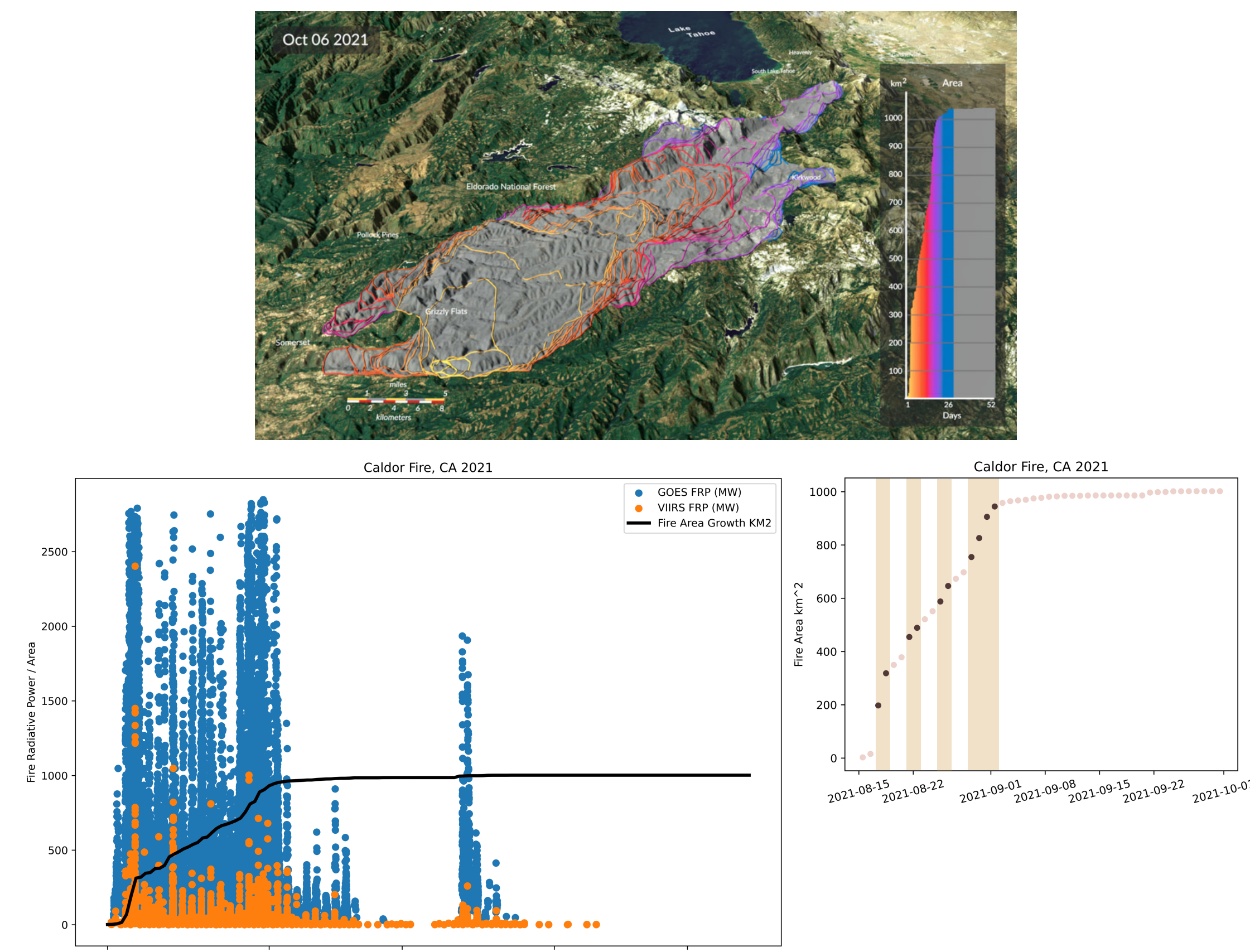


What drives periods of rapid wildfire spread?

Tempest McCabe^{1,2}, Eli Orland^{3,2}, Robert Field, Shane Coffield, Alexey Shikmonov, Yang Chen, James T Randerson, Melanie Follette Cook, Douglas Morton

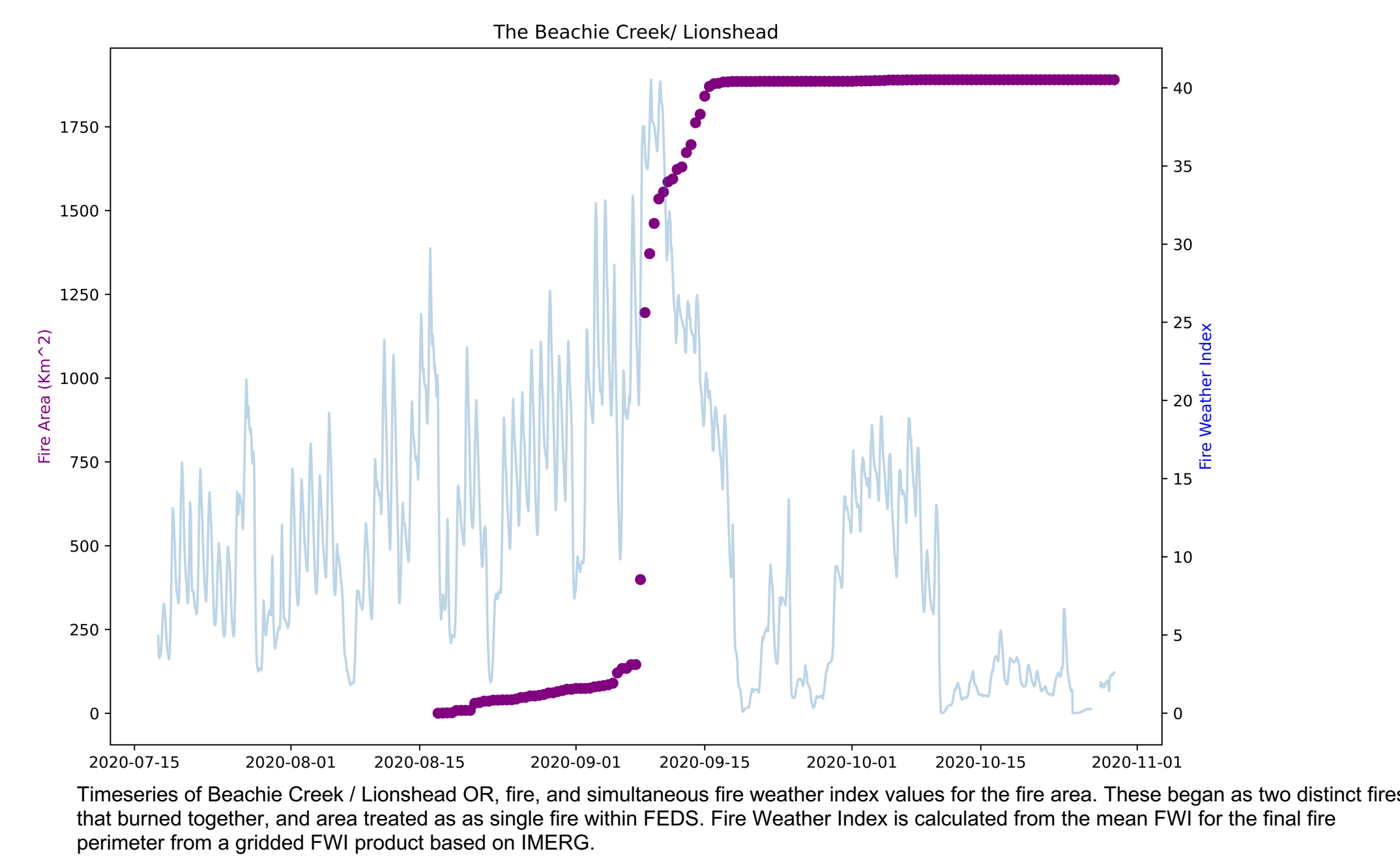
¹Earth System Science Interdisciplinary Center, University of Maryland; ²Biosphere Sciences Laboratory NASA Goddard Space Flight Center; ³GESTAR II, University of Maryland Baltimore College; ⁴NASA Goddard Institute for Space Studies; ⁵Earth System Science, University of California, Irvine;

