Fire Activity & Emission Inventories: Their Use in Smoke Management Decision Making and State Implementation Plans

Susan O'Neill, NRCS

NWCG Smoke Committee Workshop

February 24-26, 2009, Omaha, Nebraska

Photo courtesy Lorraine Vogt

- What is an Emission Inventory (EI)?
- Why are Emission Inventories necessary?
- Why is it important to have good Fire Activity data and emissions incorporated into an EI?

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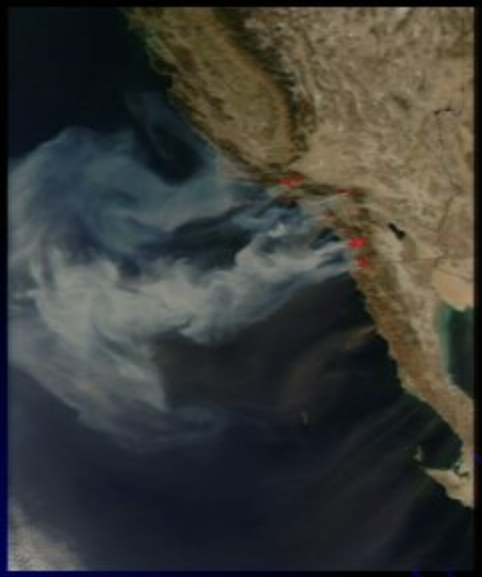
What is an Emission Inventory?

- A dataset of atmospheric trace gases emitted from various sources:

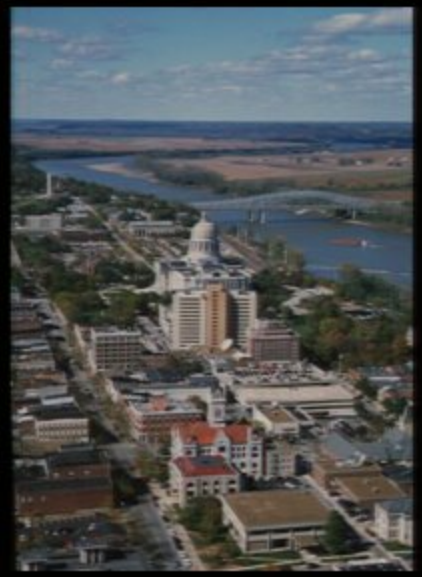
Point Sources

Vehicles – cars, trucks, trains, ships



Fire, Dust

Biogenics – vegetation (ex. isoprene, terpenes)

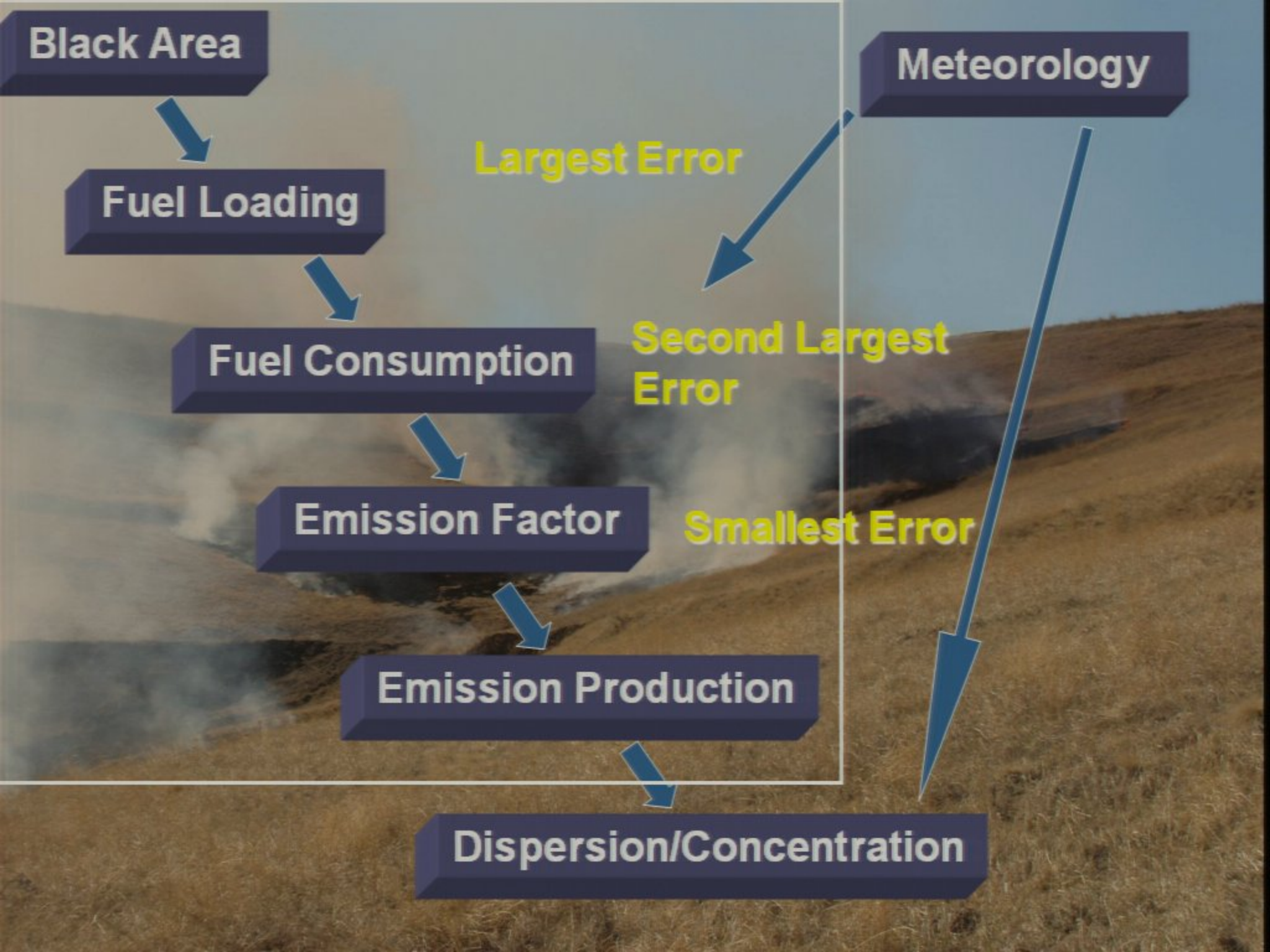


Area Sources – ex. gas stations, cleaners, restaurants, agriculture

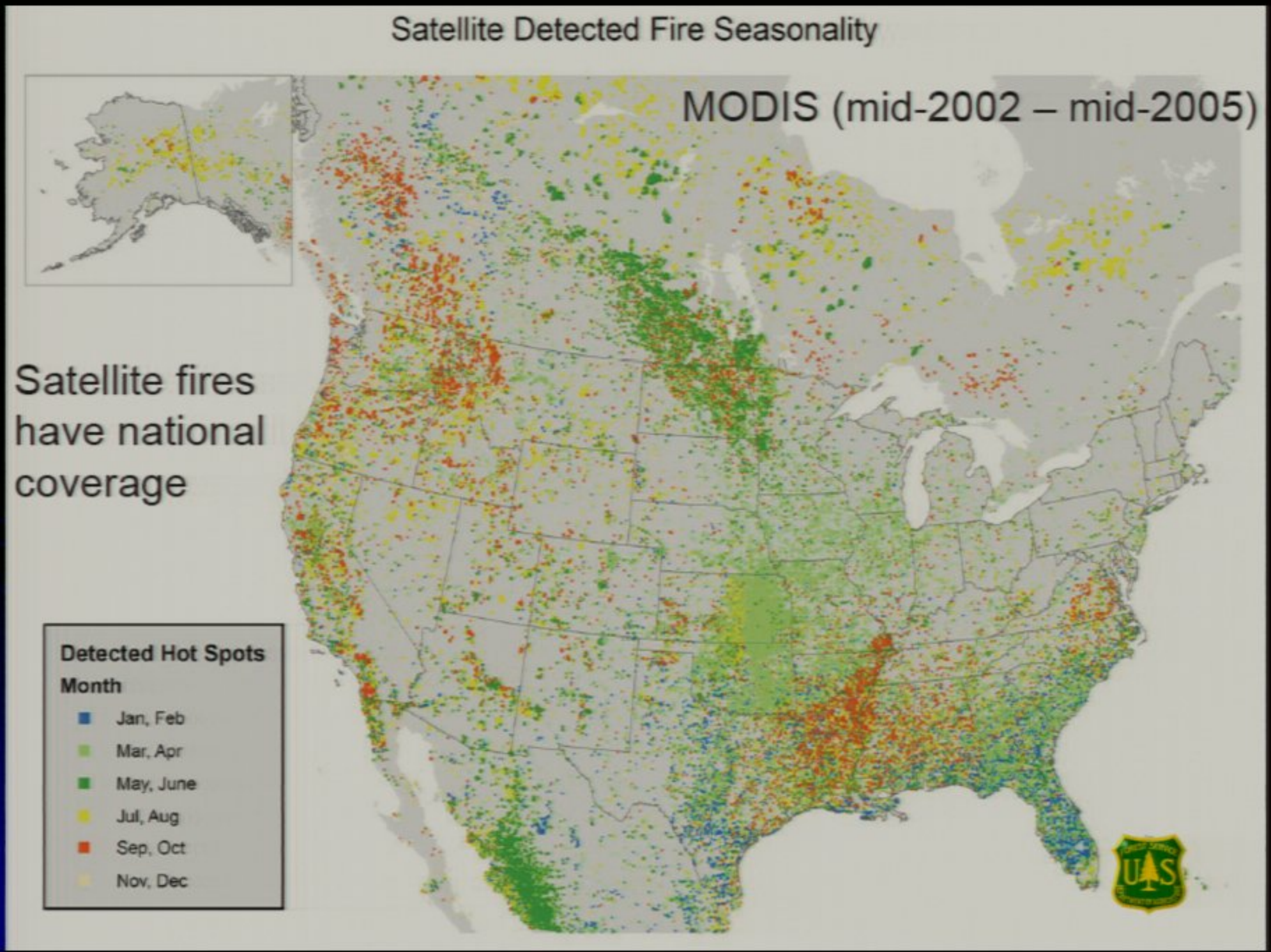
Why Are Emission Inventories Necessary?

