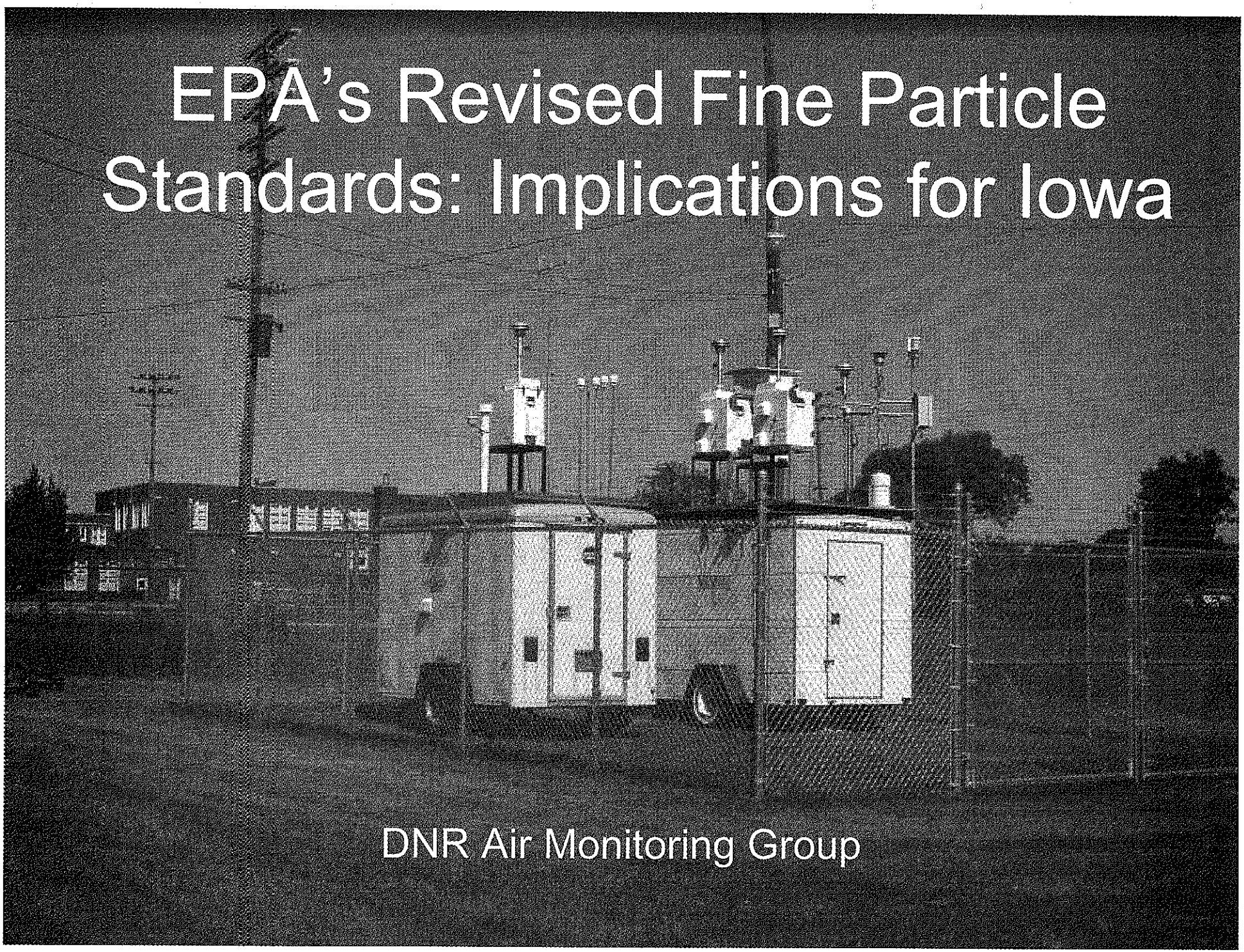
EPA's Revised Fine Particle Standards: Implications for Iowa



DNR Air Monitoring Group

$PM_{2.5}$ Basics

What is $PM_{2.5}$?

$PM_{2.5}$ (fine particulate) is any airborne solid or liquid material (other than uncombined water) with an aerodynamic diameter less than 2.5 microns.

How is $PM_{2.5}$ Formed?

- Fine particles can be directly emitted from sources or they can be created by chemical reactions in the atmosphere.
- Combustion from forest fires, industrial boilers, motor vehicles, and domestic heating gives rise to direct fine particle emissions whose composition depends on the fuel combusted. There are lots of other natural and manmade sources of fine particle emissions.
- Secondary formation of $PM_{2.5}$ occurs when fine particles are created by chemical reactions in the atmosphere. Ammonium sulfate is formed when ammonia reacts with sulfuric acid. Ammonium nitrate forms when ammonia combines with nitric acid under conditions of high humidity and low temperatures. Organic compounds can also be created by secondary formation.

How Do the New $PM_{2.5}$ Standards Compare to the Old $PM_{2.5}$ Standards?