Motivation



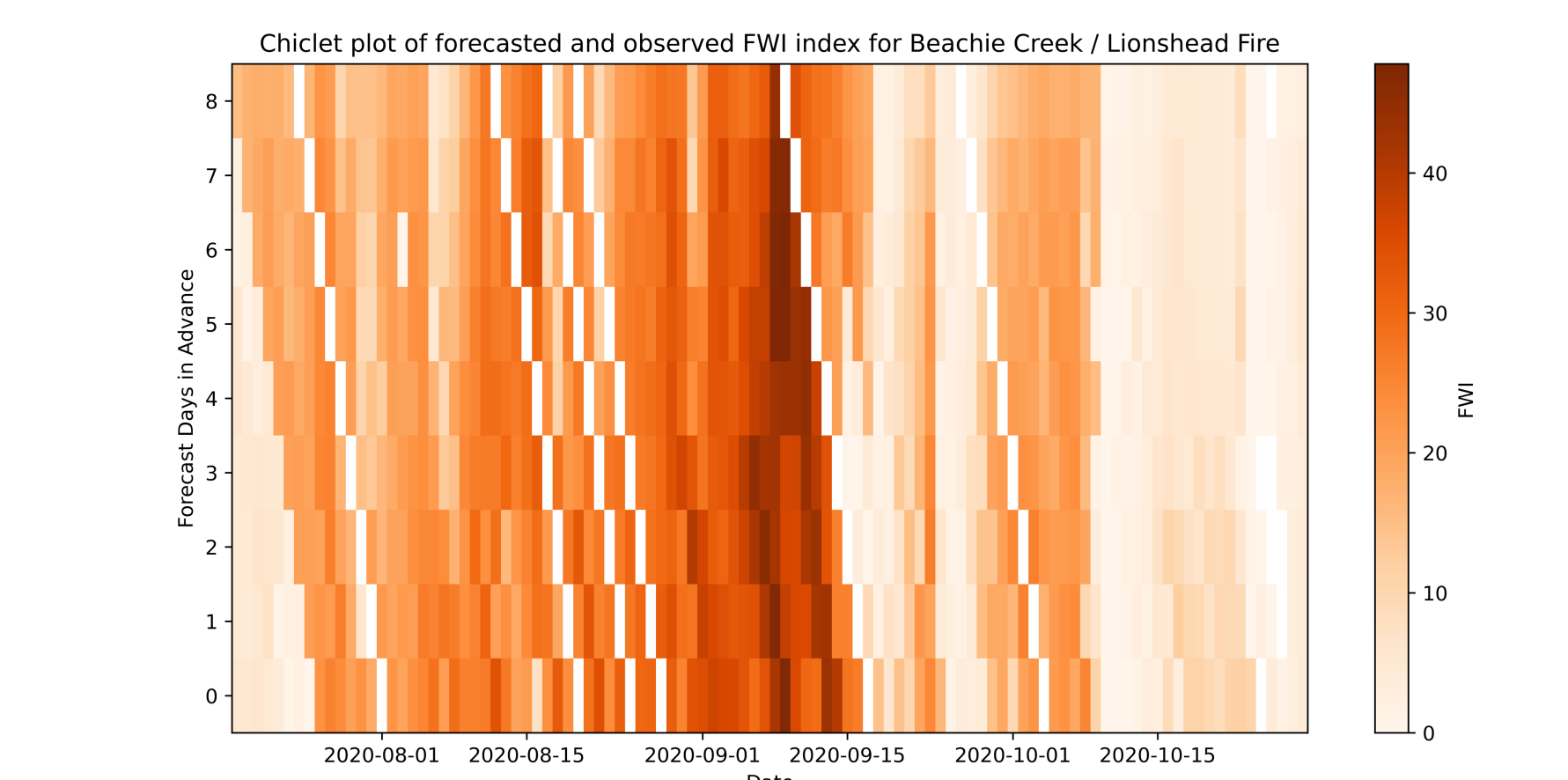
Top: FEDs Algorithm fire perimeters of Caldor fire estimated from VIIRS sensor observations taken twice daily. Perimeter colors map onto fire area timeseries insert. Lower left: Fire radiative power estimated by VIIRS sensor, GEOS sensor, and the FEDs-estimated fire area. Lower right: Periods of rapid fire spread over the lifetime of the Caldor fire.

Fires experience episodic spread.



