



Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Updates to the CONUS-wide, tree-level forest model TreeMap for circa 2020 and 2022 landscapes

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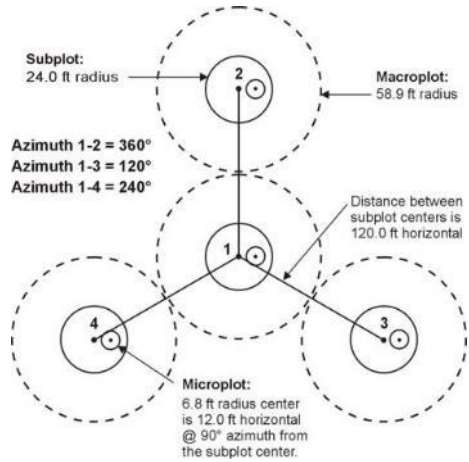
³ Rocky Mountain Research Station, USDA Forest Service, Ogden, UT, USA

Rachel M. Houtman

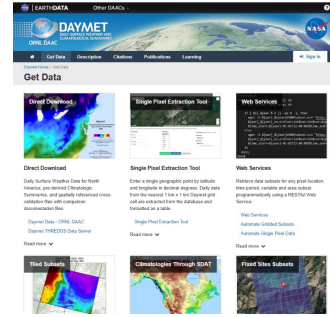
Biological Scientist, RMRS Missoula Fire Sciences Lab

GMUG, 22 April 2026

Modeling Components

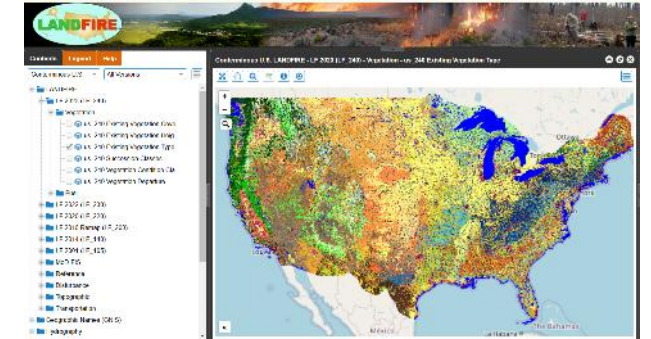


FIA plot data



DAYMET

LANDFIRE



Random Forest Imputation

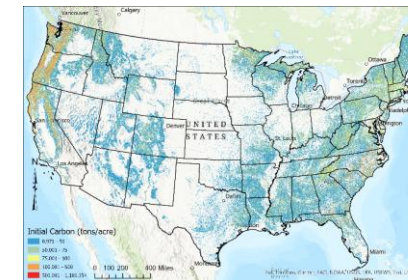
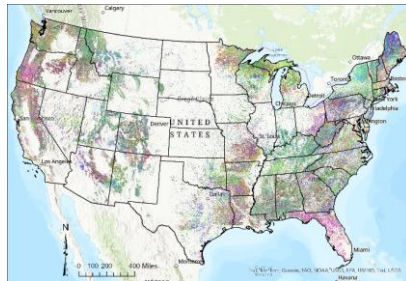
TreeMap and FuelMap

Forest Vegetation Simulator



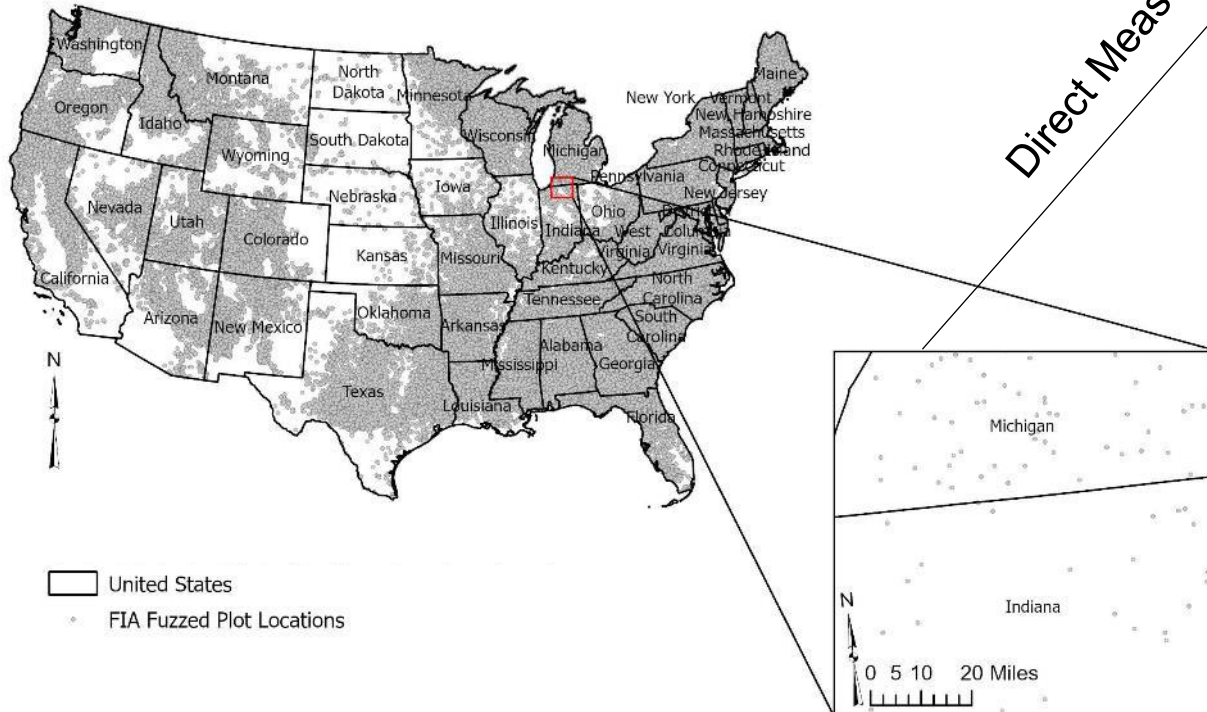
Query FIA plot attributes

Mapped forest attributes



FIA plot data (plot locations are fuzzed)

We have a lot of information about a small percent of the total landscape.



Direct Measurements of:

(For all plots)

- Land use
- Individual tree measurements:
 - DBH
 - Species
 - Live/Dead
 - Mortality agents

(For a subset of plots):

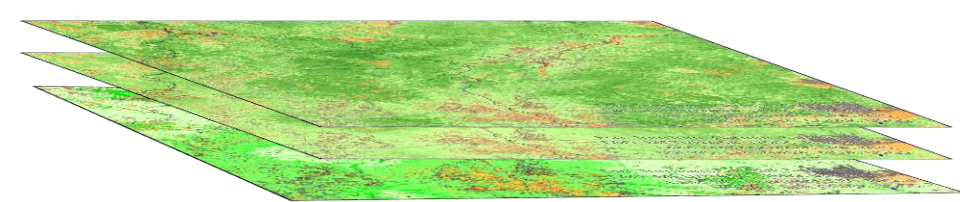
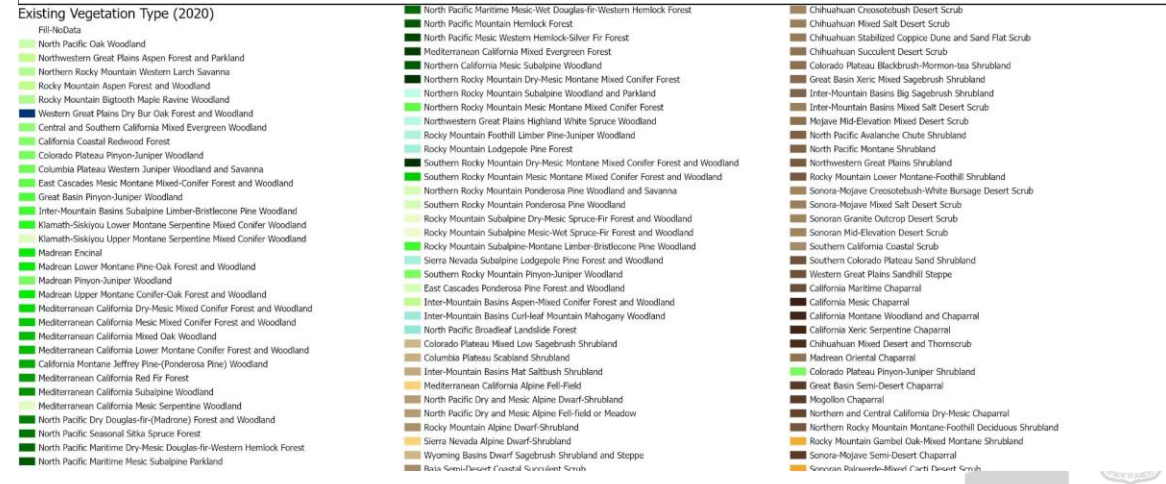
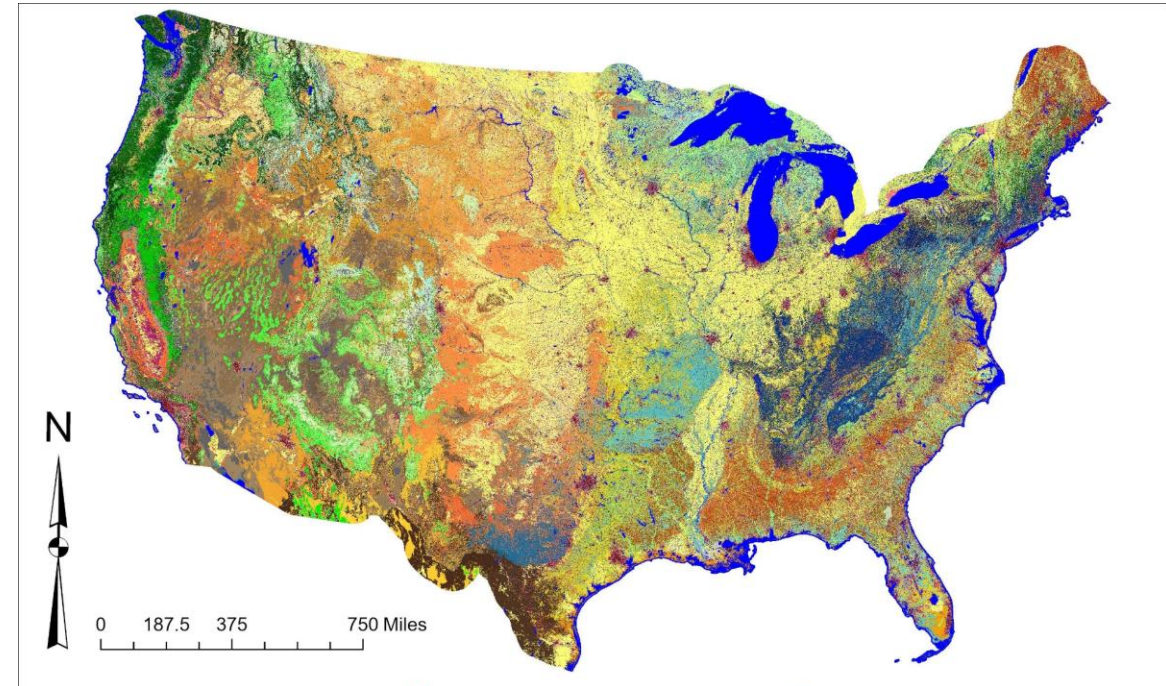
(For a subset of plots):

- Fuels
- Soils
- Understory vegetation

LANDFIRE and DAYMET datasets

We have sparse information for every 30 m point on the landscape.

Overlaying raster data allows us to create a combined dataset for the sparse data, called Target Data.



