

Smoke Management and Smoke Modeling

*Kansas Natural Resources Conference
January 2011*

Susan O'Neill, Natural Resources Conservation Service

Smoke Management Practices

- Smoke Management is about managing the emissions from fire to reduce downwind impacts.
- Smoke is unlike most other pollutant sources – a control can not be put on it to scrub the emissions.

Smoke Management Guide for Prescribed and Wildland Fire, 2001 (<http://www.treesearch.fs.fed.us/pubs/5388>)

Basic Smoke Management Practices

- #1 Meteorological scheduling and smoke impact evaluation of burning in burn planning and burn operations.
- #2 Monitor the effects of the fire on air quality and document smoke dispersion



Smoke Behavior

Atmospheric Stability

Unstable Atmosphere

- Vertical Mixing
- Smoke not at surface
- Erratic fire behavior possible under very unstable conditions



Stable Atmosphere

- Vertical Mixing limited
- Smoke at surface



Smoke Behavior Valley Flows



- Smoke caught under a valley inversion

- Smoke can be transported by down-valley winds in the morning



Smoke Dispersion and Meteorology

- Mixing Height – height through which the atmosphere will undergo mechanical or turbulent mixing, producing a nearly homogeneous air mass.
 - Minimum 1800 ft (548 m)
- Transport Winds - average wind speed and direction of all winds within the mixing layer.
 - 8 – 20 mph



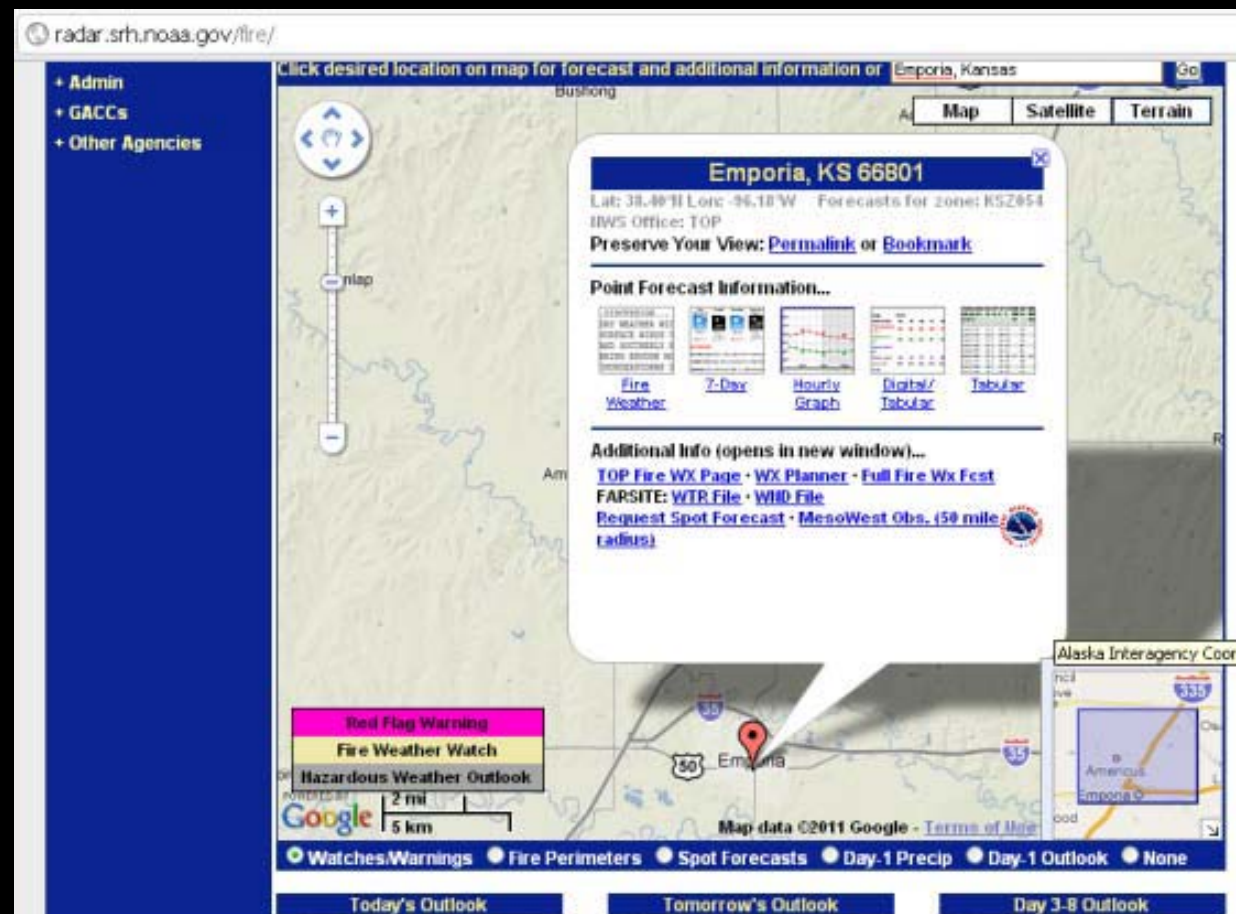
Ventilation Index

- Category Day based on Ventilation Index
 - VENT = mixing height x transport winds
- Based on “Category Day”
 - Category 1 = no burning
 - Category 2 = burn 11am – 4pm
 - Category 3 = daytime burning
 - Category 4 = burn anytime
 - Category 5 = unstable conditions. Excellent dispersion but burn with caution.