Timeseries of Beachie Creek / Lionshead OR, fire, and simultaneous fire weather index values for the fire area. These began as two distinct fires that burned together, and area treated as single fire within FEDs. Fire Weather Index is calculated from the mean FWI for the final fire perimeter from a gridded FWI product based on IMERG.

Weather conditions may be what differed between “spread days” and “stay days”.



Fire Weather Index (FWI) forecasted and observed. 0-4th day axis corresponds to the FWI timeseries in the figure above.

If we knew the weather conditions that drive spread days, we could forecast rapid fire spread

Methods

1) Construct ~12 hour fire perimeters for western us.

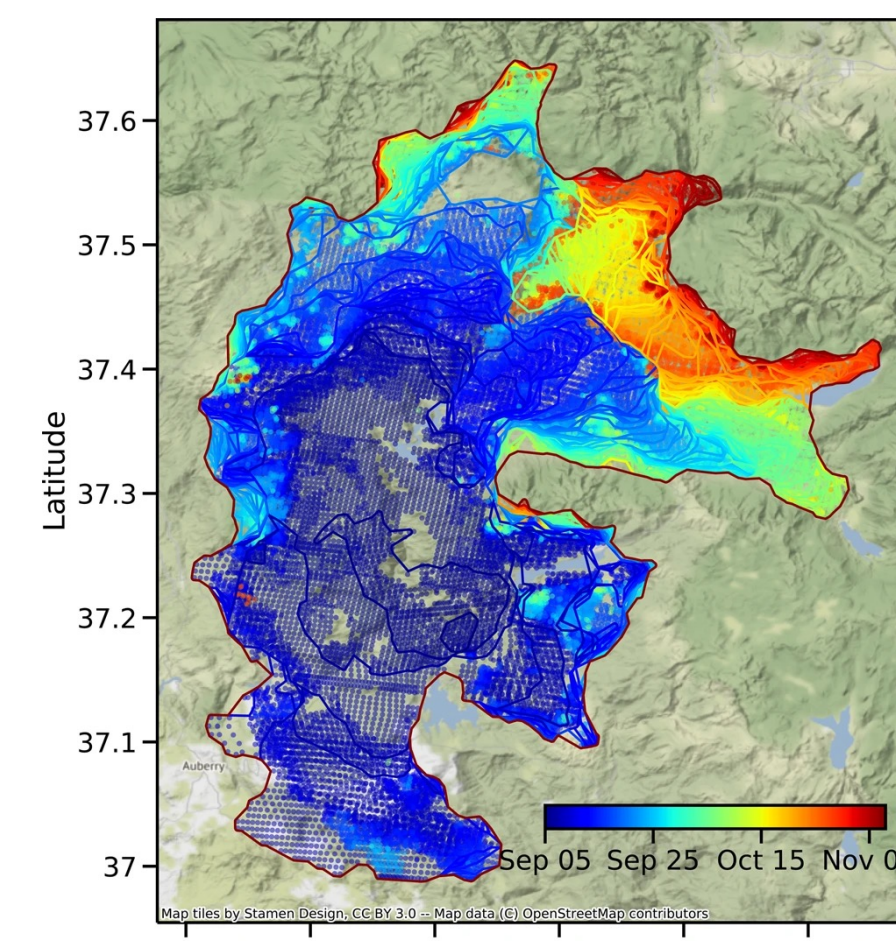
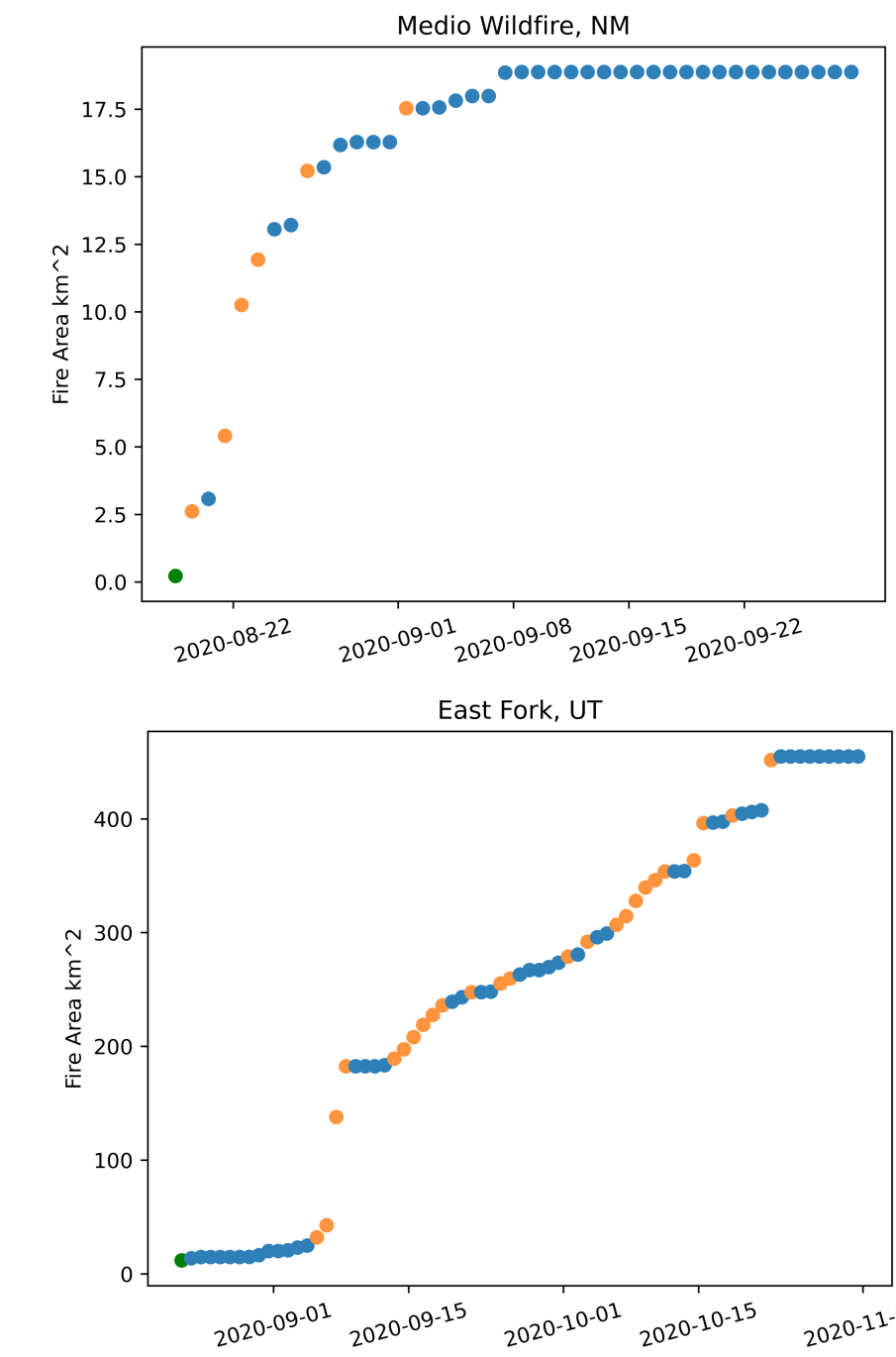


