Fire Analysis of the Thomas Fire in California Using NASA Data in a GIS

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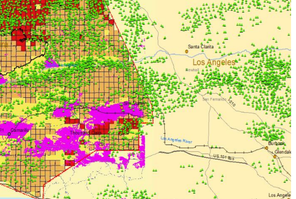
Historical Significance

In December 2017, the Thomas Fire burned areas in Ventura and Santa Barbara Counties in California, consuming 281,893 acres (440 square miles), and becoming the largest wildfire in California history. Ventura and Santa Barbara Counties have experienced more than 250 wildfires since the 1950s. With 53% of Ventura County's total area being made up of National Forest territory and the Santa Ana winds flowing through the area helping to dry the vegetation, the region is at higher risk of fire, flooding, and mudslides. With the Thomas Fire, the Santa Ana winds helped to transport flames quickly and spread the fire within a few hours or days.

Find Data

Using NASA's Worldview (https://worldview.earthdata.nasa.gov), click on "Add Layers" and a search box will display imagery layers that are organized into 10 application categories to assist in monitoring and analyzing a variety of natural and man-made hazards and disasters (e.g. floods and fires).



Download layers by clicking on the "Data" tab and on the "+" sign to select a granule within the satellite swath. Click on "Download Data" and an information box will pop up. The filename will be clickable as well as a number of information links. Click on the filename to download the file.

Create an animation in Worldview by clicking on the video icon ( ). Select the respective dates and then click the play button. To see an animation of the Thomas Fire, go to https://go.nasa.gov/2LK5aNR.

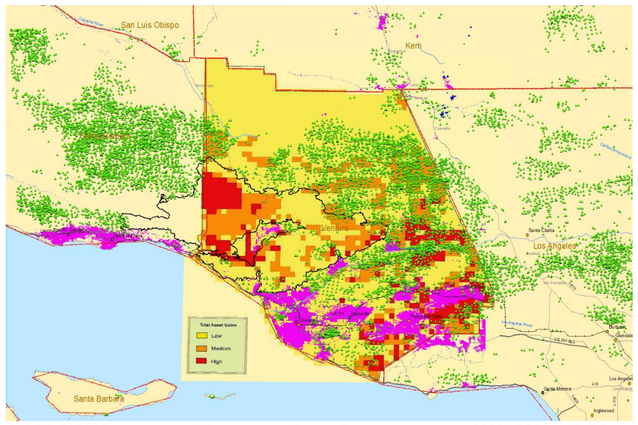
Analysis

The objective of our analysis was to

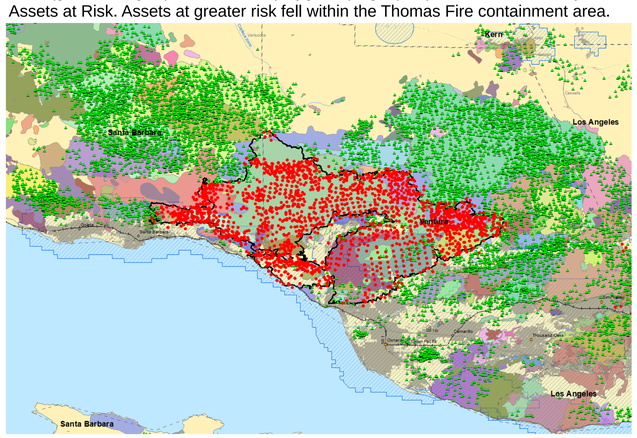
1) Identify forest fire risk zones from NASA FIRMS active fire hotspots reported between November 2000 to December 2017 in the Ventura and Santa Barbara counties area prior to the Thomas Fire incident.
2) Create a fire occurrence density map by running a kernel density on the active fire hotspots.
3) Utilize NDVI or EVI information from NASA satellite data to examine the vegetation prior to the fire, and the burn scar after the fire was contained.
4) Overlay parcel data and intersect with the burn scar to capture the affected parcels located in Santa Barbara and Ventura counties.
5) Overlay vegetation data and intersect with the burn scar to capture the affected vegetation located in Santa Barbara and Ventura counties.

This poster presents the use of datasets from NASA's inventory that have the potential for use in identification and analysis of forest fire risk and subsequent after effects within a GIS.

