

Development of Emission Inventories of Planned Burning Activities in the Central States Regional Air Planning Association (CENRAP)

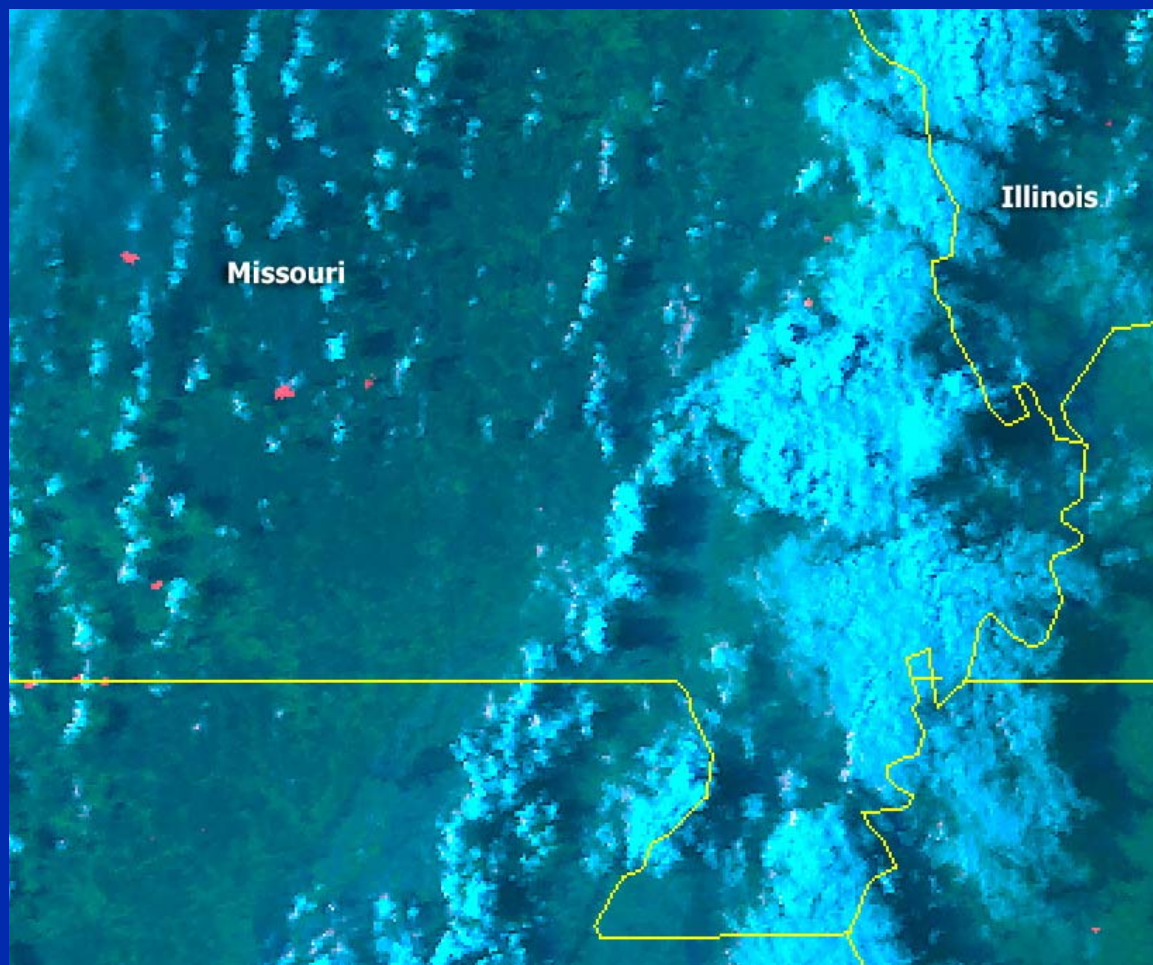
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Presented at
U.S. EPA 13th Annual Emission Inventory Conference
Clearwater, FL
June 9, 2004

Why is Open Burning Important?

- Releases fine PM and precursors to secondary PM.
- Is thought to contribute to episodes of haze and $PM_{2.5}$.
- However, emissions are poorly quantified.

April 12, 2002; 6 p.m. CDT



What are the Sources?

- Prescribed burning
- Agricultural burning
- Managed burning



- Wildfires
- Structure fires
- Waste burning

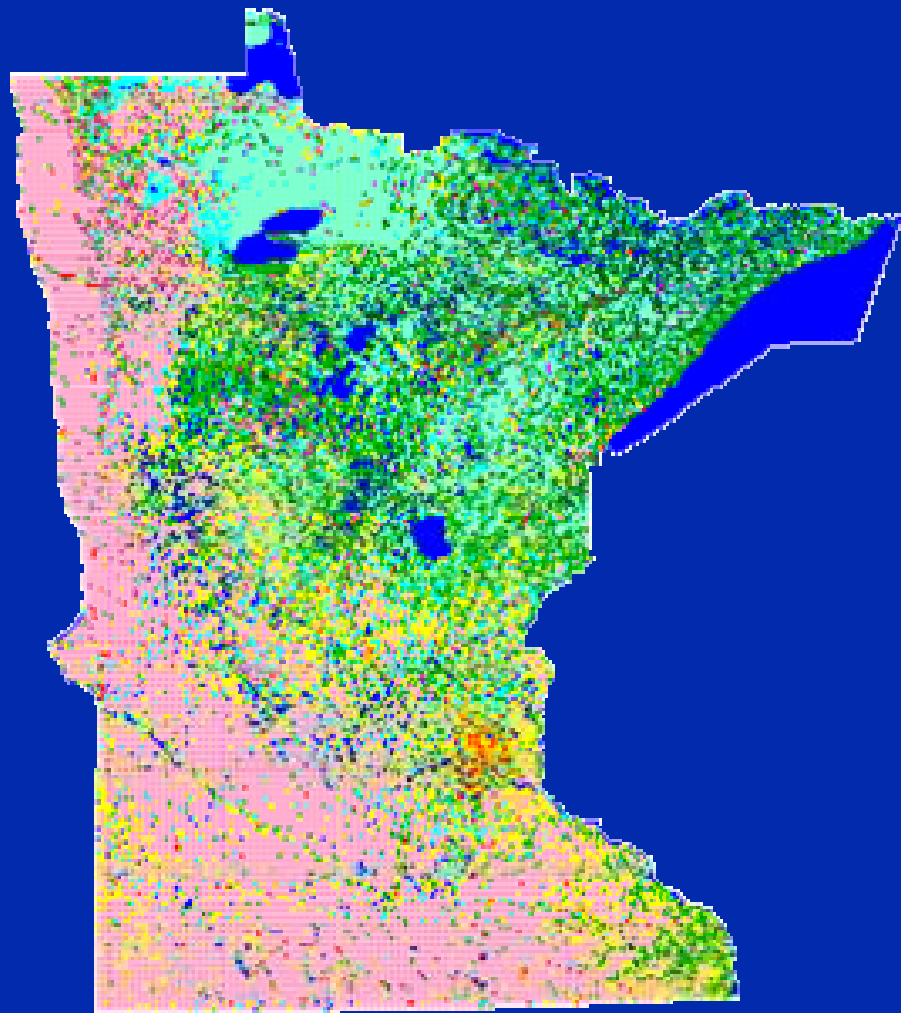


These 3 sources are being researched by other RPOs and were not included in the CENRAP-STI project.

