

Smoke Tools and Smoke Management

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SCTPBA Annual Meeting 2017

Particle levels are a principal concern in wildland fire smoke. The size of particles in the air we breathe affects their potential to cause health problems. Particle pollution may contain substances like carbon, sulphur and nitrogen compounds, metals and organic chemicals.

Particle size is usually measured in microns, which are units of one millionth of a metre. **Coarse particles range from 2.5-10 microns in diameter.** Fine particles, with diameters less than 2.5 microns are often linked to health effects. Particles in this size range are slow to clear from the lungs when they are inhaled.

Particles from smoke tend to be extremely small, with a size range near the wavelength of visible light (0.4 to 0.7 microns). At this size range, smoke particles efficiently scatter light and make it difficult to see, explaining why people often become disoriented in smoke. It also explains why some smoke particles can be inhaled deeply into the lungs and why these are a greater health concern than larger particles

Definitions:

Pm 2.5 - Particle size of 2.5 Microns or less

Micron - is a unit of measurement like inch or mile

A Micron is $1,000,000^{\text{th}}$ of a meter

There are 25,000 PM 2.5 particles in an inch

Concentration of Pm 2.5 in $\mu\text{g}/\text{m}^3$

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Models and Tools Smoke

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Smoke Models and Tools

BlueSky Framework is a model management system that facilitates the use of predictive models to simulate the cumulative impacts of smoke on air quality from forest, agricultural, and range fires.

CONSUME Newest Version of Consume Found in the **Fuel and Fire Tools (FFT)**. FFT integrates FCCS with Consume and FEPS into a single user interface, and offers direct linkages to the Pile Calculator and Digital Photo Series. The older stand-alone version of FEPS (v1.1) is still available for download but will not be updated and is no longer compatible with recent versions of Windows (7 and higher).

FEPS (Fire Emission Production Simulator) The latest version of the Fire Emissions Production Simulator (FEPS) is housed within the **Fuel and Fire Tools (FFT)**. FFT integrates FCCS with Consume and FEPS into a single user interface, and offers direct linkages to the Pile Calculator and Digital Photo Series. The older stand-alone version of FEPS (v1.1) is still available for download but will not be updated and is no longer compatible with recent versions of Windows (7 and higher).

HYSPLIT links to current NOAA weather forecasts to project plume dispersion and downwind concentrations from fires or a variety of other sources, within the next 48 hours. The model can be downloaded to a PC or run interactively on the **Air Resources Laboratory's READY** website.

The Simple Smoke Screening Model is a graphical tool created by the Southern High Resolution Monitoring Consortium (SHRMC) that predicts the downwind smoke impact zone based on the wind forecast direction, burn acres, fuel type, and ignition method. This tool is now hosted on our site.

VSmoke is a detailed planning tool that estimates downwind concentrations of particulate matter at 31 fixed distances, and how far and how well a person may see through the smoke plume at each distance.

VSmoke-Web is a user-friendly tool which produces smoke plume overlays on a map or satellite image that represent expected downwind concentrations of particulate matter relative to the Air Quality Index and potential health impacts.

Wildland Fire Air Quality Tools is an integrated site with multiple tools **related to forecasting smoke and air quality** designed especially for access in the Wildland Fire Decision Support System (WFDSS).

Epperson Burn July 12, 2017

- Conditions:
 - Temperature around 90
 - Rh 55 - 36
 - Wind speed 8-10
 - Wind direction Mostly SE

Simple Smoke Model

The screenshot displays the Simple Smoke Model web application in a web browser. The browser's address bar shows the URL: `southernfireexchange.org/Models_Tools/Simple-Smoke/simple-smoke.html`. The page features a left-hand navigation menu with the following links: Calendar of Events, Discussion Forums, Education and Training, Fire Science Libraries, Models, Tools, Apps, Plan Your Burn, Prescribed Fire Councils, SFE Publications, Spotlight Series, Webinars and Events, What's New, and Contact Us. At the bottom of this menu is the "ask an EXPERT" logo.

The main content area contains a map of the region around Rocksprings, Texas. A yellow smoke plume is shown originating from a point marked with a red pin near the intersection of Highway 377 and Highway 55. The smoke plume extends northwest, covering a large area. The map includes labels for "Rocksprings", "Devil's Sinkhole State Natural Area", and various highways (2995, 2630, 377, 55, 674, 41). A "Map" button and a "Satellite" button are located in the top left of the map area.

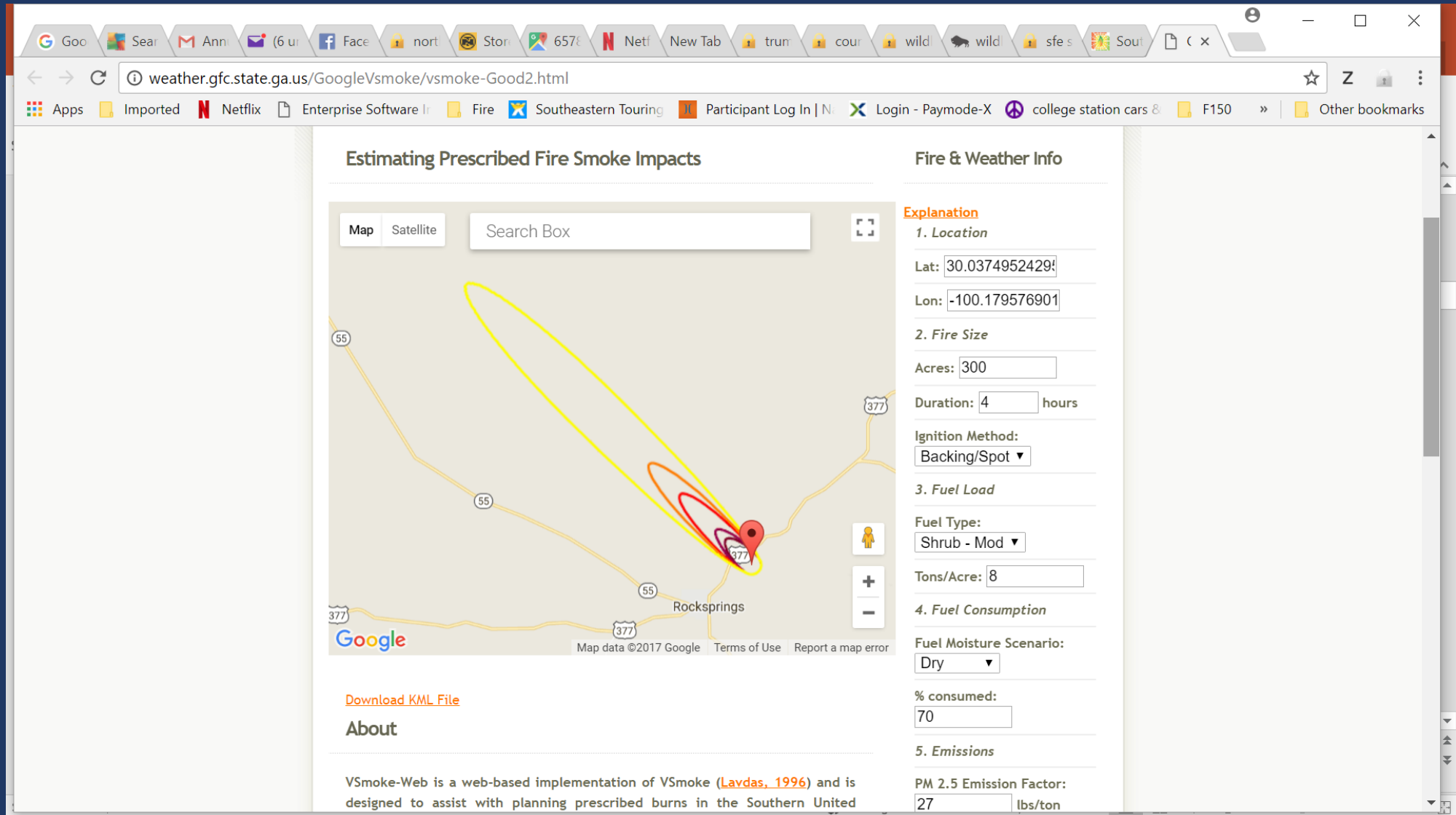
On the right side of the map, there is a "Fire & Fuel Info" panel with the following fields and controls:

