

# The 2011 National Air Toxics Assessment (NATA)

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# What is NATA?

- **Characterization of air toxics across the nation**
  - Nationwide assessment with *census tract* resolution for hazardous air pollutants (HAPs) plus diesel particulate matter (DPM)
  - Emissions, modeled ambient concentrations and estimated *inhalation exposures* from *outdoor sources*
  - *Cancer and noncancer* risk estimates for about 130 HAPs with health data based on *chronic exposures*
- **Tool for EPA and State/Local/Tribal Agencies to prioritize pollutants, emissions sources and locations of interest**

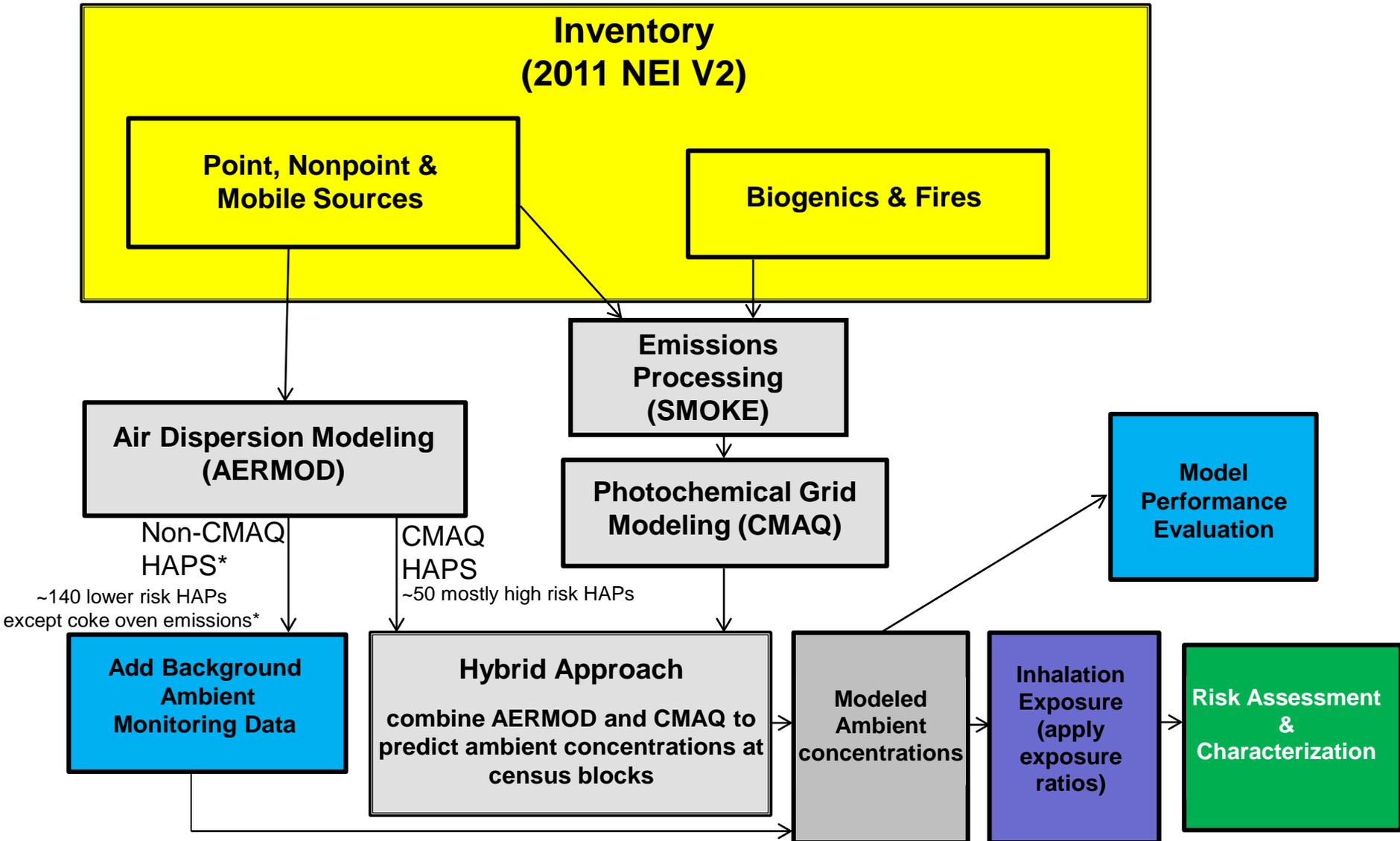
# Who Uses NATA?