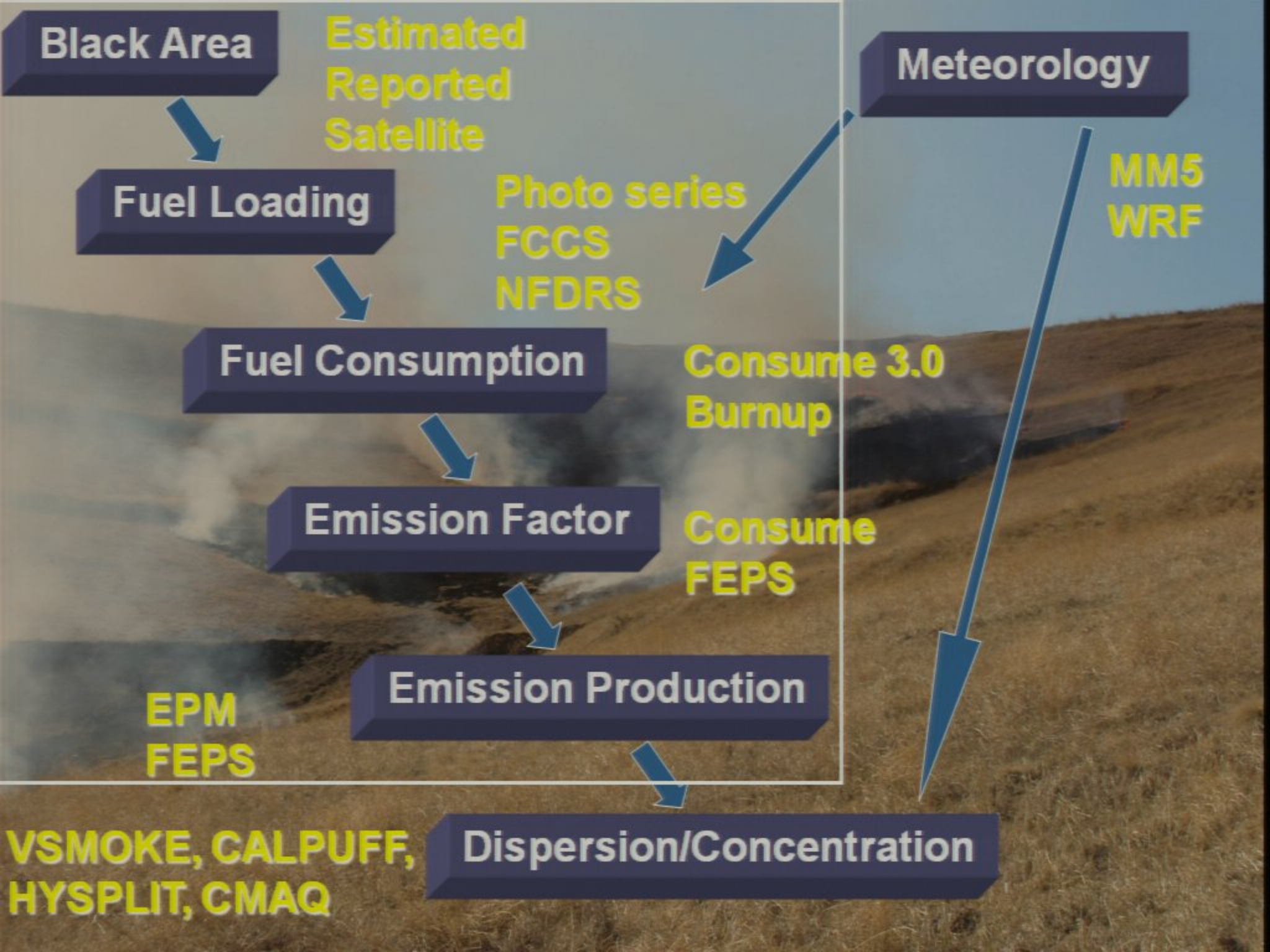
- Atmospheric dispersion modeling.
  - Useful for Smoke Management decision making
- Annual estimates of the prescribed fire program.
- Nonattainment and regional air quality planning.
- EIs can help with:
  - an exceptional event demonstration
  - General Conformity requirements
  - NEPA requirements
  - Greenhouse gas issues


• What does it take to create a fire emission inventory?
Photo courtesy Craig Ziegler


Black Area
Meteorology
Largest Error
Fuel Loading
Fuel Consumption
Second Largest Error
Emission Factor
Smallest Error
Emission Production
Dispersion/Concentration

First Step: Fire Activity Data



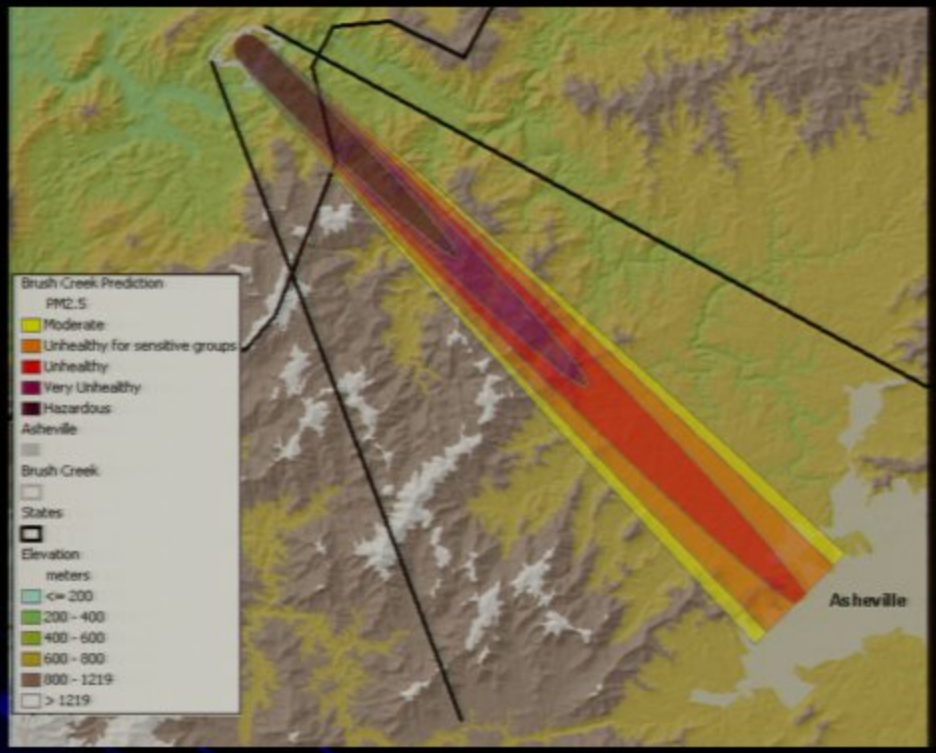

Black Area
Estimated
Reported
Satellite
Meteorology
Fuel Loading
Photo series
FCCS
NFDRS
MM5
WRF
Fuel Consumption
Consume 3.0
Burnup
Emission Factor
Consume
FEPS
Emission Production
EPM
FEPS
VSMOKE, CALPUFF,
HYSPLIT, CMAQ
Dispersion/Concentration

Uses of a Fire Emission Inventory

- So what do we do now that we've estimated hourly geo-located fire emissions?
  - Dispersion modeling for Smoke Management basic smoke management practices (BSMP)
  - Regional Coordination of burning activities (BSMP)
  - Regional air quality forecasting systems
  - Regional air quality modeling for regulatory purposes

Photo courtesy Craig Ziegler

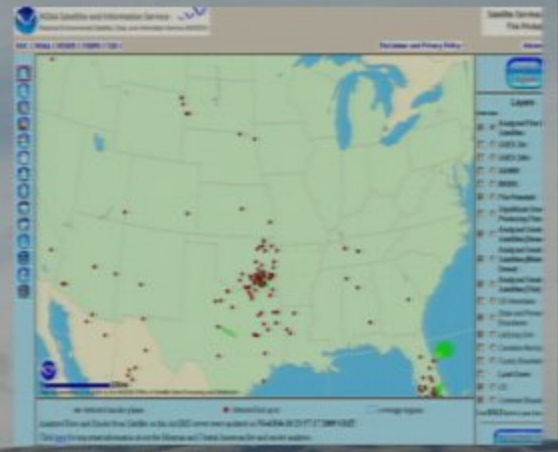
Dispersion Models



- Inputs: hourly emissions, meteorology
- Gaussian profile dispersion
- Standalone (ex. VSMOKE) or regional processing (ex. BlueSky)
- Dispersion modeling can be a BSMP and can be required in SMPs

Atmospheric Chemistry Models

- Examples:
  CMAQ & CAMx
- Used in:
  - SIP development (NAAQS, Regional Haze Rule)
  - Regional Air Quality Forecasting Systems
- Include secondary processes
  - Pollutants formed by chemical reaction in the atmosphere
    - Ozone
    - Fine Particulate Matter



