

# Development of a Local-Scale Emissions Inventory for the Cleveland Multiple Air Pollutant Study

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Presented at the 19<sup>th</sup> International Emissions Inventory Conference  
San Antonio, TX  
September 28, 2010

# Presentation Outline

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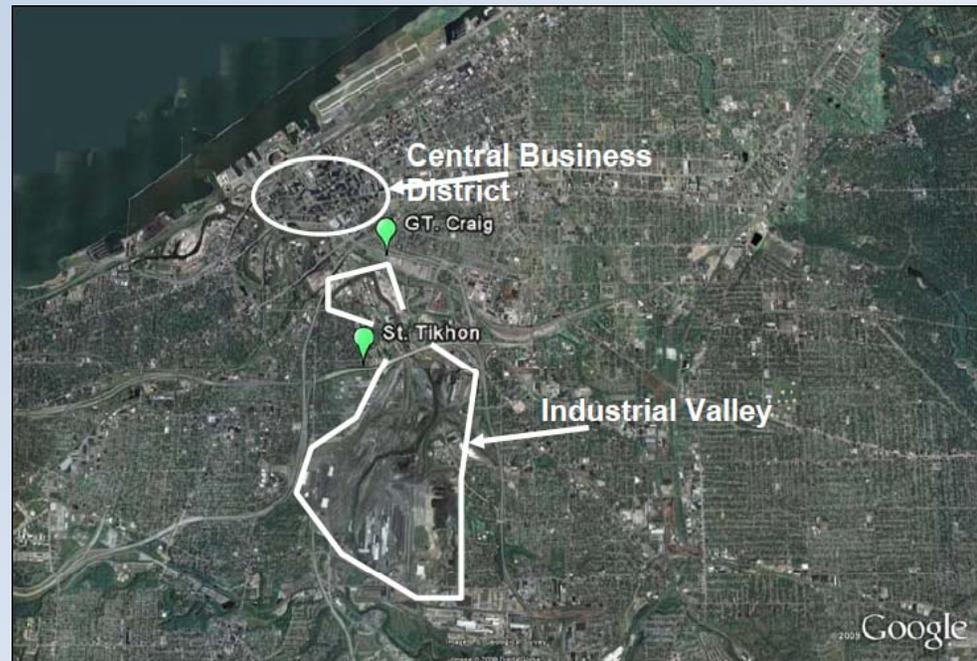
- Project background
- Emissions inventory development
  - Overview
  - Development steps
  - Emissions modeling
- Summary of results
- Questions and discussion

# CMAPS Background (1 of 4)

The Cleveland Multiple Air Pollutant Study (CMAPS) is a year-long measurement and modeling study designed to investigate sources of air pollution in the Cleveland metropolitan area.

## Partners include

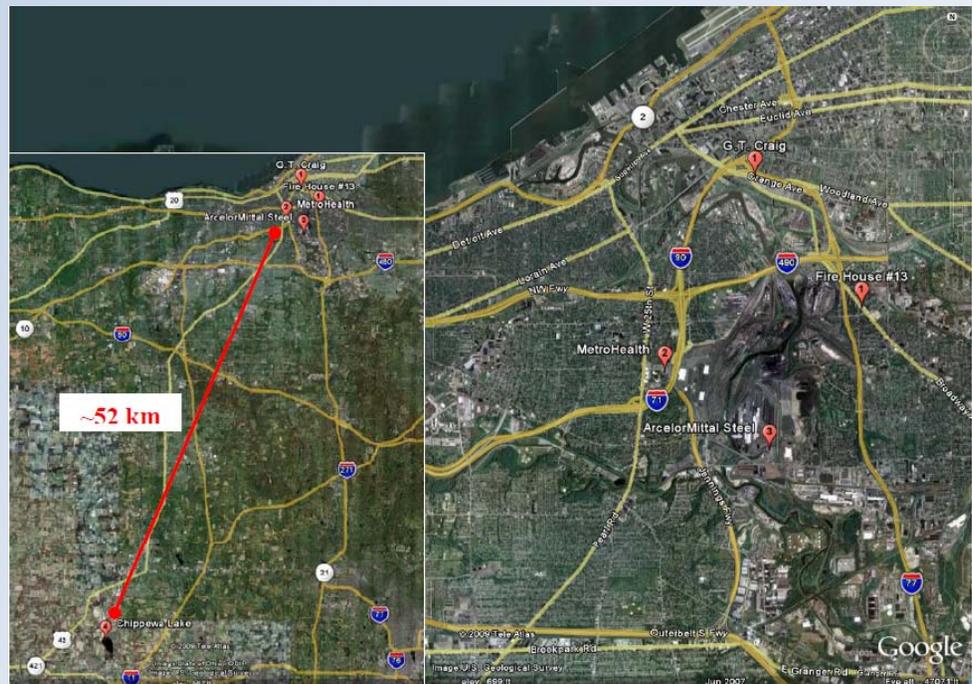
- EPA Office of Research and Development (ORD)
- Cleveland Division of Air Quality (CDAQ)
- Akron Region Air Quality Management District
- Ohio EPA
- Contractors (Alion and Sonoma Technology)



# CMAPS Background (2 of 4)

## Technical Approach

- Year-long (9/2009–9/2010) PM and Hg measurements at 1 background and 3 urban sites
- Two intensive monitoring periods (9/2009 & 2/2010) to measure additional pollutants (CO, SO<sub>2</sub>, BC, NH<sub>3</sub>, etc.)
- Intensive periods include the placement of passive monitoring devices at 20 fire stations
- Meteorological measurements collected at a site in Industrial Valley