Old $PM_{2.5}$ Standards (7/1997)

- Three year average of annual 98th percentile of daily values ("24 hr design value")
  $< 65\ \mu g/m^3$

- Three year average of annual averages ("annual design value")
  $< 15\ \mu g/m^3$

New $PM_{2.5}$ Standards (9/2006)

- **24 hr design value**
  < 35 µg/m^3

- **Annual design value**
  < 15 µg/m^3

24-hr standard lowered from 65 µg/m^3 to 35 µg/m^3; old annual standard retained.

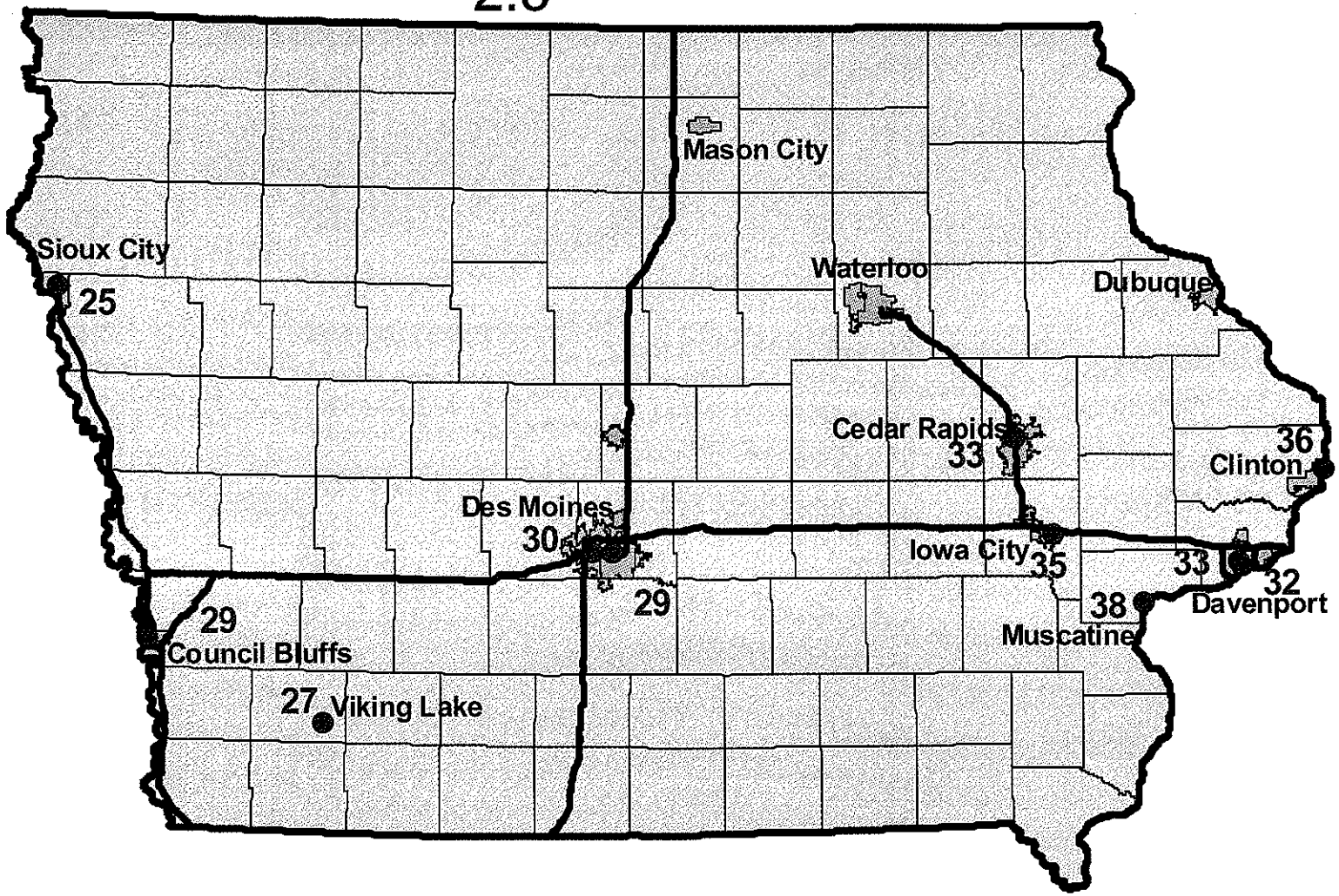
What are the Health Benefits of Meeting the New Standard?