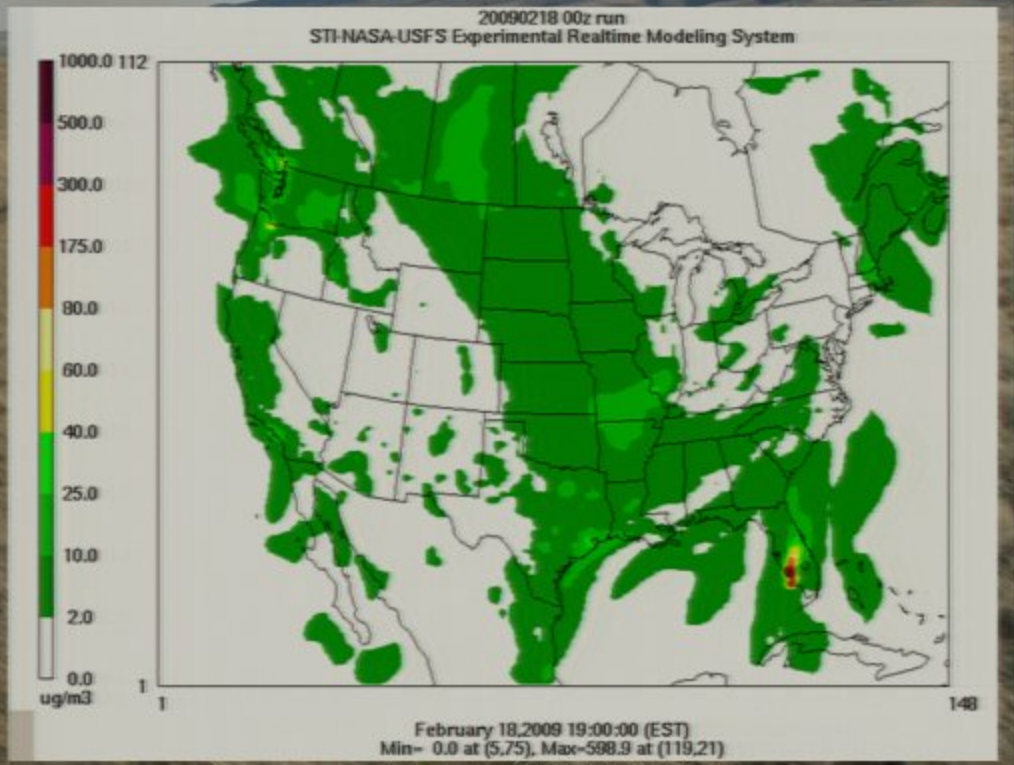


Photo courtesy Ryan Bessette

Air Quality Plans

- The air quality agencies will develop emissions inventories for all air pollution source categories.
- Assumptions will be made by the air quality agencies if the no input is offered or received from the forestry/rangeland community.
- Some stakeholders (like the utility industry) are actively questioning and researching wildland smoke impacts to air quality.

What can happen if incorrect assumptions are made about Fire Activity in EI's?

- Model results may not adequately reflect reality, leading to decisions that may not address nonattainment problems
- Burning may be conducted to maximize dispersion, but if assumptions are made due to lack of fire activity data in the EI process, then larger impacts can be simulated

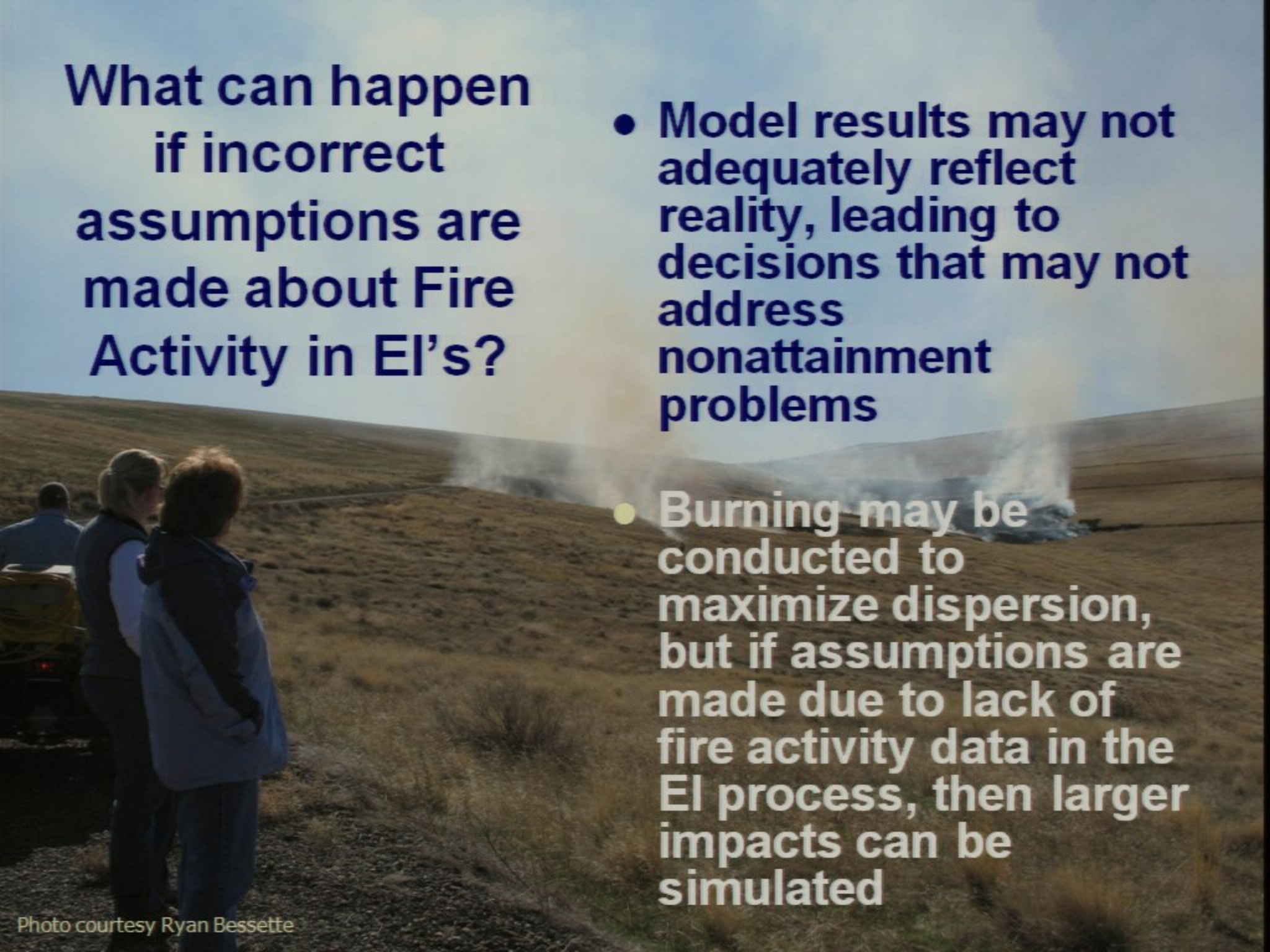
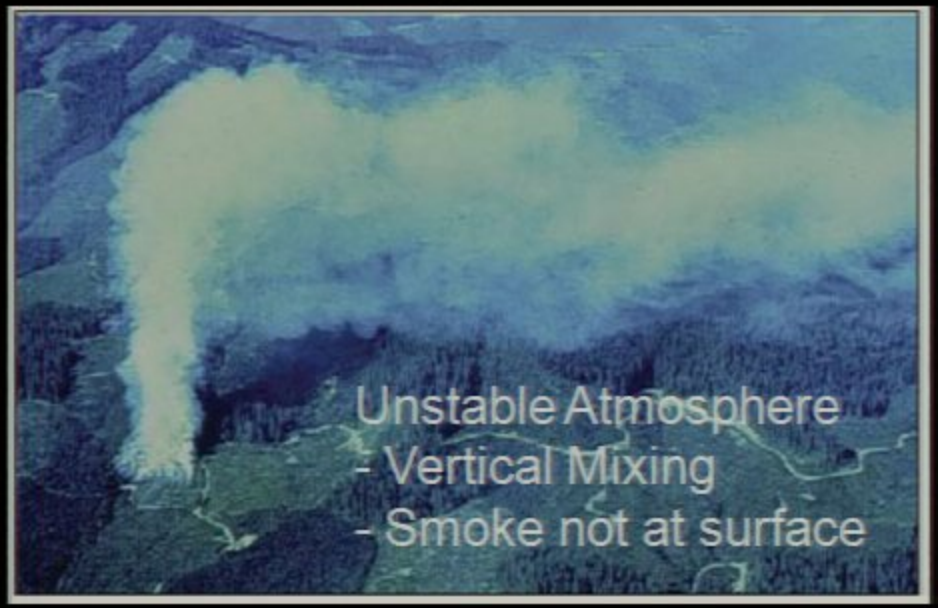


Photo courtesy Ryan Bessette

Smoke Behavior
Timing of Fire Activity

- Fire Weather and Dispersion Modeling can inform no/no-go burn decisions to optimize dispersion
- These decisions are not captured in an EI unless fire activity is tracked



EI's and NAAQS violations

- The Air Regulatory Agency will investigate the possible cause(s) of the violation (Exceptional Event?).
- Usually, one or more counties are designated as nonattainment.
- Emissions inventories are developed.
- Atmospheric models are used to demonstrate which emission reduction strategies may work to attain the NAAQS.

