

FLINT HILLS SMOKE MODELING TOOL

2013 Tallgrass Prairie & Oak Savanna
Regional Fire Conference

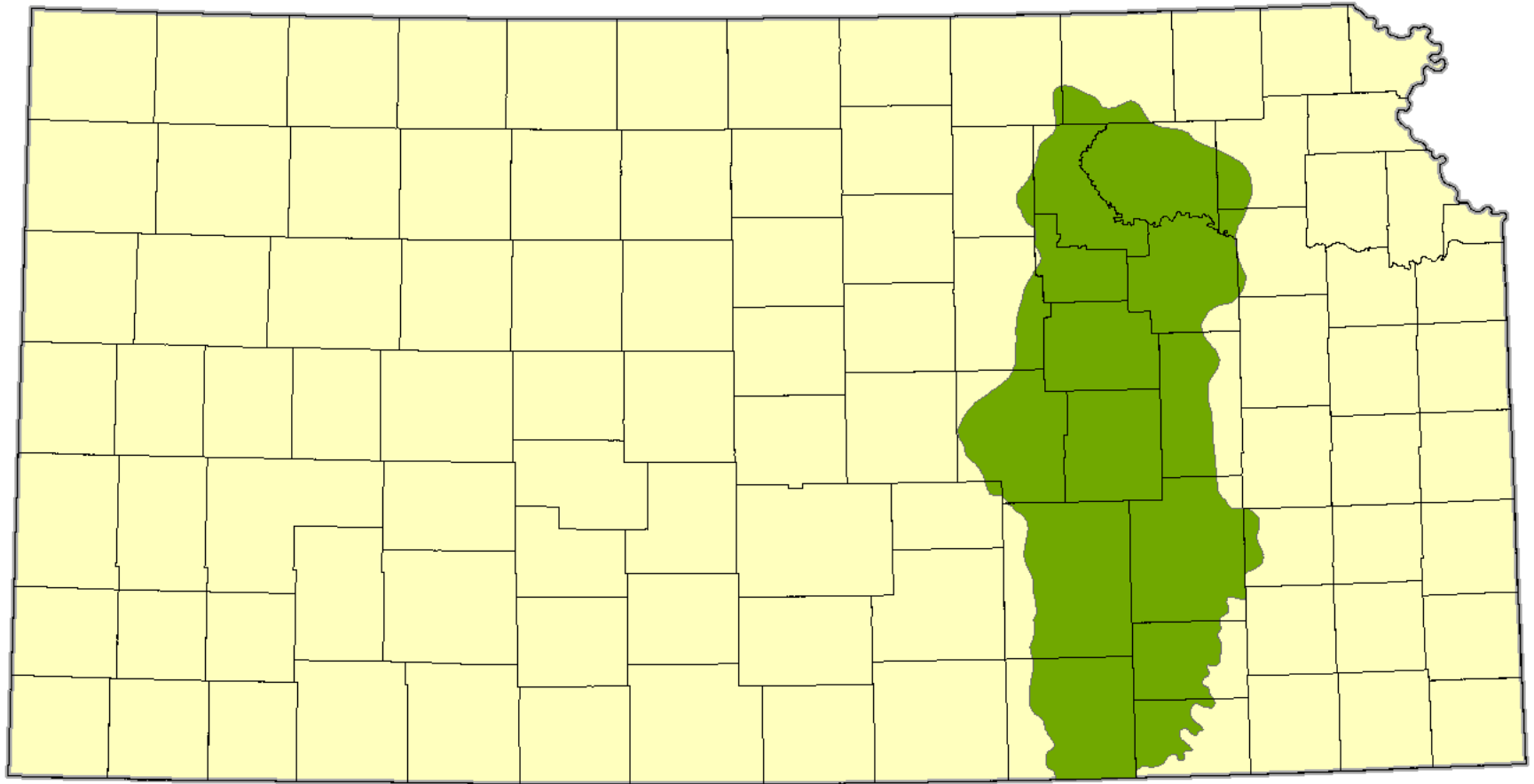
Jan 29, 2013

Tom Gross, Bureau of Air, KDHE

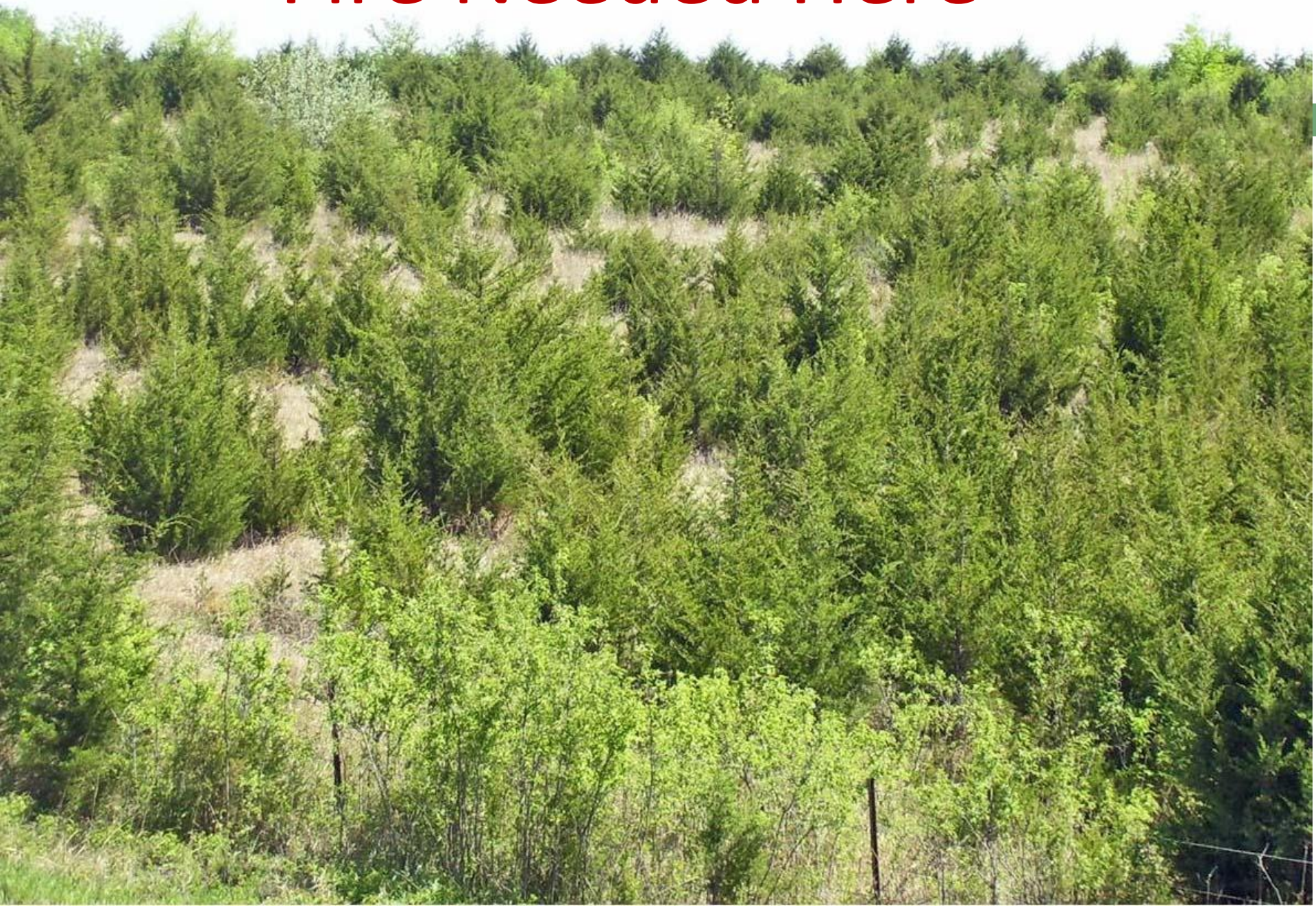
Flint Hills Tall Grass Prairie

- ❑ Over 6 million acres of tall grass prairie in eastern Kansas.
- ❑ 2 to 3 million acres are burned each spring.
- ❑ Burning improves cattle weight gain and helps prevent intrusion of invasive woody species.
- ❑ Tall grass prairie ecosystem evolved with fires every few years.