On a national level, annual reductions of:

- **1,200 to 13,000 premature deaths in people with heart or lung disease;**
- **2,600 cases of chronic bronchitis;**
- **5,000 nonfatal heart attacks;**
- **1,630 hospital admissions for cardiovascular or respiratory symptoms;**
- **1,200 emergency room visits for asthma;**
- **7,300 cases of acute bronchitis;**
- **97,000 cases of upper and lower respiratory symptoms;**
- **51,000 cases of aggravated asthma;**
- **350,000 days when people miss work or school; and**
- **2 million days when people must restrict their activities because of particle pollution-related symptoms.**

Acknowledgement: EPA: ***http://epa.gov/pm/pdfs/20070207_presentation.pdf***

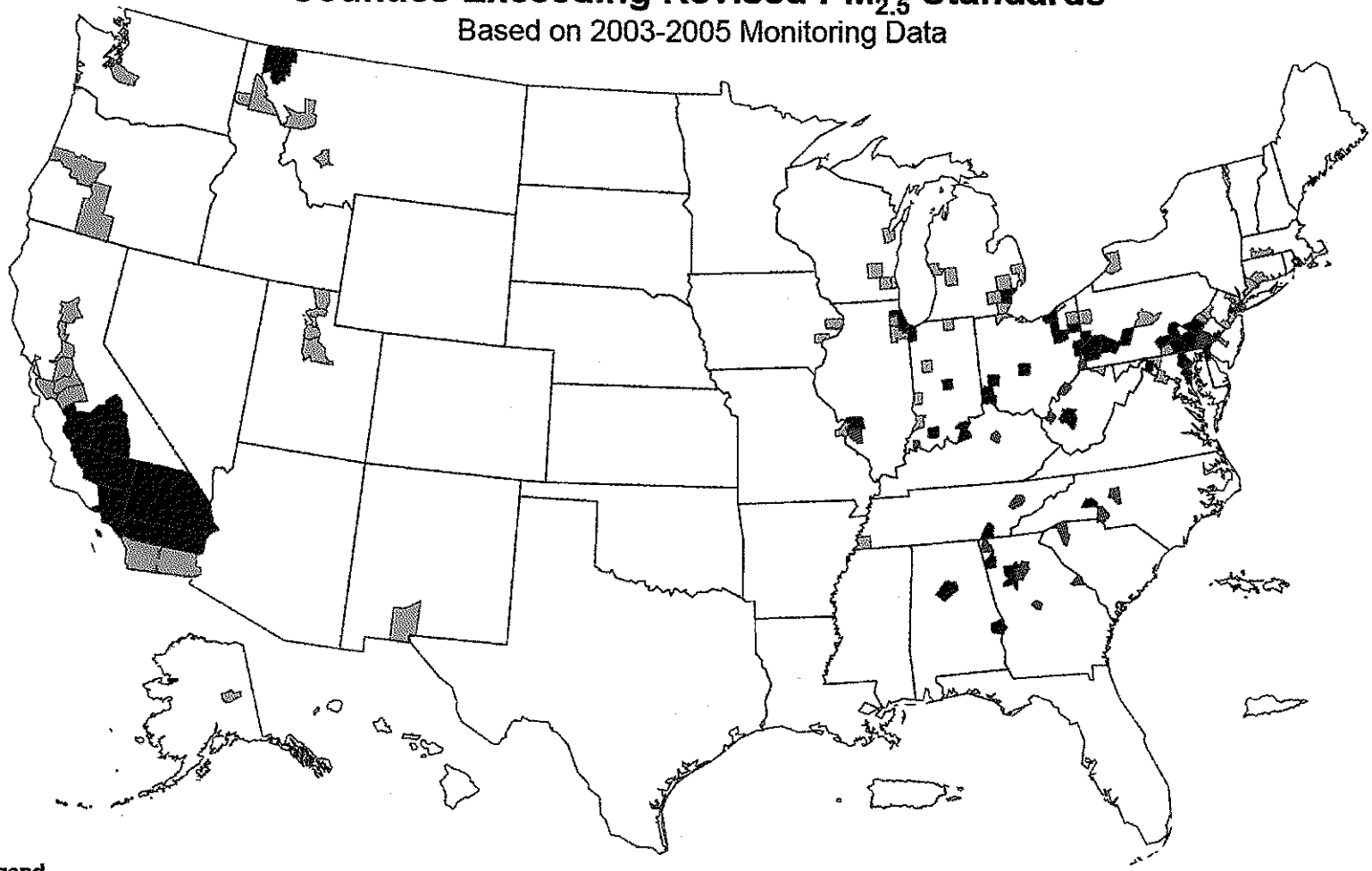
How Close is Iowa to the New 24hr $PM_{2.5}$ Standard?



24 hr $PM_{2.5}$ Design Values for Sites with Complete Data: 2003-2005

Counties Exceeding Revised $PM_{2.5}$ Standards

Based on 2003-2005 Monitoring Data



Legend

County with monitor exceeding:	Number of Counties
both annual (15 µg/m3) and 24-hour (35 µg/m3) $PM_{2.5}$ standards	56
ONLY the 24-hour $PM_{2.5}$ standard (35 µg/m3)	70
ONLY the annual $PM_{2.5}$ standard (15 µg/m3)	17
Total Counties Exceeding	**143**

- Data from AQS 7/10/2006
- Data completeness computed per CFR 7/10/2006
- EPA will not base designations for the new fine particle standards on these data.

