

Iowa Rural Air Quality

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Iowa Environmental Council Annual Conference

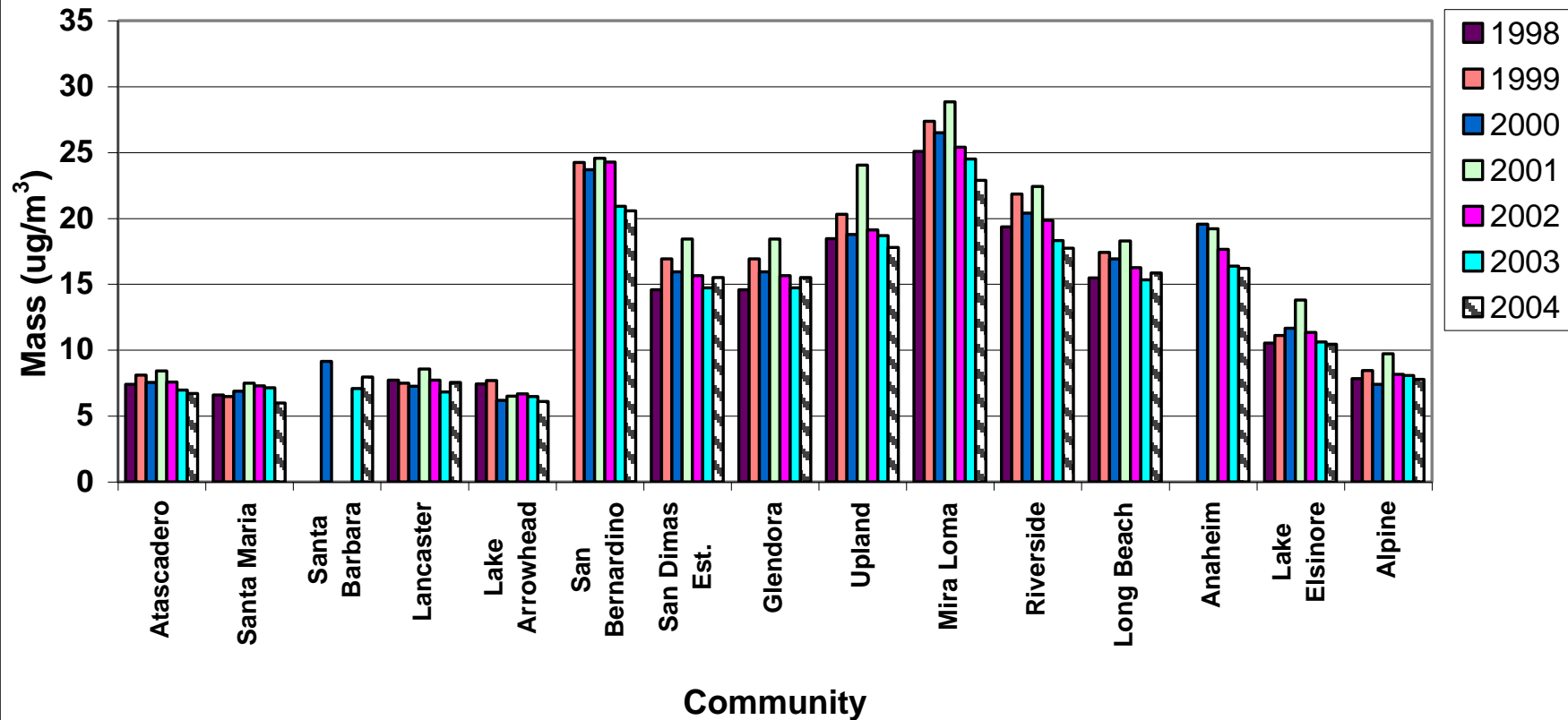
October 15, 2010

Outline

- Introduction – California Case Study
- Iowa PM_{2.5} Excursions – Stanier Report
- Rural Air Quality and Industrial Farms

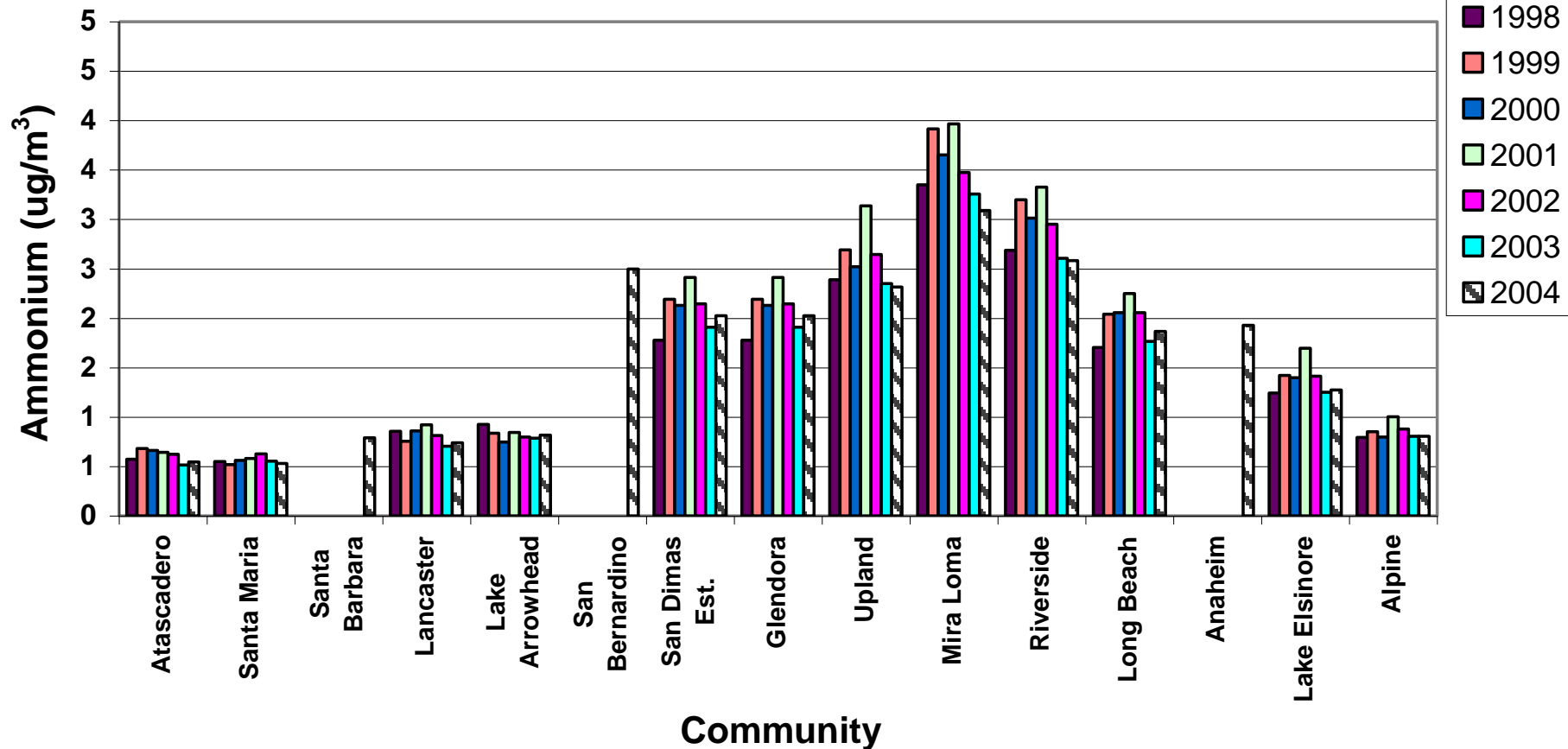
Southern California USC Children's Health Study

Annual Average PM2.5 Mass Concentrations 1998-2004
Two-Week Sampler Data



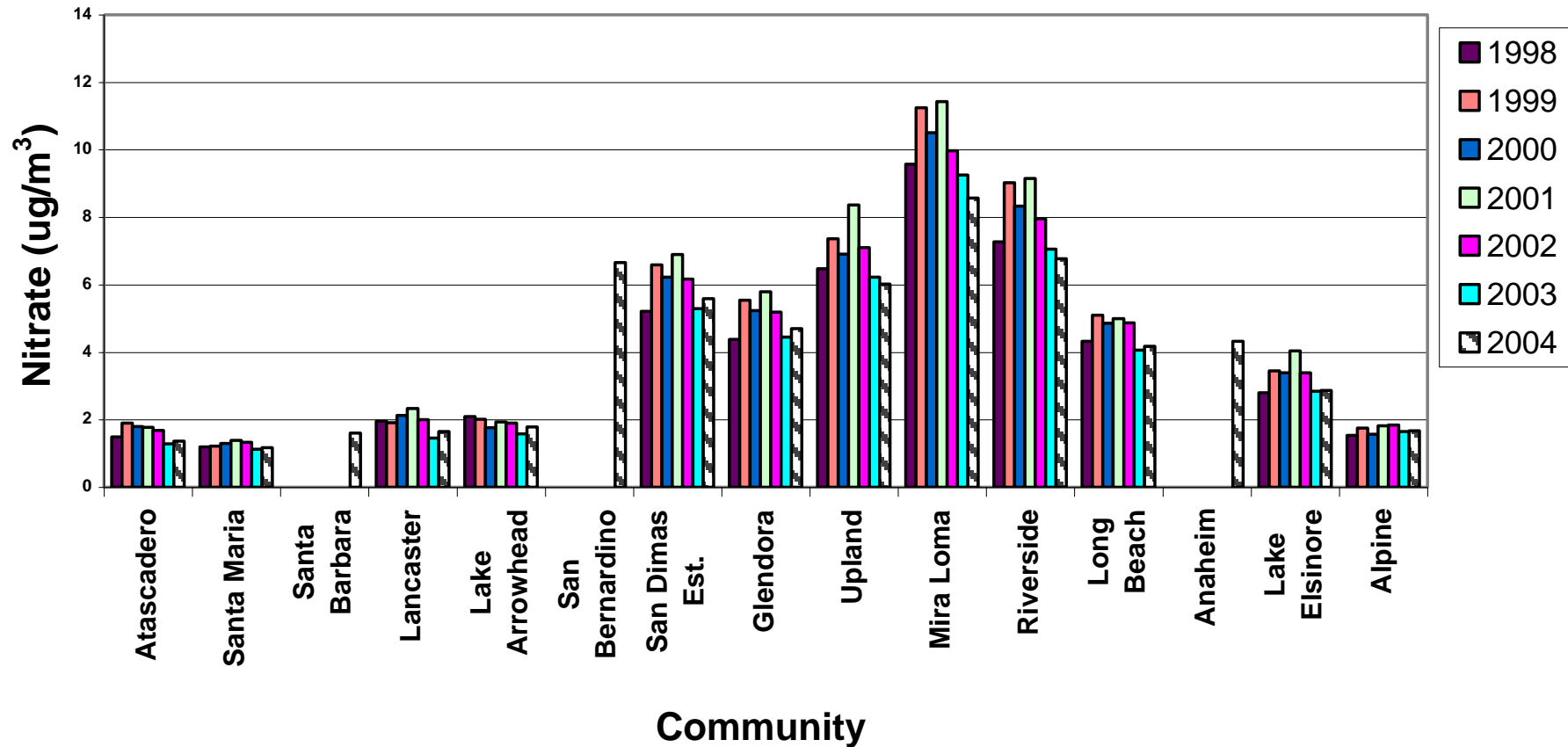
Southern California USC Children's Health Study