Existing Vegetation Cover
Existing Vegetation Height
Existing Vegetation Group

TreeMap Random Forest Imputation

Reference Data

FIA Plot Data

- Canopy cover
- Canopy height
- Existing Vegetation Group
- Disturbance
- Disturbance year

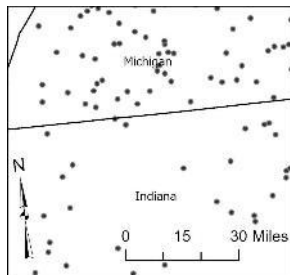
True FIA Plot Location

- Latitude
- Longitude

Biophysical Data

- Precipitation
- Solar radiation
- Snow-water equivalent
- Max and min temperature
- Vapor pressure
- Vapor pressure deficit

DAYMET data for FIA
plot locations



Fuzzed FIA plots identify location of rich data

Target Data

LANDFIRE Grids

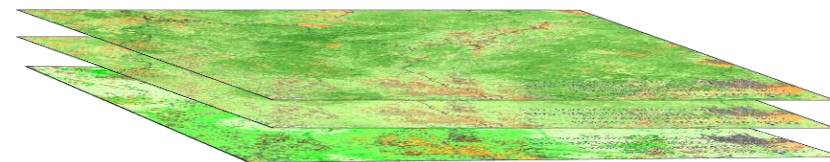
- Existing Vegetation Cover
- Existing Vegetation Height
- Existing Vegetation Group
- Disturbance
- Disturbance year

Grid point locations

- Latitude
- Longitude

DAYMET Grid Data

- Precipitation
- Solar radiation
- Snow-water equivalent
- Max and min temperature
- Vapor pressure
- Vapor pressure deficit



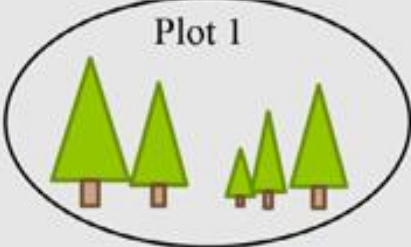
Existing Vegetation Cover
Existing Vegetation Height
Existing Vegetation Group

Raster grid sandwich of target data (this is a subset)

TreeMap Random Forest Imputation


Input 1: Reference data
Forest plot data from FIA

Plot 1



Precip. = 16
Veg. group = PP
Tree 1 = PP
Tree 2 = DF
Tree 3 = PP
Etc.

Plot 15333



Precip. = 12
Veg. group = MC
Tree 1 = DF
Tree 2 = DF
Tree 3 = LP
Etc.

+

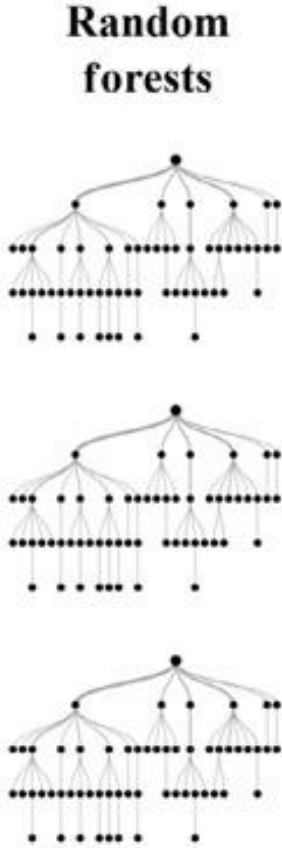
Input 2: Target data
Gridded landscape data from Landfire

Precipitation

15	16	16
15	16	16
16	16	16

Vegetation Group

PP	PP	PP
MC	PP	PP
MC	MC	MC



Output: Grid of forest plot IDs

20	5	5
12	1	5
12	12	12

Plot 1
Tree 1 = PP
Tree 2 = DF
Tree 3 = PP
Etc.

Daymet variable updates

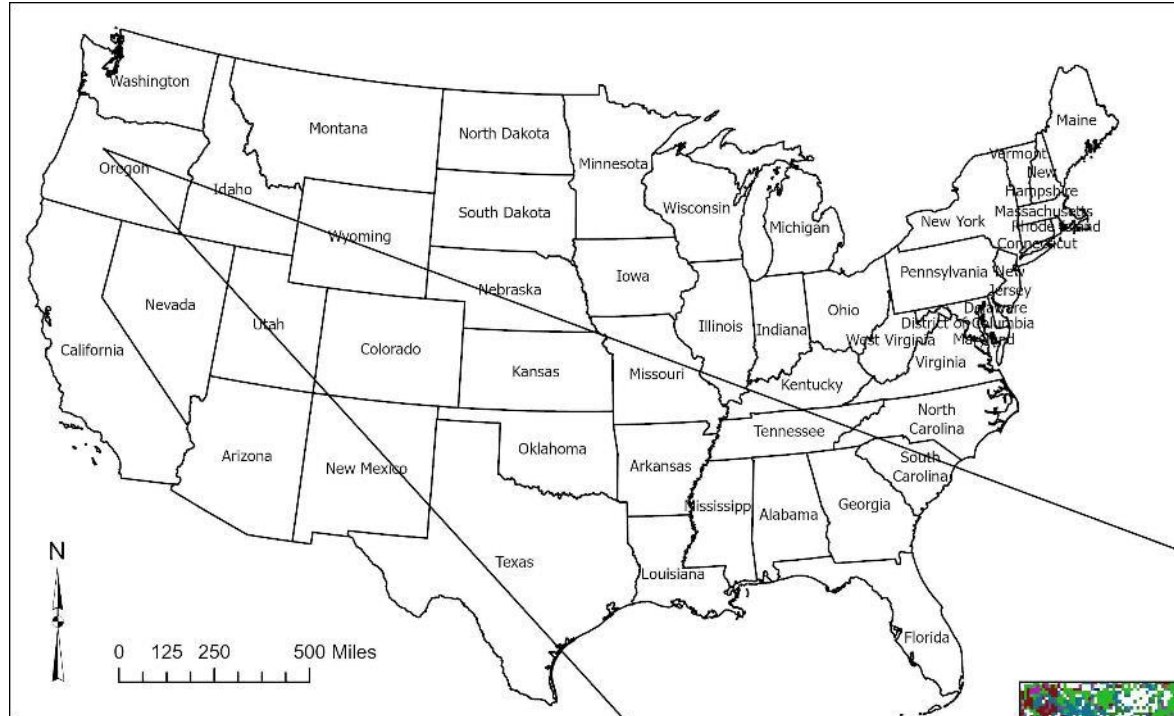
Biophysical variables were updated to Daymet maps because the methods are published through peer-review (Thornton 1997, Thornton 2021).

Reference variables include:

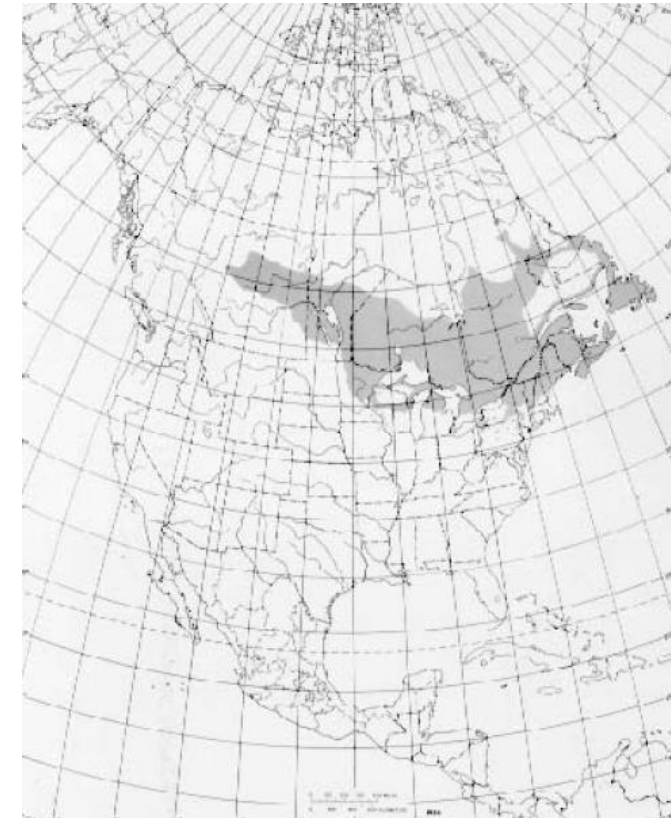
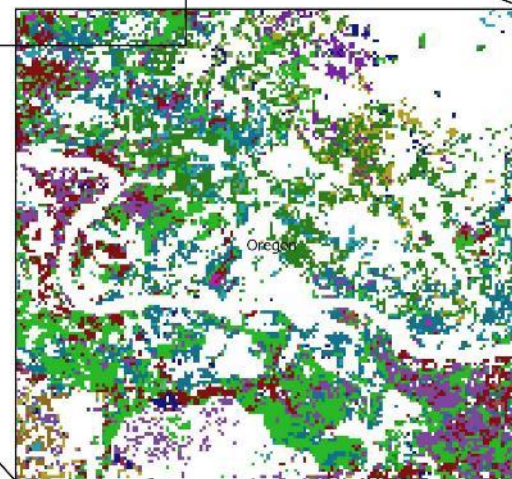
- Precipitation
- Shortwave radiation
- Snow water equivalent
- Maximum temperature
- Minimum temperature
- Vapor pressure
- Vapor pressure deficit

The screenshot displays the Daymet website interface. At the top, there's a navigation bar with 'EARTHDATA', 'Other DAACs', and a search icon. The main header features the 'DAYMET' logo, 'DAILY SURFACE WEATHER AND CLIMATOLOGICAL SUMMARIES', and 'ORNL DAAC'. Below this is a secondary navigation bar with links for 'Get Data', 'Description', 'Citations', 'Publications', 'Learning', and 'Sign in'. The main content area is titled 'Get Data' and contains six tool cards: 'Direct Download' (with a map of North America), 'Single Pixel Extraction Tool' (with a map and input fields), 'Web Services' (with a code snippet), 'Tiled Subsets' (with a map), 'Climatologies Through SDAT' (with a map), and 'Fixed Sites Subsets' (with a map). Each card includes a brief description and a 'Read more' link.

Ride-along update: The problem



Forest Types (2016)



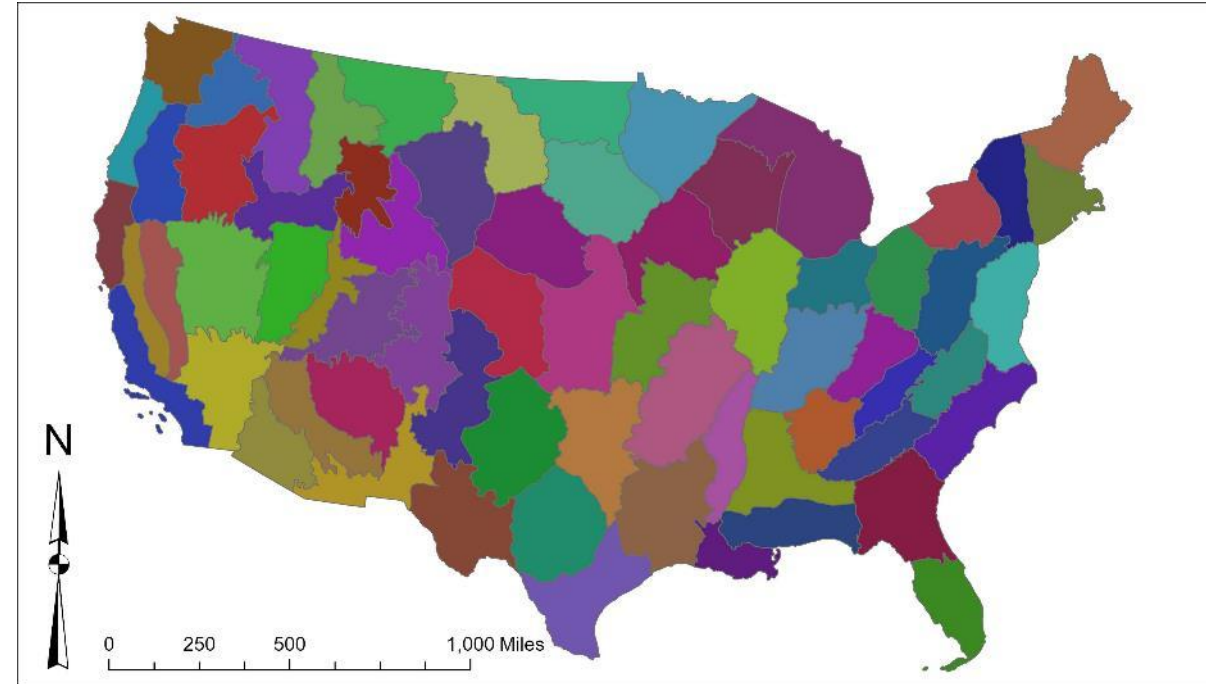
Native range of balsam fir
(*Abies balsamea*).