Definitions

- *Prescribed Burning* clears undergrowth in timberlands and grasslands for wildfire prevention and land improvement.
 - Federal agencies (USFS, DOI, BIA, etc.)
 - State agencies (DNR, DFW, etc.)
 - Private entities (TNC, timber industry, etc.)
- *Agricultural Burning* and *Managed Burning* are used by farmers and ranchers to clear harvested lands and rangeland.

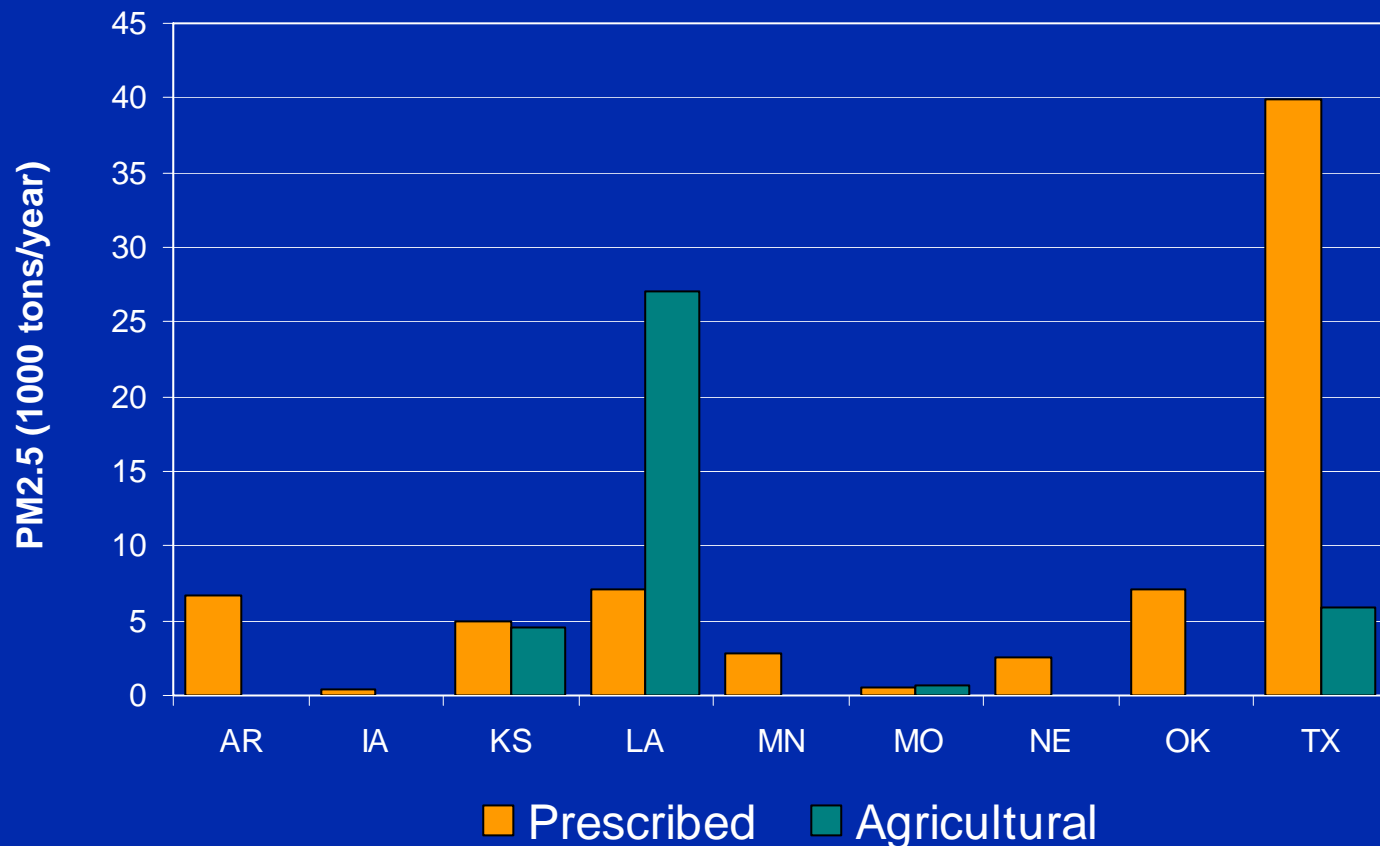
Geographic Areas: MN Example



<u>Type of Area</u>	<u>sq. miles</u>
<u>Forestlands, etc.</u>	<u>19,217</u>
Deciduous Forest	13,328
Evergreen Forest	2,531
Mixed Forest	2,896
Shrubland	434
Grasslands/Herbaceous	28
<u>Agricultural Lands</u>	<u>42,241</u>
Row Crops	30,241
Pasture/Hay	10,062
Small Grains	1,938
<u>Other</u>	<u>22,914</u>

