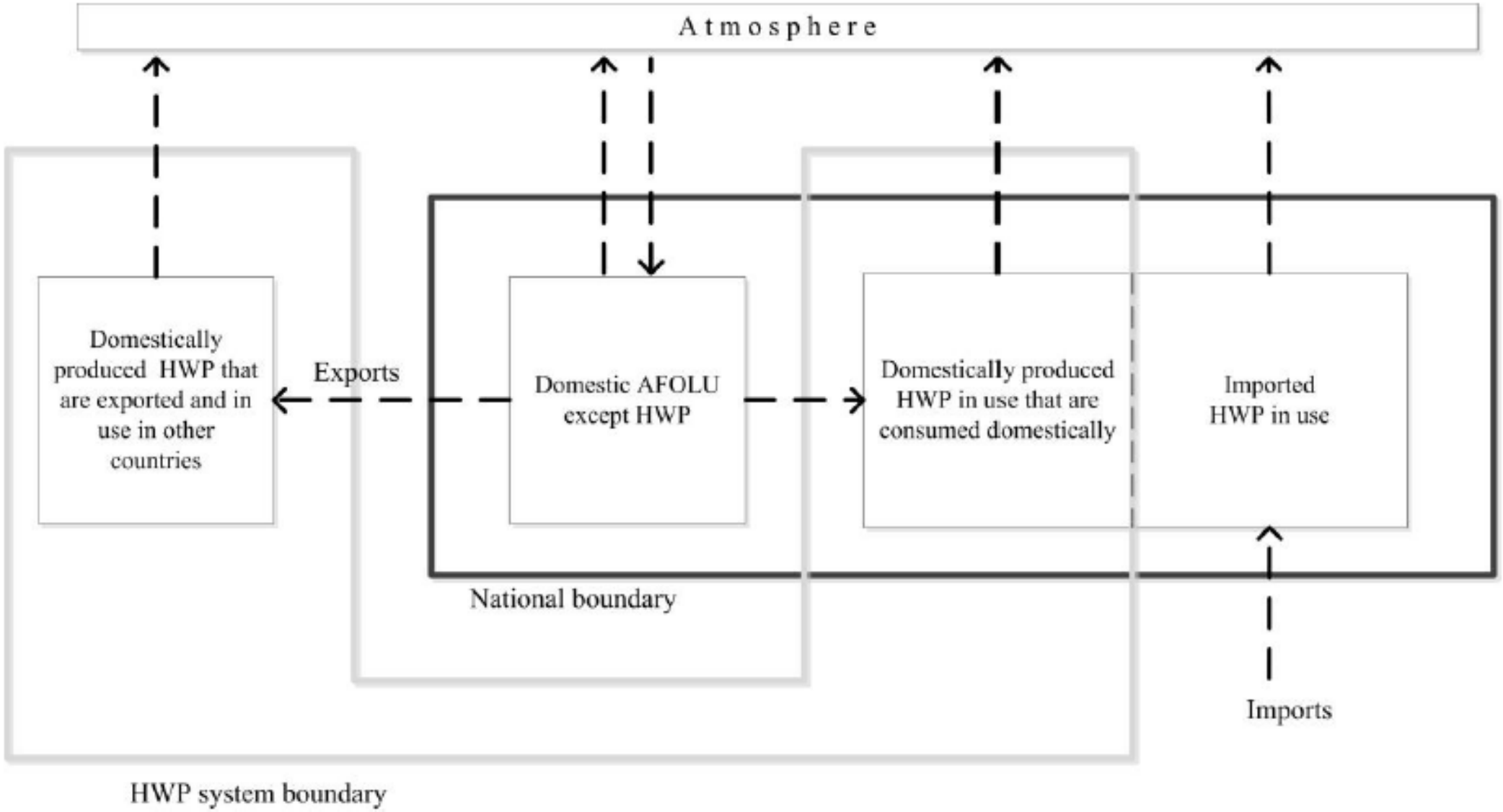
Element of wood biomass	Assumption of 'a steady-state HWP pool'	'Stock-change' approach	'Production' approach*	'Atmospheric-flow' approach
Unutilized wood harvest residues	Producing country	Producing country	Producing country	Producing country
Harvested wood biomass used directly as energy feedstocks				Consuming country
Industrial residues from manufacturing semi-finished wood products				
Industrial residues from manufacturing finished wood products in use**		Consuming country		
Wood biomass collected and burnt as post-consumer waste				

* Discussion of the 'production' approach in this section also applies for the 'simple-decay' approach (see Section 12.3 and Annex 12.A)

** In the case of the 'stock-change' approach, strictly, CO_2 emissions from wood biomass collected and burnt as post-consumer waste are only reported by a consuming country if the finished wood products are consumed and used in the country where they are manufactured and are not exported to another country.

