



Online tools for managing smoke

SCOTT GOODRICK

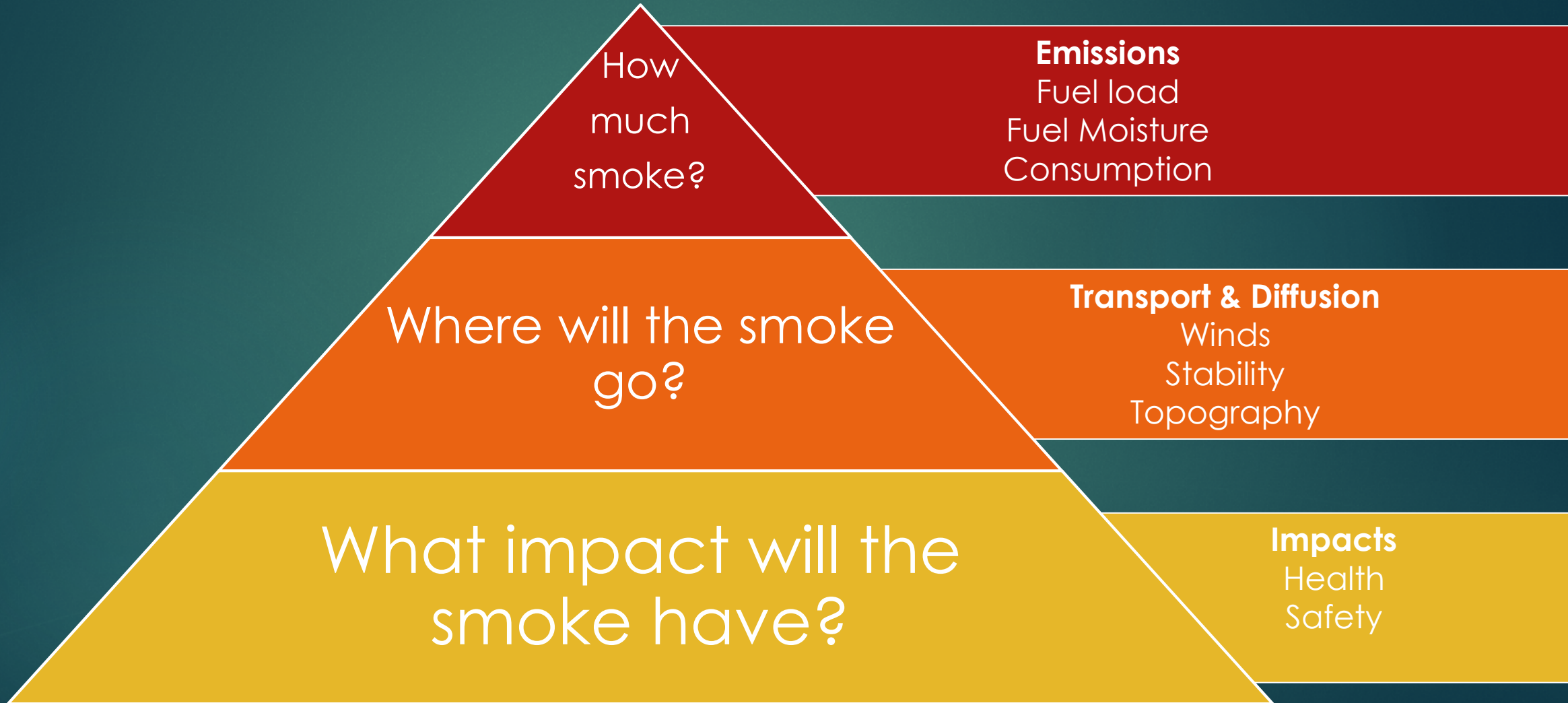
USDA FOREST SERVICE - SOUTHERN RESEARCH STATION

ATHENS GA

Smoke management



Smoke management



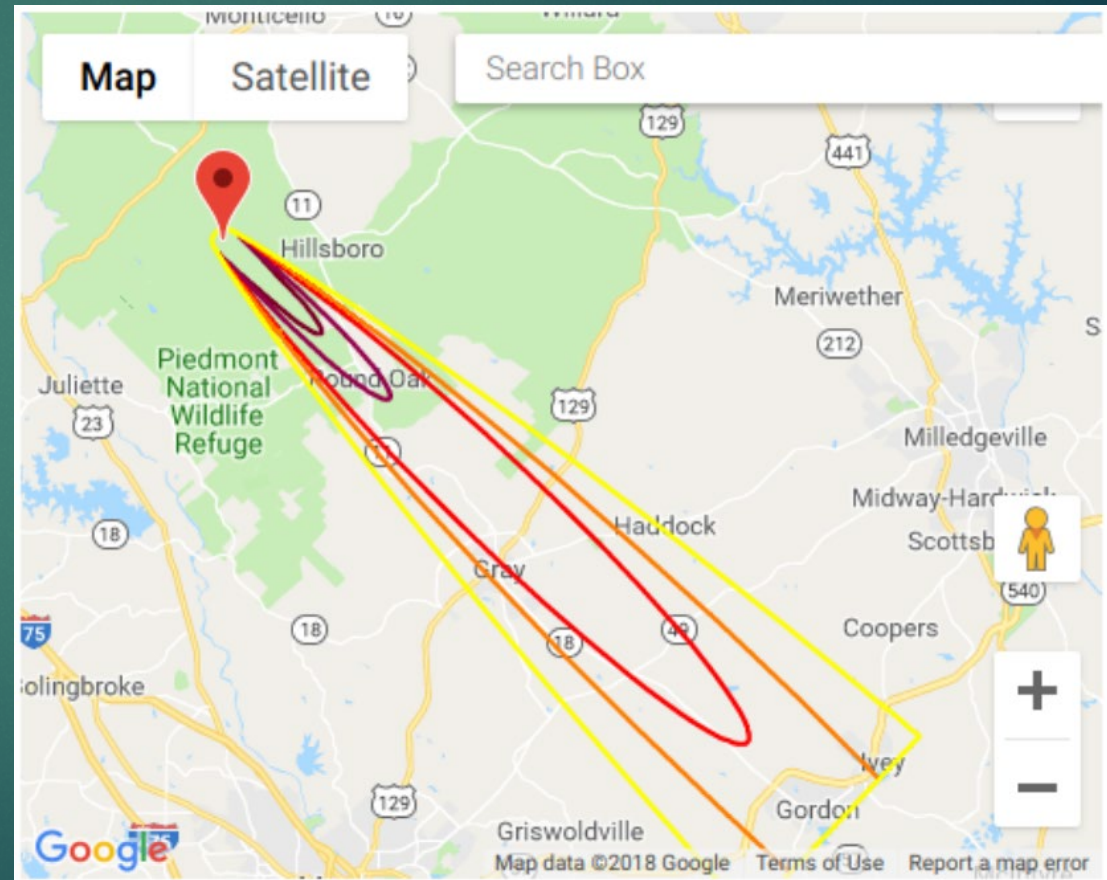
Overview

- ▶ Walkthrough 3 smoke dispersion tools currently available online
 - ▶ VSmoke
 - ▶ BlueSky Playground
 - ▶ PB-Piedmont
- ▶ Focusing on ...
 - ▶ What each tool does
 - ▶ What are the tool's strengths
 - ▶ What are the limitations