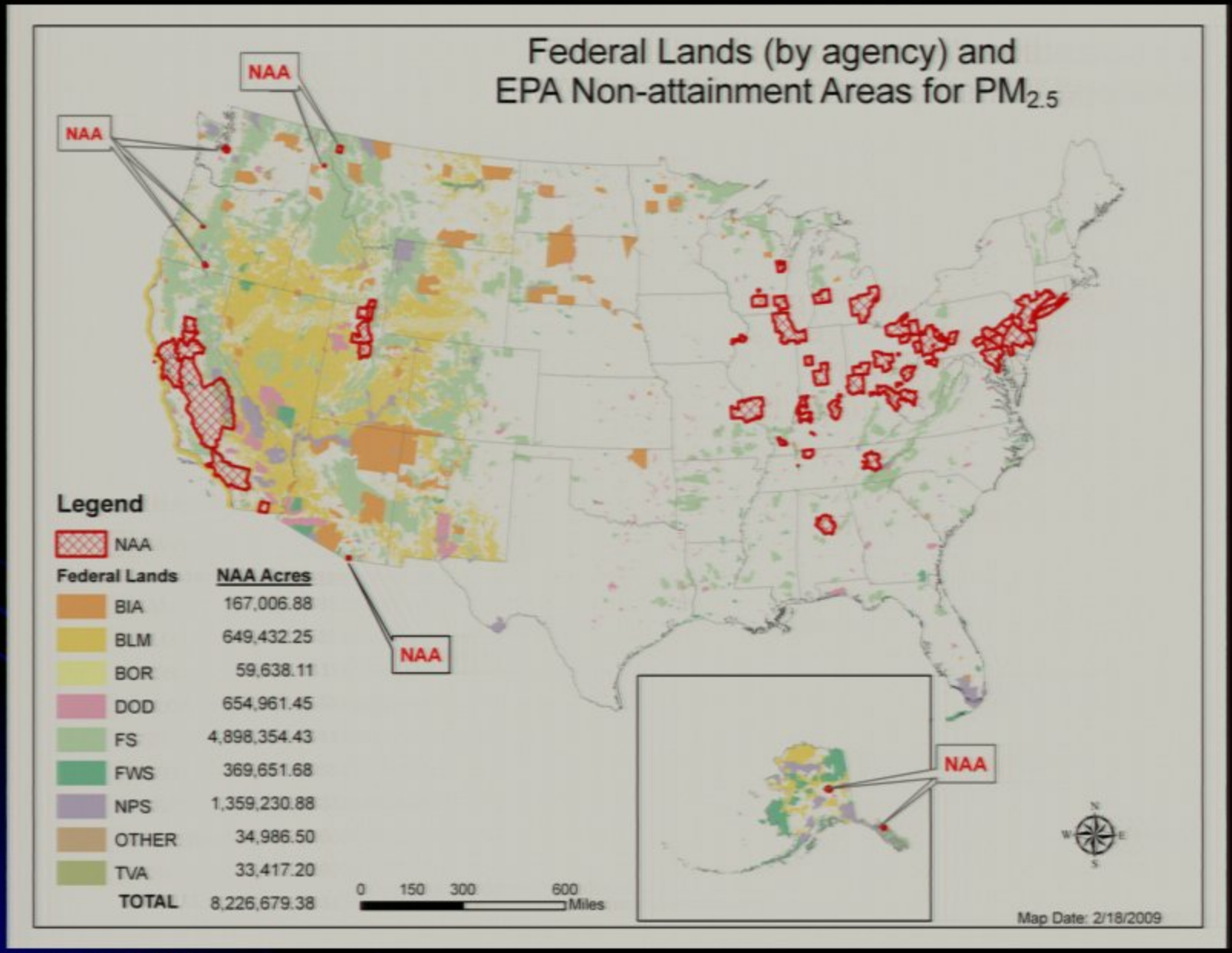
Photo courtesy Lorraine Vogt

EI's and NAAQS violations

- The State Implementation Plan will list what emission reductions necessary to bring the area back into attainment.
- Ambient monitoring may be expanded to determine if the Maintenance Plan is working.
- Federal activities in a Nonattainment Area are subject to General Conformity Determinations.

Photo courtesy Lorraine Vogt

EI's and NAAQS violations



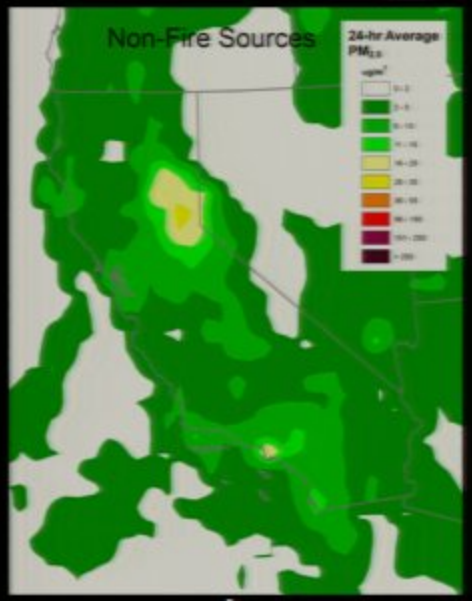
Source: FS, BLM, EPA

EI's and NAAQS violations

- What Land Managers can do:
  - Communicate with the air regulatory agencies from State designation of nonattainment areas (NAAs) to EPA finalization and throughout the SIP process.
  - Submit emission estimates from wildland fires to the air regulatory agencies.
- Hopefully, the States will incorporate the fire emissions into their "base case" of existing emissions.

Photo courtesy Lorraine Vogt

EIs for Exceptional Event Demonstrations



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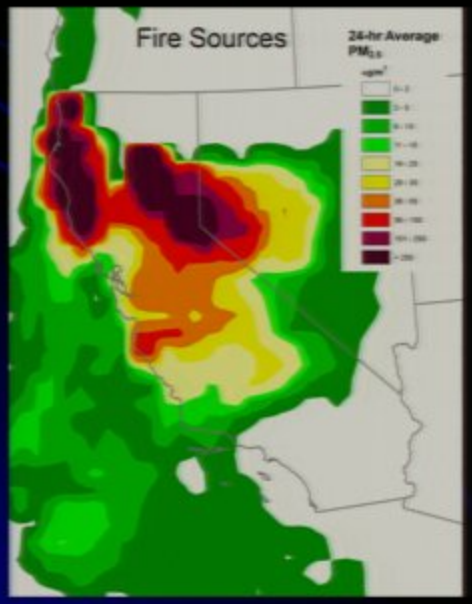

BlueSky Gateway models fire and non-fire $PM_{2.5}$ separately, allowing for exceptional event analysis.

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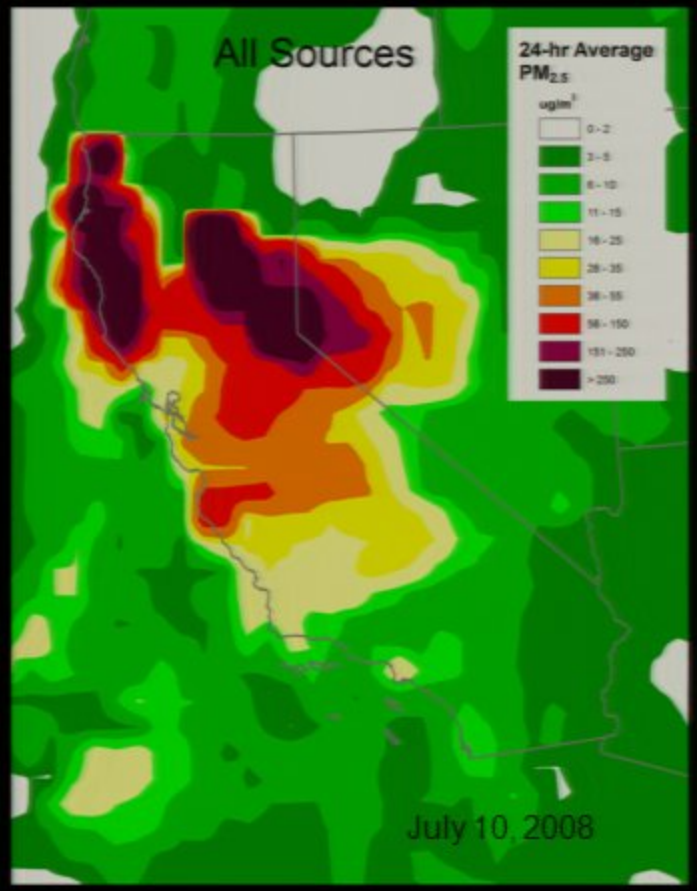
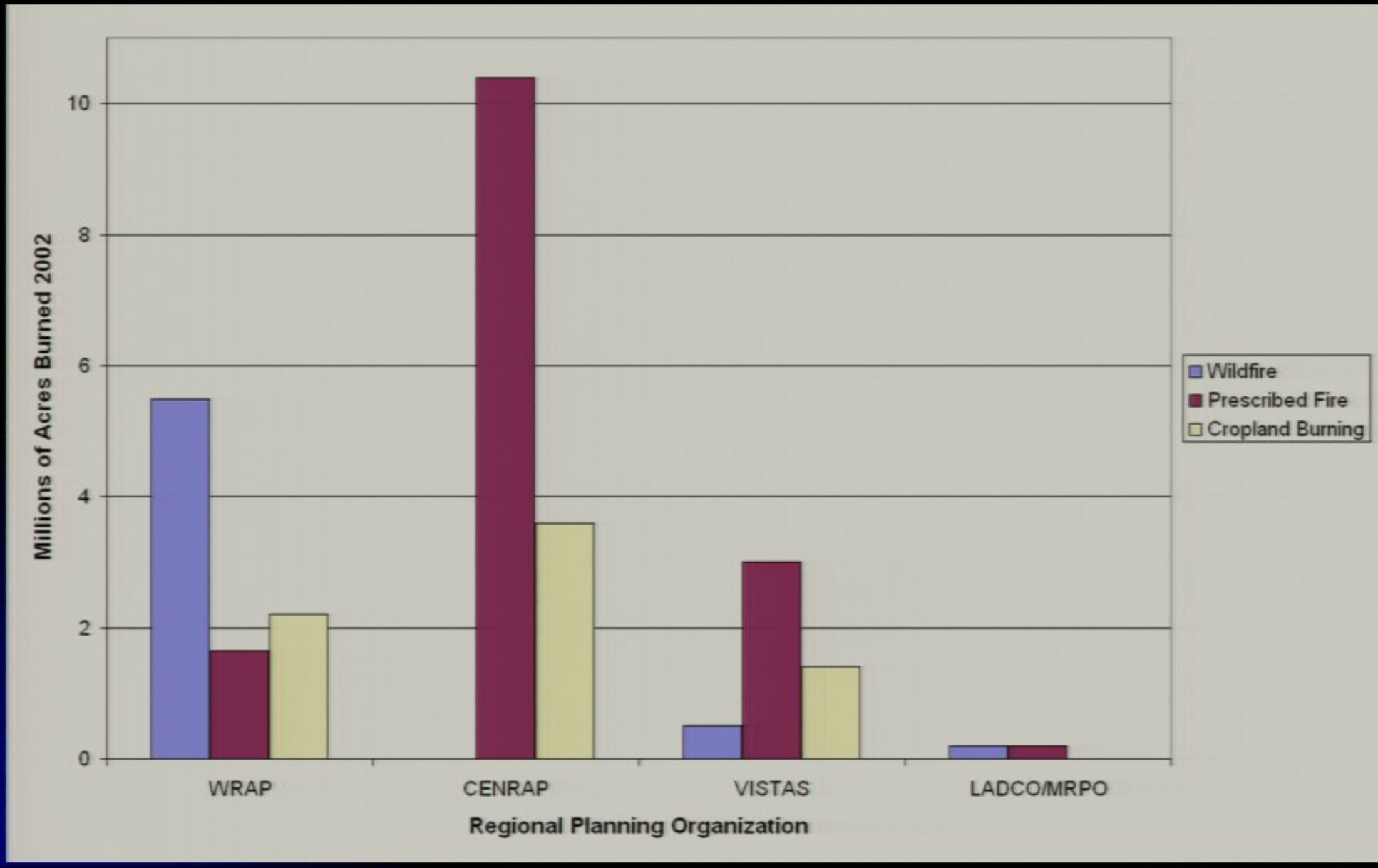
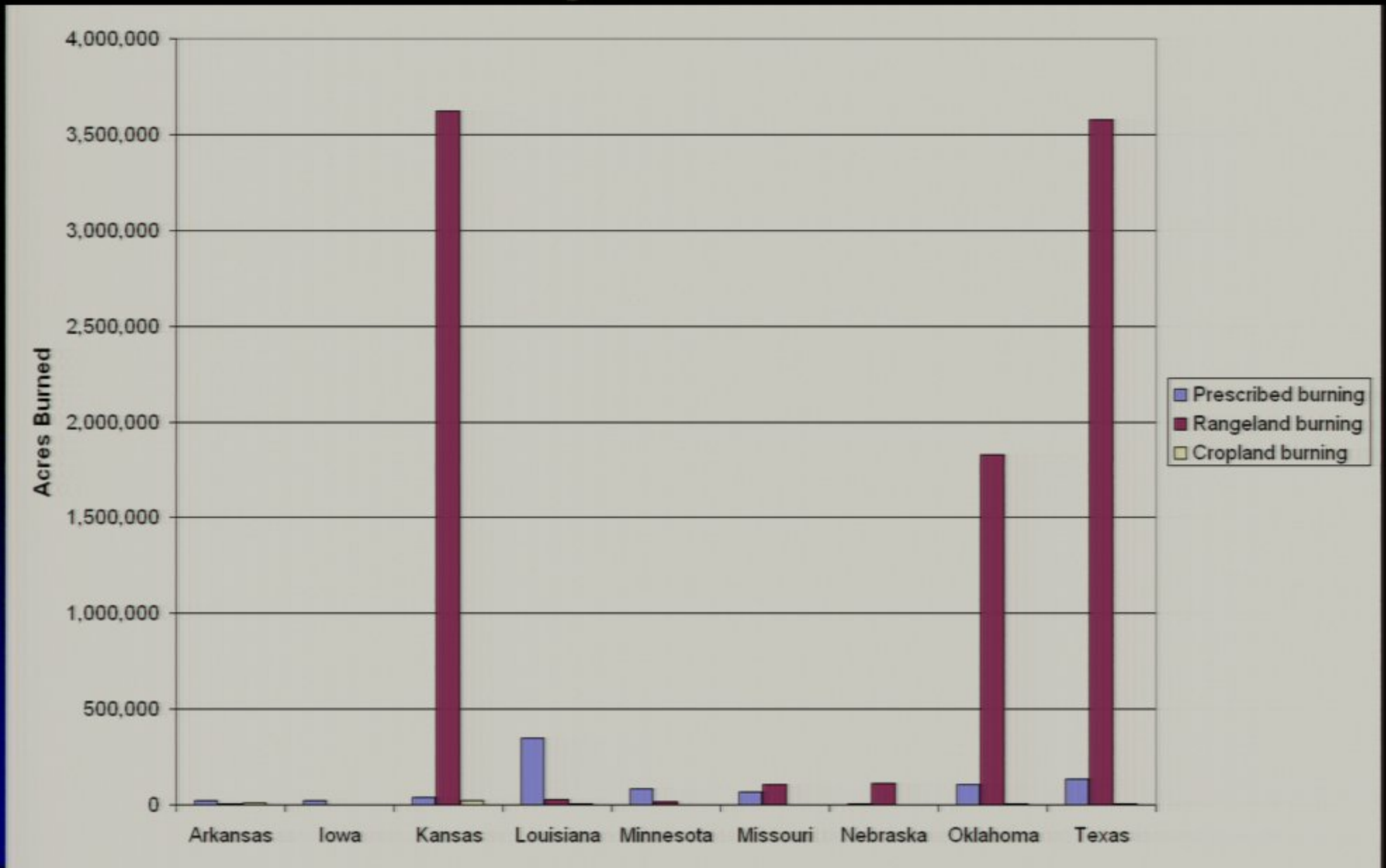


