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

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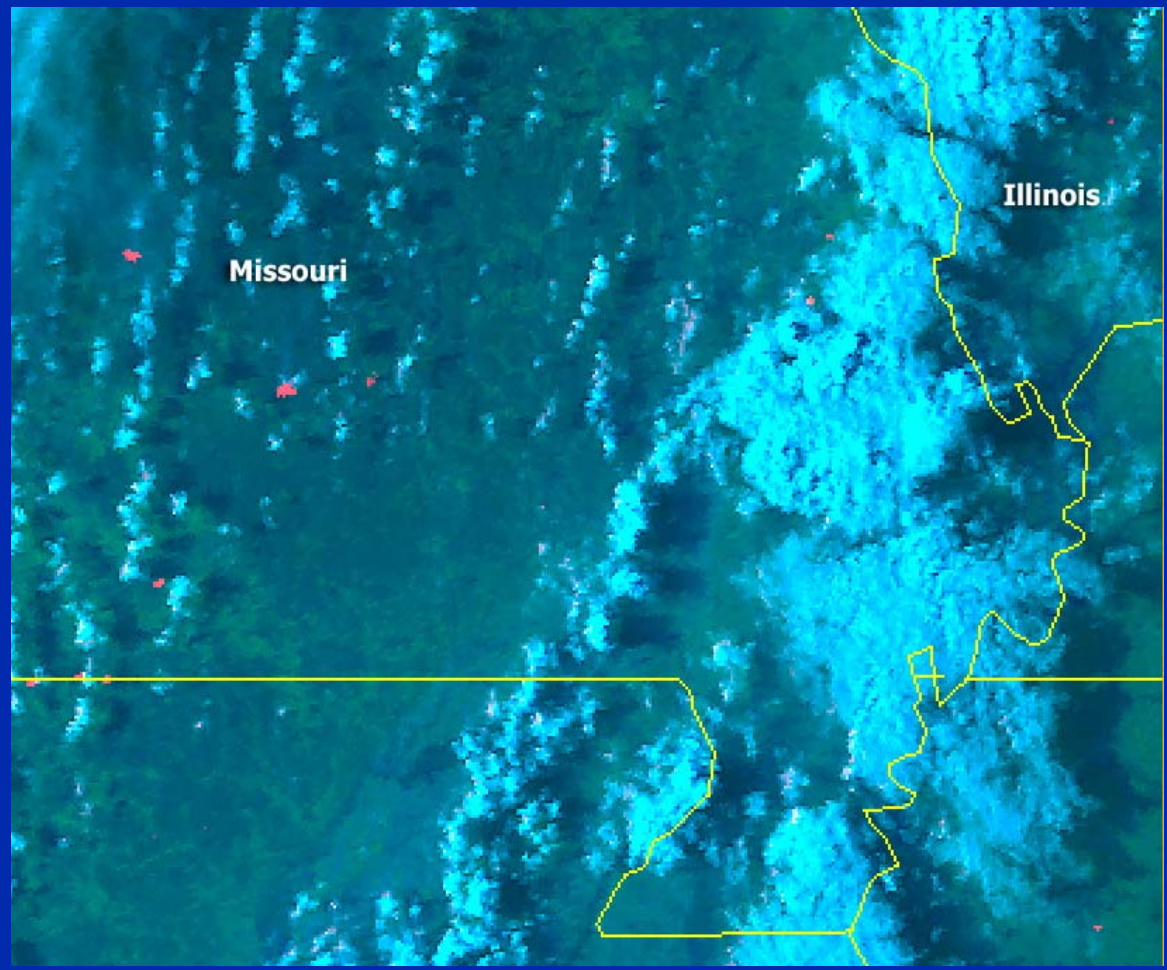
Why is Open Burning Important?

- 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



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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.

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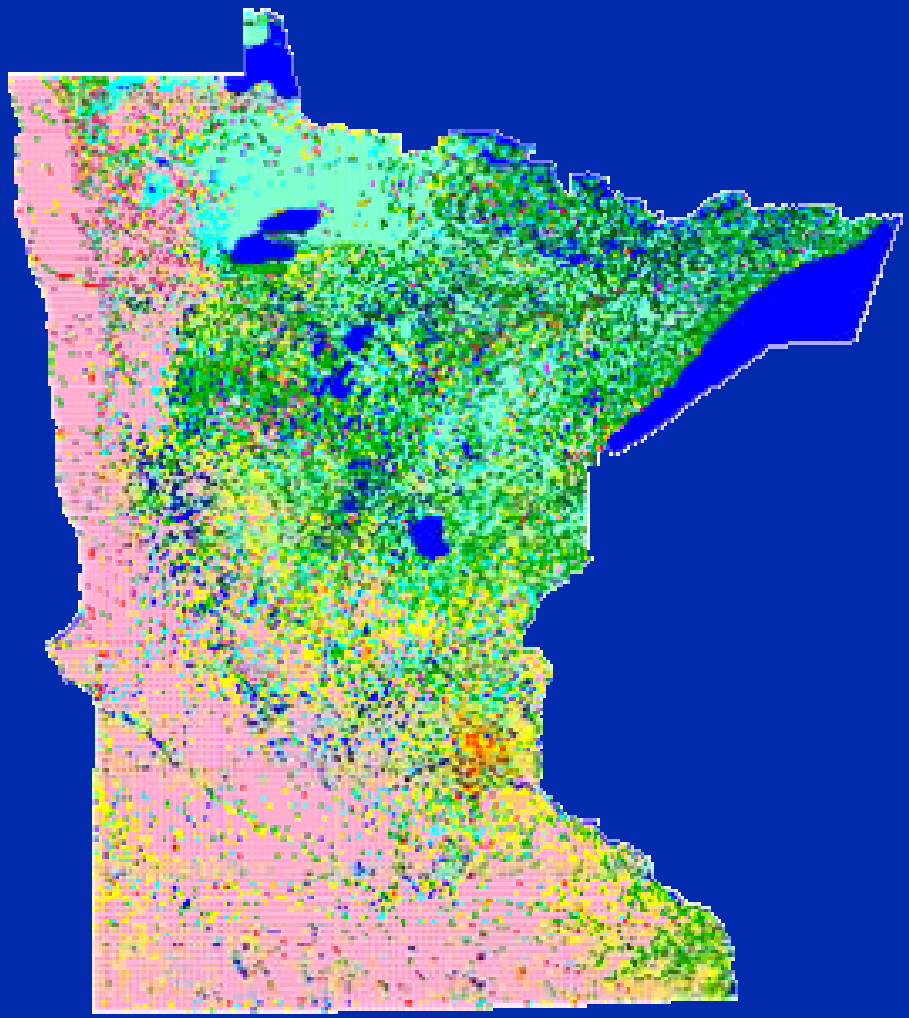
Definitions

