RESEARCH BRIEF

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# New Operational National Satellite Burned Area Product

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## *Management Implications*

- A new method of using satellite data to map burned areas has been developed.
- USGS Burned Area products are available for a long time series (1984-2019), making them useful for reconstructing recent fire histories.
- More small fires are now included in the maps, and masking removes areas burned in previous years from the annual summaries to make them more accurate.
- The annual products for each individual Landsat sensor and all sensors combined are available for download from **http://doi.org/10.5066/P9QKHKTQ** and **www.earthexplorer.usgs.gov**

## Introduction

Lack of consistent spatial and temporal fire information with relevant spatial resolution hinders land management and broad-scale assessments of fire activity, especially in the eastern United States and the Great Plains where fire is important ecologically and culturally. Remote sensing can be used to monitor fire activity, augment existing fire data, and fill information gaps. In particular, Landsat offers one of the most complete time series of remote sensing data sets as the Landsat satellites with spectral bands useful for mapping fires and burn severity have been operational since 1984. Furthermore, Landsat satellite imagery collect data at a resolution useful for on-the-ground comparisons and management decisions.

## Methods

A gradient-boosting regression model algorithm was used to predict burn probabilities (BP), indicating the likelihood that a pixel had burned in a fire. Then the algorithm translated the burn probability images to burn classification (BC) images using thresholding and region growing. Burned areas smaller than 5 acres were removed to reduce noise. The BP and BC products were generated for Landsat scenes collected from 1984 to present with <= 80% cloud cover and are available for download from USGS's EarthExplorer website (www.earthexplorer.usgs.gov).

Annual summaries were also produced from the scene-level BC and BP products. These include: 1) the maximum burn probability value from all scenes in a year, (2) the burn classification count, or the number of times a pixel was classified as burned in a year, (3) the burn date, or the day

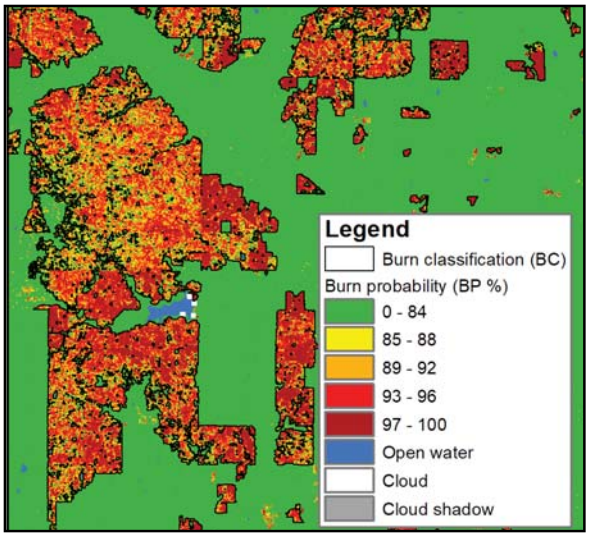


Figure 1. Example of the scene-level burn probability and burn classification products. Areas classified as burned are outlined in black.

of year of the first Landsat scene a pixel was classified as burned, and (4) a burn classification which removes burned areas still visible from previous years with a filter.

Results

The Landsat Burned Area Products identified 183% more burned area than the Monitoring Trends in Burn Severity[1] and 56% more burned area than the MODIS MCD64A1.006 products[2]. From 1984 through 2018, annual burned area mapped by the Landsat Burned Area Products averaged 30,000 km$^2$, ranged between 14,000 km$^2$ in 1991 and 46,500 km$^2$ in 2012, and increased over time at a rate of 356 km$^2$/year.

The Landsat Burned Area products consistently map burned areas 5 acres or larger over time while capturing unburned islands within fires. Such characteristics are critical for understanding long-term impacts of fires on human and natural systems. The products are being routinely produced as new Landsat data are collected and demonstrate the utility remote sensing offers for monitoring landscape change.

