3. Managing smoke: Our strategies and opportunities

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Pasture burning smoke management and air quality workshop

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Two strategies for reduction

Minimize smoke production

- Not easy
- Need more research

Reduce impact of smoke

- Timing of burn
- Communication

Minimize smoke production

- Frequency of burns
- Managing fuel load and fuel moistures
- Ignition and burn technique

Minimize smoke production

- Frequency of burns
  - Do I really need to burn this year to meet the objectives of land management?
  - Identify specific, quantifiable objectives of the prescribed fires in the Fire Management Practice Checklist
  - Consider non-burning alternative
- Managing fuel load and fuel moistures
- Ignition and burn technique

Minimize smoke production

- Frequency of burns
- Managing fuel load and fuel moistures
  - Vegetation management practices.
  - More frequent burning to reduce woody vegetation build-up
- Ignition and burn technique

Minimize smoke production

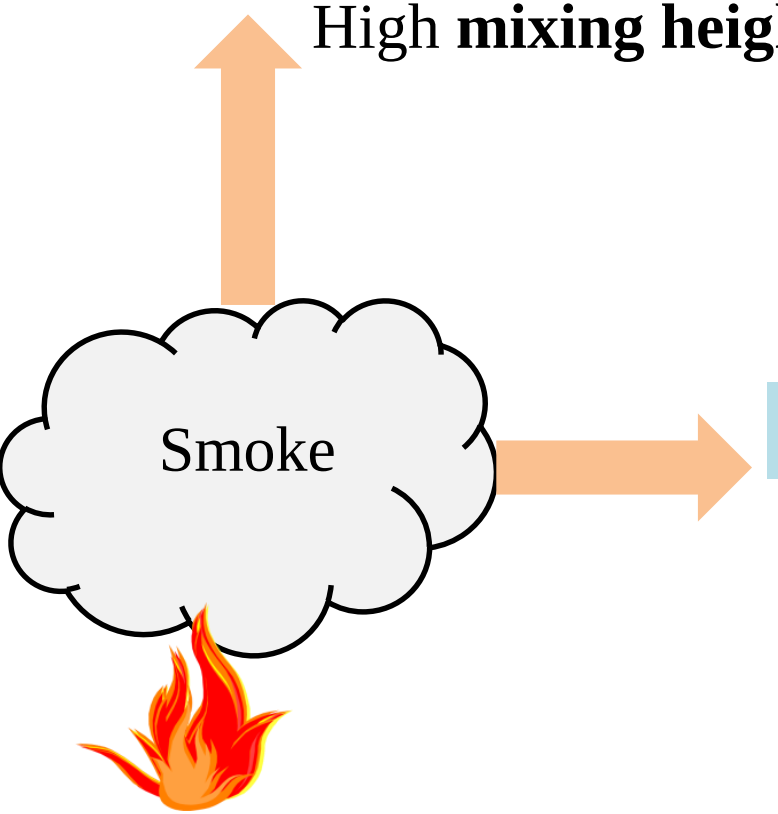
- Frequency of burns
- Managing fuel load and fuel moistures
- Ignition and burn technique
  - Backfires burn more efficiently than headfires, but headfires take less time to burn.
  - Reducing smoldering areas

Reduce impact of smoke

- Timing of burns
  - To allow for adequate smoke dispersion
  - To avoid current or forecasted poor air quality conditions

Reduce impact of smoke

How do weather conditions affect dispersion of smoke?