- *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



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

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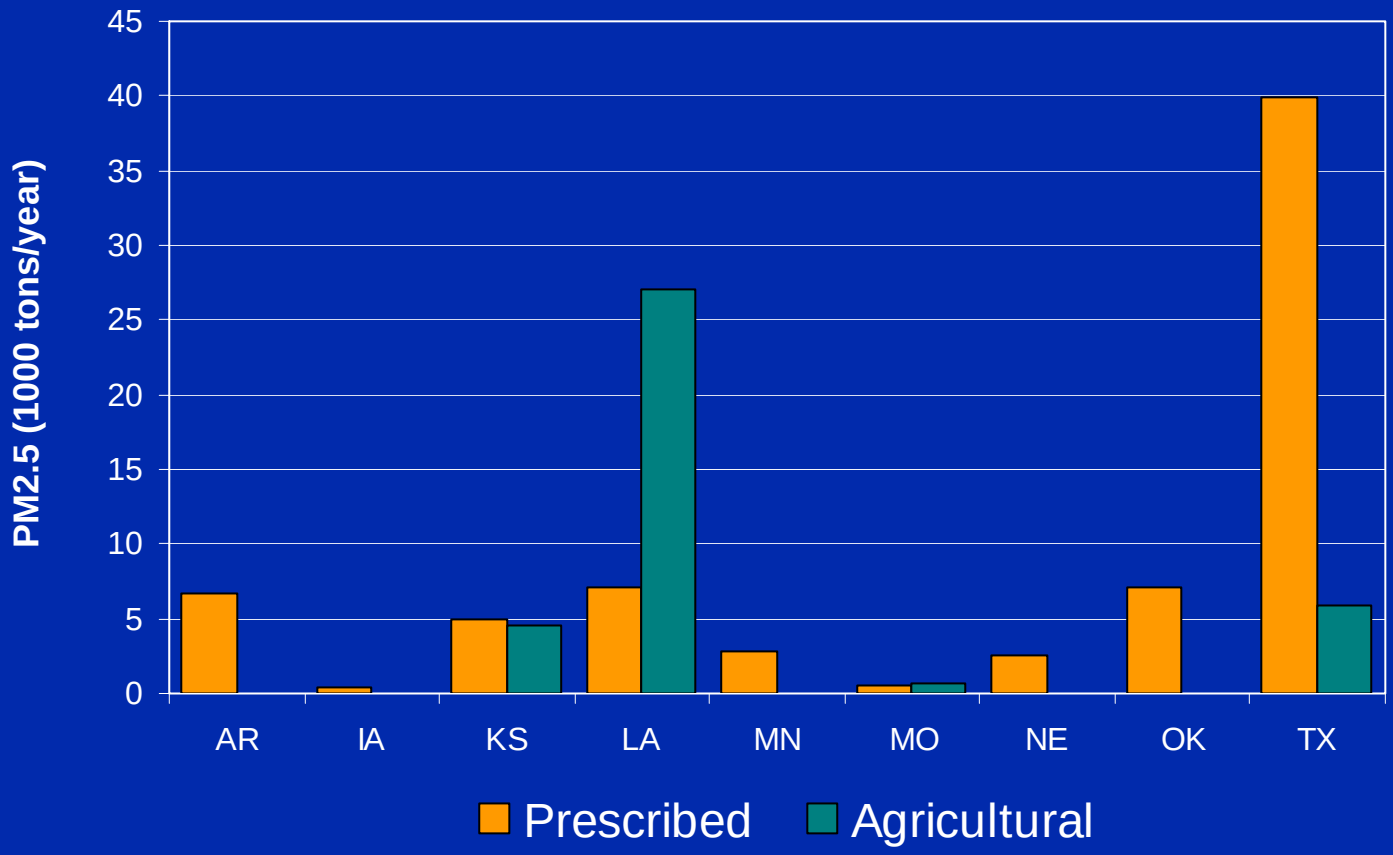
Prior Statuses of Planned Burning Inventories

Planned Burning Emissions in the 1999 NEI



Total $PM_{2.5}$: 110,000 tons

Prescribed: 72,000 tons

Agricultural: 38,000 tons

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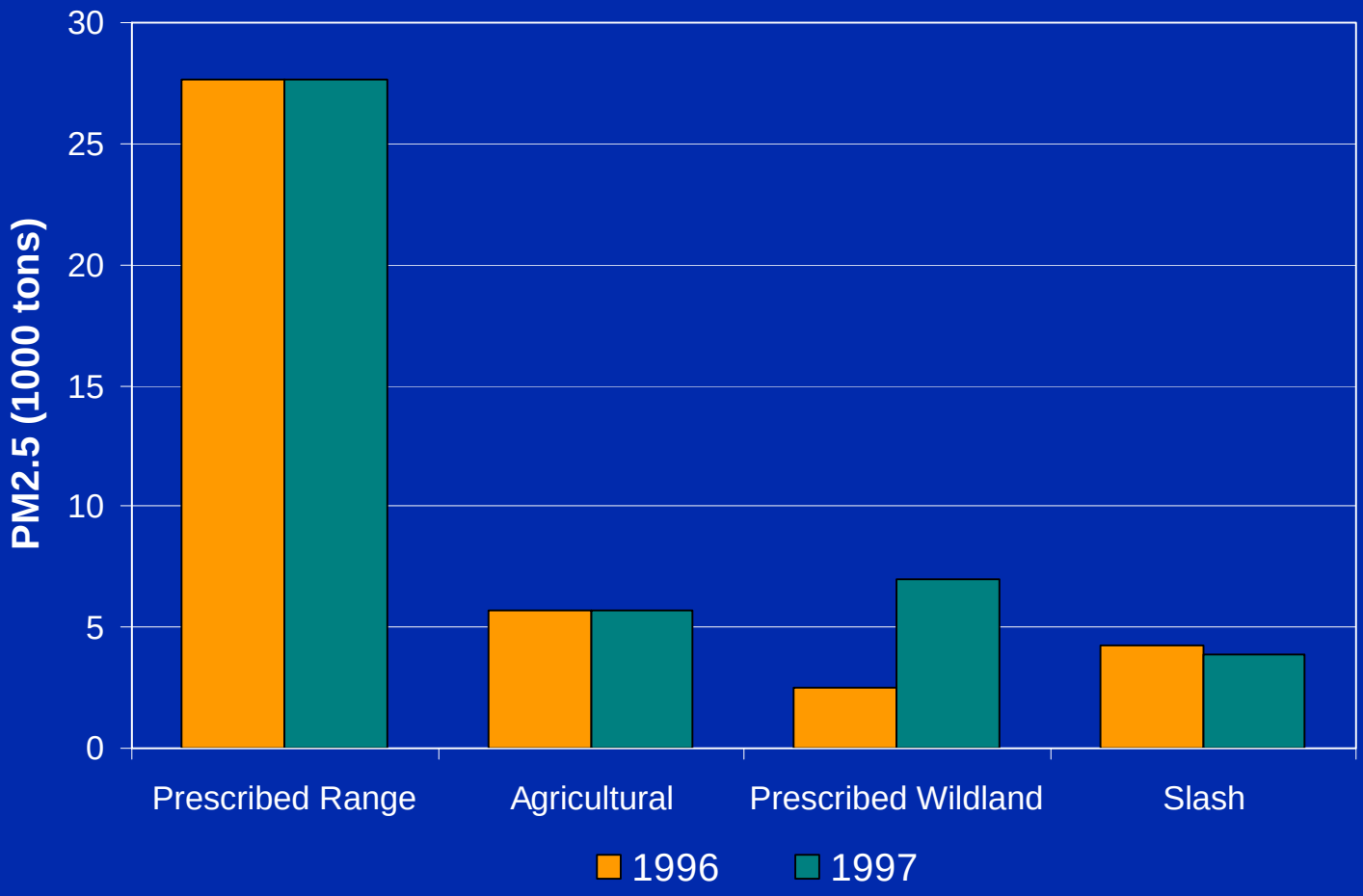
Prior Statuses of Planned Burning Inventories