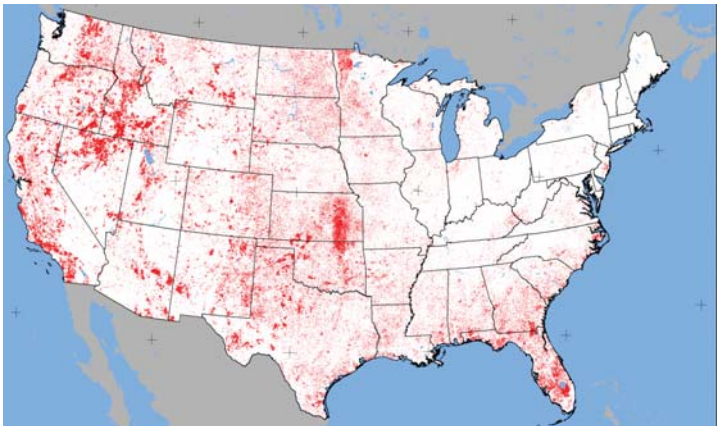

Figure 3. Areas in red on the map indicate burned areas. The Landsat Burned Area Products identified both large fires documented in incident reports as well as many smaller fires. Nearly 300,000,000 acres were identified as having burned between 1984-2018, or about 0.4% of the land in the conterminous United States.

## For Further Reading


Hawbaker, T.J., Vanderhoof, M.K., Schmidt, G.L., Beal, Y.-J., Picotte, J.J., Takacs, J.D., Falgout, J.T., Dwyer, J.L., 2020. The Landsat Burned Area algorithm and products for the conterminous United States. Remote Sensing of Environment 244, 111801. https://doi.org/10.1016/j.rse.2020.111801

Hawbaker, T.J., Vanderhoof, M.K., Teske, C. and Noble, J. 2019. Mapping burned areas from the Landsat archive Southern Fire Exchange Webinar, April 24, 2019. https://www.youtube.com/watch?v=TuXhNl6zIDo


[1]Monitoring Trends in Burn Severity https://www.mtbs.gov/

[2]MCD64A1 v006 https://lpdaac.usgs.gov/products/mcd64a1v006/

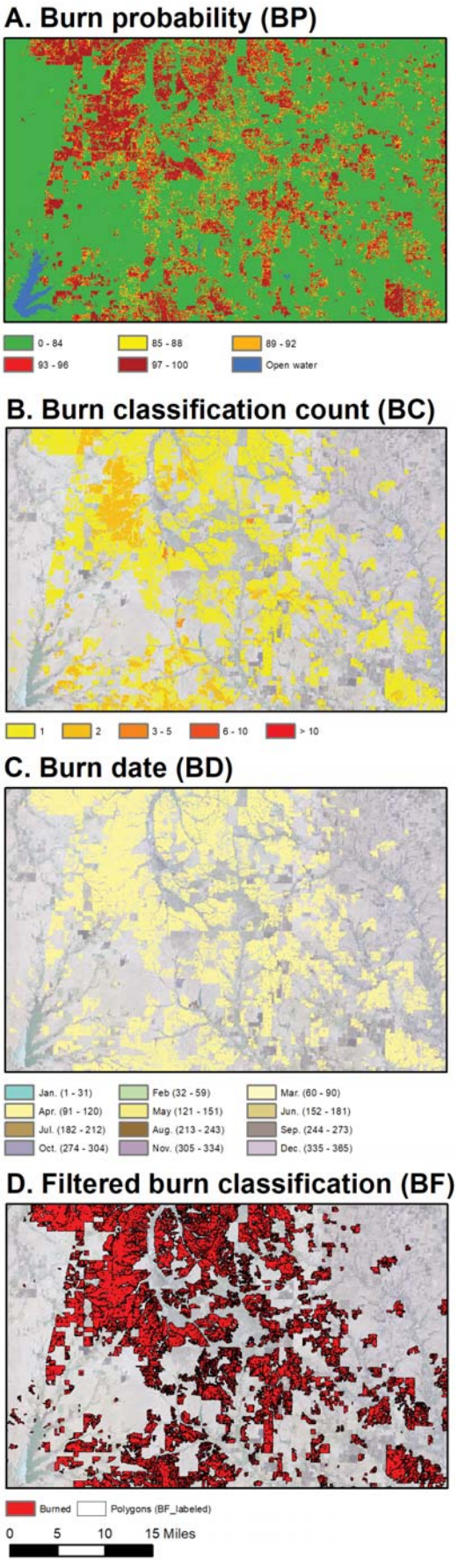


Figure 2. Examples of the Landsat Burned Area annual composite products.