Source:

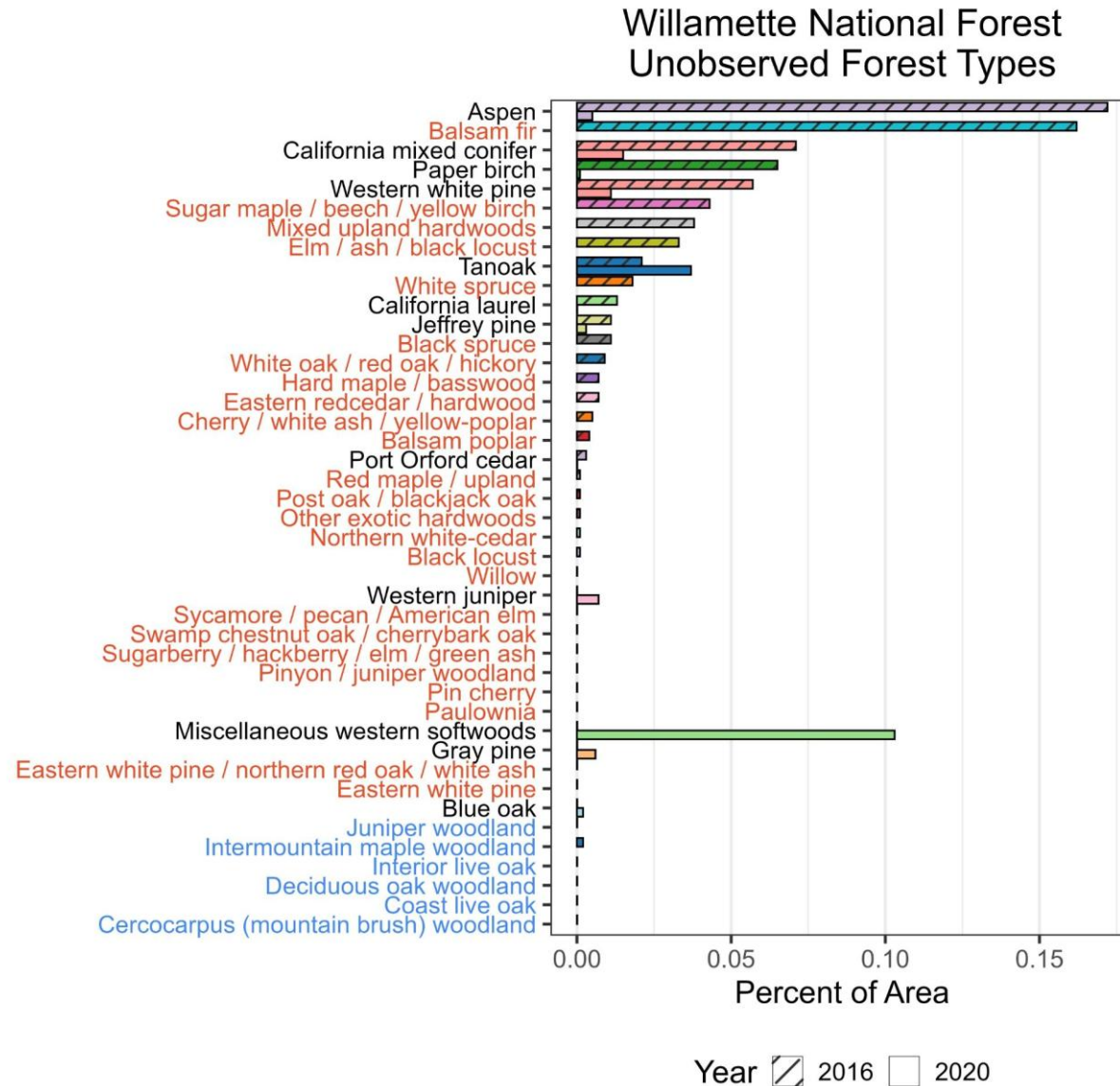
<https://research.fs.usda.gov/silvics/balsam-fir>

Ride-along update: Methods

- Random Forest is run for each LANDFIRE zone.
- Earlier iterations used all single-condition, forested plots, allowing plots far from a given location to be available for imputation.
- In this update, we compiled all the unique tree species identified in FIA plots within each zone and adjacent zones. This list was used to limit the FIA plots available to each zone by species.
- Results show that there is a small reduction in accuracy for EVH, EVC, and disturbance when limiting plots.



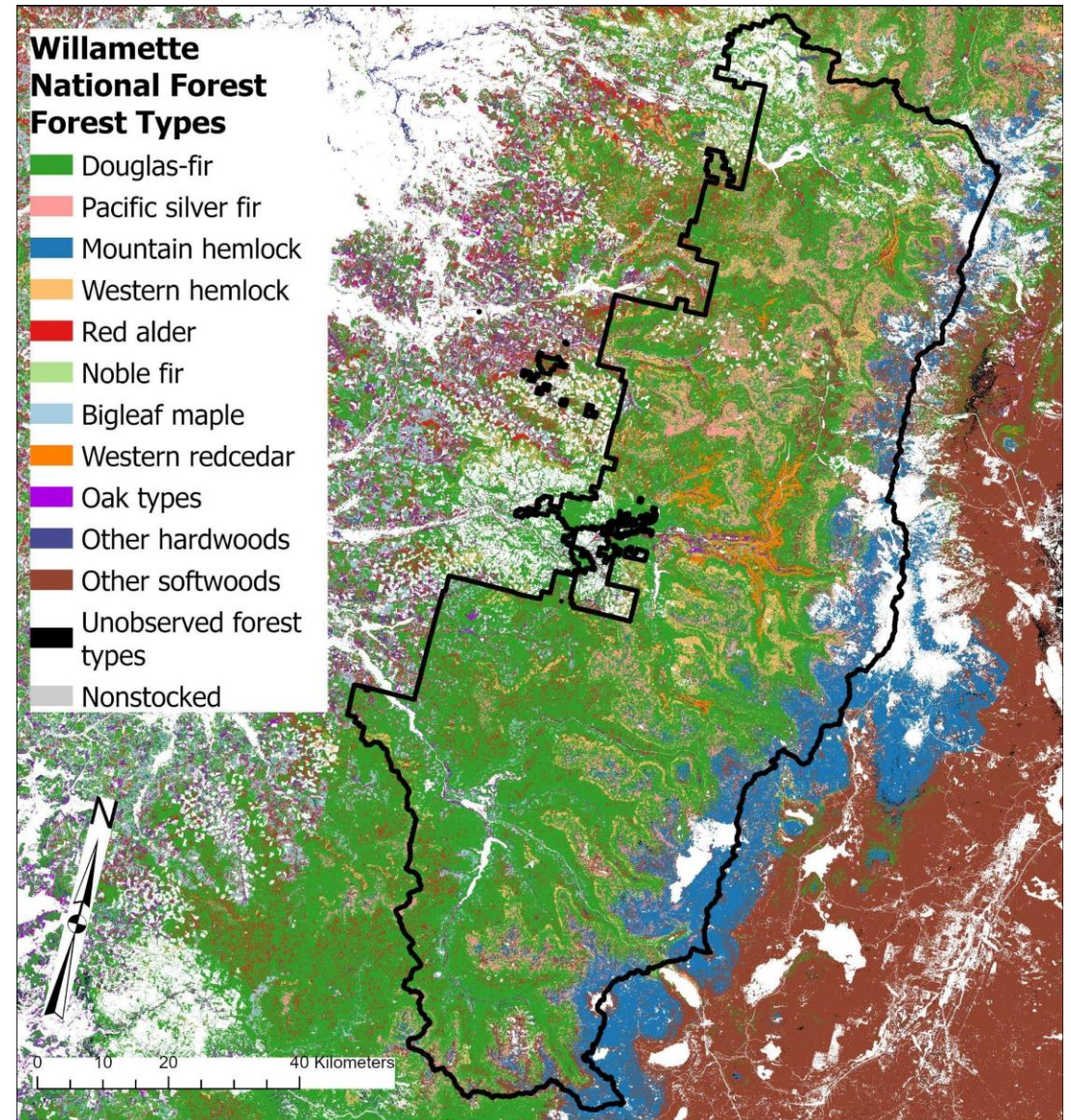
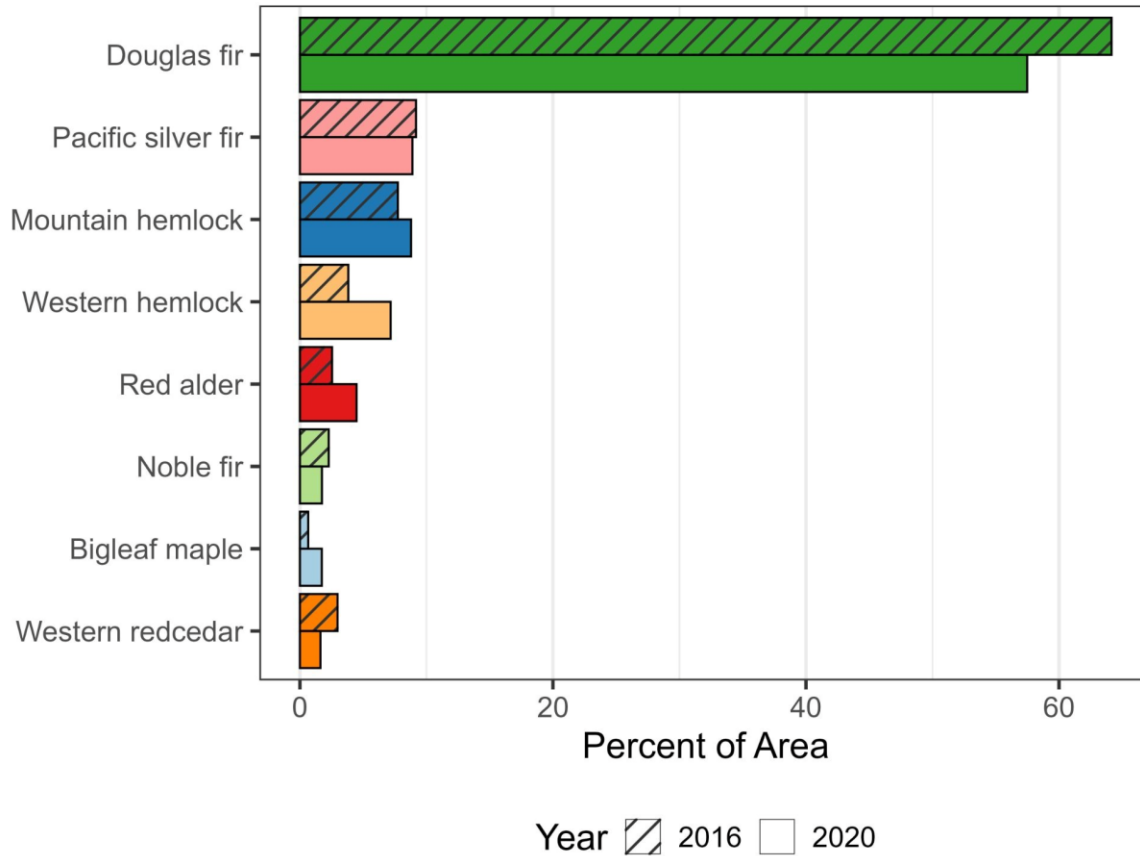
Ride-along updates: Results