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.

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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

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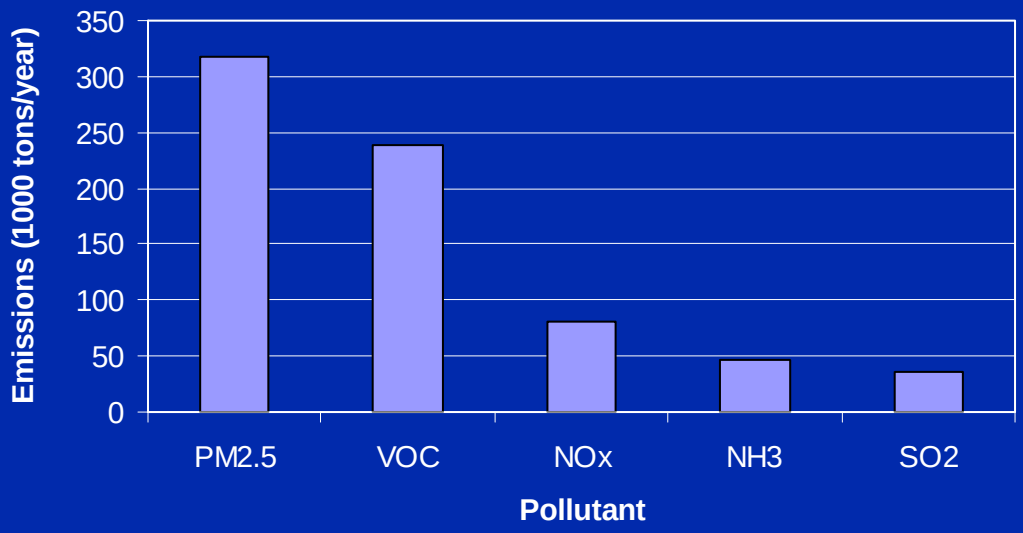
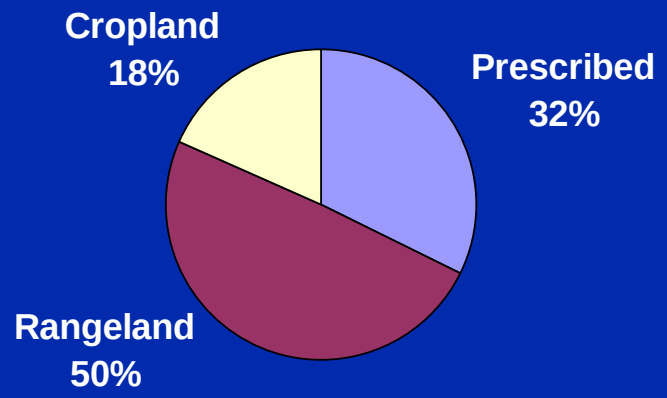
Current Status of the Inventories

2002 Emissions by Pollutant



$PM_{2.5}$ Emissions by Source Category



Total = 317,000 tons/year

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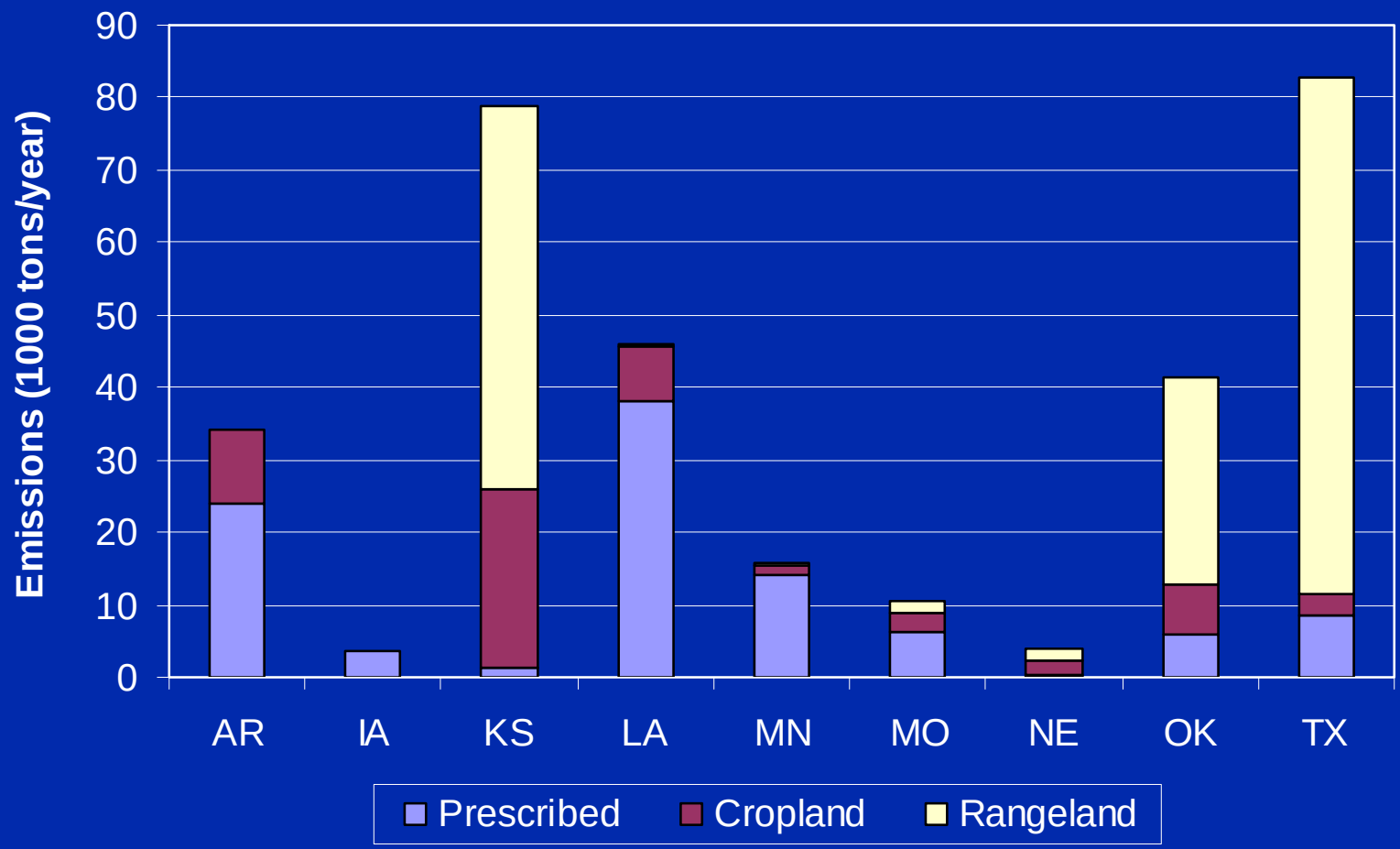
Current Status of the Inventories

