Southeast FireMap (SE FireMap) v.1 Beta
Landsat BA Derived Fire History Metrics
Product Information

In 2020, the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) provided funds through an agreement with the U.S. Endowment for Forestry and Communities to support the development of an improved regional fire mapping product. This new product, the Southeast FireMap (SE FireMap), utilizes a remote sensing approach to identify areas burned by both prescribed fire and wildfire activity on public and private lands, offering an improved fire mapping system for the Southeastern United States. This product was designed to serve as a critical decision support tool to maximize the effectiveness of fire management practices – helping achieve the varied objectives of the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and its partners such as keeping working lands working, restoring the longleaf pine ecosystem, supporting Department of Defense's (DoD) military and training mission, conserving listed and at-risk species, managing for wildfire risk, and minimizing the need to conserve species through regulation.

As part of this mapping project, a version 1 (v.1) beta or "pilot" product is being offered for 2021. The v.1 web map and data are intended for utilization by 3rd parties; however, a thorough understanding of appropriate use, interpretation and underlying data limitations are important to utility. This v.1 data is available for download on a case-by-case basis through a data use agreement with NRCS and Tall Timbers Research, Inc. (TTR). Developed during the SE FireMap project "Scoping Phase", this v.1 product provides the users with an initial burned area product and the opportunity to share feedback as product improvements are made. An improved (v.2) SE FireMap product is anticipated in 2022.

The v.1 web map, product information and a data request form can be found on the Landscape Partnership Portal (LPP) website (https://www.landscapepartnership.org/key-issues/wildland-fire/fire-mapping/regional-fire-mapping/se-firemap). New users will be required to register on the LPP site to access the web map.

Data Product Description: The SE FireMap v.1 dataset was developed by TTR and is derived from the USGS Landsat Burned Area Products (Hawbaker et al. 2017). TTR used Burned Area (BA) version 2 products to produce v.1 fire history metrics (Hawbaker et al. 2020), evaluating Landsat Burn Probability (BP) raster datasets for evidence of burns. The annual datasets span entire calendar years (e.g., Jan 1 through Dec 31) and indicate the maximum BP for each year

(0-100%). For each year between 1994 and 2021, TTR combined the annual datasets of interest within individual Landsat Analysis Ready Data (ARD) tiles into a single annual raster dataset (i.e., mosaicked the tiles) for further processing. TTR performed all additional processing steps on the annual mosaicked datasets to provide regional consistency, identifying pixels as burned or unburned according to their probability value. Initially, all pixels with an annual BP between 85-100% were retained based on Hawbaker et al. (2017). Values between 90-100% were then converted to presence/absence rasters and image processing methods were utilized to remove 'speckling' (e.g., fill in small holes within a burned area and remove groups of pixels less than a specified size/amount). This process resulted in annual rasters and vectors indicating burn presence (with 90-100% probability) for groups of pixels greater than ~2.24 acres (e.g.,10 30m pixels, in any arrangement). Fire regime metrics such as number of times burned, year last burned, and time since previous fire (as measured from 2022) are included in the SE FireMap v.1 dataset and were derived using these annual presence/absence rasters and vectors.

Fire Frequency refers to the number of times a specific location has burned in the period of record (or for a given period of interest if a subset of total fire record). In a raster dataset, fire frequency is calculated at a pixel level; in a vector dataset, it is calculated as the geometric intersection where more than one polygon overlap. Either way, the burned area is categorically differentiated from the unburned area, and the total number of occurrences is 'summed' over a pixel or common area through time. This value cannot be greater than the number of years in the fire history record.

Time Since Previous Fire (or Time Since Last Fire; TSPF or TSLF) is the measure of time from a specific date back in time to the last date of a detected or known fire. Units can be months, days, or years. In the database, it is reported as the number of years from "present" to the last identifiable burn, since we used annual burned areas to populate the database. This value cannot be greater than the number of years in the fire history record.

Year Last Burned (YLB) is the year of the last detected fire in a location; it corresponds with the Time Since Previous Fire. For the purposes of this project, the four-digit year was used to designate this information (i.e., YLB=2008). This value cannot be outside the range of years in the fire history record.

Fire Free Interval (FFI) is the period between two consecutive fires in a given location. In places where more than two fires have burned throughout time, FFI represents the interval between the 2 most recent fires and the longest (LFFI; or shortest [SFFI]) fire free intervals are calculated as the maximum (or minimum) period

between two consecutive fires at a given location within the time period. For purposes of V.1 release, the LFFI metric was calculated for the complete fire record analyzed, 1994-2021. The term Fire Return Interval is often used interchangeably in the southeast with this term. However, the time between fires in a defined area is not specifically the same as the FRI, which is defined as the time period (T) divided by the number of fire occurrences plus 1 (i.e., T / [FRQ+1], Safford et al. [2014]; which more closely represents the average number of years between fires in a given time period).

Known Issues and Limitations: The fire history metrics were derived from Landsat Burned Area products described in the Metadata. The Burned Area products are meant to provide a supplemental spatial (and temporal) record of burned area detection. The products represent the general ecological pattern of fire on the landscape, and the derivative products (e.g., fire history metrics) can be used to help describe and analyze the fire regimes found in various ecosystems on both public and private lands in the Southeast. The data provided herein may not represent all fires and should not be considered a census database of known fire records. There are instances where known fires may not be mapped and other instances where fires are mapped but no known fires actually occurred (or did not fully burn); these are documented and known issues and limitations of using 30m remotely sensed products (see Vanderhoof et al. 2017). These Burned Area and Fire History products are meant to supplement local and regional expert knowledge by providing a seamless fire regime product to assist in management decisions, especially in those areas where fire records currently are not required or kept.

Known Limitations:

1. In agricultural and developed areas, frequent changes in site conditions (green vegetation, non-photosynthetic vegetation, burned, tilled) make it challenging to use change-detection approaches to distinguish burn events (Vanderhoof et al. 2017)
2. High soil moisture levels and consequently patchy (low severity) fires can also confound detection in certain circumstances. Wet soils can be much darker than dry soils, and may be misclassified as burned areas (Flasse et al. 2004)
3. Impediments to burned area detection include rapid green-up following a burn; cloud cover and shadows obscuring the land surface; difficulty detecting or differentiating a low intensity burns beneath tree canopies; and the spatial resolution of satellite imagery being too coarse to capture fine-scale differences or small burns (Hawbaker et al. 2008, 2017).

Considerations:

- The spatial resolution of the raster products used to produce the fire history metrics is 30 meters and while individual fires represent a combination of 10, 30-meter pixels, the application scale of the product is much larger in some cases.
- Fire history metrics produced by this product are not meant to replace local products but rather supplement these products where data gaps occur.
- This product supports regional and sub-regional analysis and may be inappropriate for site specific analysis given the limitations described above.

References:

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United States Geological Survey [USGS]. 2019. Landsat Level-3 Burned Area Science Product. < *https://www.usgs.gov/centers/eros/science/usgs-eros-archive-landsat-landsat-level-3-burned-area-ba-science-product?qt-science_center_objects=0#qt-science_center_objects*>.
Digital Object Identification: doi.org/10.5066/F77W6BDJ

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