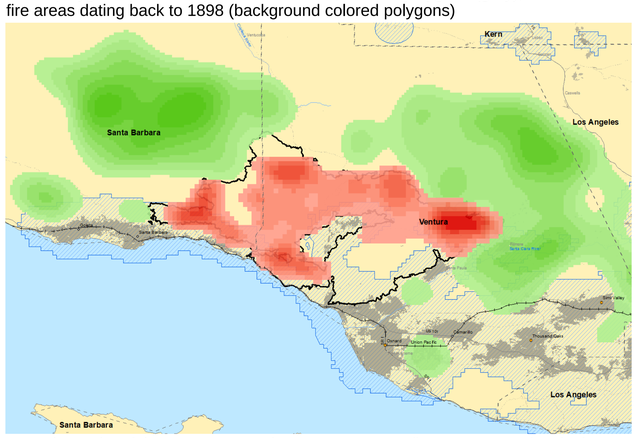
Active Fire Hotspots in Ventura and Santa Barbara counties, NOV 2000 to DEC 2017 (green triangles), with HBASE polygons (bright pink) and the Ventura County Hazard Fuels map. Thomas Fire was high risk, and historical fire areas were very high risk.



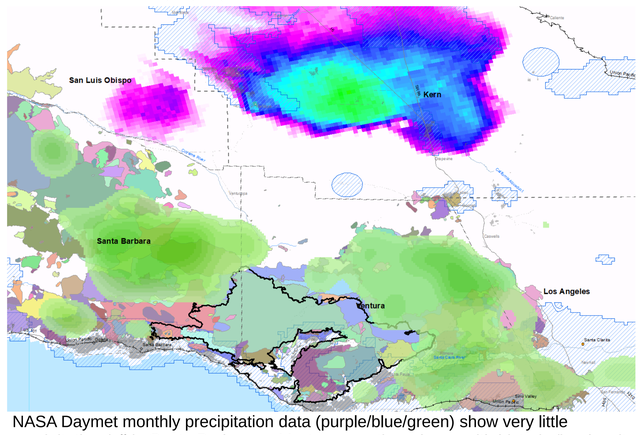
NASA FIRMS hotspots in Ventura and Santa Barbara counties, NOV 2000 to DEC 2017 (green triangles), with HBASE polygons (bright pink) and Ventura County Assets at Risk. Assets at greater risk fell within the Thomas Fire containment area.



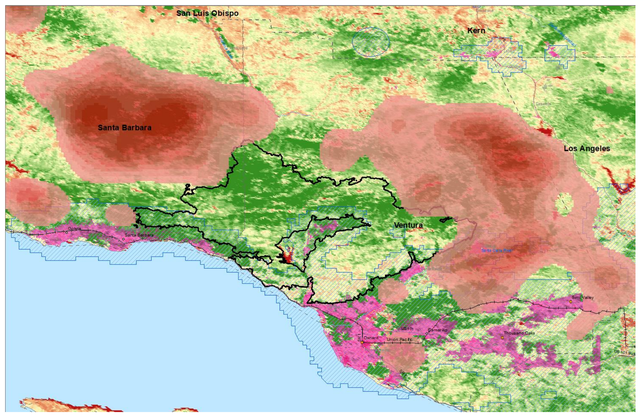
NASA FIRMS Active Fire Hotspots in Ventura and Santa Barbara counties from NOV 2000 to DEC 2017 (green triangles) and the Thomas Fire (red hexagons), with urban extent polygons (blue hash) from GRUMP v1, HBASE polygons (gray), and historic fire areas dating back to 1898 (background colored polygons)