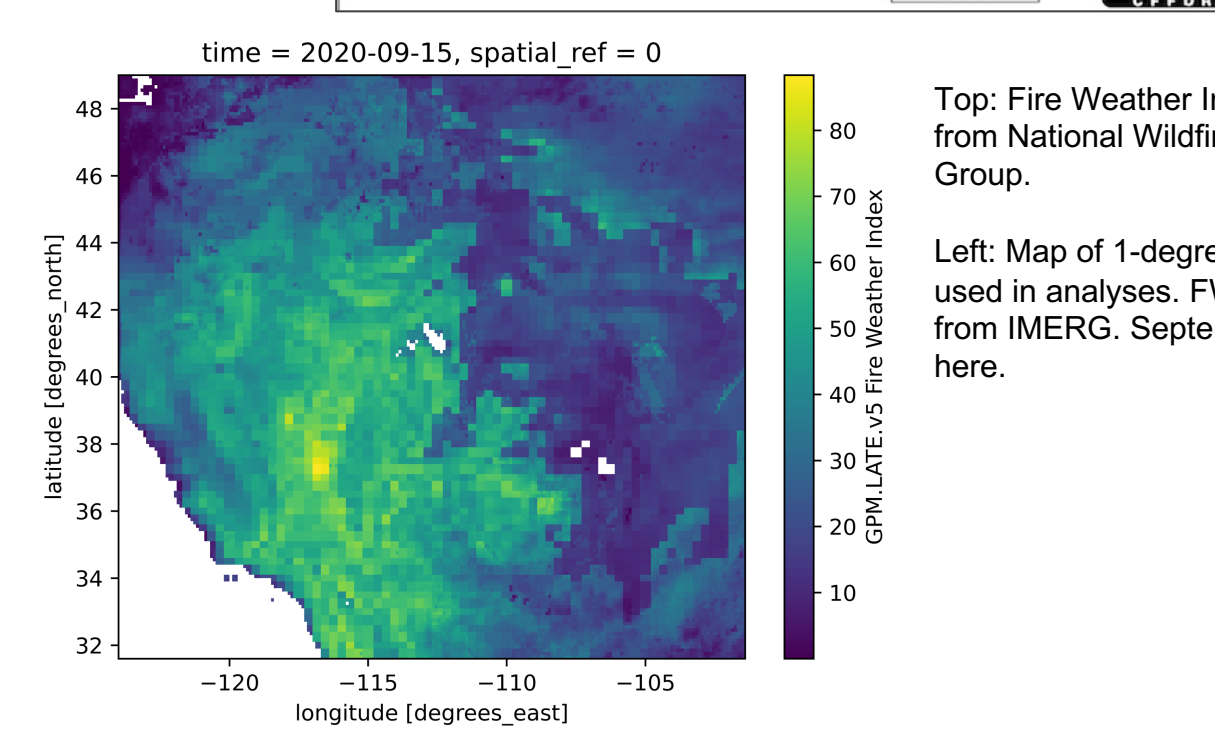
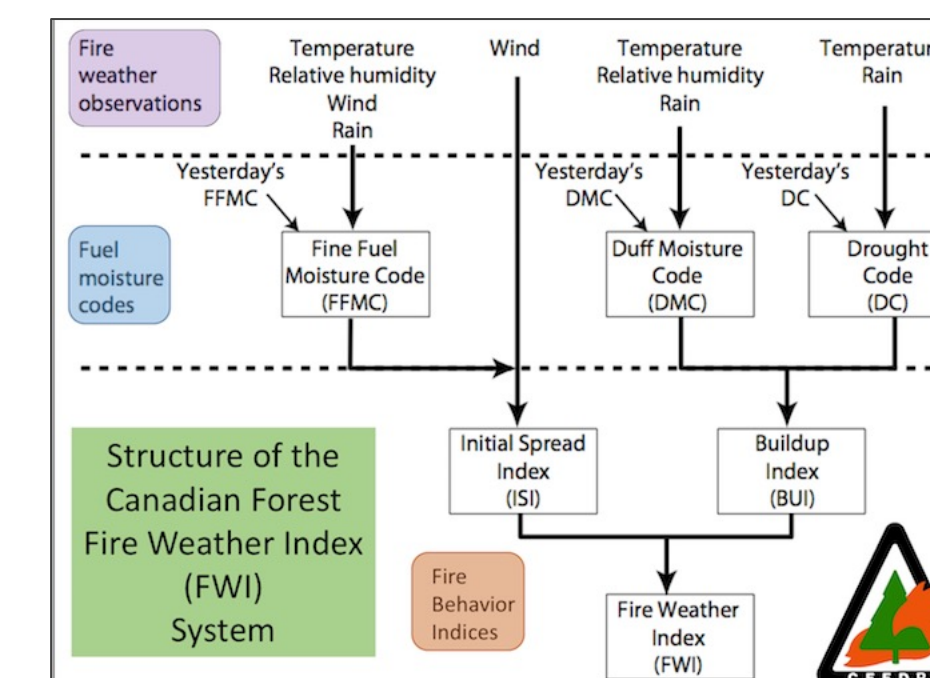
Figure from: Chen, et al. (2022). California wildfire spread derived using VIIRS satellite observations and an object-based tracking system. Example of the FEDs algorithm.

2) Identify periods of ignition and rapid spread.



Two sample fires with periods of rapid spread and ignition colored. Ignitions are green circles, periods of rapid spread are orange. Rapid spread calculated as 20% of the largest difference between two points.