- Red = present in 2016, excluded by fix
- Blue = not present in 2016, added in 2020 and 2022
- Black = present in all datasets

Ride-along updates: Results

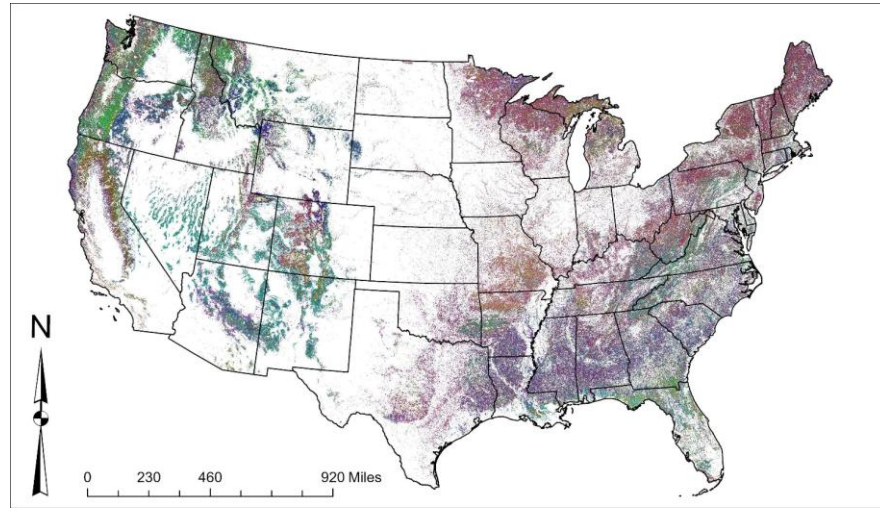
Willamette National Forest
Most Common Forest Types



Results for TreeMap 2020 and 2022

TreeMap 2020

- Imputed 64,743 plots to 2,696,548,860 forested pixels

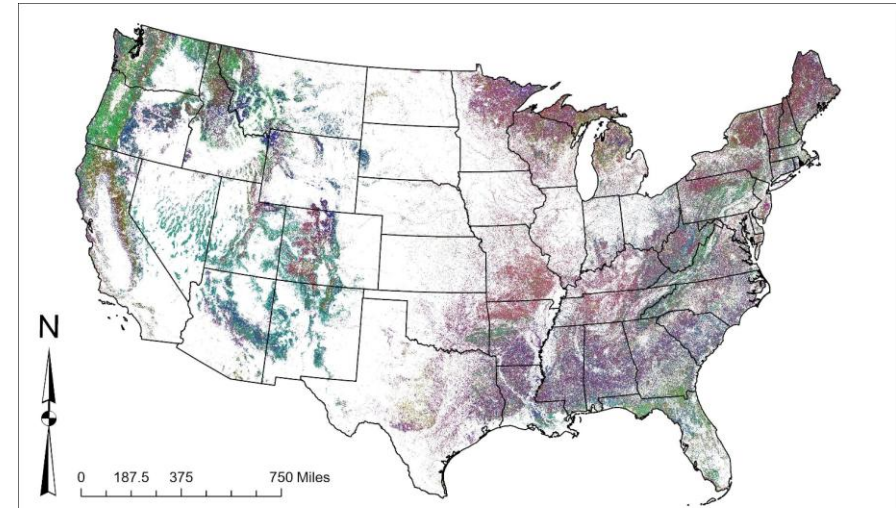


TreeMap 2020

Forest Type	Color	Forest Type	Color	Forest Type	Color	Forest Type	Color
Juniper woodland	Light Blue	Western hemlock	Dark Green	Loblolly pine	Light Purple	Eastern hemlock	Light Purple
Pinyon / juniper woodland	Light Blue	Western juniper	Dark Green	Yellow-poplar / white oak / northern red oak	Light Purple	Cherry / white ash / yellow-poplar	Light Purple
Evergreen oak woodland	Light Blue	Red alder	Dark Green	Yellow-poplar	Light Purple	Red maple / lowland	Light Purple
Grand fir	Light Blue	Mountain hemlock	Dark Green	Sugarberry / hackberry / elm / green ash	Light Purple	Inconspicuous	Light Purple
Lodgepole pine	Light Blue	Tanoak	Dark Green	Elm / ash / black locust	Light Purple	Balsam poplar	Light Purple
Douglas-fir	Light Blue	Western larch	Dark Green	Post oak / black locust	Light Purple	Post oak / blackjack oak	Light Purple
Ponderosa pine	Light Blue	Table fir	Dark Green	Eastern redcedar / hardwood	Light Purple	Shortleaf pine / oak	Light Purple
Western redcedar	Light Blue	California black oak	Dark Green	Sycamore / pecan / American elm	Light Purple	Alaska-yellow-cedar	Light Purple
Aspen	Light Blue	Oregon white oak	Dark Green	Eastern white pine	Light Purple	Scrub oak	Light Purple
Deciduous oak woodland	Light Blue	Douglas-fir	Dark Green	Chestnut oak	Light Purple	Red maple / oak	Light Purple
Intermountain maple woodland	Light Blue	Redwood	Dark Green	Eastern white pine / northern red oak / white ash	Light Purple	Scotch pine	Light Purple
California mixed conifer	Light Blue	Canyon live oak	Dark Green	Sugar maple / beech / yellow birch	Light Purple	Black locust	Light Purple
Subalpine fir	Light Blue	Coast live oak	Dark Green	Other pine / hardwood	Light Purple	Sassafras / persimmon	Light Purple
Limber pine	Light Blue	Gray pine	Dark Green	Atlantic white-cedar	Light Purple	Other exotic hardwoods	Light Purple
Engelmann spruce / subalpine fir	Light Blue	Intermountain maple woodland	Dark Green	Jack pine	Light Purple	Sugar pine	Light Purple
Engelmann spruce	Light Blue	Genesee (mountain bristle) woodland	Dark Green	Black locust	Light Purple	Scrub pine	Light Purple
Bur oak	Light Blue	Subalpine fir	Dark Green	Other pine / hardwood	Light Purple	Scrub pine	Light Purple
Nonstocked	Light Blue	Limber pine	Dark Green	Hard maple / basswood	Light Purple	Shortleaf pine	Light Purple
Blue spruce	Light Blue	Engelmann spruce / subalpine fir	Dark Green	Black ash / American elm / red maple	Light Purple	Overcup oak / water hickory	Light Purple
Paper birch	Light Blue	Engelmann spruce	Dark Green	Swamp chestnut oak / sherrypark oak	Light Purple	Sweetgum / Nuttall oak / willow oak	Light Purple
Whitebark pine	Light Blue	Bur oak	Dark Green	Baldcypress / water tupelo	Light Purple	Pin cherry	Light Purple
Cottonwood	Light Blue	Nonstocked	Dark Green	Black walnut	Light Purple	White spruce	Light Purple
White oak / red oak / hickory	Light Blue	Blue spruce	Dark Green	Longleaf pine	Light Purple	Black walnut	Light Purple
White oak	Light Blue	Paper birch	Dark Green	Longleaf pine	Light Purple	Balsam fir	Light Purple
Rocky Mountain juniper	Light Blue	Whitebark pine	Dark Green	Baldcypress / pondgrass	Light Purple	Northern red oak	Light Purple
White fir	Light Blue	Cottonwood	Dark Green	Palms	Light Purple	Southern scrub oak	Light Purple
Cottonwood / willow	Light Blue	White oak / red oak / hickory	Dark Green	Other exotic softwoods	Light Purple	Longleaf pine / oak	Light Purple
		White oak	Dark Green	Montserony pine	Light Purple	Virginia pine / southern red oak	Light Purple
		Rocky Mountain juniper	Dark Green				
		White fir	Dark Green				
		Cottonwood / willow	Dark Green				

TreeMap 2022

- Imputed 65,043 plots to 2,687,805,994 forested pixels



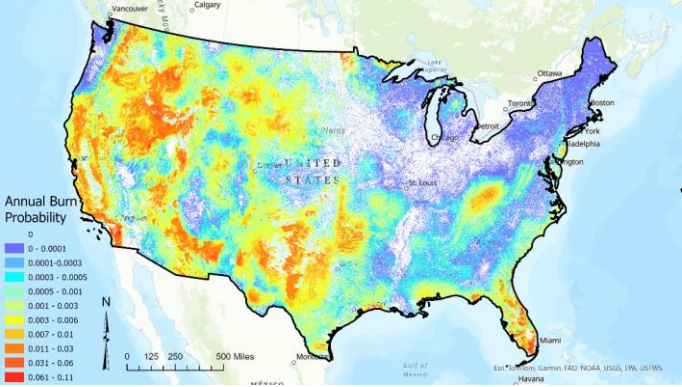
TreeMap 2022

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		Rocky Mountain juniper	Dark Green				
		White fir	Dark Green				
		Cottonwood / willow	Dark Green				

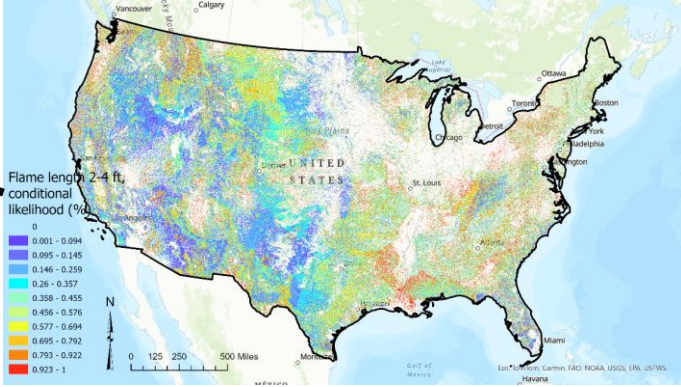
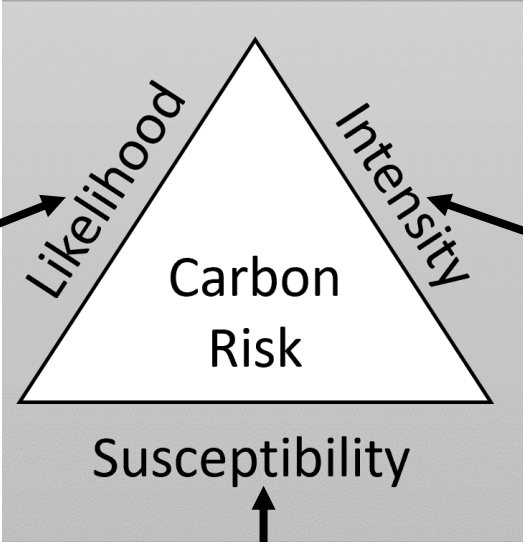
TreeMap Results