# CMAPS Background (3 of 4)

## Technical Approach

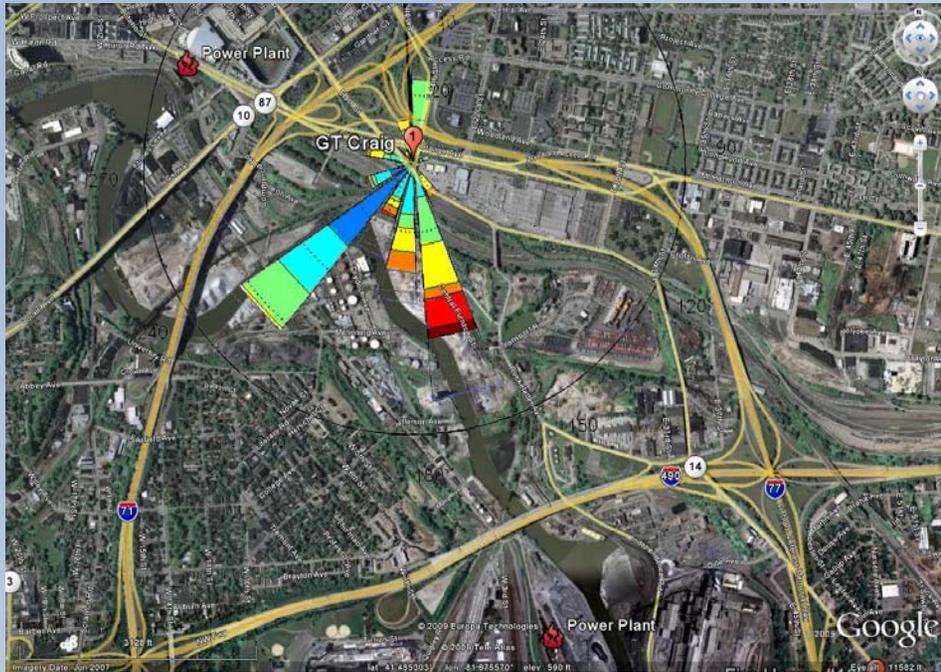
- Receptor modeling with Chemical Mass Balance (CMB), Positive Matrix Factorization (PMF), and Unmix
- Photochemical grid modeling with WRF and CMAQ

## CMAQ Emissions Inputs

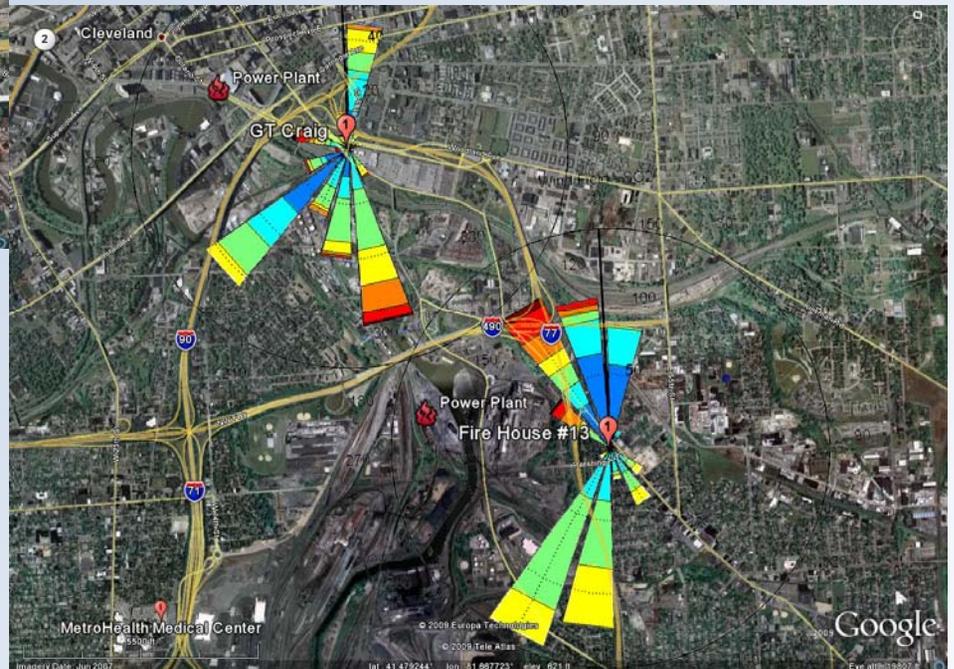
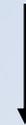
- Update the 2005 NEI to make the inventory more representative of the CMAPS study period, capturing effects of recent economic downturn
- Focus on key sources in Cleveland and the region (e.g., industrial sources, power plants, on-road mobile sources)



# CMAPS Background (4 of 4)



SO<sub>2</sub> pollution roses show impact of power plants and industrial sources



NO<sub>2</sub> pollution rose shows impact of roadways and industrial sources

# Emissions Inventory Development (1 of 6)

## Point sources

- 21 key Cleveland facilities
  - Identified by CDAQ and EPA
  - Invited to March meeting at CDAQ
  - Follow-up survey by phone and email
  - Data collected from 17 of 21 facilities



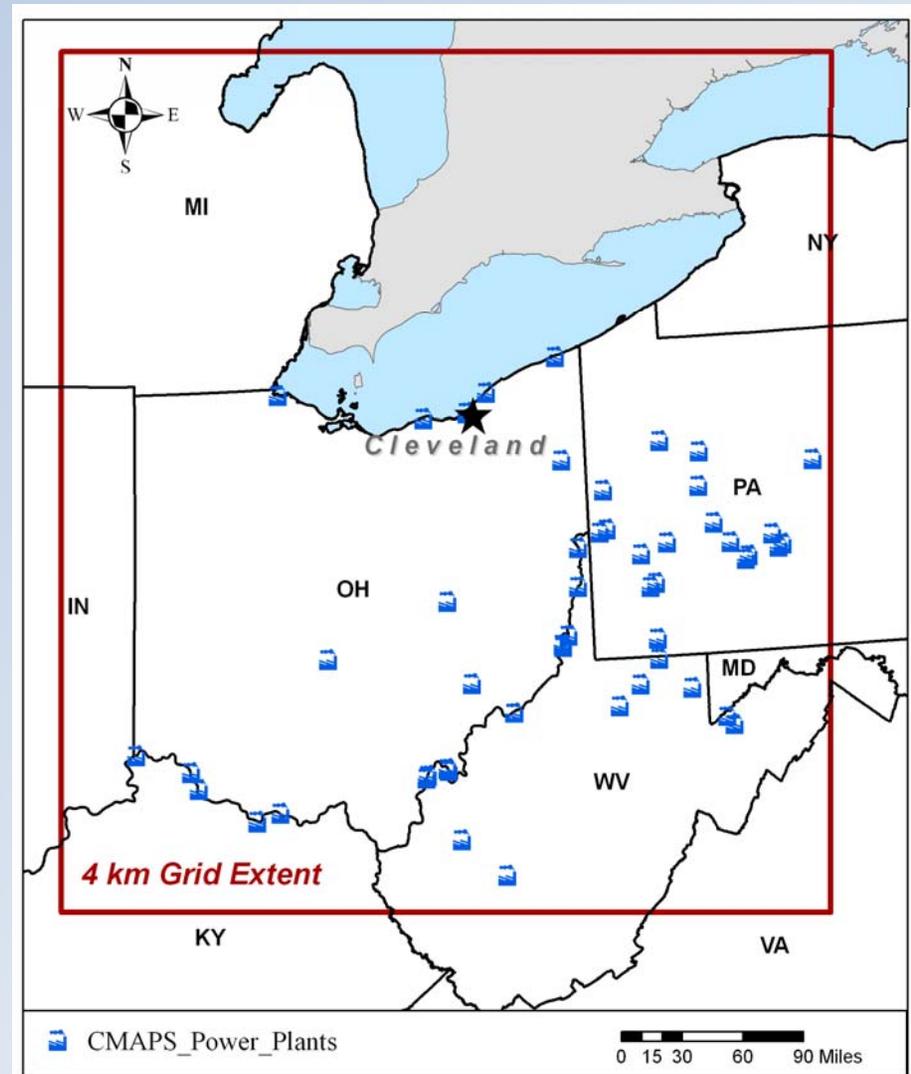
### Data requested included:

- 2009 annual emissions
- Monthly production/fuel combustion
- Daily production/fuel combustion for Aug 2009 and Feb 2010

# Emissions Inventory Development (2 of 6)

## Point sources

- Regional power plants
  - Focus on OH and western parts of PA and WV (52 facilities)
  - Obtained monthly  $\text{SO}_2/\text{NO}_x$  emissions and heat input for 2009 and 1<sup>st</sup> quarter of 2010 from EPA's Clean Air Markets Division (CAMD) database



# Emissions Inventory Development (3 of 6)

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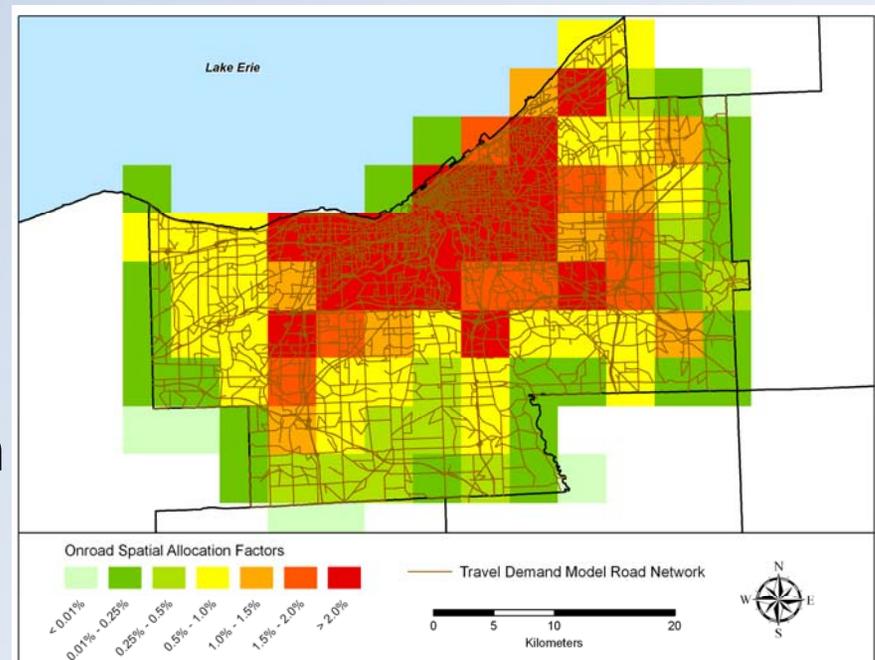
## Point sources

- Regional power plants
  - Scaled emissions for Hg and other pollutants on the basis of heat input
  - Reduced Hg<sup>2+</sup> emissions by 95% for units with wet FGD systems installed since 2005

# Emissions Inventory Development (4 of 6)

## On-road mobile sources

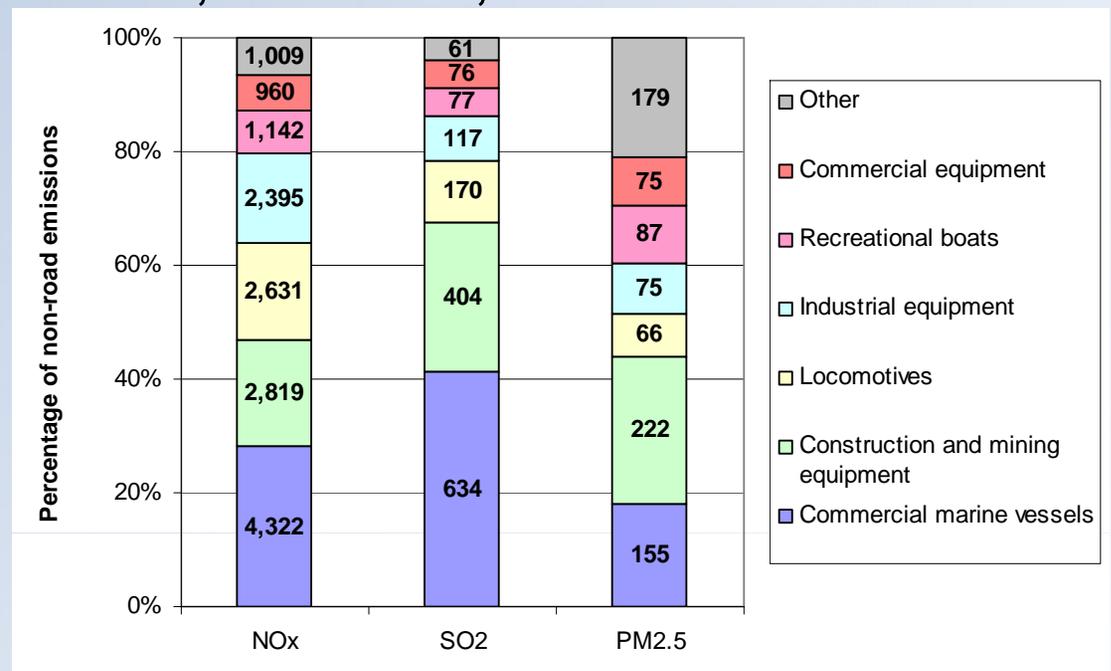
- Acquired 2009 travel demand model outputs from the Northeast Ohio Areawide Coordinating Agency (NOACA)
- Used TDM VMT data to update MOVES county database and develop 4-km spatial allocation factors (SAFs)
- Updated MOVES met data for Cuyahoga County
- Ran MOVES for all counties in the 4-km modeling domain