2002 $PM_{2.5}$ Emissions by State and Source Category



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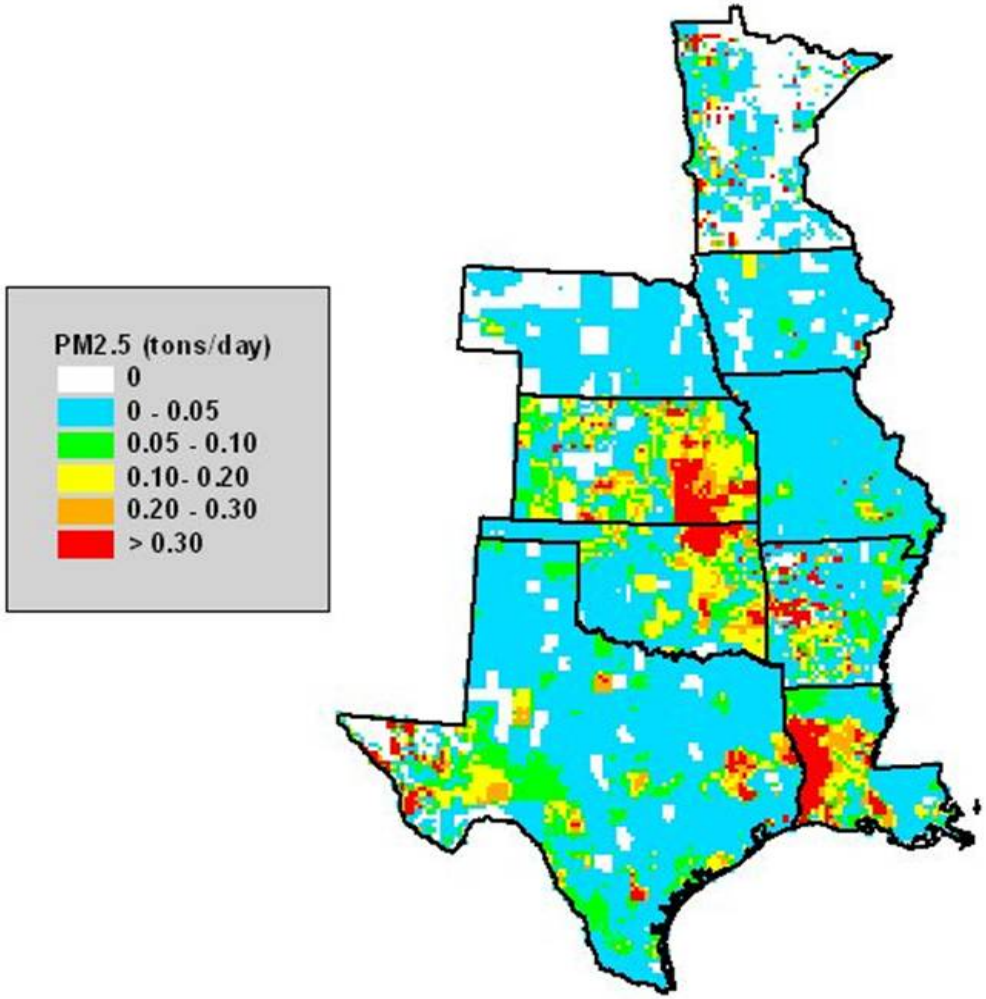
Current Status of the Inventories