- Lat:
- Lon:
- Acres:
- Fuels:
- Ignition Method:
- Wind Direction: +/-
-
- After generating a grid save the data for display in Google Earth
-
-

Simple Smoke model

- Basically a trajectory model
- Darker color represents area of highest concern for public safety.

Vsmoke Web



Vsmoke

- VSmoke-Web is a web-based implementation of VSmoke ([Lavdas, 1996](#)) and is designed to assist with planning prescribed burns in the Southern United States. VSmoke is a simple gaussian smoke dispersion model that calculates isopleths of **surface smoke concentration**. **Output from the model represents *peak hourly concentrations of PM2.5* or visibility (under development)**. Contour values and their colors correspond to the PM 2.5 thresholds for the Air Quality Index (AQI) and reflect potential health impacts ranging from moderate to hazardous ([Visit AirNow for more AQI info](#)).

Vsmoke concentrations Pm 2.5

weather.gfc.state.ga.us/GoogleVsmoke/vsmoke-Good2.html

Apps Imported Netflix Enterprise Software Inc Fire Southeastern Touring Participant Log In | N Login - Paymode-X college station cars & F150 Other bookmarks

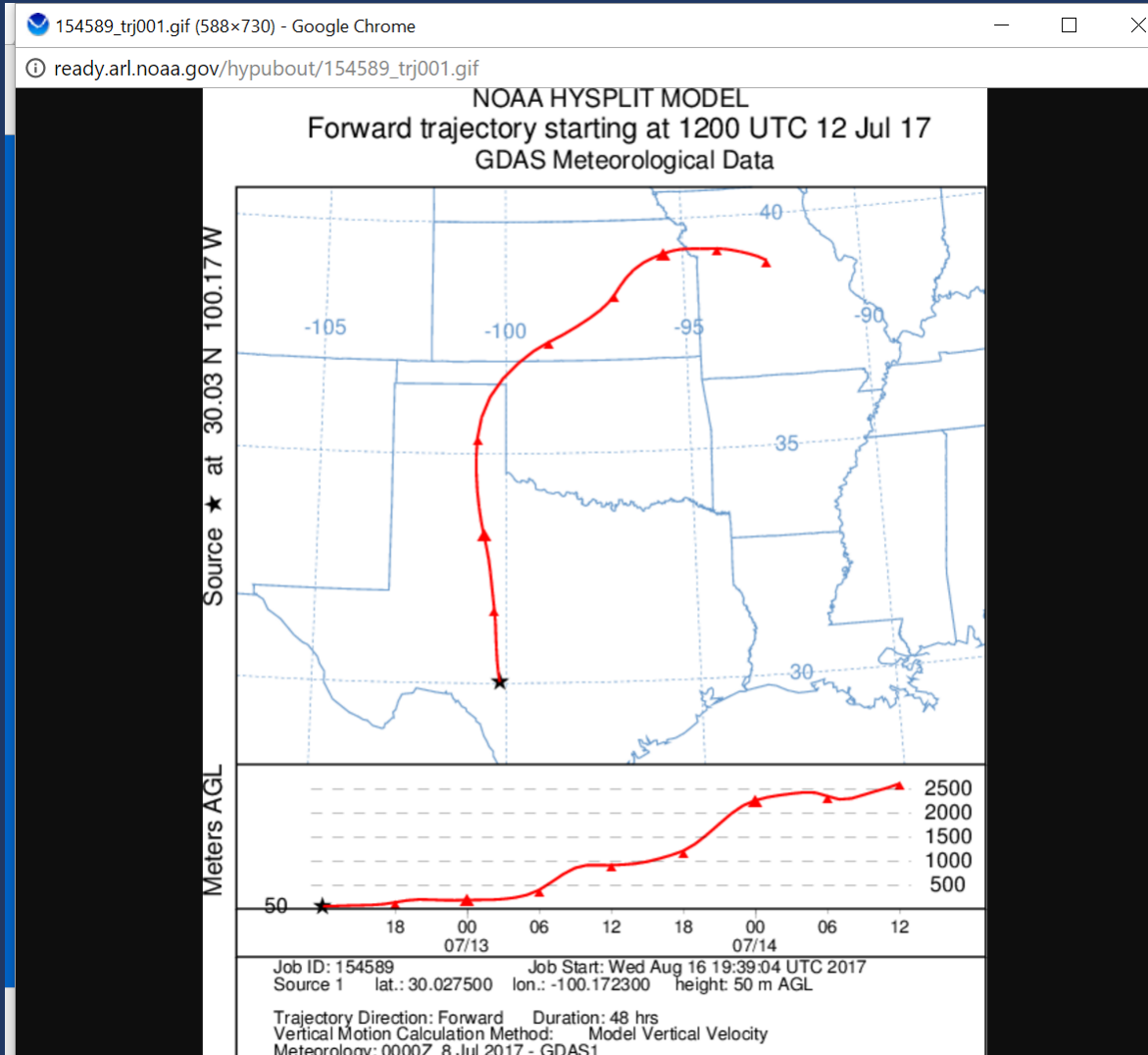
AQI

Levels of Health Concern	AQI Value	Hourly PM 2.5 Conc.	Meaning
Good	0 to 50	0 to 38	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	39 to 88	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	89 to 138	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	139 to 351	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	352 to 526	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	> 526	Health warnings of emergency conditions. The entire population is more likely to be affected.