Vertical dispersion

High **mixing height** = gets smoke up, up, and away

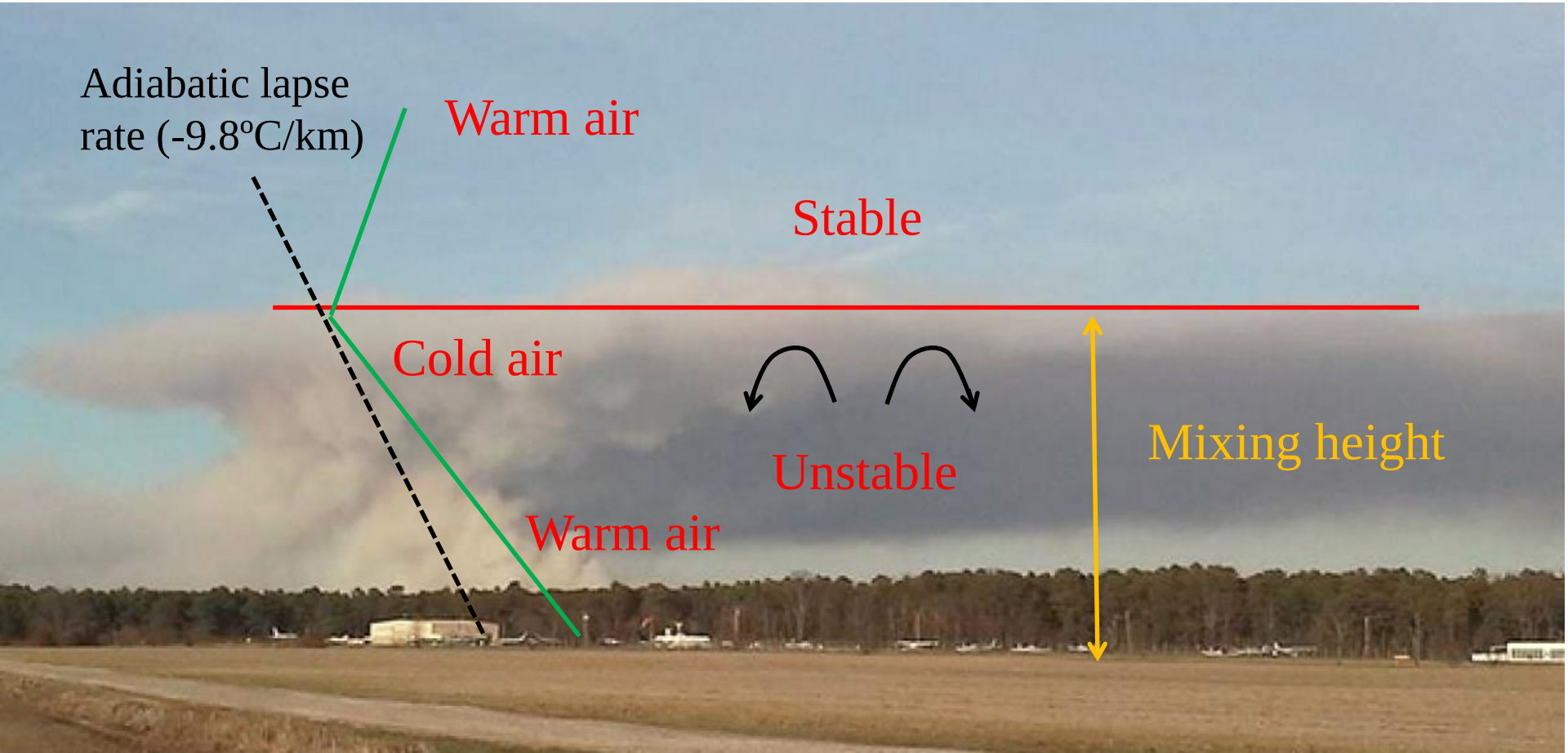
Horizontal dispersion

Good **transport wind** = smoke goes away

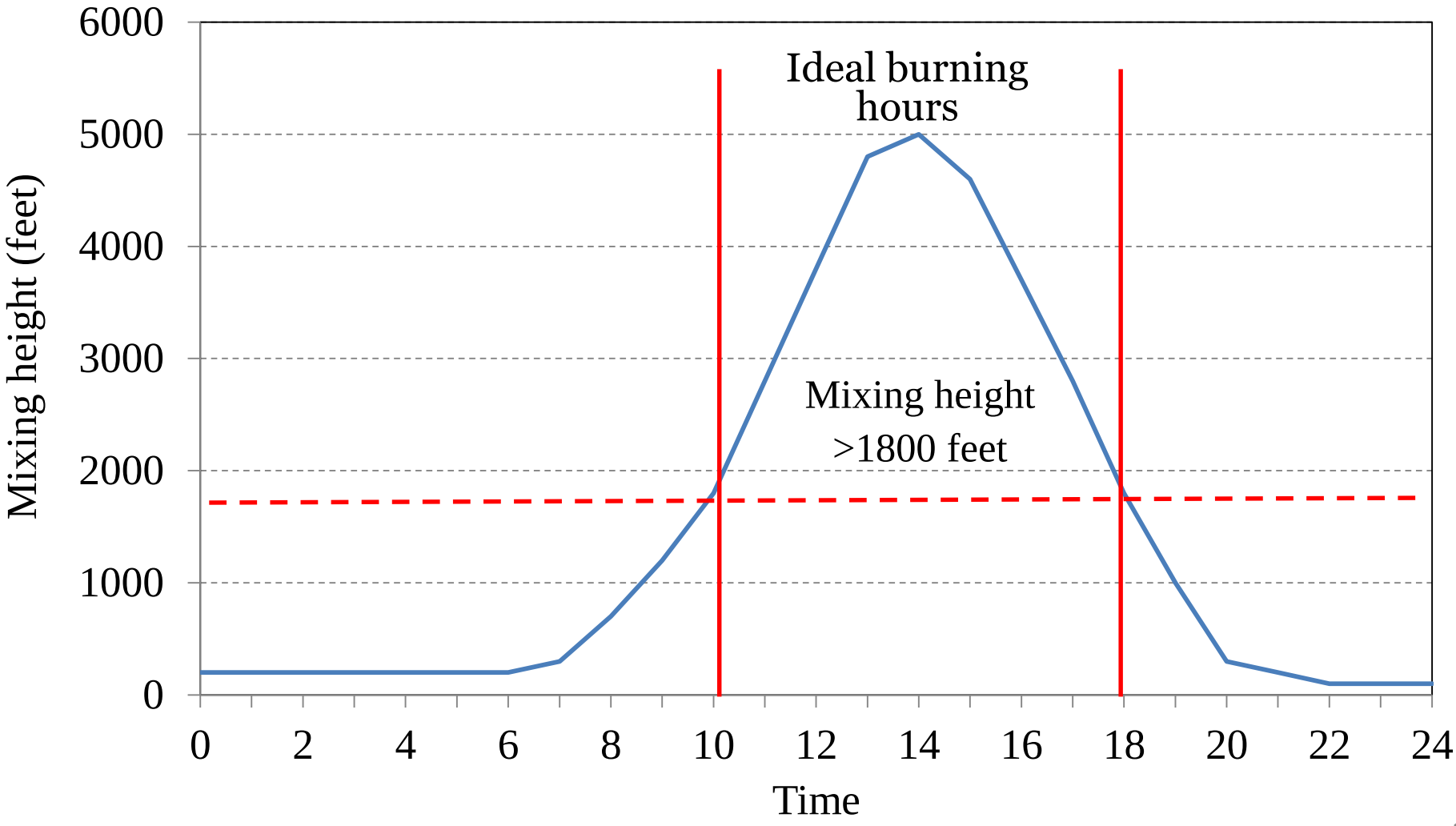
Good wind direction = less smoke on sensitive spots

Reduce impact of smoke

Mixing height defines the height above the ground through which the air is under turbulent mixing. It is the height at which smoke stops rising.