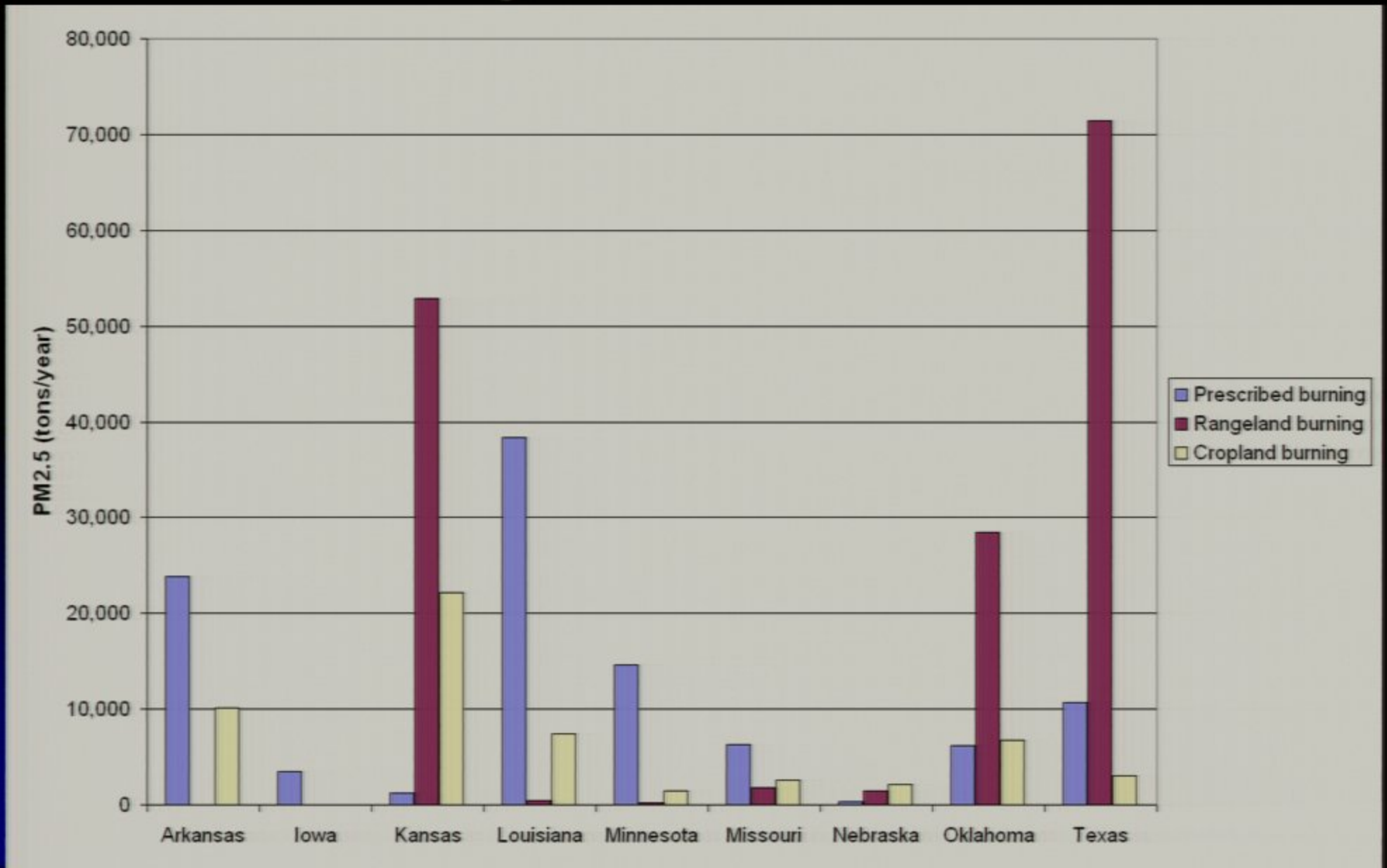
2002 Fire Emission Inventory Inter-RPO Comparison - Acres Burned