Annual Average PM2.5 Ammonium Concentrations 1998-2004 Two-Week Sampler Data

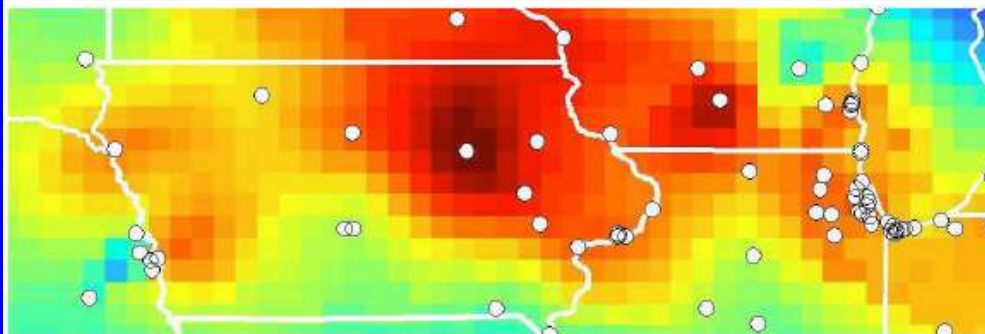


Southern California USC Children's Health Study

Annual Average PM2.5 Nitrate Concentrations 1998-2004
Two-Week Sampler Data



Understanding Episodes of High Airborne Particulate Matter in Iowa

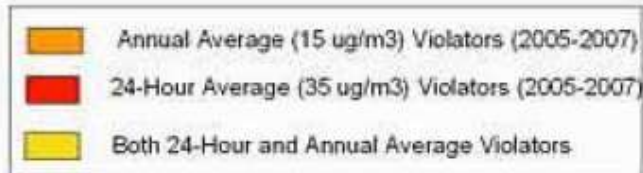
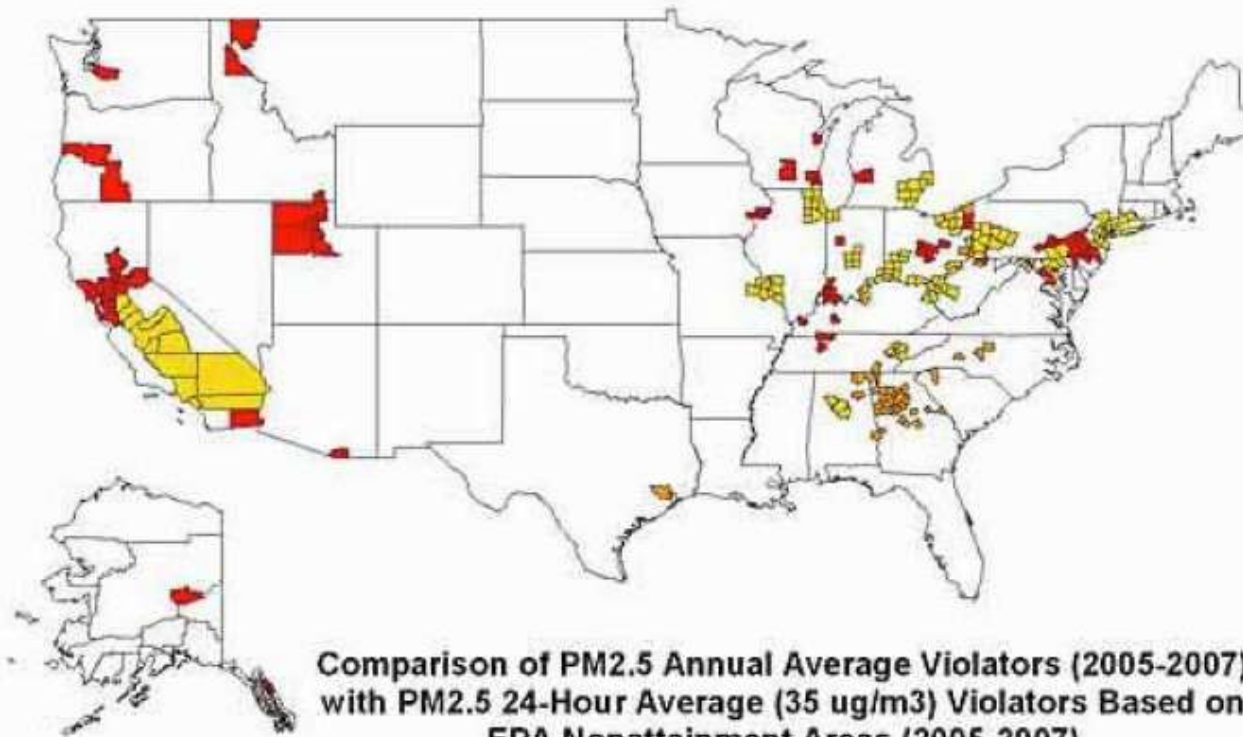


Center for Global and Regional Environmental Research at the University of Iowa
Charles Stanier, Editor

U.S. Clean Air Act Standards

- **Old Standard (1997)**
 - Annual average of $15 \mu\text{g m}^{-3}$
 - 24 hour average (98th percentile) of **$65 \mu\text{g m}^{-3}$**
- **New Standard (2006)**
 - Annual average of $15 \mu\text{g m}^{-3}$
 - 24 hour average (98th percentile) of **$35 \mu\text{g m}^{-3}$**

US PM2.5 Annual Average Violations



Source: Based upon U.S. EPA data interpreted by A.S.L. & Associates, Helena, MT

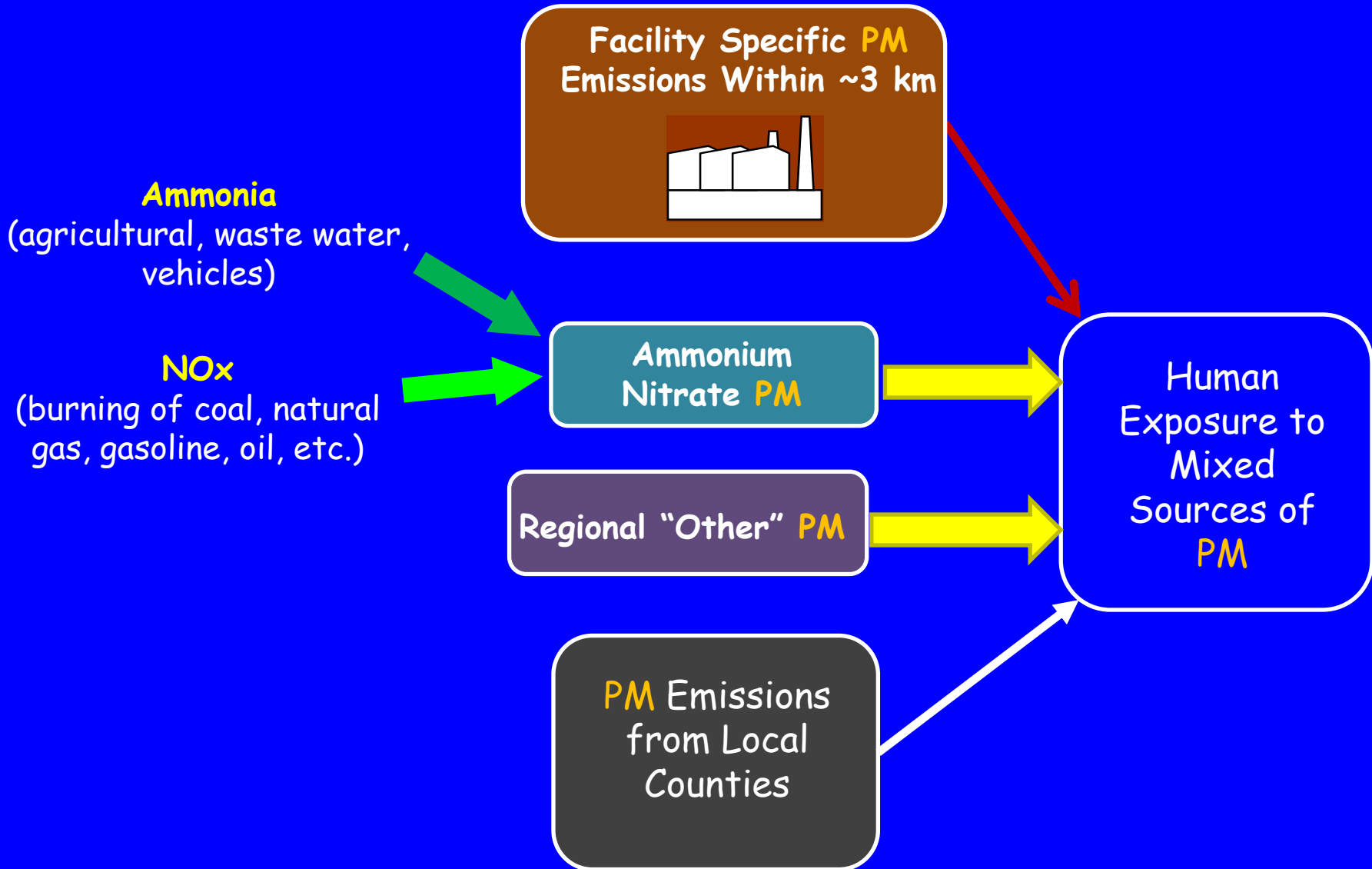
12/2008

Source: Understanding Episodes of High Airborne Particulate Matter in Iowa (2009), C. Stanier, ed.

