Fire weather forecast & meteorological inputs for fire modelling

Root directory: /fire_weather_forecast

Description: CONUS 5-day hybrid forecast derived from 3 operational weather models created by ELMFIRE's weather analytics pipeline. Native forecast outputs are used to calculate live and dead fuel moisture values needed for fire modeling. Stacked GeoTiff rasters contain hourly outputs where band 1 corresponds to forecast hour zero, band 2 is forecast hour 1, and so on. A new 5-day forecast is generated every 6 hours.

Forecast is derived from operational weather models as follows:

- Forecast hour 0 – 36: Average values from High Resolution Rapid Refresh (HRRR) and North American Mesoscale Forecast System (NAM) at 3 km resolution
- Forecast hour 37 – 60: Values from NAM forecast at 3 km resolution
- Forecast hour 61 – 120: Values from Global Forecast System (~13 km resolution resampled to same projection, resolution, and extents as the HRRR/NAM).

Filenames and units:

The convention for timestamps in subdirectories and filenames is YYYYMMDD_CC where:

- YYYY = 4 digit year
- MM = 2 digit month
- DD = 2 digit day
- CC = 2 digit forecast cycle (00, 06, 12, or 18)

All times are in UTC. Within each subdirectory is a series of GeoTiff files with filenames that begin with the above timestamp (shown as "*" in the table below):

Filename	Units	Description
*apcp01.tif	kg/m^2	Precipitation accumulated in previous hour
*erc.tif	$0.04 \times Btu/ft^2$	Energy release component (NFDRS fuel model G)
*fmc.tif	%	Foliar moisture content
*m1.tif	%	1-hour dead fuel moisture
*m10.tif	%	10-hour dead fuel moisture
*m100.tif	%	100-hour dead fuel moisture
*m1000.tif	%	1000-hour dead fuel moisture
*mlh.tif	%	Live herbaceous fuel moisture
*mlw.tif	%	Live woody fuel moisture
*netrad.tif	W/m^2	Net radiation flux at ground or water surface
*rh.tif	%	2 m relative humidity
*tmpf.tif	°F	2 m temperature
*wd.tif	degrees	20 ft wind direction, meteorological convention
*ws.tif	mph	20 ft wind speed

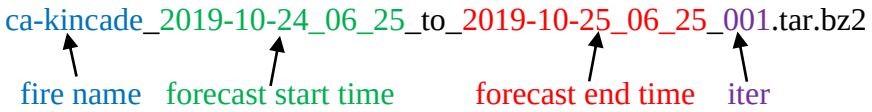
Fire spread forecasts

Root directory: /fire_spread_forecast

Description: Outputs from fire progression forecasts of active fires, including both initial attack and campaign fires.

Directory structure/compressed archive naming convention

Forecasts data is grouped by fire in a directory named state-fire_name, *i.e.* the folder ca-kincade contains fire forecast GIS data for California's 2019 Kincade fire. Within each directory are several compressed tar/bzip2 archives with names similar to:

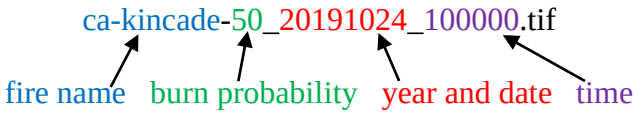


This should be self-explanatory, except "iter" which is the forecast iteration (in some cases multiple iterations of the same forecast are run with slightly different inputs).

Within each tar/bzip2 archive is two folders:

1. isochrone_geotiffs: GeoTiff files showing fire front position at various times
2. isochrone_shapefiles: ESRI shapefiles showing fire front position at various times

Isochrone GeoTiffs and shapefiles are named with the following convention:



In the above example, the GeoTiff file is the 50% burn probability[1] forecast of the Kincade Fire perimeter on 10/24/2019 at 10:00:00 UTC.

[1] Isochrones are generated from ensemble fire spread forecasts with ~1,000 ensemble members. An explanation of the ensemble fire forecast methodology and associated burn probabilities will be provided in a near-term risk forecast modelling framework summary to be completed by June 26, 2020.