Graphic Courtesy of EPA: ***http://epa.gov/pm/pdfs/20061025_graphsmaps.pdf***

What is the Timeline for Meeting the New Standards?

Milestone	1997 PM2.5 Primary NAAQS	2006 PM2.5 Primary NAAQS
Promulgation of Standard	July 1997	Sept. 2006
Effective date of Standard	Sept.1997	Dec. 2006
State Recommendations to EPA	Feb. 2004 (based on 2001-2003 monitoring data)	Dec. 2007 (based on 2004-2006 monitoring data)
Final Designations Signature	Dec. 2004	Dec. 2008/2009
Effective Date of Designations	April 2005	90 days after publication in the *Federal Register*
SIPs Due	April 2008	3 years after effective date of designations
Attainment Date	April 2010 (based on 2007-2009 monitoring data)	No later than 5 years after effective date of designations
Attainment Date with Extension	Up to April 2015	Up to 10 years from effective date of designations

Acknowledgement: EPA: ***http://epa.gov/pm/pdfs/20070207_presentation.pdf***

What Types of $PM_{2.5}$ Monitoring Data are Gathered?

- Filter (FRM) $PM_{2.5}$ data
- Continuous $PM_{2.5}$ data
- Speciated $PM_{2.5}$ data

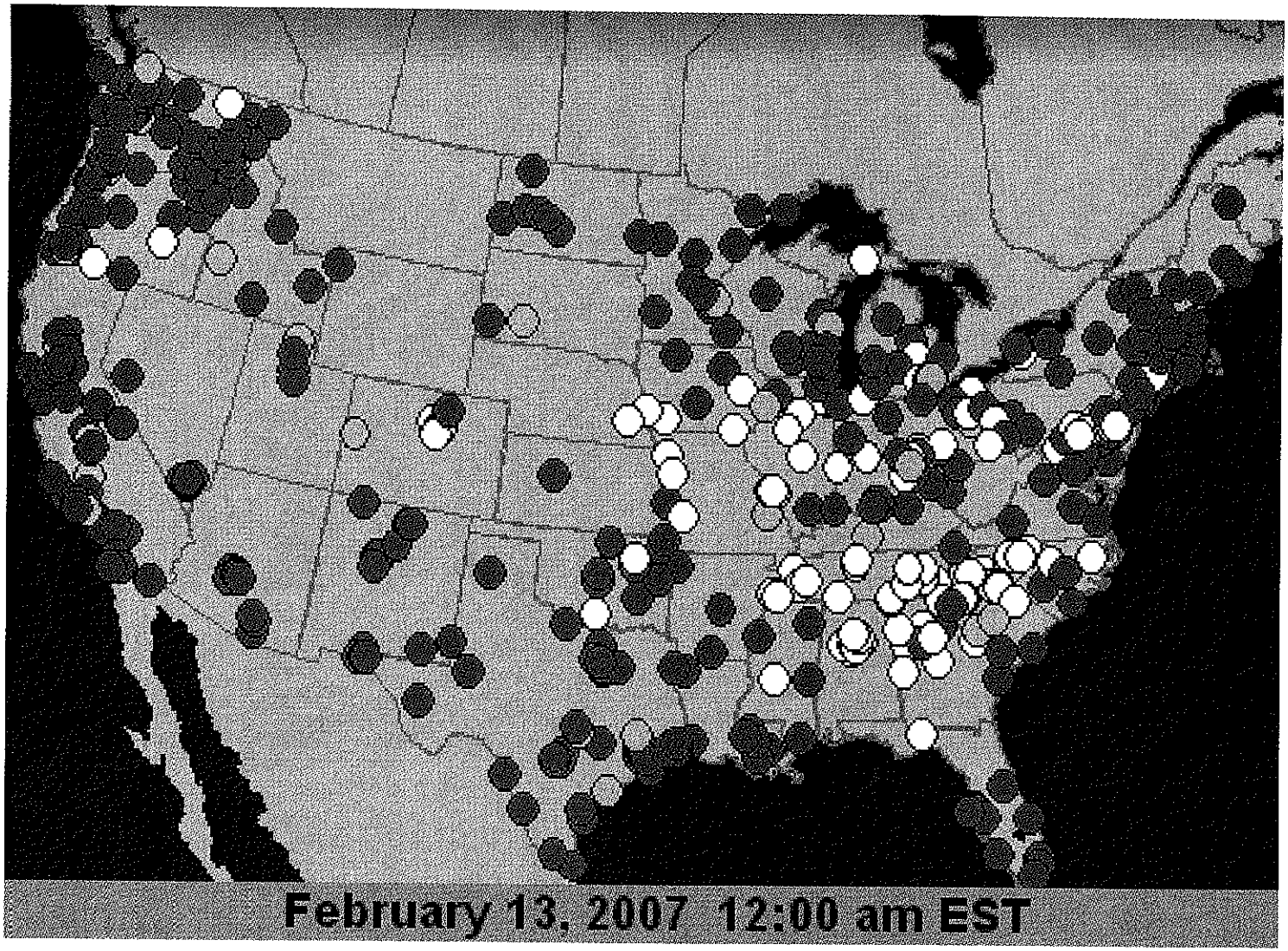
Filter Sampler (FRM) Data

- Twenty-four hour $PM_{2.5}$ samples are collected with EPA approved ("FRM") samplers on Teflon filters.
- Most FRM samplers are operated at a frequency of one sample every third day. Some samplers are operated on a daily schedule in order to increase the accuracy of the design values.
- Filters are analyzed at Iowa's weighing laboratory (operated by the University of Iowa Hygienic Laboratory in Iowa City) under carefully controlled conditions of relative humidity and temperature.
- The turn-around time for FRM data is typically about eight weeks.
- FRM data is very precise, and it is currently the only type of data EPA will accept for determining attainment with the $PM_{2.5}$ standards.

Continuous $PM_{2.5}$ Monitoring Data

- High time resolution (typically one-hour).