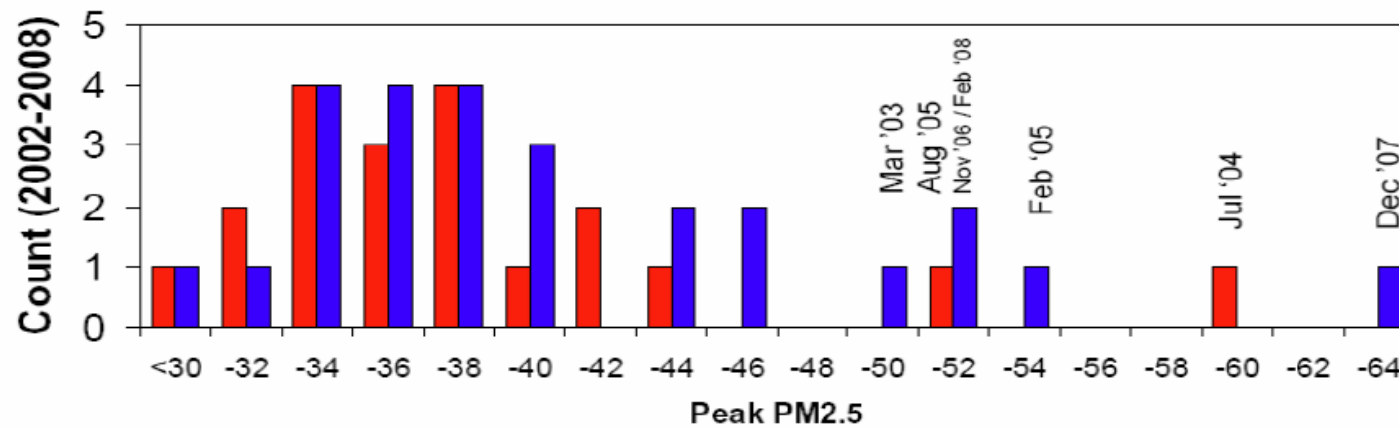
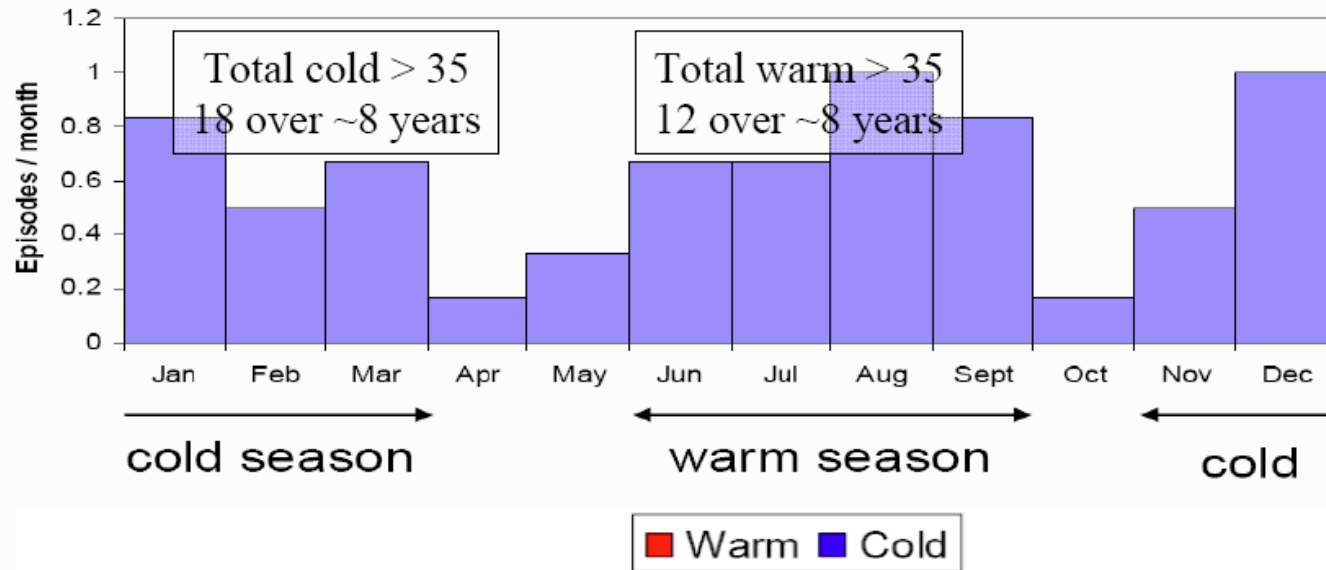


Source: Understanding Episodes of High Airborne Particulate Matter in Iowa (2009), C. Stanier, ed.

Sources of PM



PM episodes occur during both warm and cold seasons. The warm and cold weather episodes are of comparable magnitude and impact on compliance with air quality standards.



Source: Understanding Episodes of High Airborne Particulate Matter in Iowa (2009), C. Stanier, ed.

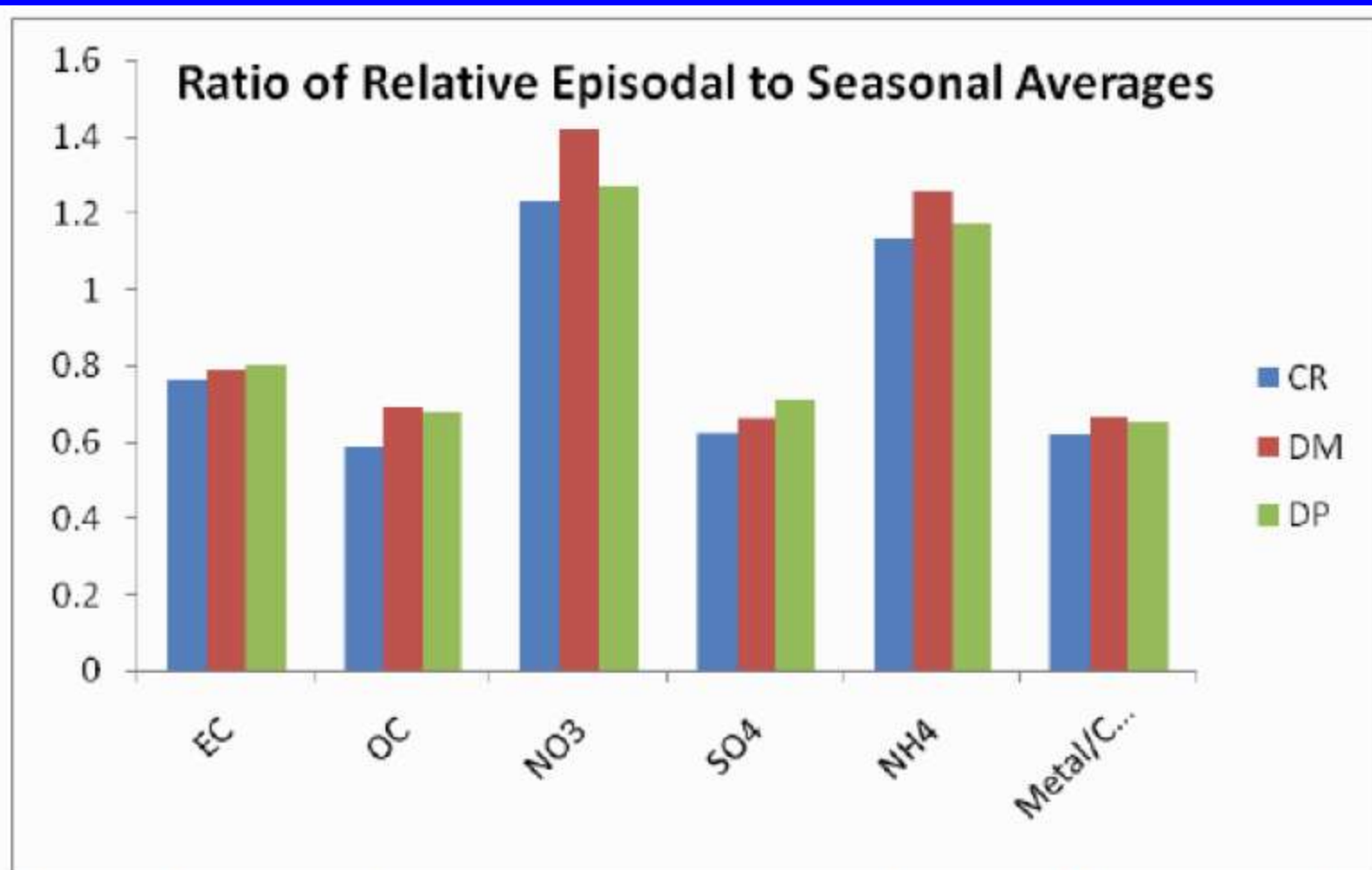


Figure 5-3. Enrichment ratios for six aerosol species during episodes. Values greater than 1 indicate an increase in the fraction of the aerosol attributable to that species during episodes. (e.g. 10% by mass on average, and 15% by mass during episodes would be a ratio of 1.5).

Conclusions

Regional episodes in excess of $35 \mu\text{g m}^{-3}$ are probably not frequent enough to, by themselves, put Eastern Iowa into noncompliance. The accuracy of this conclusion is predicated on the assumption that the period 2002-2008 is representative of future conditions.

http://www.engineering.uiowa.edu/~cs_proj/iowa_pm_project/iowa_pm.htm

Rural Air Quality & Industrial Farm Animal Production

- Aerial spraying of manure slurry produces further transport and higher airborne exposures



Duplin Co. NC. Air spraying of swine waste to lower lagoon level.

Source: Statement of Richard J. Dove before the Senate Cmte on Env & Public Works, Sept. 6, 2007

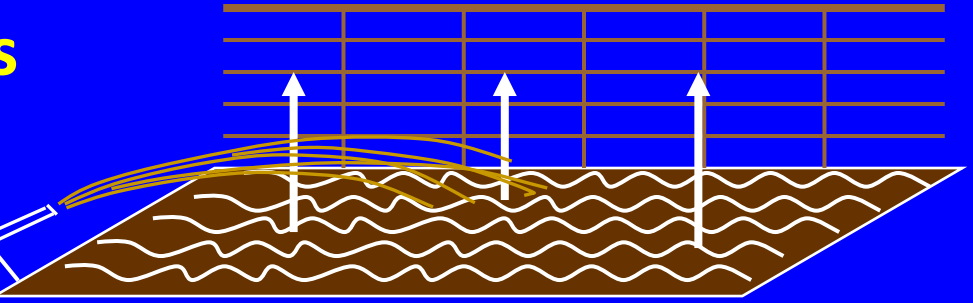
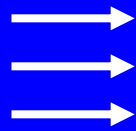
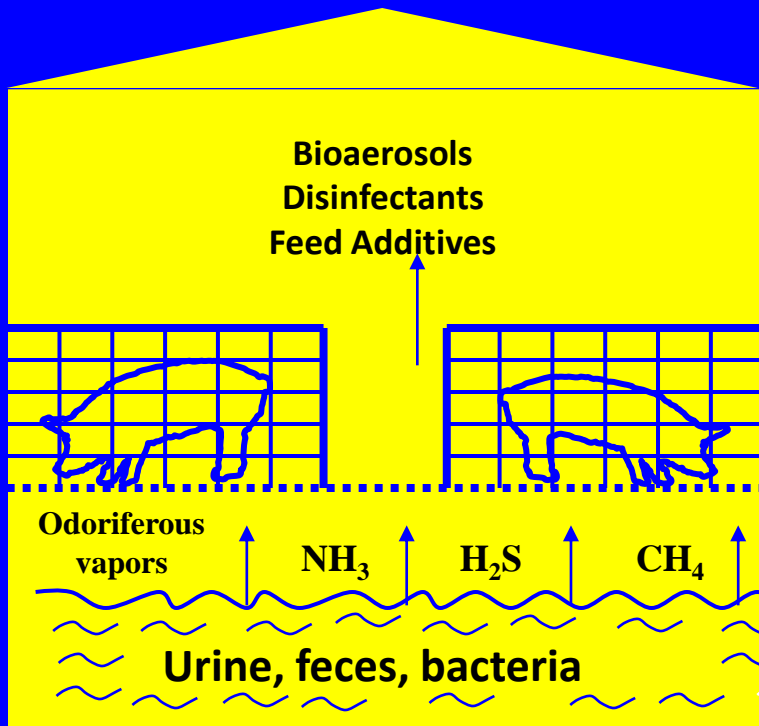


“Center pivot irrigation is a widely used method of (manure) application at many of our farms.”