- ❑ Under certain weather patterns, smoke impacts downwind cities.
- ❑ Smoke has caused exceedances of the air quality standards for ozone and particulate matter in Kansas and beyond.

Kansas Flint Hills Tall Grass Ecosystem

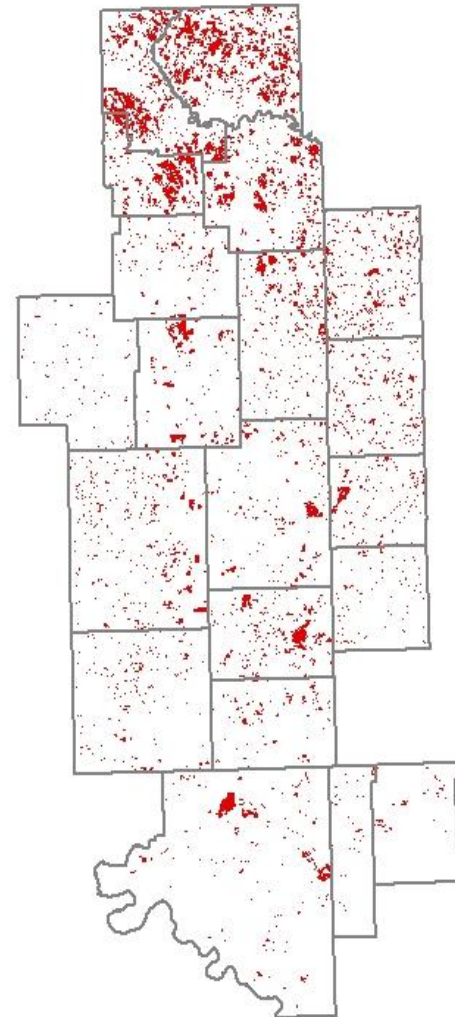
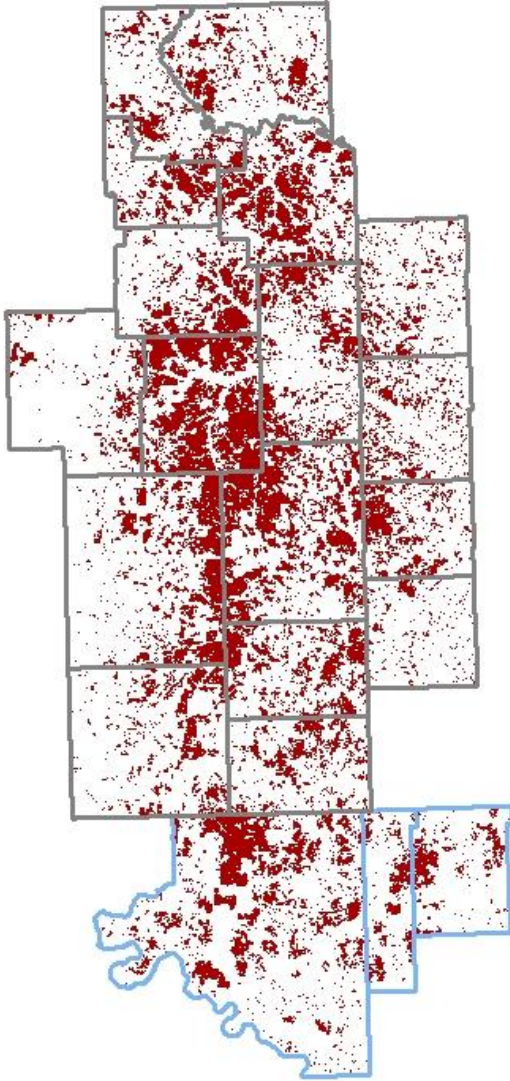


Fire Needed Here



2011 – 2.6 million acres burned

2012 – 706,018 acres burned



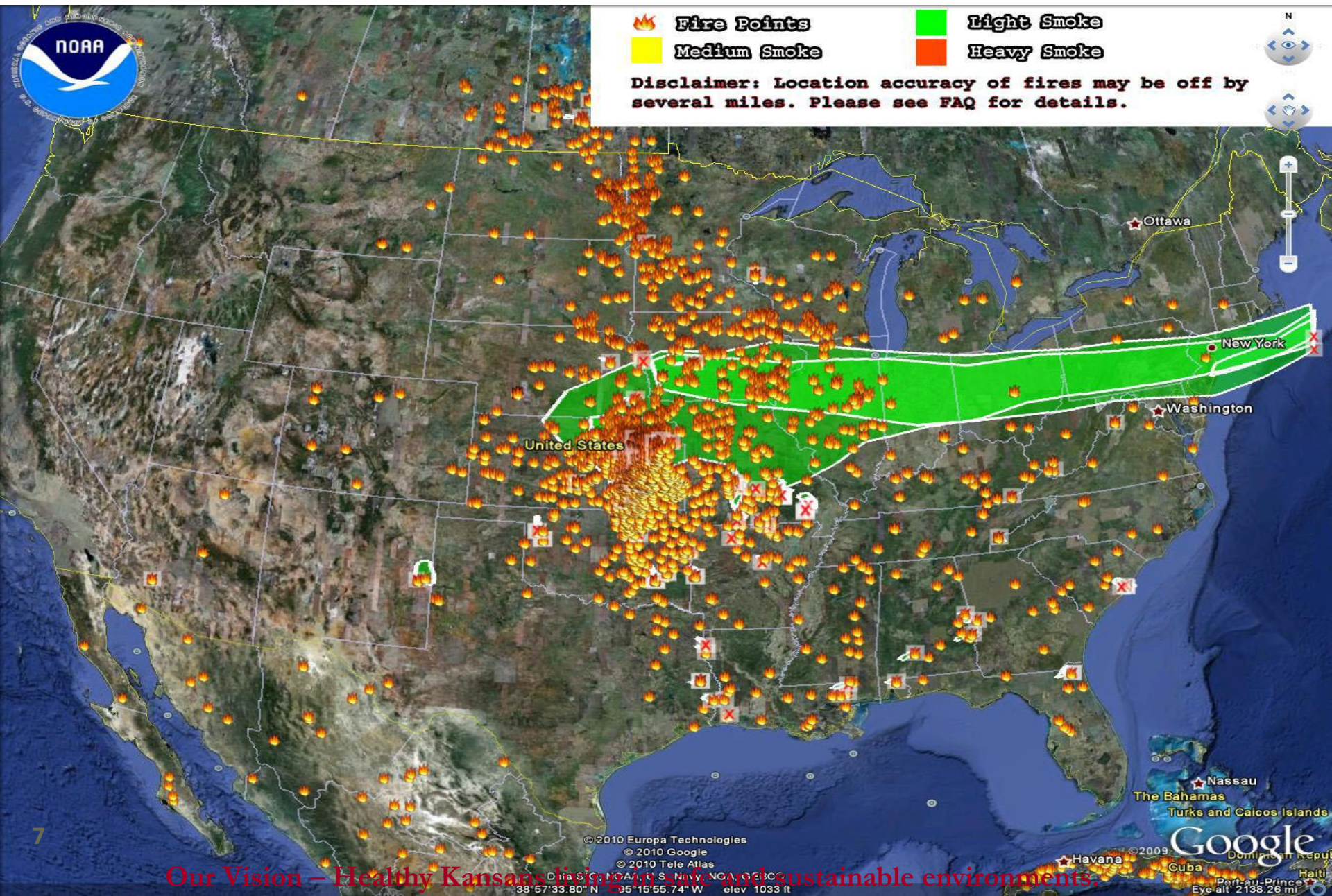
Map generated using MODIS data downloaded from NASA website at <https://wist.echo.nasa.gov/api/>