VSmoke

<http://weather.gfc.state.ga.us/GoogleVsmoke/vsmoke-Good2.html>

- ▶ Simple Gaussian plume model
- ▶ Very basic interface for estimating fuel loads and emissions
- ▶ Best used for burns conducted with fairly constant weather, especially wind direction
- ▶ Topography must be carefully considered when looking at results
- ▶ Does not provide information on movement of residual smoke at night



VSmoke Demonstration

- ▶ <http://weather.gfc.state.ga.us/GoogleVsmoke/vsmoke-Good2.html>



Estimating Prescribed Fire Smoke Impacts



Fire & Weather Info

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:

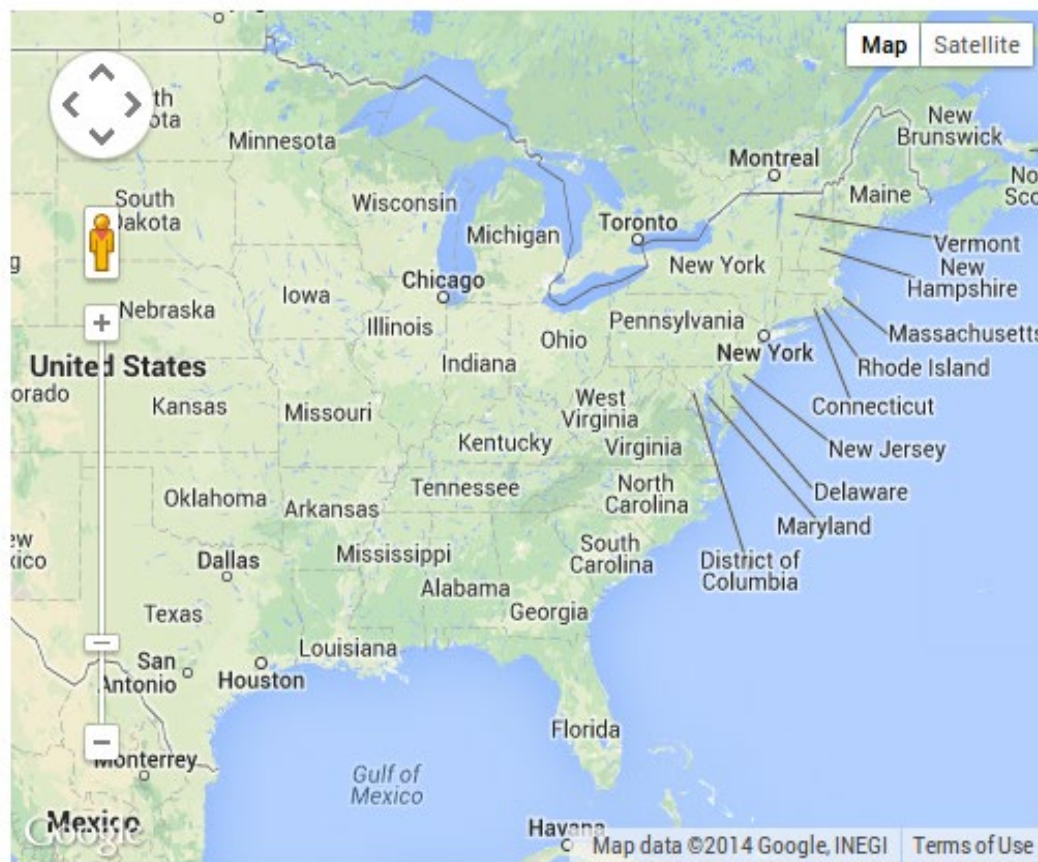
% consumed:

5. Emissions
PM 2.5 Emission Factor:
 lbs/ton

About

VSmoke-Web is a web-based implementation of VSmoke (Lavdas, 1996) and is designed to assist with planning prescribed burns in the Southern United

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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

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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.

PM 2.5 Emission Factor:

lbs/ton

Particulate Emission Rate:

grams/sec

Heat Release Rate:

MW

6. Weather

Mixing Height:

ft

Transport Wind:

mph

Stability Class:

7. Update Map

8. Misc Options

Background PM 2.5:

ug/m3

Plume Rise Fraction:

9. HYSPLIT Info

Total Emissions:

ug

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ug/m3

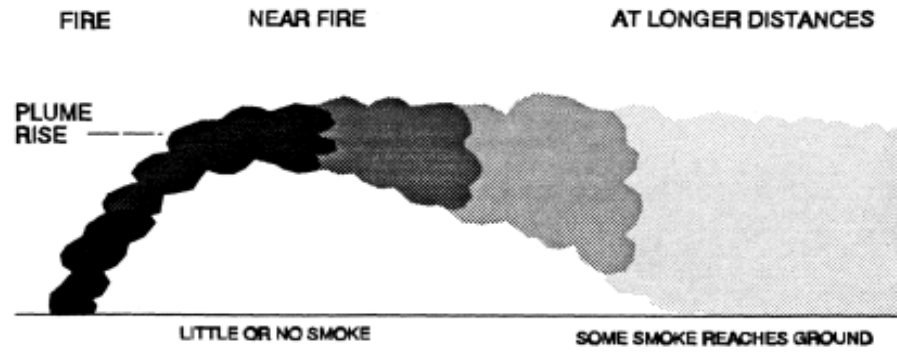
Plume Rise Fraction:

9. HYSPLIT Info

Total Emissions:

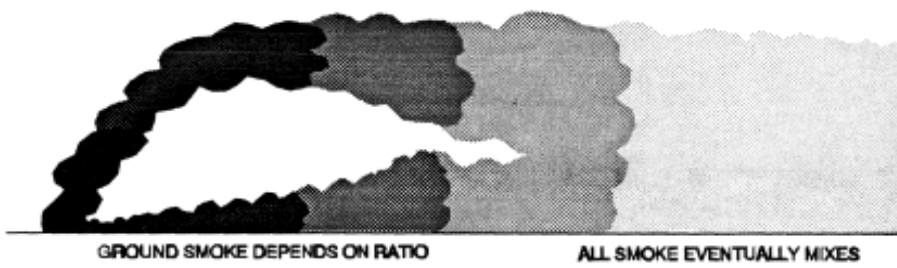
ug

PRF = 1.0



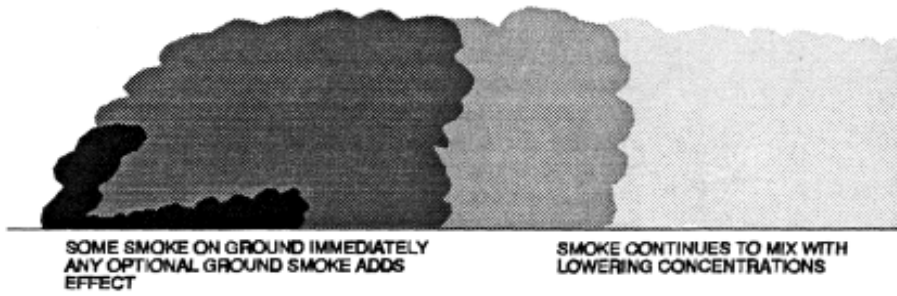
A. ALL SMOKE RISES

$0 < PRF < 1.0$



B. SPLIT PLUME RISE WITH RISE-NO RISE RATIO SET BY INPUT

$-1 < PRF < 0$



C. SMOKE CURTAIN WITH OPTIONAL GROUND SMOKE

Figure 2—Effects of plume rise options on smoke concentrations at the ground.