# Emissions Inventory Development (5 of 6)

## Non-road mobile sources

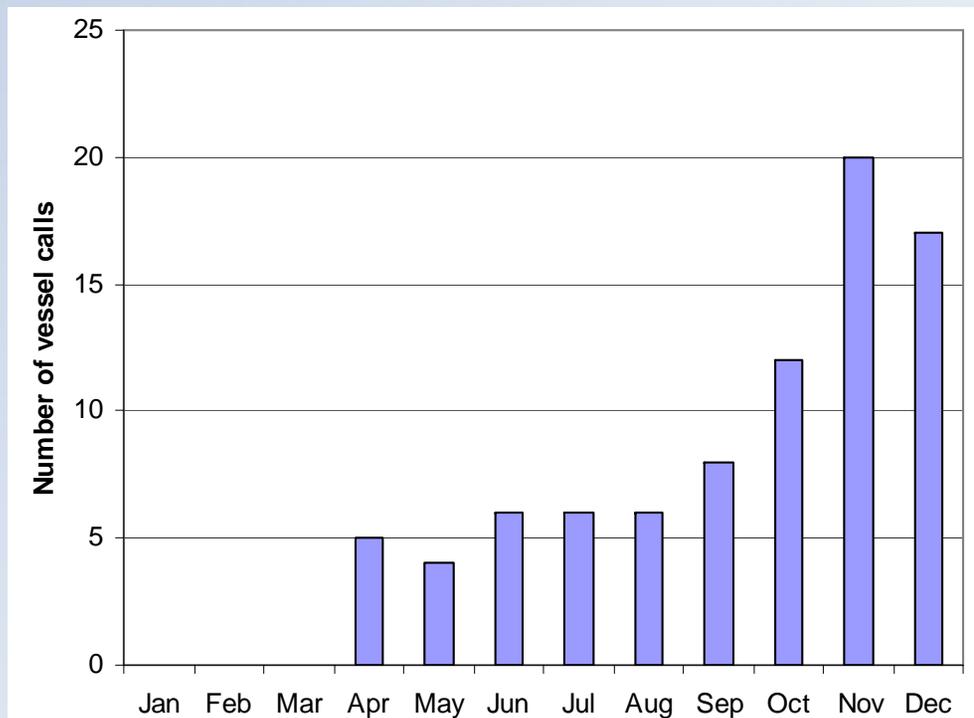
- Analyzed 2005 NEI to determine key sources (marine vessels, construction equipment, locomotives)
- Contacted Port of Cleveland, railroads, and Cleveland Planning Department
- Only port data was obtained in time for use in developing EI



# Emissions Inventory Development (6 of 6)

## Non-road mobile sources

- During 2009, vessel traffic at the Port of Cleveland was at a 50-year low (91% lower than in 2005)
- 2005 emissions scaled based on vessel calls
- Monthly emissions profile developed from 2009 vessel call data



# Emissions Modeling (1 of 2)

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## Starting point

EPA's 2005-based modeling platform, version 4

### Growth and Controls

- Adjusted 2005 emissions for point, on-road, and non-road sources to account for 2009/2010 activity levels

### Spatial Allocation

- Verified the location of key point sources using Google Earth
- Re-projected EPA's default 4-km surrogates to match the CMAPS modeling domain
- Developed spatial allocation factors (SAFs) for on-road mobile sources based on NOACA's travel demand model (TDM) outputs
- Development of 1-km surrogates is pending

# Emissions Modeling (2 of 2)

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## Temporal Allocation

- Developed day-specific emissions files for August 2009 and February 2010 for key point sources
- Developed monthly profiles for power plants and commercial marine vessels

## Speciation

- Updated SMOKE's inventory tables and speciation profiles to include the full range of species to be modeled by EPA

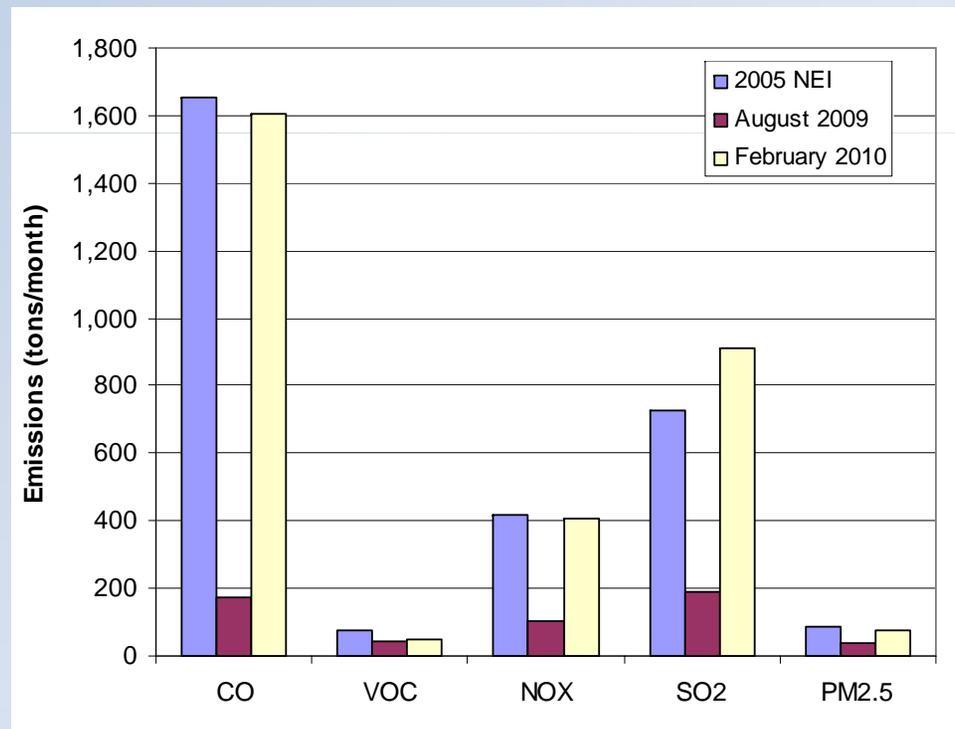
Ran SMOKE to produce CMAQ-ready emissions files for the CMAPS 4-km domain for:

- July 21–August 31, 2009
- January 22–March 2, 2010

# Summary of Results (1 of 9)

## Key facilities in Cleveland

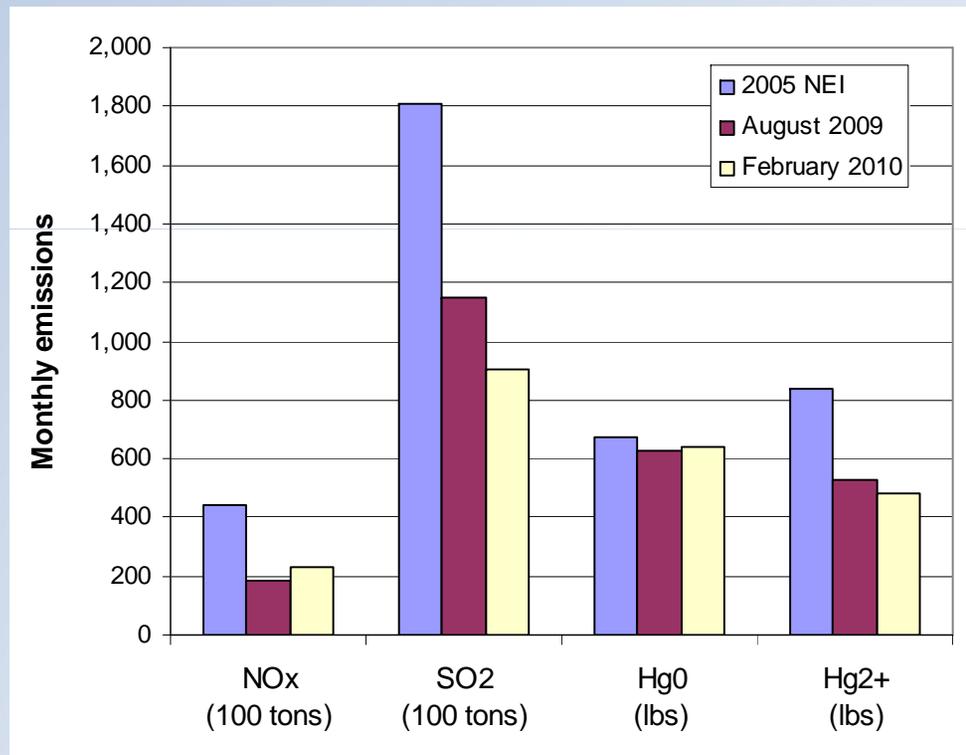
- August 2009 emissions 39-90% lower than 2005 levels (steel mill and power plant not active in August)
- February 2009 emissions comparable to 2005 levels ( $\pm 30\%$ )



# Summary of Results (2 of 9)

## Regional power plants

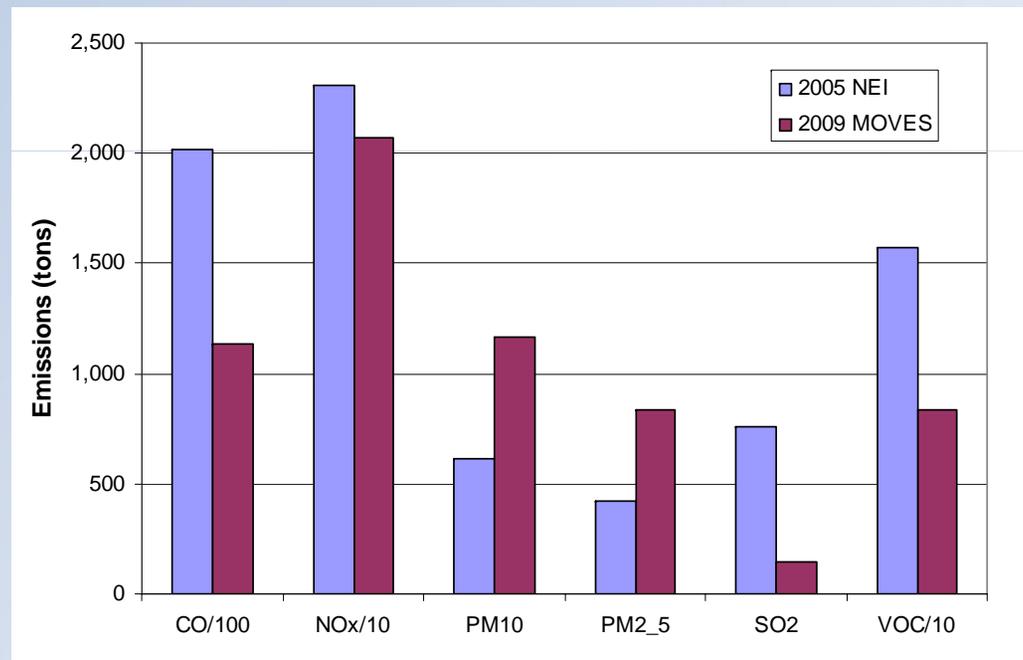
- SO<sub>2</sub>, NO<sub>x</sub> and Hg<sup>2+</sup> emissions during the two intensive months 37%–58% lower than 2005 levels