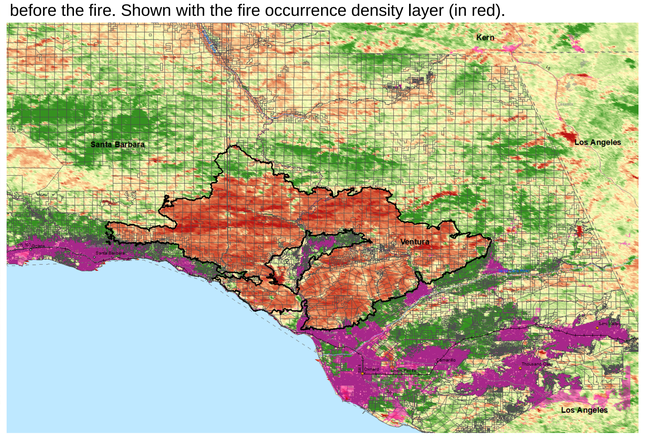
Kernel Density of the NASA FIRMS hotspots creates a fire occurrence density layer (in green) representing those areas with the highest prevalence for a wildfire to occur. The fire density layer (in red) represents where the Thomas Fire occurred.



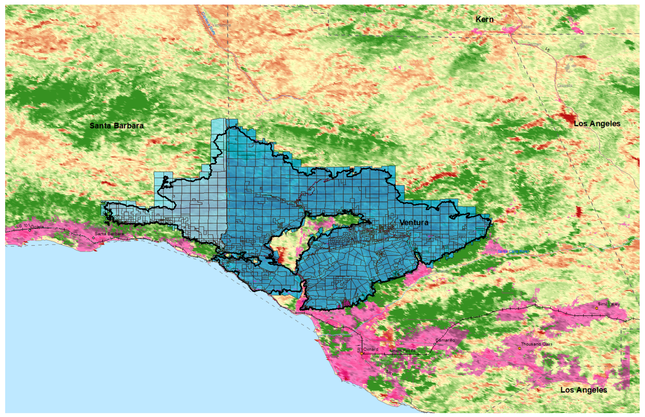
NASA Daymet monthly precipitation data (purple/blue/green) show very little precipitation fell in Santa Barbara or Ventura counties, shown with historic fire density layer (green hues), HBASE polygons (gray), urban extent polygons (blue hash), and historic fire polygons (colored, in background).



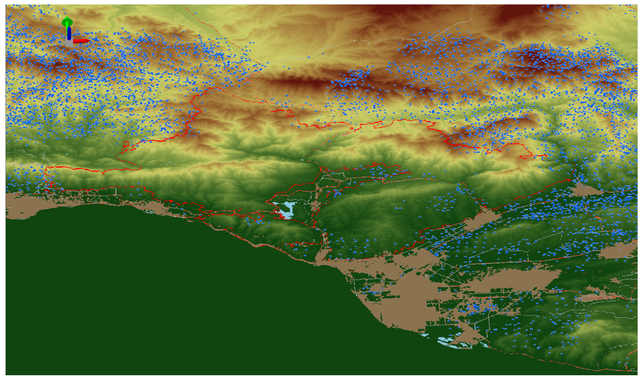
NASA Normalized Difference Vegetation Index (NDVI) information (above) from MODIS/Terra Vegetation Indices, displaying the density of vegetation (green) within the study area. The NDVI clearly shows an abundance of vegetation in the area before the fire. Shown with the fire occurrence density layer (in red).



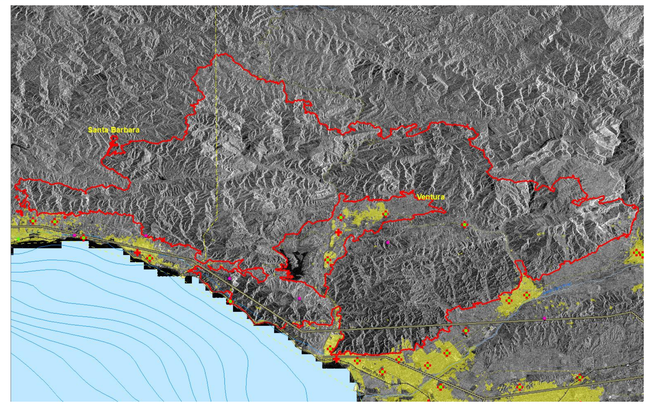
Enhanced Vegetation Index (EVI) (above) after the Thomas Fire was contained from December 19, 2017 clearly show the burn scar area, including an overlay of parcel data from Santa Barbara County and Ventura County.