2002 CENRAP RPO Emissions Inventory Acres Burned



2002 CENRAP RPO Emissions Inventory PM2.5 Emissions



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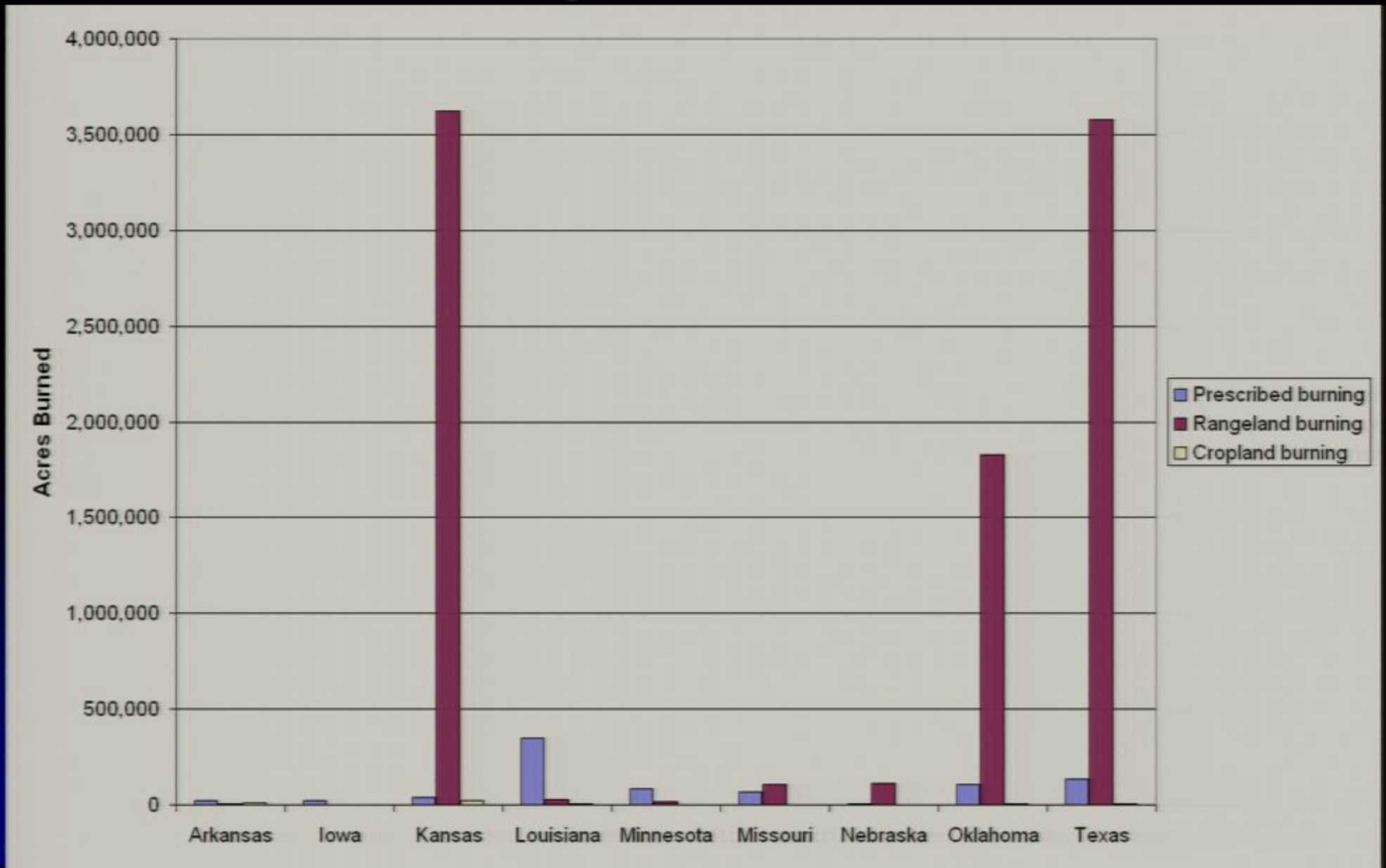

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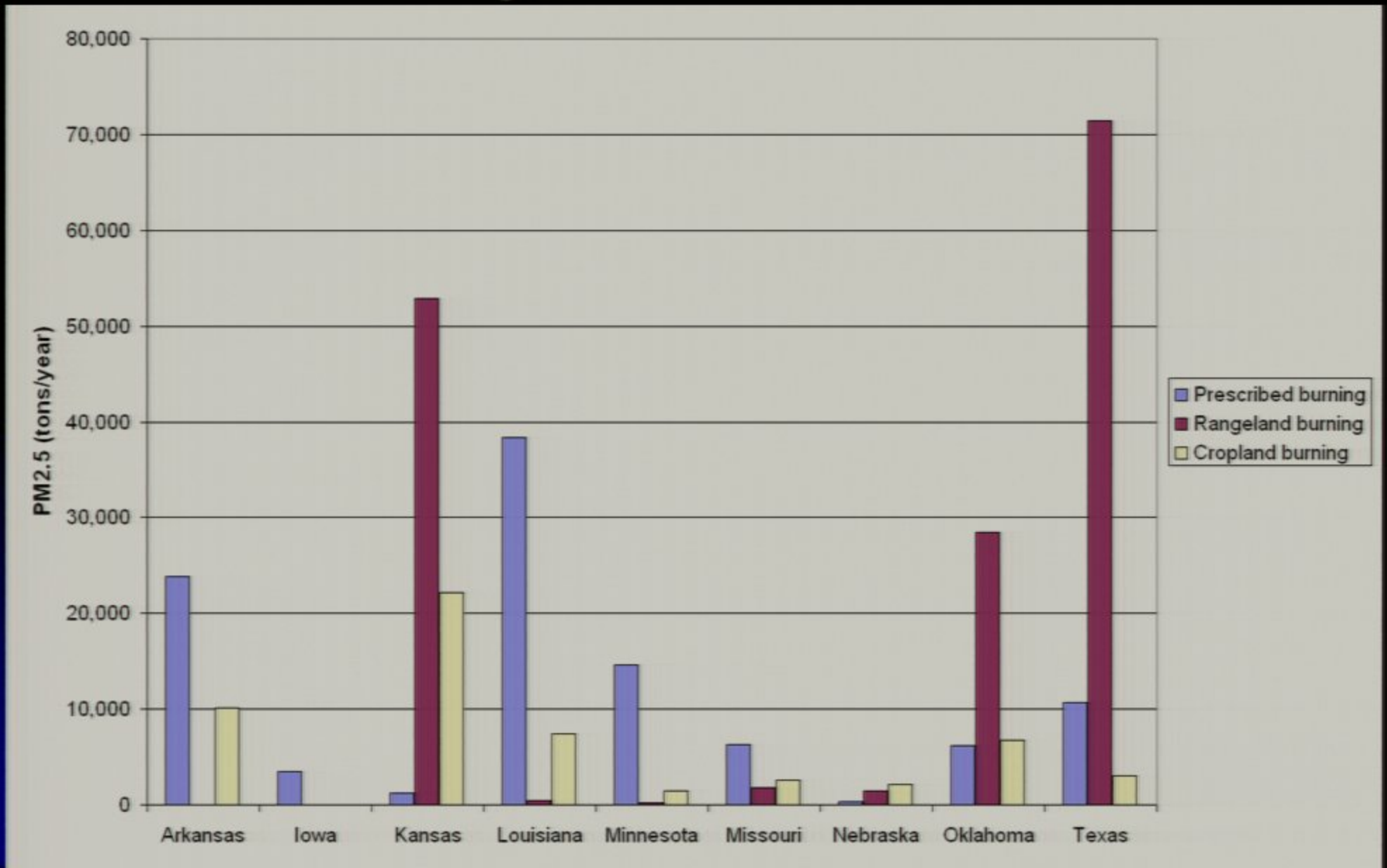

EPA 2008 Fire National Emission Inventory

- Released 2/2009
- Unique Features:
  - Satellite-based fire detections augmented with ground-based fire activity information
  - Greenhouse gases may be reported

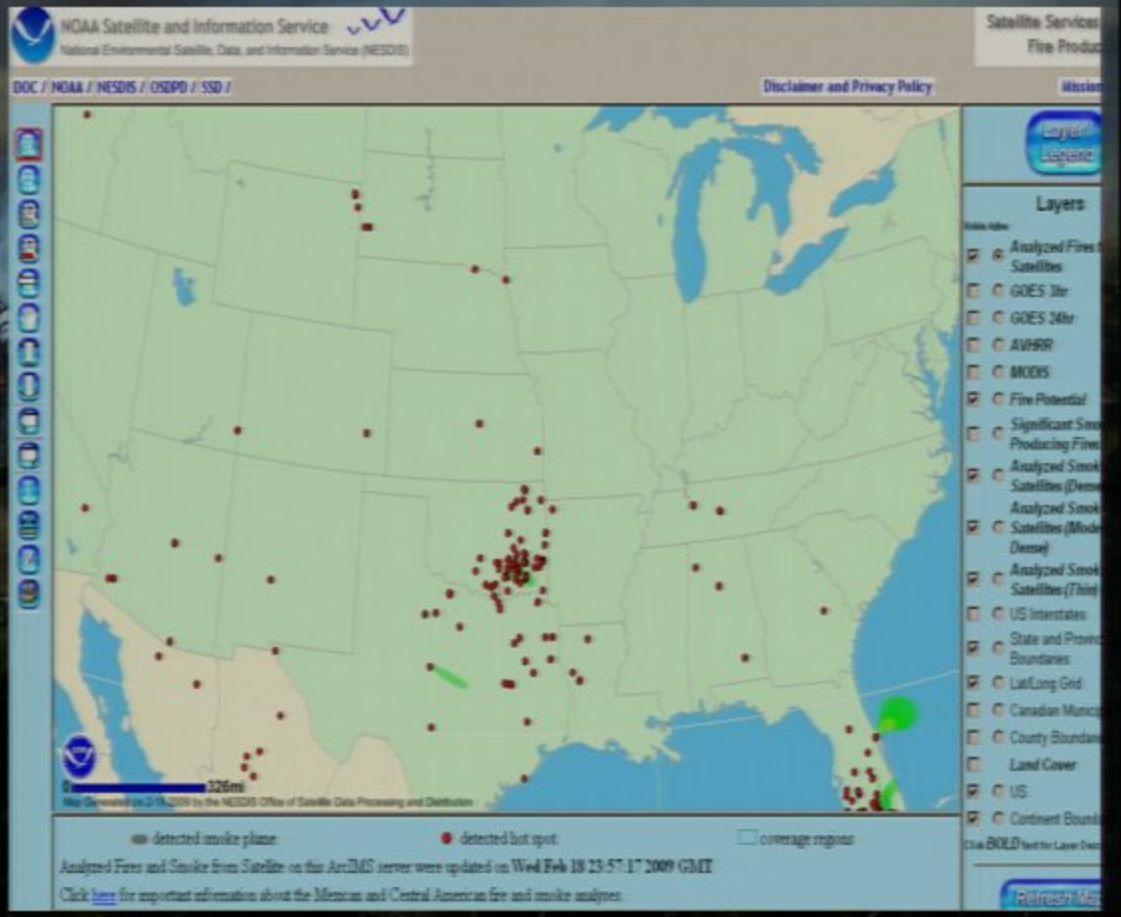

Photo courtesy Lorraine Vogt

http://www.epa.gov/ttn/chief/net/neip/index.html, Section 11

SMARTFIRE: Incorporating Satellite Fire Data

Ground-based Systems
- **FETS**
- **FAETS**

Satellite fire info (NOAA HMS)
http://www.ssd.noaa.gov/PS/FIRE/hms.html

SMARTFIRE

Reconciled fire info including sub-grid fuels and plume information

BLUESKY

http://www.getbluesky.org/bluesky/sti

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Expert Users
(ex. Incident Command Teams)