Prior Statuses of Planned Burning Inventories

Planned Burning Emissions in the 1999 NEI



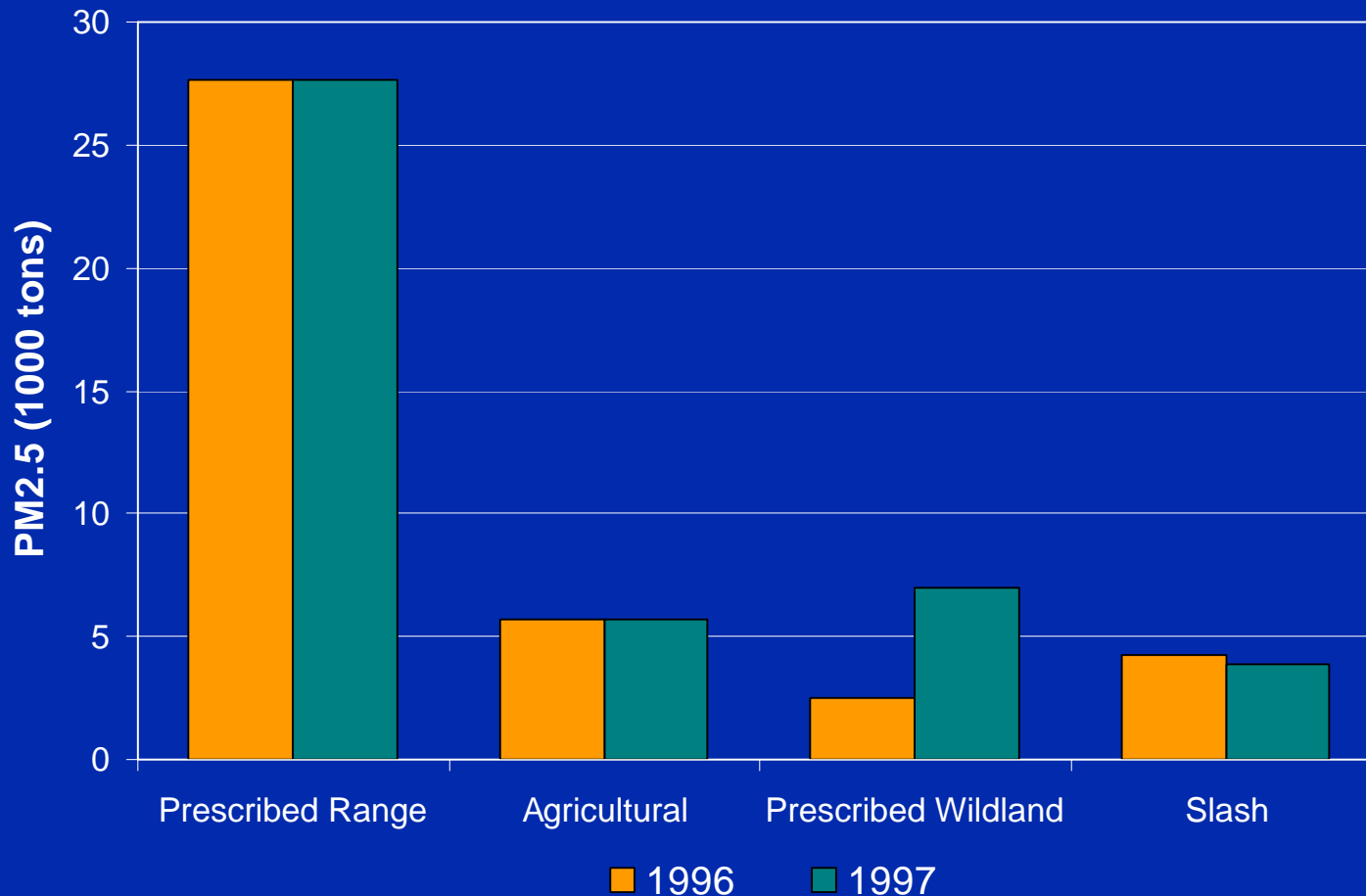
Total PM_{2.5}:
110,000 tons

Prescribed:
72,000 tons

Agricultural:
38,000 tons

Prior Statuses of Planned Burning Inventories

Planned Burning Emissions in Texas*



Total PM_{2.5} -1997

44,200 tons

Rangeland:

27,600 tons

Agricultural:

5,700 tons

Wildland:

7,000 tons

Slash:

3,900 tons

*Source: Dennis et al. (2002) Atmospheric Environment, Vol. 36, pp. 3779-3792.

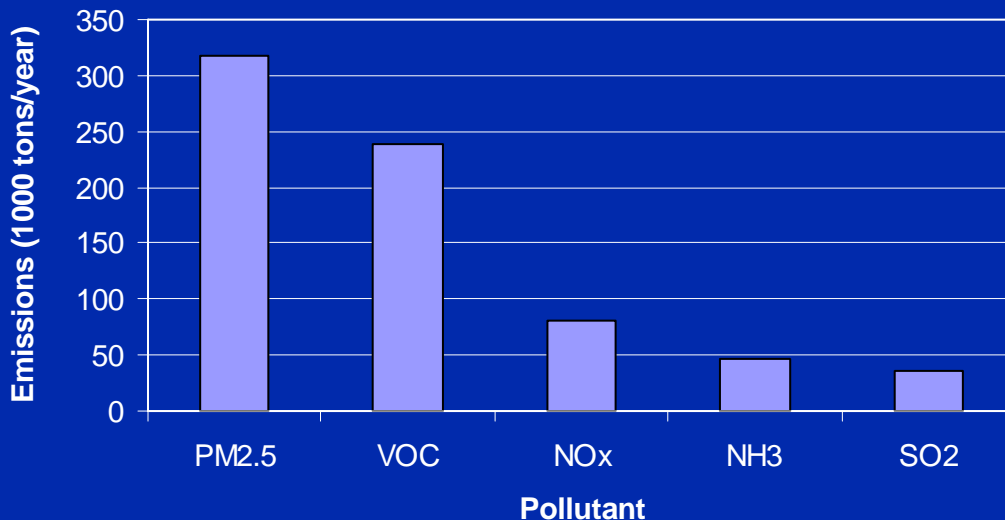
Prior Statuses of Planned Burning Inventories

Sources of uncertainty:

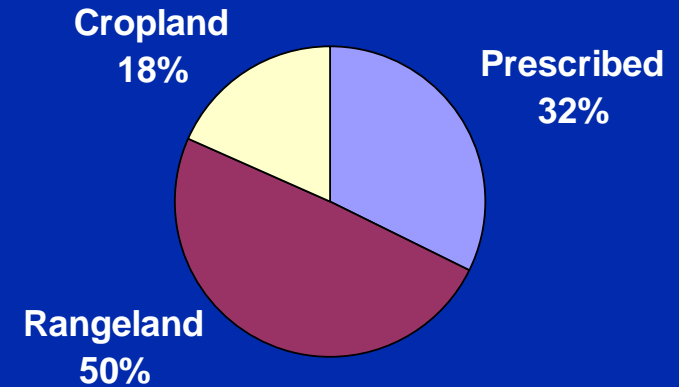
- The NEI is estimated on an annual average basis.
- Prescribed burning activities fluctuate dramatically from year to year.
- Burning activities depend on:
 - Local agencies' policies
 - Individuals' or businesses' (largely) unregulated decisions
 - Climate conditions
 - Assessments of the density of undergrowth and fuel