ENVI and ArcGIS software used for image analysis

Safety Is a primary concern....but



April 11, 2010 Fire and Smoke Plumes



Smoke Management Plan Background

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- ❑ KDHE and EPA & KDHE met with ag reps from 2003 to present to work towards solutions.
- ❑ Exceedances occurred in 2003, 2009, 2010 & 2011.
- ❑ Commitment to develop Smoke Management Plan in 2009.
- ❑ Committee formed and multiple meetings held to create plan during 2010.
- ❑ Plan adopted by KDHE in December 2010.
- ❑ Outreach and education regarding plan began immediately for April 2011 burn season.

The Smoke Management Plan

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- ❑ Describes the Tall grass prairie ecosystem and the balance between air quality and the Flint Hills ag economy
- ❑ Is voluntary for prescribed burns of rangeland
- ❑ Includes restrictions on some types of burning in April
- ❑ Outreach activities by KSU, KDHE, KLA, KFB, EPA, and more
- ❑ Includes resources to help land managers and local fire officials make burn decisions
- ❑ A website with tools to predict smoke plume movement
- ❑ Lays groundwork to get monitoring data flagged

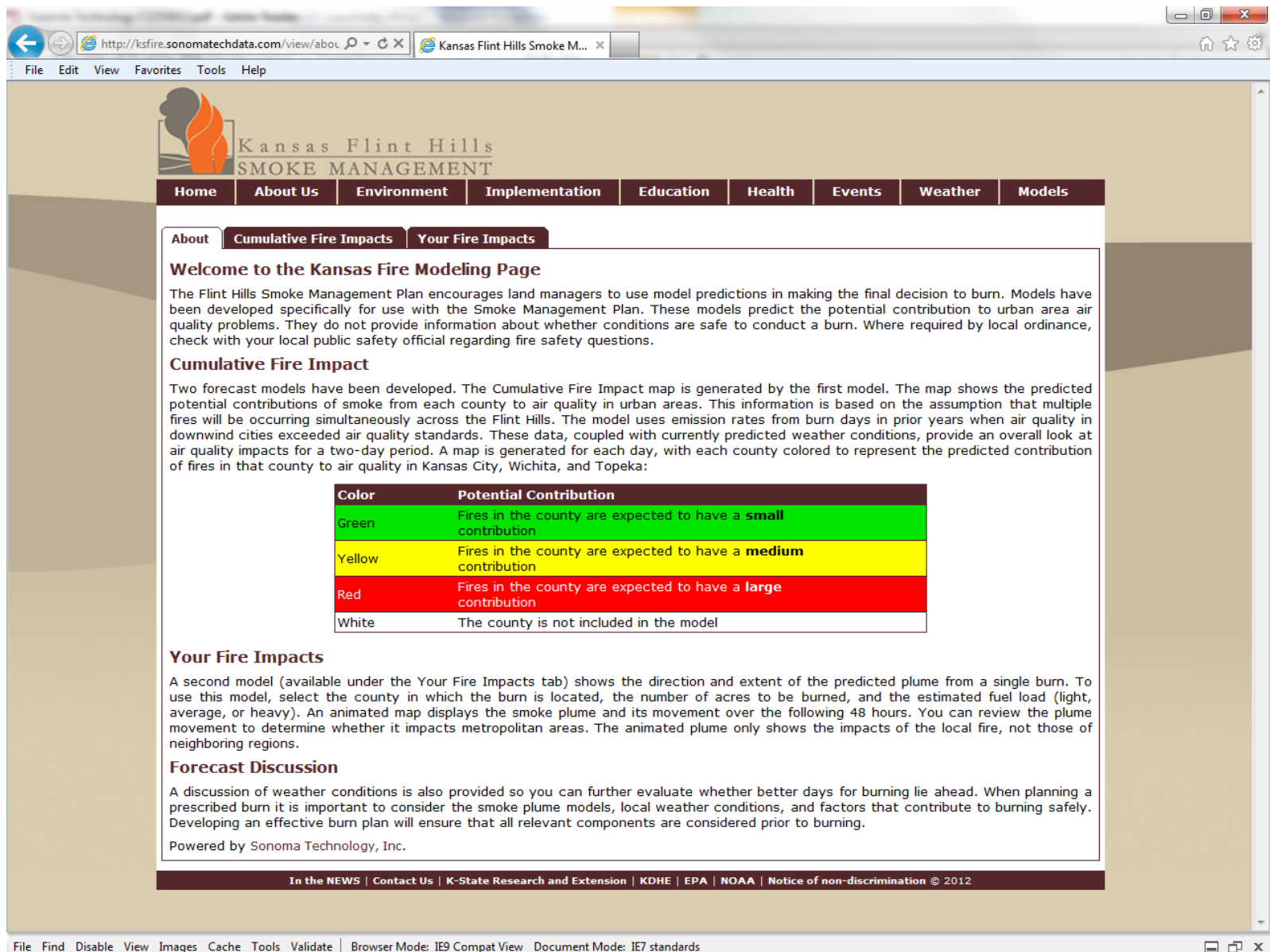
Forecasting Background

- Ozone is created from chemical reaction of nitrogen oxides and volatile organic compounds with sunlight.
- Particles are emitted directly by fires and created via chemical reactions.
- Movement of smoke can be predicted using weather forecasts and estimates of burning activity.



Many fires contributed to peak 8-hour average ozone (84 ppb) in Topeka on April 12, 2011.

KsFire.com Website Modeling Home Page



Kansas Flint Hills SMOKE MANAGEMENT

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About **Cumulative Fire Impacts** **Your Fire Impacts**

Welcome to the Kansas Fire Modeling Page

The Flint Hills Smoke Management Plan encourages land managers to use model predictions in making the final decision to burn. Models have been developed specifically for use with the Smoke Management Plan. These models predict the potential contribution to urban area air quality problems. They do not provide information about whether conditions are safe to conduct a burn. Where required by local ordinance, check with your local public safety official regarding fire safety questions.