Source: www.psfarms.com

Concentrated Animal Feeding Operation (CAFO) Source of Air Emissions

Confinement Barn



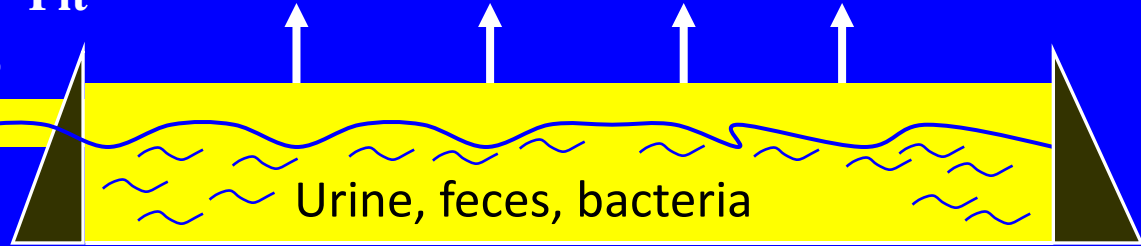
Manure Application

Gases & Vapors
Odors, Bioaerosols

Manure Pit



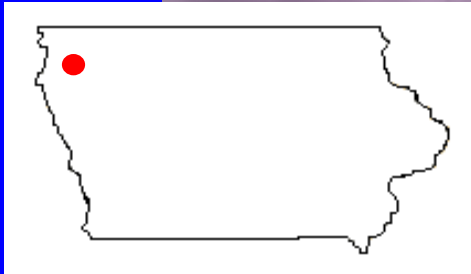
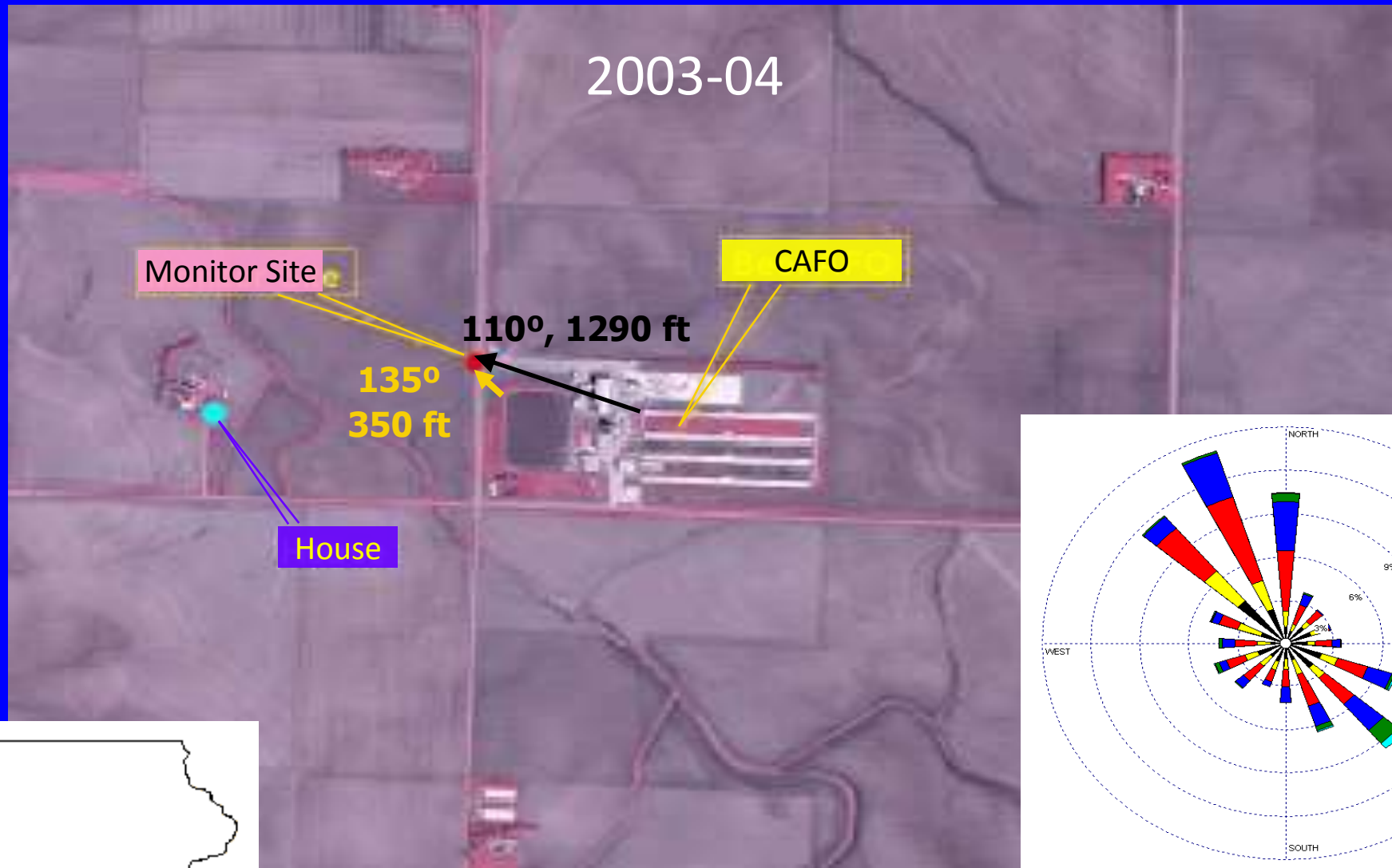
Lagoon



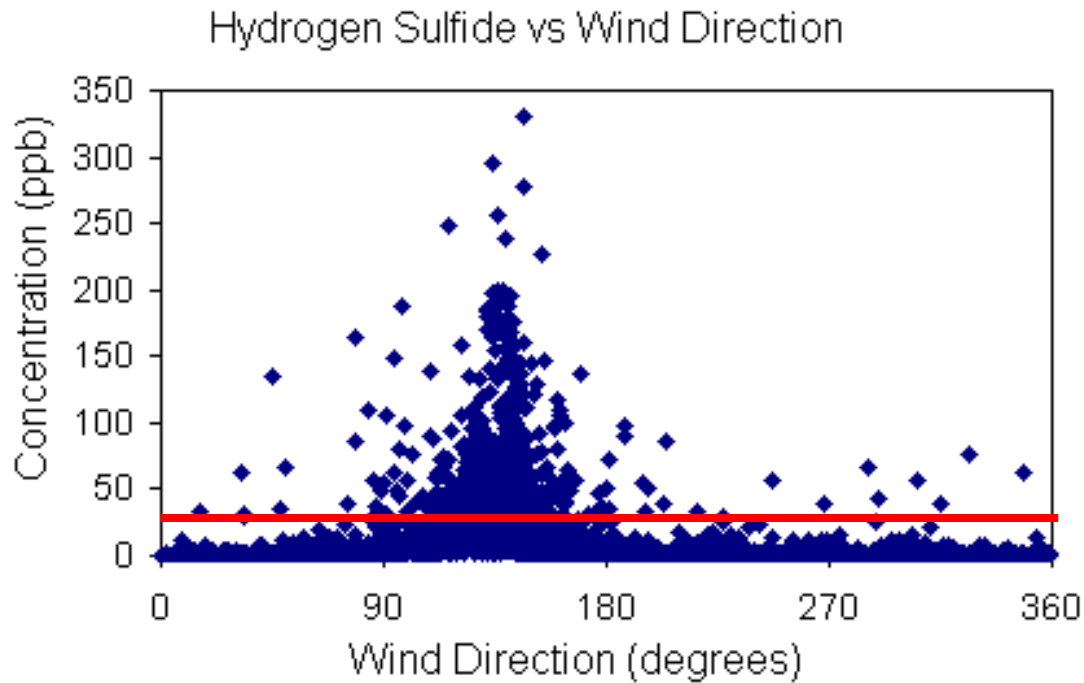
IDNR Monitoring Results

- IDNR placed hydrogen sulfide and ammonia monitors around large CAFOs in Iowa
- Early efforts involved monitors close to (<1500 ft) from CAFOs
- Later sampling placed monitors beyond expected setback distances

Industrial Livestock Facility – NW Iowa



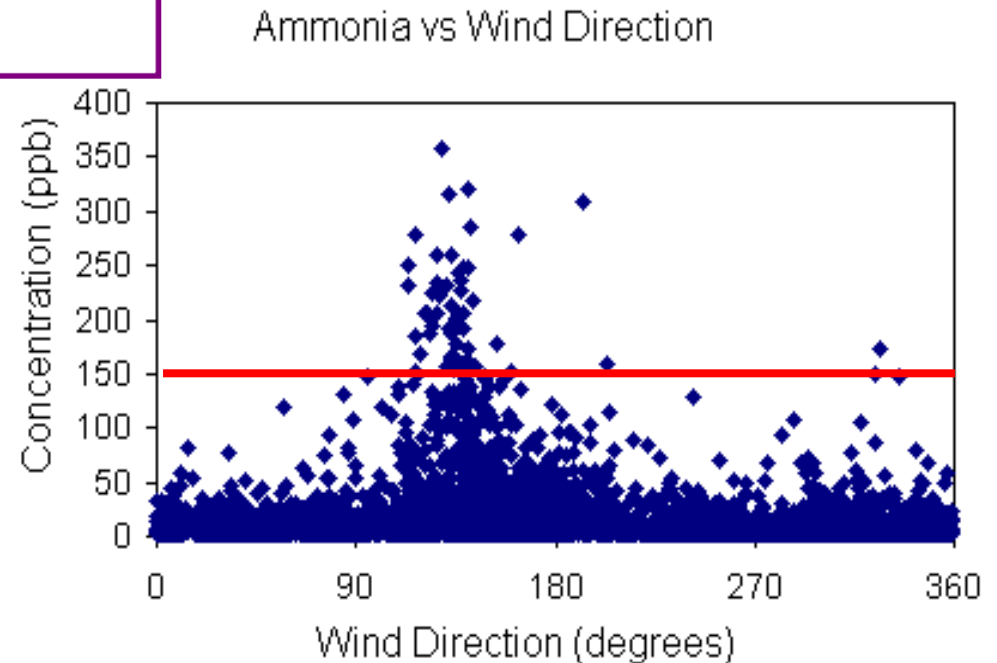
Prevailing winds are from the NNW and SE