Fire risk forecasts

Root directory: /fire_spread_forecast

Description: Outputs near-term fire risk forecast. These rasters are generated from Monte Carlo fire spread analyses where ignitions are distributed randomly across the landscape to mimic natural and anthropogenic fires, including fires ignited by the electrical grid. Ignition density patterns are a function of intermediate to long-term dryness as quantified by ERC. Two types of ignition patterns are currently modeled[2]:

1. *Natural and anthropogenic fires from all causes excluding fires ignited by the electrical grid*. Spatial ignition density pattern is a function of human presence on the landscape (as quantified by road density) and lightning probability (as quantified by GFS gridded LAMP product).
2. *Fires ignited by the electrical grid*. Here, the spatial ignition distribution pattern follows powerlines and increases with wind speed. For initial testing purposes, the ignition pattern is constrained to fires ignited within a buffer surrounding transmission line corridors as identified from publicly-available GIS data.

Although statewide fire spread runs are conducted at a resolution of 30 m, rasters are resampled to 150 m. New 5-day forecasts with hourly outputs are generated nominally twice per day but can be generated every six hours during high risk weather events.

Directory structure naming convention

Outputs are stored in `/fire_risk_forecast/YYYYMMDD_CC-type` where:

- YYYY = 4 digit year
- MM = 2 digit month
- DD = 2 digit day
- CC = 2 digit forecast cycle (00, 06, 12, or 18)
- type is either "all" or "tlines":
    - all: natural and anthropogenic from all causes except the electrical grid
    - tlines: fires ignited by the electrical grid – currently transmission lines only

File naming convention

The convention for filenames is `quantity_###.tif` where `###` is the three-digit forecast hour and `quantity` is described in the table below:

Filename	Units	Description
affected_population_###.tif	structures	# of structures within fire perimeter
surface_fire_area_###.tif	Acres	Fire area
surface_fire_volume_###.tif	acre-ft	Fire volume
burn_probability_summed_###.tif	%	# of times burned

[2] These methodologies will be explained in greater detail in a near-term risk forecast modelling framework summary to be completed by June 26, 2020.

Fuels and topography

Root directory: /fuels_and_topography

Description: CONUS static fuels and topography inputs for use in fire modelling generated by ELMFIRE. Where available, LANDFIRE Remap (LF 2.0.0) is used and LANDFIRE 2014 (LF 1.4.0) is used elsewhere.

Filenames and units:

Filename	Units	Description
asp.tif	Degrees	Topographical aspect
cbd.tif	$100 \times kg/m^3$	Canopy bulk density
cbh.tif	$10 \times m$	Canopy base height
cc.tif	%	Canopy cover
ch.tif	$10 \times m$	Canopy height
dem.tif	m	Elevation
fbfm13	Categorical	Fuel model (Anderson 13 system)
fbfm40	Categorical	Fuel model (Scott/Burgan 40 system)
slp.tif	Degrees	Topographical slope

Structure density

Root directory: /structure_density

Description: CONUS structure density derived from most recent census (2010) generated by ELMFIRE. Will be updated to 2020 census data when available.

Filenames and units:

Filename	Units	Description
structure_density.tif	Structures / sq mi	Structure density

Orthoimagery

Root directory: /orthoimagery

Description: 2016 NAIP orthoimagery mosaic for California. Resampled to 6 m resolution. 2018 NAIP orthoimagery will be added later.

Filenames:

Filename	Units	Description
ca_naip_2016.tif	-	CA NAIP orthoimagery mosaic

NIFC large fires

Root directory: /nifc_large_fires

Description: Location of large fires tracked by the National Interagency Fire Center (NIFC), updated in real-time by ELMFIRE's fire detection and mapping pipeline.

Filenames: Every time a fire is added or removed from this list, a new shapefile is generated and archived in a .zip file named nifc_large_fires_YYYYMMDD_hhmmss.zip where:

- YYYY = 4 digit year
- MM = 2 digit month
- DD = 2 digit day
- hh = 2 digit hour
- mm = 2 digit minute
- ss = 2 digit second

Real-time fire progression data

Root directory: /real_time_fire_progression

Description: Real-time fire progression GIS data collated together by ELMFIRE's fire detection and mapping pipeline from three different sources:

1. GeoMAC perimeters
2. Terra/Aqua MODIS detections
3. Suomi NPP VIIRS detections

Directory and File Names:

GIS data for each separate fire are contained in a directory named as state-firename. Within each directory are shapefiles named as timestamps of the form YYYY-MM-DD_hh_mm.shp. All times are in UTC.