- Available to the public in real time via EPA's AIRNOW website.
- Data can be combined with hourly wind speed and wind direction data to provide insight into how $PM_{2.5}$ is transported from one location to another.
- New types of continuous $PM_{2.5}$ monitors may be available in the summer of 2007 that are accurate enough to use in place of FRM data for determining attainment.

Real-time Map of Continuous $PM_{2.5}$ Data



Graphic Courtesy of EPA AIRNOW (http://airnow.gov)

Speciated $PM_{2.5}$ Monitoring Data

- Speciated $PM_{2.5}$ data provides information on the chemical composition of $PM_{2.5}$.
- There are two national $PM_{2.5}$ speciation programs sponsored by EPA:
  - The IMPROVE program, focused on National Parks.
  - The Speciation Trends Network (STN) program, focused on cities.
- Each of these networks incorporate standardized samplers and analytical methods for chemical analysis of $PM_{2.5}$ and provide integrated data analysis products for the entire nation.
- EPA uses data from speciation samplers to validate regional dispersion models, to relate modeled concentrations of speciated $PM_{2.5}$ components to FRM concentrations in a particular area, and to establish the "urban excess" of $PM_{2.5}$ in a particular urban area when compared to nearby rural areas.
- Iowa currently operates two IMPROVE samplers, at one at Viking Lake State Park in the Southwest corner of the state and the other at Lake Sugema in the Southeast corner the state, as well as three STN samplers in Davenport, Des Moines and Cedar Rapids.

Composition of Fine Particles in Remote Areas

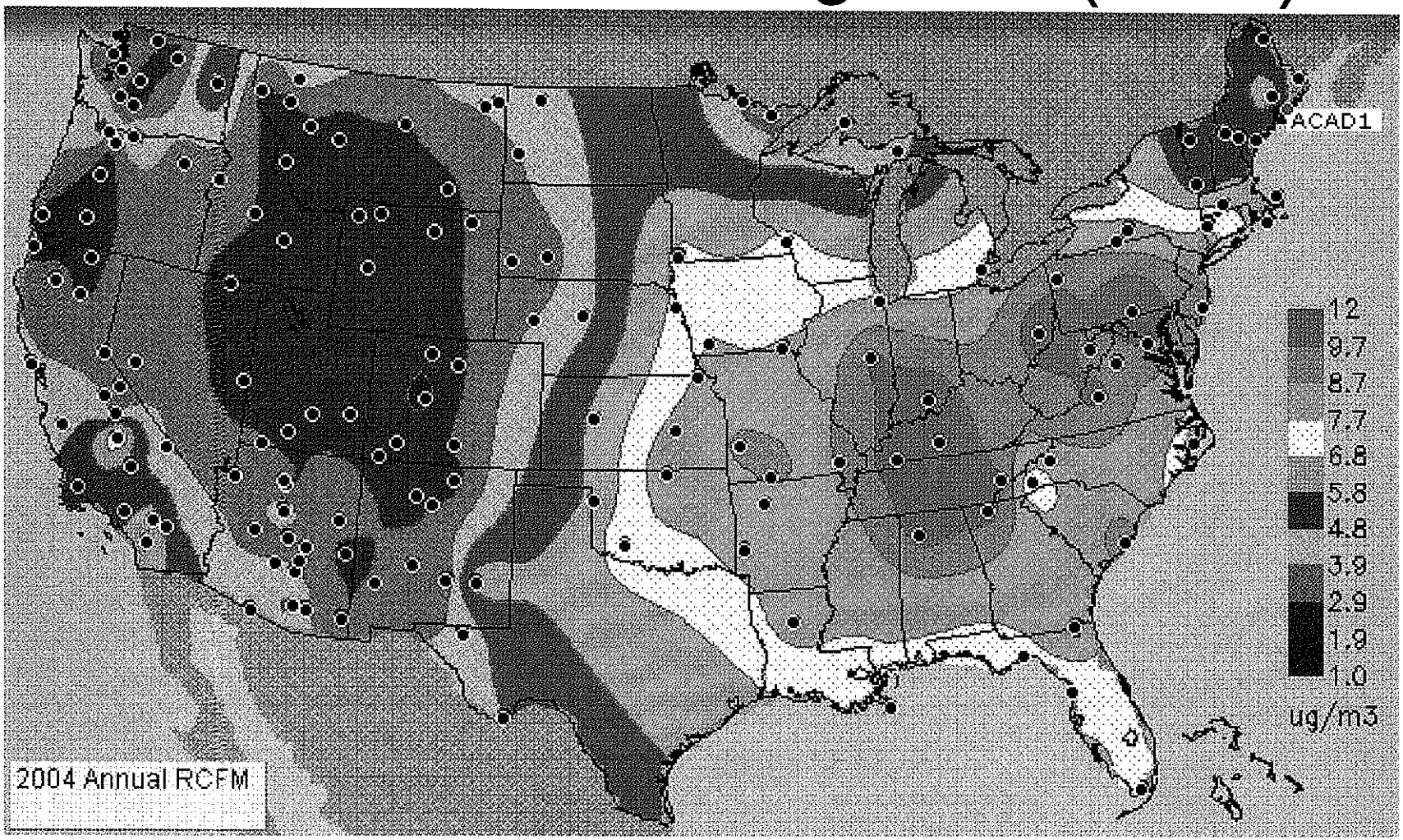
Away from urban and industrial sources, gradients in fine particulate concentrations should typically be low. Monitoring in these areas should provide insights into the regional character of fine particulate pollution problems.