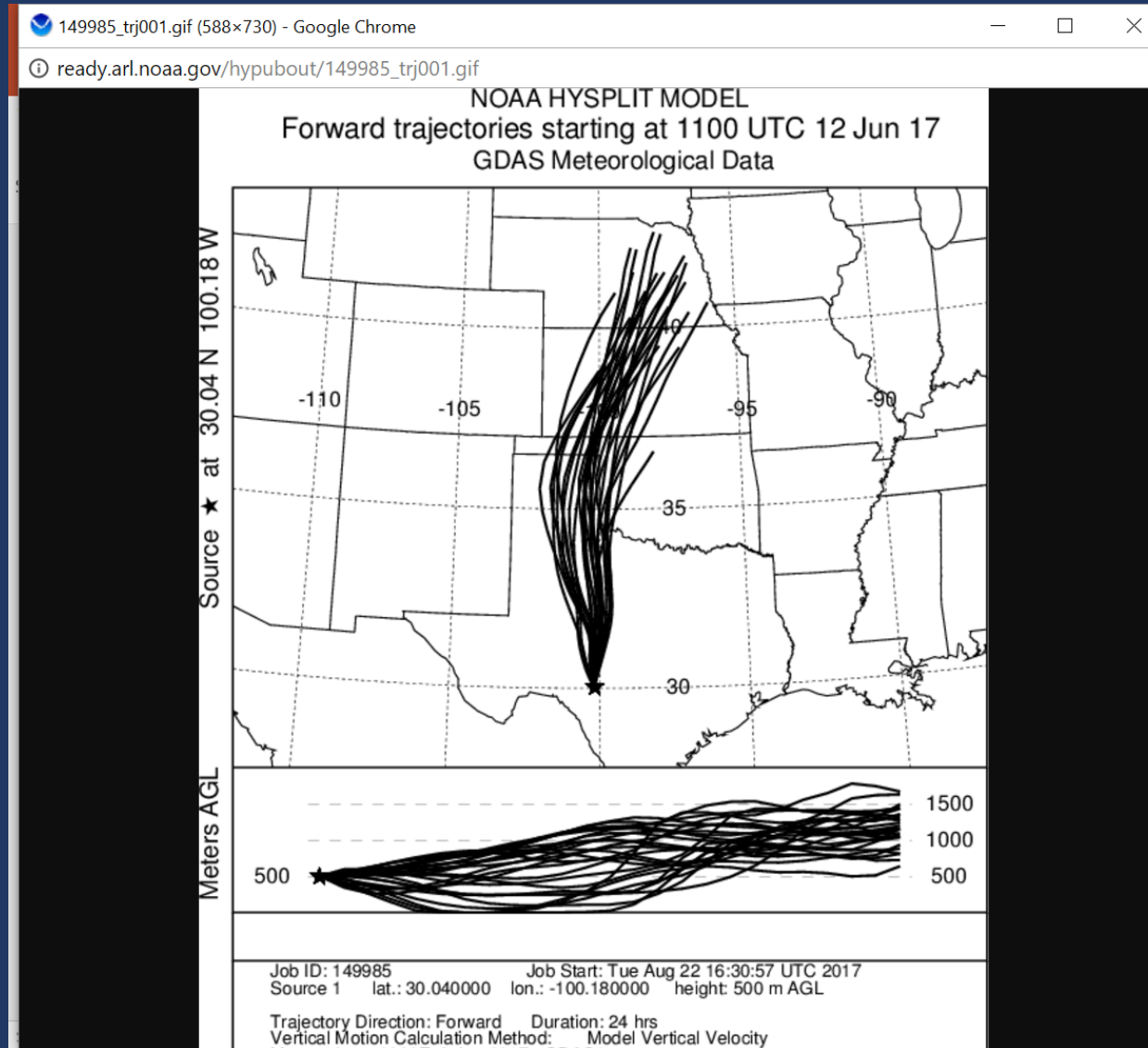
Transport Wind: 10 mph
SE
Stability Class: Moderately Unstable
7. Update Map
Run Model
8. Misc Options
Background PM 2.5: 5 ug/m3
Plume Rise Fraction: -0.50
9. HYSPLIT Info
Total Emissions: 2.062e+13 ug

Product of the Fire Consortium for Advanced Modeling of Meteorology and Smoke (FCAMMS)

Hysplit



Hysplit every 6 hr trajectory



Let's go to the playground

Bluesky playground that is:

- www.playground.airfire.org
- Create an emissions scenario
 - You can make changes to the inputs.
- Create a dispersal scenario

Bluesky components

FUELS INFORMATION DATASETS

- FCCS – Fuels Characteristic Classification System, *U.S. Forest Service FERA Team, esp. Dr. Don McKenzie*
- LANDFIRE – *U.S. Forest Service Missoula Fire Lab*

CONSUMPTION MODELS

- CONSUME – *U.S. Forest Service FERA Team, esp. Drs. Roger Ottmar, Susan Prichart, and Clint Wright also many thanks to MTRI and Prof. Nancy French.*

EMISSIONS FACTORS / MODELS

- FEPS – *U.S. Forest Service FERA Team, esp. Dr. Sam Sandberg*

Bluesky components

DISPERSION MODELS

- HYSPLIT – *NOAA Air Resources Laboratory, esp. Dr. Roland Draxlar*
- VSMOKE-GIS – *U.S. Forest Service Southern Research Station, esp. Dr. Scott Goodrick*

METEOROLOGICAL FORECASTS

- National 12-km Forecast – *from the National Weather Service NAM forecast model*
- PNW 4-km Forecast – *from the Northwest Regional Modeling Consortium, lead Prof. Cliff Mass, University of Washington*
- California / Nevada 2-km Forecast – *from the California / Nevada Smoke and Air Consortium (CANSAC), led by Prof. Tim Brown, Desert Research Institute*

Home » My Emissions » E burn 1 (Wildfire)