NWS Fire Weather Webpage

- Fire Weather Forecast
- Weather Planner
- Request a spot forecast
- Observational data
- FARSITE files



<http://radar.srh.noaa.gov/fire/>



NWS Fire Weather Forecast

- Cloud Cover
- 20 ft winds
- Transport Winds
- Mixing Height
- Smoke Dispersion
- Lightning Activity Level
- Haines Index

	TODAY	TONIGHT	SAT
CLOUD COVER	MCLDY	PCLDY	PSUNNY
PRECIP TYPE	SNOW	NONE	NONE
CHANCE PRECIP (%)	30	0	0
TEMP	31	13	33
RH %	67	98	68
20FTWND (MPH)	S 10 G25	W 10	W 5
PRECIP AMOUNT	0.02	0.00	0.00
MIXING HGT(FT-AGL)	1536		601
TRANSPORT WND (MPH)	SW 22		S 14
SMOKE DISPERSAL	GOOD		POOR
LAL	1	1	1
HAINES INDEX	3(VLOW)	3(VLOW)	4(LOW)

REMARKS...

.....SUPPLEMENTAL WIND DATA (MPH).....

	09 AM	12 PM	03 PM	06 PM
WIND	S-13	SSW-16G25	SW-13	W-10

.FORECAST FOR DAYS 3 THROUGH 7...

.SUNDAY...CLOUDY WITH A 50 PERCENT CHANCE OF SNOW. LOWS AROUND 20. HIGHS IN THE UPPER 20S. NORTHWEST WINDS 5 TO 15 MPH.

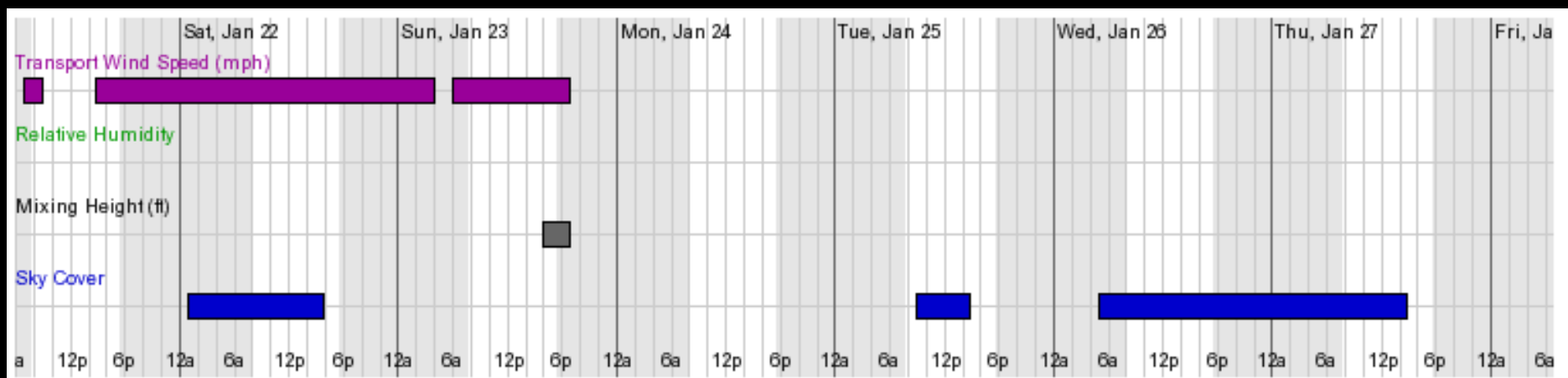
.MONDAY...MOSTLY CLOUDY. A 20 PERCENT CHANCE OF SNOW. LOWS AROUND 14. HIGHS IN THE UPPER 20S. NORTHWEST WINDS 5 TO 15 MPH.

.TUESDAY...MOSTLY CLOUDY. LOWS AROUND 16. HIGHS IN THE LOWER 30S. WEST WINDS UP TO 10 MPH.

.WEDNESDAY...PARTLY CLOUDY. LOWS AROUND 16. HIGHS IN THE UPPER 30S. NORTHWEST WINDS UP TO 10 MPH.

.THURSDAY...PARTLY CLOUDY. LOWS AROUND 20. HIGHS IN THE LOWER 30S. NORTH WINDS 5 TO 10 MPH.

NWS Weather Planner



Friday, January 28 at 5am

[48-hr Element Meteorogram](#)

Transport Wind: N/A
 Relative Humidity: N/A Sky Cover: N/A
 Mixing Height: N/A

Element	Min	Max	Element	Min	Max
Transport Wind (mph) <input type="text" value="8"/> <input type="text" value="20"/>	8	to 20	Mixing Height (ft) <input type="text" value="1800"/> <input type="text" value=""/>	1800	to
Relative Humidity <input type="text" value="30"/> <input type="text" value="55"/>	30	to 55	Sky Cover <input type="text" value="30"/> <input type="text" value="50"/>	30	to 50
Surface Wind Speed (mph) <input type="text" value=""/> <input type="text" value=""/>		to	Precipitation Potential <input type="text" value=""/> <input type="text" value=""/>		to

