A Deeper Look at Drivers of Fire Activity, Re-burns, and Unburned Patches in Alaska's Boreal Forest

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Drivers of High Fire Activity

Alaska's fire managers are well aware that most boreal burning occurs during relatively brief periods of high fire activity. This was well-illustrated in the 2015 fire season (*below*). There is also evidence to suggest that fires may be more severe (Barrett and Kasischke 2013) and resistant to control during these periods. Scientists and managers both seek better understanding of why and when these periods are likely to occur. Fire protection agencies would like to have longer-term seasonal fire activity predictions for preparedness and strategy decisions while land managers and scientists want to inform models of long-term ecosystem response to changes in climate and/or vegetation succession and repeat disturbance.

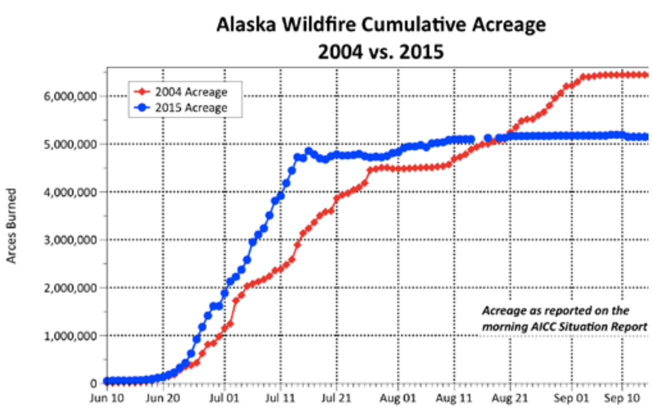
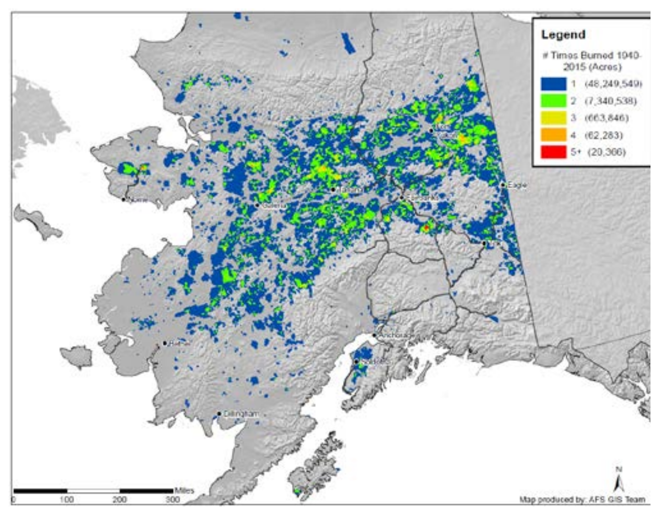


Figure by Rick Thoman, NWS Alaska Climate Center

A recent paper in Ecosphere (Barrett et al. 2016) explores the drivers behind sporadic periods of high fire activity, by seeking what defines large vs. small fire years. They looked at a number of variables, including season, Fire Weather Indices (from the [Canadian Forest Fire Danger Rating System](#)) vegetation, topography, drainage and previous fire history. Seasonal fire activity was determined using MODIS active fire detections from May-September (MCD14DL). This database now has information going back to 2002, making it possible to analyze fire activity on daily or weekly timescales, something that was not possible with agency fire reports, which typically summarize starting and ending dates and final size. Investigators were thus able to look at both temporal (day of year) and spatial (mapped drainage type, vegetation type) variables for their influence on fire growth response. Results suggested that location does matter—in other words, where the fires start is significant because the pattern of land cover and fuelbed continuity influences the magnitude of seasonal activity. It was not surprising that 11-day periods of high fire activity tended to coincide with low precipitation in the preceding 10 days and also when the fires started in better-drained areas.