Size and Location | Fuels | Moisture | Consumption | Timing | Emissions | Notes

Daily Size (growth) in acres

Day 1

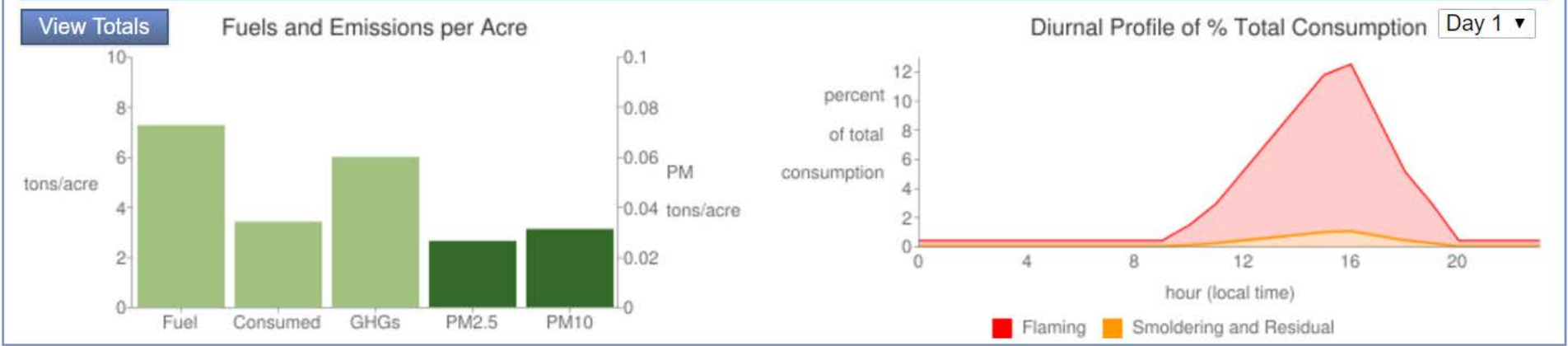
Day 2

Total Size: 375 acres

[Add a Day](#)

Latitude

Longitude



Home » My Emissions » E burn 1 (Wildfire)

Size and Location | **Fuels** | Moisture | Consumption | Timing | Emissions | Notes

Use Fuels From

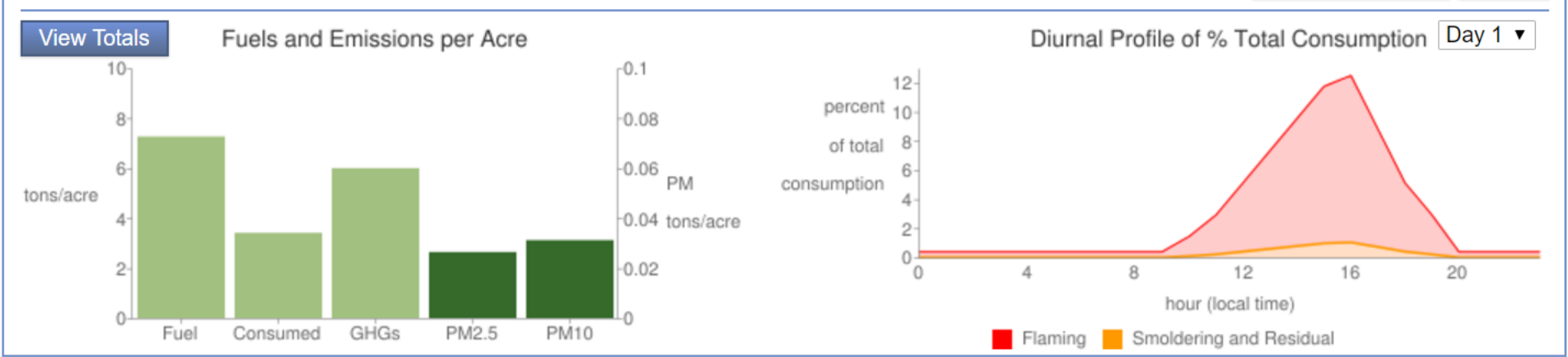
- ☒ FCCS Fuelbed #411 From Map
- ☐ FCCS Fuelbeds
- ☐ LANDFIRE Fuel Loading Models
- ☐ Custom Fuel Loading

Fuel Loading Results

1-hr	<input type="text" value="0.2"/>	tons/acre	Canopy	<input type="text" value="2.26"/>	tons/acre
10-hr	<input type="text" value="0.4"/>	tons/acre	Shrubs	<input type="text" value="0.75"/>	tons/acre
100-hr	<input type="text" value="0.8"/>	tons/acre	Grasses	<input type="text" value="0.18"/>	tons/acre
1,000-hr	<input type="text" value="0.2"/>	tons/acre	Litter	<input type="text" value="0.046"/>	tons/acre
10,000-hr	<input type="text" value="0"/>	tons/acre	Rotten	<input type="text" value="0"/>	tons/acre
>10,000-hr	<input type="text" value="0"/>	tons/acre	Total Above Ground	3.24	tons/acre
Total Sound Woody	1.60	tons/acre			
Duff Depth	<input type="text" value="0.2"/>	inches	Total Fuel Loading	7.26	tons/acre

Discard Changes

Apply



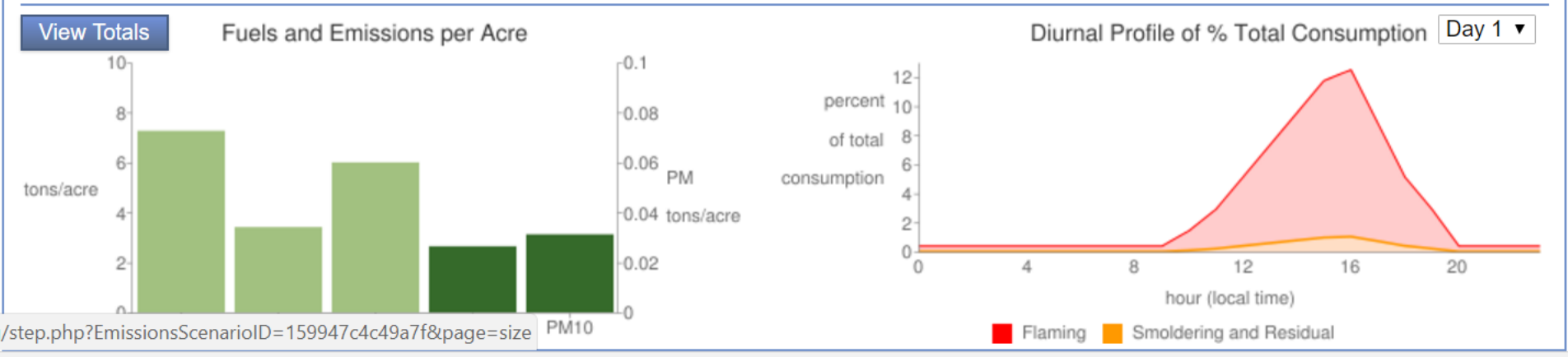
Home » My Emissions » E burn 1 (Wildfire)

Size and Location | **Fuels** | **Moisture** | Consumption | Timing | Emissions | Notes

Fuel Moisture Conditions
Moderate ▼

Fuel Moisture Results (Percent)
10-hr: 9 %
1,000-hr: 15 %
Duff: 70 %

Discard Changes | Apply



Home » My Emissions » E burn 1 (Wildfire)

- Size and Location
- Fuels
- Moisture
- Consumption
- Timing
- Emissions
- Notes