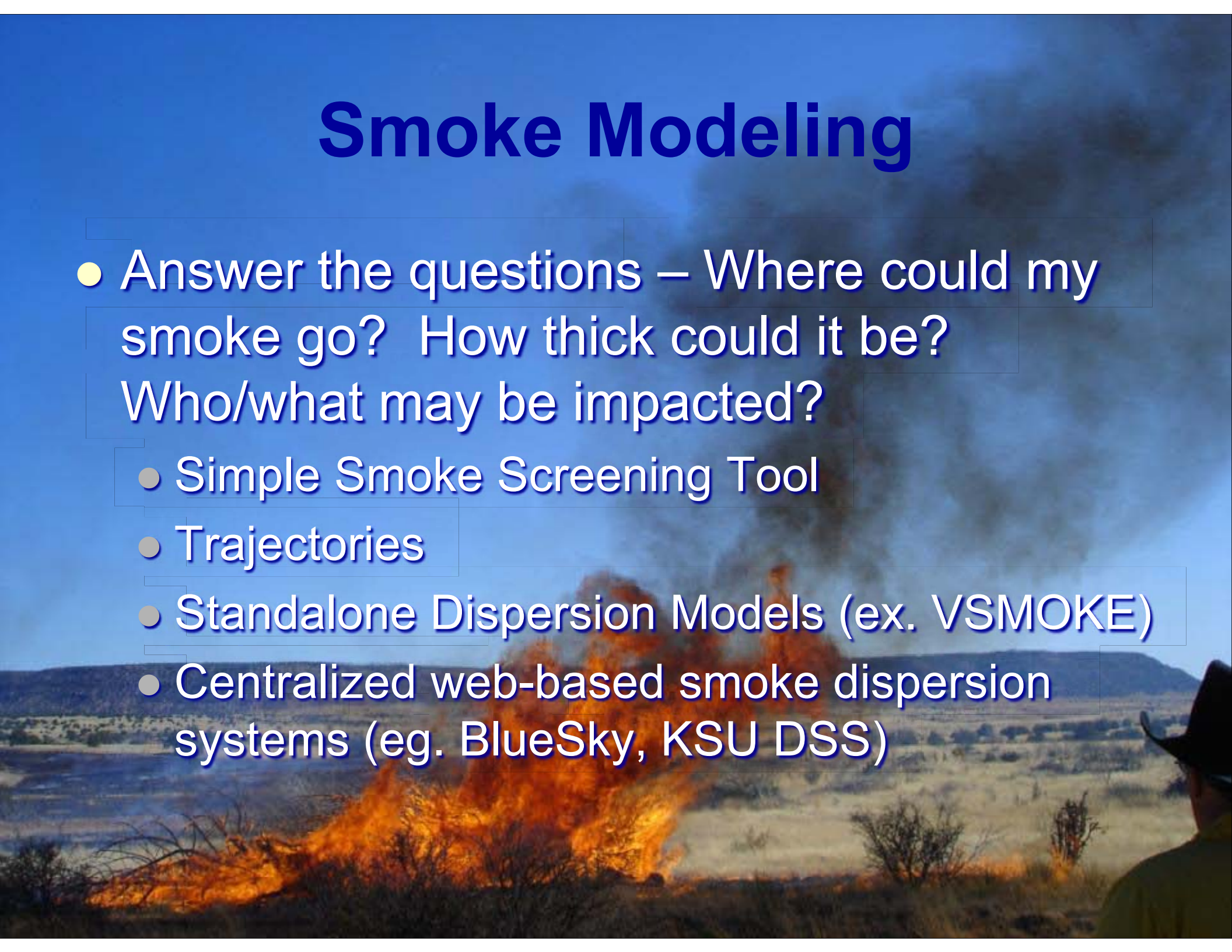
Latitude/Longitude Entry

decimal degrees (i.e. 42.134) or deg min sec (i.e. 42 23 34)
 Use "-" (negative sign) in longitude for locations in Western Hemisphere

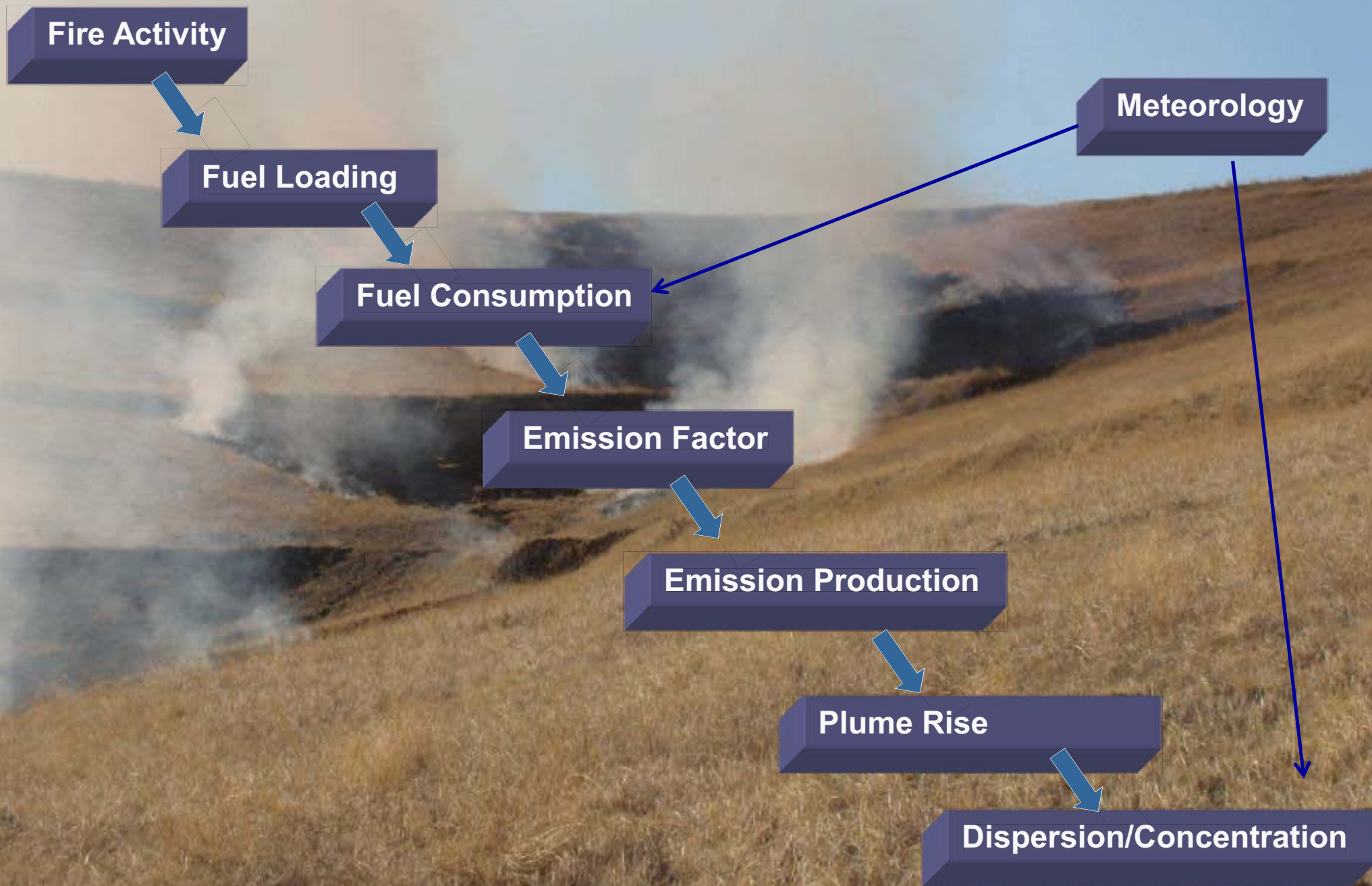
Latitude:
Longitude:

Smoke Modeling

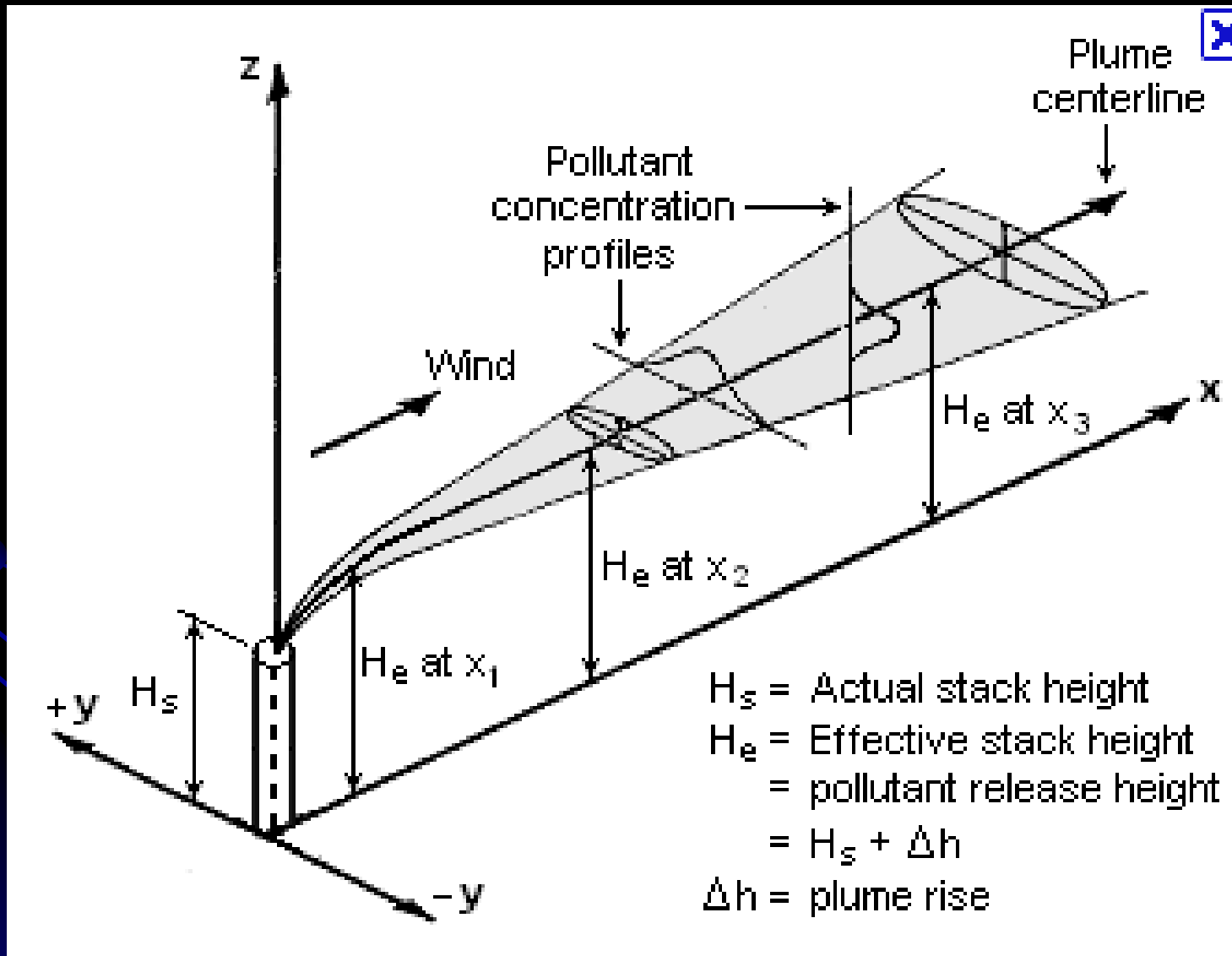
- Answer the questions – Where could my smoke go? How thick could it be? Who/what may be impacted?
 - Simple Smoke Screening Tool
 - Trajectories
 - Standalone Dispersion Models (ex. VSMOKE)
 - Centralized web-based smoke dispersion systems (eg. BlueSky, KSU DSS)