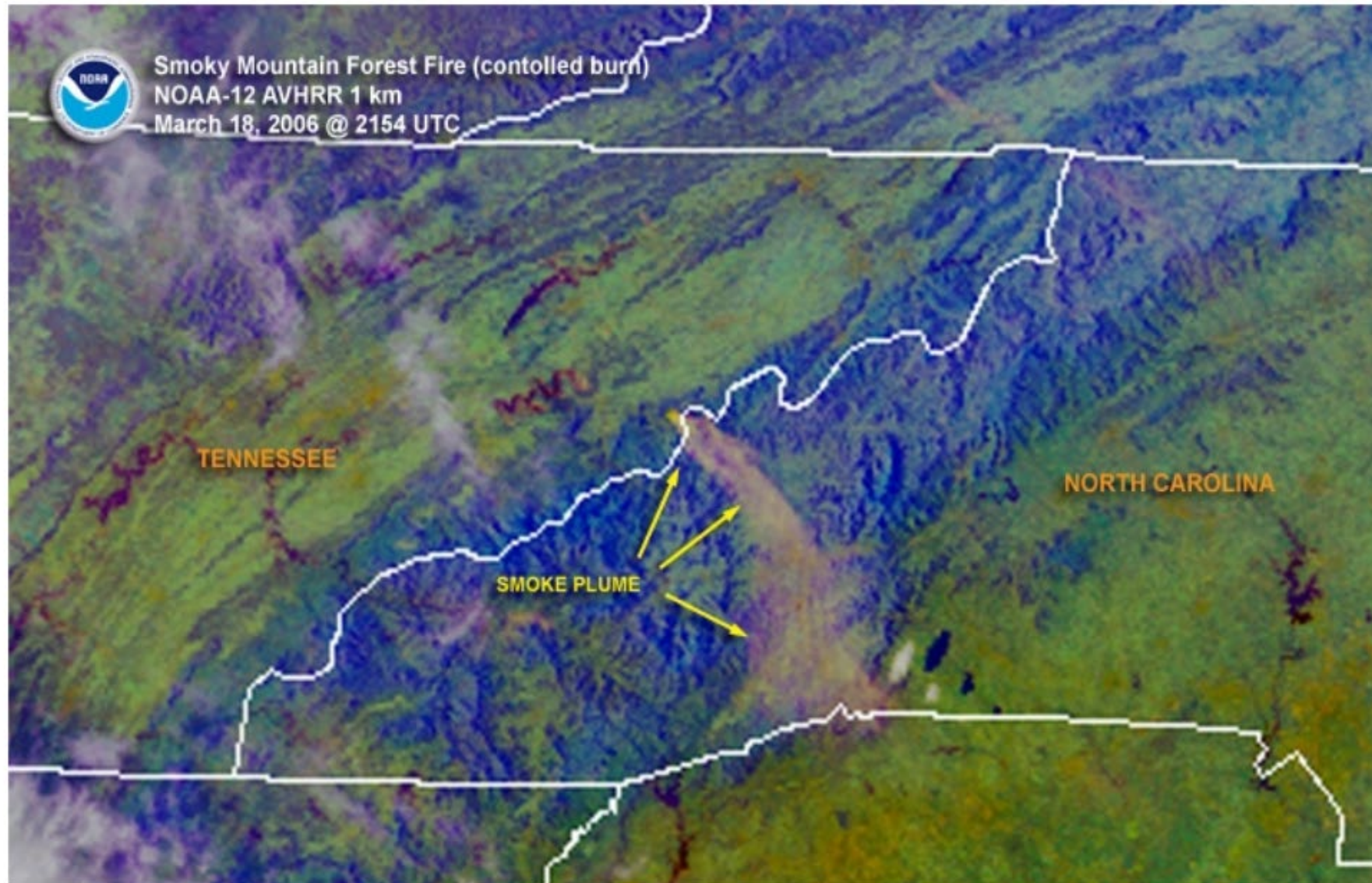
Case Study



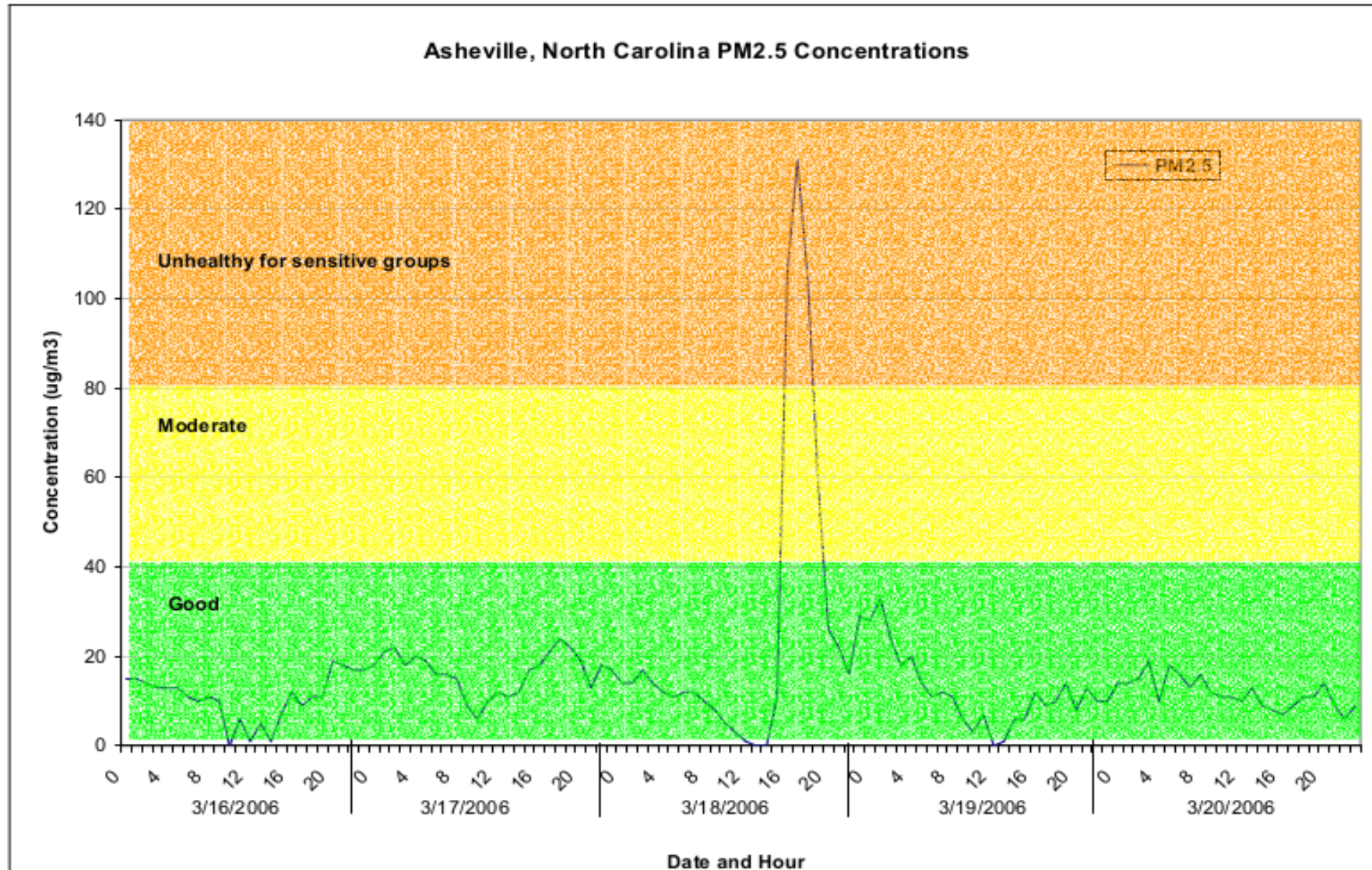
Case Study – Fire Information

- Brush Creek burn on Cherokee National Forest in March 2006
- 1,840 acres
- FCCS fuel bed - classified as chestnut oak - white oak – red oak (FCCS: 275)
- Area had not been burned in recent memory by wildfire and no previous prescribed burning had been done
- Fuel consumption estimated at 12 tons per acre

Case Study - Plume