H_2S and NH_3
1,290 ft from a CAFO

10 months monitoring data

— Health Guidelines:
30 ppb H_2S
150 ppb NH_3



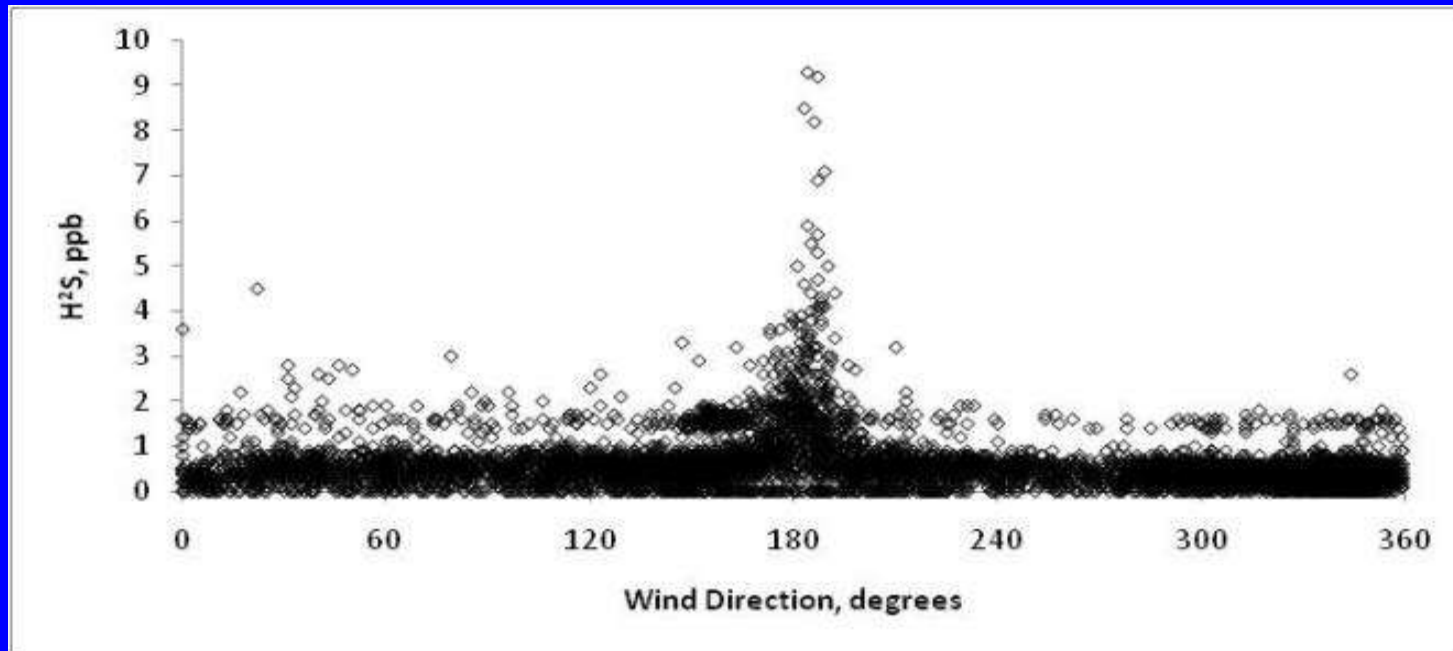
Wright County, Iowa Site Description



Source: O'Shaughnessy, Great Plains Center for Agricultural Health and Safety

H₂S by Wind Direction

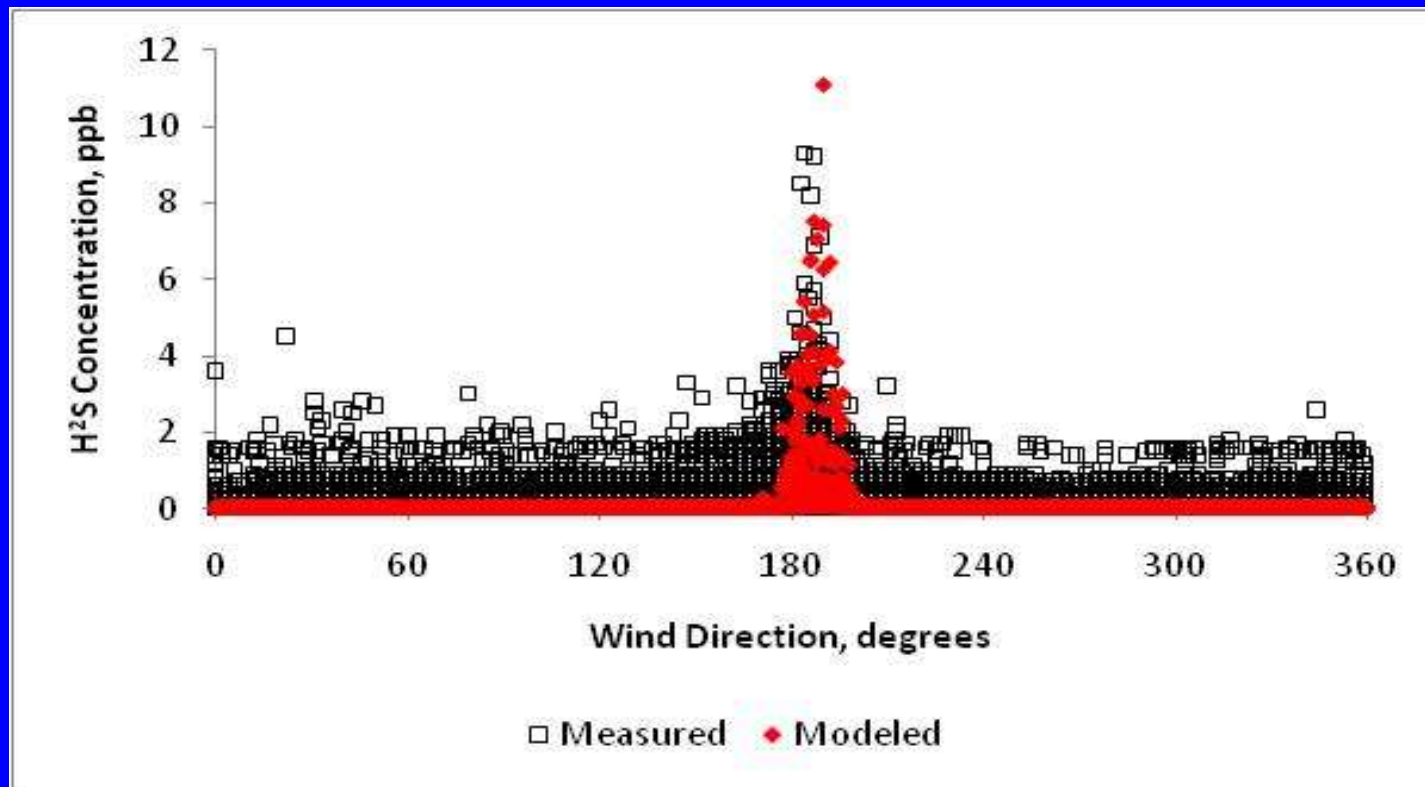
Peak resulting from CAFO directly south of monitoring station



Source: O'Shaughnessy, Great Plains Center for Agricultural Health and Safety

Air Dispersion Model Output

Dispersion model applied to CAFO emissions of H₂S closely matches actual measurements

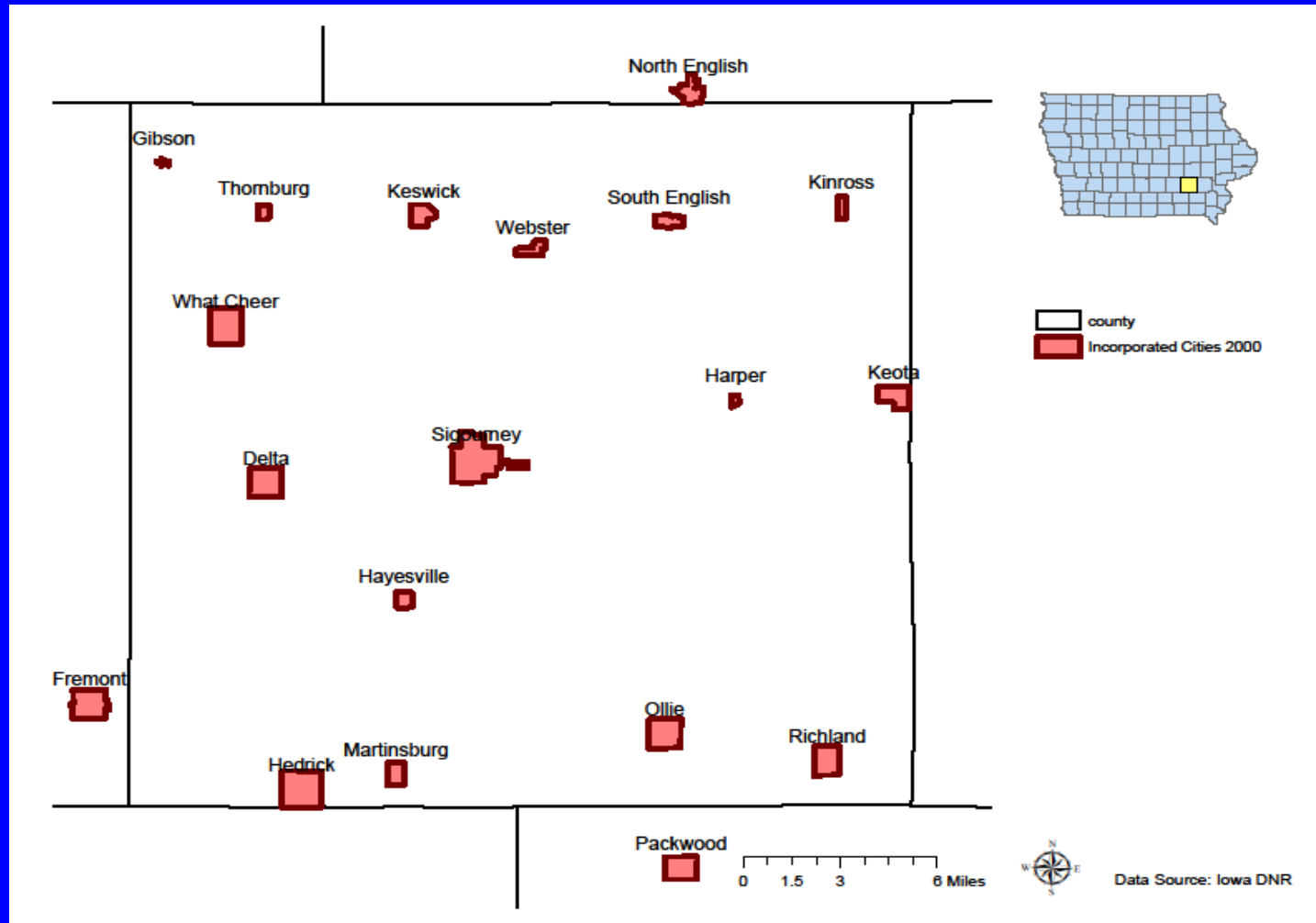


Source: O'Shaughnessy, Great Plains Center for Agricultural Health and Safety

Modeling County-wide Concentrations

- Model was calibrated relative to IDNR CAFO sites
- All CAFOs in Iowa were identified by IDNR permitting system and tax credit application records
- Model applied to all CAFOs to estimate H₂S concentrations on a county-wide scale