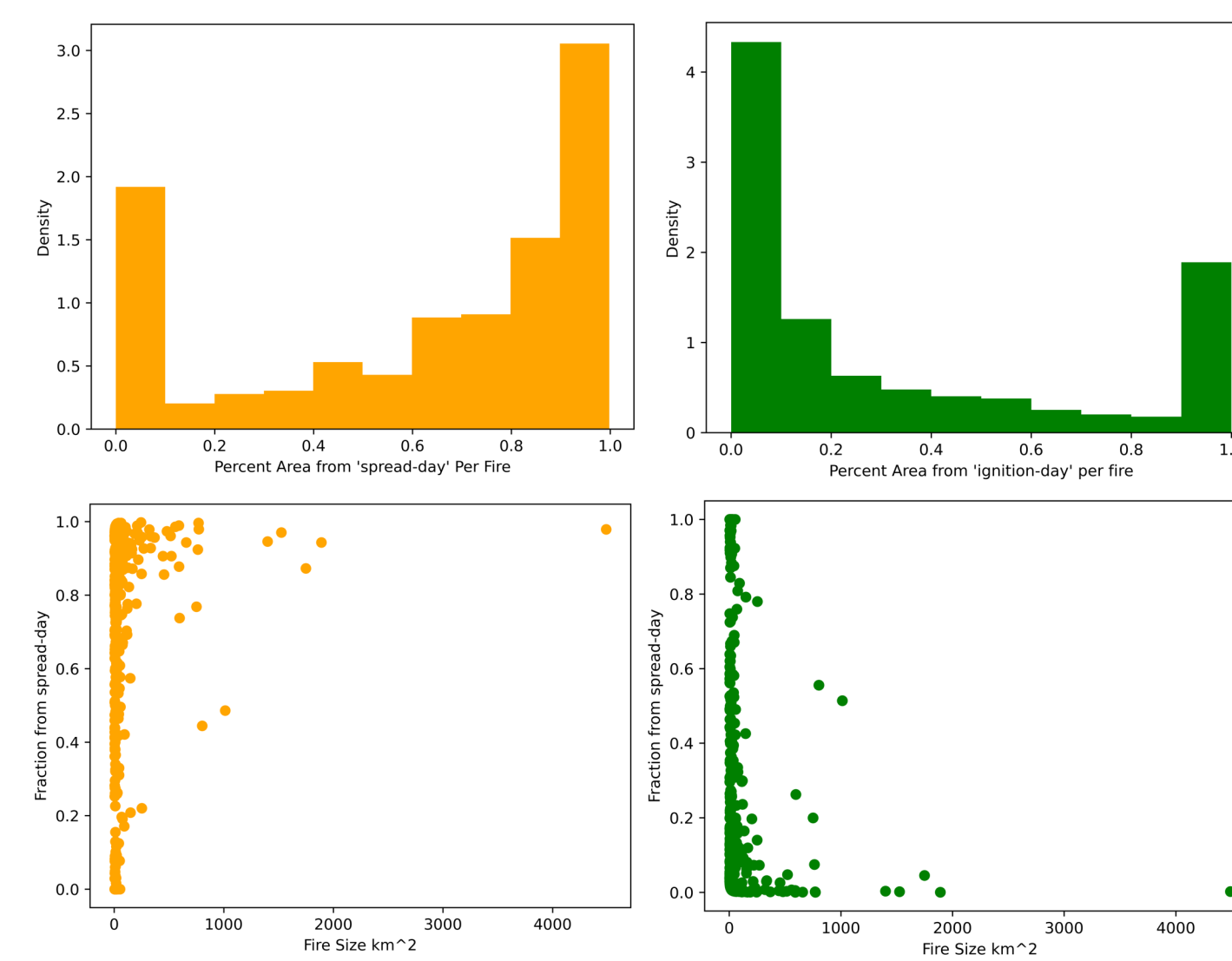
3) Connect to climate metric.



Top: Fire Weather Index explanation from National Wildfire Coordinating Group. Left: Map of 1-degree FWI product used in analyses. FWI calculated from IMERG. September 15th shown here.

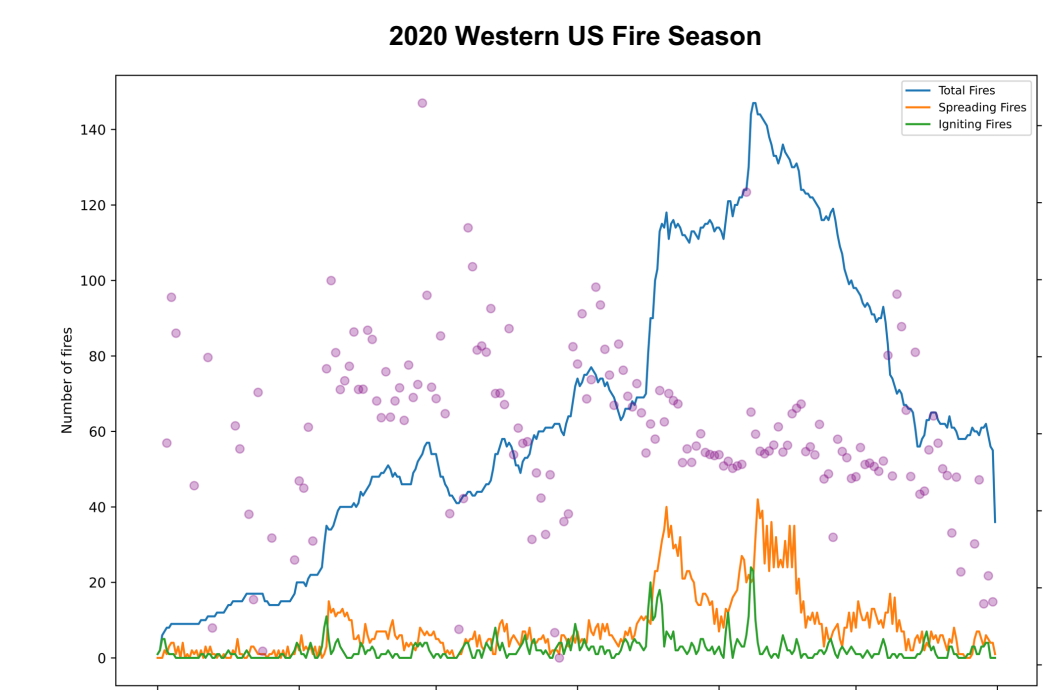
Results

“Spread days” account for 84% of total fire area in 2020 fire season.