IPCC 2019, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds). Published: IPCC, Switzerland.

Production approach



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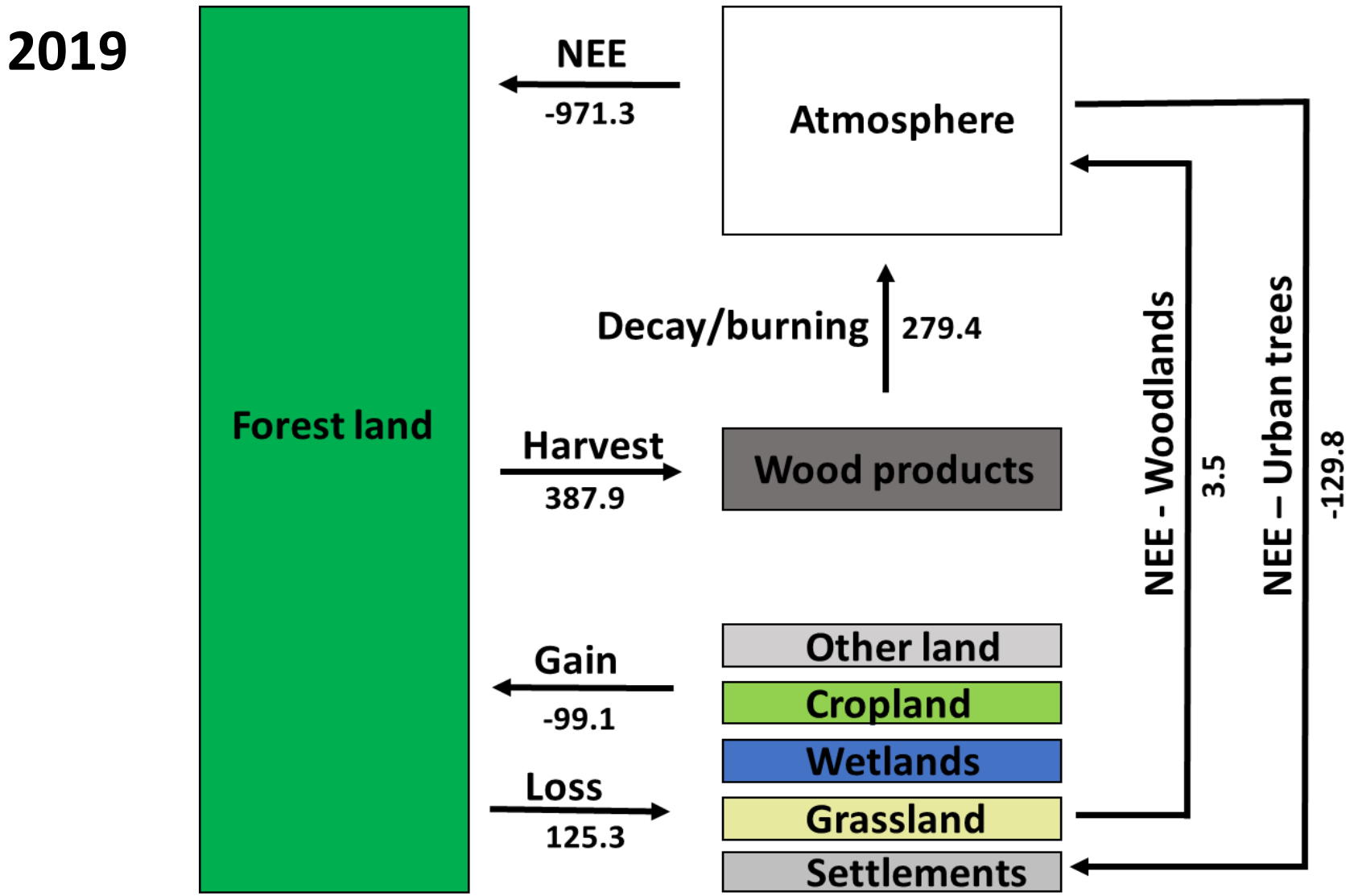
Forest land carbon cycling (MMT CO_2 eq.)