# Summary of Results (3 of 9)

## On-road mobile sources

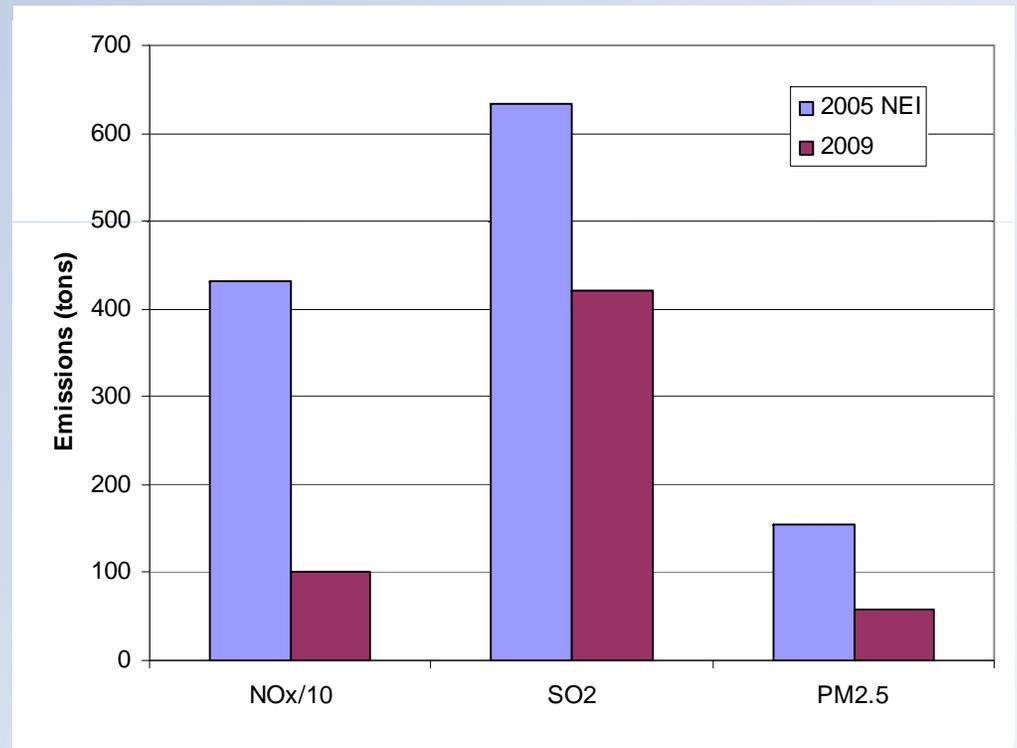
- Significant reductions in CO, SO<sub>2</sub>, and VOC compared to 2005 National Emissions Inventory (NEI)
- Slight decrease in NO<sub>x</sub> and actual increases in PM
- Consistent with other comparisons of MOBILE6 and MOVES



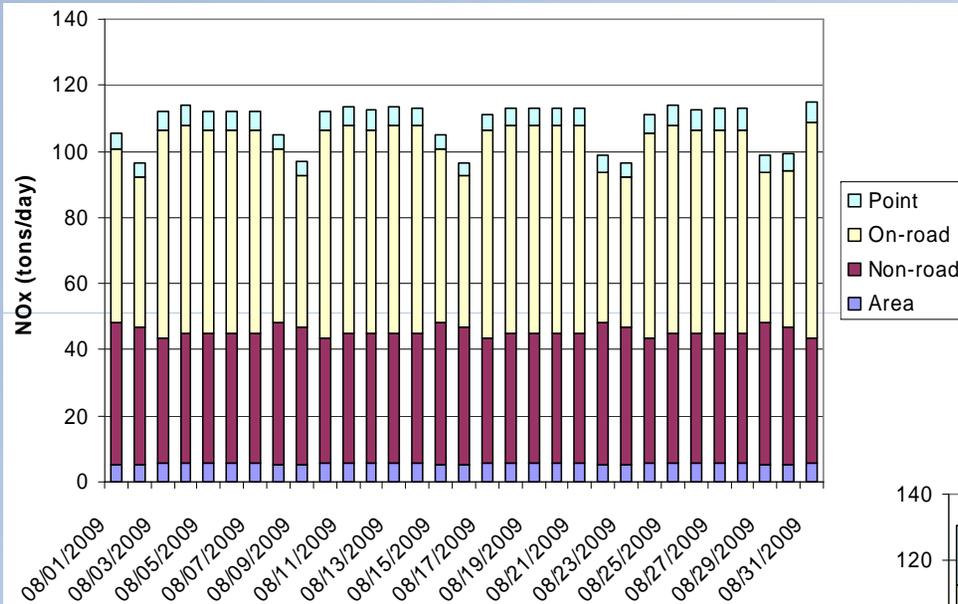
# Summary of Results (4 of 9)

## Port of Cleveland

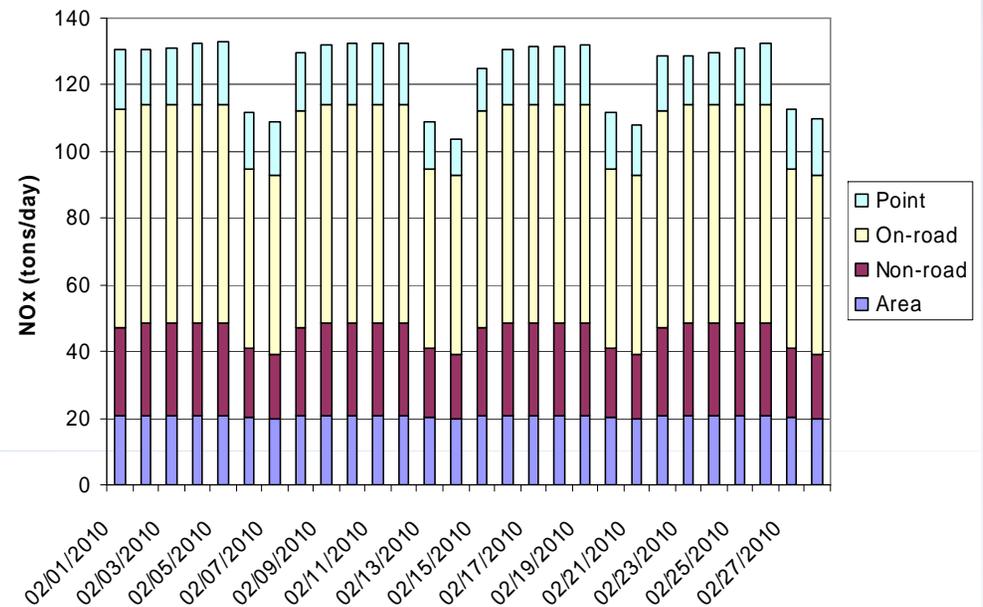
- Significant reductions in vessel calls, cargo tonnage between 2005 and 2009
- Emission reductions of 77% for NO<sub>x</sub>, 34% for SO<sub>2</sub>, and 62% for PM<sub>2.5</sub>
- No vessel calls at port in winter months (Jan–Mar)