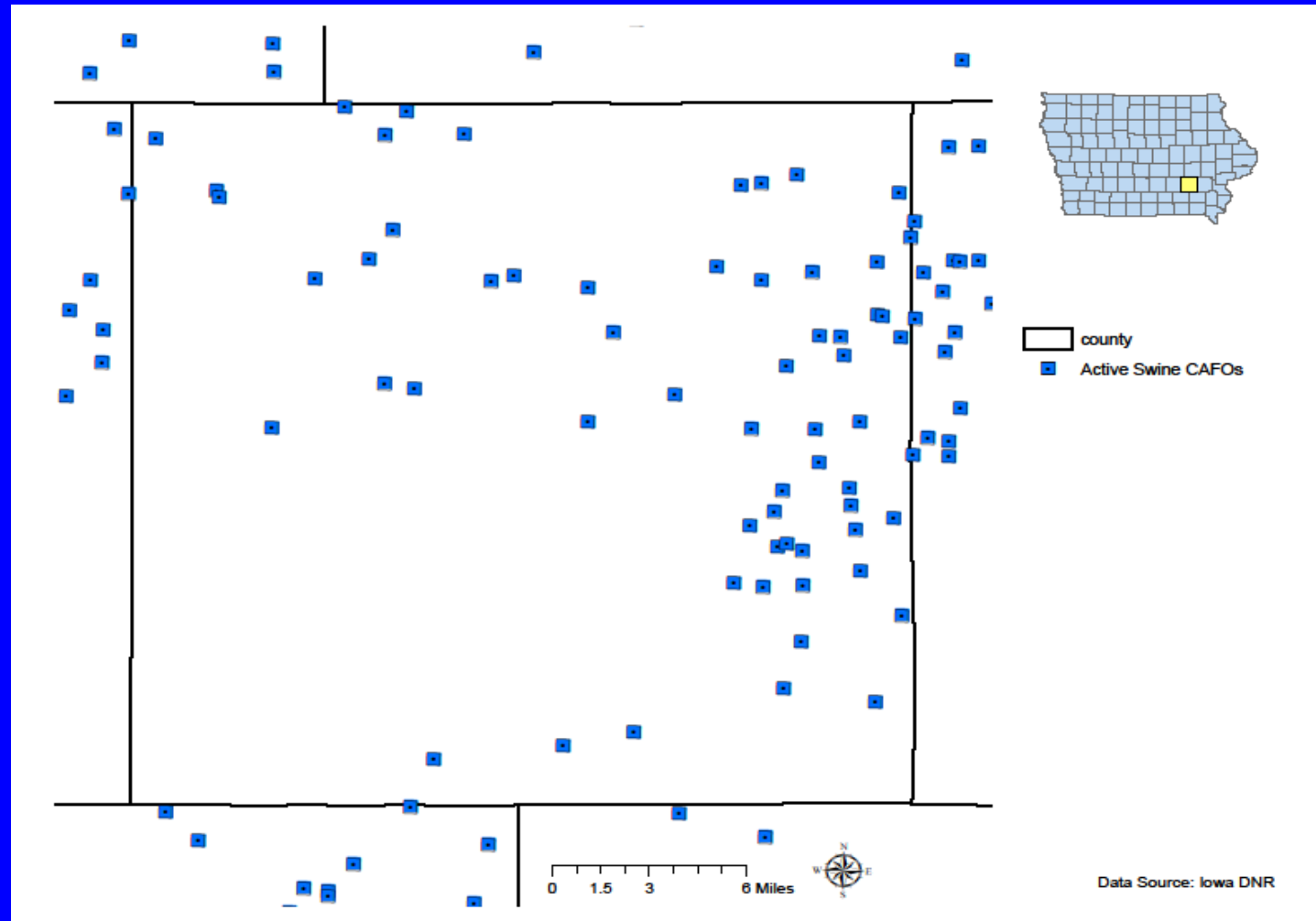
Keokuk County, Iowa Towns



Source: Iowa DNR

Keokuk County, Iowa IDNR CAFOs

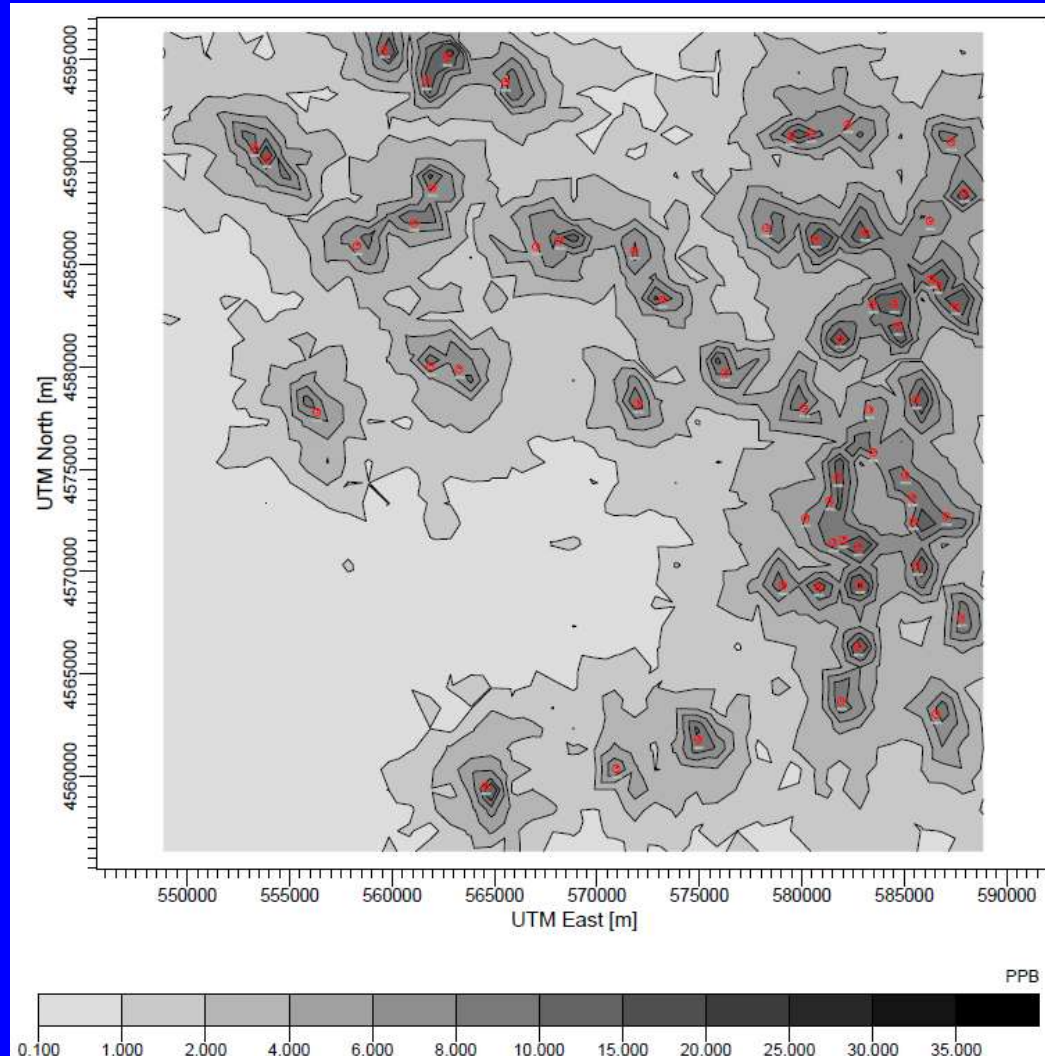
69 CAFOs
registered in
the County



Source: Iowa DNR

Dispersion Model of H₂S to IDNR CAFOS

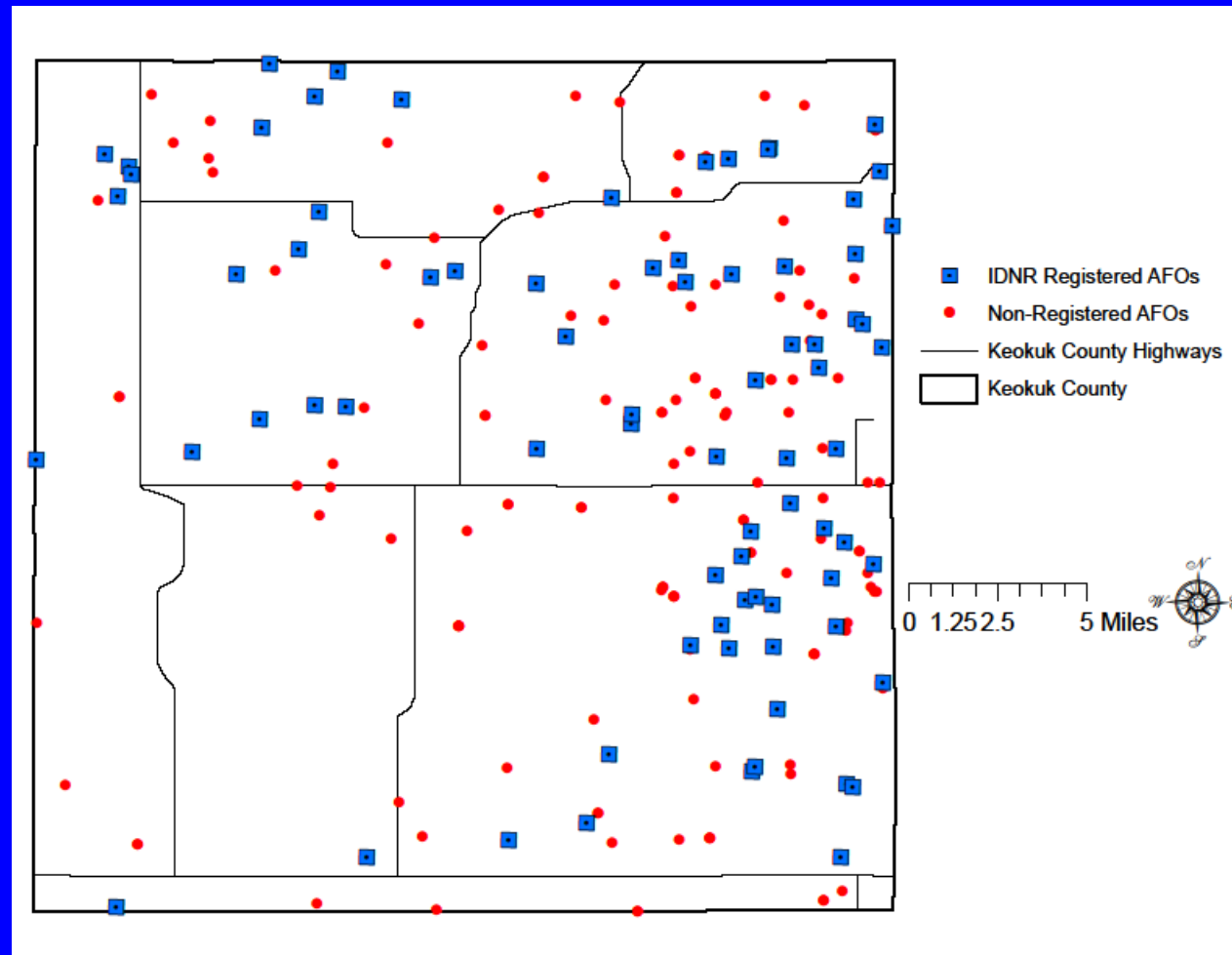
Maximum
Concentrations over
a 1-year period