Current Status of the Inventories

2002 Emissions by Pollutant



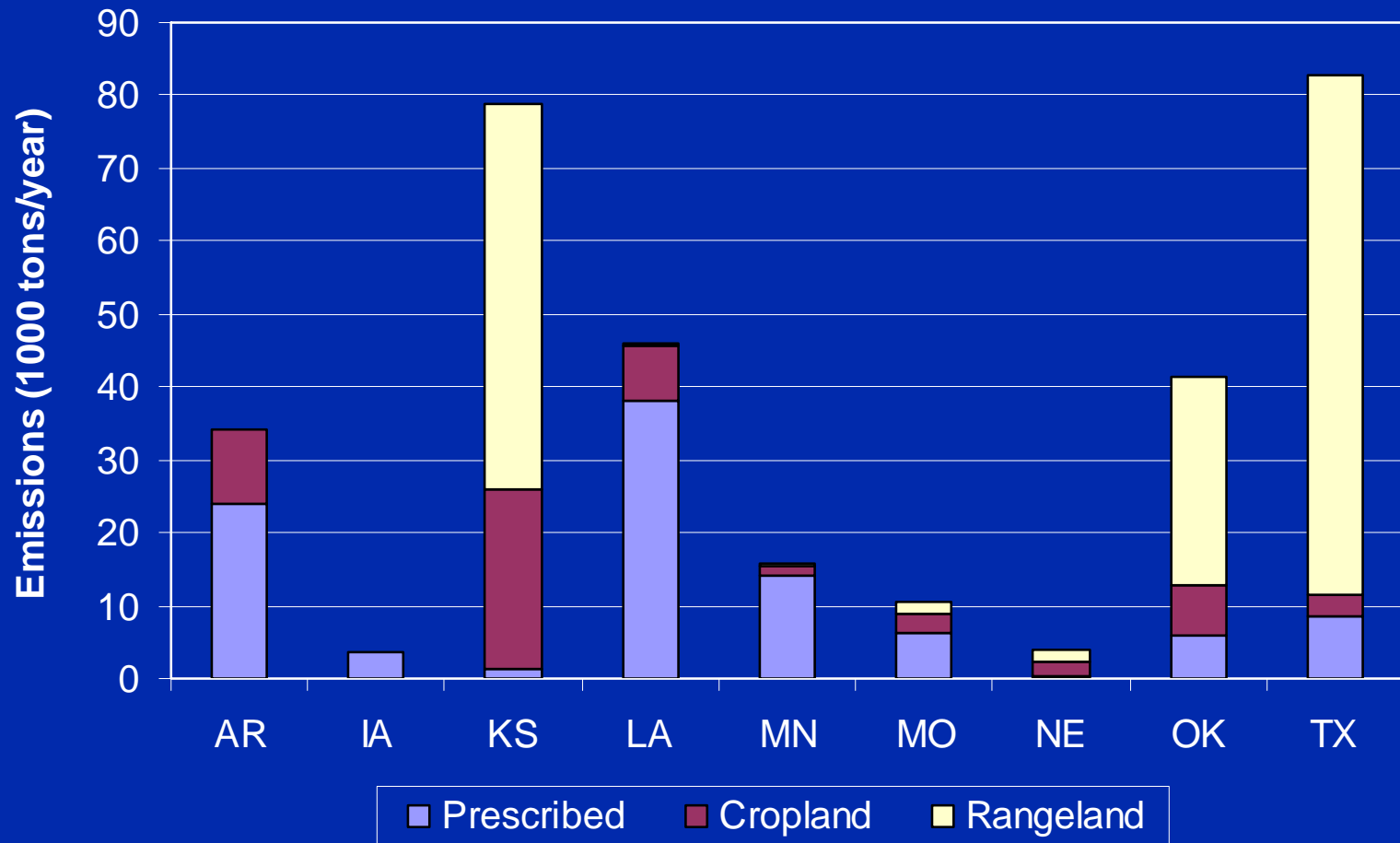
PM_{2.5} Emissions by Source Category



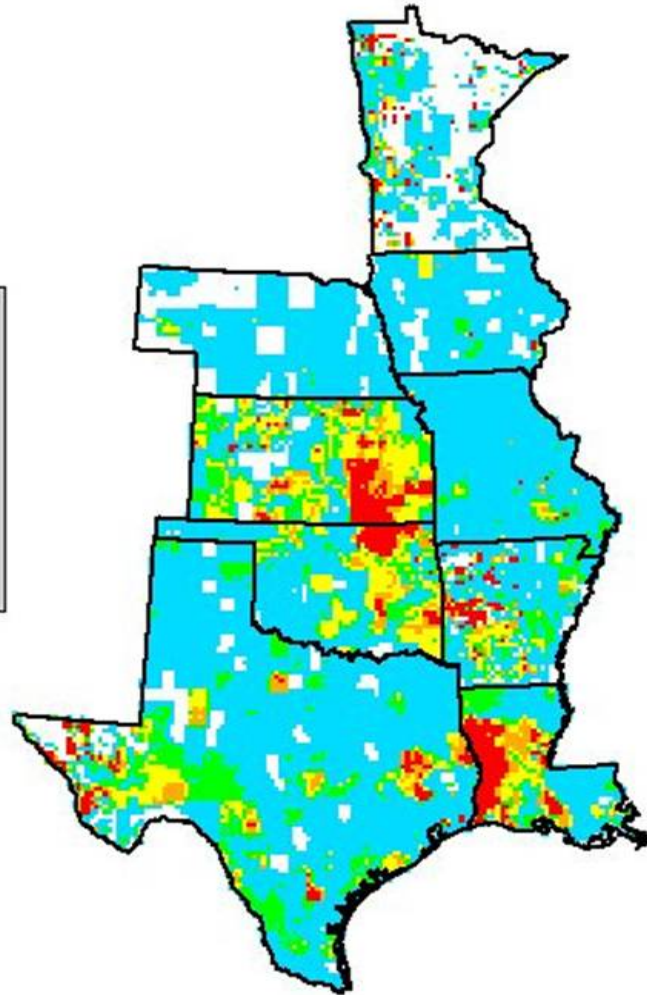
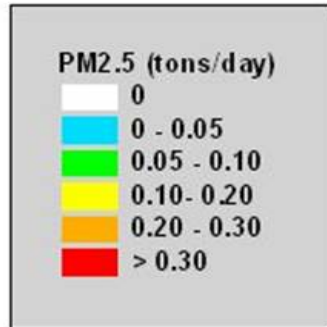
Total = 317,000 tons/year