Consumption Model
☒ Consume 3

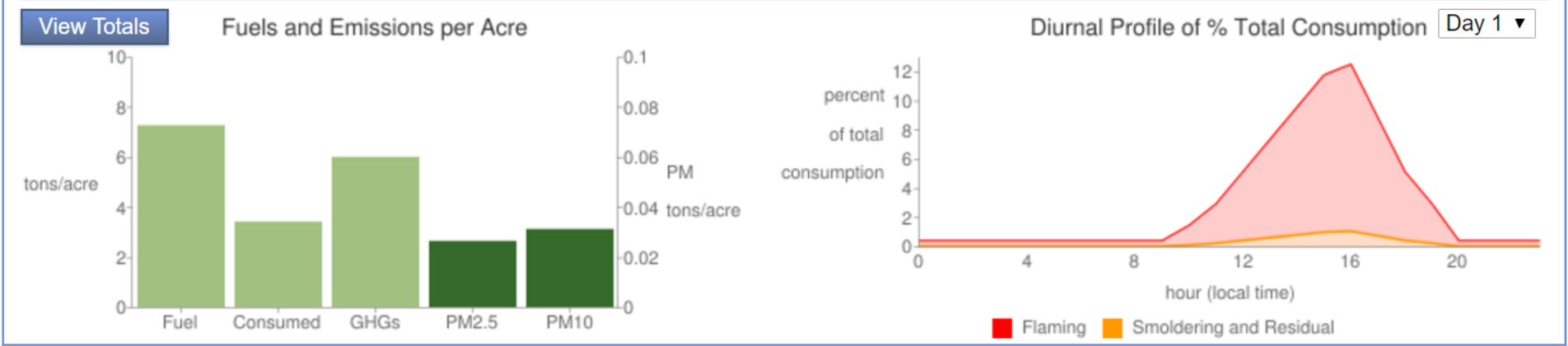
Canopy Consumed %

Consumption Results

Flaming	3.15	tons/acre	Duff	0.00	tons/acre
Smoldering	<input type="text" value="0.23"/>	tons/acre			
Residual	<input type="text" value="0.03"/>	tons/acre			
Total	3.41	tons/acre			

Discard Changes

Apply



Home » My Emissions » E burn 1 (Wildfire)

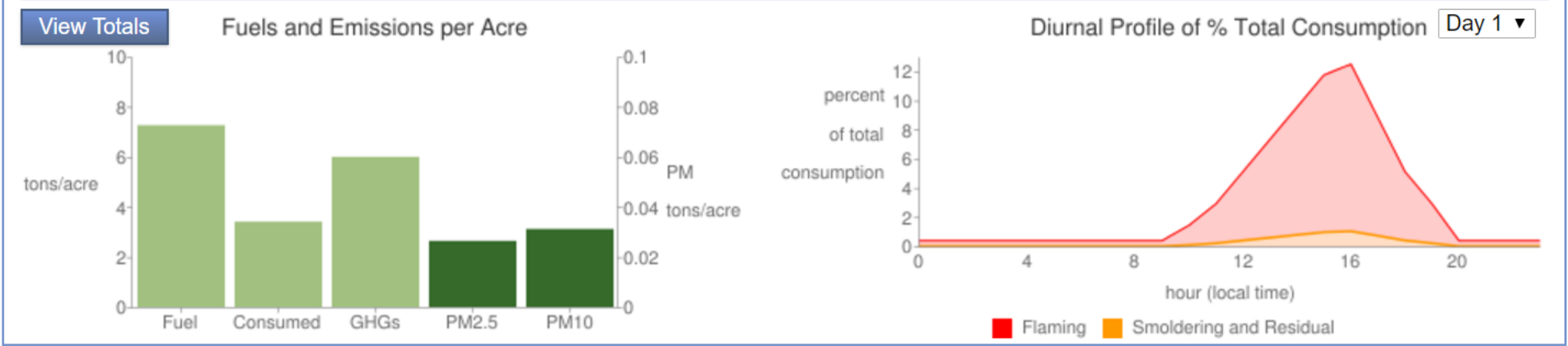
Size and Location | Fuels | Moisture | Consumption | Timing | Emissions | Notes

Emissions Model
☒ FEPS

Emissions Results

PM _{2.5}	<input type="text" value="9.91"/>	tons	CH ₄	<input type="text" value="5.31"/>	tons
PM ₁₀	<input type="text" value="11.69"/>	tons	NO _x	<input type="text" value="2.84"/>	tons
CO	<input type="text" value="102.21"/>	tons	VOCs	<input type="text" value="24.52"/>	tons
CO ₂	<input type="text" value="2013.58"/>	tons	NH ₃	<input type="text" value="1.71"/>	tons
GHGs	<input type="text" value="2248.54"/>	tons CO ₂ e	SO ₂	<input type="text" value="1.21"/>	tons
			Heat	<input type="text" value="222.19"/>	BTU/ft ²

Discard Changes | Apply



Home » My Dispersions » E burn 1 dispersion (HYSPLIT)