County Border

Source: Great Plains Center for Agricultural Health and Safety

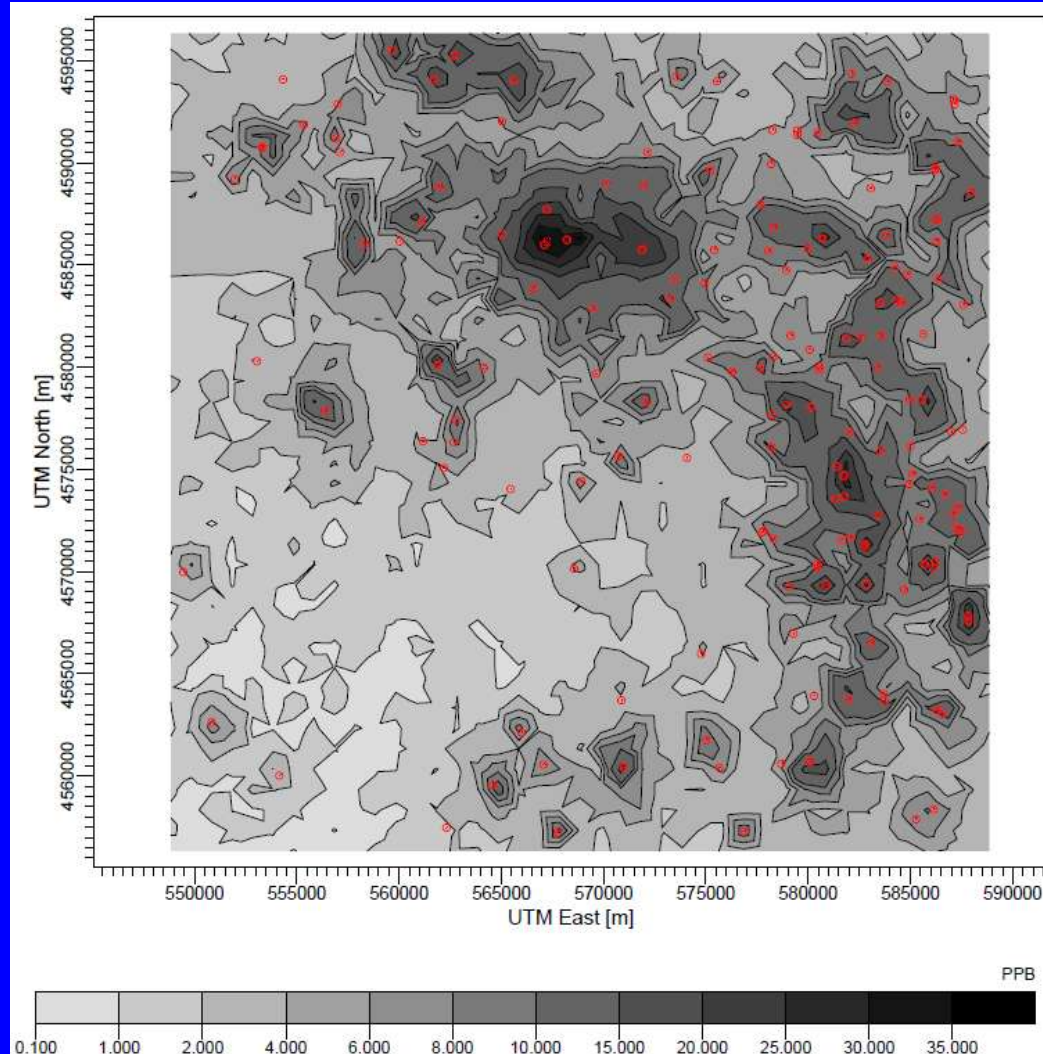
Keokuk County Registered and non-Registered CAFOs



166 total CAFOs
identified

Dispersion Model of H₂S to All CAFOS

Maximum
Concentrations over
a 1-year period



Source: Great Plains Center for Agricultural Health and Safety

Health Effects of Low-Level Exposures

- **Hydrogen sulfide, H₂S**
 - **Eye & throat irritation, headache, nausea, lung irritation, cough, sleeplessness**
 - **Elevated rates of respiratory infection, asthma, chronic bronchitis**
 - **Neuropsychologic disturbances, mood disorders, visual impairment**
 - **Lethal at higher concentrations**
 - **ATSDR intermediate minimal risk level = 30 ppb**
 - **UI-ISU AQS: 15 ppb at residence; 70 ppb at CAFO property line (1 hr average) and no more than 7 exceedances per calendar year with 48 hr notice**

Keokuk County Rural Health Study – Round 1

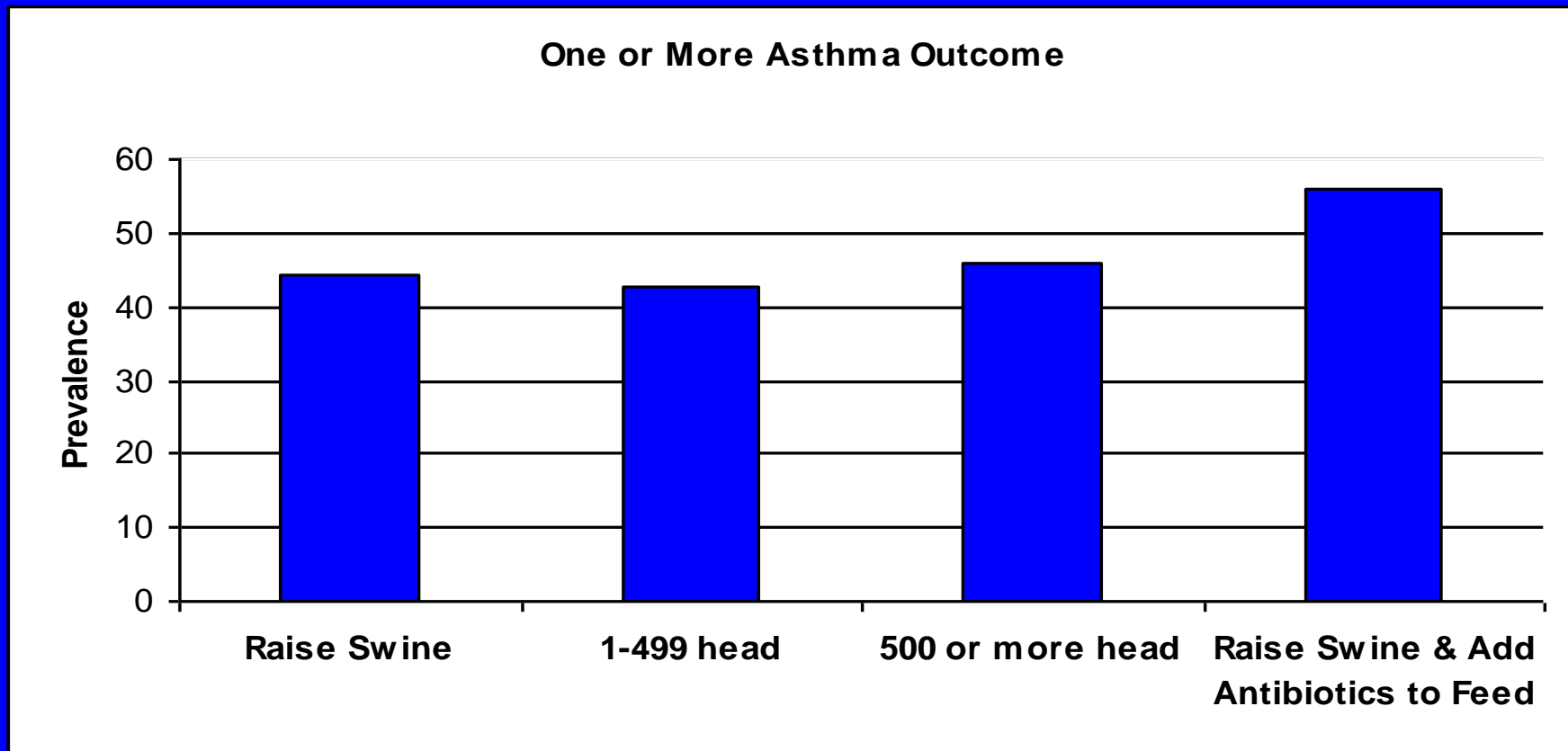
Childhood Asthma Outcomes

- ◆ Doctor diagnosed asthma $72/610 = 12\%$
- ◆ Asthma/medication for wheeze in last 12 months $101/610 = 17\%$
- ◆ Current wheeze $120/490 = 24\%$
- ◆ Cough with exercise $117/493 = 24\%$

Source: *Environmental Health Perspectives*, 2005;113(3)

Keokuk County Rural Health Study – Round 1

Asthma Outcome Prevalence and Swine Exposure



Source: *Environmental Health Perspectives*, 2005; 113(3)