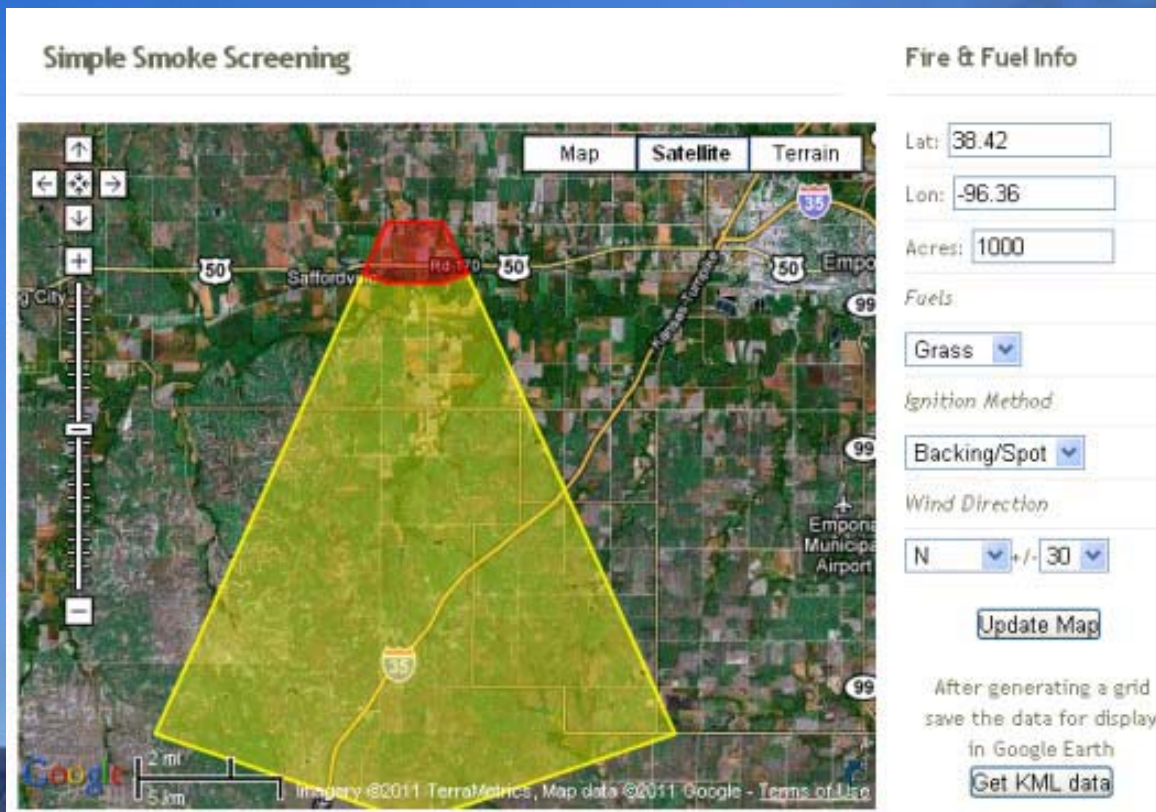
Components of Smoke Modeling



Gaussian Plume Models



Simple Smoke Screening Tool



<http://shrmc.ggy.uga.edu/>

- Select: Smoke Products -> Smoke Screening
- Google Map application
 - Zoom-in
 - View Smoke Sensitive Areas
- Enter Location, Acres, Fuel type, ignition method, wind direction
- Can also do manually on a map

From the Southern Forestry Smoke Management Guide

<http://www.srs.fs.usda.gov/pubs/viewpub.php?index=683>

Wildland Fire Air Quality Tools

WFDSS Integrated Tools v1.0 (Beta Test)

STATUS: Updated 10/25: 8 of 8 tools linked and running. Help pages online. Products now open in separate tabs. VCIS table fixed. Some additional development work occurring. See notes below each tool's link for additional information.

STEP 1

Set your fire location:



location used for tailored products.

Latitude °N

Longitude °E

Location is set.

STEP 2

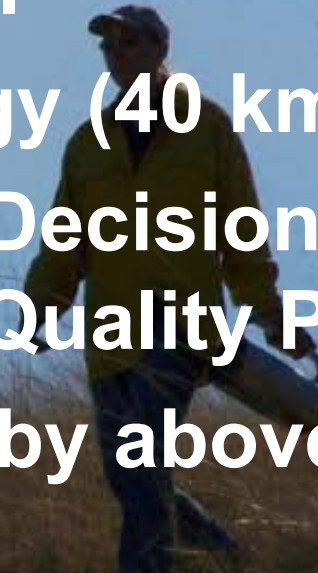
Select Your Tool:

- ▶ Smoke Guidance Point Forecast
- ▶ Smoke Guidance Regional Maps
- ▶ Diurnal Surface Wind Pattern Analysis
- ▶ Climatological Ventilation Index Point Statistics
- ▶ Current Air Quality Conditions Map
- ▶ Fire Information & Smoke Trajectories
- ▶ Customized Fuels, Consumption, & Smoke Modeling
- ▶ Probabilistic Smoke Impacts based on Past Weather

See below for tool description, attributes, and other details.

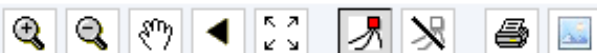
● <http://firesmoke.us/wfdss/>

Air Parcel Trajectories

- Gives information about where a parcel of air will travel
 - NOAA HYSPLIT Model
 - NWS NAM Meteorology (40 km resolution)
 - Via the Wildland Fire Decision Support System (WFDSS) Air Quality Portal
 - Plume rise simulated by above ground release height
 - No Chemistry, No Particle Concentration
 - Each point is one hour out in time, number is the height above ground
- 
- A person wearing a cap and a jacket is walking through a field of tall, dry grass. The background shows a clear sky with a warm, golden light, suggesting a sunset or sunrise. The person is carrying a bag or equipment.