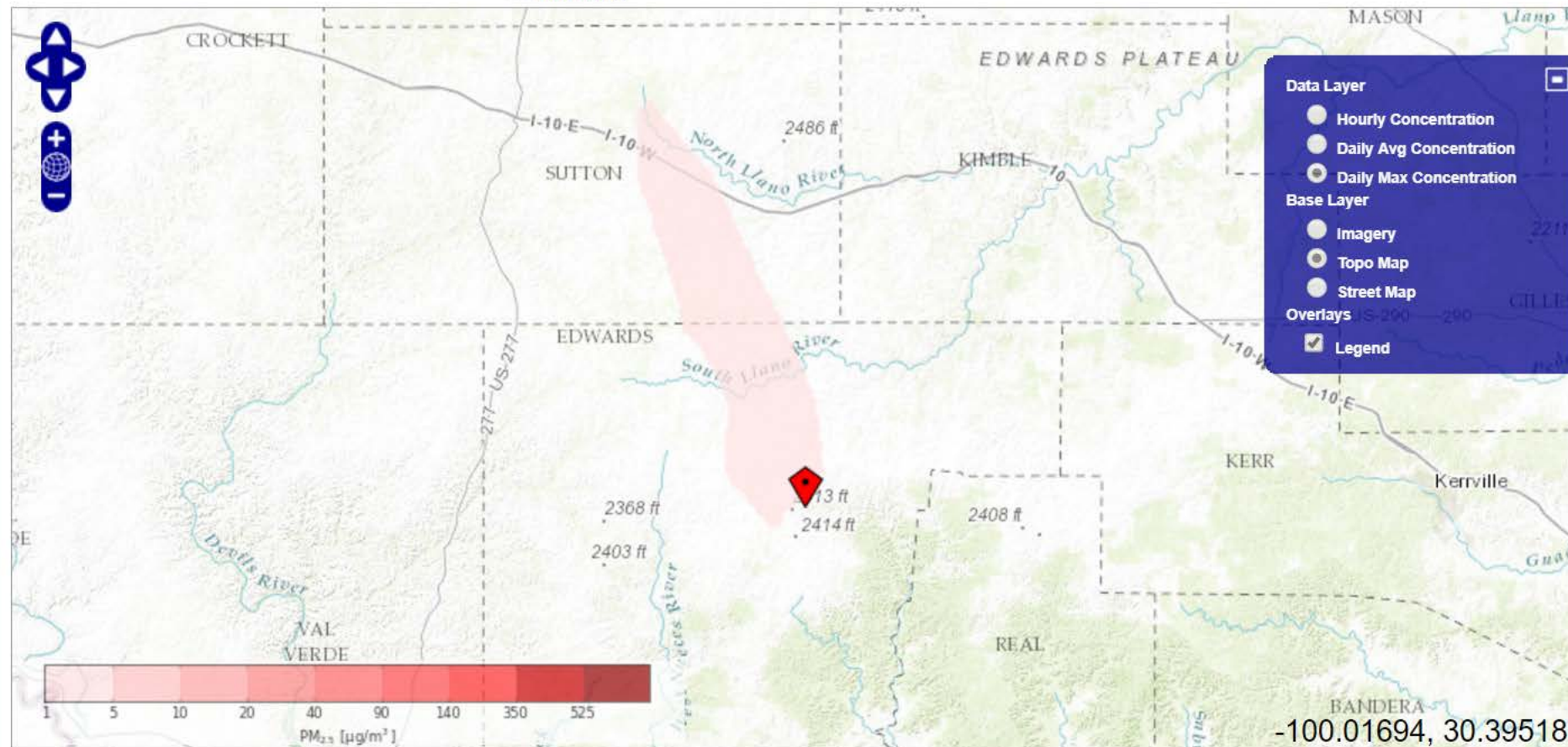
Settings Results Notes

Full Dispersion Forecast

<< << >> >> day0 - Jul 12, 2017 ▾

☐ Animate

 Download To Google Earth



Home » My Dispersions » E burn 1 dispersion (HYSPLIT)