$PM_{2.5}$ Emission Densities for the CENRAP Region

April 10, 2002

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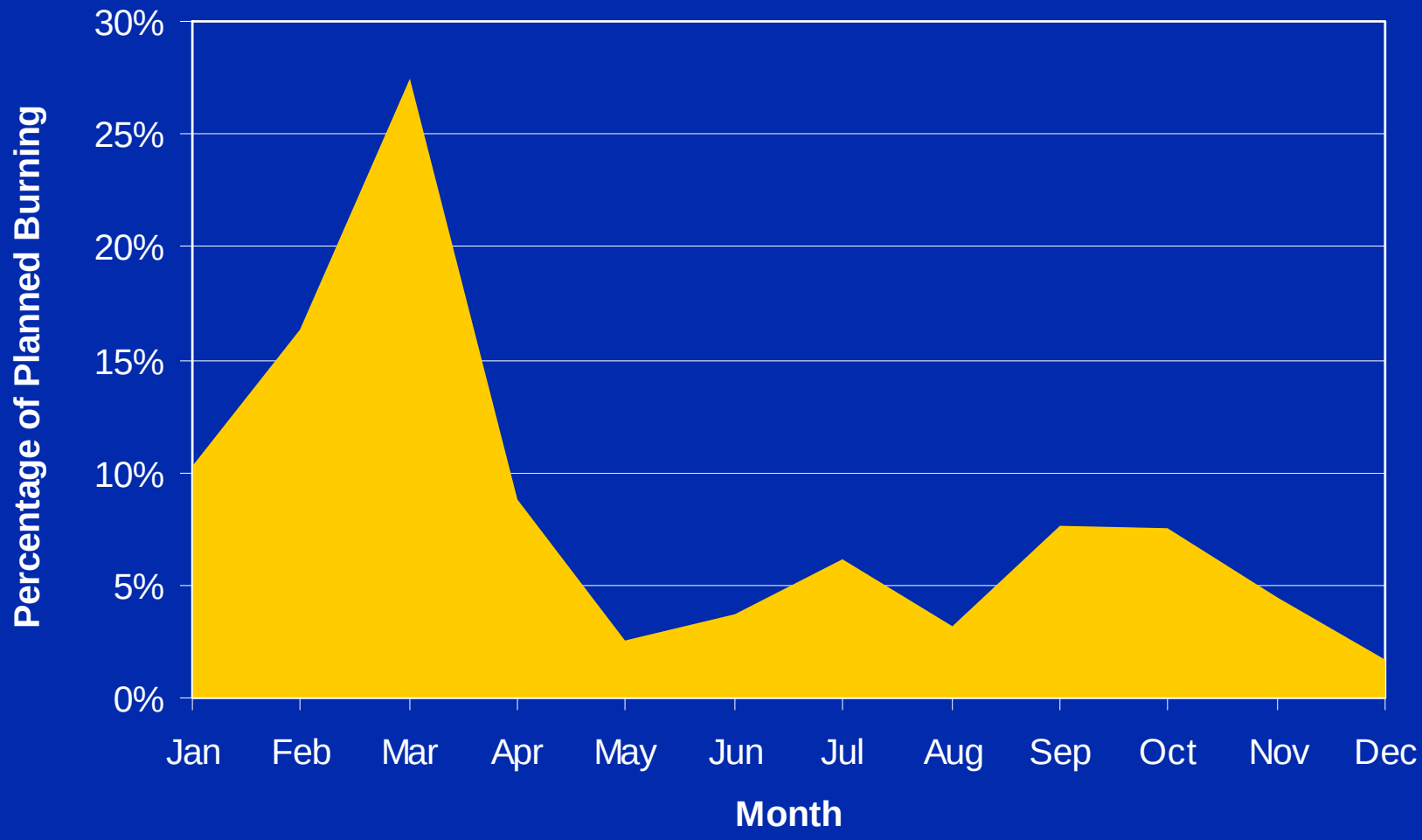
Current Status of the Inventories

Monthly Variations in Planned Burning Emissions for 2002



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Development of the Inventories

Basic Equation

Emissions (lb) =

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

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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

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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.)

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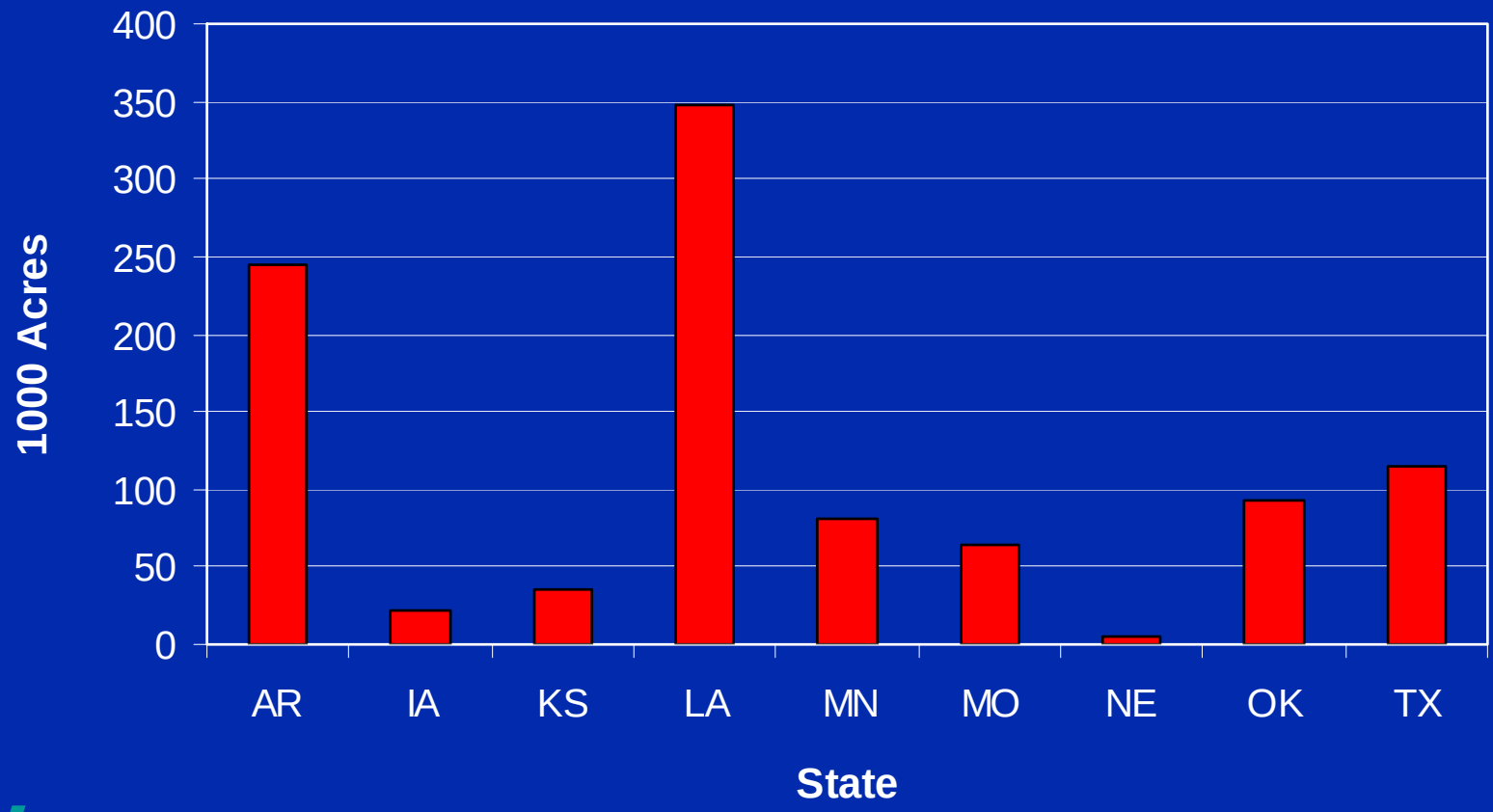
Development of the Inventory

Prescribed Burning Activity Data

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



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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.