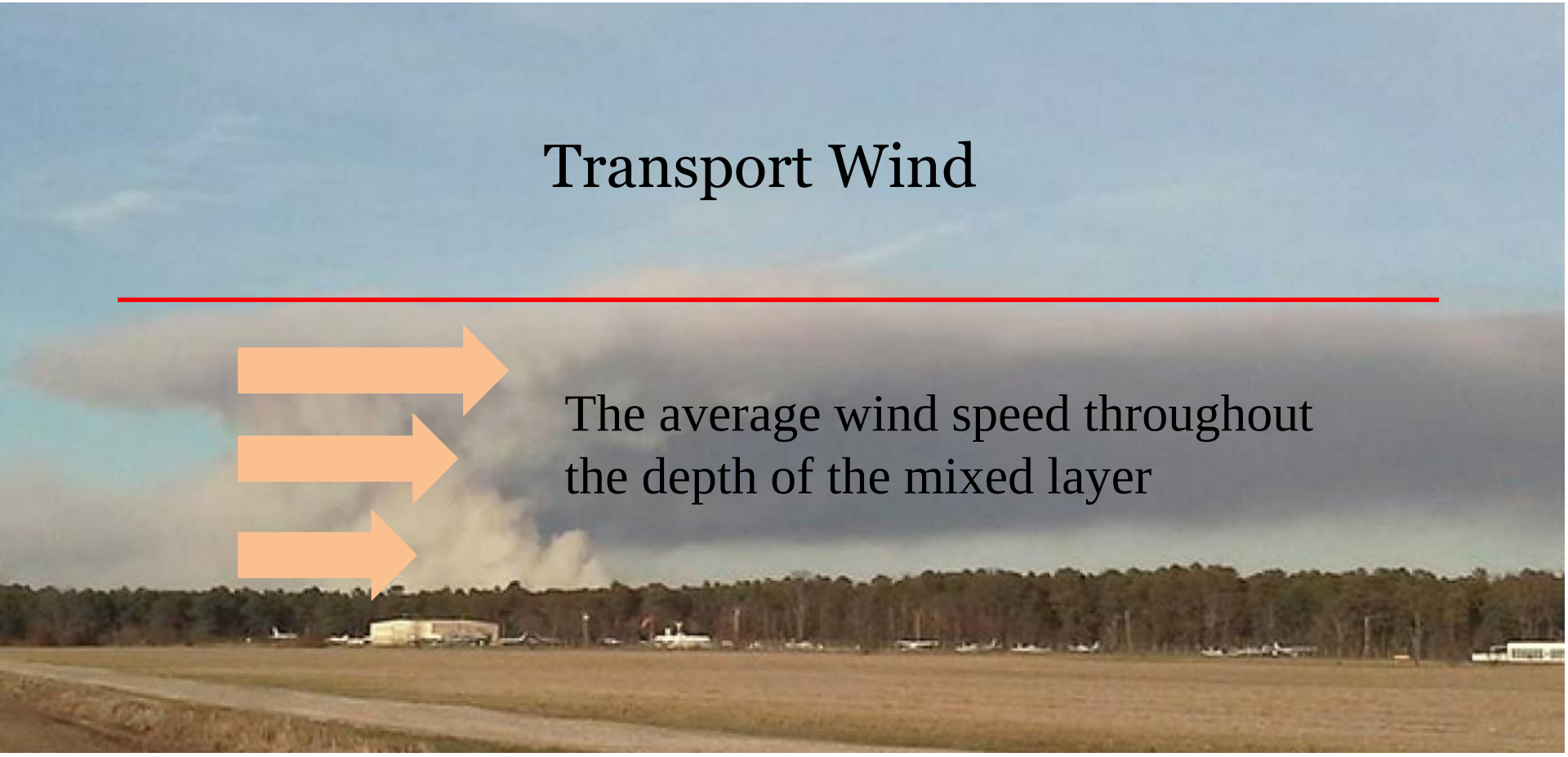


Reduce impact of smoke



Reduce impact of smoke

Transport wind generally refers to the average rate of the horizontal transport of air within the mixing layer. Transport wind at 8-20 mph is desired for burning.



Reduce impact of smoke

Recommended weather conditions for burning in the SMP

Relative Humidity: 30-55%	Reduced smoke production
Mixing height: >1,800feet (548m)	Adequate smoke dispersion
Transport winds: 8-20 mph (3.6-8.9m/s)	
Preferred start/stop times: 10 am to 6 pm	
Cloud cover: 30 to 50%	Reduced ozone production

Reduce impact of smoke

The National Weather Service (NWS) offer forecasts of **mixing height** and **transport winds** in their fire weather forecasts.