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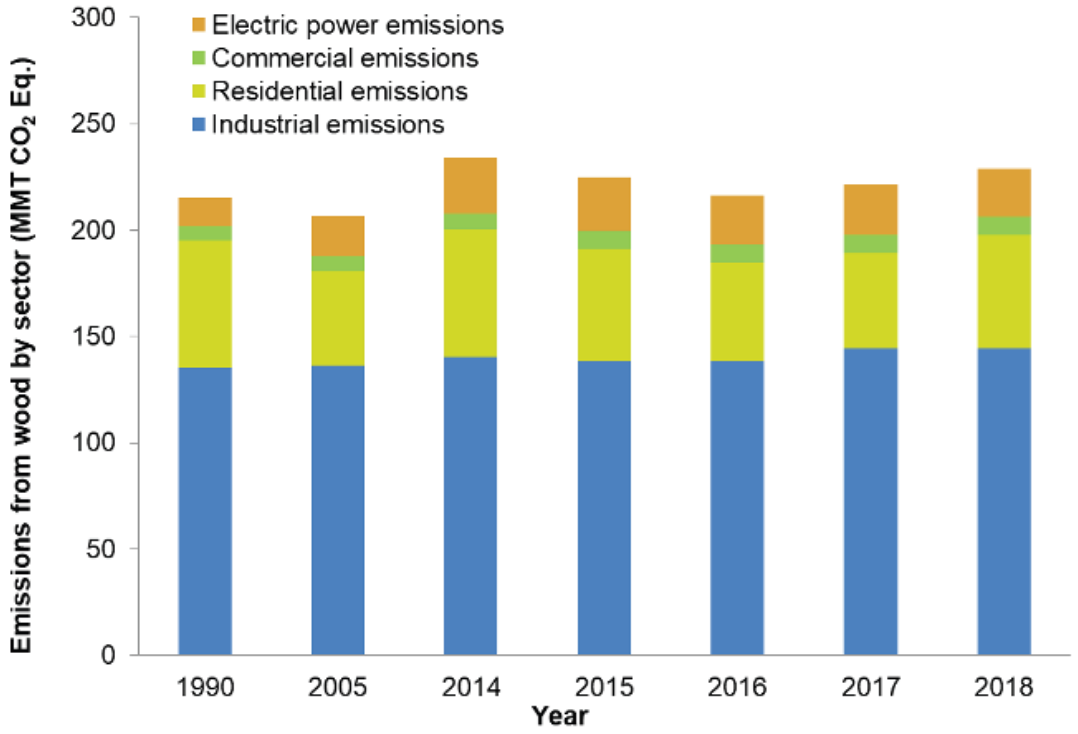
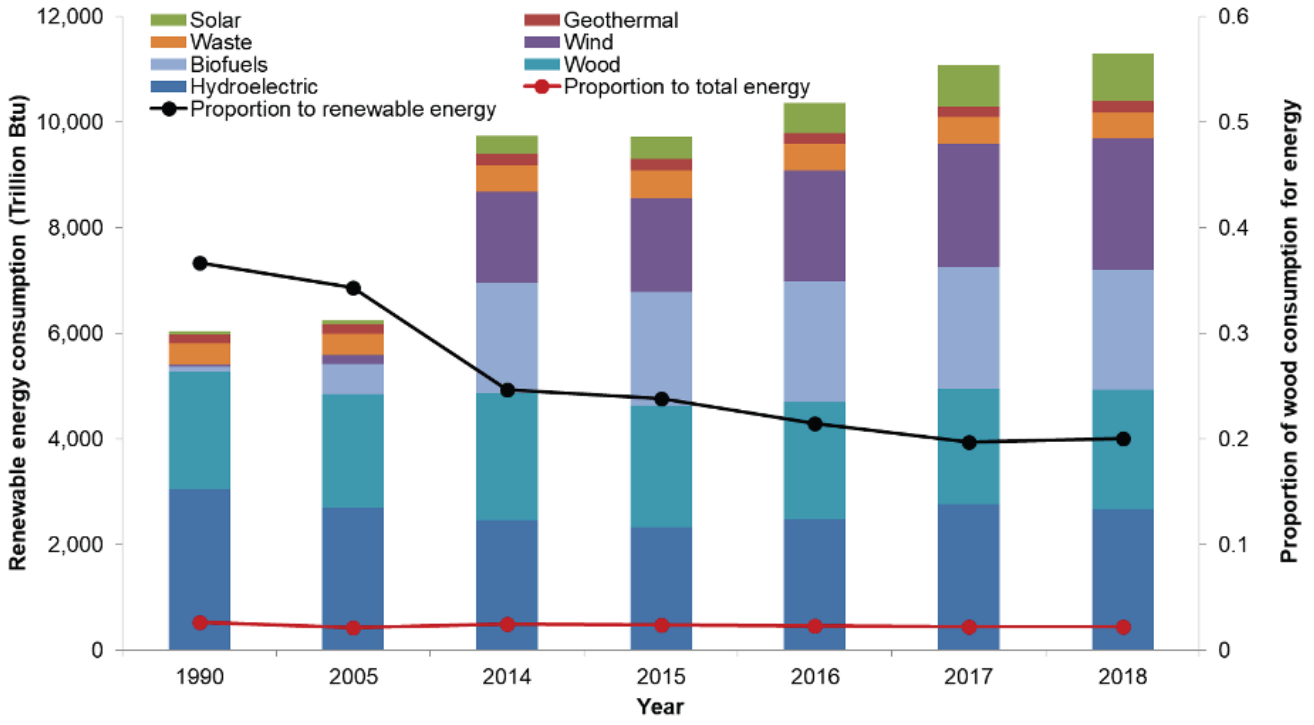
Wood consumption for energy in the US