Validation Method	Year	EVC	EVH	EVT-GP	Disturbance Presence
OOB Accuracy (%)	2016	99.30	99.96	99.65	100.00
	2020	99.47	99.98	99.68	100.00
	2022	99.47	99.98	99.68	100.00
Target Layer Accuracy (%)	2016	97.70	99.60	94.80	99.98
	2020	96.28	99.48	97.24	99.77
	2022	96.13	99.43	97.14	99.70

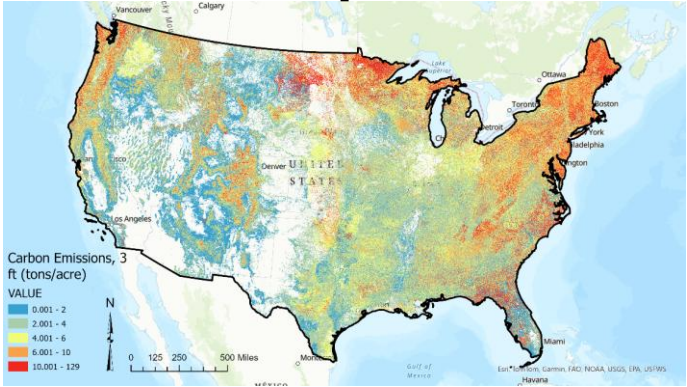
TreeMap Use Case: Wildfire risk to carbon



Burn Probability from FSim

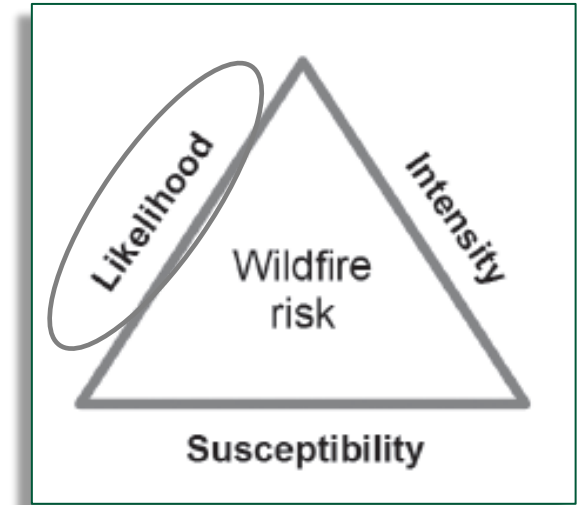
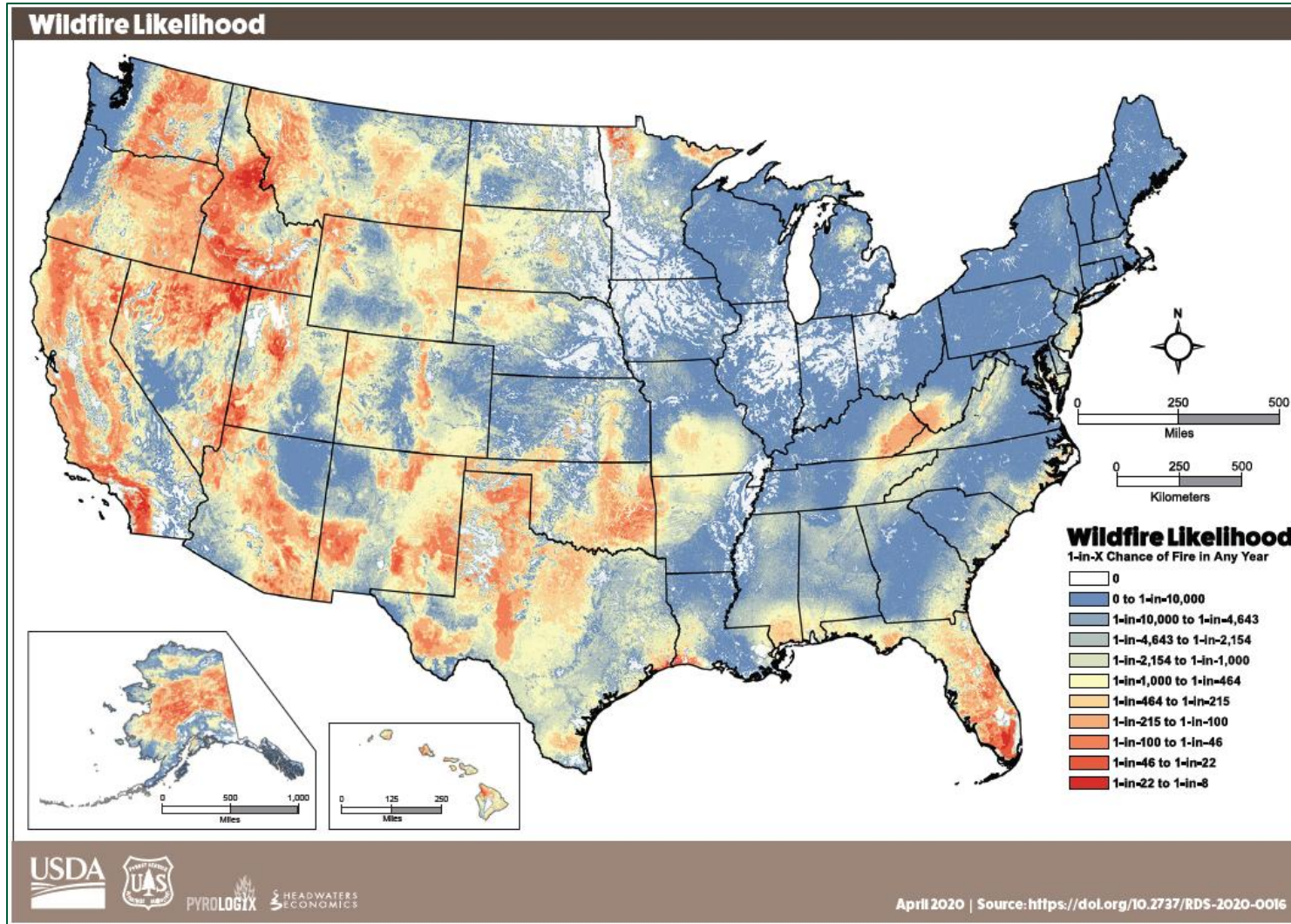


Conditional Intensity Probability from FSim



Carbon Impact from TreeMap + FuelMap and FVS

Likelihood: FSim: the Large Fire Simulator



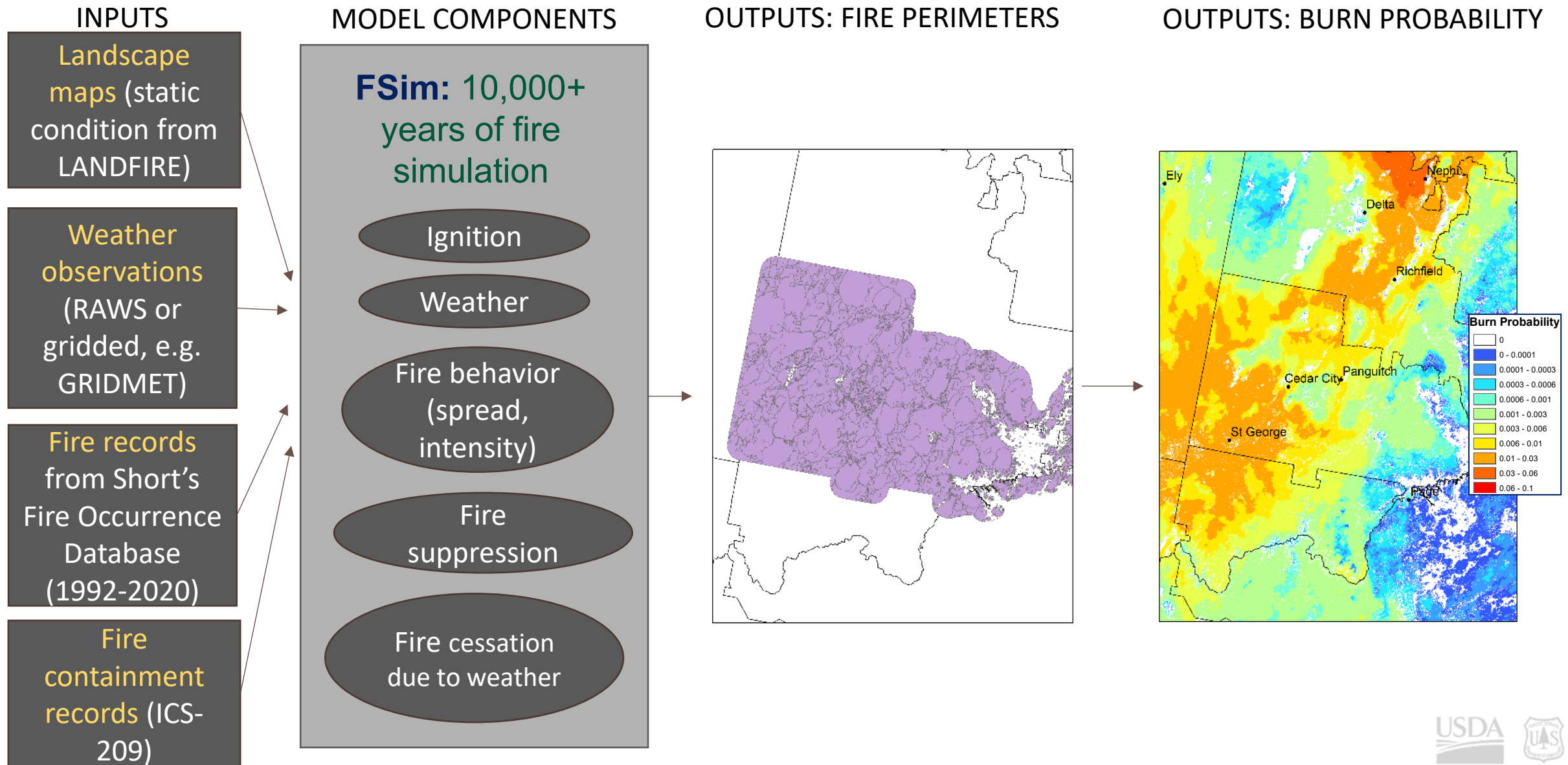
Stoch Environ Res Risk Assess (2011) 25:973–1000
DOI 10.1007/s00477-011-0462-z