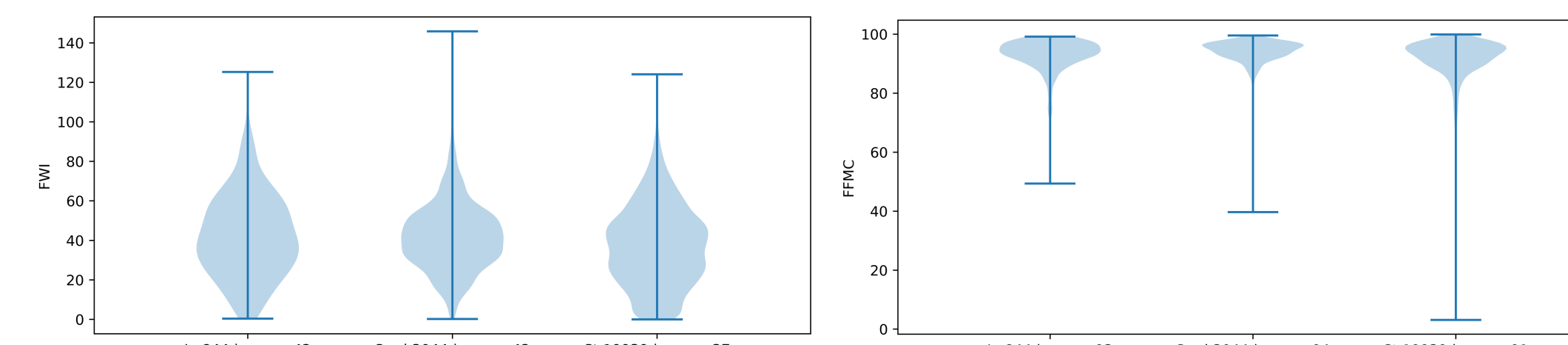
Total Area from spread-days: 84%
Total area from ignitions: 12%
Average area from spread per fire : 62%

Top: Distribution of area contributions from spread-days and from ignitions. Bottom: The same fractions plotted by fire size.



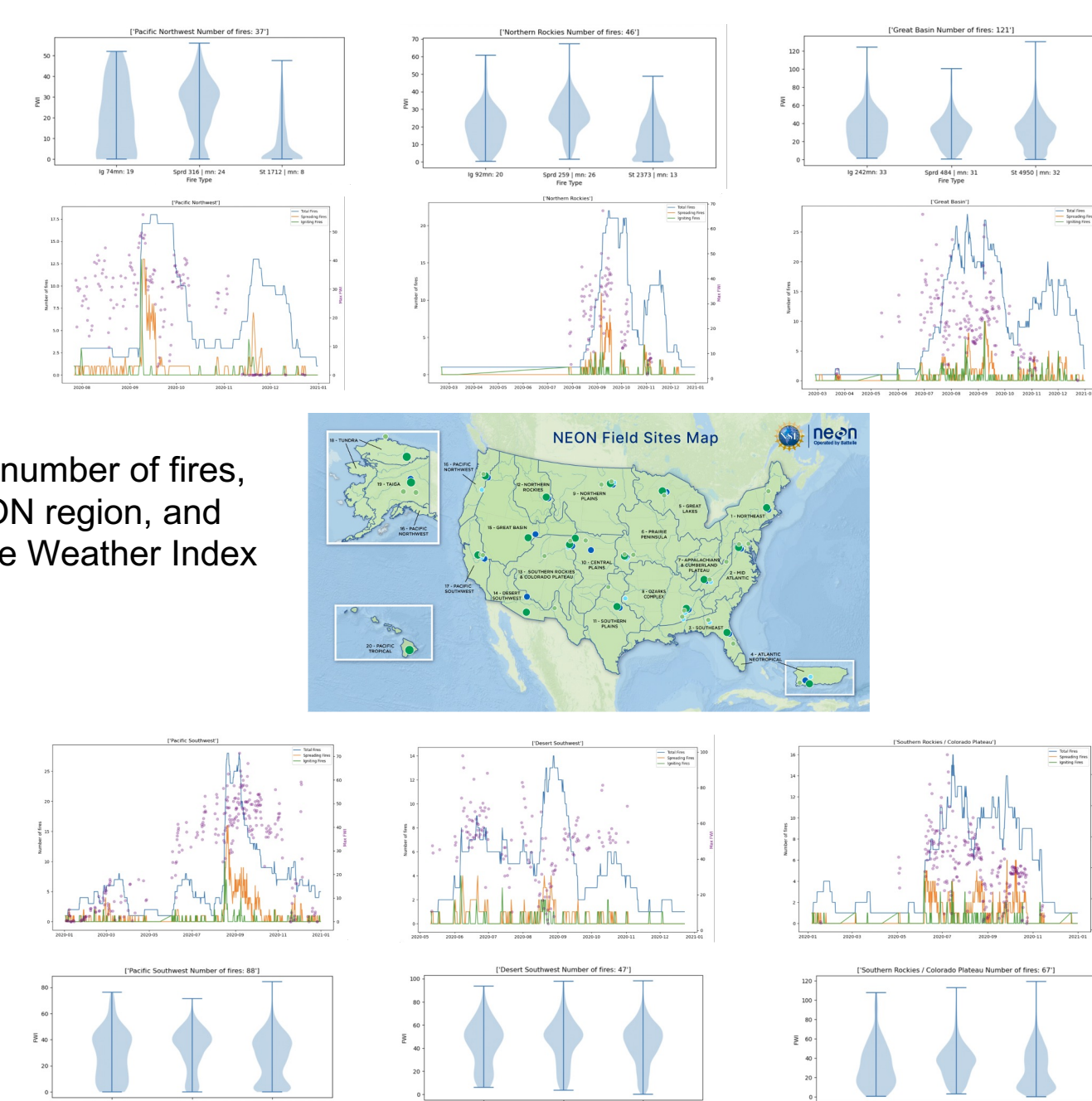
Timeseries of the number of fires, number of igniting fires, and number of spreading fires. The maximum FWI within the fire perimeters is plotted in purple dots.

FWI is higher during “spread days” and “ignition days” but the signal gets swamps at large regions/temporal scales.