Epidemiological Studies

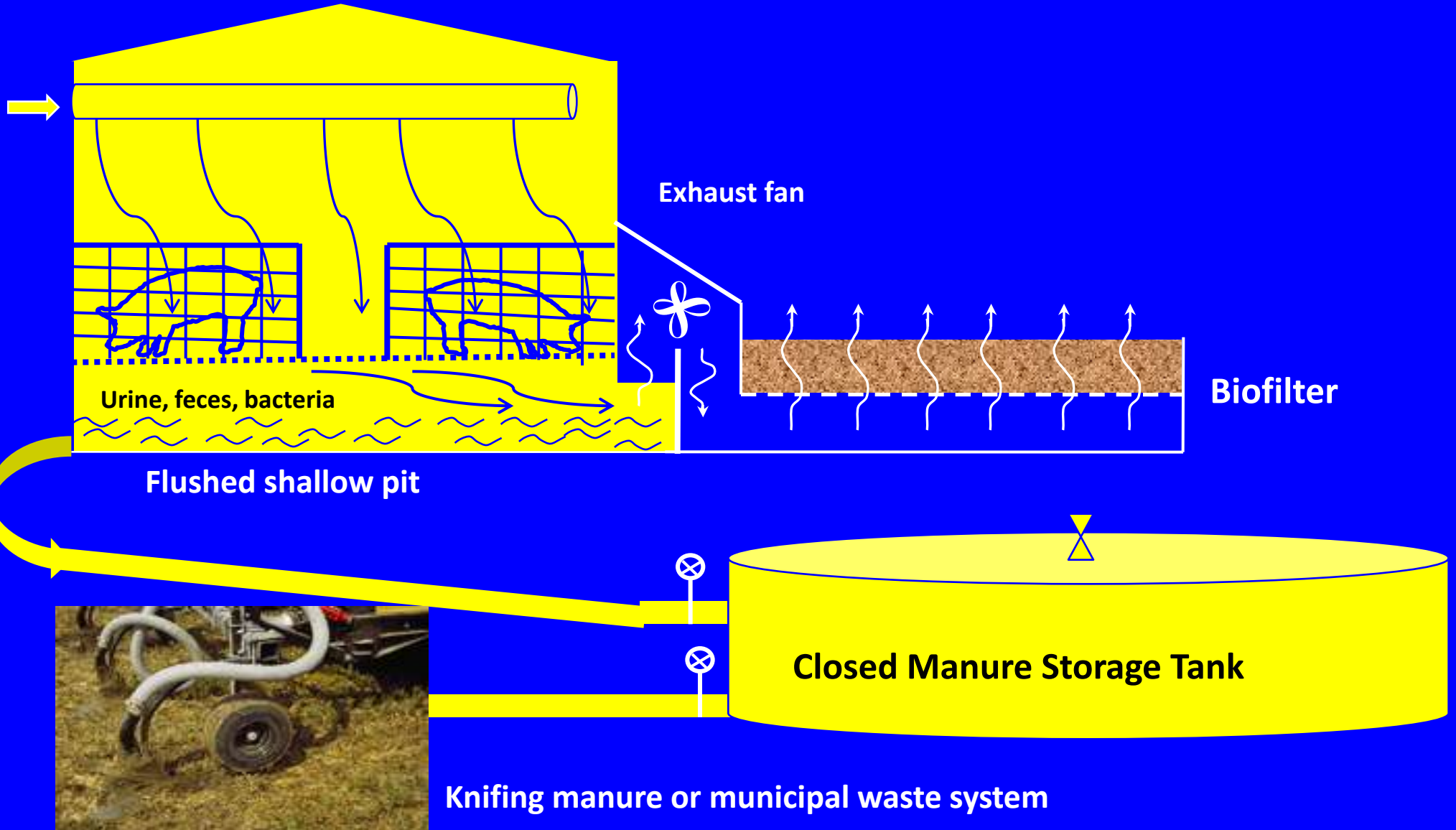
Association between CAFOs and Asthma

Merchant et al 2005	Keokuk County Rural Health Study (Iowa), 1000 rural households with high rates of childhood asthma, 44.1% among children living and often working on farms raising swine
Sigurdarson & Klein 2006	Iowa children in school proximate to CAFO, OR of 5.71 for doctor diagnosed asthma
Mirabelli et al 2006 a, b	NC children living within 3 miles of CAFO had significantly more doctor-diagnosed asthma, used more asthma meds and had more asthma-related ER visits and/or hospitalizations than children > 3miles
Radon et al 2007	Adults in 4 rural German towns in proximity to CAFOs reported asthma with increasing odor annoyance; the concentration of CAFOs within 500 meters was found to be a predictor of wheeze and decreased FEV1

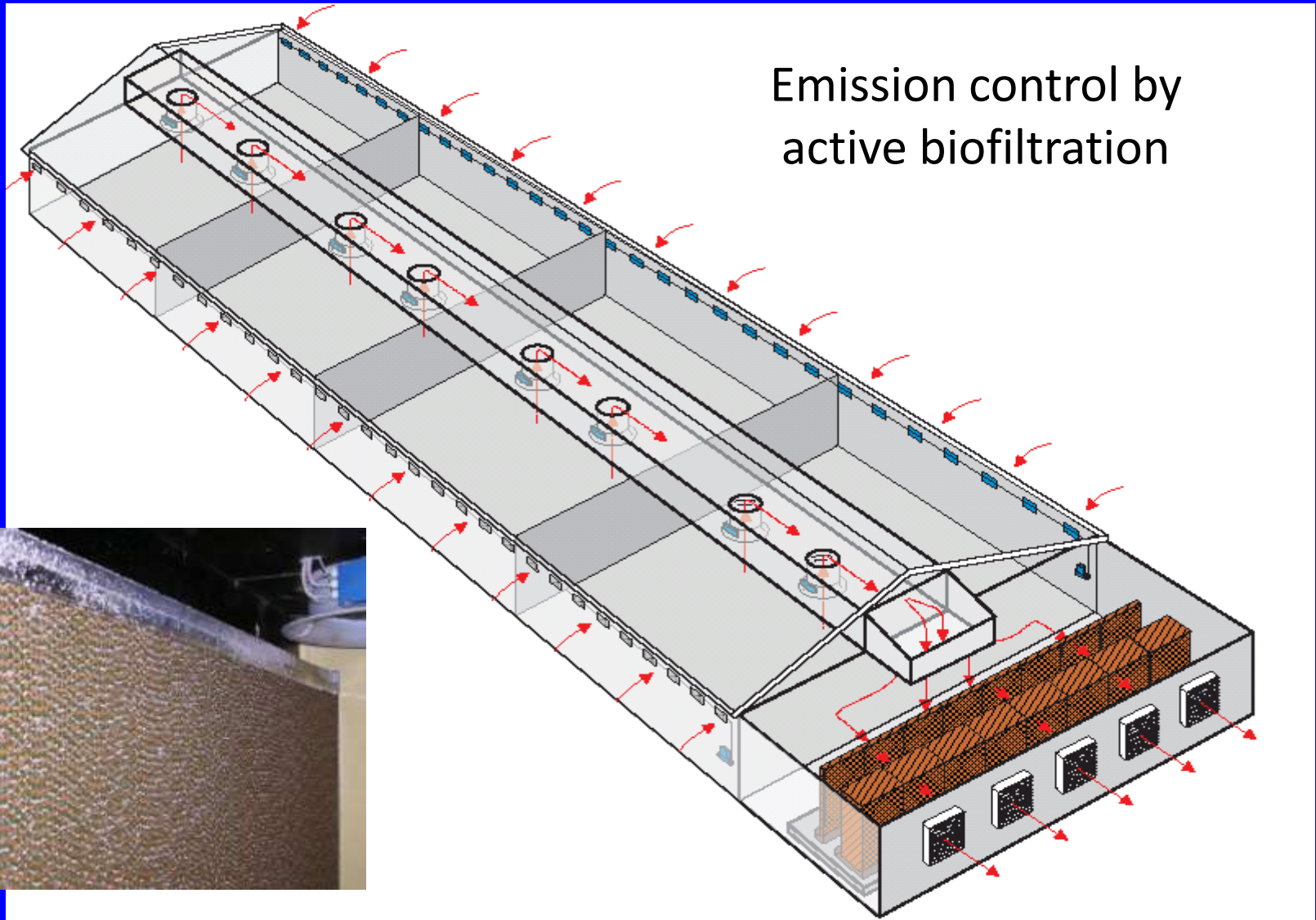
Control Approaches to Limit Exposures to Air Emissions

- **Local control of zoning decisions (overturned in Iowa)**
- **County health department rulings (overturned by Iowa Supreme Court)**
- **Master Matrix to guide evaluation for permitting (Iowa)**
- **Set backs - typically 500 to 3000 ft**
- **Biofilters**
- **Enclosed manure storage**
- **Subsurface soil injection of manure slurry**
- **Industrial or municipal waste treatment systems**
- **Law suits, civil judgments, consent agreements**

CAFO Emission Controls



Control of Airborne Exposures



Features of Emission Controls

- **Biofiltration**

 - Highly effective in Denmark and The Netherlands

 - Low capital investment

 - ~\$3.00 per 1000 cfm per year to power fans

 - Power with wind turbines

- **Municipal wastewater treatment systems**

- **Innovative waste treatment models (e.g., Aitken, UNC; Duke Power, North Carolina)**

- **Knifing manure into the soil**

 - Reduces nutrient loss and surface water pollution.

 - Works with conservation tillage systems - less disruption of crop residues.

Putting Meat on the Table: Industrial Farm Animal Production in America

**A Report of the Pew Commission
on Industrial Farm Animal Production**

www.pcifap.org

Recommendations

Environmental Impact Recommendations

- 1. Improve enforcement of existing federal, state, and local IFAP facility regulations to improve the siting of IFAP facilities and protect the health of those who live near and downstream from them.**
- 2. Develop and implement a new system to deal with farm waste (that will replace the inflexible and broken system that exists today) to protect Americans from the adverse environmental and human health hazards of improperly handled IFAP waste.**
- 3. Increase and improve monitoring and research of farm waste to hasten the development of new and innovative systems to deal with IFAP waste and to better our understanding of what is happening with IFAP today.**
- 4. Increase funding for research into improving waste handling systems and standardize measurements to allow better comparisons between systems.**

Community Impact Conclusion

There is clear epidemiological evidence that IFAP facilities are associated with increased asthma outcome risk among those living nearby, but there is a need to develop and understand exposure and health outcome relationships.

Community Impact Recommendations

- 1. Increased research on the public health effects of industrial farm animal production in people living and working on or near these operations, and incorporate the findings into a new system for siting and regulating IFAP.**
- 2. States, counties and local governments should implement zoning and siting guidance governing new IFAP operations that fairly and effectively evaluate the suitability of a site for these types of facilities.**
- 3. Implement policies to allow for a competitive marketplace in animal agriculture to reduce the environment and public health impacts of IFAP.**