Trajectories – April 8, 2010

Options Tool Options



Trajectory Parameters

Start Hour

00Z

Hours

24hr Forward

Height (m agl)

100 m

Trajectory cluster

Create trajectory clusters

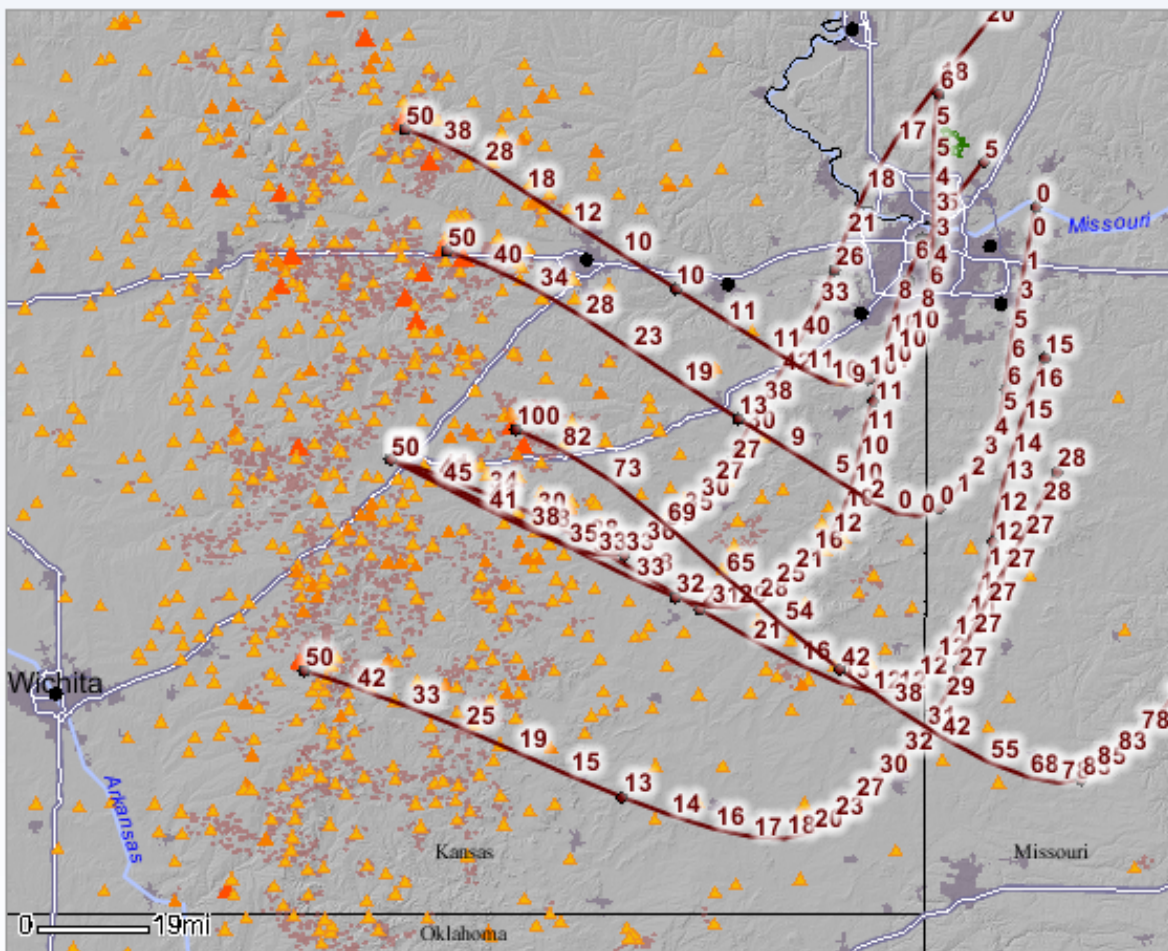
Label

(Only appears when map scale is less than 22 mi)

- Hour
- Height (m agl)
- Pressure (mb)
- None

Source:

[NOAA HYSPLIT model](#)
 NAMNDAS models (40km)
 Most Recent: 17 Jan 2011 00Z
 Model vertical velocity