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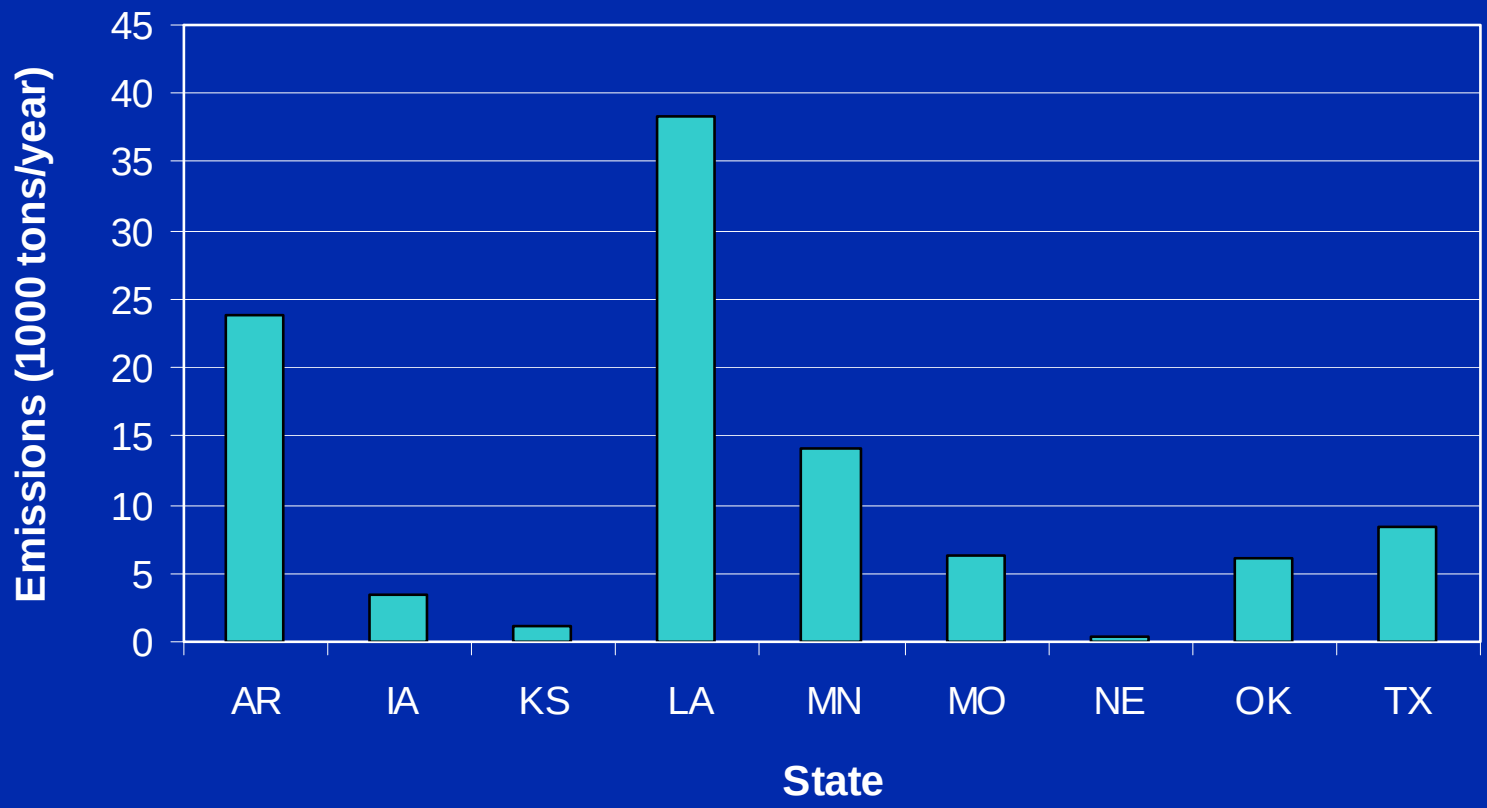
Development of the Inventory

Prescribed Burning Results

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



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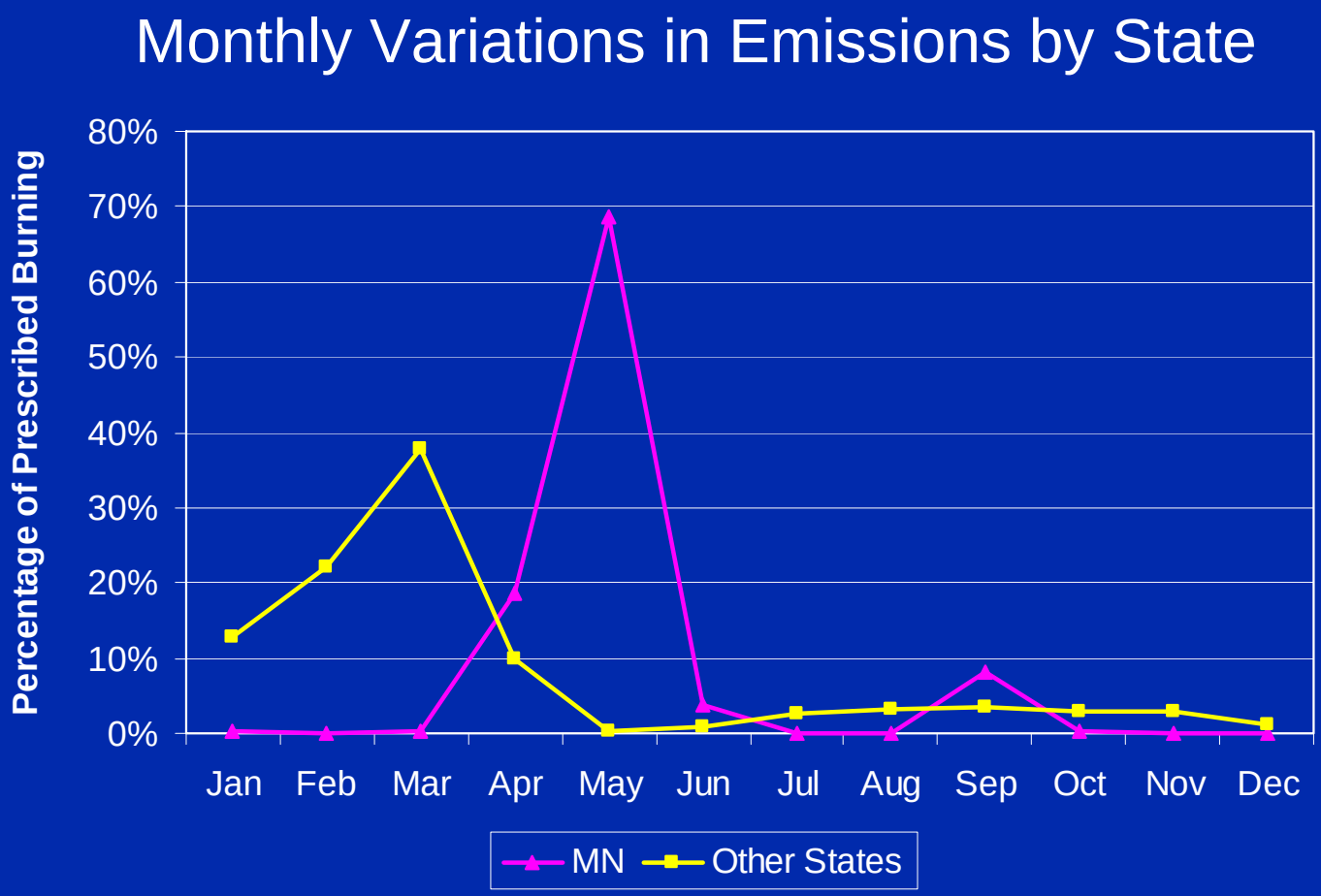
Development of the Inventory