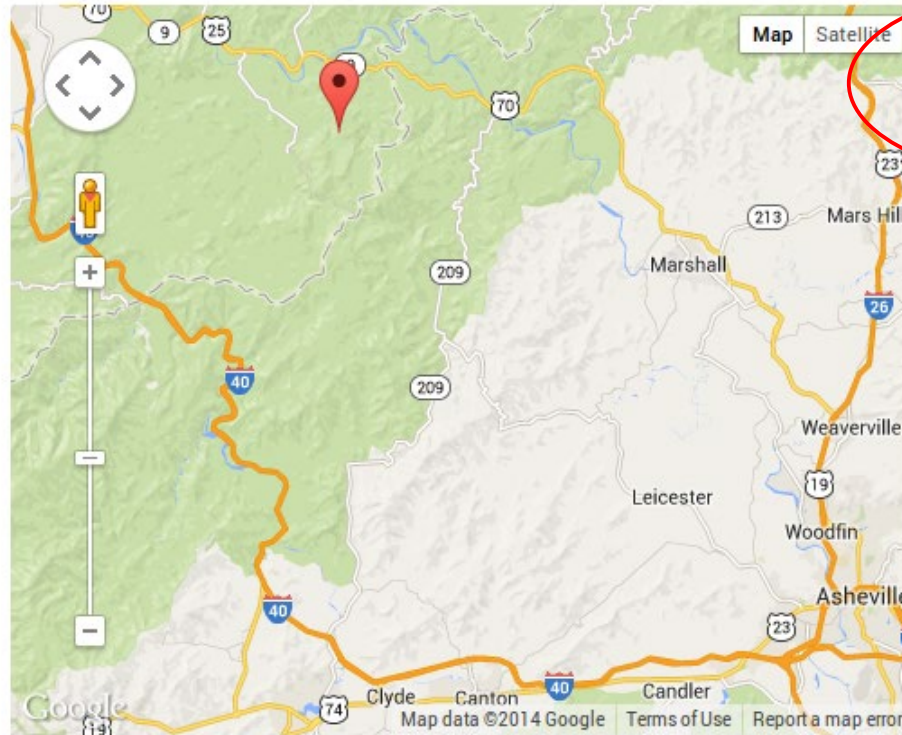


Case Study – PM Monitor



Case Study – Fire Location

Estimating Prescribed Fire Smoke Impacts



Fire & Weather Info

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:

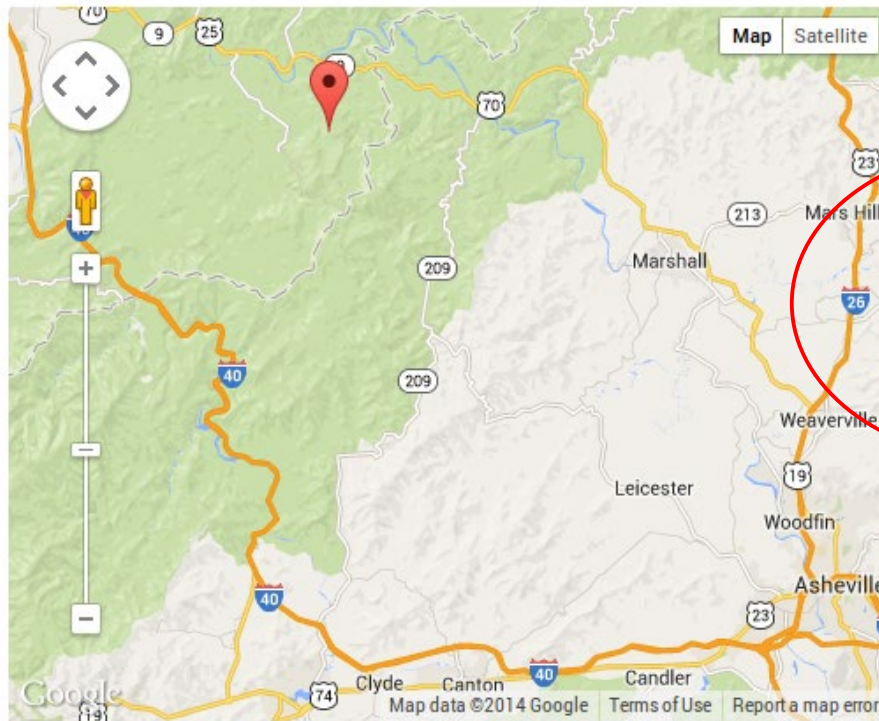
grams/sec

About

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Case Study – Fire Information

Estimating Prescribed Fire Smoke Impacts



Fire & Weather Info

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:

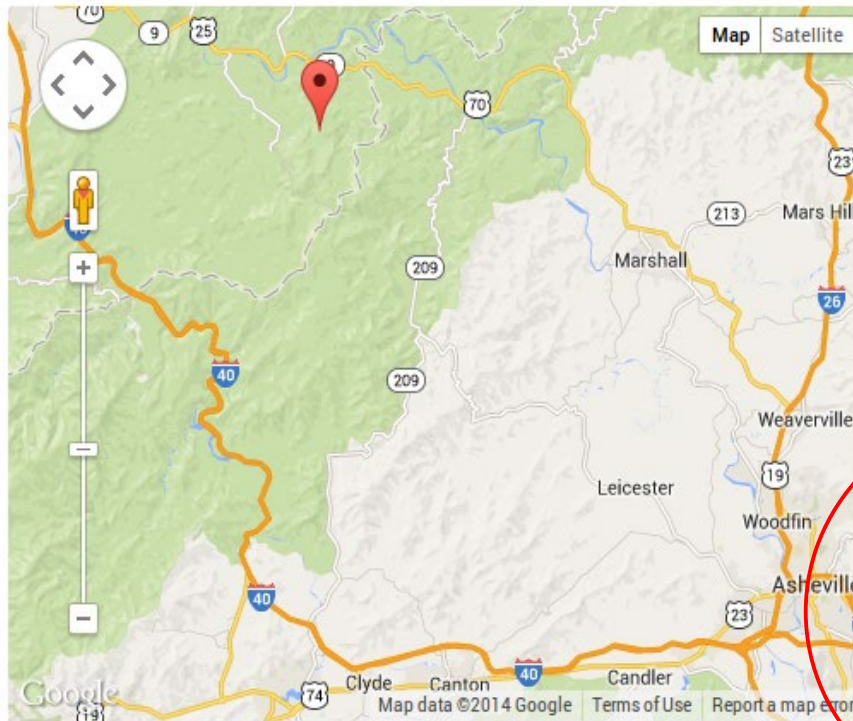
grams/sec

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Case Study - Fuels

Estimating Prescribed Fire Smoke Impacts



Fire & Weather Info

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:

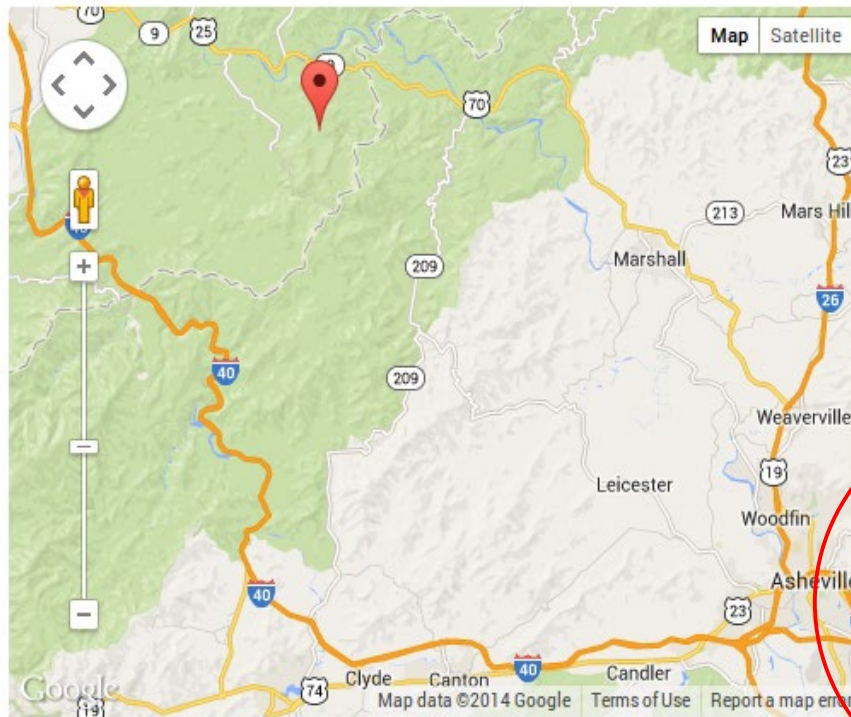
grams/sec

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Case Study – Edited Fuels

Estimating Prescribed Fire Smoke Impacts



Fire & Weather Info

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

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Case Study - Weather

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Good	0 to 50	0 to 18	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.

% consumed:

5. Emissions

PM 2.5 Emission Factor:

lbs/ton

Particulate Emission Rate:

grams/sec

Heat Release Rate:

MW

6. Weather

Mixing Height:

ft

Transport Wind:

mph

Stability Class:

7. Update Map

8. Misc Options

Background PM 2.5:

ug/m3

Plume Rise Fraction:

9. HYSPLIT Info

Total Emissions:

ug

Case Study - Weather

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AQI

Levels of Health Concern	AQI Value	Hourly PM 2.5 Conc.	Meaning
Good	0 to 50	0 to 35	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.
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% consumed:

5. Emissions

PM 2.5 Emission Factor:
 lbs/ton

Particulate Emission Rate:
 grams/sec

Heat Release Rate:
 MW

6. Weather

Mixing Height:
 ft

Transport Wind:
 mph

Stability Class:

7. Update Map

8. Misc Options

Background PM 2.5:
 ug/m3

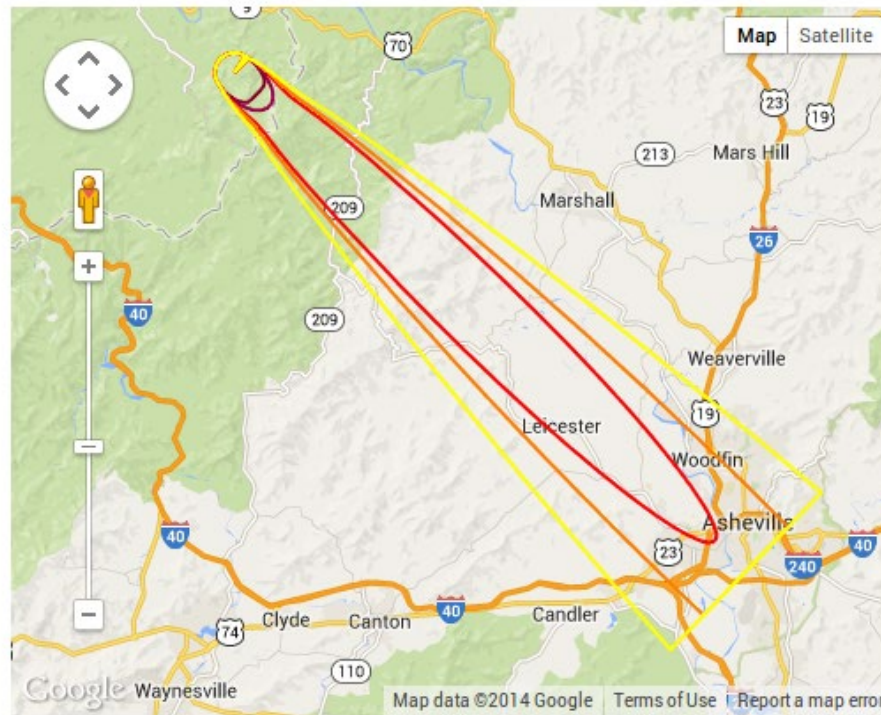
Plume Rise Fraction:

9. HYSPLIT Info

Total Emissions:
 ug

Case Study - Results

Estimating Prescribed Fire Smoke Impacts



[Download KML File](#)

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Fire & Weather Info

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:

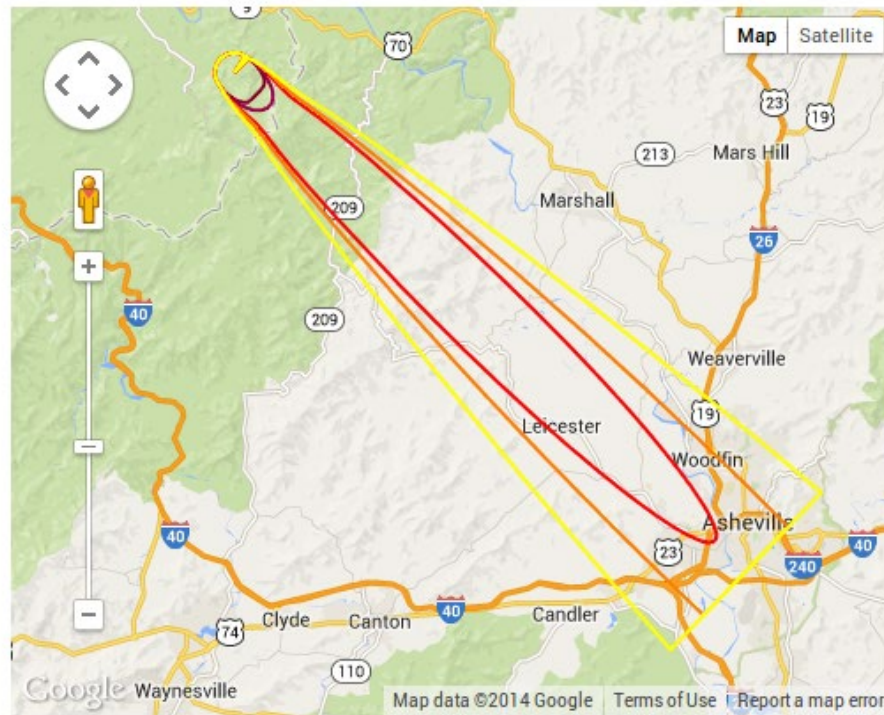
lbs/ton

Particulate Emission Rate:

grams/sec

Case Study – KML File

Estimating Prescribed Fire Smoke Impacts



[Download KML File](#)

[About](#)

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1. Location

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Acres:

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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

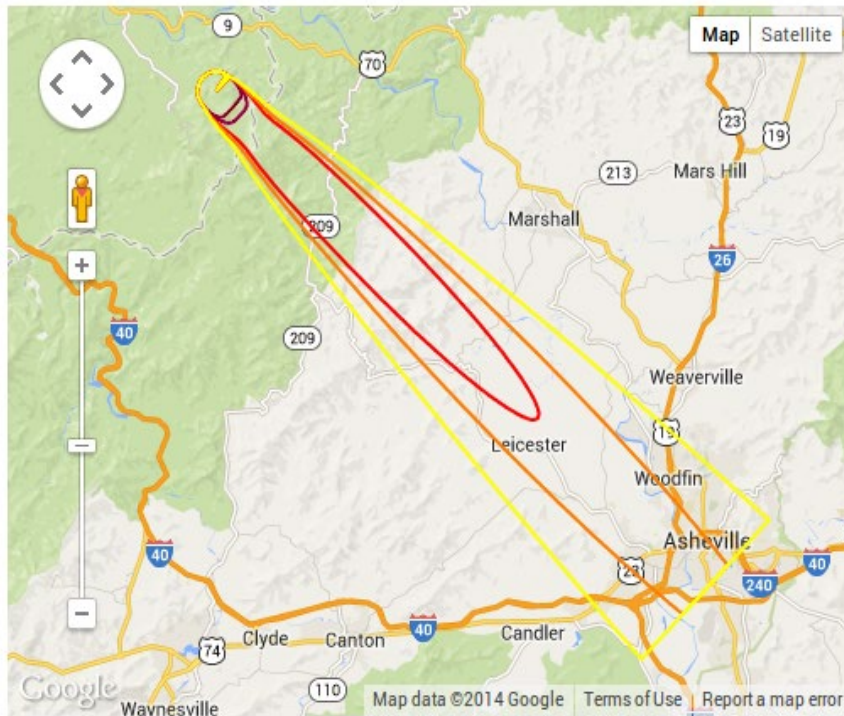
Case Study - Mitigation

- What could be done to reduce impact?
 - Burn over a longer period to reduce peak hourly emissions



Case Study – Extend Burn Period

Estimating Prescribed Fire Smoke Impacts



[Download KML File](#)

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Fire & Weather Info

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:

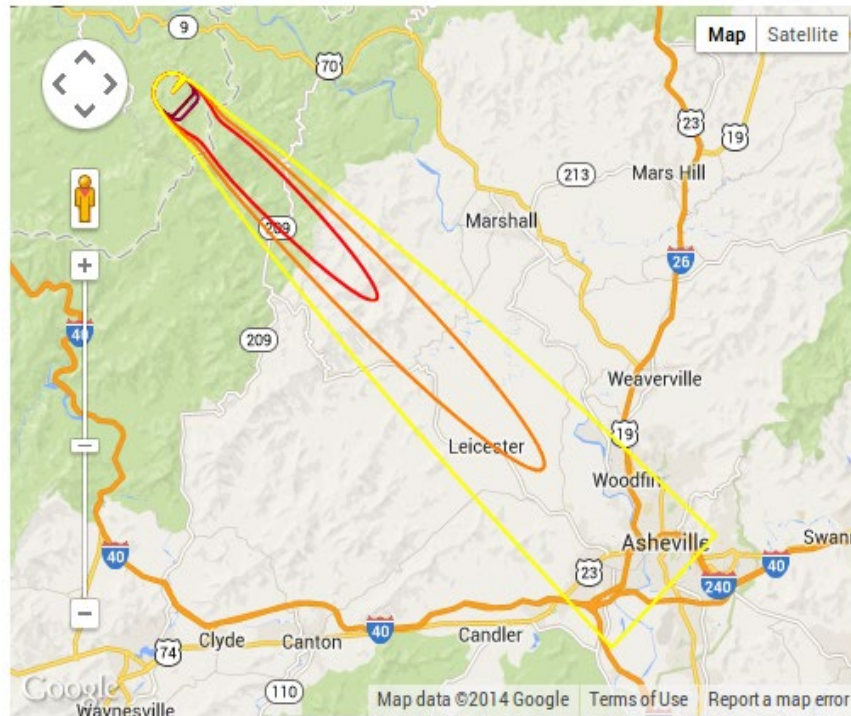
grams/sec

Case Study - Mitigation

- What could be done to reduce impact?
 - Burn over a longer period to reduce peak hourly emissions
 - Consume less fuel by burning at higher fuel moisture level

Case Study – Higher Fuel Moisture

Estimating Prescribed Fire Smoke Impacts



[Download KML File](#)