Cumulative Fire Impact

Two forecast models have been developed. The Cumulative Fire Impact map is generated by the first model. The map shows the predicted potential contributions of smoke from each county to air quality in urban areas. This information is based on the assumption that multiple fires will be occurring simultaneously across the Flint Hills. The model uses emission rates from burn days in prior years when air quality in downwind cities exceeded air quality standards. These data, coupled with currently predicted weather conditions, provide an overall look at air quality impacts for a two-day period. A map is generated for each day, with each county colored to represent the predicted contribution of fires in that county to air quality in Kansas City, Wichita, and Topeka:

Color	Potential Contribution
Green	Fires in the county are expected to have a small contribution
Yellow	Fires in the county are expected to have a medium contribution
Red	Fires in the county are expected to have a large contribution
White	The county is not included in the model

Your Fire Impacts

A second model (available under the Your Fire Impacts tab) shows the direction and extent of the predicted plume from a single burn. To use this model, select the county in which the burn is located, the number of acres to be burned, and the estimated fuel load (light, average, or heavy). An animated map displays the smoke plume and its movement over the following 48 hours. You can review the plume movement to determine whether it impacts metropolitan areas. The animated plume only shows the impacts of the local fire, not those of neighboring regions.

Forecast Discussion

A discussion of weather conditions is also provided so you can further evaluate whether better days for burning lie ahead. When planning a prescribed burn it is important to consider the smoke plume models, local weather conditions, and factors that contribute to burning safely. Developing an effective burn plan will ensure that all relevant components are considered prior to burning.

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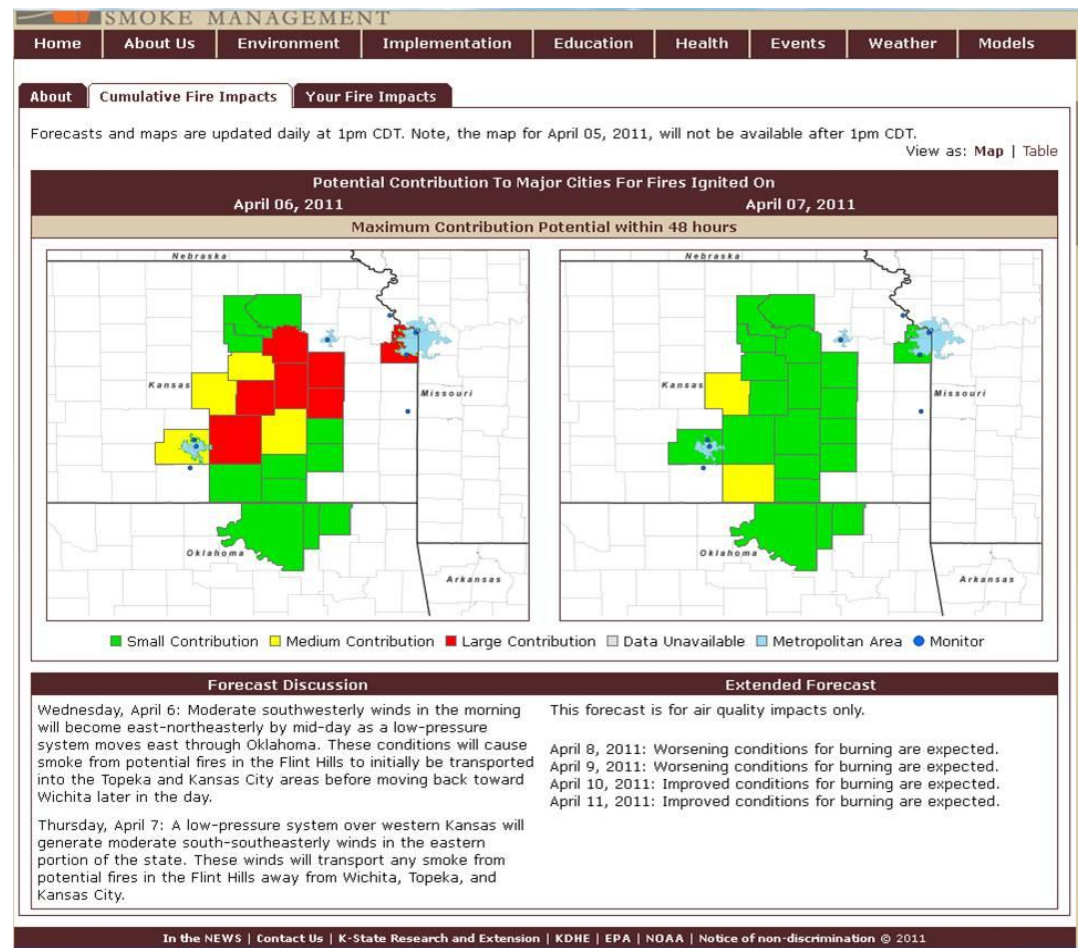
Burn Guidance Tools

Sonoma Technologies Inc. and KDHE developed tools to provide land managers daily information on when to burn to reduce air quality impacts.

Web site: <http://www.ksfire.org>

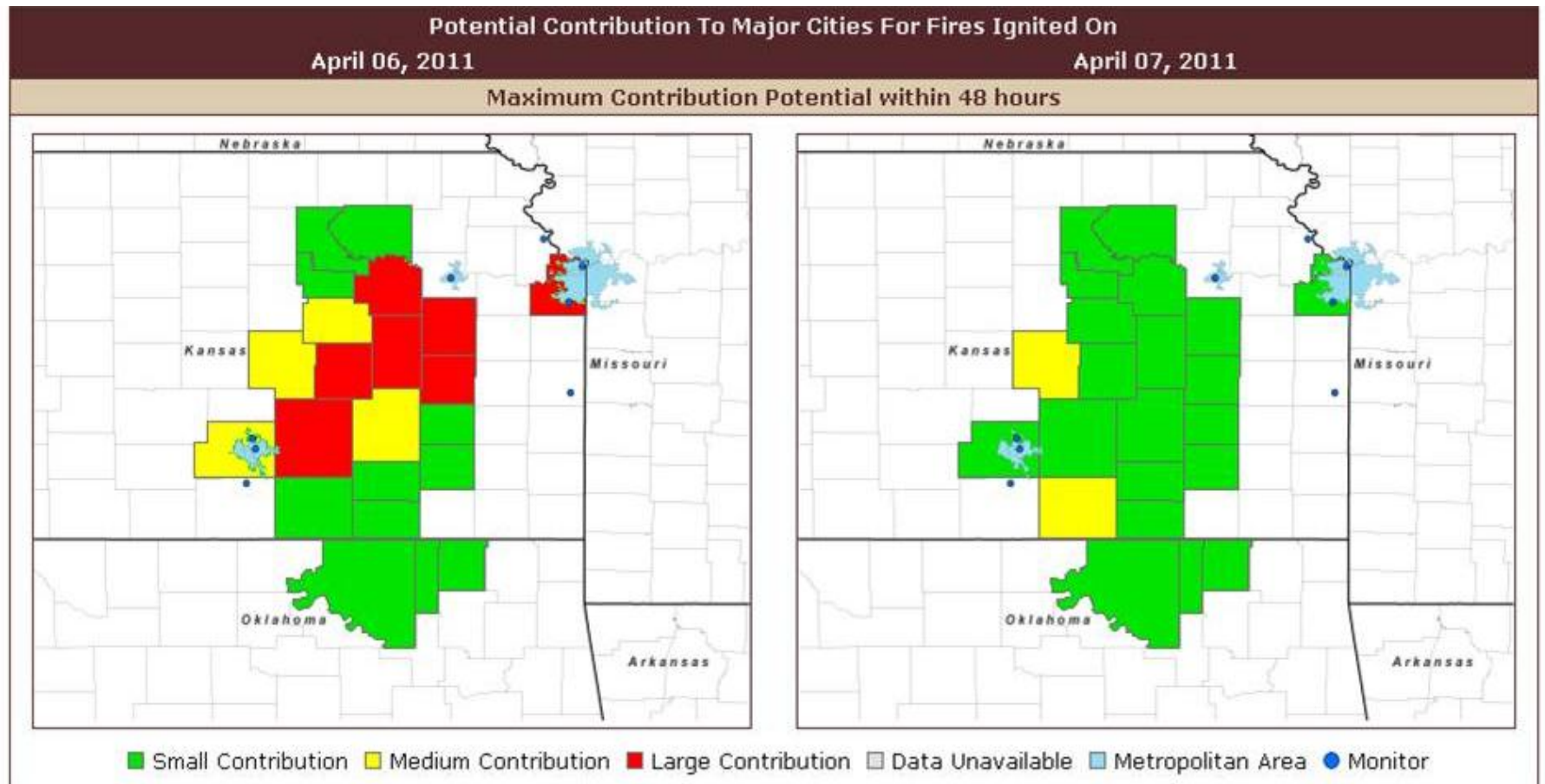
Tools provide daily:

- Burn guidance by county for the “next” two days
- Forecast discussions
- Extended outlooks
- County-level burning scenarios



April 5, 2011 Model Guidance

- Maximum contribution based on cumulative impact from potential fires
- County designated red, yellow or green based on county's contribution
- Uses forecasted meteorology and expected emissions for large burns



Example Guidance – Discussion

Meteorologists provide additional information on possible smoke impacts and extended outlooks.

Forecast Discussion

Wednesday, April 6: Moderate southwesterly winds in the morning will become east-northeasterly by mid-day as a low-pressure system moves east through Oklahoma. These conditions will cause smoke from potential fires in the Flint Hills to initially be transported into the Topeka and Kansas City areas before moving back toward Wichita later in the day.

Thursday, April 7: A low-pressure system over western Kansas will generate moderate south-southeasterly winds in the eastern portion of the state. These winds will transport any smoke from potential fires in the Flint Hills away from Wichita, Topeka, and Kansas City.

Extended Forecast

This forecast is for air quality impacts only.

April 8, 2011: Worsening conditions for burning are expected.
April 9, 2011: Worsening conditions for burning are expected.
April 10, 2011: Improved conditions for burning are expected.
April 11, 2011: Improved conditions for burning are expected.

Example Guidance – Individual Plumes

Provides hourly
plume movement
and concentration
to assess a burn.

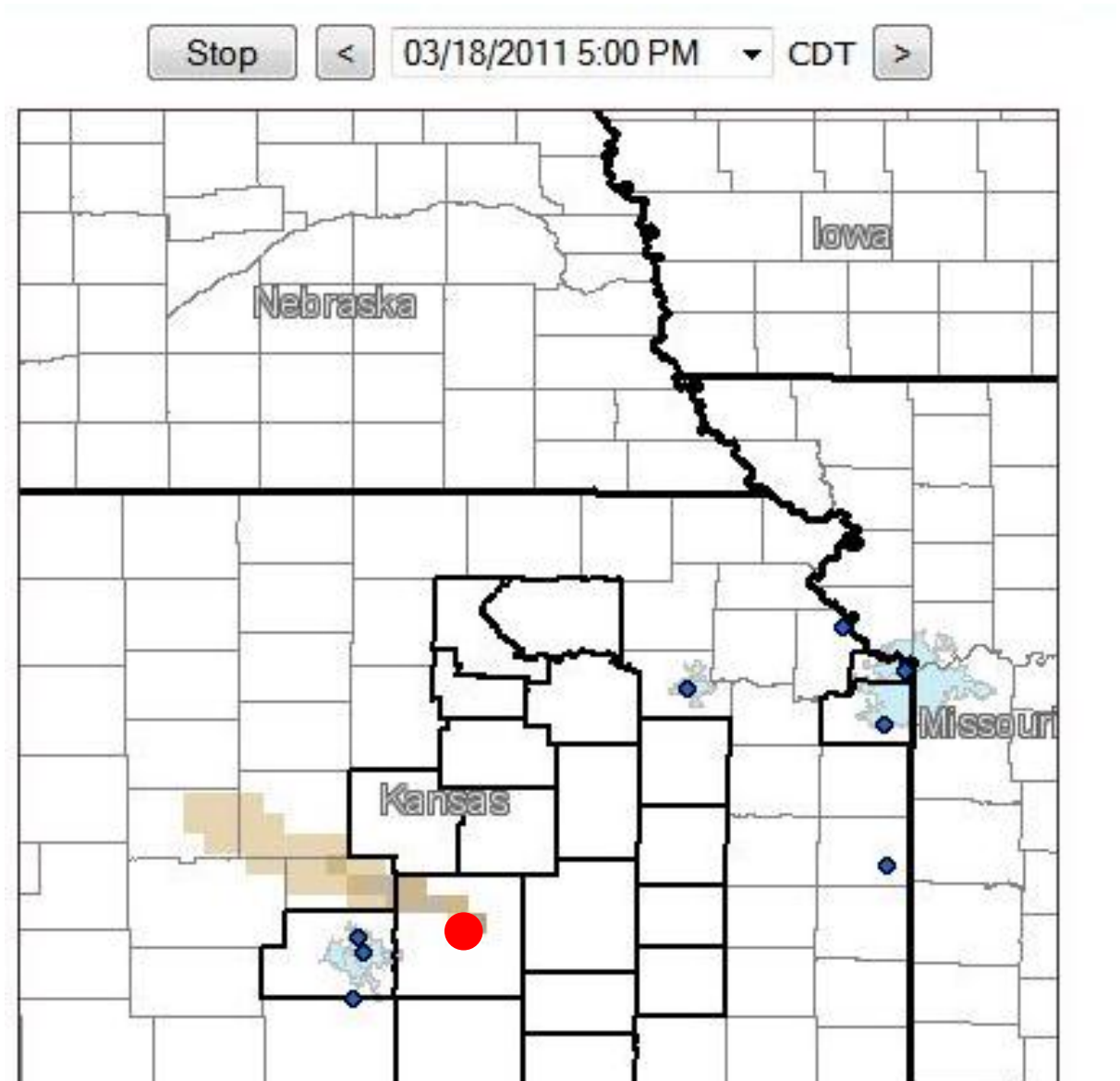
Users enter:

- County
- Fire size
- Fuel load

Plume is brown

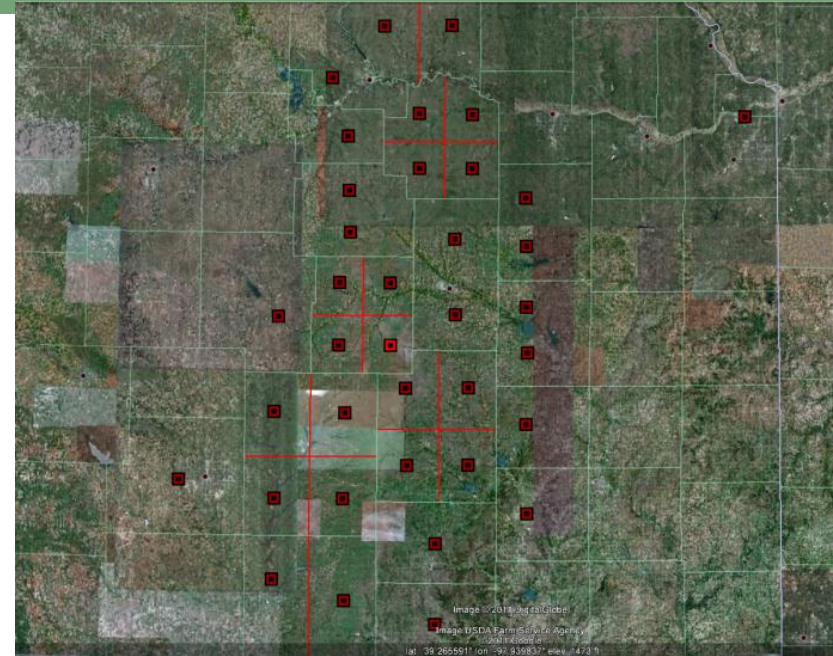
Fire location is red

Monitors are blue



Generating the Guidance

- STI created a system that runs BlueSky with HYSPLIT each day to predict smoke plume movement and dispersion
- Smoke plumes are derived from hypothetical burns
 - For individual plumes, burn characteristics are provided by users
 - For cumulative impact, burn characteristics are fixed
- Smoke emission estimates are generated from BlueSky Framework
- Weather inputs used by BlueSky are prepared from NCEP North American Model (NAM) 40 km forecast data



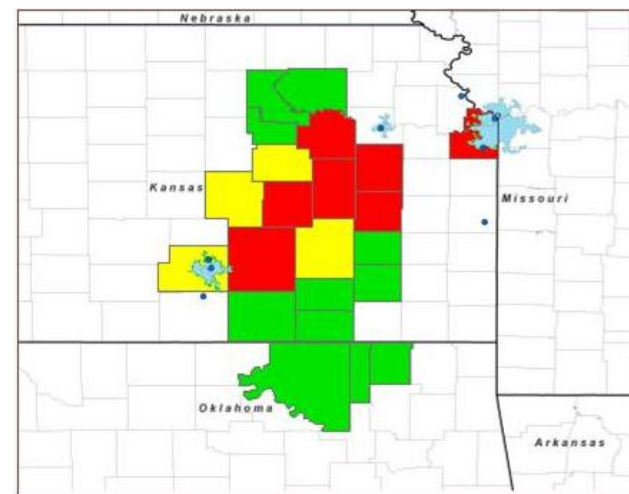
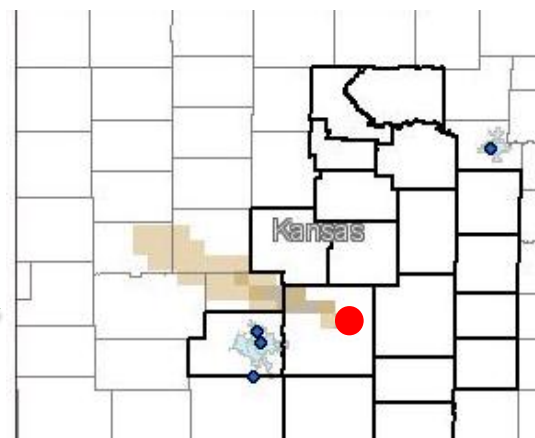
Hypothetical fire locations

The USDA Forest Service BlueSky Framework enables the use of state-of-the-science algorithms for simulating smoke impacts, air quality, and emissions from fires.

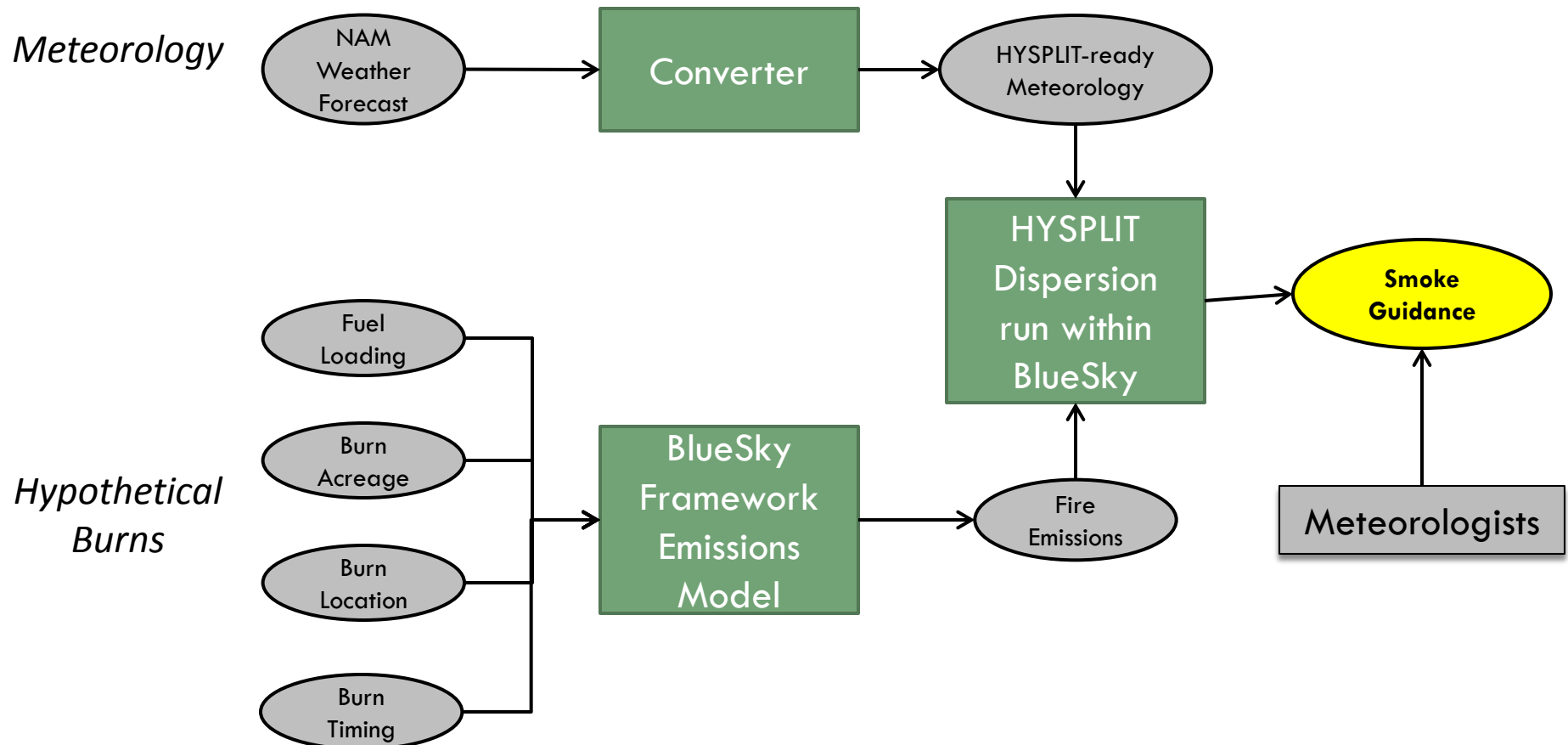
HYSPLIT is the Hybrid Single-Particle Lagrangian Integrated Trajectory Model, developed by the National Oceanic and Atmospheric Administration's Air Resources Laboratory.