Topeka:
http://www.weather.gov/forecasts/wfo/sectors/topFireDay.php

Wichita:
http://www.weather.gov/forecasts/wfo/sectors/ictFireDay.php

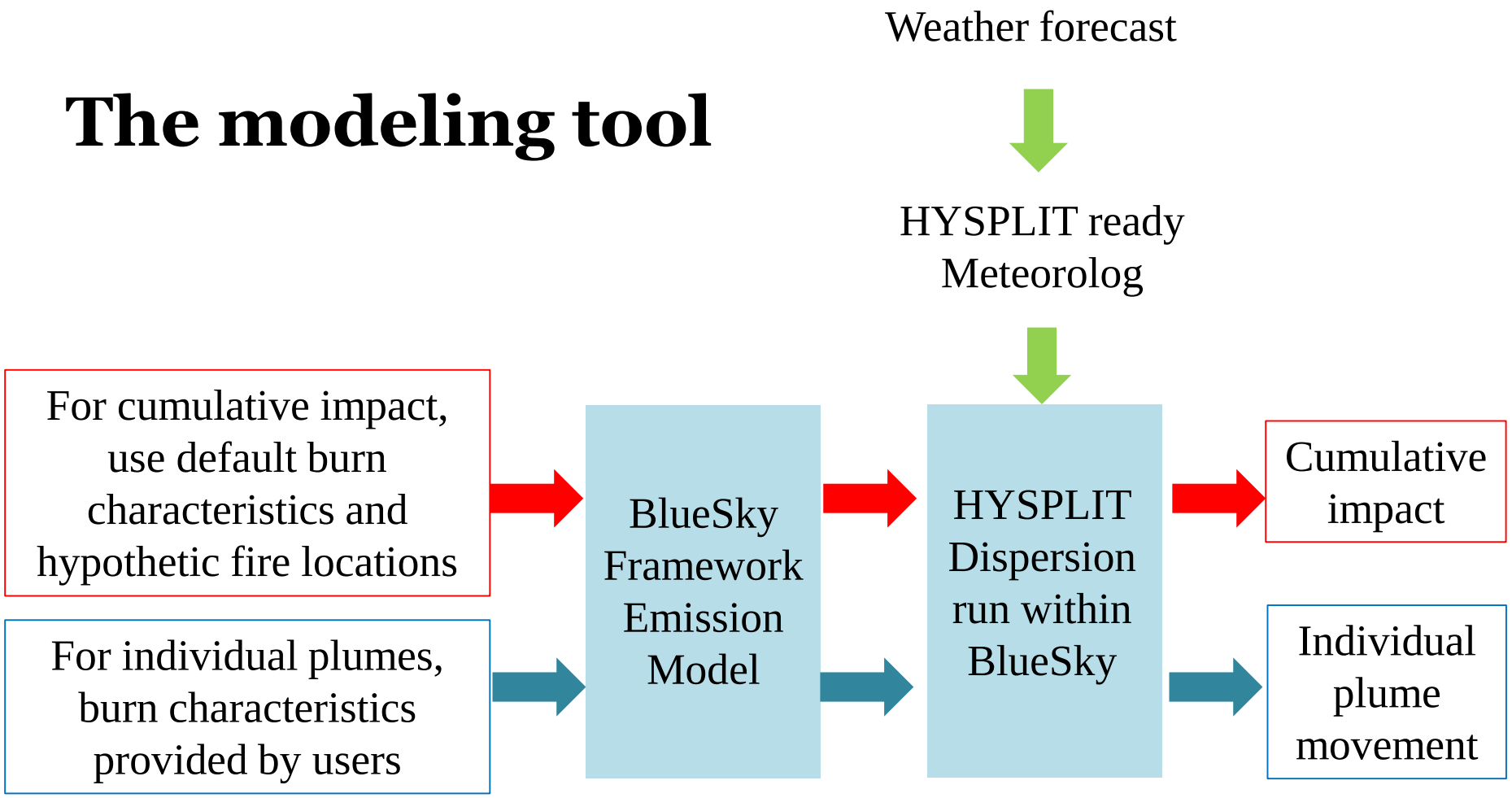
Reduce impact of smoke

Smoke screening

- Redistribute the emissions by burning when wind direction is favorable
- Use the smoke modeling tool provided on www.ksfire.org to understand
  - Where your individual plume will go?
  - Maximum contribution to major cities based on cumulative impact from fires that could be ignited within 48 hours

Reduce impact of smoke

The modeling tool



Reduce impact of smoke

Two smoke models on www.ksfire.org

- Model 1: Estimate maximum contribution by county to major cities based on cumulative impact from fires that could be ignited within the next 48 hours
  - Use forecasted meteorology and expected emissions
  - County designated red, yellow or green based on country's contribution to downwind air quality monitors.
- Model 2: Provide hourly individual plume movement and concentration to assess a burn
  - Users enter county, fire size, fuel load
  - Plume is brown, showing where the plume will go.
- Forecast discussion

Reduce impact of smoke

Kansas Flint Hills SMOKE MANAGEMENT

www.ksfire.org

Smoke Management

Kansas Flint Hills Smoke Management

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- Regulations
- Education
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Contact us