Prescribed Burning Results



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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%)

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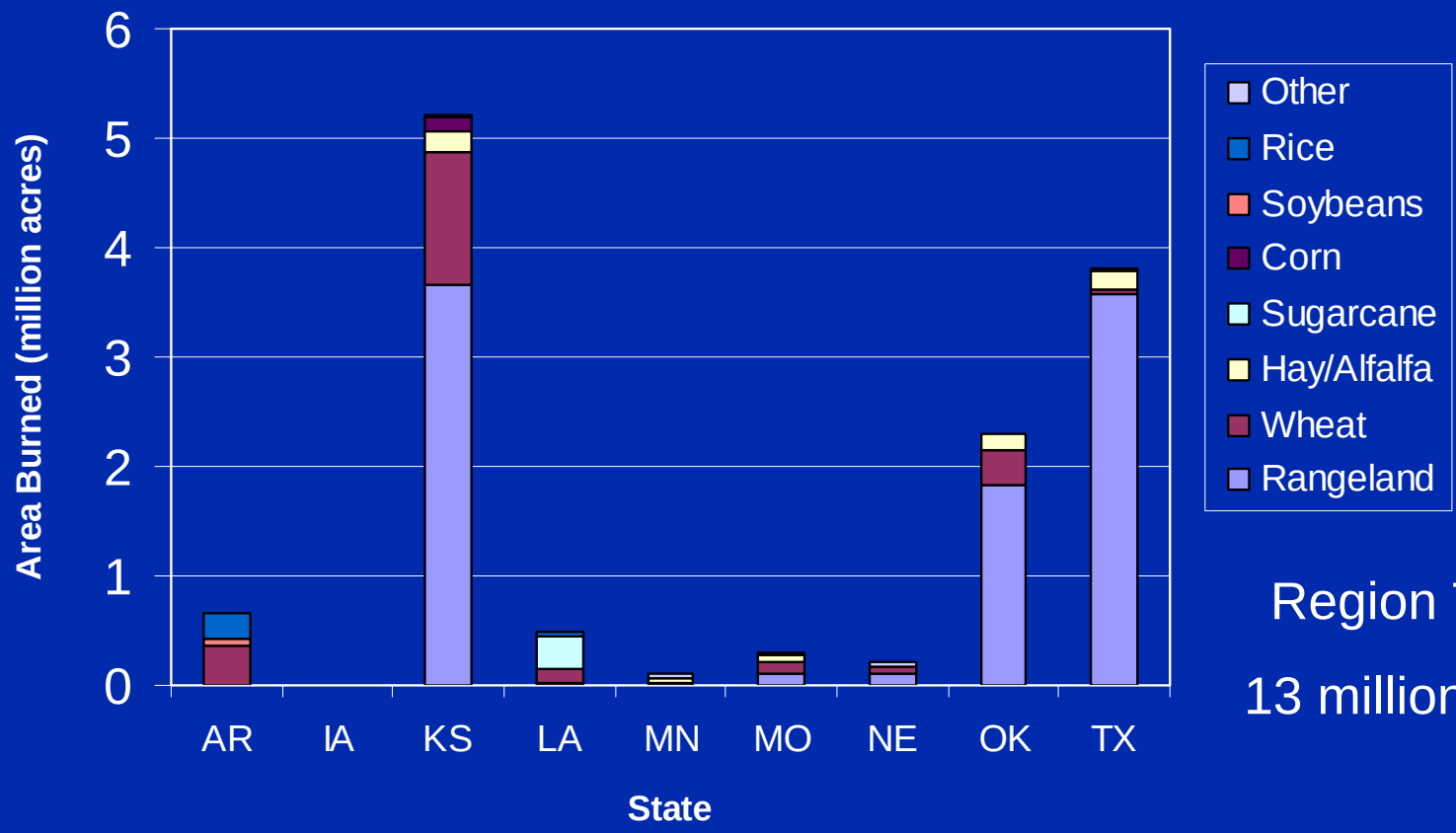
Development of the Inventory

Agricultural Burning Activity Data

2002 Acres Burned by State and Crop



Region Total:

13 million acres

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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.