- **EPA**
  - Office of Air Quality Planning and Standards (OAQPS)
    - Report to Congress, Monitoring, Grants, Risk and Technology Rules (RTR)
  - Office of Transportation and Air Quality (OTAQ)
    - National Rules
  - Office of Research and Development (ORD)
    - Research agenda, field studies, community tools (Community-Focused Exposure and Risk Screening Tool)
  - Office of Environmental Information (OEI)
    - Environmental Justice /Community Tool– EJ SCREEN – NATA is one of several environmental layers in the soon to released EJSCREEN model developed by OEI/OEJ
- **States/local/Tribal**
  - Many State Air Toxics Programs set priorities using NATA (Oregon, New York, New Jersey)
  - Identify gaps in emissions inventories, encourage inventory improvements
- **Academia**
  - NATA referenced in over a hundred papers and numerous health studies

# NATA History

- **1996 NATA**
  - Based on 1996 National Toxics Inventory Assessment System for Population Exposure Nationwide (ASPEN)
  - Released in May 2002 (6 year lag)
  - 33 HAPs + DPM
  - Census tract resolution
- **1999 NATA**
  - Based on 1999 National Emissions Inventory (NEI), ASPEN and American Meteorological Society (AMS) and U.S. EPA Regulatory Model (AERMOD)
  - Released in February 2006 (7 year lag)
  - 177 HAPs + DPM
  - Census tract resolution
- **2002 NATA**
  - Based on 2002 NEI, ASPEN and AERMOD
  - Released in June 2009 (7 year lag)
  - 180 HAPs + DPM
  - Census tract resolution
- **2005 NATA**
  - Based on 2005 NEI, ASPEN, AERMOD, and secondary formation from the Community Multi-Scale Air Quality (CMAQ) model
  - Released in March 2011 (6 year lag)
  - 178 HAPs + DPM
  - Secondary using CMAQ
  - Census tract/block resolution
- **2011 NATA**
  - Based on 2011 NEI, AERMOD and CMAQ (hybrid approach)
  - Release expected in mid 2015 (4 year lag)
  - Improved temporal and spatial allocations
  - Approximately 178 HAPs + DPM
  - Census tract/block resolution
  - Improved atmospheric chemistry
  - Enhanced mapping tools
  - Integrate with CMAQ (Hybrid)

# 2011 NATA Approach



\*includes all HAPs in AK/HI/PR/VI since not part of CMAQ modeling domain

# Key Features of 2011 NATA: Emissions

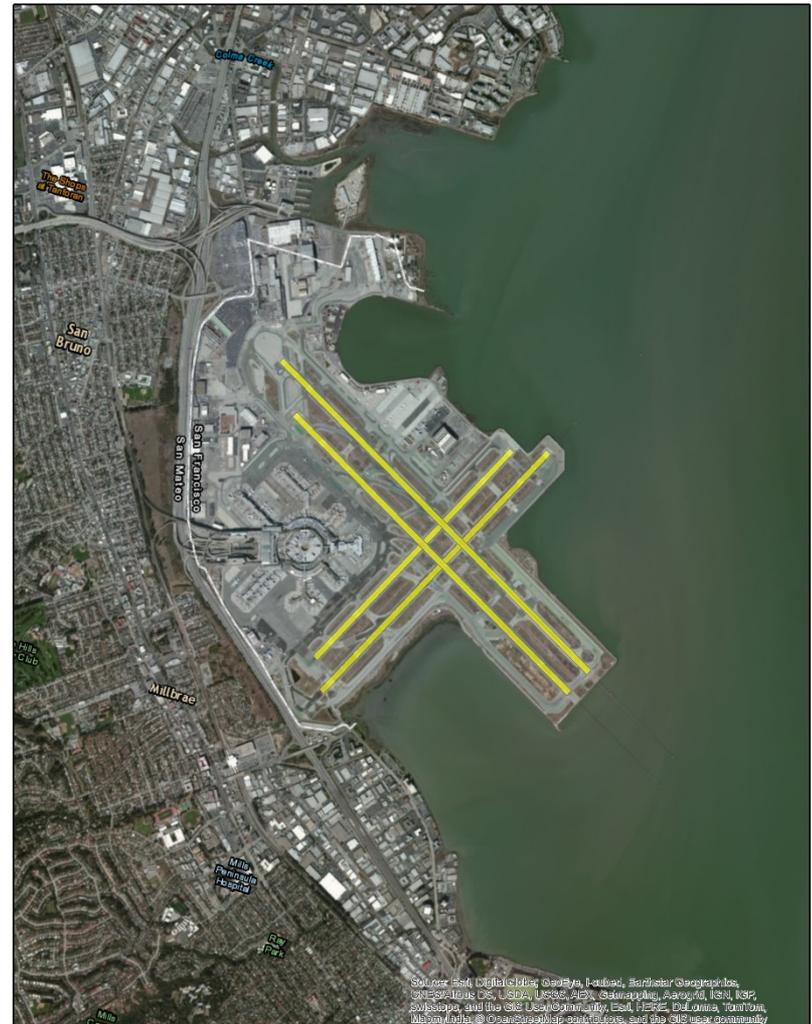
- NEI emissions from S/L/T and gap filled by EPA
- 2011 NEI **Version 1** “dry run”
  - Preliminary risk estimates of point and nonpoint portions of emissions inventory were calculated and reviewed by regions/state/local agencies
- 2011 NATA uses **Version 2** of the 2011 NEI
- The 2011 NEI/emissions processing includes key improvements over 2005, e.g., oil&gas, commercial marine vessel spatial resolution, improved spatial surrogates and temporal allocation approaches
- Most nonpoint/mobile inventories are at county level and allocated to tracts for modeling using surrogates
  - This leads to increased modeling uncertainty at finer scale resolutions
- Utilize MOVES2014 to develop emissions for mobile onroad