Generating the Guidance

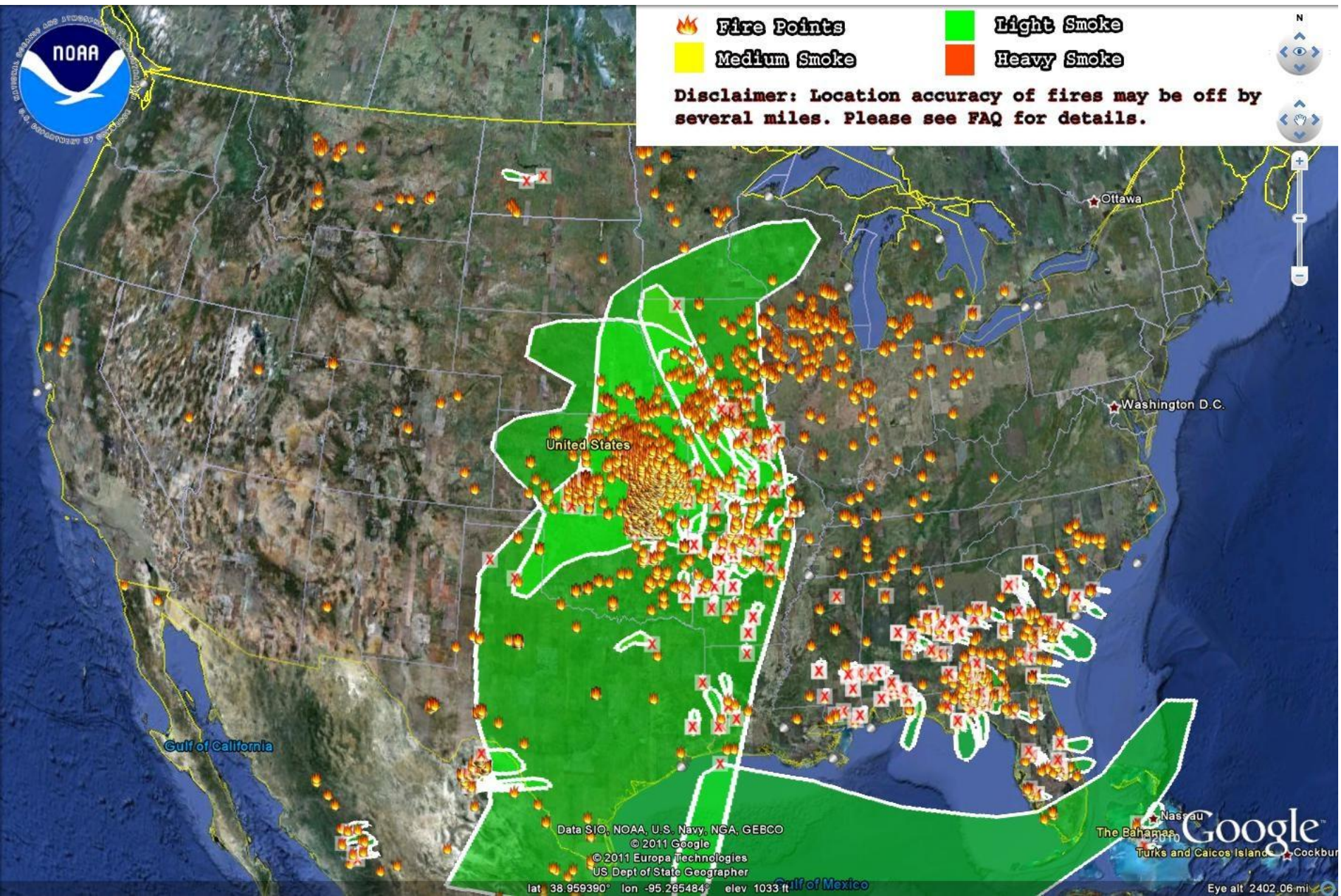
- Hypothetical fires burn each day from 10 AM to 6 PM
- Concentrations are tracked for 48 hours
- For individual fires, hourly smoke plumes from each burn are mapped at 15 km resolution
- For cumulative impact
 - 24-hr surface PM concentrations from all fires are summed by grid cell
 - If contribution is large and downwind concentration is high in city of concern, then the county is colored red