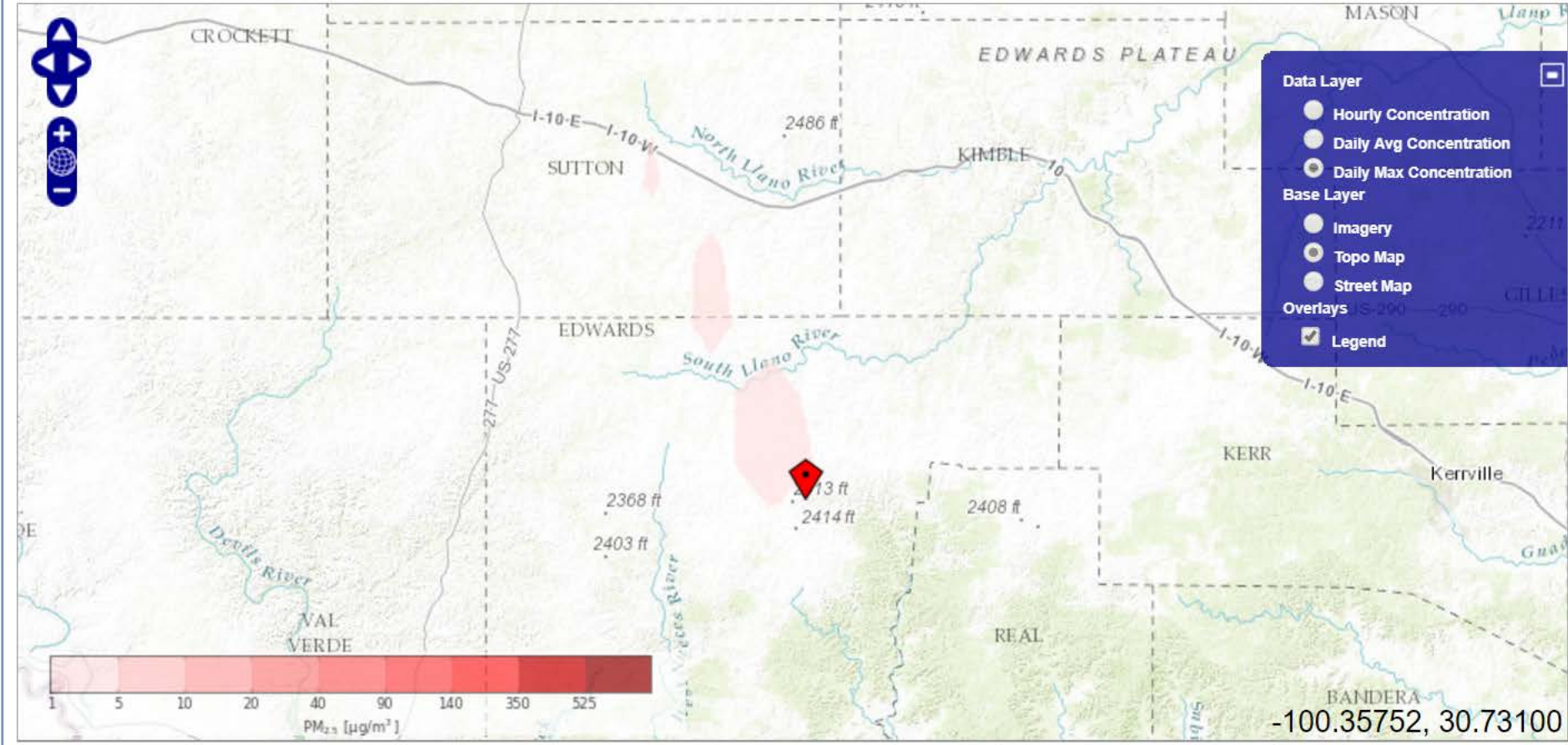
Settings Results Notes

Full Dispersion Forecast

Navigation controls: |<< << slider >> >>| day1 - Jul 13, 2017 ▾

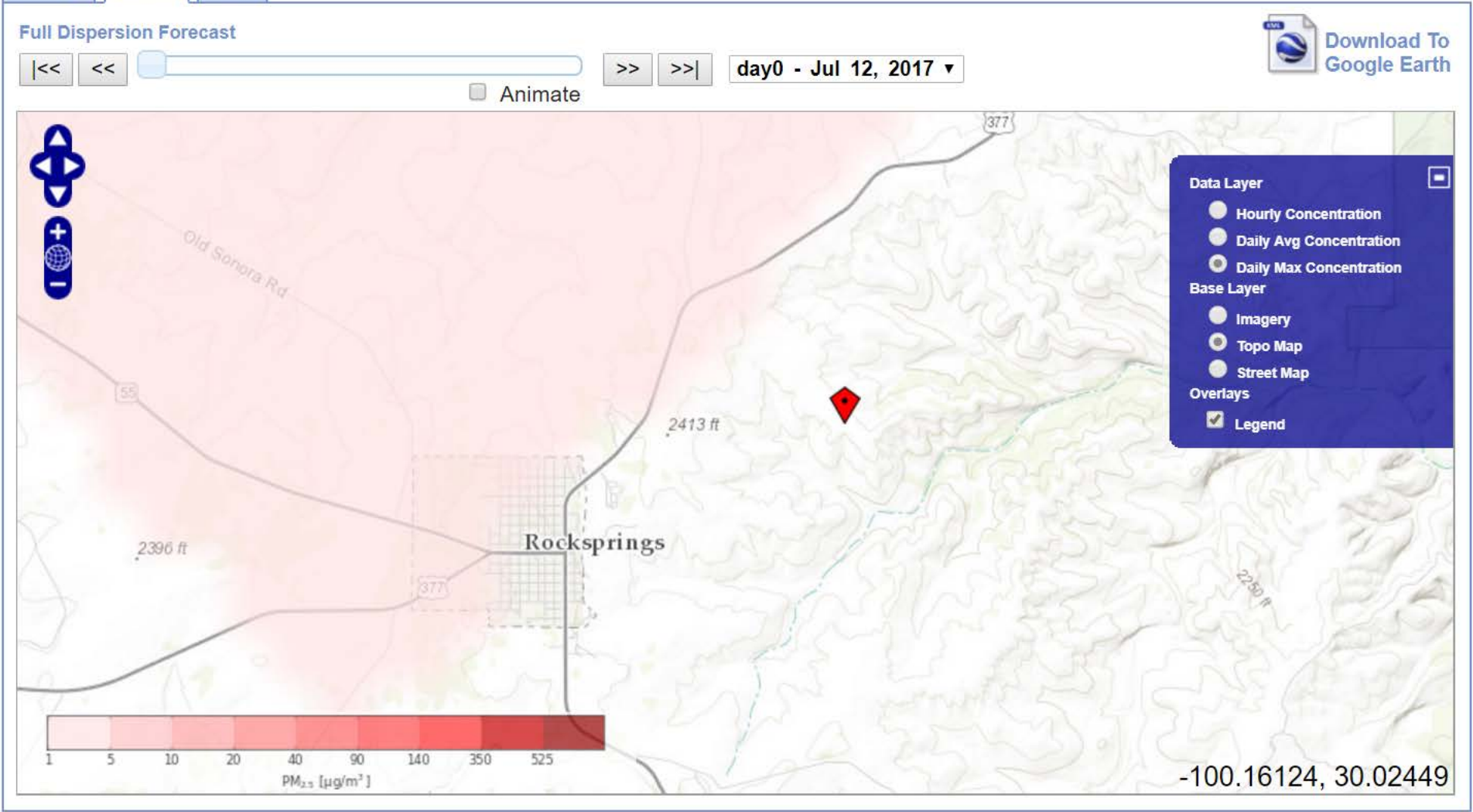
☐ Animate

 Download To Google Earth



Home » My Dispersions » E burn 1 dispersion (HYSPLIT)

Settings Results Notes



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Hazardous	301 to 500	> 526	Health warnings of emergency conditions. The entire population is more likely to be affected.

10 mph

N

Stability Class:
Moderately Unstable

7. Update Map

Run Model

8. Misc Options

Background PM 2.5:
5 ug/m3

Plume Rise Fraction:
-0.50

9. HYSPLIT Info

Total Emissions:
ug

Assessing Air Quality

Category	PM2.5 1-hr avg. concentration ($\mu\text{g}/\text{m}^3$)	Visibility Range (miles)
Good	0-40	10 miles and up
Moderate	41-80	6 to 9 miles
Unhealthy for Sensitive Groups	81-175	3 to 5 miles
Unhealthy	176-300	1 1/2 to 2 1/2 miles
Very Unhealthy	301-500	1 to 1 1/4 mile
Hazardous	Over 500	3/4 mile or less

The procedure for using personal observations to determine the approximate PM₂₅ concentration for local areas without official monitors is:

1. Face away from the sun.
2. Determine the limit of your visible range by looking for targets at known distance (miles). Visible range is that point at which even high contrast objects totally disappear.
3. Use the values above to determine the local forest fire smoke category.

Divide the
Visibility Range
by 2 for night
time.

Developing a smoke management plan using Vsmoke-Web


Hypothetical smoke management plan

	Today	Tonight	Thu
Cloud Cover		Pcldy	MCldy
Precip Type		0	0
Chance Precip (%)		0	0
Temp		91	71
RH %		39	90
20FtWnd-AM(MPH)		6-10	6-10
20FtWnd-PM(MPH)		6-10	6-10)
Mixing Hgt(Ft-AGL)		6641	90
Transport Wnd (MPH)		S 7	SE 8

Morning Backfire
No major smoke issue on
highway. Visibility
greater than or equal to
10 miles.

Enterprise Software Inc. Fire Southeastern Touring Participant Log In | N Login - Paymode-X college station

Map Satellite Search Box



Map data ©2017 Google Terms of Use Report a map error

[Download KML File](#)

About

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1. Location

Lat:

Lon:

2. Fire Size

Acres:

Duration: hours

Ignition Method:

3. Fuel Load

Fuel Type:

Tons/Acre:

4. Fuel Consumption

Fuel Moisture Scenario:

% consumed:

5. Emissions

PM 2.5 Emission Factor: lbs/ton

Particulate Emission Rate: grams/sec

Heat Release Rate:

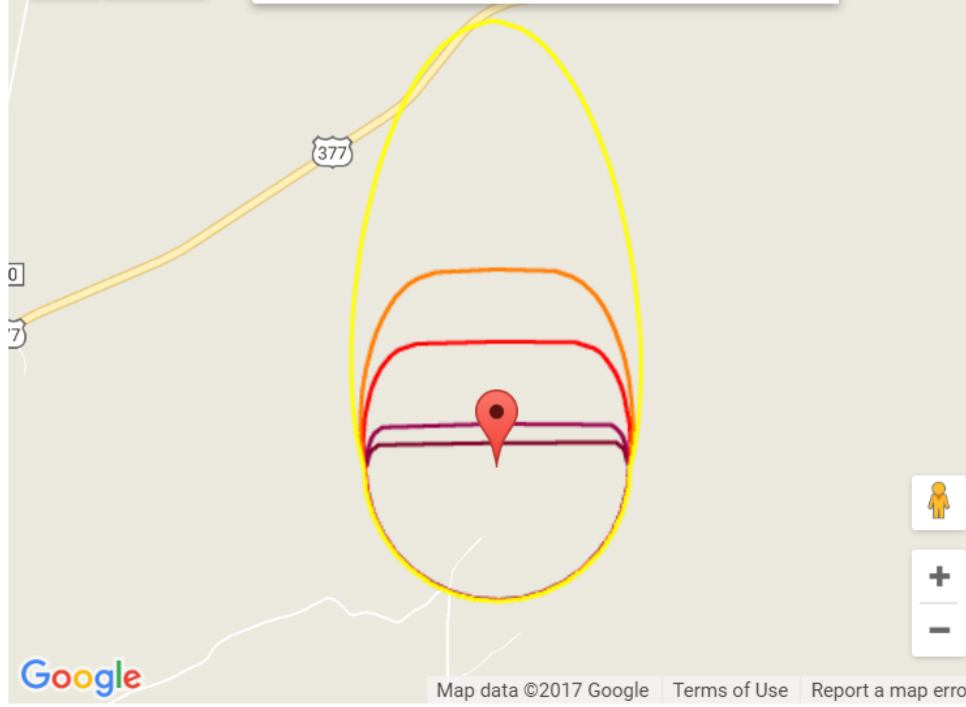
Afternoon Headfire

No major highway
problems. Visibility
greater than 10 miles.

GoogleVsmoke/vsmoke-Good2.html

Enterprise Software | Fire | Southeastern Touring | Participant Log In | Login - Paymode-X | college station

Map Satellite Search Box



Download KML File

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1. Location

Lat: 30.0351175174

Lon: -100.169963864

2. Fire Size

Acres: 300

Duration: 6 hours

Ignition Method: Head/Aerial

3. Fuel Load

Fuel Type: Grass - Lght

Tons/Acre: 1

4. Fuel Consumption

Fuel Moisture Scenario: Dry

% consumed: 80

5. Emissions

PM 2.5 Emission Factor: 27 lbs/ton

Particulate Emission Rate: 136.36363636 grams/sec


Heat Release Rate:

Overnight

Possible visibility issue on the highway.

Visibility potential of less than .3 mile overnight.

Enterprise Software Inc. Fire Southeastern Touring Participant Log In | Ne Login - Paymode-X college station



Lat:
Lon:

2. Fire Size

Acres:

Duration: hours

Ignition Method:

3. Fuel Load

Fuel Type:

Tons/Acre:

4. Fuel Consumption

Fuel Moisture Scenario:

% consumed:

5. Emissions

PM 2.5 Emission Factor:
 lbs/ton

Particulate Emission Rate:
 grams/sec

Heat Release Rate:
 MW

6. Weather

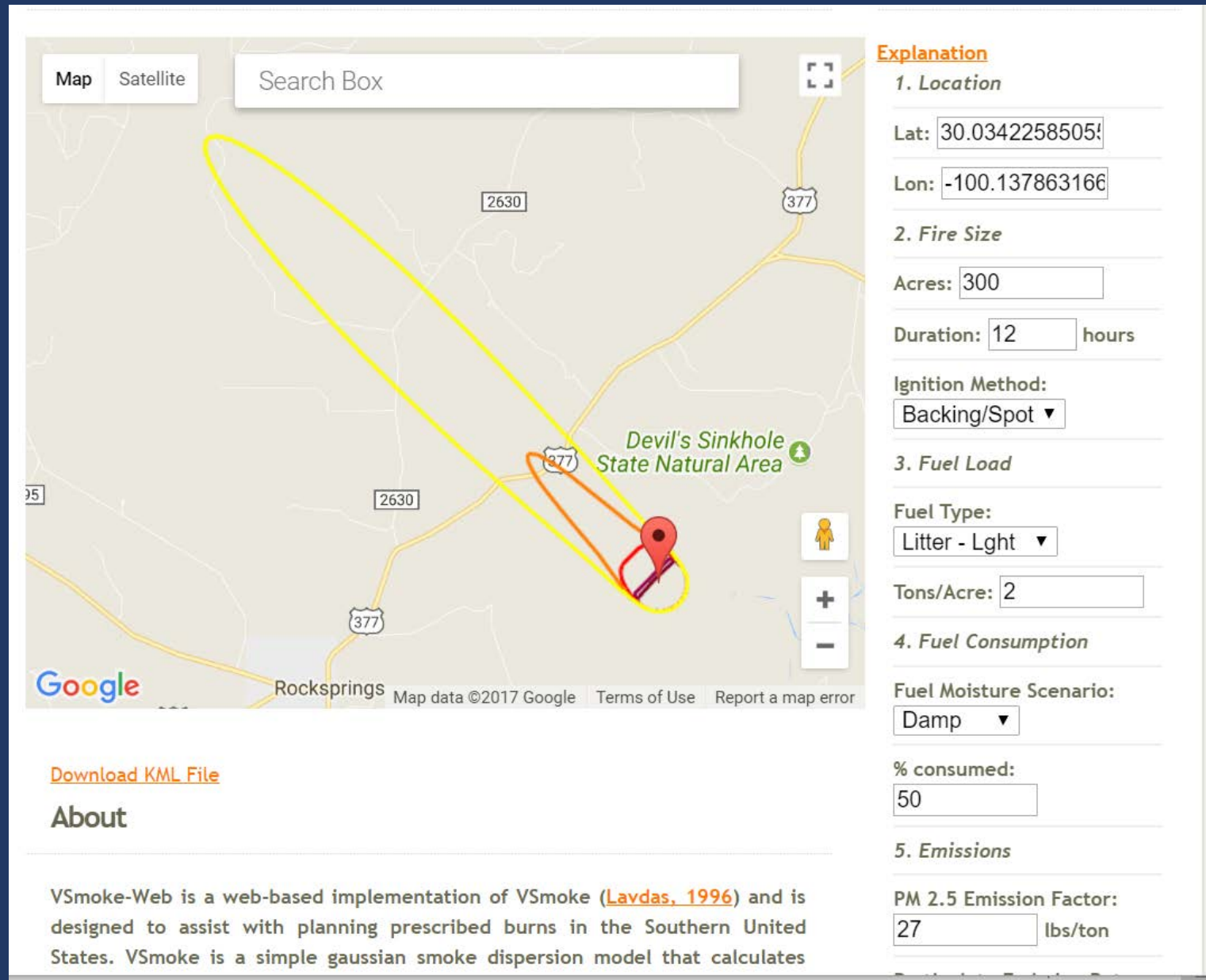
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Plan for a mixing height
with a minimum of 500'
and 10 mph transport
wind speed.

Night distance of 3-5 miles?



Smoke Management Plan

Spend some time developing a smoke management plan. Hope you don't need one but remember you own that smoke!