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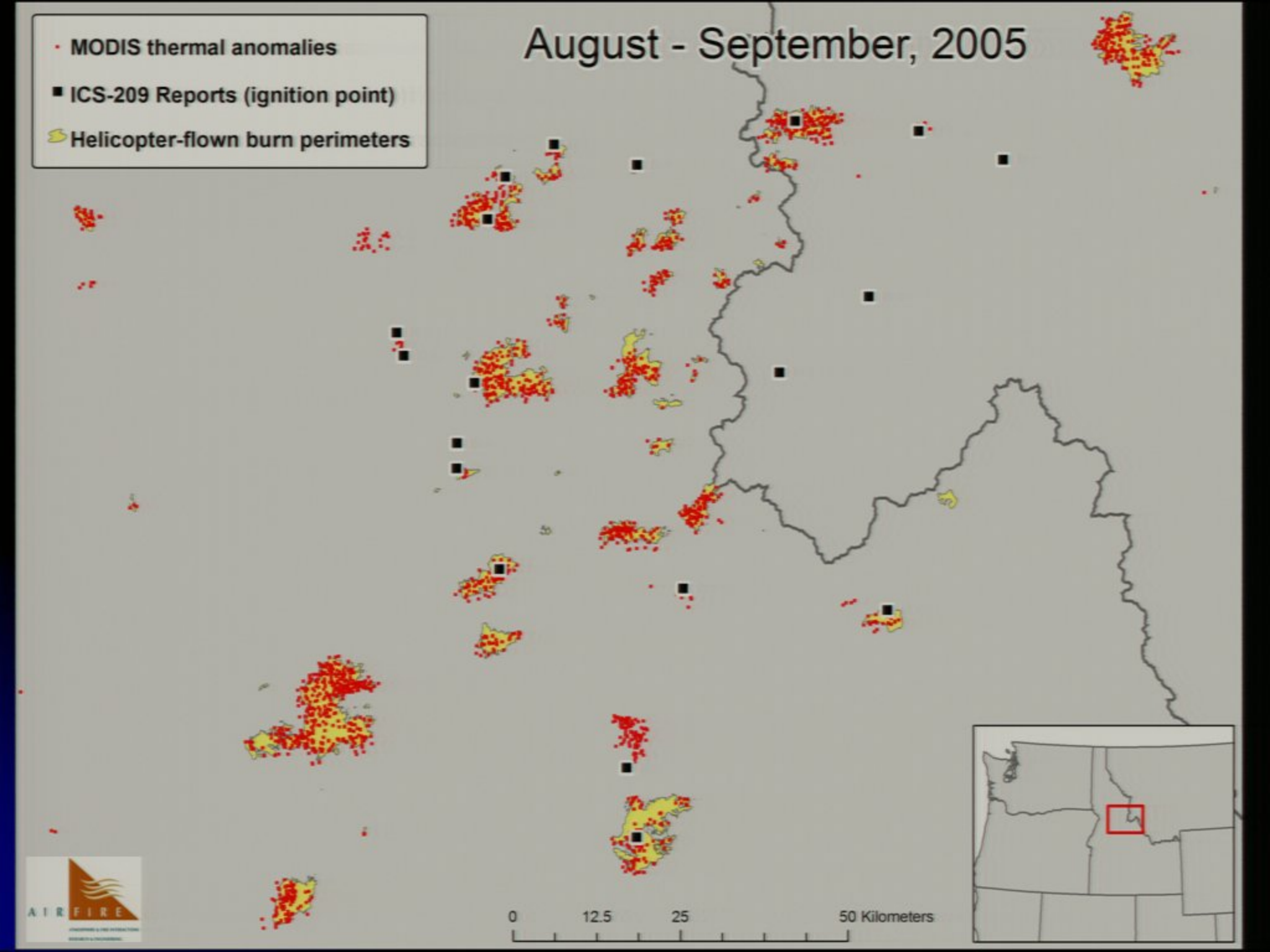

MODIS thermal anomalies
ICS-209 Reports (ignition point)
Helicopter-flown burn perimeters
August - September, 2005
0
12.5
25
50 Kilometers
AIR FIRE

Satellite-detected Fires vs. Reports

Clearly, satellite-detected fires are better than ICS-209 reports for this application.

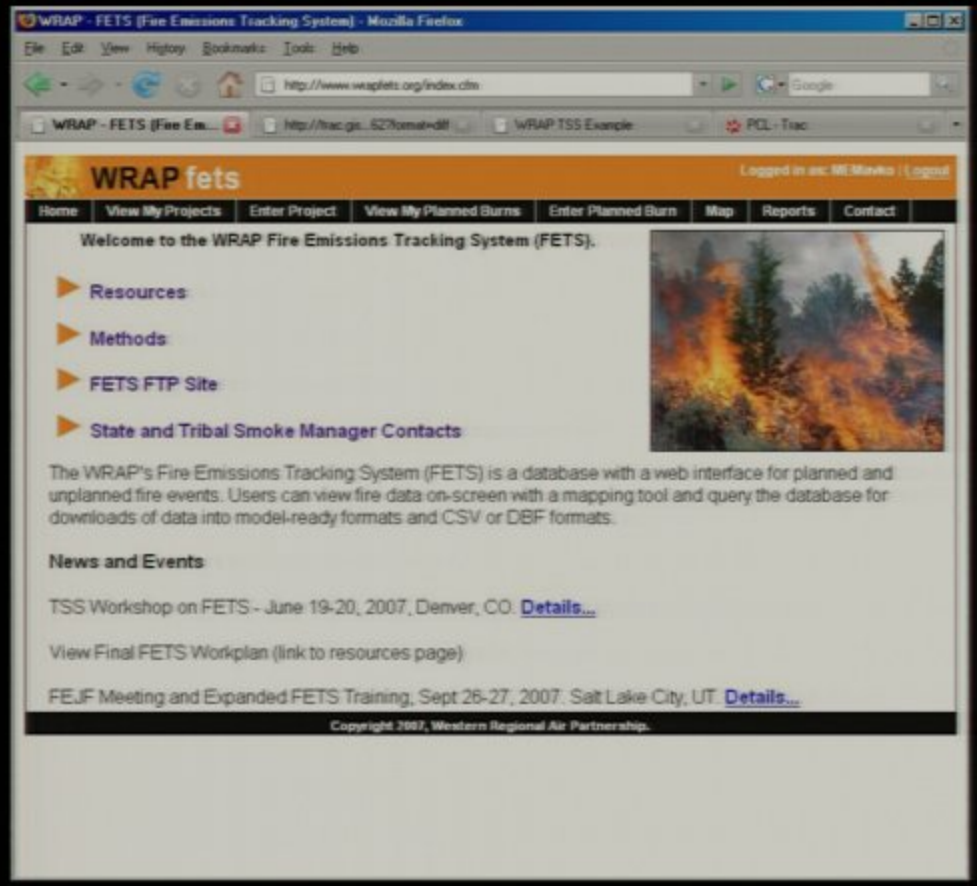
Or are they?

- Limitations of satellite data
  - Detection limit – variable, 0.5 ha optimally
    - Limited detection of underburns and rangeland burns
  - Cloud interference
  - Size estimation
  - Only active burns (no planned/future info)
- Benefits of reported fire activity data
  - Smaller fires, Planned/Future fires
  - Additional useful information
    - Fuels information, Fire size, Ignition Time
  - Not all fires reported

Photo courtesy Lorraine Vogt

Fire Activity Reporting

- WRAP Fire Emission Tracking System (FETS)
  - Web-based
  - Coordination with existing fire tracking databases
  - Burn Data requirements: Date, Location, Area, Fuel Type, Fuel Loading, Type
  - Other elements: Mapped fuel loads, emissions calculations, emission reduction techniques
- Fire Activity and Emission Tracking System (FAETS)
  - North Carolina, Pennsylvania
  - Awaiting funds
  - Based upon Florida System



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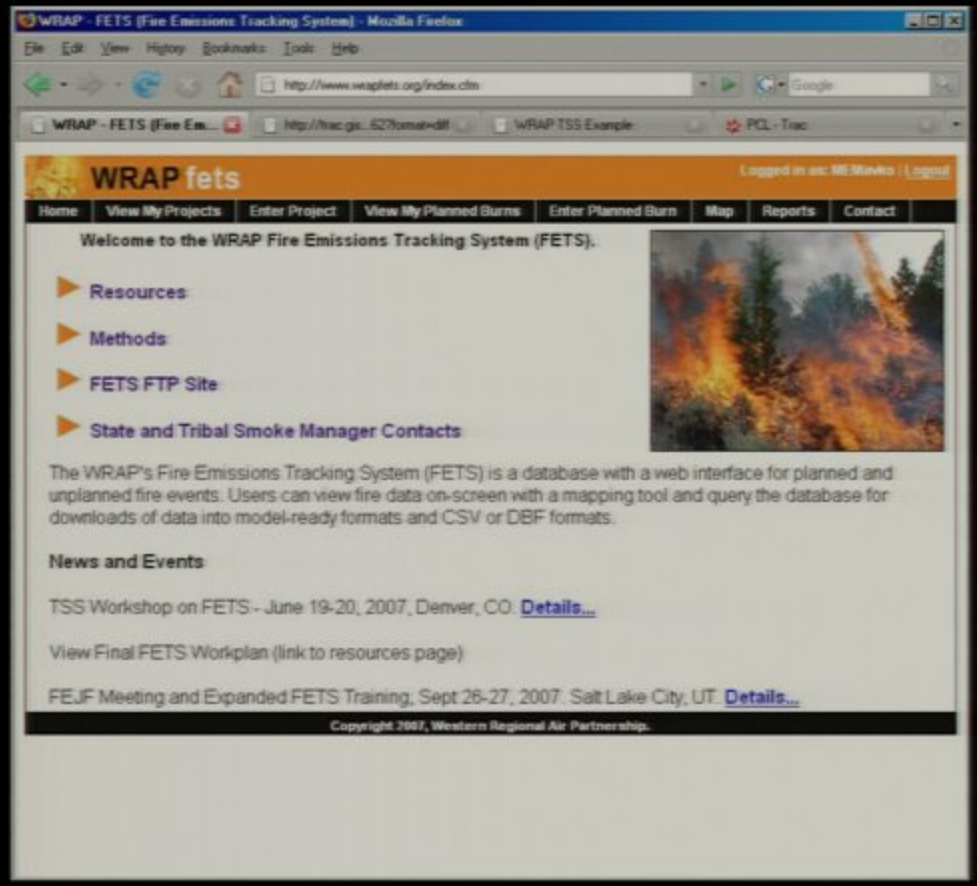

