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Rocky Mountain Research Station

Science You Can Use *(in 5 minutes)*

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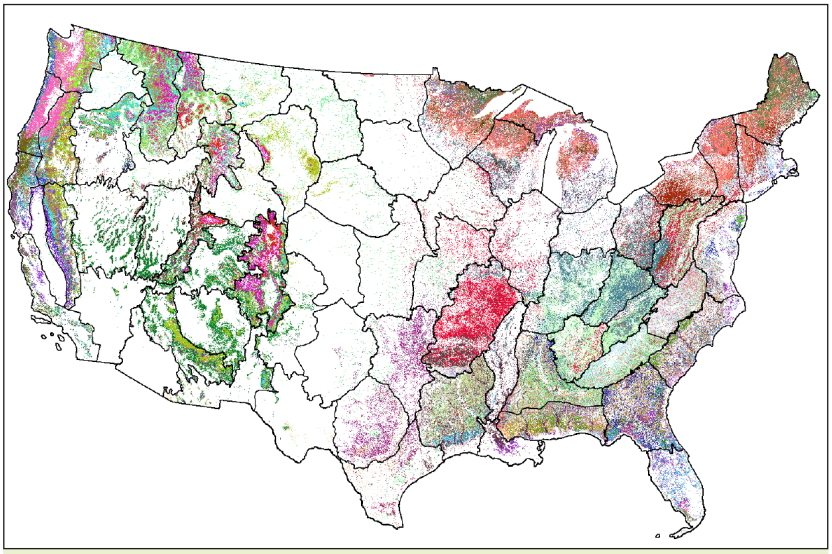
Seeing the forest AND the trees: TreeMap provides a tree-level forest model

A decade ago, Rocky Mountain Research Station scientists Karin Riley, Isaac Grenfell, and Mark Finney were stuck on a tough problem – understanding the risks wildfire posed to carbon stored in forests. They had a good grasp of the fire side of the equation, but the carbon side was tougher. To figure it out, they needed a dataset describing U.S. forests at the individual tree level.

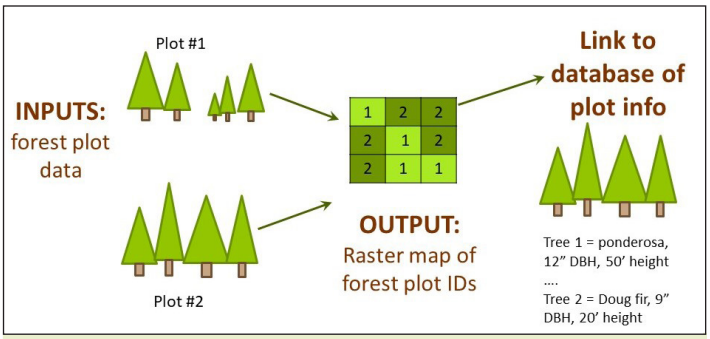
Creating that dataset was a daunting task. But with some out-of-the box thinking, the scientists developed TreeMap – essentially a tree-level map of the forests of the conterminous United States. Despite the specific purpose it was developed for, TreeMap has broad management applications, from inventorying wildlife habitat to assessing snag hazards.

In a recent publication, the scientists describe how they paired two databases to develop TreeMap. The Forest Inventory and Analysis (FIA) database contains tree-level information from thousands of plots across the United States, but the plots don't provide wall-to-wall coverage. The LANDFIRE project provides a 30x30 meter grid of geospatial information like vegetation type and disturbance history for the entire United States, but it lacks information at the tree level. To pair the advantages of both databases, Riley and colleagues used an artificial intelligence approach appropriately called Random Forest. This technique essentially matches each LANDFIRE pixel with an FIA plot based on characteristics like topography, vegetation, recent disturbance, and climate for the year 2014. For any 30x30-meter pixel, a TreeMap user can pull tree-level information from FIA that is expected to be representative of that area. Users can then produce maps of those attributes, like tree density, heights, and species.

The FIA program is not only a source of data used in the development of TreeMap, it is also a likely user of TreeMap. Because of the unique way that TreeMap and FIA data are linked, many possible applications of the data are being explored by FIA analysts. The TreeMap team is actively collaborating with FIA Research Forester John Shaw on new applications, for example, generating national maps of forest



The TreeMap team used 30x30 meter pixels from the LANDFIRE database as the foundation for their analysis. LANDFIRE zones are shown here outlined in black, with forested pixels in colors indicating their vegetation class. Non-forested pixels are shown in white.



TreeMap links each forested pixel from LANDFIRE to a specific FIA plot that is expected to be representative of that area. Those plot IDs can then be used to pull tree-level information from FIA, like tree density, heights, and species.

type. TreeMap is already being used by land managers to inventory wildlife habitat and map forest types at fine spatial resolution. It can also help evaluate how proposed management actions may affect carbon stocks and local hydrology.

TreeMap also has immediate utility for fire managers. RMRS ecologist Jessica Haas and colleagues have used it to provide snag hazard maps for active fire incidents through the Risk Management Assistance dashboard. Snags are one of the most common causes of firefighter casualties, and these maps provide incident response teams a quick picture of what conditions to expect on the ground and identify hazardous areas, helping improve firefighter safety.

KEY MANAGEMENT CONSIDERATIONS

- TreeMap is a new tree-level model of U.S. forests developed to support analysis of wildfire risk to carbon. It has a range of other management applications, from inventorying wildlife habitat to modeling the impacts of fuel treatments.
- For any 30x30 meter pixel in the conterminous United States, a user can pull tree-level information from FIA that is expected to be representative of that area and map attributes like tree heights and species.
- TreeMap is also supporting new analyses of snag hazards for active fire incidents.

RMRS research ecologist Kit O'Connor is now working with the Forest Service Pacific Southwest Region's Remote Sensing Lab to augment this analysis by combining TreeMap's information on trees in a given area with a remote sensing-derived index of cumulative forest mortality caused by, for example, drought or insect outbreaks.

"It's so satisfying to see the TreeMap helping land managers and researchers with real-world problems, like making decisions about locating fuel treatments, assessing habitat, and protecting firefighters," said Riley.

What's next for the TreeMap team? First, they have plans to map fuels across the United States. Then, they plan to get back to the question they started with – understanding wildfire risks to carbon stocks now and into the future.

PROJECT LEAD

Karin Riley is a Research Ecologist with the Rocky Mountain Research Station in Missoula, Montana. Her research focuses on better understanding the relationship between climate and wildfire and how spatial planning can be utilized to inform fire and landscape management options.

FURTHER READING

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. *Nature Scientific Data*.

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.

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.

The Rocky Mountain Research Station is one of seven units within USDA Forest Service Research & Development. RMRS maintains 14 field laboratories throughout a 12-state geography encompassing parts of the Great Basin, Southwest, Rocky Mountains, and the Great Plains. While anchored in the geography of the West, our research is global in scale. RMRS also administers and conducts research on 14 experimental forests, ranges and watersheds and maintains long-term research databases for these areas. Our science improves lives and landscapes. More information about Forest Service research in the Rocky Mountain Region can be found here: https://www.fs.usda.gov/rmrs/.