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Fire & Weather Info

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:

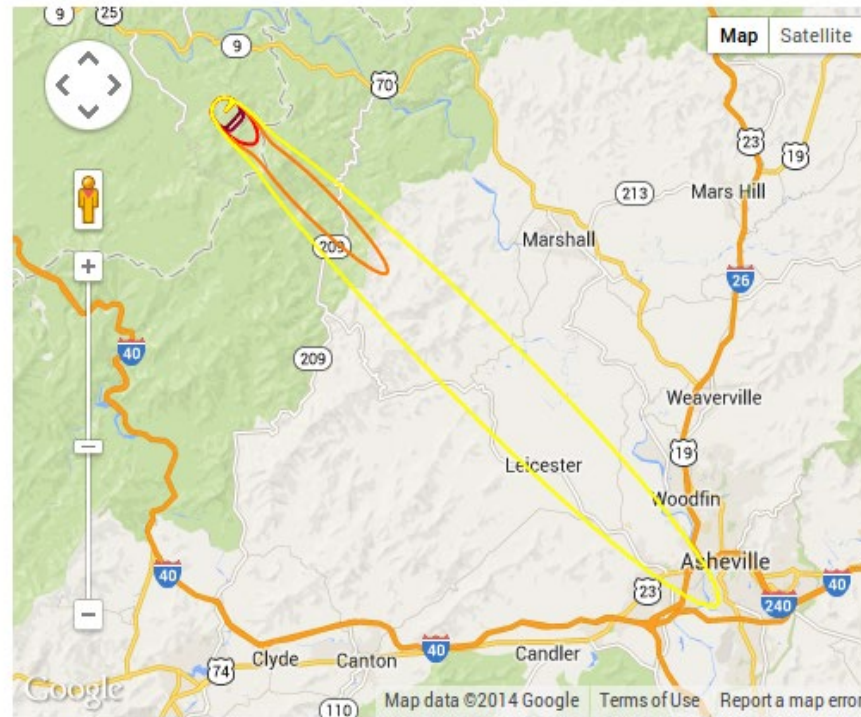
grams/sec

Case Study - Mitigation

- What could be done to reduce impact?
 - Burn over a longer period to reduce peak hourly emissions
 - Consume less fuel by burning at higher fuel moisture level
 - Break the unit in half

Case Study – Reduced Acres

Estimating Prescribed Fire Smoke Impacts



[Download KML File](#)

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Fire & Weather Info

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

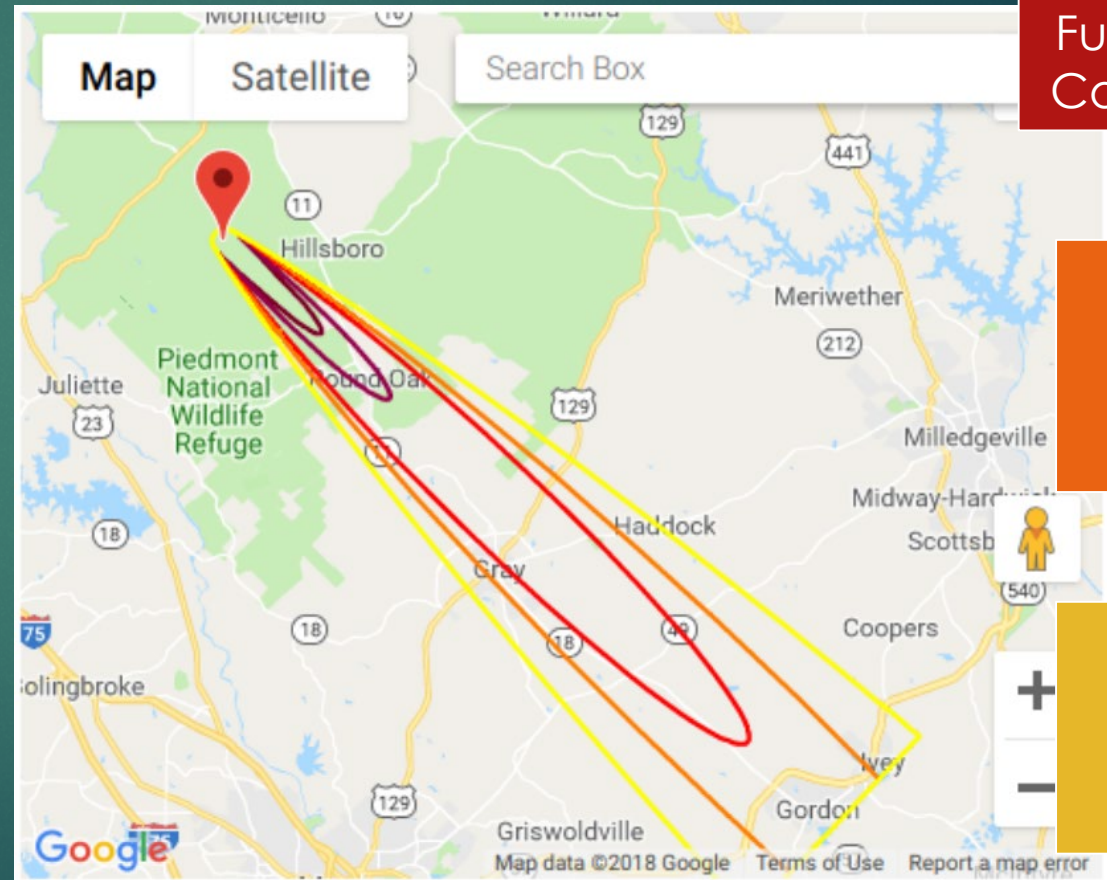
Case Study - Mitigation

- What could be done to reduce impact?
 - Burn over a longer period to reduce peak hourly emissions
 - Consume less fuel by burning at higher fuel moisture level
 - Break the unit in half
 - Use different burn technique

VSmoke

<http://weather.gfc.state.ga.us/GoogleVsmoke/vsmoke-Good2.html>

- ▶ Simple Gaussian plume model
- ▶ Very basic interface for estimating fuel loads and emissions
- ▶ Best used for burns conducted with fairly constant weather, especially wind direction
- ▶ Topography must be carefully considered when looking at results
- ▶ Does not provide information on movement of residual smoke at night