Current Status of the Inventories

2002 PM_{2.5} Emissions by State and Source Category



Current Status of the Inventories

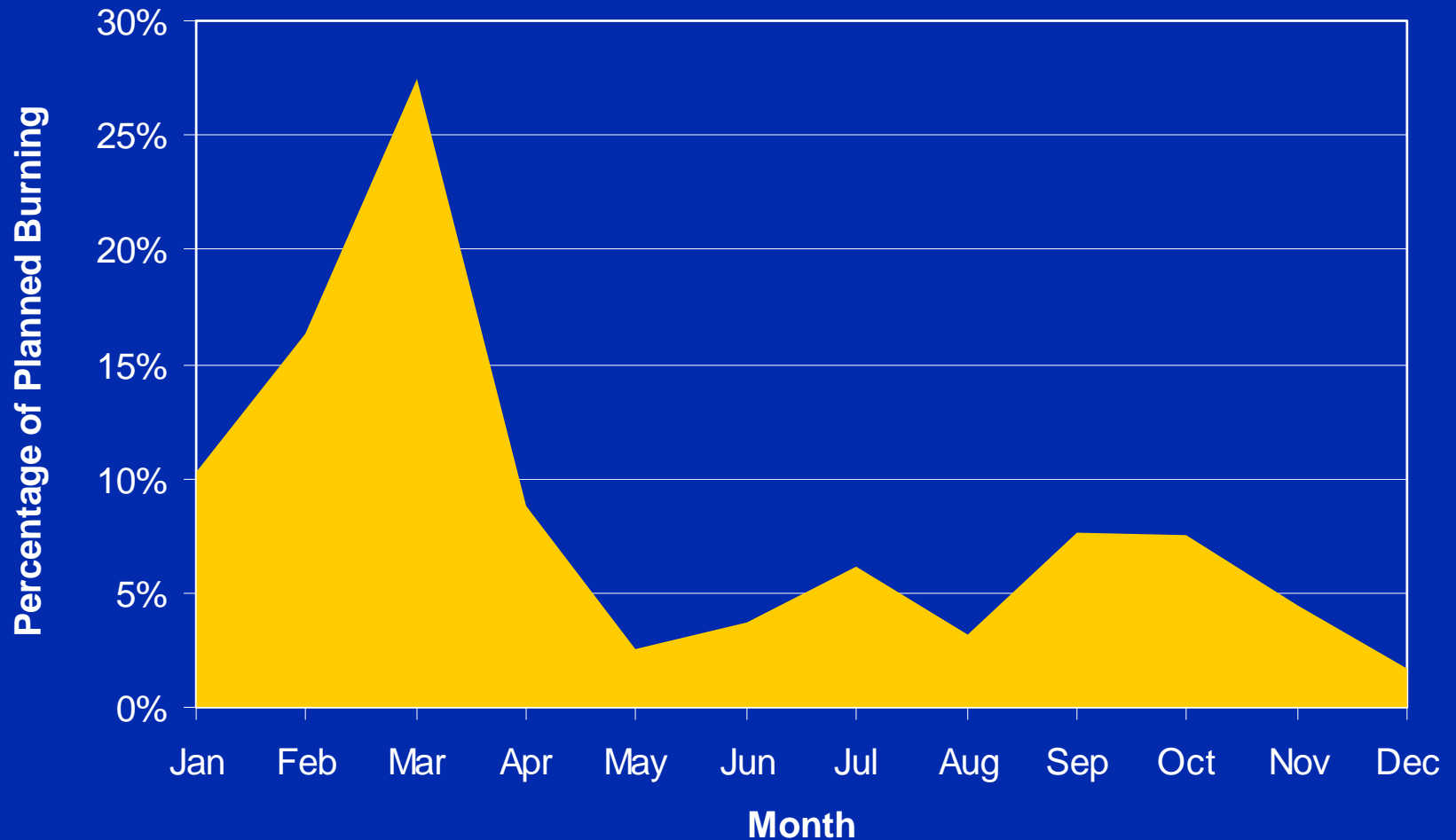


PM_{2.5} Emission
Densities for the
CENRAP Region

April 10, 2002

Current Status of the Inventories

Monthly Variations in Planned Burning Emissions for 2002



Development of the Inventories

Basic Equation

Emissions (lb) =

*Burn area (acres) * Fuel loading (ton/acre) * Emission factor (lb/ton)*

Development of the Inventory Prescribed Burning Activity Data

Federal/Tribal Lands:

- The National Fire Plan Operations and Reporting System (NFPORS)*
- The National Interagency Fire Management Integrated Database (NIFMID)
- Data from state smoke management programs

*Minnesota and Missouri only

Development of the Inventory

Prescribed Burning Activity Data

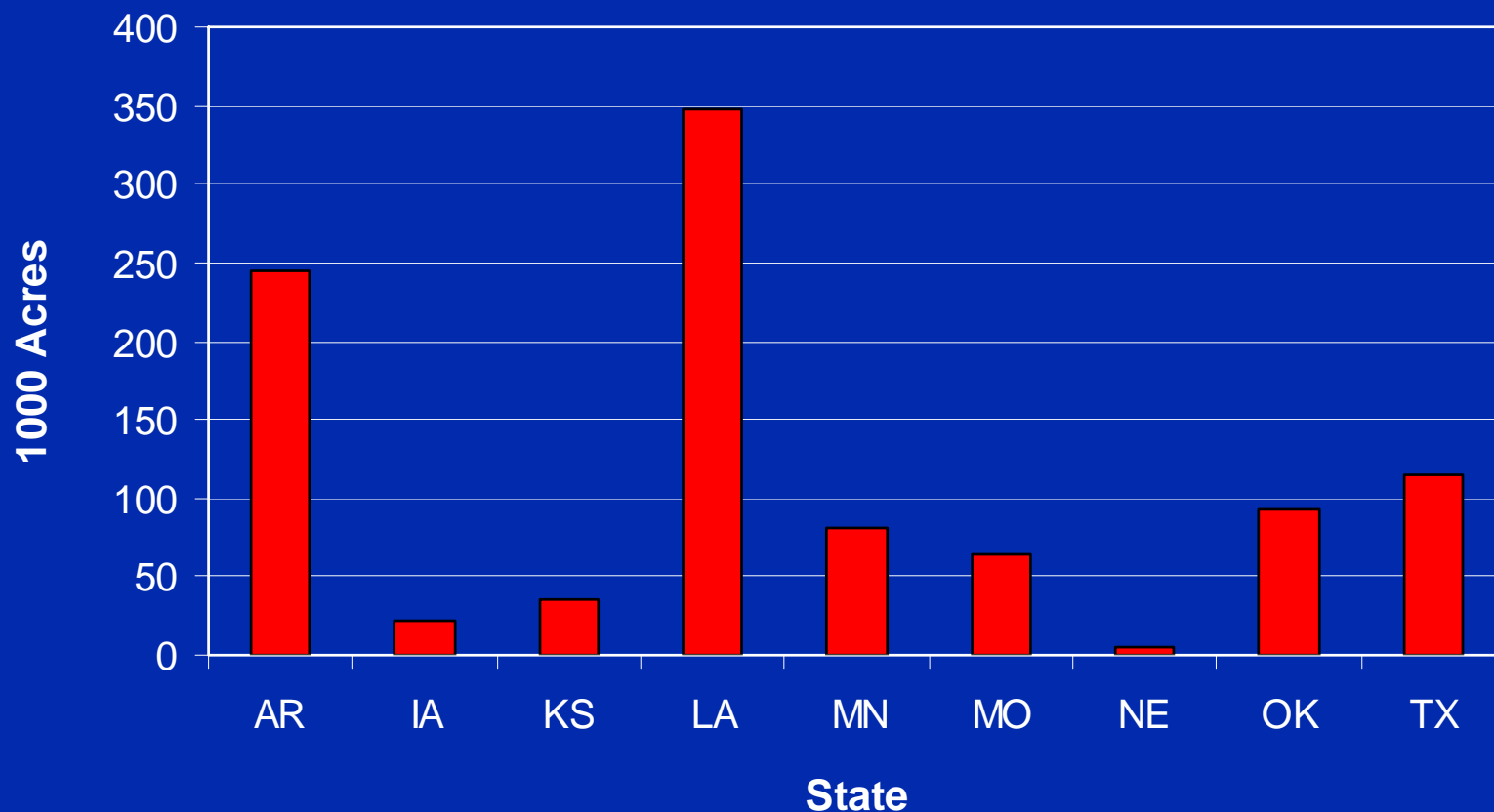
State/Private Lands:

- State smoke management programs
- Fire marshals
- State forest services
- Other state agencies (Bureau of Wildlife, etc.)

Development of the Inventory

Prescribed Burning Activity Data

2002 Acres Burned by State (Total ~ 1 million acres)



Development of the Inventory

Prescribed Burning Emission Factors

First Order Fire Effects Model (FOFEM):