## 2011 NATA General Approach Spatial Allocation

<b>Category</b>	<b>Inventory Resolution</b>	<b>Spatial Approach for AERMOD</b>	<b>Spatial approach for CMAQ</b>
<b>Point (non Airports)</b>	Point	Point – vertical stack and fugitive	12km by 12 grid cells, Vertical based on plume calculations
<b>Airports</b>	Point	Point – runways & 10mX10m areas	12km by 12 grid cells
<b>Locomotives</b>	Point (railyards) and County/Shape	Nonpoint - Tracts Point - Point Fugitives	12km by 12 grid cells
<b>Commercial Marine Vessels</b>	County/Shape	Shapes	12km by 12 grid cells
<b>Onroad, Nonroad Equipment and other nonpoint</b>	County	Tracts	12km by 12 grid cells
<b>Fires (prescribed and wild)</b>	Point	Not Modeled	12km by 12 grid cells, Vertical based on plume calculations

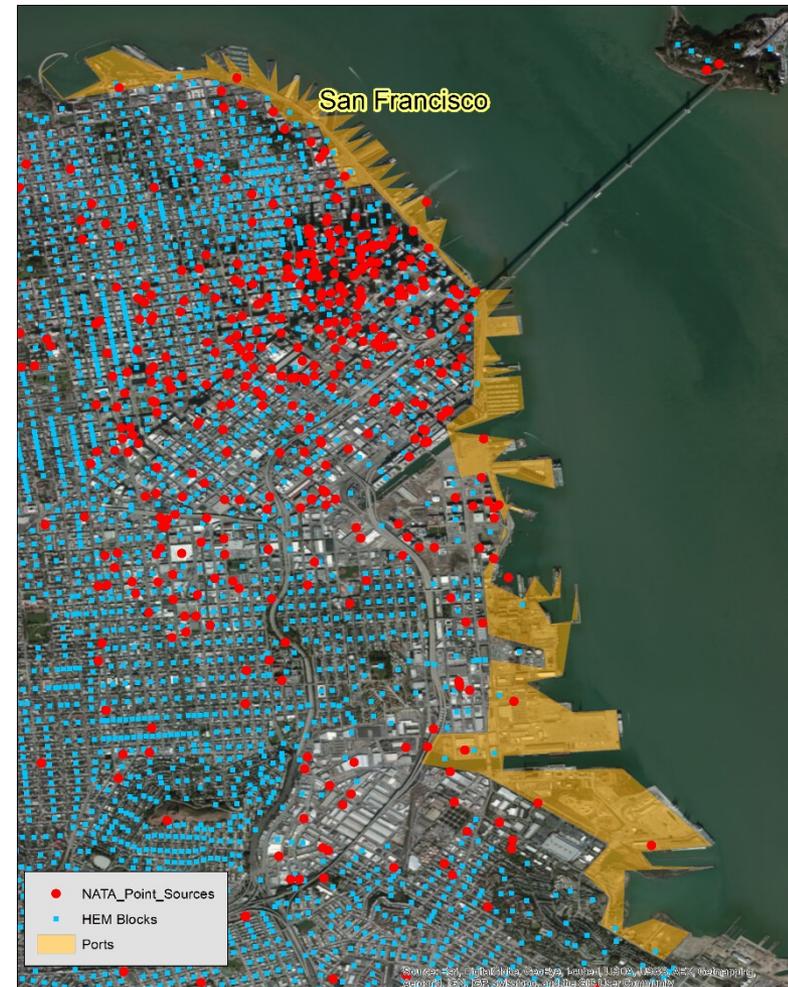
# 2011 NATA Mobile Source Modeling - Airports