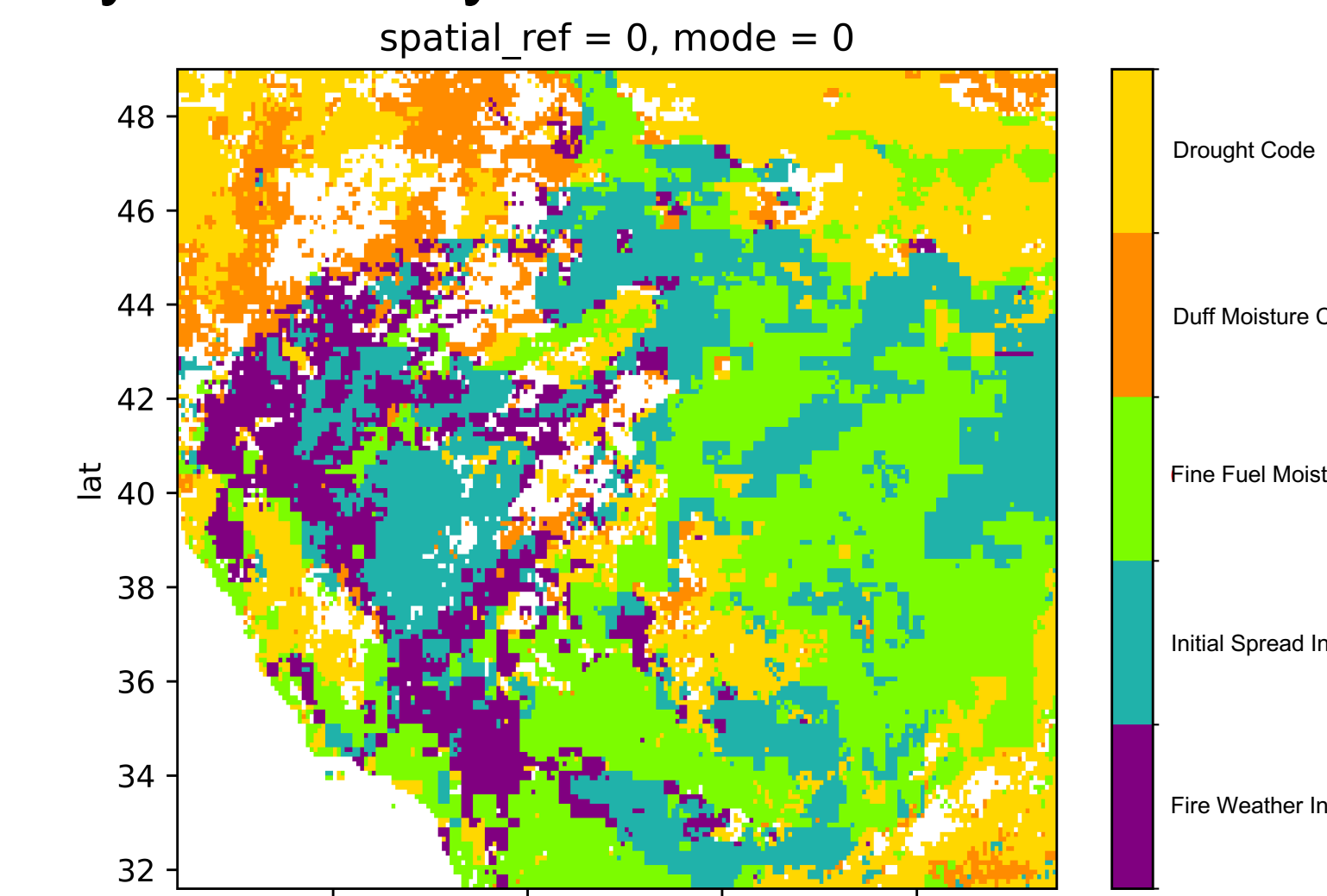
Distribution of Fire Weather Index Values and Fine Fuel Moisture Code separated by ignitions, spread days, and stay-days.

There is synchronicity in fires across the western us.



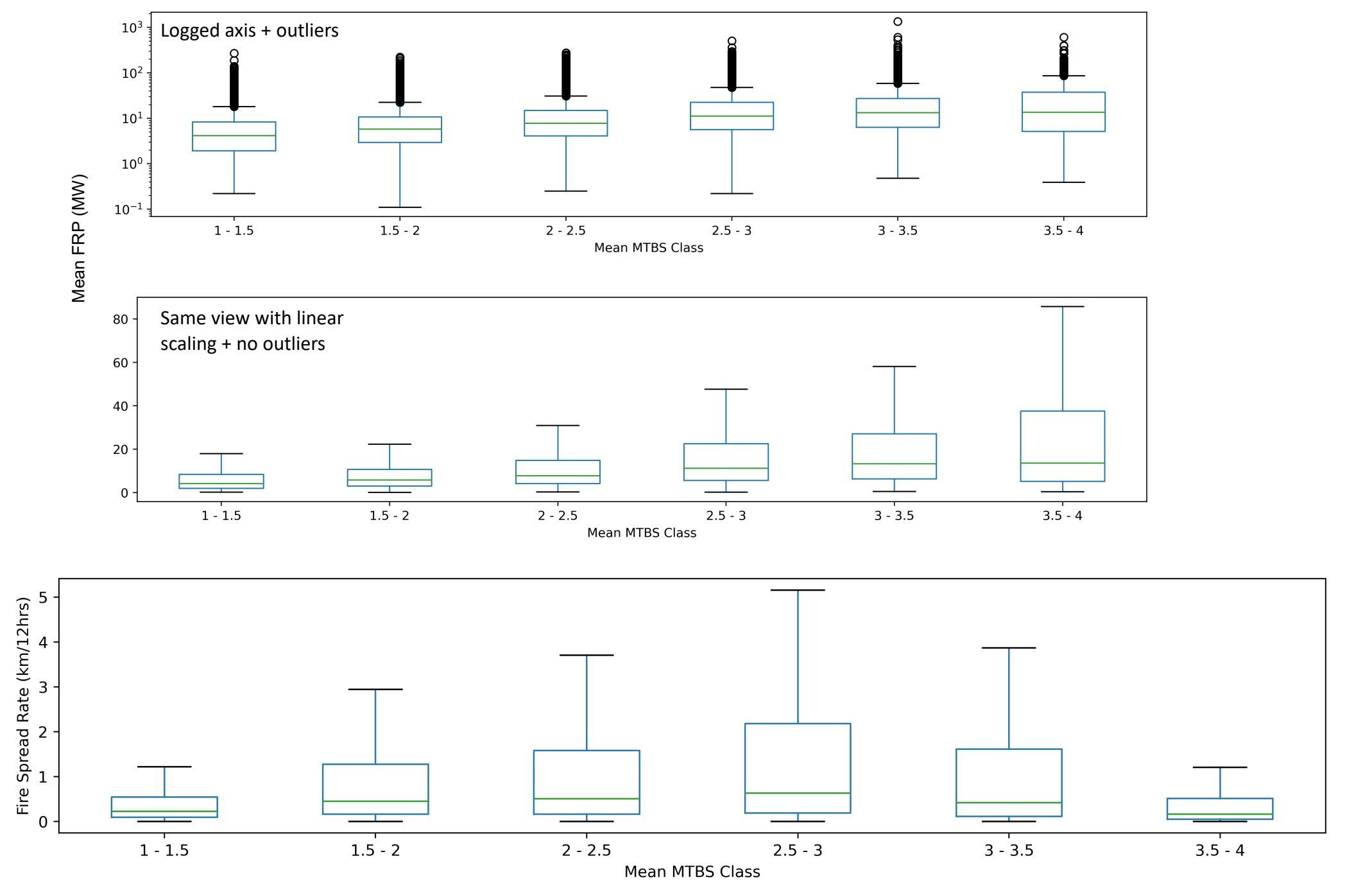
Timeseries of the number of fires, separated by NEON region, and distributions of Fire Weather Index by type.