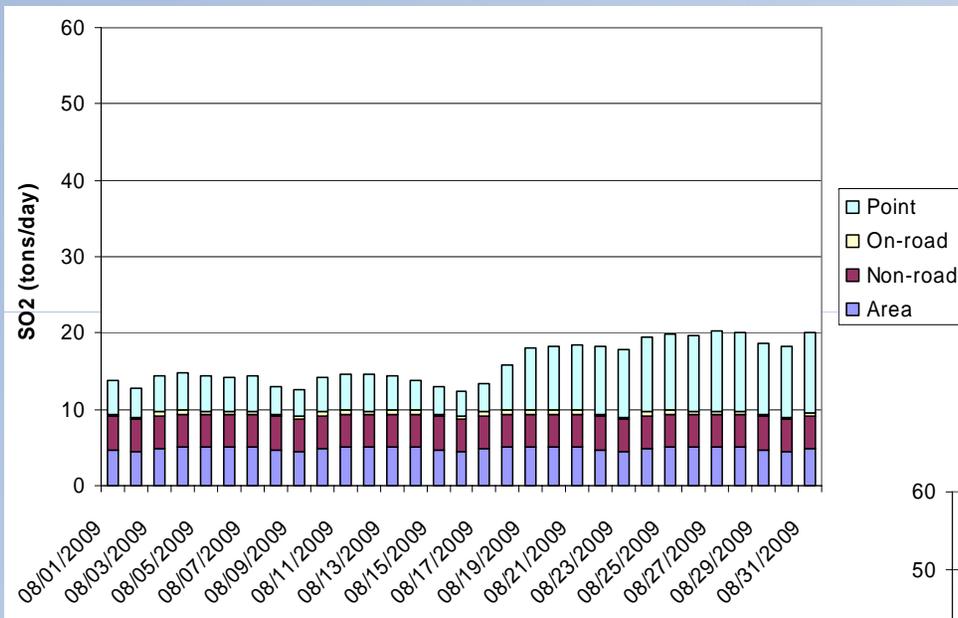
# Summary of Results (5 of 9)



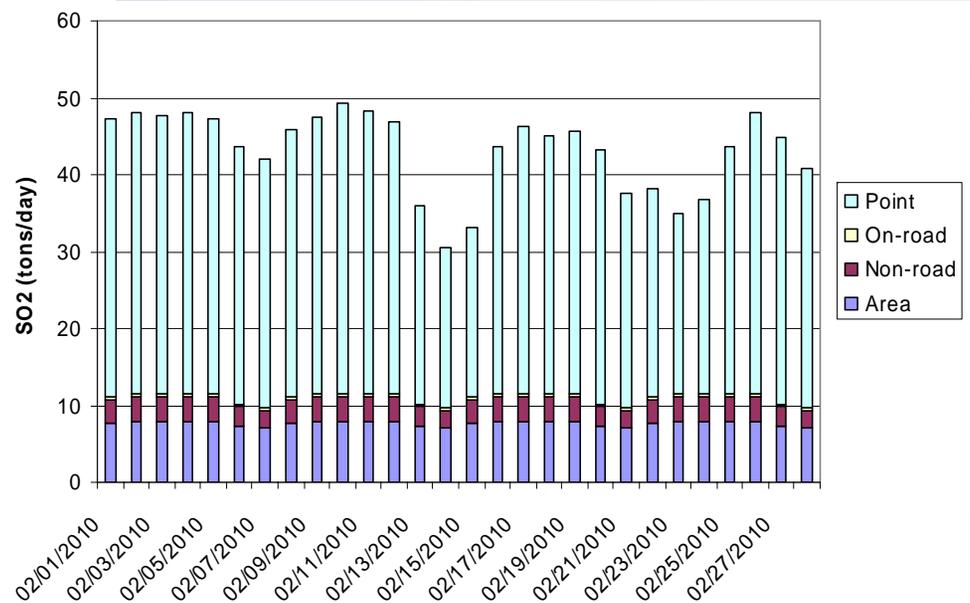
Daily NO<sub>x</sub> emissions for August 2009 and February 2010



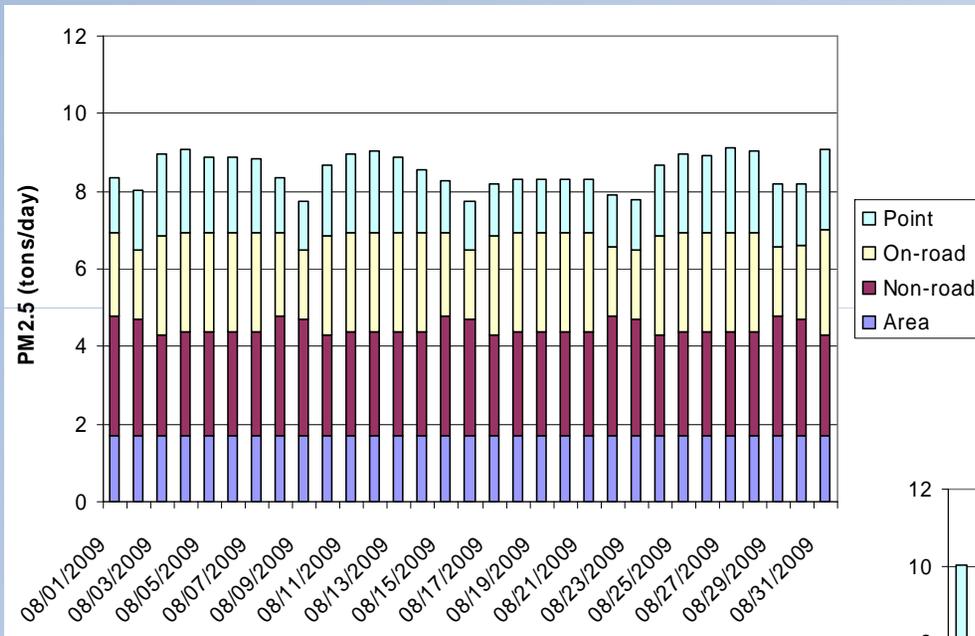
# Summary of Results (6 of 9)