Legend

Legend

Today's Fire Locations

- 100 acres or less
- 100 - 500 acres
- 500 - 5000 acres
- more than 5000 acres

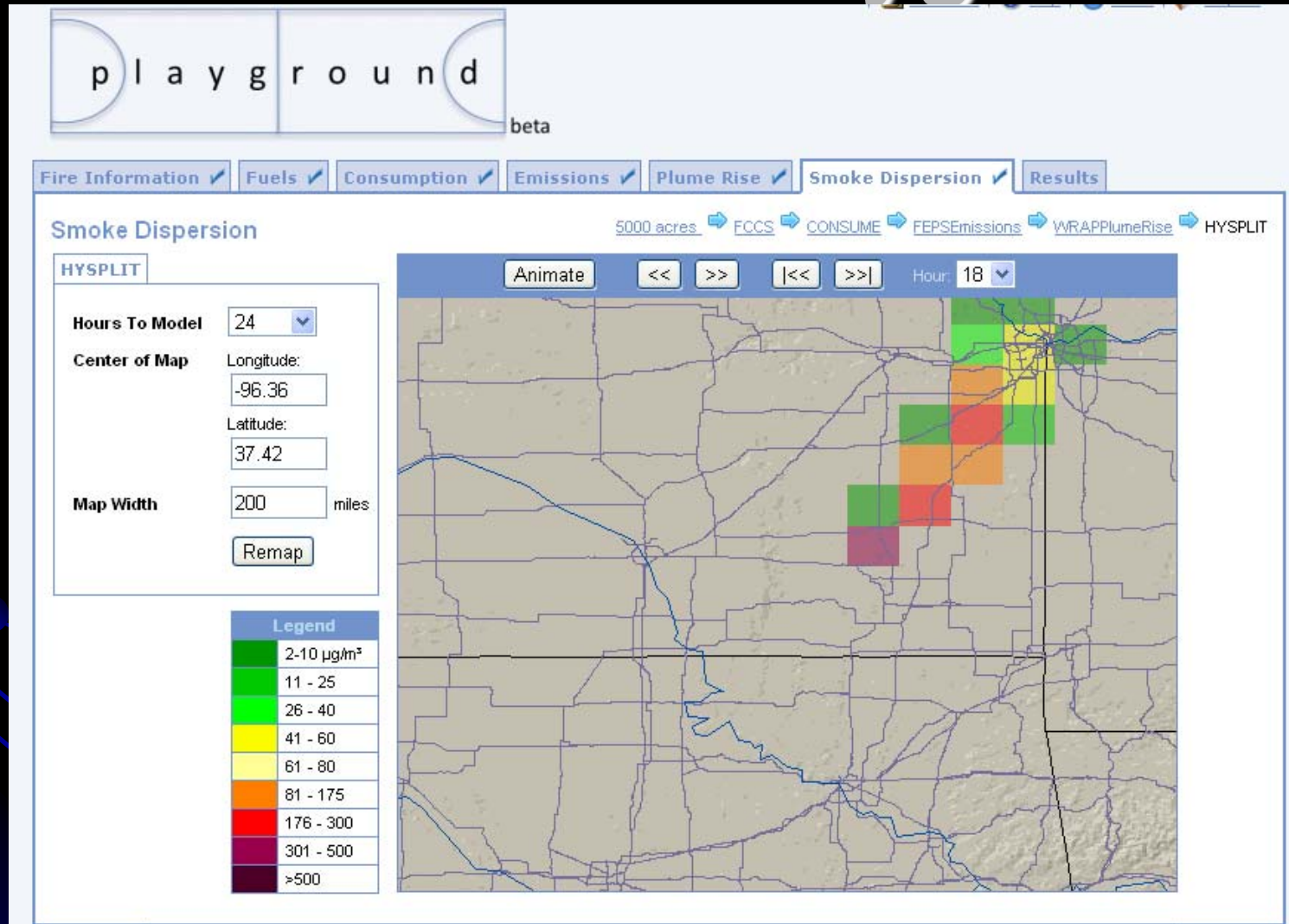
Today's Fire Perimeters

- Total Fire Perimeters
- Today's HMS fire detects
- Today's ICS-209 reports

[Additional legend information](#)

Apply Changes

BlueSky Smoke Modeling Framework & Playground



Centralized websites under development:
www.blueskyframework.org, www.getbluesky.org

National Smoke Management Website

<http://www.nifc.gov/smoke>



National Interagency Fire Center



Smoke Management - Overview

[Overview](#) | [Tools](#) | [Regulations and Policies](#) | [Emissions](#) | [Training Publications](#) | [Links](#)

The information within these pages is offered by the Interagency Smoke Committee (Smoc). Smoc is chartered by the National Wildfire Coordinating Group (NWCG) to provide leadership, coordination and integration of air resource and fire management objectives.

[NIFC Home](#)

[Aviation](#)

- Tools
 - Smoke/Weather Forecasts
 - Smoke Modeling
 - Smoke Monitoring
 - Remotely Sensed Data
 - After Action Review
 - NEPA
- Regulations and Policies
- Emissions
- Training
- Publications
- Links



NWCG Smoke Committee (SmoC)



- One of 14 Committees chartered under the National Wildfire Coordinating Group (NWCG)
- Current Members: USFS, NPS, FWS, BLM, BIA, NASF, NRCS, NACAA, TNC
- Products, Topics and Issues
 - Training
 - www.nifc.gov/smoke
 - www.myfirecommunity.net “Air Quality and Fire Issues” Neighborhood
 - Fire emissions: Black Carbon, NO₂, GHGs, PM_{2.5}, Ozone precursors
 - Smoke Monitoring
 - Exceptional Events
 - Federal Fire Policy

SmoC Subcommittees

- Smoke Managers
 - Kansas is participating
- Training
 - Online Training
 - Smoke Assessment
 - Effective Communication Workshop
- Technical Smoke Topics
 - Smoke Management Guide Revision
 - Smoke Monitoring



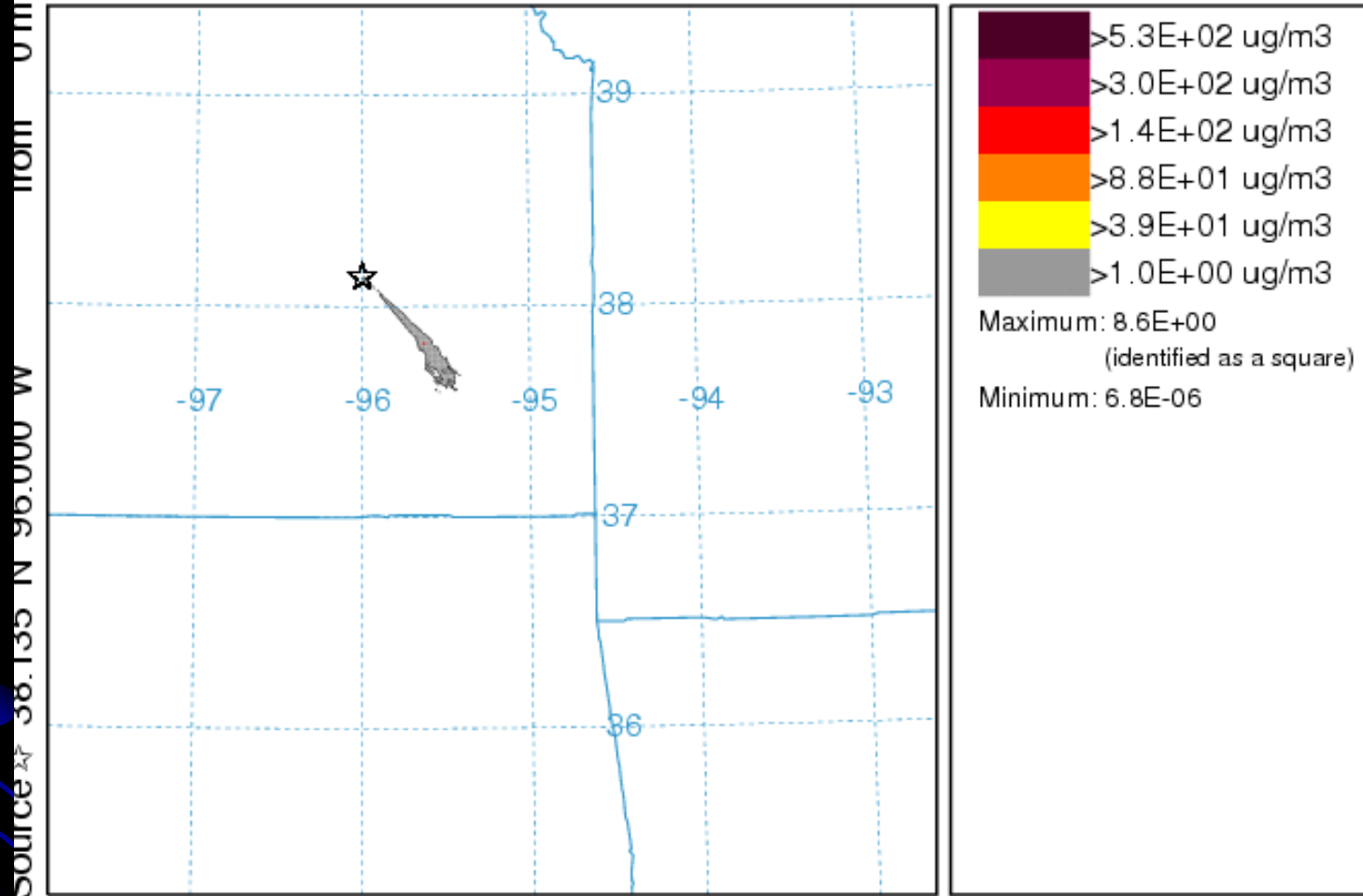
Thank you! Questions, Comments, Discussion