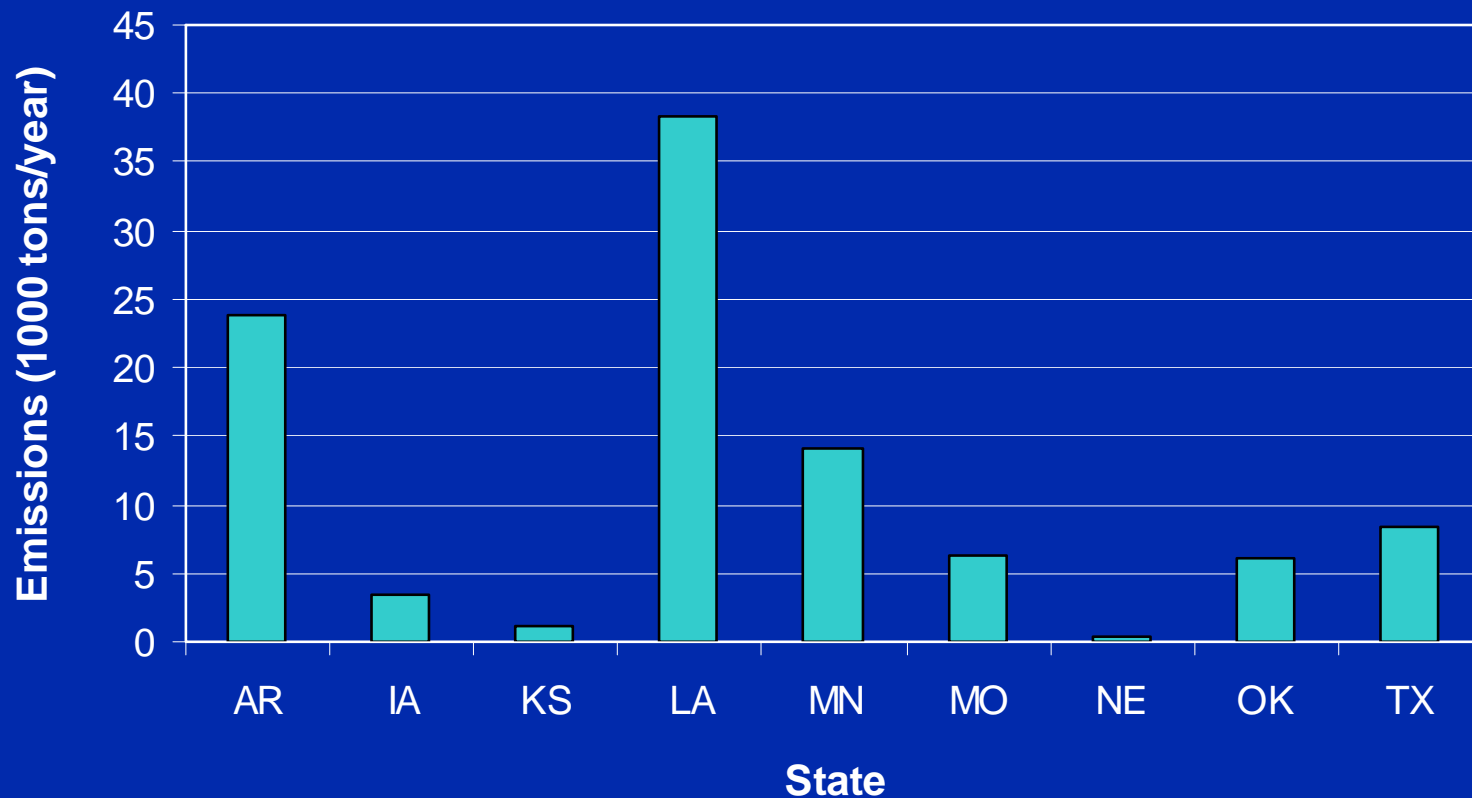
- Cross-walk developed with EPA's Biogenic Emissions Landcover Database (BELD)
- Default fuel loadings used*
- Fuel moisture values set using day-specific Weather Information Management System (WIMS) data
- Produces vegetation-specific emission factors in lbs/acre burned

*Fuel loadings provided by the USFS were used for some burns in MN.

Development of the Inventory

Prescribed Burning Results

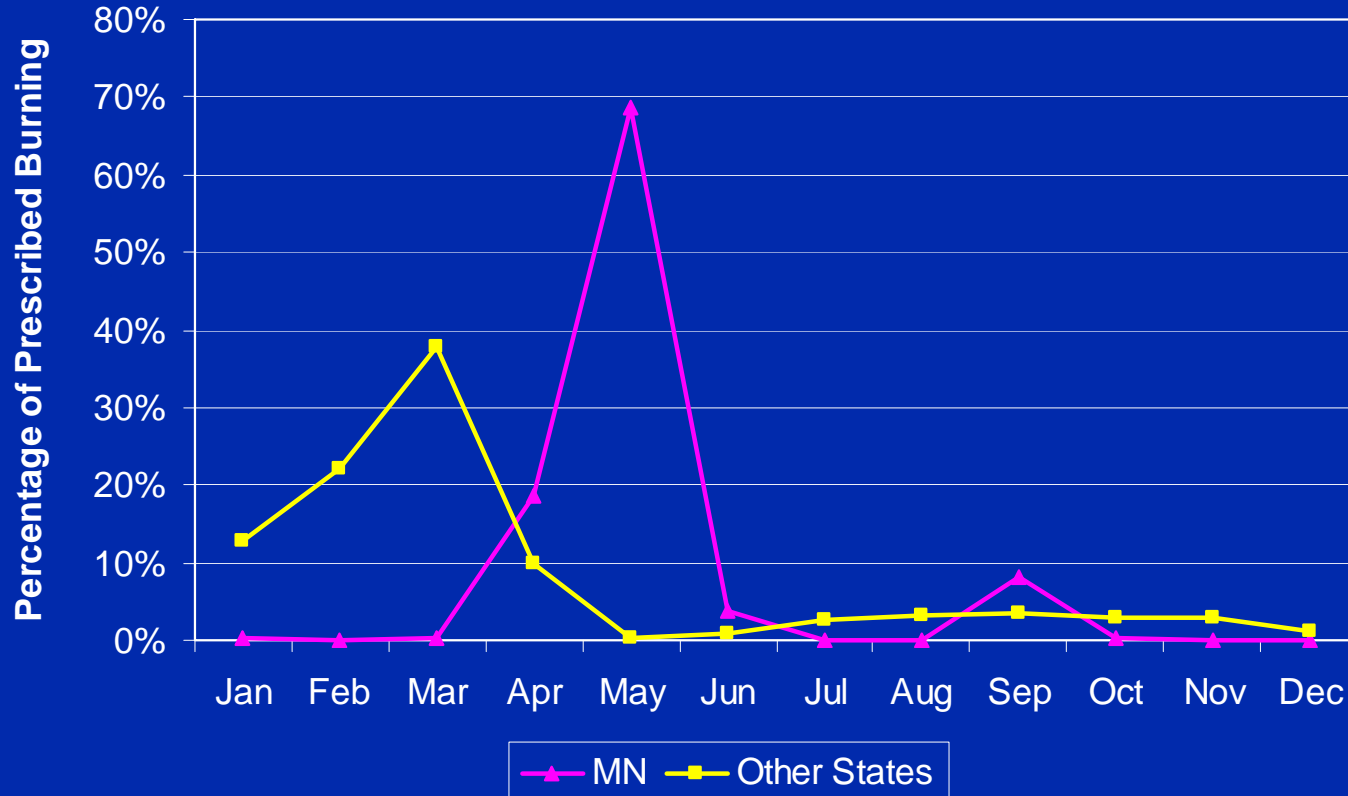
2002 PM_{2.5} Emissions by State (Total ~ 100,000 tons)



Development of the Inventory

Prescribed Burning Results

Monthly Variations in Emissions by State



Development of the Inventory Agricultural Burning Activity Data

Acres harvested by county and crop type:

- 2002 National Agricultural Statistical Service data

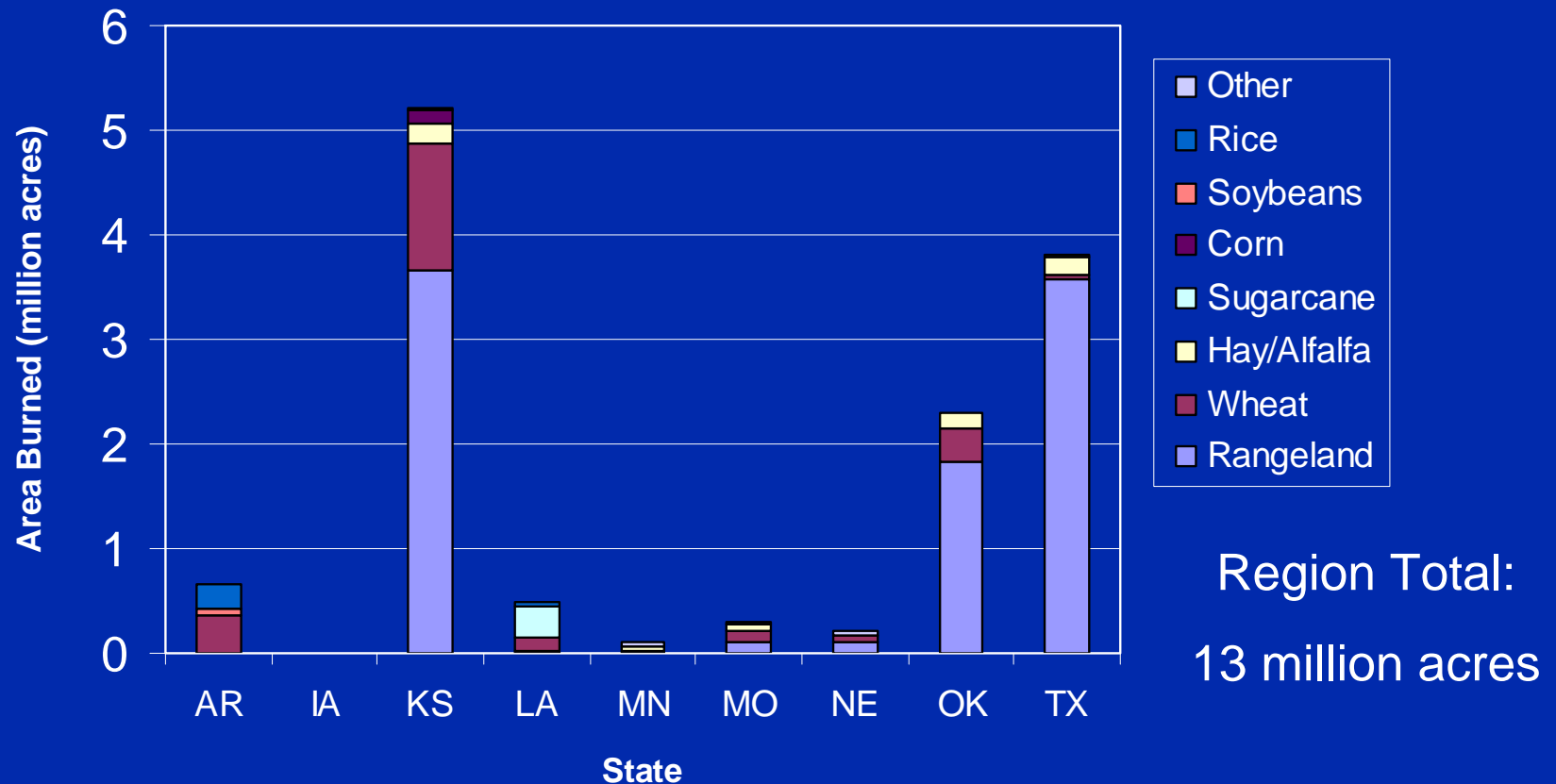
Fraction of harvested acres burned per year:

- Telephone surveys of Agricultural Extension Service (AES) personnel
- 549 completed surveys out of 969 county AES offices contacted (56%)

Development of the Inventory

Agricultural Burning Activity Data

2002 Acres Burned by State and Crop



Development of the Inventory

Agricultural Burning Emission Factors

Fuel loadings and emission factors vary by crop type. Data sources:

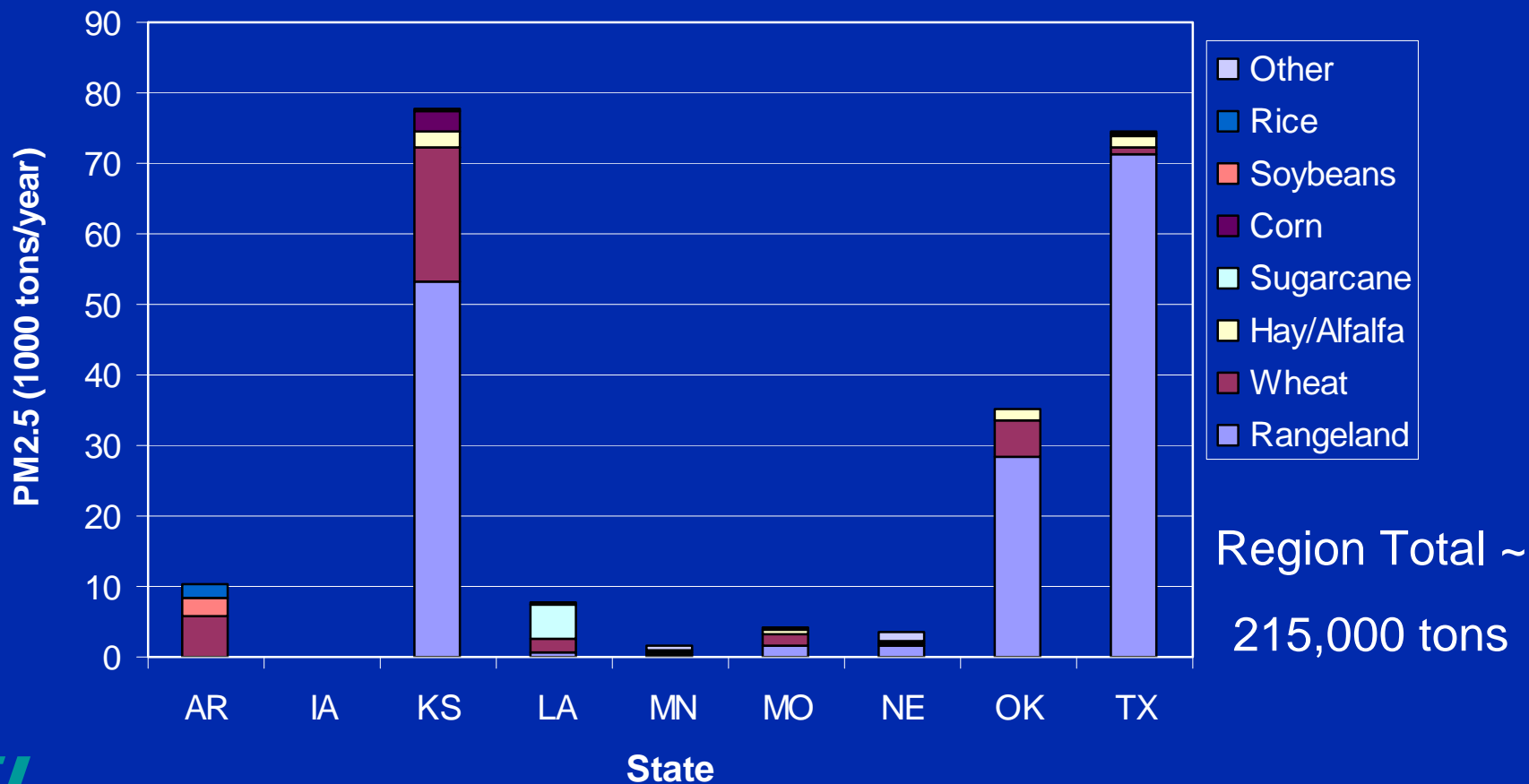
- UC-Davis study* (emission factors for barley, wheat, rice, corn)
- AP-42 (emission factors for other crops; all fuel loadings)