Kansas Flint Hills Smoke Management

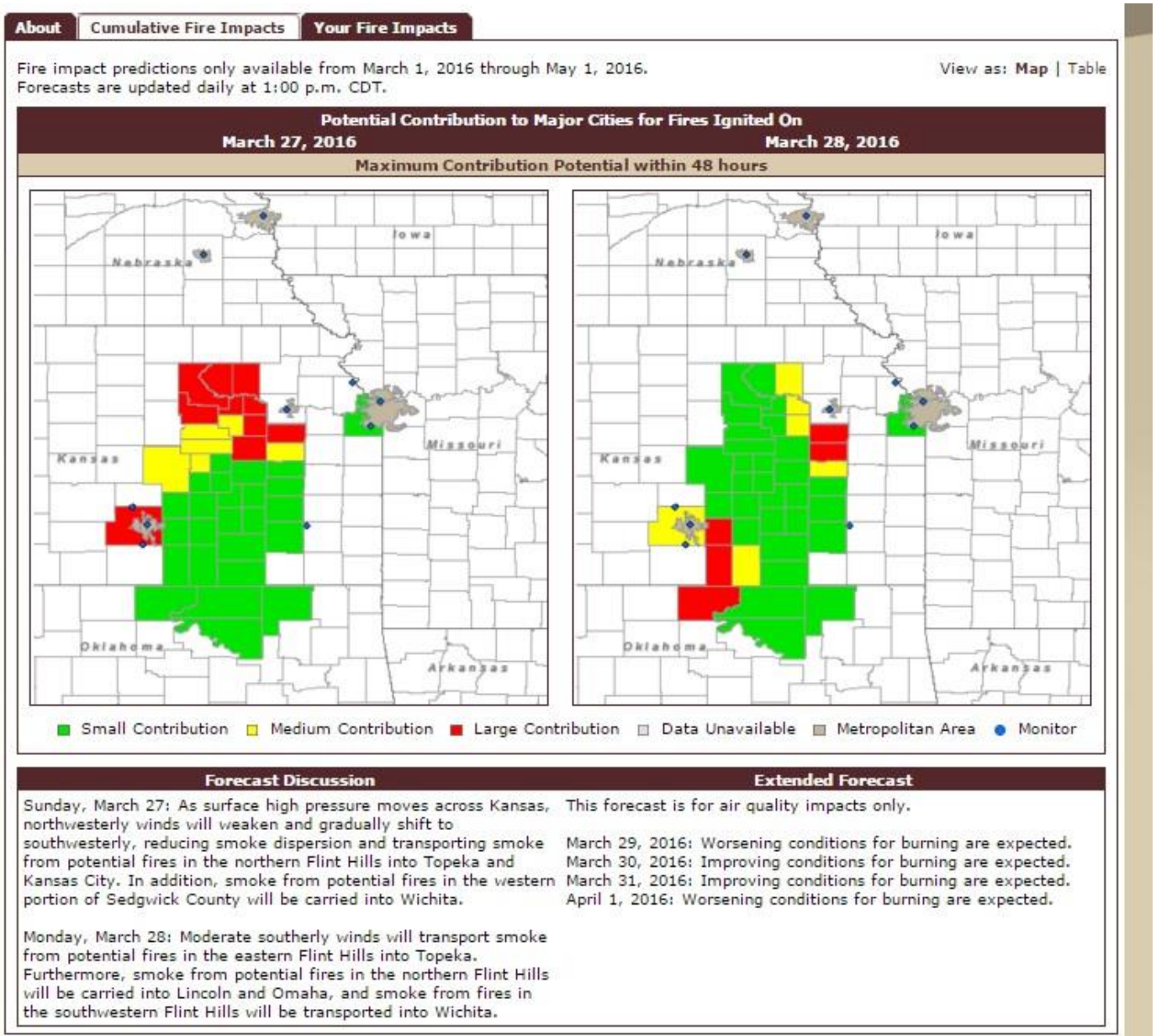
Welcome to the Kansas Flint Hills Smoke Management Website. This site provides a single location for land managers conducting prescribed burns in the Flint Hills to obtain information and access tools to assist them in making burn decisions.

This website supports the Flint Hills Smoke Management Plan, which was developed in an attempt to balance the need for prescribed fire in the Flint Hills with the need for clean air in downwind communities.