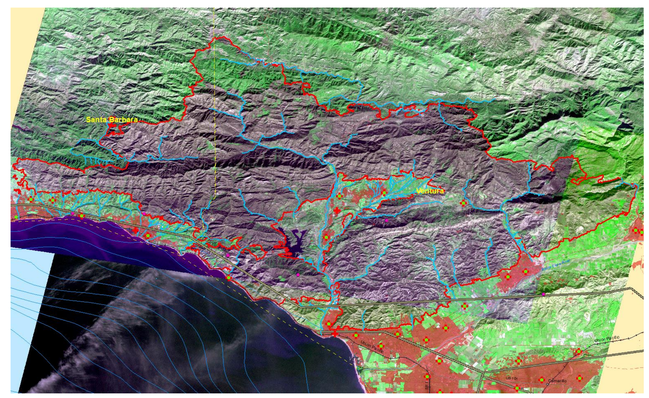
Intersection of the Thomas Fire containment boundary (January 12, 2018) with parcel data creates the affected parcels of Santa Barbara (light blue on left) and Ventura (darker blue on right) counties, with HBASE polygons in pink.



NASA Global Digital Elevation Model (GDEM) can be opened in ArcScene and floated onto a custom surface to visualize the elevation and layer the Thomas Fire containment border (dark red), HBASE polygons (brown) and historical fire hotspots (blue dots). This visualization is a better depiction of the 17 named canyons and several unnamed canyons that were scarred by the Thomas Fire. This visualization can be augmented with ancillary layers to further the focus of the analysis.



Copernicus Sentinel-1A Synthetic Aperture Radar (SAR) data (retrieved from ASF DAAC JAN 2018, processed by ESA) displays terrain in the Thomas Fire burn scar (red outline). The Sentinel-1A C-band SAR provides images with 10m resolution within hours of acquisition, which can emergency response efforts. The image includes HBASE polygons (yellow), and layers of emergency medical service (EMS) stations (red crosses), fire stations (green dots), cellular towers (pink pentagons), natural gas liquid pipelines (yellow lines), and bathymetry contours (blue lines).



NASA ASTER L1T data, captured on December 26, 2017, clearly shows the burn scar area; image includes HBASE polygons (red), and ancillary layers of emergency medical service (EMS) stations (red crosses), fire stations (green dots), cellular towers (pink pentagons), natural gas liquid pipelines (yellow lines), affected streams and creeks (blue lines), and bathymetry contours (blue lines in ocean).

Data Used:

Alaska Satellite Facility (ASF) Distributed Active Archive Center (DAAC)
https://www.asf.alaska.edu/about/asf-daac/
- Copernicus Sentinel-1A Synthetic Aperture Radar (SAR) data, January 2018, processed by the European Space Agency (ESA)

Fire Information for Resource Management System (FIRMS)
https://firms.modaps.eosdis.nasa.gov/active_fire/#firms-shapefile
- Active Fire Hotspots from MODIS Collection 6 (C6), November 2000 – December 2017

Land Processes DAAC (LP DAAC)
https://lpdaac.usgs.gov/
- ASTER Global Digital Elevation Model version 2 (GDEM v2)
- ASTER Level 1 Precision Terrain (L1T) Corrected Registered At-Sensor Radiance V003
- MODIS Collection 6 (C6) Vegetation Indices 16-Day L3 Global 250m SIN Grid

Oak Ridge National Laboratory (ORNL) DAAC
https://daac.ornl.gov/
- Daymet version 3 monthly precipitation for December 2017

Socioeconomic Data and Applications Center (SEDAC)
http://sedac.ciesin.columbia.edu/
- Global Rural Urban Mapping Project version 1 (GRUMP v1) urban extent polygons
- Global Human Built-up and Settlement Extent (HBASE) polygons

Department of Homeland Security (DHS) Homeland Infrastructure Foundation-Level Data (HIFLD) Open Data
https://hifld-geoplatform.opendata.arcgis.com/
- Bathymetry Contours
- Cellular Towers
- Emergency Medical Service (EMS) stations
- Fire Stations
- Natural Gas Liquid Pipelines

Santa Barbara County GIS
https://www.countyofsb.org/mapping.sbc
- Parcel data

Ventura County GIS
https://www.ventura.org/gis-and-mapping/
- Parcel data and maps for Assets at Risk, Hazard Fuels