ORIGINAL PAPER

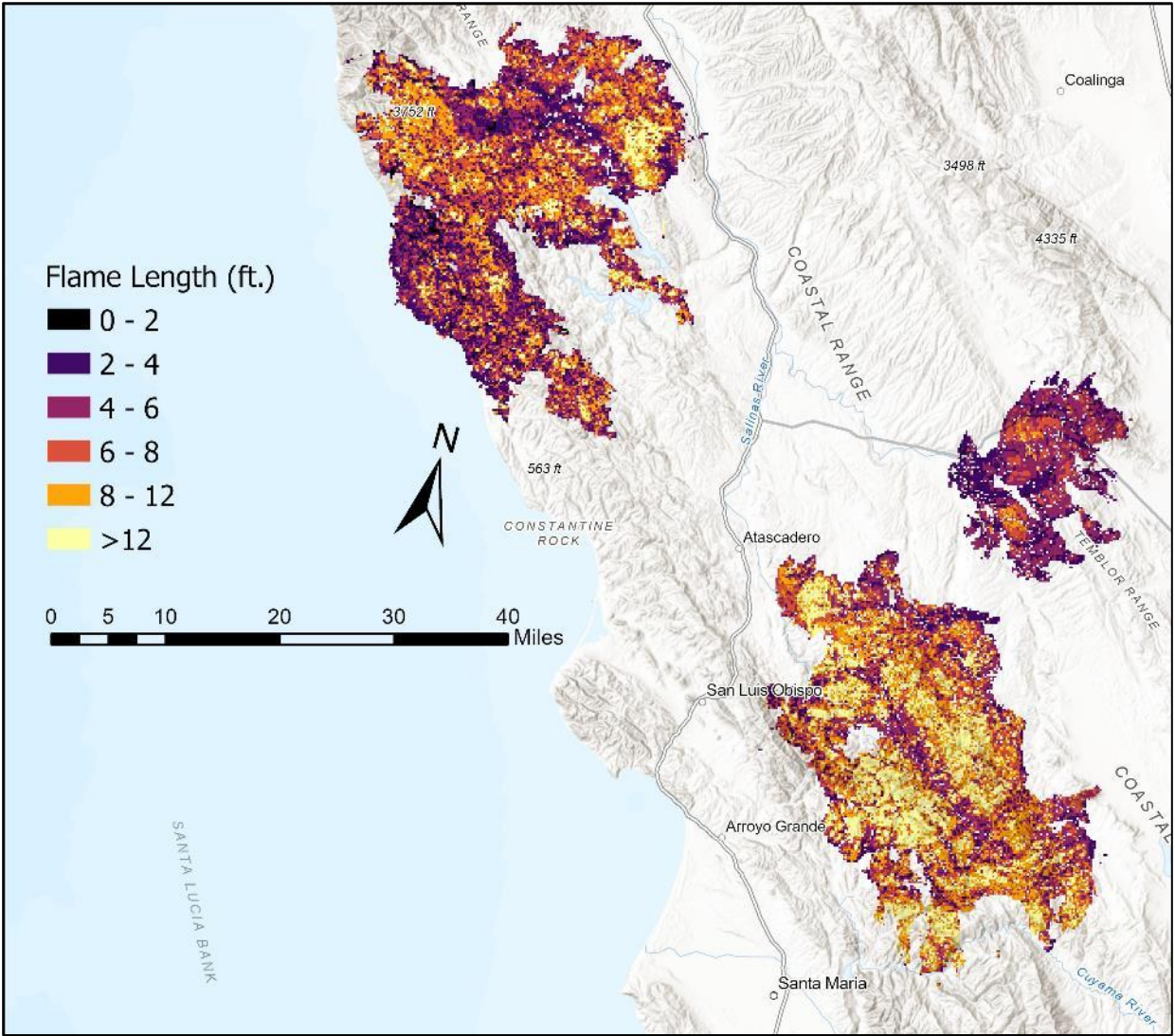
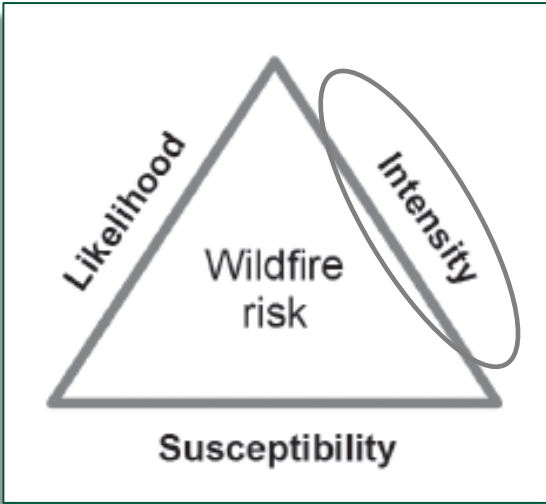
A simulation of probabilistic wildfire risk components for the continental United States

Mark A. Finney · Charles W. McHugh · Isaac C. Grenfell · Karin L. Riley · Karen C. Short

Likelihood: the Large Fire Simulator

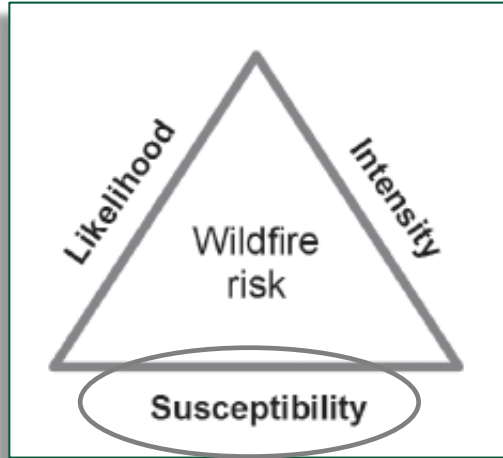


Intensity: FSim



Rasters from three individual fires in California

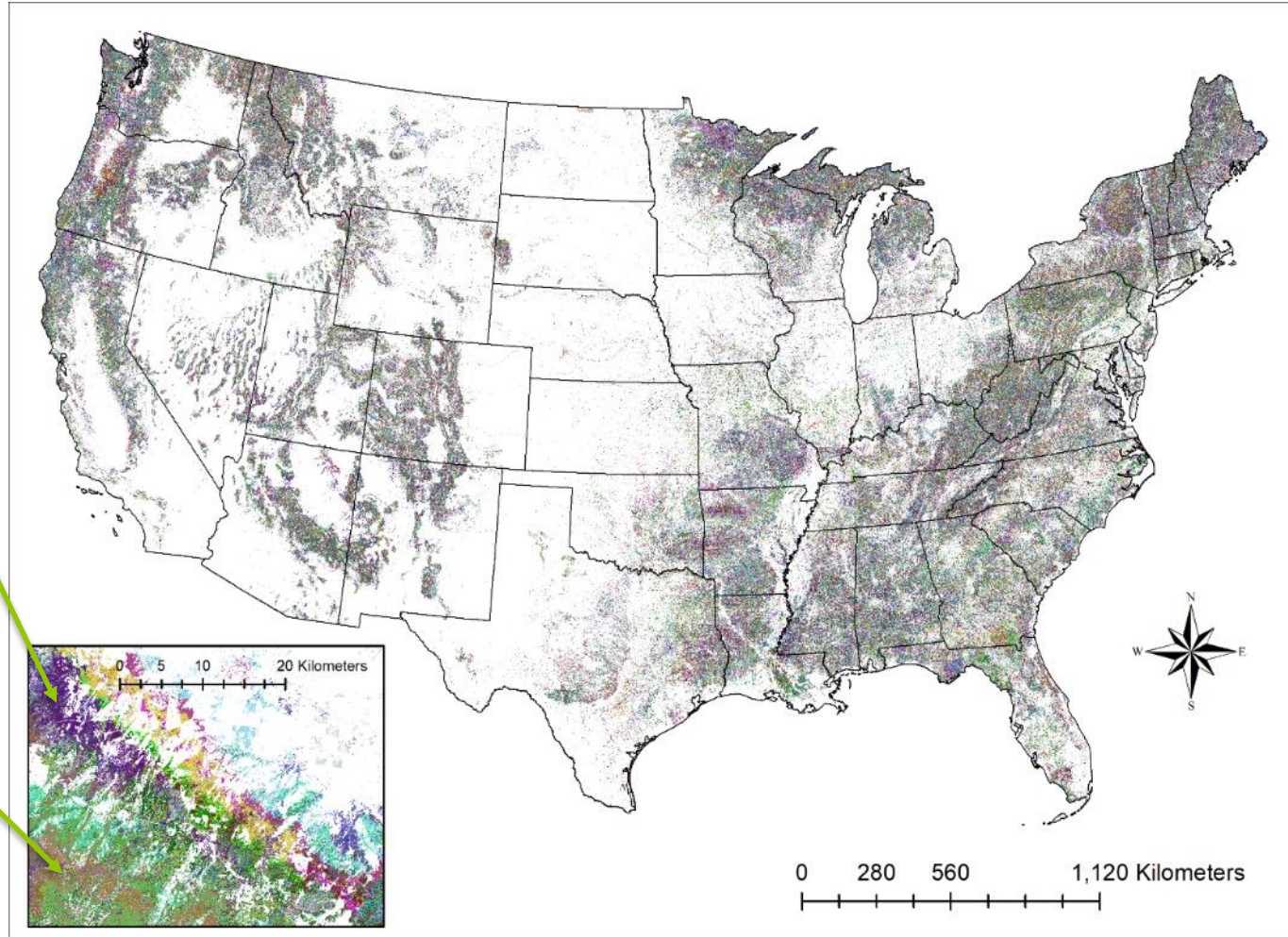
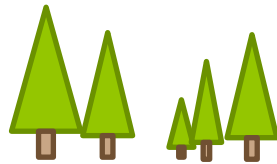
Susceptibility: Wildfire risk to forest carbon



Plot ID (CN) =
175742190010854



Plot ID (CN) =
264159709489998



SCIENTIFIC DATA

OPEN

TreeMap, a tree-level model of conterminous US forests circa 2014 produced by imputation of FIA plot data

Karin L. Riley¹, Isaac C. Grenfell², Mark A. Finney³ & Jason M. Wiener²

DATA DESCRIPTOR

Tree-level model of forests of CONUS: TreeMap

Main ingredients: FIA plots, gridded map of LANDFIRE, and DAYMET predictors



Susceptibility: Wildfire risk to forest carbon

- FuelMap dataset provides information on loading of litter, duff, coarse and fine woody debris
 - Critical for emissions calculations
 - The dataset is a second imputation using only plots where FIA records Downed Woody Material (DWM)



USDA U.S. DEPARTMENT OF AGRICULTURE

Research Data Archive
Roots of our Research

Catalog ▾ Our Formats Metadata & Tools Submitting Data Digitizing Conditions of Use About Us

Search catalog 

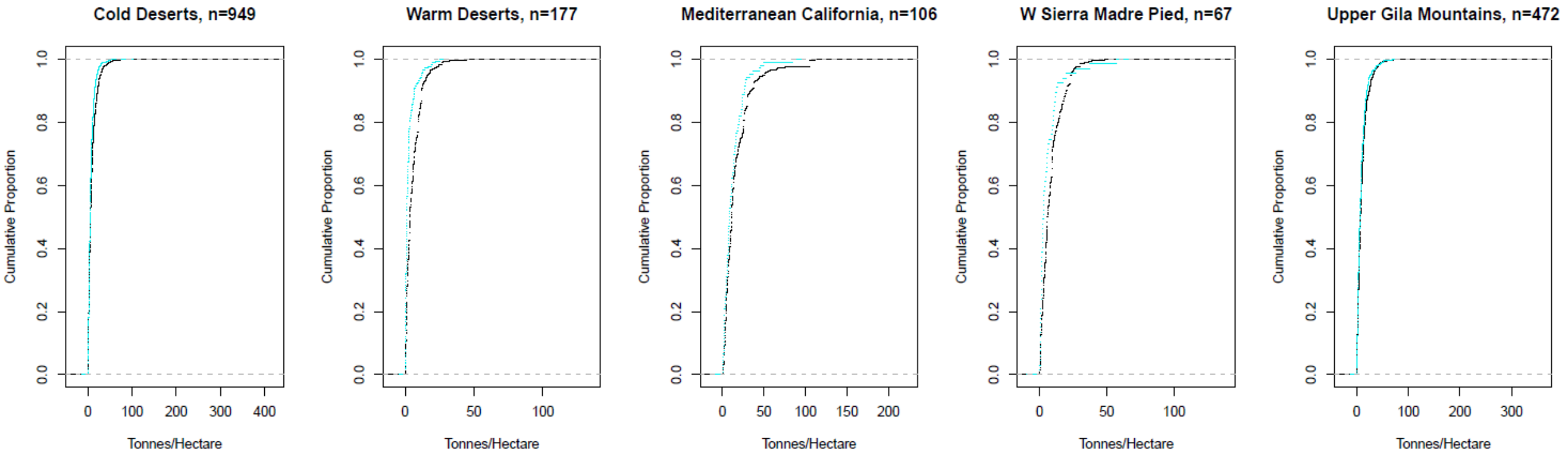
Publication Details

Title: FuelMap 2014: Imputed map of carbon stored in litter, duff, fine woody debris, and coarse woody debris for CONUS forests circa 2014 