At A Glance

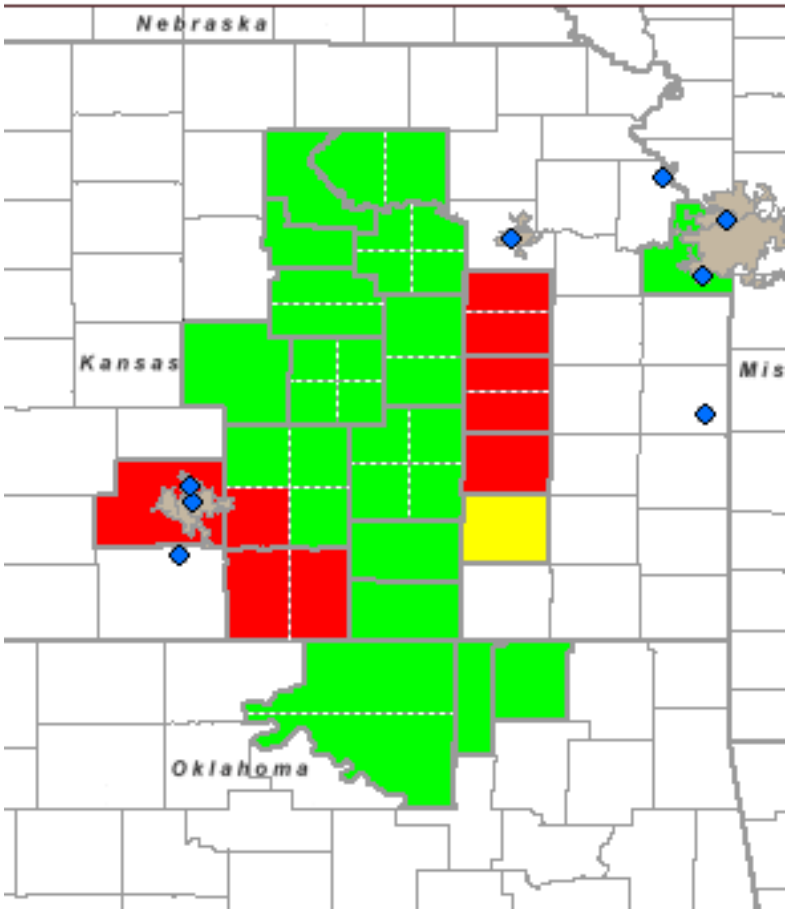
- 2016 Air Quality Health Advisory Alert
- 2015 Flint Hills Acres Burned
- April Burning Restrictions (Regulations)
- April Burning Restrictions (FAQ)
- Kansas Smoke Management Plan - KDHE
- Fire Management Practices to Improve Air Quality (PDF)
- County Burn Permit Information
- Current Burn Bans- Contact your local Emergency Manager
- Fire Management Practices to Reduce the Impacts of Smoke (PDF)

Reduce impact of smoke

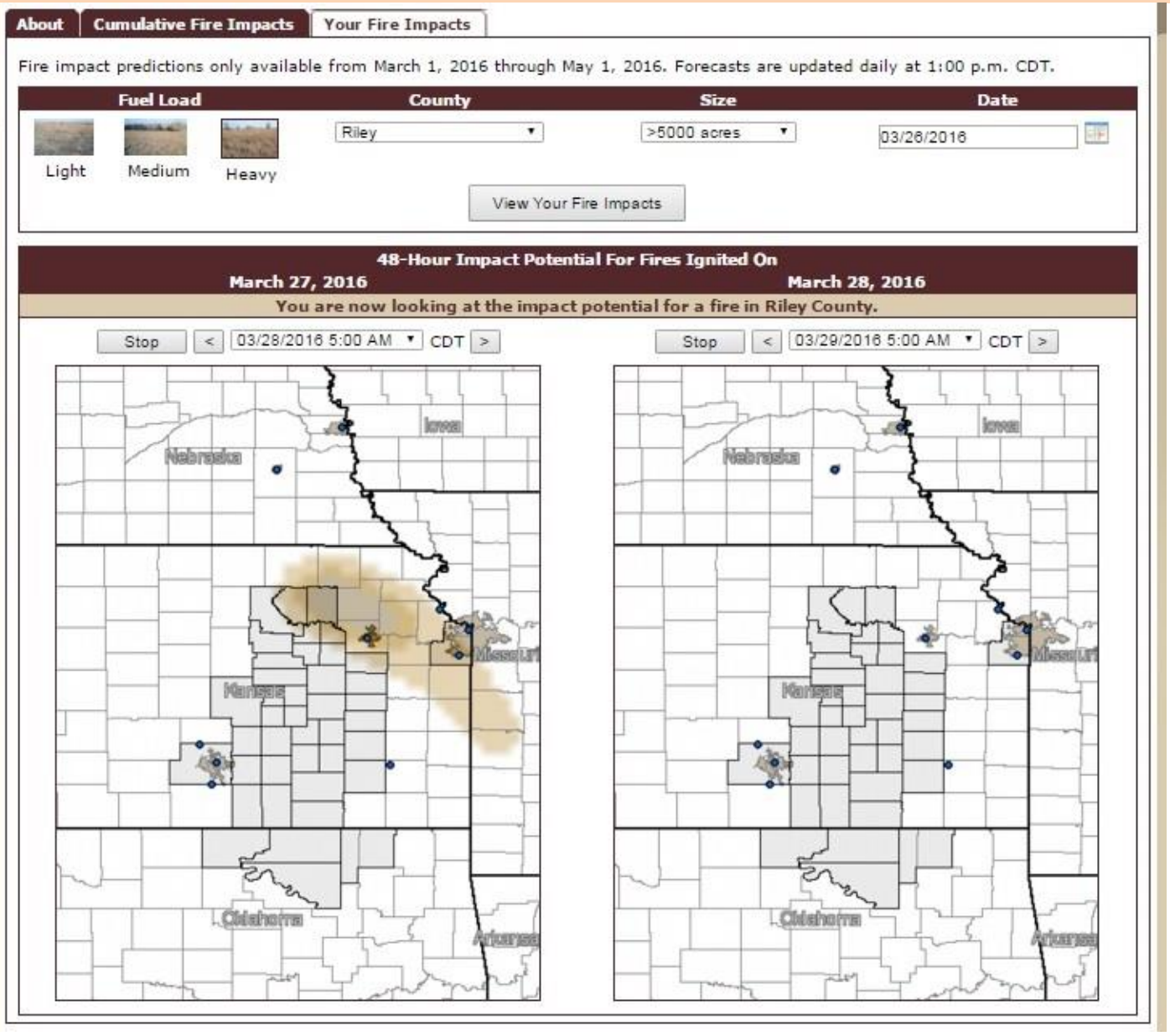


Model 1:
cumulative impact

- A smoke green day is not necessary a safety green day.
- Unstable and windy conditions are excellent for smoke dispersal but burn with caution!