- NEI Point Source Data Category
- 20,000 facilities, including heliports, sea plane bases.
- AERMOD
  - Nearly 13,000 airports modeled as line sources with emissions assigned to runways
  - Remainder are modeled as 10m<sup>2</sup> area sources centered around the NEI coordinates for smaller airports
- Key pollutants: formaldehyde, acrolein, naphthalene, and 1,3-butadiene

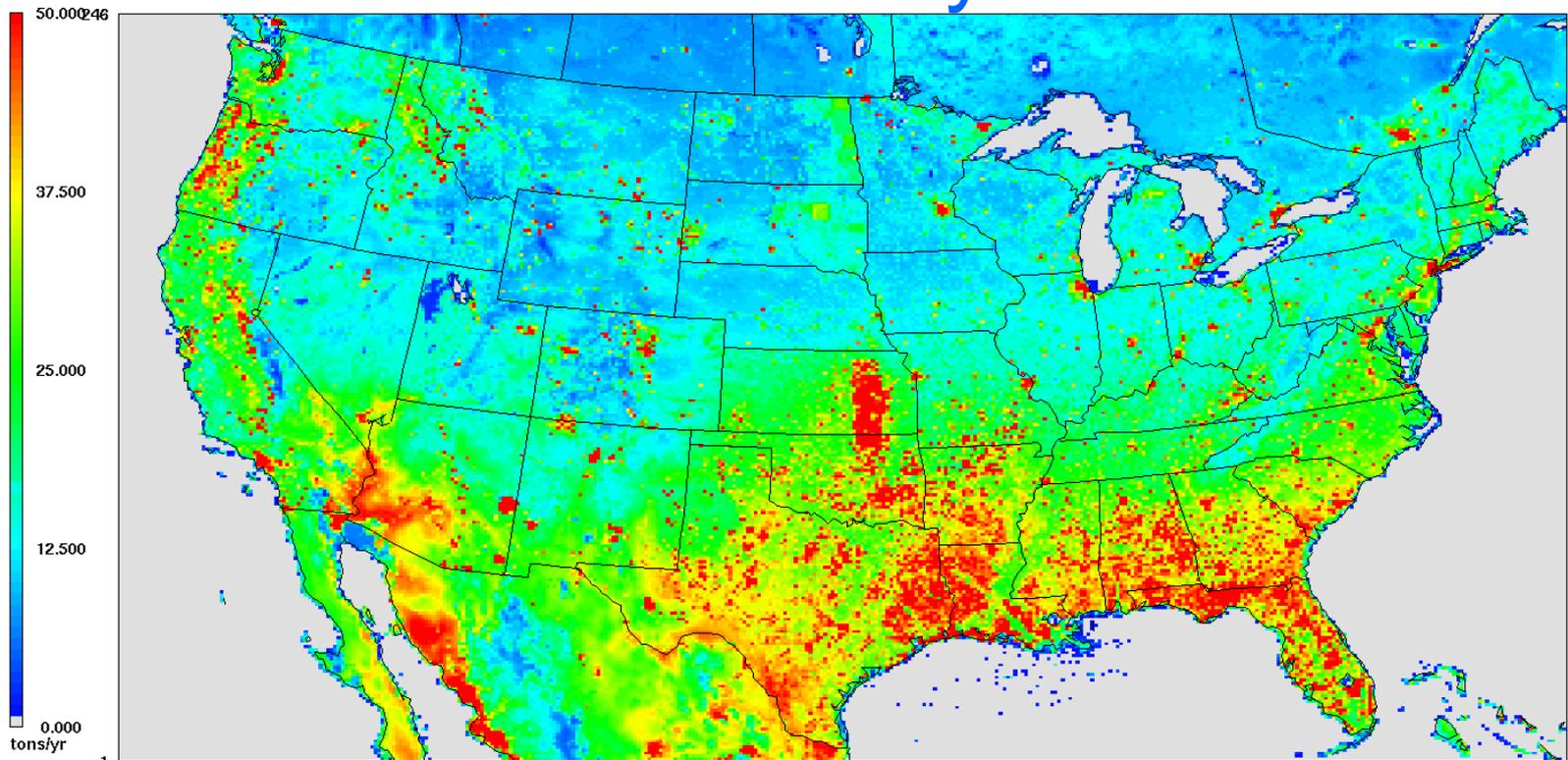


# 2011 NATA Mobile Source Modeling - Commercial Marine Vessels (CMV)

- Modeled in AERMOD as ~370 port shapes and ~3500 underway shapes
- CMV emissions assigned to shapes by EPA, reported to these shapes by S/L/T
- PM from diesel and residual oil vessels modeled as diesel PM
- Key pollutants: nickel, hexavalent chromium, arsenic, formaldehyde, diesel pm (noncancer)