Emissions
Fuel load
Fuel Moisture
Consumption

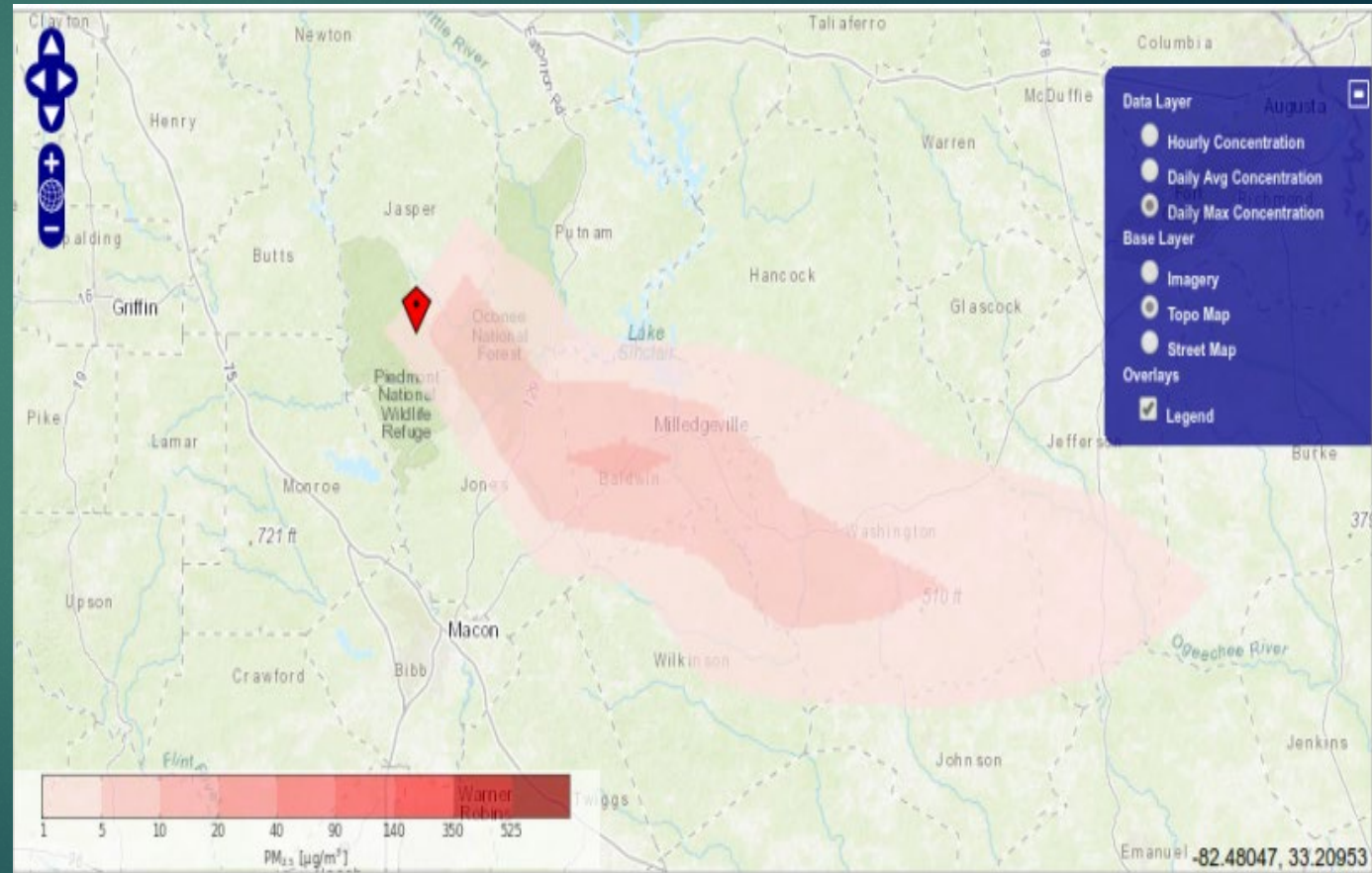
Transport
Winds
Stability

Impacts
Health
Safety

BlueSky Playground

<https://playground.airfire.org>

- ▶ Toolbox with a wide range of tools for estimating emissions and smoke dispersion
- ▶ Scenario-based interface
- ▶ Dispersion modeling options include VSmoke and HYSPLIT
- ▶ HYSPLIT requires more weather information but provides estimates of hourly concentrations
- ▶ Does not provide information on movement of residual smoke at night



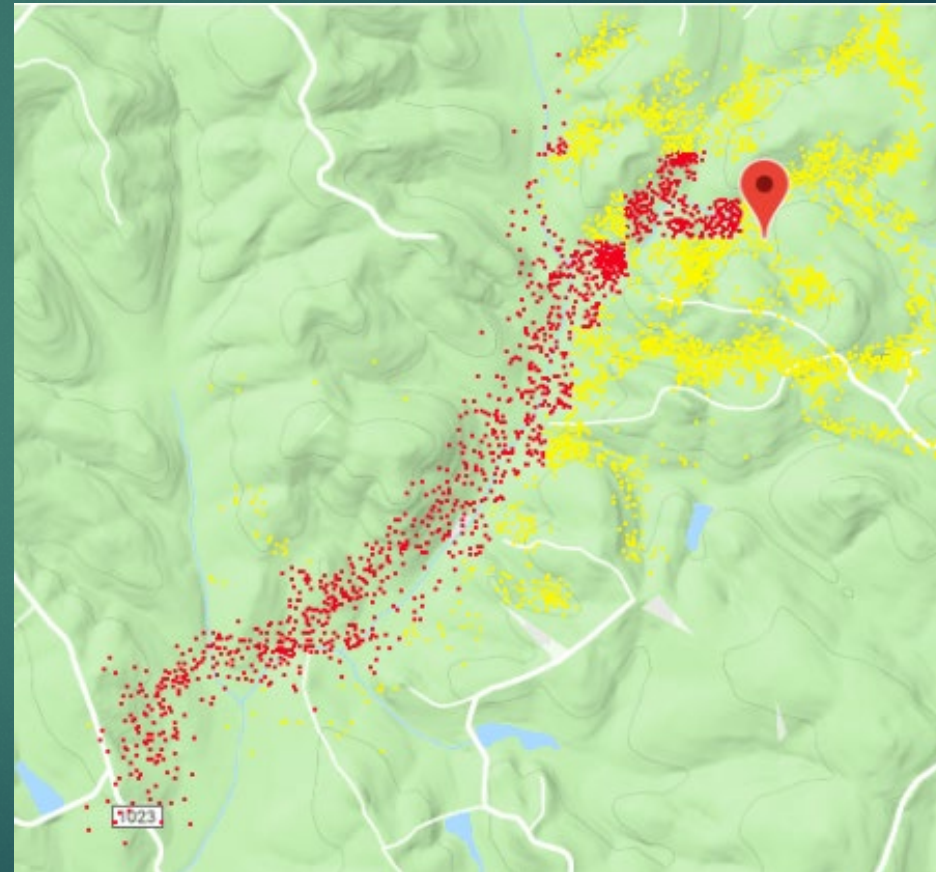
BlueSky Demonstration

▶ <https://playground.airfire.org>

PB-Piedmont

<https://piedmont.dri.edu>

- ▶ Simulates the movement of residual smoke at night under stable conditions when terrain induced drainage flows dominate
- ▶ Use either the day before or the morning of a burn to determine the potential for residual smoke to cause a problem on a local roadway
- ▶ Only provides information on where smoke is likely to go
- ▶ Does NOT provide smoke concentrations
- ▶ Smoke particles in the model are either yellow (just smoke) or red (mixture of smoke and fog possible)



Emissions

Transport
Winds
Stability
Topography

Impacts

Safety