Reduce impact of smoke



Model 2:
individual plume

Reduce impact of smoke

Avoid current or forecasted poor air quality conditions in downwind areas. Especially, avoid high O_3 day.

- Air quality condition - KDHE

http://keap.kdhe.state.ks.us/airvision/

- Air quality forecast - NOAA

http://airquality.weather.gov/

- Advisory comments on the smoke modeling tool on www.ksfire.org

Reduce impact of smoke

Other practices

- Test fire & evaluation
- Ration your smoke (less smoke density)
- Coordination of area burning to minimize cumulative smoke impacts

Reduce impact of smoke

Sometimes it is difficult to tell which way your smoke will go.

Reduce impact of smoke

Coordination of area burning to minimize cumulative smoke impacts

- On a day with suitable weather conditions for burning, too many burns may occur at the same time. Preferably, burning can be planned cooperatively so as not to overwhelm the ability of the atmosphere to disperse the smoke.

Reduce impact of smoke

Summary of tools available to help you plan for, and communicate the impacts of smoke

- The smoke modeling tool on www.ksfire.org for smoke screening
- Recommended weather conditions for burning in the SMP
- Fire weather forecasts provided by www.weather.gov/forecasts
- Air quality information provided by KDHE and NOAA websites
- Data collection pilot program and the Fire Management Practice Checklist
- FIRMS web fire mapper at https://firms.modaps.eosdis.nasa.gov/firemap/

Two strategies for communication

Notification

- Sensitive populations
- Authorities

← Data collection pilot program in the SMP

Critical if seeking to be qualified as exceptional events →

Documentation

- Record-keeping of BSMP's, fire activity, and smoke behavior
- After-burn evaluation

Notification

- The SMP currently does not mandate notification and data collection. Currently each county has differing levels of reporting procedures and gathering of this information.

- The goal of the data collection pilot program is to develop a centralized reporting system that would make this information not only more accurate but also timelier, while protecting landowner and/or prescribed fire practitioner privacy.

Documentation

Record-keeping of BSMP's, fire activity, and smoke behavior

- Monitor the effects of the fire on air quality
  - Keeping track of where the smoke goes, how high it goes and whether it disperses well or is tight and dense, which can be done through visual monitoring and can be documented by notes, photographs
- If air quality problems occur, documentation helps analyze and address air regulatory issues
- If the state decides to seek to remove the data from the monitoring record, then documentation of BSMPs are critical.

Documentation

- ✓ Contact information
- ✓ Burn method and fuel type
- ✓ Smoke sensitive areas
- ✓ Acceptable smoke prescription
- ✓ Contingency planning
- ✓ Burn monitoring procedures
- ✓ Location and size of the burn
- ✓ Expected air emissions
- ✓ Smoke travel projections
- ✓ Description of alternatives to burning
- ✓ Public notification procedures
- ✓ Maps that show boundaries, ownership, control lines (& natural barriers) areas to be excluded

A comprehensive burn plan

Documentation

After-burn evaluation

- Was preburn preparation properly done?
- Were objectives met?
- Was burn plan adhered to?
- Were all parameters (fuel, weather, smoke, fire behavior) within planned limits?
- Was burning technique correct?
- How can similar burns be improved?

Contingency measures

If the SMP is not effective enough to prevent an exceedance of the NAAQS, then certain contingency measures may need to be considered

- Expand April burning restrictions to additional counties and applications
- The scope and county coverage of smoke plans could be increased.
- Notification and data collection could become a requirement.
- Establish requirement for burn approvals based on meteorological and other conditions.
- Create a time of day window for burns.
- Open burning could be banned on certain days in which air quality could be severely impacted.

Smoke science and research needs

- Characterize emissions using different burn techniques and under different burn conditions
- Using remote sensing data to characterize fuel loading
- Monitoring of air quality during fire events
- Timing and frequency of burns
- Air quality implications of various management practices
- Health impact
- Burning effects on prairie chicken populations

Smoke research in KSU

- Source apportionment studies.
- Modeling analysis of history O_3 data in burn seasons.
- Assimilate satellites aerosol products such as aerosol optical depth (AOD) into the current emission processing model in order to improving emission estimation of prescribed burns.

Wish list of KDHE (from Thomas Gross)

- Add Lincoln, Omaha, other cities as potentially impacted areas to modeling tool, add extreme danger impact color code to model
- Conduct annual clipping study or satellite imagery analysis to determine fuel load
- Modeling analysis of history data in burn seasons to evaluate alternative control scenarios
- Study to determine baseline emissions profile of burning in the Flint Hills and changes with geography, time, and met conditions.