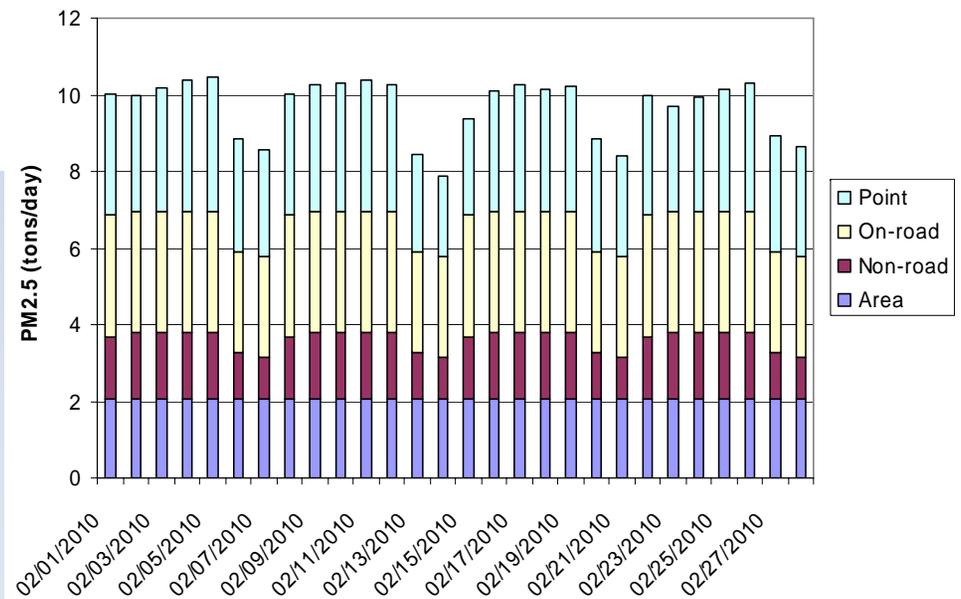
## Daily SO<sub>2</sub> emissions for August 2009 and February 2010



# Summary of Results (7 of 9)

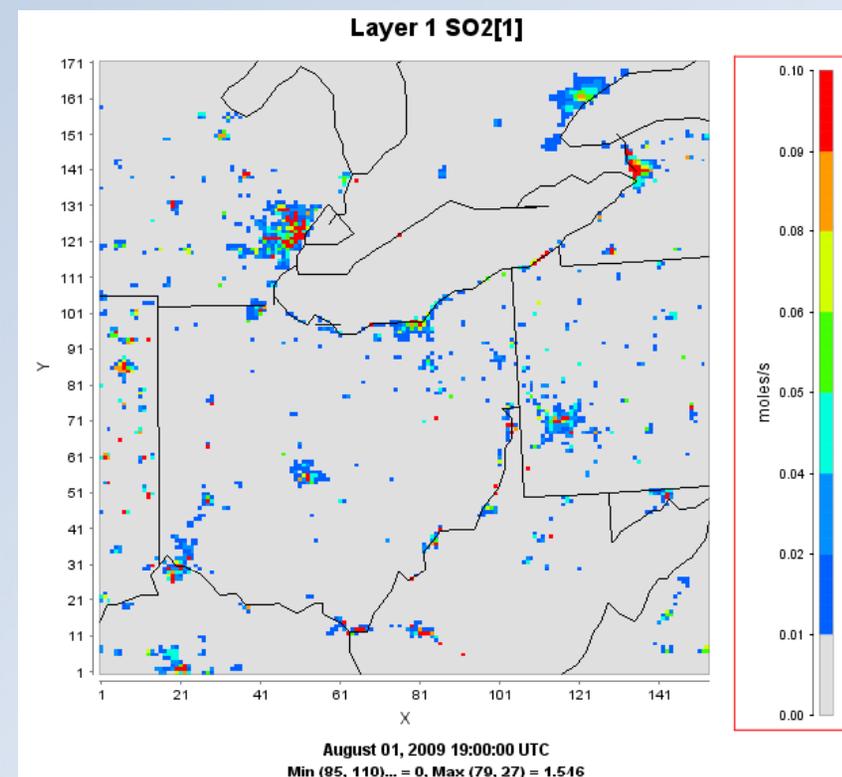
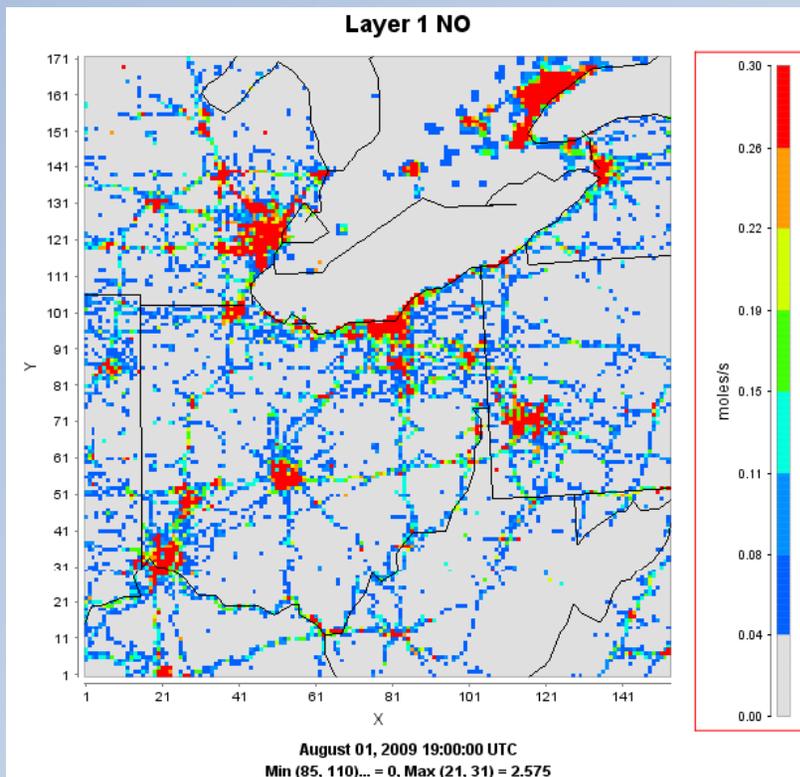


Daily PM<sub>2.5</sub> emissions for August 2009 and February 2010



# Summary of Results (8 of 9)

## Emissions density plots for August 1, 2010



# Summary of Results (9 of 9)

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## Recap and next steps

- Updated Cleveland emissions inventory was developed for point sources, on-road mobile sources, and commercial marine vessels
- CMAQ-ready inputs for 4-km modeling domain were prepared for August 2009 and February 2010
- 1-km domain for metropolitan Cleveland may be required to resolve local-scale pollutant gradients

# Questions and Discussion

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