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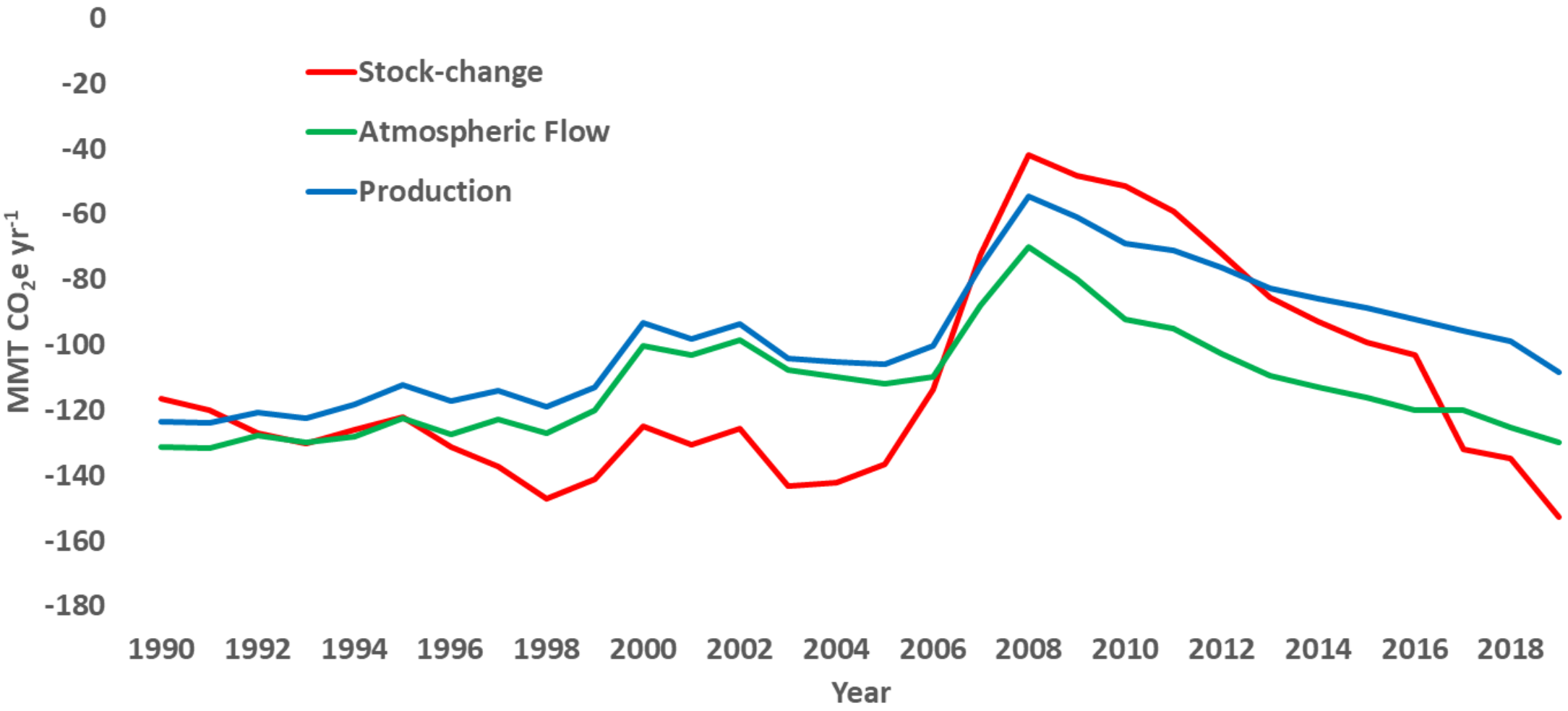
Oswalt, Sonja N.; Smith, W. Brad; Miles, Patrick D.; Pugh, Scott A., coords. 2019. Forest Resources of the United States, 2017: a technical document supporting the Forest Service 2020 RPA Assessment. Gen. Tech. Rep. WO-97. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office. 223 p. https://doi.org/10.2737/WO-GTR-97.

Comparison of approaches



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Final thoughts

- Forest Service continues to be a major producer and consumer of data and data products in support of carbon science, management, and reporting
- FIA data continues to be the foundation
- We are developing more spatially and temporally resolved information
- Moving beyond monitoring to mitigation activities
- Continue to improve and expand capabilities - collaboration and partnerships are essential!
- Inform policy and land management practices across scales

Thanks!

Grant Domke: grant.m.domke@usda.gov

FIA program: www.fia.fs.fed.us

FIA carbon: https://www.fia.fs.fed.us/forestcarbon/