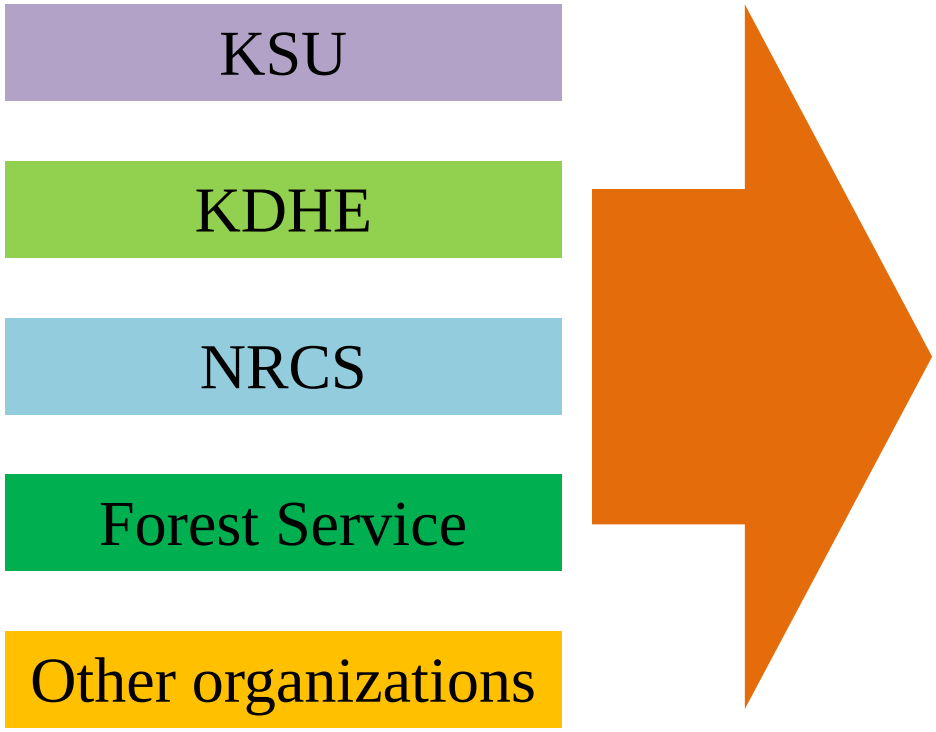
Long term strategies

- Smoke modeling
  - Improve and validate
  - Use real time fire data from remote sensing
  - Improve emission factors
  - A photochemical model that would provide a prediction of both O_3 and secondary organic aerosols from the burning
  - Future changes to air quality standards may require additional modeling tools.

Long term strategies

- Smoke measurement
  - Recent technology has made breakthroughs in measurement of organic compounds and has identified many new species in fire smoke.
  - Ground-based and aircraft aerosol measurements
  - Determine the optical density of the smoke by measuring the attenuation of a beam of light passing through the smoke
  - Investigate the evolution of secondary organic and black carbon aerosols

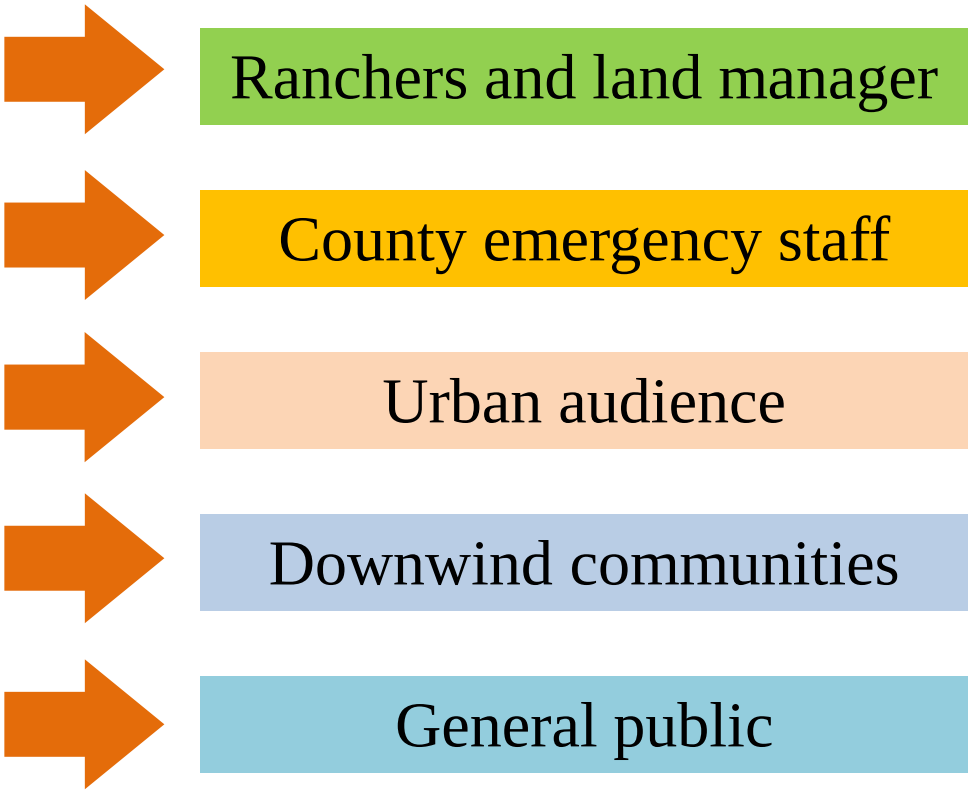
Extension and outreach strategies



Coordinate and create one authoritative information source, providing easy access to information

Extension and outreach strategies

Identify target audiences and develop targeted messages, addressing specific information needs



The key messages