*Source: Jenkins et al. (1996) California Air Resources Board Project No. A932-126, April.

Development of the Inventory

Agricultural Burning Results

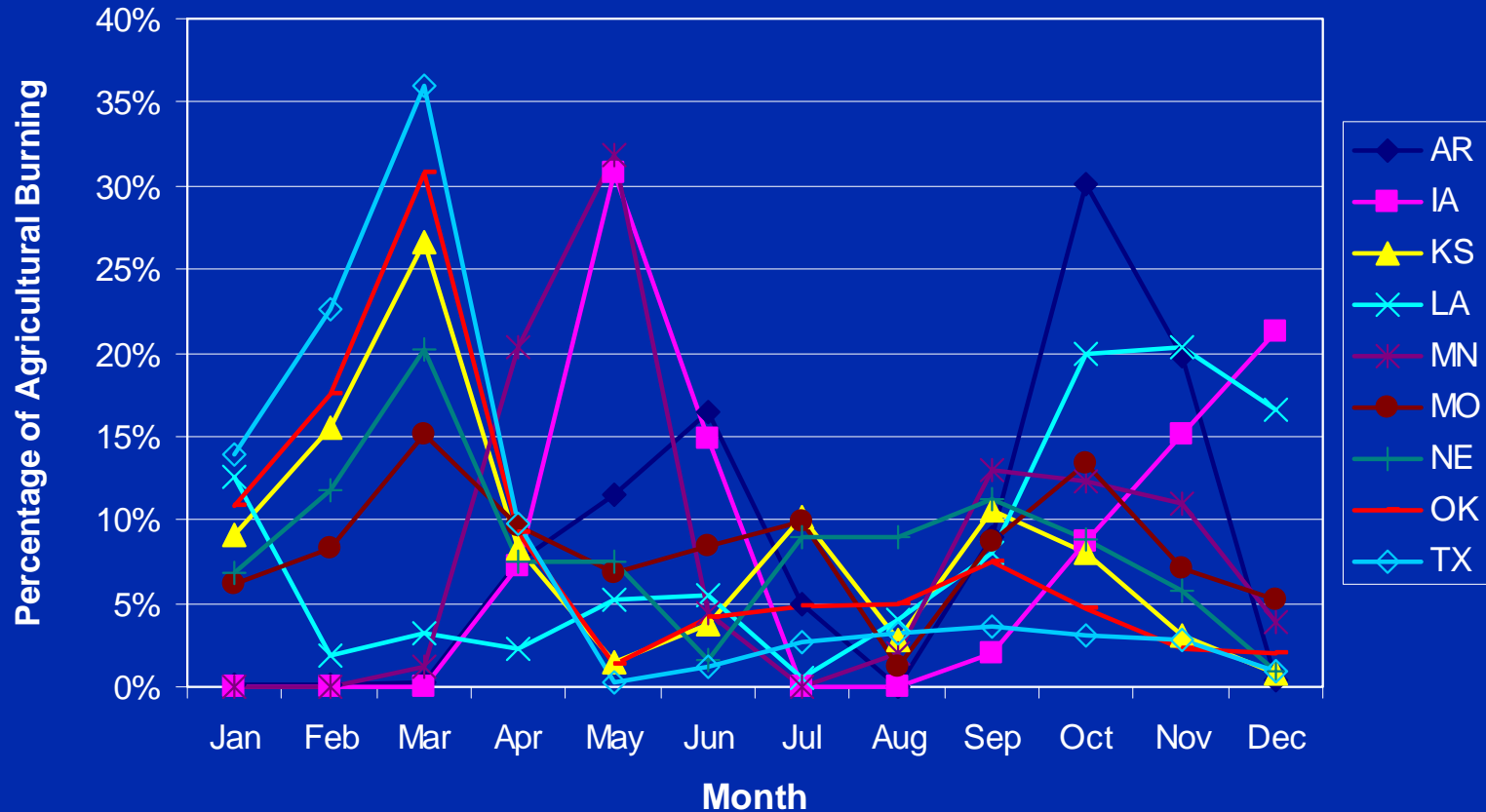
2002 PM_{2.5} Emissions by State and Crop



Development of the Inventory

Agricultural Burning Results

Monthly Variations in Emissions by State



Pilot Ambient Data Analysis

Background

STI used ambient speciated $PM_{2.5}$ data from two IMPROVE stations in Arkansas to assess planned burning contributions to visibility events in Class I areas.

Pilot Ambient Data Analysis

Preliminary Findings

- Smoke constituents were not a significant fraction of the $PM_{2.5}$ mass and light extinction (ammonium sulfate is the dominant constituent).
- On some days, influences from known prescribed burns were seen, though they were generally less than 10% of the $PM_{2.5}$ mass and light extinction.

Recommendations for Further Research

Activity Data:

- Acquire NFPORS data to verify that USFS burns are accounted for (especially in KS and NE).
- Acquire National Fire Initiative (NFI) data to account for burns by private organizations.
- Investigate local regulations that restrict open/agricultural burning and their enforcement.

Recommendations for Further Research

Fuel loadings and emission factors:

- Improve FOFEM's default fuel loadings where possible (as was done for selected fires in MN).

Ambient Data Analysis:

- Analyze data from additional IMPROVE sites, such as those in KS and MN.
- Use source apportionment tools to better quantify the influence of burning.

Recommendations for Further Research

Other:

- Alternative and newly emerging data sources such as satellite data should be explored to help characterize fire locations and day-specific activity levels

Glossary

BELD = EPA's Biogenic Emissions Landcover Database

BIA = Bureau of Indian Affairs

CENRAP = Central Regional Air Planning Association

DFW = Department of Fish and Wildlife

RPO = Regional Planning Organization

DOI = Department of the Interior

DNR = Department of Natural Resources

FOFEM = First Order Fire Effects Model

IMPROVE = Interagency Monitoring of Protected Visual Environments

NEI = National Emissions Inventory

NFI = National Fire Initiative

NFPORS = National Fire Plan Operations and Reporting System

NIFMID = National Interagency Fire Management Integrated Database

STI = Sonoma Technology, Inc.

TNC = The Nature Conservancy

USFS = United States Forest Service

WIMS = Weather Information Management System