Following the chemical constituent model used by EPA's visibility (IMPROVE) program:

Reconstructed fine mass (RCFM) =
ammonium nitrate + ammonium sulfate + organic carbon + elemental carbon + fine soil

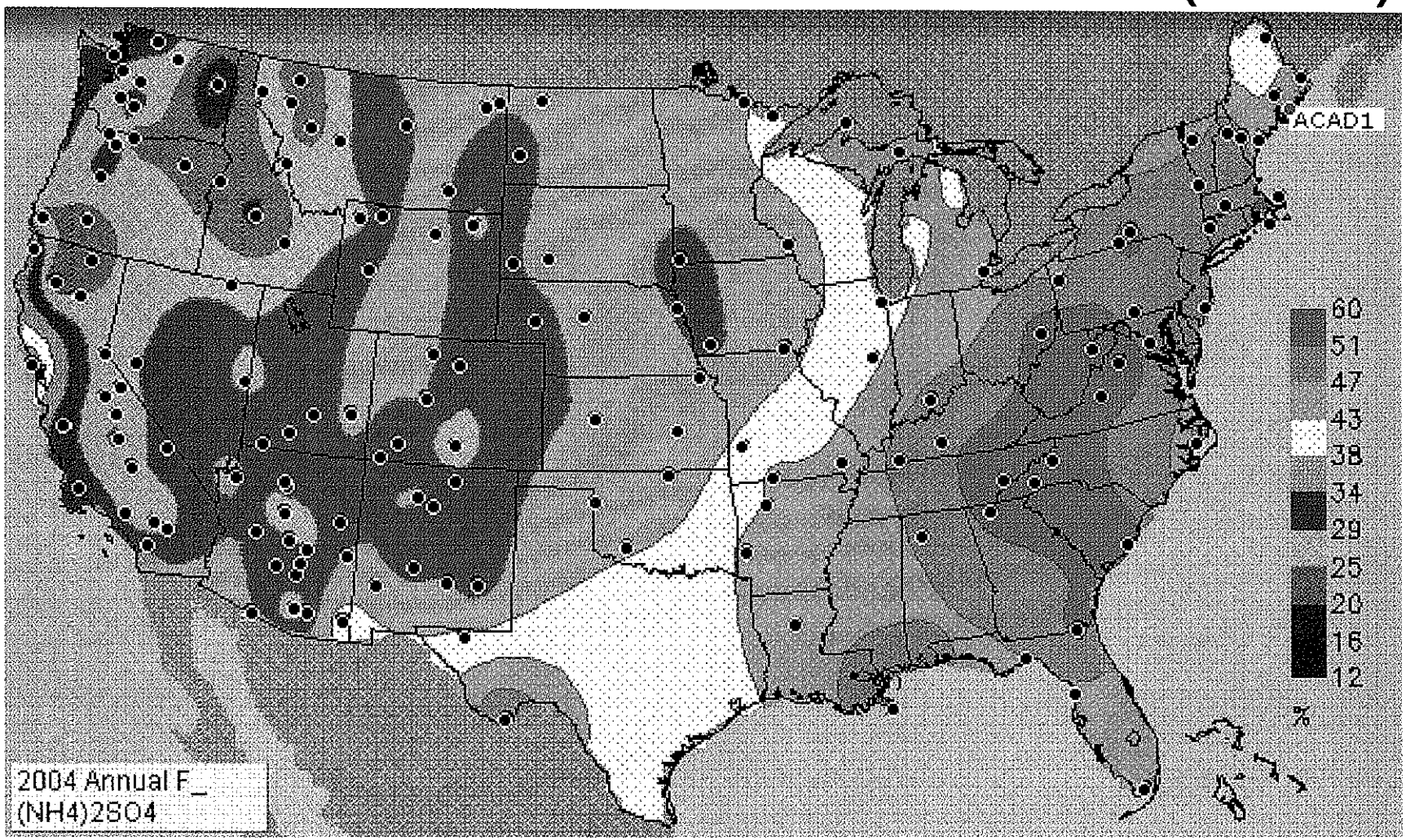
where the magnitude of each of these terms is established by chemical analysis.

