California Vegetation Burn Severity Datasets Metadata

Summary

This metadata is for composite burn index (CBI) and relativized burn ratio (RBR) data produced by CAL FIRE's Fire and Resource Assessment Program (FRAP). CBI is defined in Key and Benson (2006) and RBR is defined in Parks et al. (2014). Both severity datasets were derived using methods detailed in Parks et al. (2019).

Data represent impacts to vegetation approximately one year post-fire. They are provided for California wildfires ≥1,000 acres and wildfires ≥10 acres that were a part of complexes ≥1,000 acres from 1985 to the most recent year of available source data. Raster data are 30 m resoultion and display continuous data. Vector data are categorical with four classes.

These dataset types are currently available for download:

- Individual fire RBR rasters
- Individual fire CBI rasters
- Statewide annual mosaic RBR rasters
- Statewide annual mosaic CBI rasters
- Statewide all-years CBI vector

Description

RBR and CBI data provide estimations of each fire's burn severity, with burn severity defined here as fire-induced change to vegetation between the growing season in the year prior to the fire and the year after the year in which the fire occurred. RBR is a unitless remotely sensed index of the pre- to post-fire change in vegetation (Parks et al. 2014). CBI is a standardized field measure of vegetation burn severity (Key and Benson 2006). Here we use a machine learning model to estimate CBI as a function of spectral data from Landsat, climate data, and latitude (Parks et al. 2019). These datasets are limited to the extents of fires included in CAL FIRE's Historic Wildland Fire Perimeters databases (firep23_1 for fires in years 2023 and prior [CAL FIRE 2024], and the database of each corresponding year for fires in years 2024 and later [e.g. CAL FIRE 2025]).

These datasets were developed to satisfy the requirements of Senate Bill No. 1101: *An act to amend Sections 10295 and 10340 of the Public Contract Code, and to add Section 4114.4 to the Public Resources Code, relating to fire prevention*.

Methods

To develop these datasets, a feature class for fire perimeters was created from FRAP's Historic Wildland Fire Perimeters database (CAL FIRE 2024, CAL FIRE 2025) for fires ≥1,000 acres and fires ≥10 acres that were a part of complexes ≥1,000 acres from 1985 to 2024.

After this feature class was uploaded to Google Earth Engine (GEE) as an asset, the Parks et al. (2019) GEE script, with a modification for use with Landsat Collection 2 data, was used to generate RBR and bias-corrected CBI data for each individual fire. Both datasets were created using 30 m resolution Landsat Collection 2 data (EROS 2020a, 2020b, 2020c), and the 4 km climate data to create CBI was from TerraClimate (Abatzoglou et al. 2018). A mean composite scene selection method utilized all valid pixels in all Landsat scenes over a specified date range to calculate the spectral data inputs (Parks et al. 2018). To specify the date range of Landsat satellite images to be queried to create the one-year pre-fire and one-year post-fire mean composite image scenes, the variable "startday" was set to 152 (June 1st) and the variable "endday" was set to 258 (September 15th), as specified in Parks et al. (2019). The script used a Random Forest machine learning model to estimate CBI as a function of RBR, differenced mid-infrared bi-spectral index (MIRBI), delta normalized differenced vegetation index (dNDVI), post-fire MIRBI, mean climatic water deficit from 1981–2010, and latitude, and was trained on CBI field plot data from forests across the U.S. and Canada.

Once the raster data for each fire were produced using the modified Parks et al. (2019) GEE script, a Python script using the arcpy package was used to mask each fire-specific, continuous, RBR or CBI geotiff to the extent of the fire perimeter. To create the statewide annual mosaic rasters of continuous RBR and CBI, all individual fire rasters from each calendar year were mosaicked together to create files for each metric and year. To create the classified CBI vector file, individual continuous CBI files were classified using the schema below, converted from raster to vector format, and then merged together to create the final output.

CBI values are classified as follows:

Lower Limit (CBI)	Upper Limit (CBI)	Burn Severity
0.00	<0.10	Unchanged
0.10	<1.25	Low Vegetation Burn Severity
1.25	<2.25	Moderate Vegetation Burn Severity
2.25	3.00	High Vegetation Burn Severity

Very few CBI field plots exist in California or elsewhere in the U.S. for vegetation types other than forest. Although data for all land cover types are available in the CBI data provided, caution should be used when utilizing these data outside the extent of conifer and hardwood forests.

Revisions

This is version 1 of the publicly available datasets and there are no revisions to report.

Credits

Abatzoglou JT, Dobrowski SZ, Parks SA, Hegewisch KC. 2018. Terraclimate, a high-resolution global dataset of monthly climate and climatic water balance from 1958–2015. Scientific Data 5:170191. https://doi.org/10.1038/sdata.2017.191.

California Department of Forestry & Fire Protection, Fire & Resource Assessment Program. 2024. Historic Wildland Fire Perimeters (firep23_1). https://www.fire.ca.gov/what-we-do/fire-resource-assessment-program/fire-perimeters.

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Earth Resources Observation and Science (EROS) Center. 2020a. Landsat 4–5 Thematic Mapper Level-2, Collection 2 [dataset]. U.S. Geological Survey. https://doi.org/10.5066/P9IAXOVV.

Earth Resources Observation and Science (EROS) Center. 2020b. Landsat 7 Enhanced Thematic Mapper Plus Level-2, Collection 2 [dataset]. U.S. Geological Survey. https://doi.org/10.5066/P9C7I13B.

Earth Resources Observation and Science (EROS) Center. 2020c. Landsat 8–9 Operational Land Imager / Thermal Infrared Sensor Level-2, Collection 2 [dataset]. U.S. Geological Survey. https://doi.org/10.5066/P9OGBGM6.

Parks SA, Dillon GK, and Miller C. 2014. A New Metric for Quantifying Burn Severity: The Relativized Burn Ratio. Remote Sensing 6:1827-1844. https://doi.org/10.3390/rs6031827.

Parks SA, Holsinger LM, Koontz MJ, Collins, Whitman E, et al. 2019. Giving ecological meaning to satellite-derived fire severity metrics across North American forests within Google Earth Engine. Remote Sensing 11:1735. https://doi.org/10.3390/rs11141735.

Parks SA, Holsinger LM, Voss MA, Loehman RA, Robinson NP. 2018. Mean composite fire severity metrics computed with Google Earth Engine offer improved accuracy and expanded mapping potential. Remote Sensing 10:879. https://doi.org/10.3390/rs10060879.

Use limitations

Users of the fire severity data must exercise extreme caution in application of the data, especially in unforested areas. Careful use of the fire severity database will prevent users from drawing inaccurate or erroneous conclusions from the data.

When using this product, please cite the California Department of Forestry & Fire Protection, Fire & Resource Assessment Program and the following paper:

Parks SA, Holsinger LM, Koontz MJ, Collins, Whitman E, et al. 2019. Giving ecological meaning to satellite-derived fire severity metrics across North American forests within Google Earth Engine. Remote Sensing 11:1735. https://doi.org/10.3390/rs11141735.

Legal Constraints

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