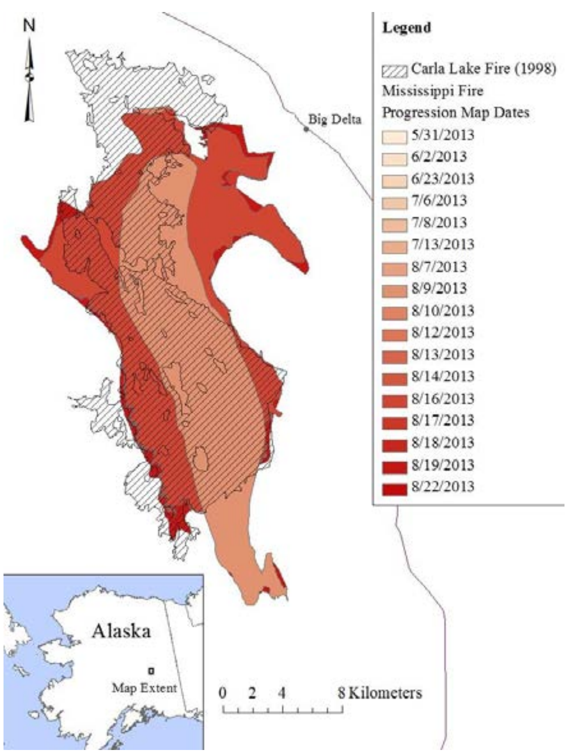


Fire re-entry 1940-2015 illustrated by overlap in mapped fire polygons, figure courtesy of J. Jenkins, BLM Alaska Fire Service.

However, investigators were surprised to find that these active periods were more likely when over 10% of MODIS fire detections were located in deciduous stands. They believe this indicates the effectiveness of deciduous stands as natural fire breaks decreases under more extreme weather conditions: conditions that Alaska is seeing more of as the climate warms. This analysis would be improved by availability of more accurate annual representations of vegetation cover.

Fire Re-Entry in Immature Stands

Interestingly, fire re-entry into recent burn areas (<60 years) seemed to be mostly a function of weather, with little model influence from the static landscape variables. The dominance of weather in the repeat burn phenomenon model indicates future fire return interval will be highly sensitive to projected climate changes in the region. Fire protection and land management agencies are already looking at the fire re-entry issue and have voiced an interest in further research to define predisposing specific near-term weather parameters. A 2013 fire on military lands (*below*) is an example of fire re-entry where fire moved very rapidly (5 miles in 12 hours overnight) through a 14-year-old burn scar with woody debris from previous fire and 1-2 m brush and grass.



Fire progression map of the 2013 Mississippi Fire overlapping the Carla Lake Fire scar (1998), BLM Alaska Fire Service.

Unburned Inclusions

Unburned patches are important for their influence on fuelbed continuity as well as for their influence on post-fire regeneration and seed stocks. Data from the Monitoring Trends in Burn Severity (MTBS) project in addition to the other variables outlined above was used to examine trends in the prevalence of unburned patches in burn perimeters. Unburned inclusions in the study accounted for about 18% of the overall burn area, similar to previous findings (Kasischke and Hoy, 2012: 20%).

Modeling to predict the presence of more unburned inclusions proved problematic, as they seemed to be associated with both fire-promoting (high ambient temperatures and wind speed) and fire-hindering (higher 30-day cumulative precipitation) conditions. Investigators theorized that fires might leave more unburned inclusions under two different scenarios: poor burning conditions or conversely under elevated fire danger conditions when fires spread into forest types that would normally be resistant to burning.

Putting It All Together for the Future

This work illustrates how new remote sensing data is gaining importance as a means to understand fire-weather-landscape relationships that are significant operationally and for ecosystem management. Barrett's findings reiterate the importance of brief periods of high fire activity accounting for most of Alaska's cumulative burn acreage. In this case, just 36 days, or 6% of the fire season total days (May-September from 2002-2010), accounted for over 50% of the total area burned.

By studying topics of current interest in the fire and land management commutities in Alaska (repeat burning and sub-seasonal fire activity predictors) this effort connects the research to real management needs. Would it surprise you to know that the study was partially supported by NASA? Dr. Barrett and other members of her study team plan to attend a remote sensing workhop with fire managers slated for April 2017 (link to workshop website)—also supported by NASA—to further explore research questions that may be accessible with new remotely-sensed data.

CITATIONS

Barrett, K, T. Loboda, AD McGuire, H. Genet, E. Hoy, and E. Kasischke. 2016. Static and dynamic controls on fire activity at moderate spatial and temporal scales in the Alaskan boreal forest. *Ecosphere* 7(11):e01572. 10.1002/ecs2.1572

Barrett, K., and ES Kasischke. 2013. Controls on variations in MODIS fire radiative power in Alaskan boreal forests: implications for fire severity conditions. *Remote Sensing of Environment* 130:171–181.

Kasischke, ES and EE Hoy. 2012. Controls on carbon consumption during Alaskan wildland fires. *Global Change Biology 18*: 685-699.

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