Susan O'Neill, susan.oneill@por.usda.gov
503-273-2438

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program.

NOAA HYSPLIT MODEL

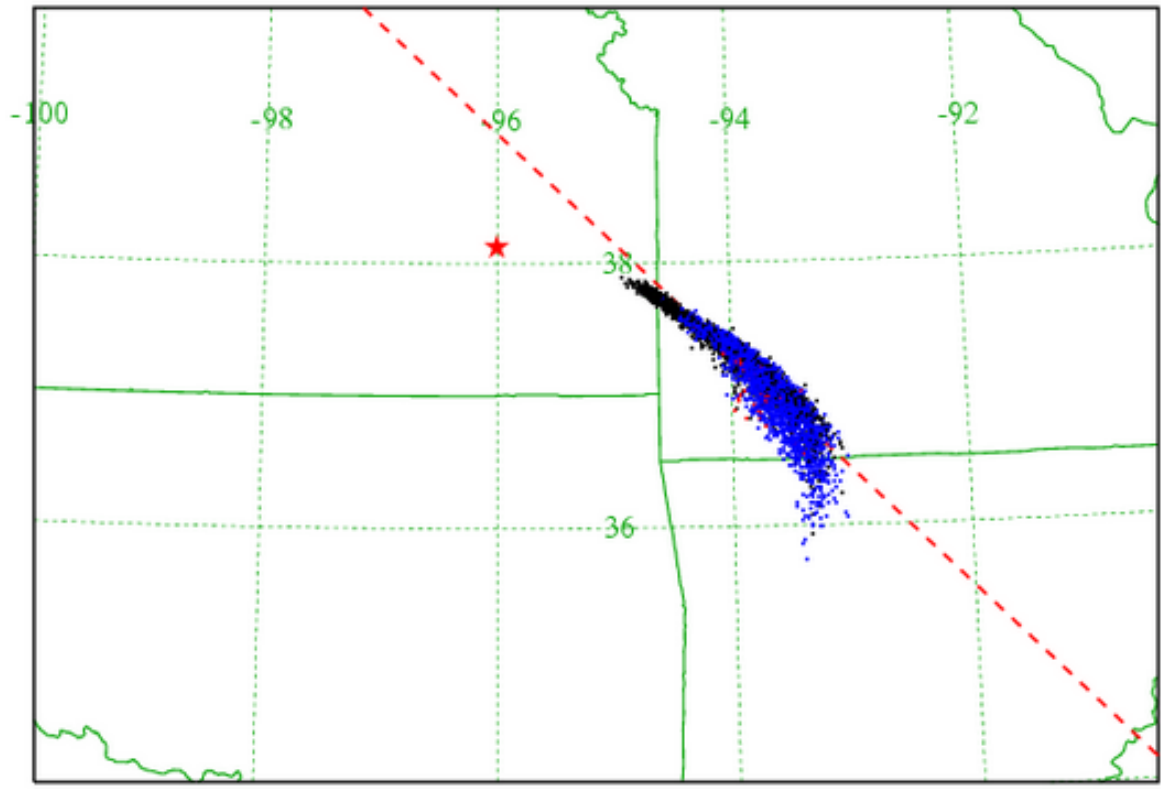
Concentration (ug/m3) averaged between 0 m and 100 m
Integrated from 1800 08 Apr to 1900 08 Apr 10 (UTC)
PM25 Release started at 1600 08 Apr 10 (UTC)



NAM METEOROLOGICAL DATA

Job ID: 2972 Job Start: Fri Jan 21 04:40:17 UTC 2011
Release: lat.: 38.135 lon.: -96 Hgt: 0 m
Pollutant: PM2.5
Release Quantity: 1 g Start: 10 04 08 16 Duration: 0 hrs, 0 min
Pollutant Averaging/Integration Period: 1 hrs and 0 min
Dry Deposition rate: 0 cm/s Wet Removal: None #Part: 5400
Meteorology: 0000Z 08 Apr 2010 - NAM12

NOAA HYSPLIT MODEL PARTICLE CROSS-SECTIONS PARTICLE POSITIONS AT 04 UTC 09 Apr 10



LAYER (m): < 1000 < 2000 < 3000 < 4000 < 5000

