



How much of the Great Plains burns? Effect of scale characterizing fire frequency.

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INTRODUCTION

The Great Plains of the US is characterized by grassland communities. Fire plays an important role in maintaining these grasslands. However, it has been difficult to understand how much fire occurs in the Great Plains and how fire occurrence might vary across the region.

TREATMENTS

Using satellite data from a 27-year dataset (1984-2012), we looked for regional patterns based on spatial scale and the variability at each scale. Our work showed that the scale at which you characterize the data affects conclusions. We analyzed the number of fires at four different spatial grain sizes: 3 km X 3 km, 30 km X 30 km, 300 km X 300 km and 1500 X 2700km.

RESULTS

We found that as grain increased, variance of fire return interval increased (Table 1). The percent of area burned increased as spatial grain increased as well. However, variance (log) between units decreased as grain increased, and variance within units did not change (Figure 1).

Because of the local concentrations of fire, larger grains appeared to have more fire frequent activity. However, across smaller grain sizes, it becomes clear that the vast majority of the region has infrequent fire activity (Figure 2). We predicted that an ecological model that describes differences in variance by scale could predict the fire occurrence patterns by grain size as well (Weins 1989). The pattern of variance we observed was predicted by Weins (1989) except when looking within units where we found variability to be stable. Weins predicted within unit variance to decrease (Figures 1 and 2).

Units (Grain)	n	Median	95th	Min-Max	% Area burned	MFRI
3 km x 3 km	219384	0	0	0 - 17	1.75	0.008
30 km x 30 km	2373	0.01	0.09	0 - 1.71	52.76	0.023
300 km x 300 km	37	0.01	0.08	0 - 0.12	94.60	0.839
1500 km x 2700 km	2	0.01	0.02	0 - 0.02	50	29

Table 1. Median (50th percentile), 95th percentile, minimum and maximum numbers of fires as well as the mean fire return interval (MFRI) in years at each grain in the Great Plains region. MFRI-Mean fire return interval. % Area burned is the number of pixels with a fire recorded/total number of pixels (n) per unit (*100).

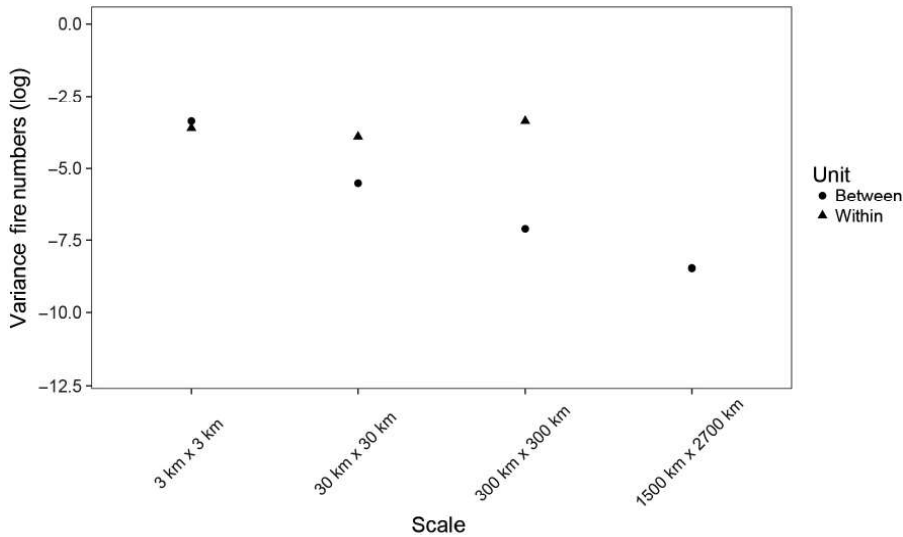
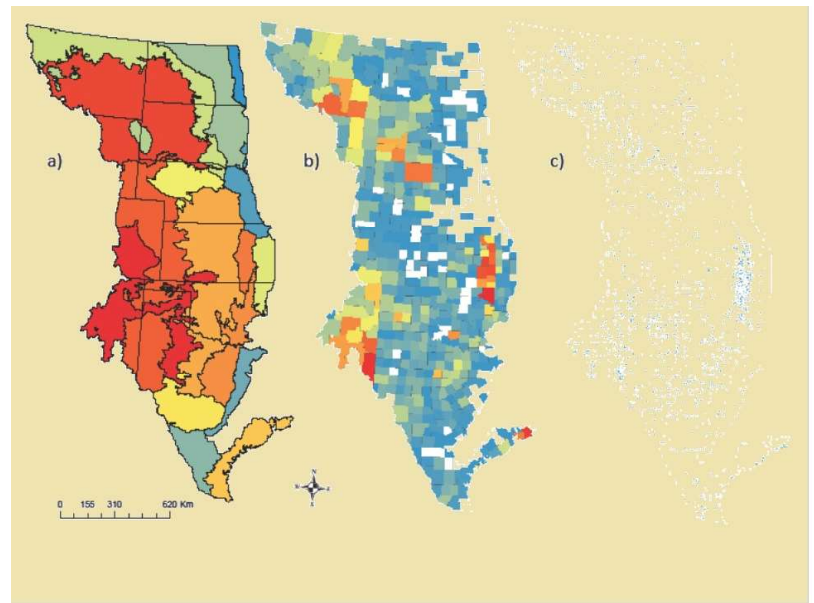


Figure 1. The log (variance) in the numbers of fires at each grain (y-axis) between and within units as grain increases (x-axis). Circles show the log (variance) between units, while triangles show the log(variance) within units.

Figure 2. Interpretation of the number of fire occurrences between 1984 and 2012 changes as the observational scale changes leading to differing interpretation of fire activity and pattern as scale changes. Panels represent the (a) ecoregion, (b) municipal county, and (c) plot (3 9 3 km) scales. For panels (b) and (c), red refers to high fire occurrences, blue refers to low fire occurrences, and clear refers to zero fire occurrences.



IMPLICATIONS

Causes of regional variability include but are not limited to: cultural acceptance, fire suppression policies, grassland loss to agriculture, woodland expansion, and energy development. Most states in the region use fire primarily in the dormant season and northern states use fire less frequently in general (Leis and Symstad 2017). Despite the range of fire use in the region, classical fire metrics such as mean fire return interval may not adequately describe fire activity at large scales because regions such as the Great Plains are very heterogeneous in fire pattern.

Furthermore, if management goals include structural or pyric heterogeneity, the scale in which you measure or report fire occurrence is crucial. The increase in mean fire return interval with grain size was disproportional with the change in scale. Fire patterns cannot be generalized well at the regional scale. Mean fire return interval alone should not be used to generalize prescriptions, targets, fire regime, or policy within the region. Rather, the inclusion of supporting metrics like variability would provide the most insight. Further exploration of how the heterogeneity of fire in the region relates to vegetation dynamics is still needed.

Original publication:

Scholtz, R., S. D. Fuhlendorf, S. A. Leis, J. J. Picotte, and D. Twidwell. 2018. Quantifying variance across spatial scales as part of fire regime classifications. *Ecosphere* 9(7):e02343. 10.1002/ecs2.2343

For more information, visit www.gpfirescience.org.