Author(s): [Riley, Karin L.](#); [Grenfell, Isaac C.](#); [Shaw, John D.](#)

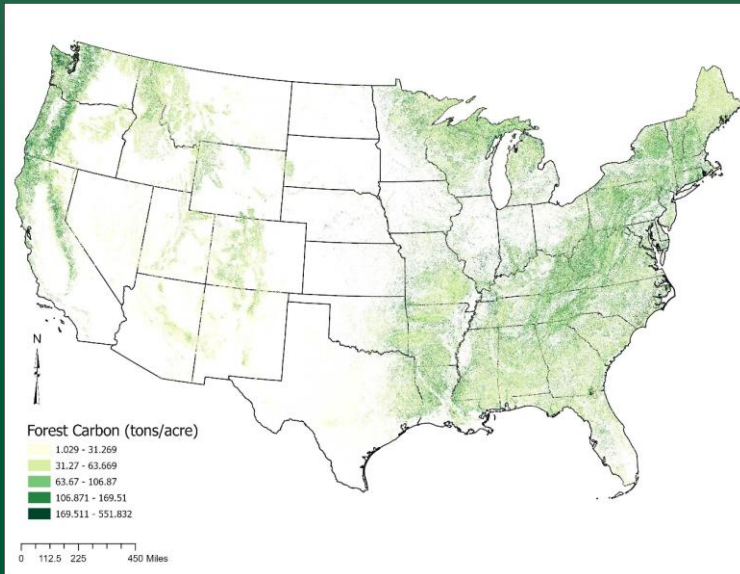
Publication Year: 2023

Total DWM carbon (black = FIA plot, blue=FuelMap)

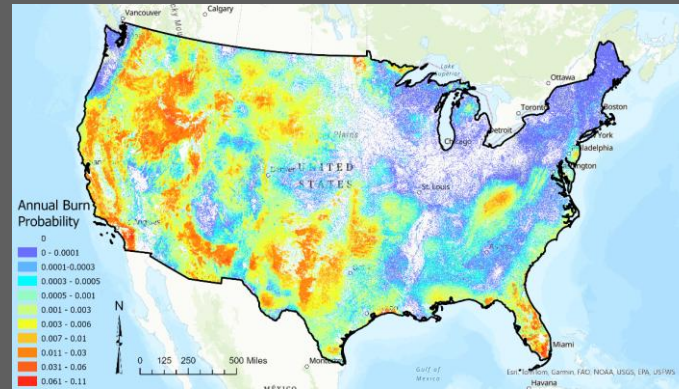


Bringing together the datasets

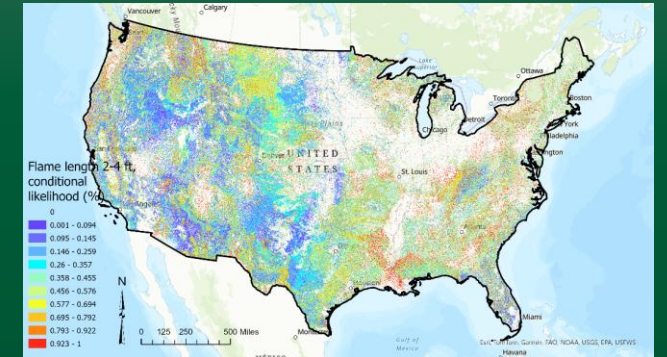
Baseline carbon from TreeMap & FuelMap in forested pixels, as modeled in FFE-FVS



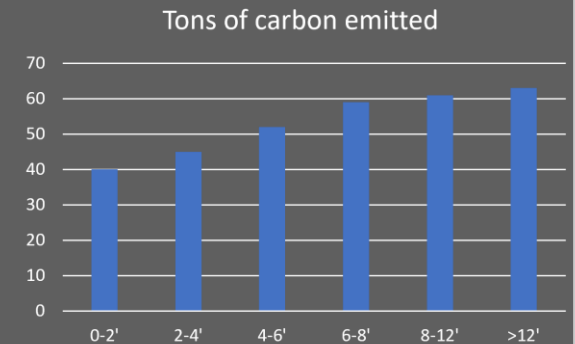
Likelihood: Annual burn probability from FSim



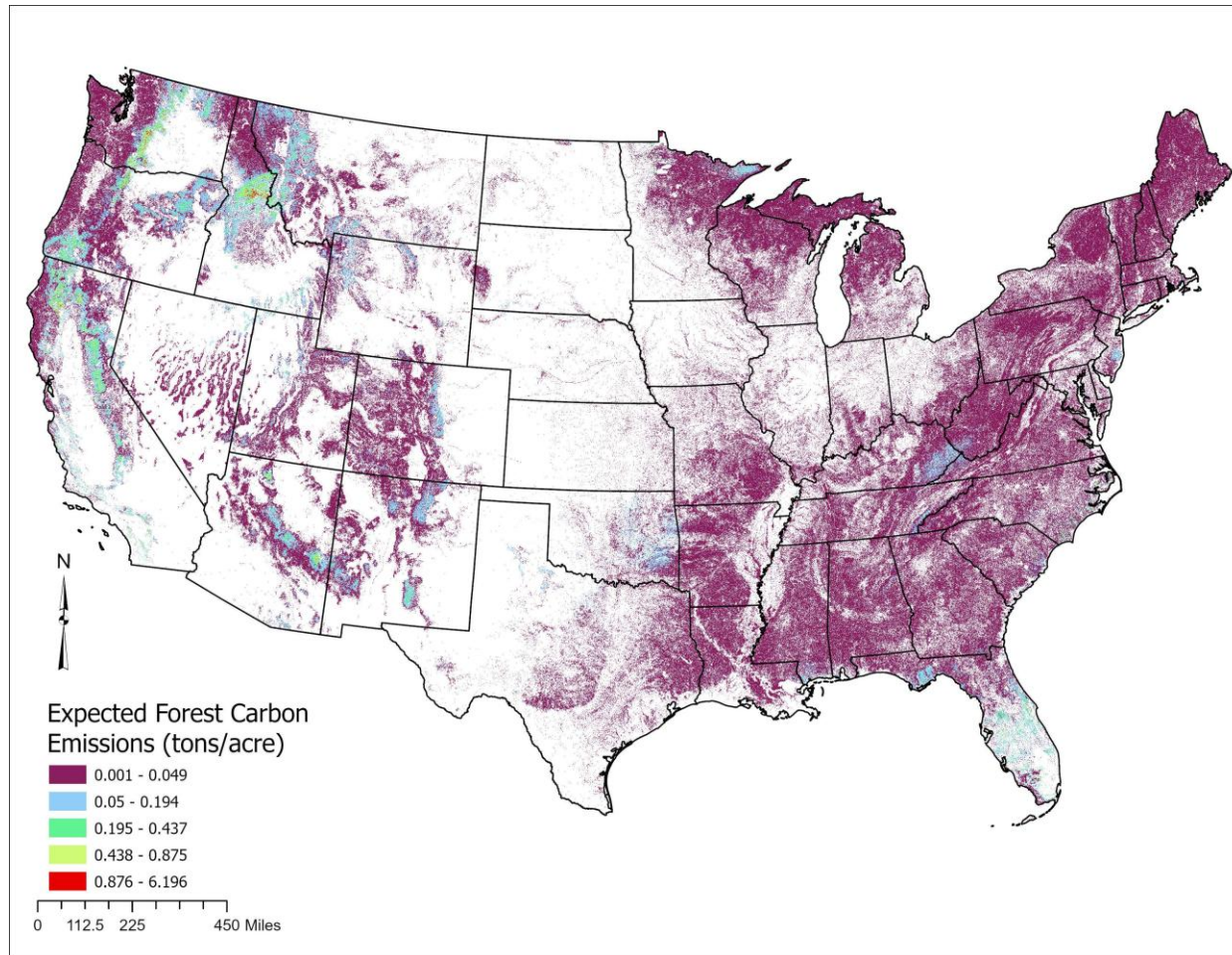
Intensity: Flame length probability from FSim (6 rasters)



Susceptibility: TreeMap carbon emitted under fires of six different intensities in forests using FVS-FFE



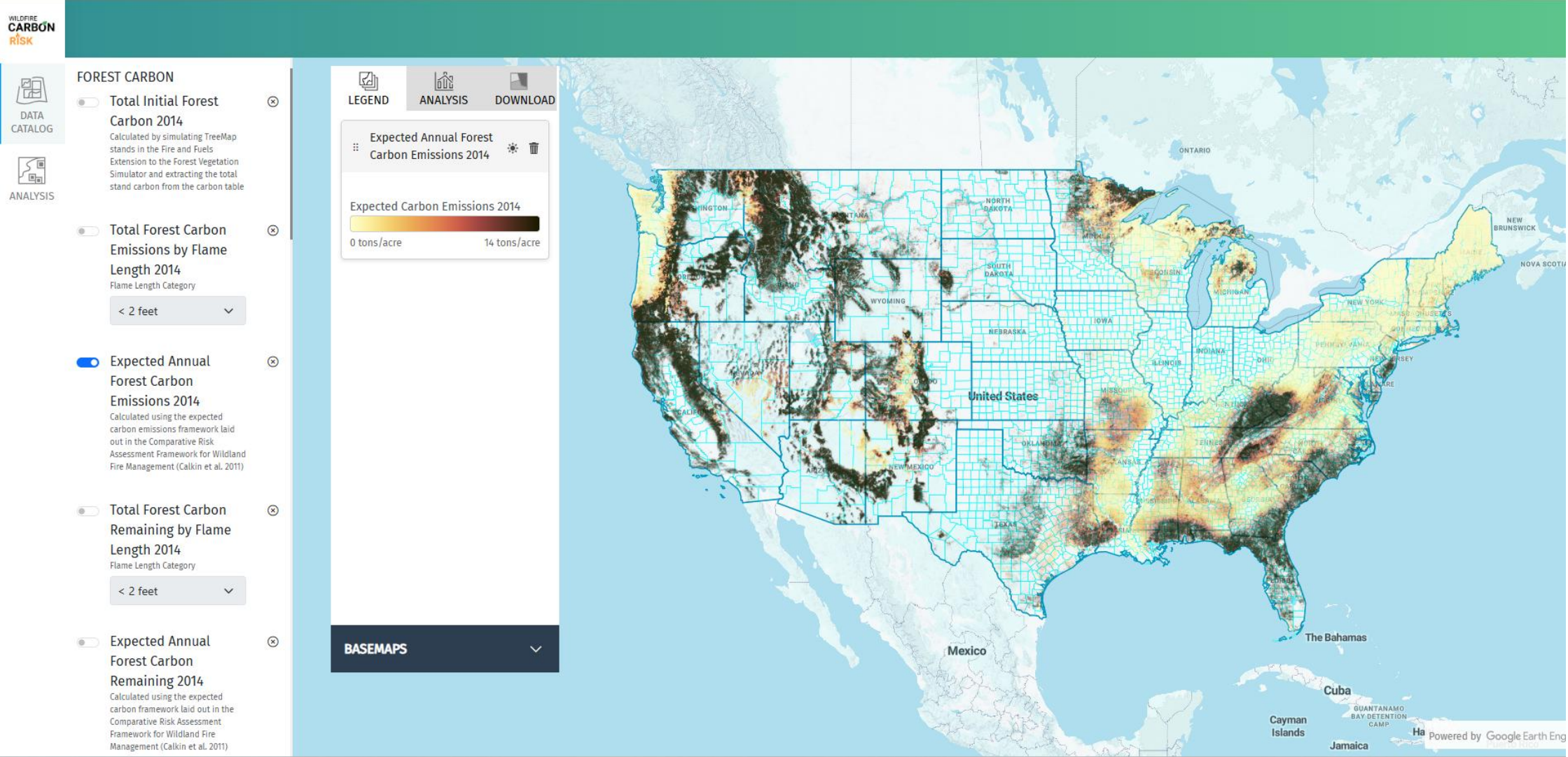
Actuarial risk calculation: Expected emissions: annual emissions given probability of burning



$$E(C_s) = \sum_{n=1}^j p(f_i)RF_c(f_i)$$

- $E(C_s)$ = expected carbon emissions
- f_i = flame length categories 0' (no fire), 2', 4', 6', 8', 10', and 20' (six flame length categories)
- $P(f_i)$ = probability of a fire of flame length category i
- RF_c = amount of carbon predicted to be emitted in a fire of intensity level i
- j = number of pixels in landscape

