Intersecting fire, insect, and drought disturbance and the fate of western US forests in a changing climate

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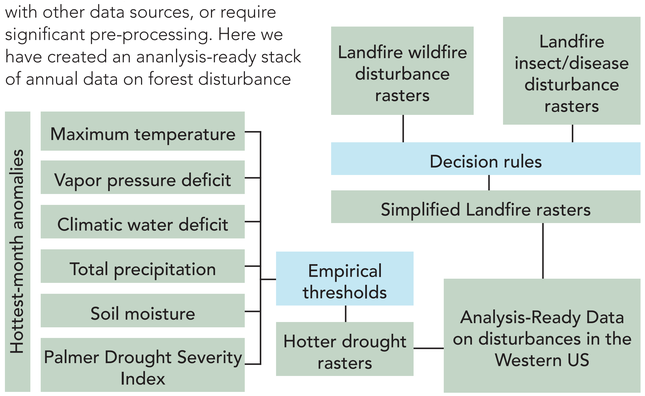
Analysis-Ready disturbance data

Interactions between multiple temporally- or spatially-overlapping disturbances affect both ecosystem resilience and resistance.[1,2,3] Investigating the impacts of interacting disturbances on forested ecosystems requires analysis-ready and well-defined data, but relevant observational datasets are often spatially incomplete, are incompatible with other data sources, or require significant pre-processing. Here we have created an ananlysis-ready stack of annual data on forest disturbance agents in the Western United States from 1999 - 2000. This stack was created from a) pre-processed Landfire[4] annual disturbance data that were then categorized by a set of decision rules, and, b) a hotter drought layer derived from TerraClimate[5] monthly data and defined according to empirical thresholds determined by Hammond et al. 2022.[6]



Analysis-Ready Data enables collaborative synthesis

Providing open access to a portion of the dataset described here at a recent working group demonstrated that access to large-scale, analysis-ready data enables creative collaborative data synthesis in the fields of macrosystems ecology and forest resilience.

In February of 2023 a group of 32 scientists and forest managers came together at the University of Colorado at Boulder for the Forest Resiliency Data Synthesis Working Group. The event's objectives included improving participants' data skills, providing training in data- and compute-intensive workflows, and promoting synthesis science capabilities and data-driven inquiry.

"We went from conceptual ideas to tangible workflows and even a big data-derived product within a day."

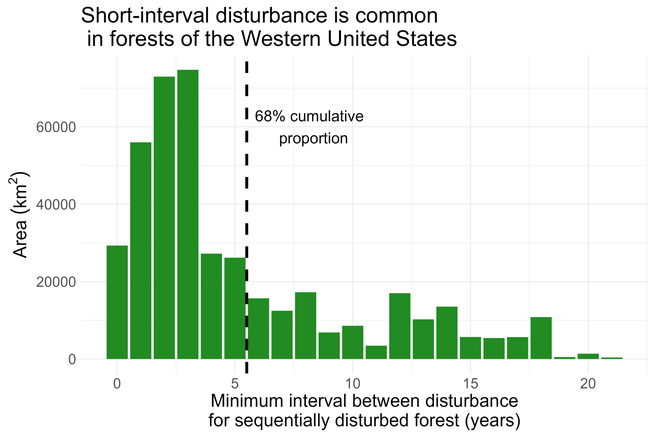
-Anonymous participant

The working group leveraged resources that included an easy-access cyberinfrastructure architecture and a library of analysis-ready data–including a portion of the dataset described here—to enhance accessibility and collaborative synthesis. Multiple synthesis groups used the provided stack of well-defined disturbances to approach problems that would have otherwise been time- or effort-prohibitive within the bounds of the event.

Sequences of overlapping, short-interval disturbances are common in the Western United States

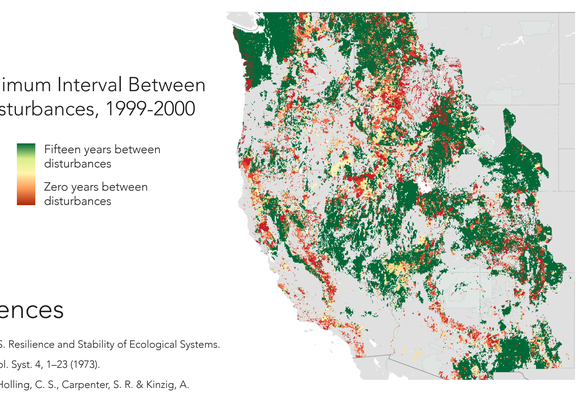
Hotter drought, wildfire, and insect or disease disturbance in the Western United States from 1999-2020 for all ecosystem types

Sequences of disturbances in forested ecosystems often occur over short intervals



We identified 801,729.3 km² of potential forest in the western U.S. based on Landfire biophysical settings. Of that area, over half (52.55%; 421,335.6 km²) was impacted by at least one fire, insect/disease, or hotter drought over the 1999 to 2020 period. Over the same time period, 3.96% of the area (31,754.2 km²) was impacted by at least one fire or insect/disease disturbance.

We find that 68% of potential forest areas in the Western United states that saw sequential disturbance experienced those effects within a 5-year interval. 25.18% of potential forest area in the Western United States (201,863.7 km²) was impacted by at least one short-interval multidisturbance between 1999 and 2020, defined as when more than one fire, insect/disease event, or hotter drought occur within the span of 5 years). 1.41% of the area (11,294.6 km²) was impacted by at least one short-interval multidisturbance of fire and/or insect/disease.



References

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