Average Reconstructed Fine Mass at IMPROVE Monitoring Sites (2004)



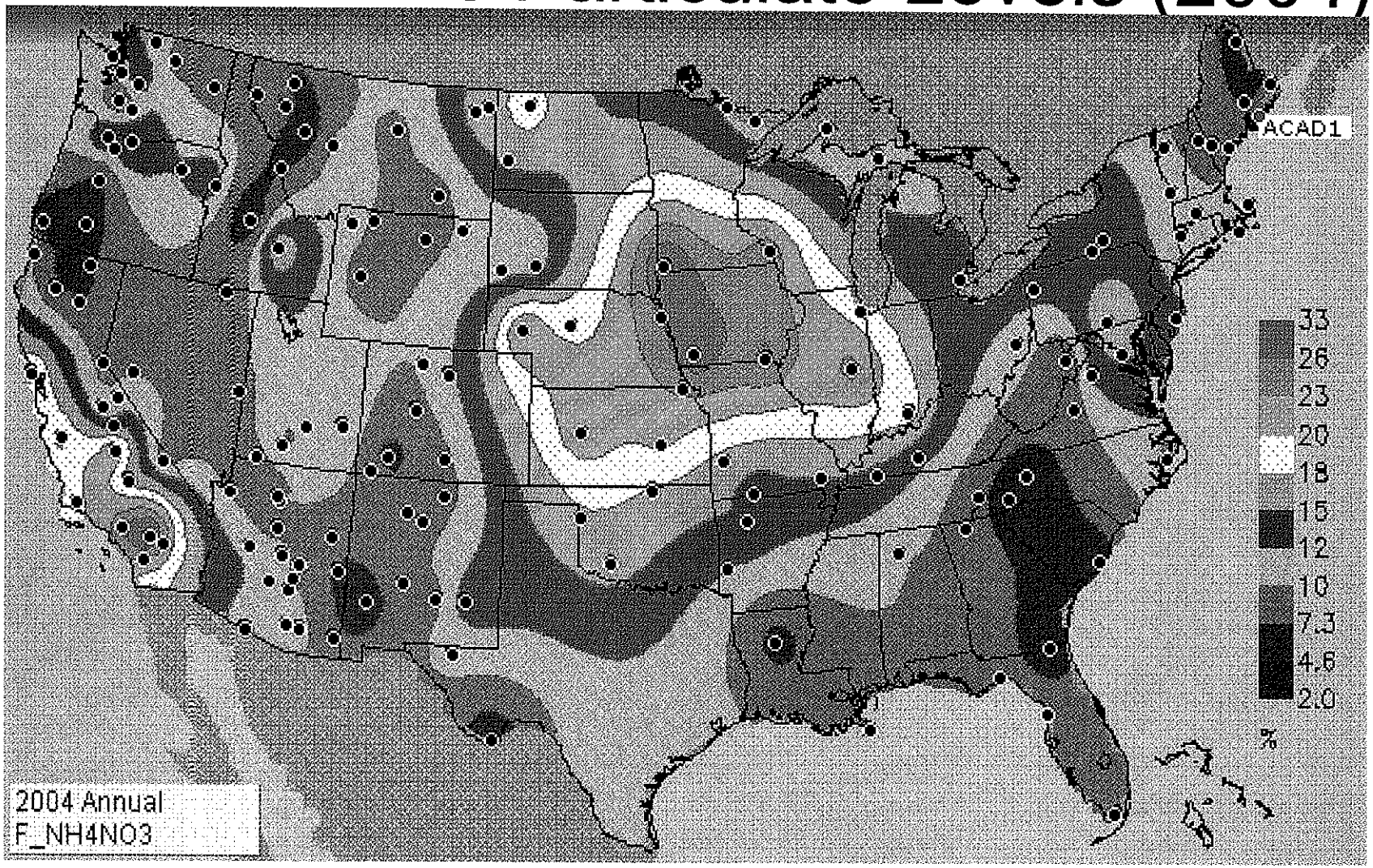
Graphic Courtesy of Views (http://vista.cira.colostate.edu/views)

Fractional Contribution of Ammonium Sulfate to Fine Particulate Levels (2004)