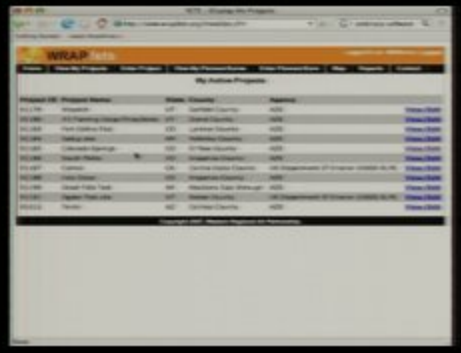

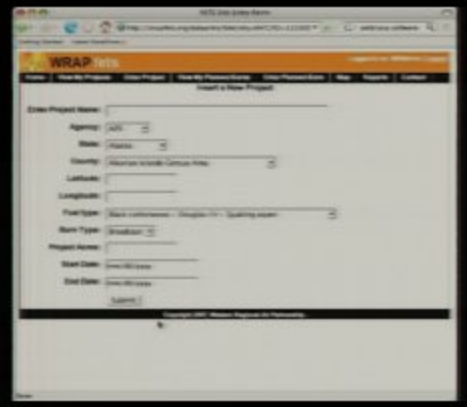

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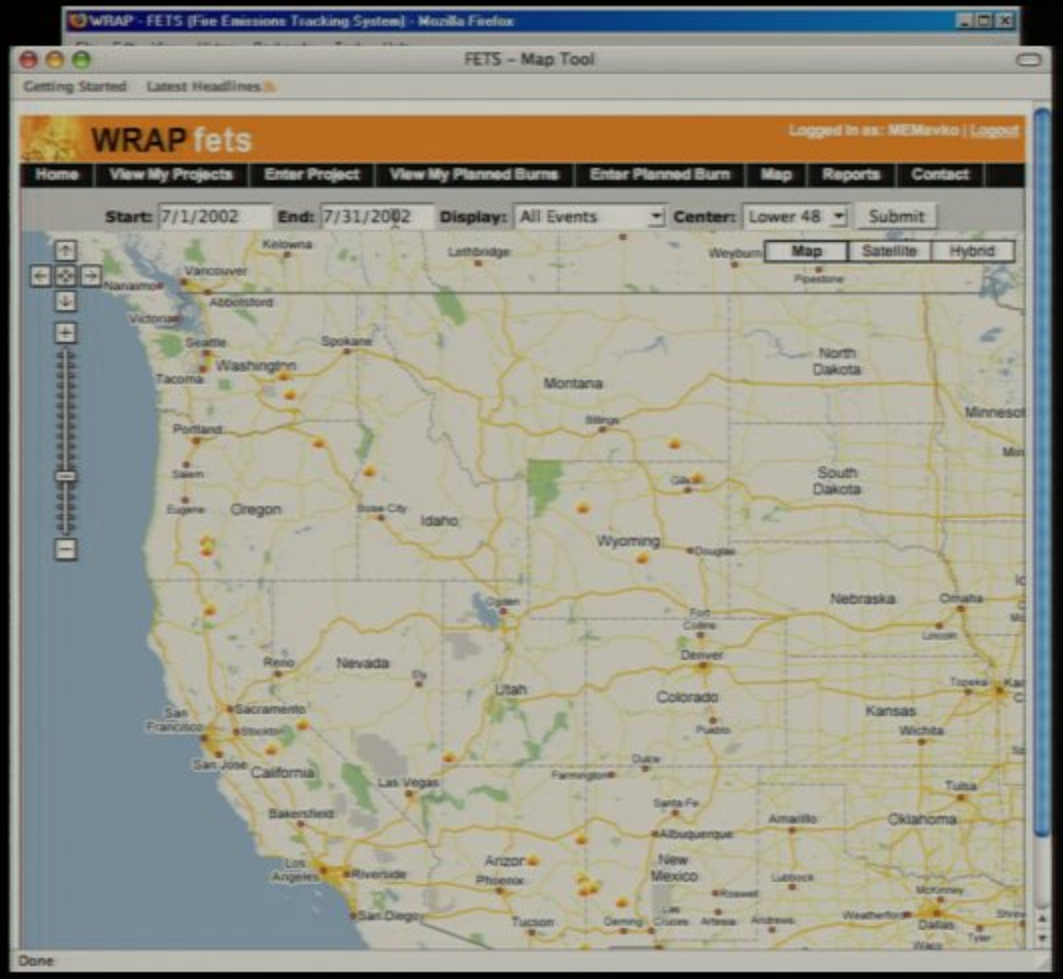
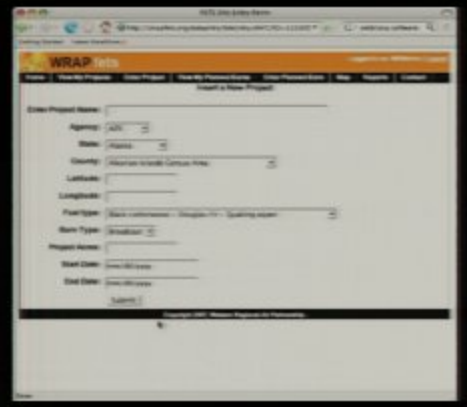
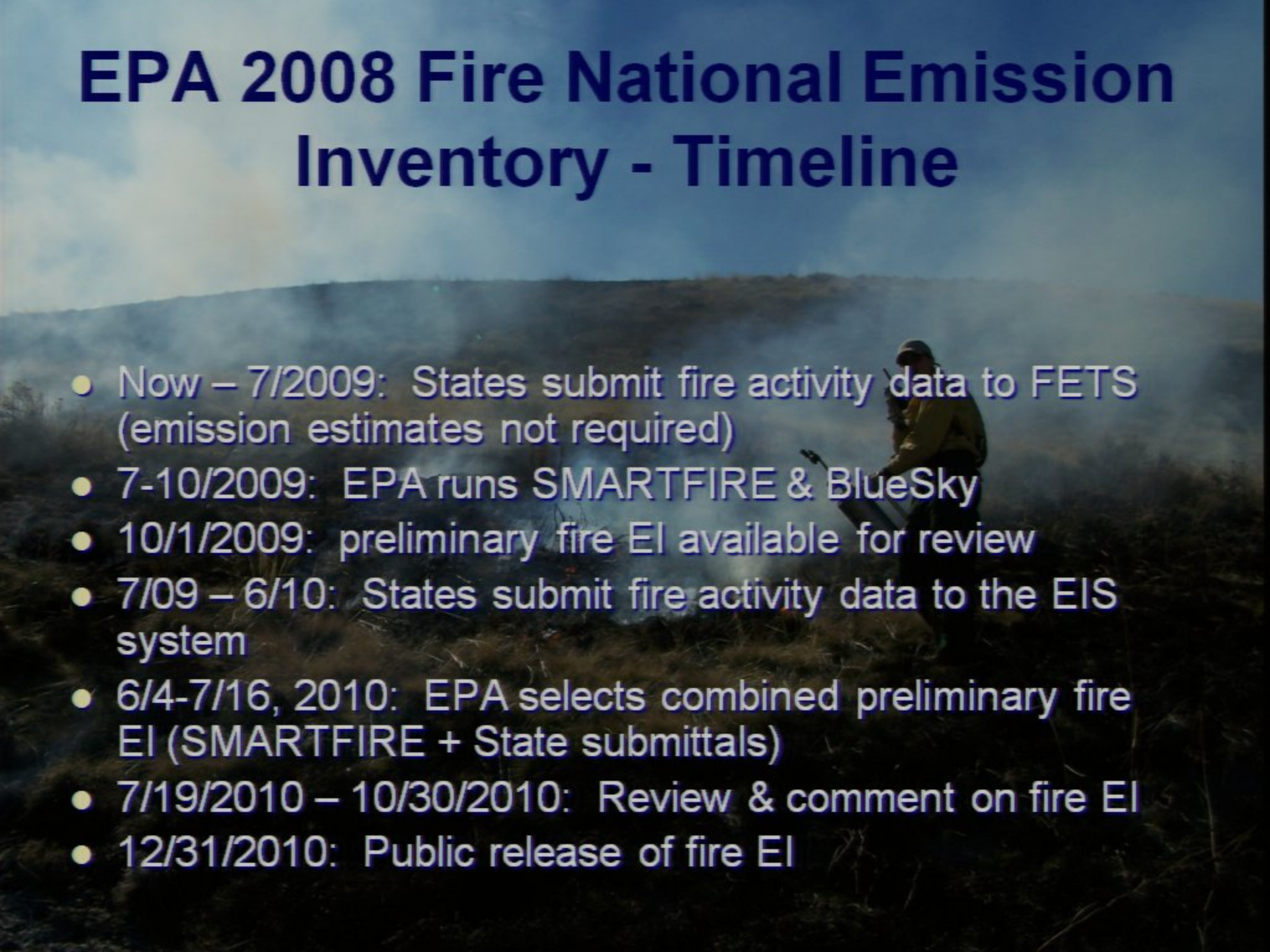




EPA 2008 Fire National Emission Inventory - Timeline



- Now – 7/2009: States submit fire activity data to FETS (emission estimates not required)
- 7-10/2009: EPA runs SMARTFIRE & BlueSky
- 10/1/2009: preliminary fire EI available for review
- 7/09 – 6/10: States submit fire activity data to the EIS system
- 6/4-7/16, 2010: EPA selects combined preliminary fire EI (SMARTFIRE + State submittals)
- 7/19/2010 – 10/30/2010: Review & comment on fire EI
- 12/31/2010: Public release of fire EI

Thank you! Questions, Comments, Discussion

National Smoke Management Website

http://www.nifc.gov/smoke

My Fire Community "Air Quality and Fire Issues"

www.myfirecommunity.net

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Photo courtesy Lorraine Vogt

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