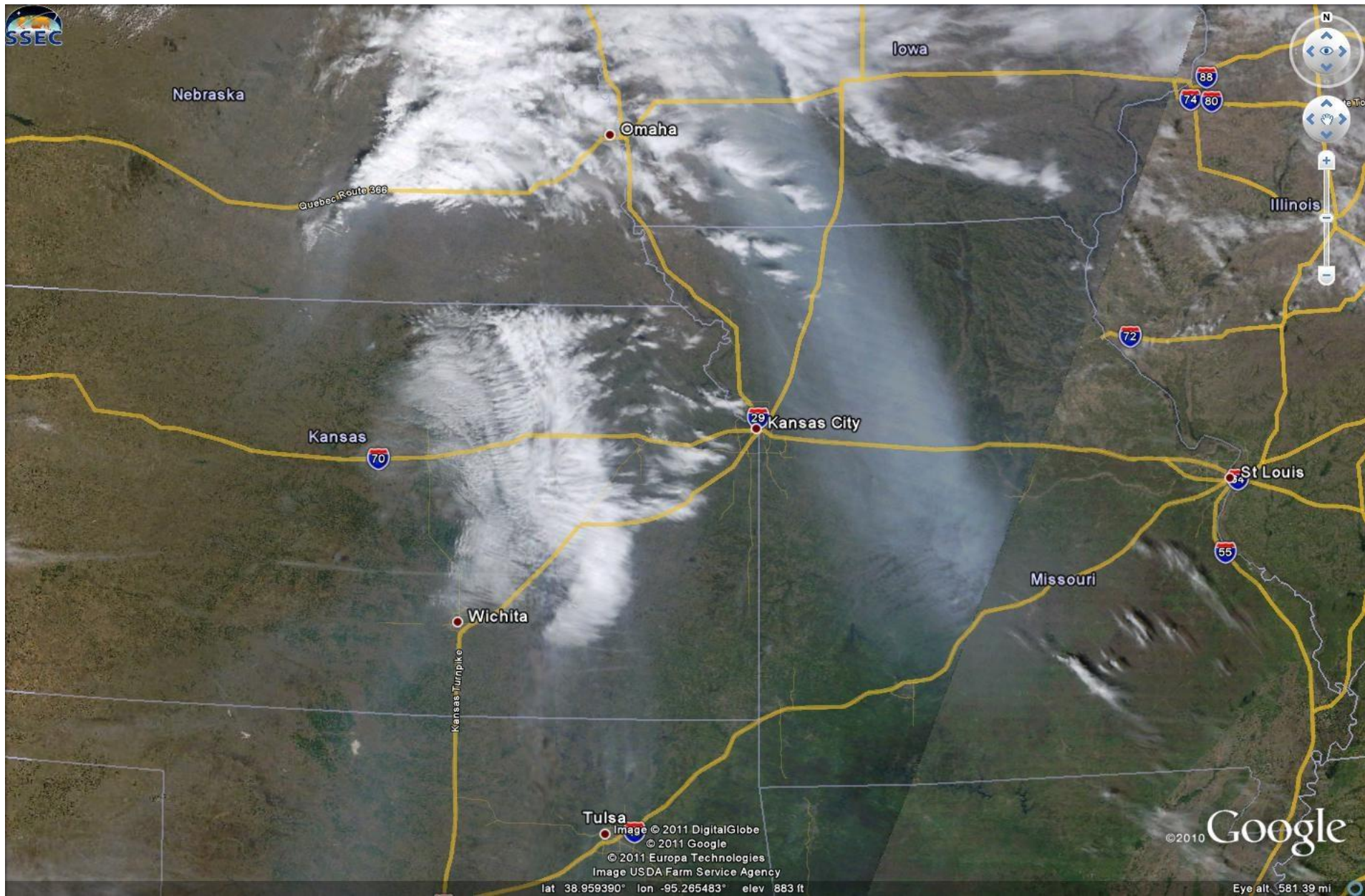
Generating the Guidance – Summary



NOAA Fire and Smoke Plume Map - April 13, 2011



NOAA Visible Satellite Pass – April 13, 2011



April 2011 Monitoring Results

Current Ozone Standard = 75 ppb

Date	Location	Pollutant	Concentration
April 6, 2011	Mine Creek	Ozone	76 ppb
April 6, 2011	Wichita - HD	Ozone	79 ppb
April 6, 2011	Wichita - Peck	Ozone	82 ppb
April 12, 2011	Konza Prairie	Ozone	78 ppb*
April 12, 2011	Topeka - KNI	Ozone	84 ppb
April 13, 2011	KC, Mo	Ozone	76 ppb
April 13, 2011	Konza Prairie	Ozone	79 ppb*
April 29, 2011	Peck	Ozone	77 ppb

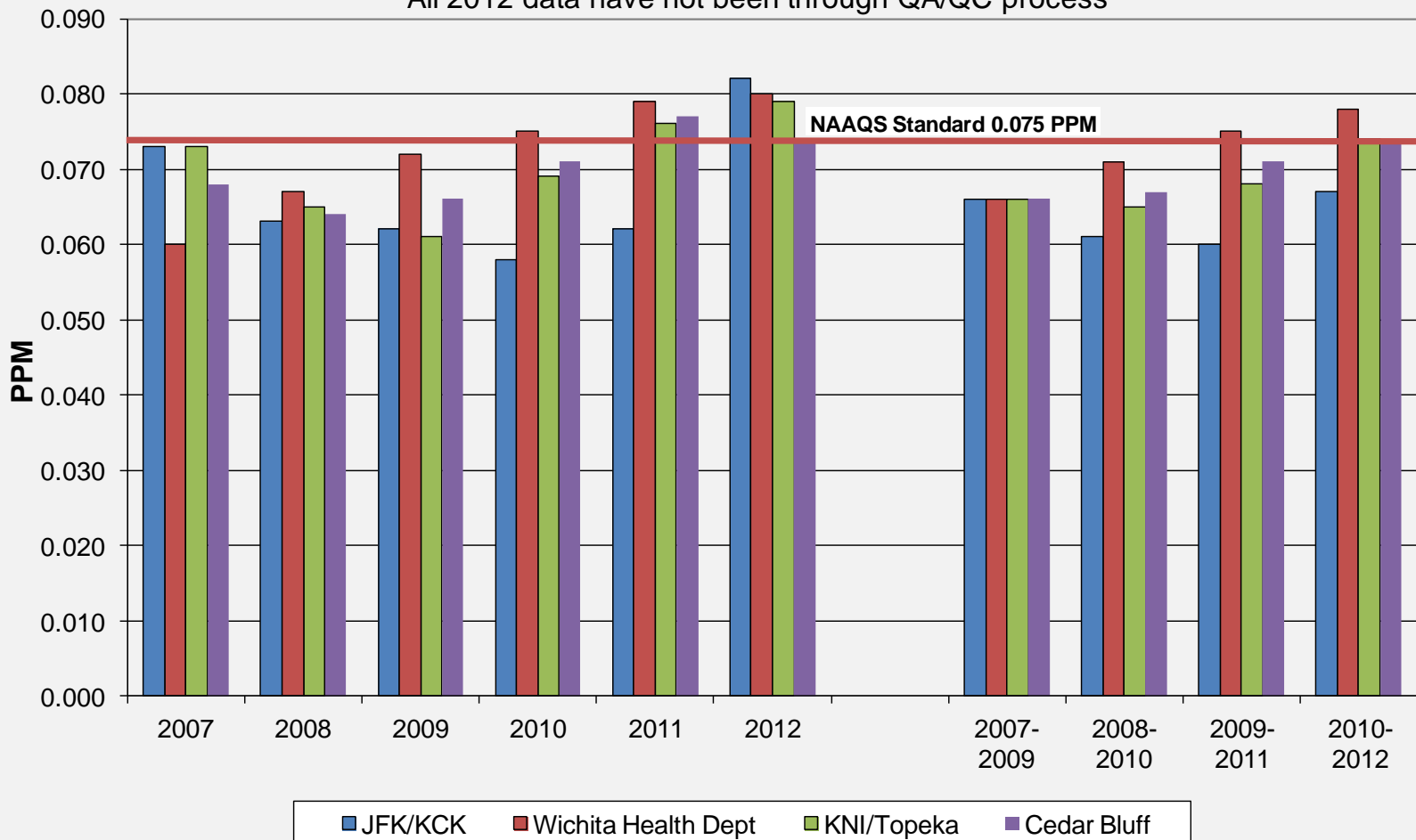
*- CASTNET site that is not run by KDHE BOA

Why are we concerned?

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Annual 8 Hour Ozone 4th Highs

All 2012 data have not been through QA/QC process



What if the standards are not met?

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- State Implementation Plan (SIP) preparation
 - ▣ New rules to reduce NO_x and VOCs emissions
 - ▣ Must be approved by EPA
 - ▣ Federally enforceable
- Transportation plan conformity with SIP
- Curtails economic development
- Potential loss of federal highway funds if transportation plan does not conform with air quality plan
- Increased costs to consumers
- Citizens breathing polluted air

Exceptional Events Request

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- ❑ Flint Hills burning in April of 2011 caused exceedances at Wichita, Kansas City and Mine Creek monitors
- ❑ Monitors impacted for 4 days
- ❑ KDHE developed request to flag the data in 2012
- ❑ Submitted request to EPA in November 2012
- ❑ Received letter granting approval in December 2012
- ❑ April 2011 days will not count in determining compliance with ozone air quality standard

Thanks to:

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- ❑ KSU Extension and Agronomy
- ❑ Sonoma Technology
- ❑ Kansas Livestock Association
- ❑ Kansas Farm Bureau
- ❑ The Nature Conservancy
- ❑ NRCS
- ❑ Kansas Forest Service
- ❑ EPA
- ❑ Many others





QUESTIONS?

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