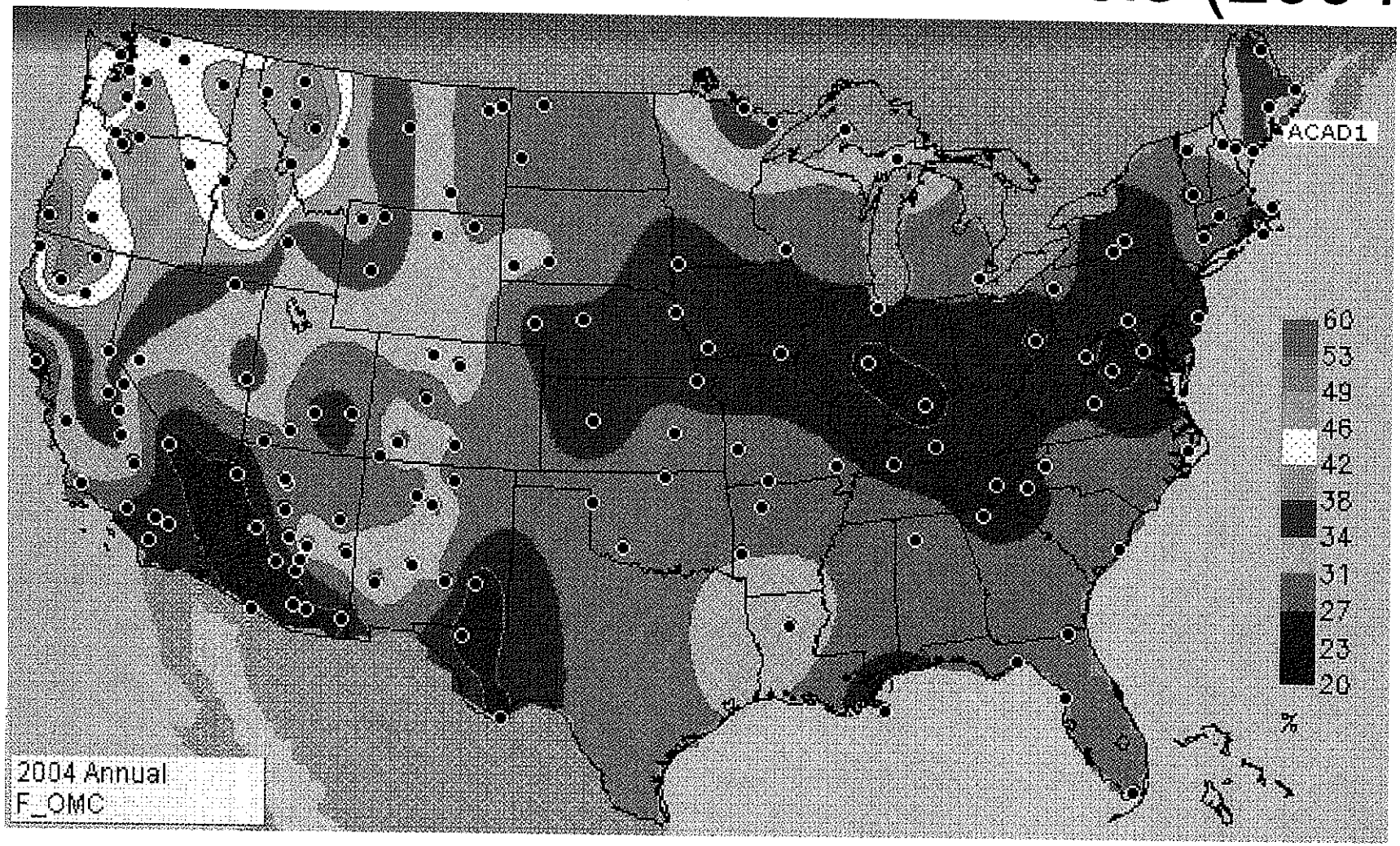
Graphic Courtesy of Views (http://vista.cira.colostate.edu/views)

Fractional Contribution of Ammonium Nitrate to Fine Particulate Levels (2004)



Graphic Courtesy of Views (http://vista.cira.colostate.edu/views)

Fractional Contribution of Organic Carbon to Fine Particulate Levels (2004)



Graphic Courtesy of Views (http://vista.cira.colostate.edu/views)

Summary:

- Monitoring sites in Iowa record levels that are close to EPA's new 24 hour $PM_{2.5}$ health standard. Muscatine and Clinton Counties exceed the standard based on the most recent (2003-2005) data.
- FRM data is used to determine attainment with standards, continuous data is used for public reporting, and speciated data provides the composition of fine particles.

Future challenges include:

- Increasing the FRM sampling frequency at locations in eastern Iowa that are close to the new standard.
- Maintaining sufficient sites in western Iowa to support public reporting and permitting activities.
- Maintaining adequate speciation monitoring in order to determine what types of sources contribute to elevated $PM_{2.5}$ levels.
- Upgrading continuous monitors in order to make the data used for real time public reporting as accurate as possible.

For Additional Information

http://www.iowadnr.com/air/prof/monitor/monitor.html

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