Weather may explain that spatial synchronicity.



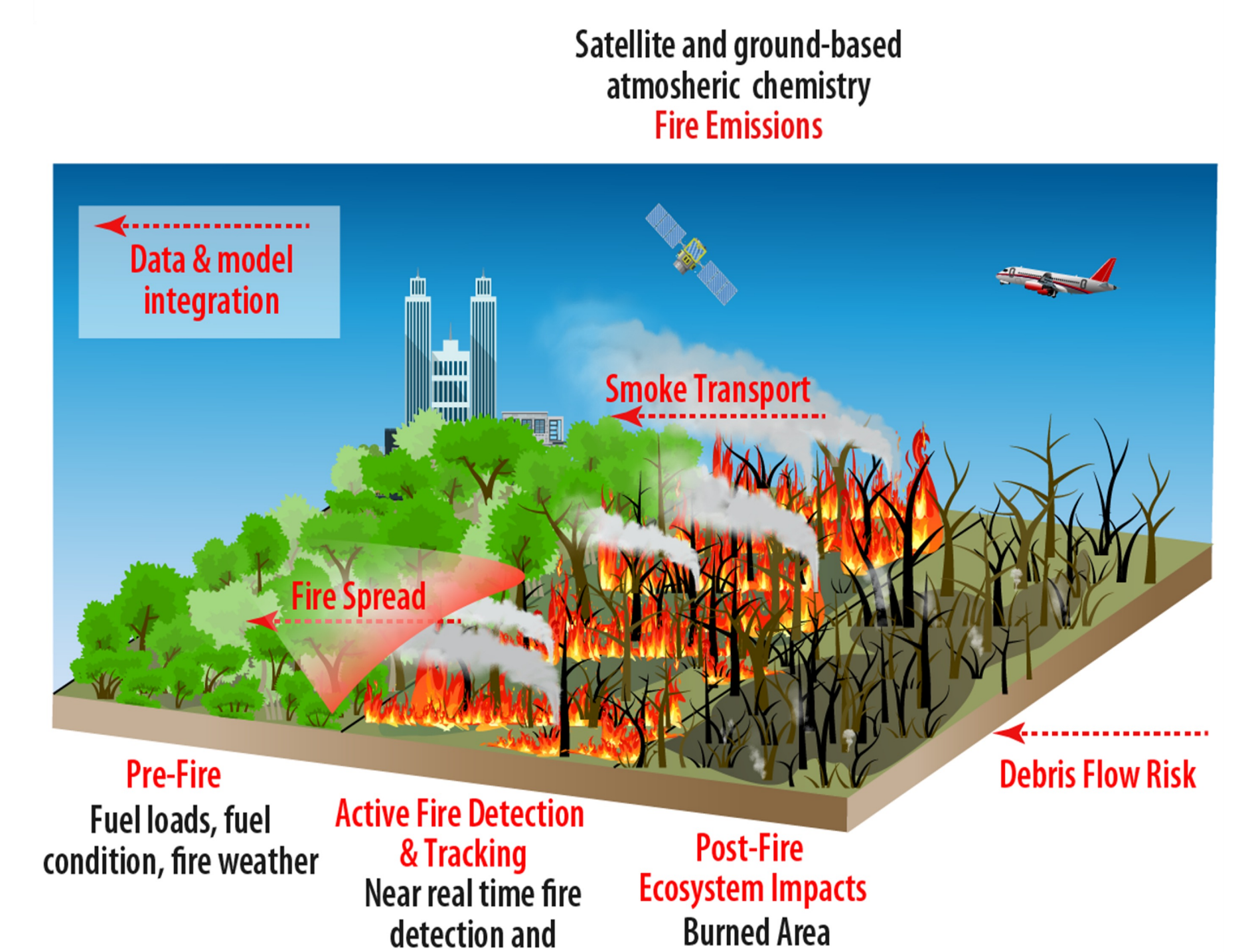
Composite map of Fire Weather Index component most correlated with the first Principle Component of the fire maximum fire radiative power.

Rapid spread & severity



Top: Mean Fire Radiative Power and Monitoring Trends in Burn Severity (MBTS) classification. Bottom: Estimated fire spread by MBTS classification.

Perspectives



Fire Perimeters in Near Real Time

API

<https://firenrt.delta-backend.com>

Documentation

<https://nasa-impact.github.io/veda-docs/example-notebooks/wfs.html>



Acknowledgements

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Citations

Chen, Y., Hantson, S., Andela, N., Coffield, S. R., Graff, C. A., Morton, D. C., Orl, L. E., Fountoula-Georgiou, E., Smyth, P., Goulden, M. L., & Randerson, J. T. (2022). California wildfire spread derived using VIIRS satellite observations and an object-based tracking system. *Scientific Data*, 9(1), Article 1. <https://doi.org/10.1038/s41597-022-01543-3>
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