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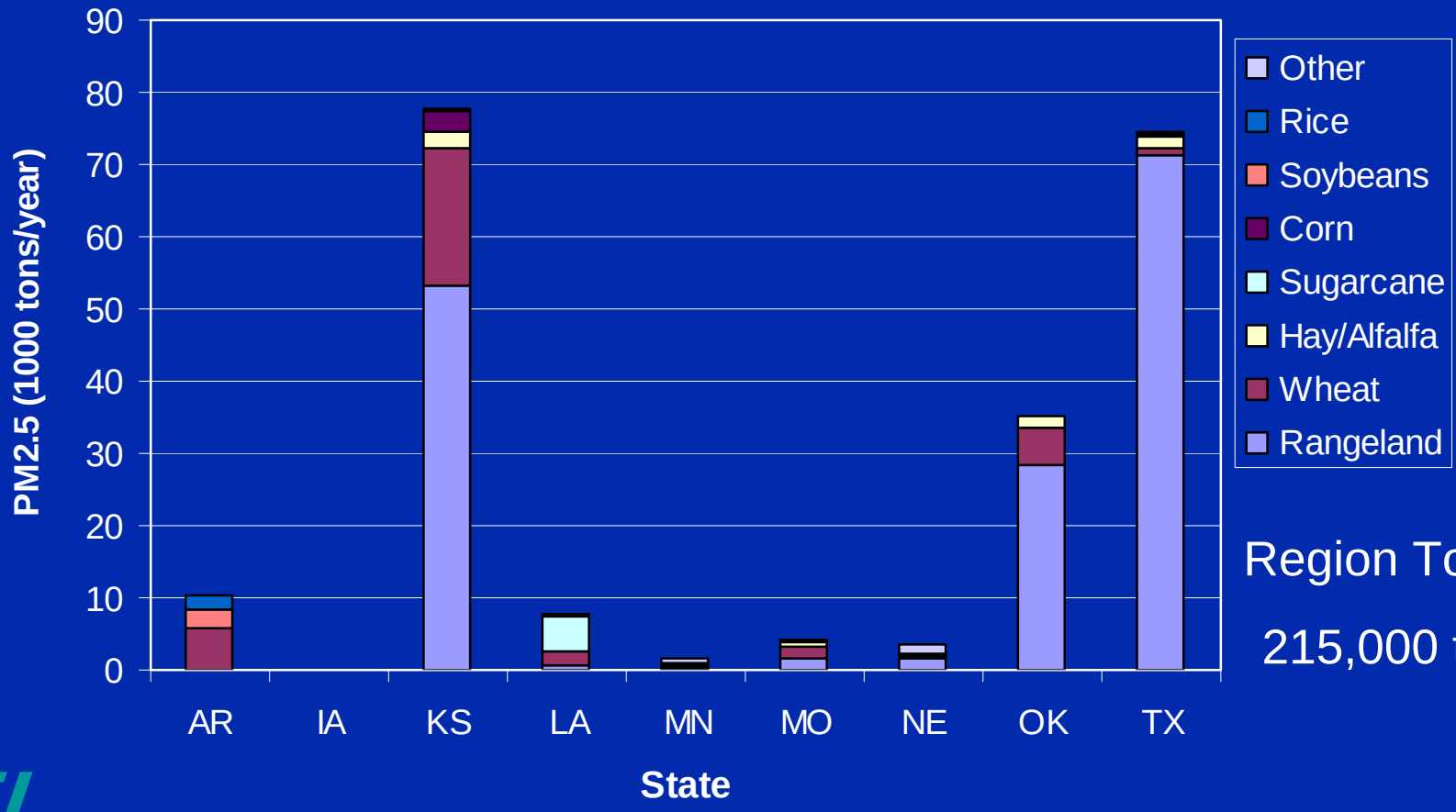
Development of the Inventory

Agricultural Burning Results

2002 $PM_{2.5}$ Emissions by State and Crop



Region Total ~

215,000 tons

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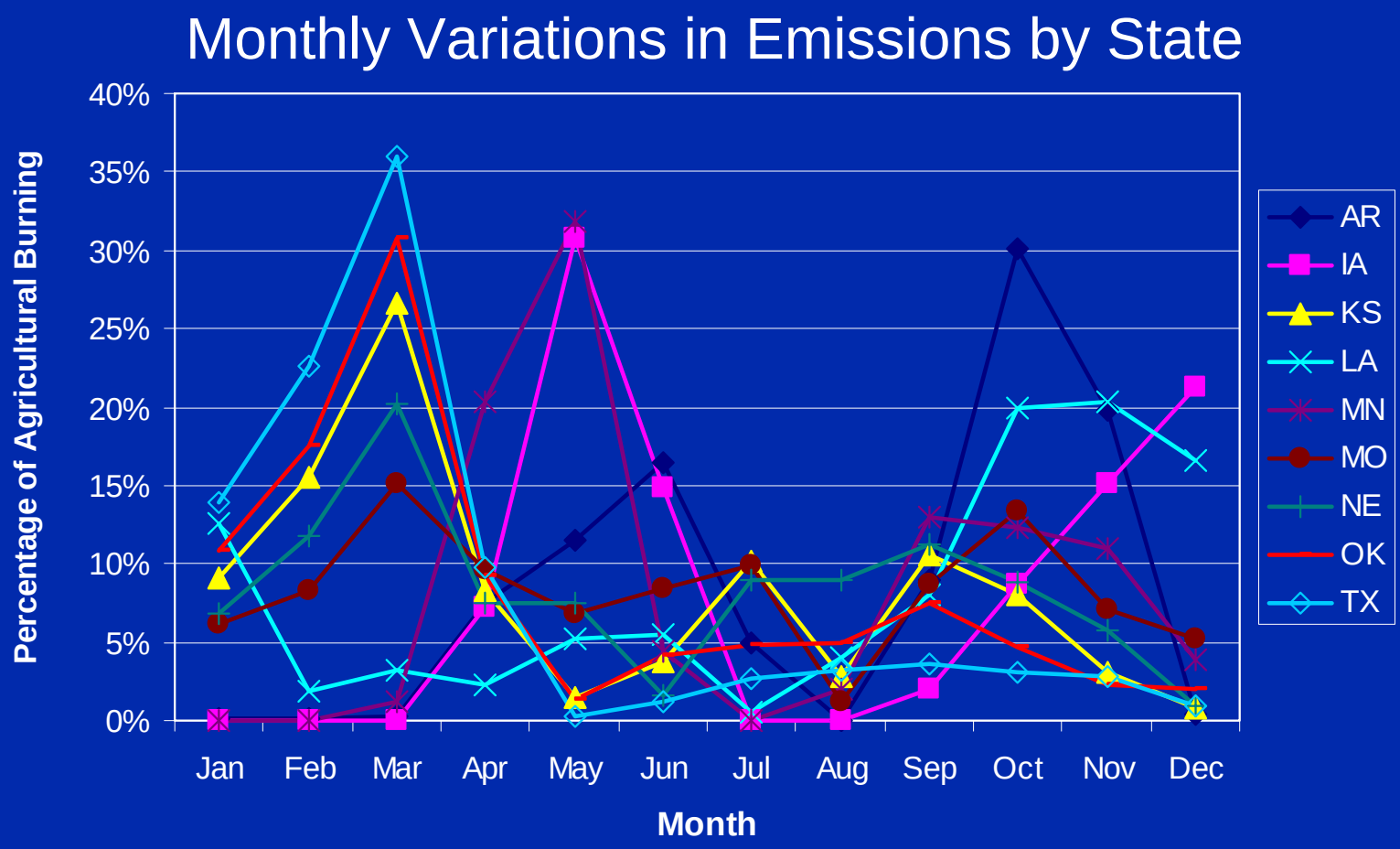
Development of the Inventory

Agricultural Burning Results



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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.

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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

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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