Wildfire risk to carbon dashboard



Thank you and questions

The screenshot shows the USDA Forest Service website. At the top, there is a navigation bar with the USDA and Forest Service logos, the text 'Forest Service U.S. DEPARTMENT OF AGRICULTURE', and a 'RESEARCH & DEVELOPMENT' section with links for 'Forest Service Home', 'Inside the Forest Service', and 'About the Agency'. Below this is a dark green header for the 'Missoula Fire Sciences Laboratory' with a search bar and a menu. The main content area features a sidebar with 'Data and Tools', 'Publications', 'Articles', 'Multimedia', and 'Seminar Series'. The main article is titled 'TreeMap: A tree-level model of United States forests' with a release date of August 26, 2021. The article text describes a machine learning model for pairing forest plot data with landscape characteristics to create a seamless tree-level forest map. It details the dataset's spatial model, resolution, and the data sources used, including the Forest Inventory and Analysis (FIA) and the LANDFIRE project. A final paragraph explains the machine learning process of matching forest plot data to gridded vegetation maps to produce a seamless model of the trees of the forests of the US.

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Accessing TreeMap: Full Raster Datasets

TreeMap 2009 (western states only)

Riley, Karin L.; Grenfell, Isaac C.; Finney, Mark A.; Wiener, Jason M. 2018. Fire Lab tree list: A tree-level model of the western US circa 2009 v1. Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2018-0003>

Riley, Karin L.; Grenfell, Isaac C.; Finney, Mark A. 2016. Mapping forest vegetation for the western United States using modified random forests imputation of FIA forest plots. *Ecosphere*. 7(10): e01472.

TreeMap 2014

Riley, Karin L.; Grenfell, Isaac C.; Finney, Mark A.; Wiener, Jason M.; Houtman, Rachel M. 2019. Fire Lab tree list: A tree-level model of the conterminous United States landscape circa 2014. Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2019-0026>

Riley, Karin L.; Grenfell, Isaac C.; Finney, Mark A.; Wiener, Jason M. 2021. TreeMap, a tree-level model of conterminous US forests circa 2014 produced by imputation of FIA plot data. *Scientific Data*. 8: 11.

TreeMap 2016

Riley, Karin L.; Grenfell, Isaac C.; Finney, Mark A.; Shaw, John D. 2021. TreeMap 2016: A tree-level model of the forests of the conterminous United States circa 2016. Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2021-0074>

Riley, Karin L.; Grenfell, Isaac C.; Shaw, John D.; Finney, Mark A. 2022. TreeMap 2016 dataset generates CONUS-wide maps of forest characteristics including live basal area, aboveground carbon, and number of trees per acre. *Journal of Forestry*. 2022: 607-632.

TreeMap 2020

Zimmer, Scott N.; Houtman, Rachel M.; Leatherman, Lila S. T.; Housman, Ian W.; Shrestha, Abhinav; Shaw, John D.; Riley, Karin L. 2025. TreeMap 2020 CONUS: A tree-level model of the forests of the conterminous United States circa 2020. Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2025-0031>

TreeMap 2022

Houtman, Rachel M.; Leatherman, Lila S. T.; Zimmer, Scott N.; Housman, Ian W.; Shrestha, Abhinav; Shaw, John D.; Riley, Karin L. 2025. TreeMap 2022 CONUS: A tree-level model of the forests of the conterminous United States circa 2022. Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2025-0032>

Accessing TreeMap: Raster Data Gateway



The screenshot shows the USDA Forest Service FSGeodata Clearinghouse website. The header includes the USDA logo, "United States Department of Agriculture Forest Service", and "FSGeodata Clearinghouse" with the UAS logo. A navigation bar contains "Clearinghouse Home", "Help", and "Contact Us". A left sidebar lists categories: "Enterprise Data" (Downloadable Data, Geospatial Data Discovery Tool, Data.gov Open Data, Map Services), "Maps" (FSTopo, Standard Map Products, Other Map Products), and "Raster Data" (FIA BIGMAP, Caribbean Island Land Cover, Chugach Updates, Forest Biomass, Hazards/Disasters, Landscape Change Monitoring System, National Forest Type, Rangelands). The main content area features a "TreeMap" heading, a "Purpose:" section with two paragraphs of text, and a "Data Availability:" section.

USDA United States Department of Agriculture
Forest Service

FSGeodata Clearinghouse

Clearinghouse Home Help Contact Us

Enterprise Data

- Downloadable Data
- Geospatial Data Discovery Tool
- Data.gov Open Data
- Map Services

Maps

- FSTopo
- Standard Map Products
- Other Map Products

Raster Data

- FIA BIGMAP
- Caribbean Island Land Cover
- Chugach Updates
- Forest Biomass
- Hazards/Disasters
- Landscape Change Monitoring System
- National Forest Type
- Rangelands

TreeMap

Purpose:

Geospatial data describing tree species or forest structure are required for many analyses and models of forest landscape dynamics. Forest data must have resolution and continuity sufficient to reflect site gradients in mountainous terrain and stand boundaries imposed by historical events, such as wildland fire and timber harvest. The TreeMap 2014 dataset (Riley et al. 2019) was the first of its kind to provide such detailed forest structure data across the forests of the conterminous United States. Prior to the TreeMap 2014 imputed forest data, assessments relied largely on forest inventory at fixed plot locations at sparse densities. The TreeMap 2016 dataset (Riley et al. 2021, Riley et al. 2022) updated the 2014 version to include disturbance as a response variable, which improved accuracy in disturbed areas.

The TreeMap 2020 and 2022 CONUS datasets update the TreeMap 2016 dataset to landscape conditions circa 2020 and 2022 respectively and updates the methods by 1) using a different suite of climate variables in the imputation and 2) improving species composition assignments to prevent plots being imputed to areas where their existing vegetation type was not present, an issue which affected a small number of pixels in previous TreeMap versions.

TreeMap is being used in both the private and public sectors for projects including fuel treatment planning, snag hazard mapping, and estimation of terrestrial carbon resources.

Data Availability:

<https://data.fs.usda.gov/geodata/rastergateway/treemap/index.php>

Accessing TreeMap: The TreeMap Explorer

The screenshot displays the TreeMap Explorer interface. On the left, the 'PARAMETERS' section shows 'TreeMap Year Selection' with radio buttons for 2016 (selected), 2020, and 2022, and a 'Submit' button. Below it, the 'TreeMap DATA' section lists various data layers with checkboxes and sliders, including 'TreeMap ID', 'ALSTK: All-Live-Tree Stocking (percent)', 'BALIVE: Live Tree Basal Area (ft²)', 'CANOPYPCT: Live Canopy Cover (percent)', 'CARBON_D: Carbon, Standing Dead (tons/acre)', 'CARBON_DWN: Carbon, Down Dead (tons/acre)', 'CARBON_L: Carbon, Live Above Ground (tons/acre)', 'DRYBIO_D: Dry Standing Dead Tree Biomass, Above Ground (tons/acre)', 'DRYBIO_L: Dry Live Tree Biomass, Above Ground (tons/acre)', 'FLDSZCD: Field Stand-Size Class Code', 'FLDTYPCD: Field Forest Type Code' (selected), 'FORTYPCD: Algorithm Forest Type Code', 'GSSTK: Growing-Stock Stocking (percent)', and 'QMD_RMRS: Stand Quadratic Mean Diameter'. The main map area shows a forest with a color-coded overlay representing different tree species. A legend on the right, titled 'FLDTYPCD: Field Forest Type Code', lists 20 species with corresponding color swatches: Jack pine, Red pine, Eastern white pine, Eastern white pine / eastern hemlock, Eastern hemlock, Balsam fir, White spruce, Red spruce, Red spruce / balsam fir, Black spruce, Tamarack, Northern white-cedar, Fraser fir, Longleaf pine, Slash pine, Loblolly pine, Shortleaf pine, Virginia pine, Sand pine, Table Mountain pine, Pond pine, Pitch pine, and Eastern redcedar. The map also shows roads (126, 20), 'First Creek', 'Wilderness', 'Santiam Pass Ski Lodge', and 'Santiam Snow Park'. The bottom status bar shows 'Active tools: Pixel Tools-Query Visible Map Layers', 'Number of map layers loading: 0', 'Lng: -121.8427, Lat: 44.4397, Elevation: 1090(m), 3576(ft), Zoom: 14, 1:72,224', and links for 'Privacy Policy', 'Accessibility Statement', and 'Disclaimers'.

<https://apps.fs.usda.gov/lcms-viewer/treemap.html>

Accessing FuelMap: Full Raster Datasets

FuelMap 2014

Riley, Karin L.; Grenfell, Isaac C.; Shaw, John D. 2023. FuelMap 2014: Imputed map of carbon stored in litter, duff, fine woody debris, and coarse woody debris for CONUS forests circa 2014. Updated 30 August 2024. Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2023-0042>

FuelMap 2020 and 2022

Zimmer, Scott N.; Riley, Karin L.; Grenfell, Isaac C.; Shaw, John D. 2026. FuelMap 2020 and 2022: Imputed map of carbon stored in litter, duff, fine woody debris, and coarse woody debris for CONUS forests circa 2020 and 2022. Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2026-0016>

Accessing Wildfire Risk to Carbon Datasets

Risk to Forest Carbon 2014

Houtman, Rachel M.; Riley, Karin L.; Finney, Mark A.; Ager, Alan A. 2026. Spatial datasets of wildfire risk to forest carbon for the conterminous United States (30m) circa 2014 landscapes. Fort Collins, CO: Forest Service Research Data Archive.

<https://doi.org/10.2737/RDS-2026-0014>

Risk to Rangeland Carbon 2014 and 2020 (related dataset)

Zimmer, Scott N.; Riley, Karin L.; Reeves, Matthew C; Urbanski, Shawn P. 2026. Spatial datasets of wildfire risk to rangeland carbon for the conterminous United States (30m) circa 2014 and 2020 landscapes. Fort Collins, CO: Forest Service Research Data Archive.

<https://doi.org/10.2737/RDS-2026-0015>

Wildfire Risk to Carbon Dashboard provides users access to visualize and summarize subsets of the 2014 data here: <https://app.wildfireriskcarbon.org/home/>

Additional Citations

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Thornton, P. E., R. Shrestha, M. Thornton, S.-C. Kao, Y. Wei, and B. E. Wilson. 2021. Gridded daily weather data for North America with comprehensive uncertainty quantification. Scientific Data 8. <https://doi.org/10.1038/s41597-021-00973-0>

Thornton, P.E., Running, S.W., White, M.A. 1997. Generating surfaces of daily meteorological variables over large regions of complex terrain. Journal of Hydrology 190: 214 - 251. [https://doi.org/10.1016/S0022-1694\(96\)03128-9](https://doi.org/10.1016/S0022-1694(96)03128-9)