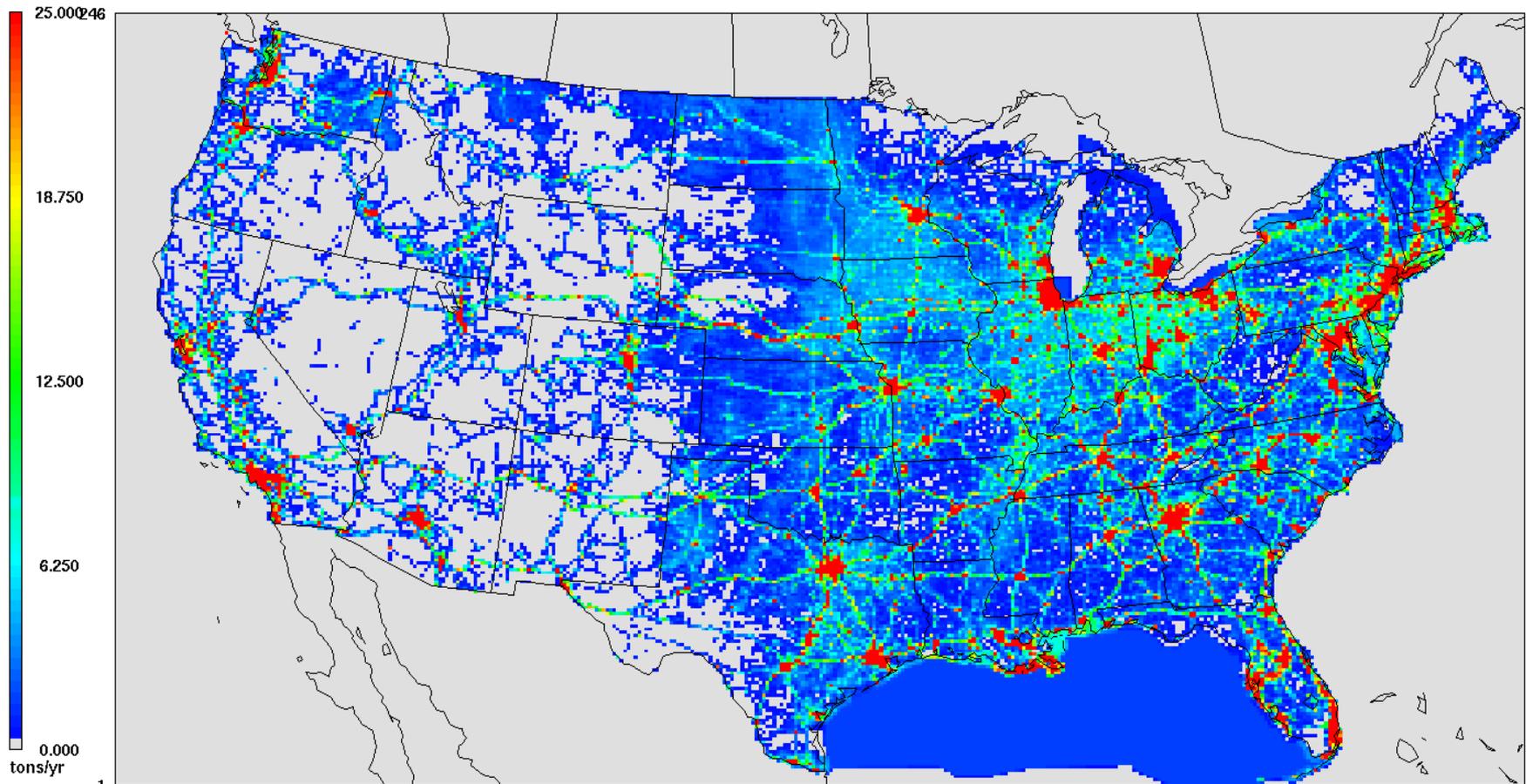
# Gridded Emissions input to CMAQ Formaldehyde



January 1, 2011 0:00:00  
Min= 0.000 at (4,1), Max=7938.230 at (319,59)

396

# Gridded Emissions Input to CMAQ Diesel Particulate Matter



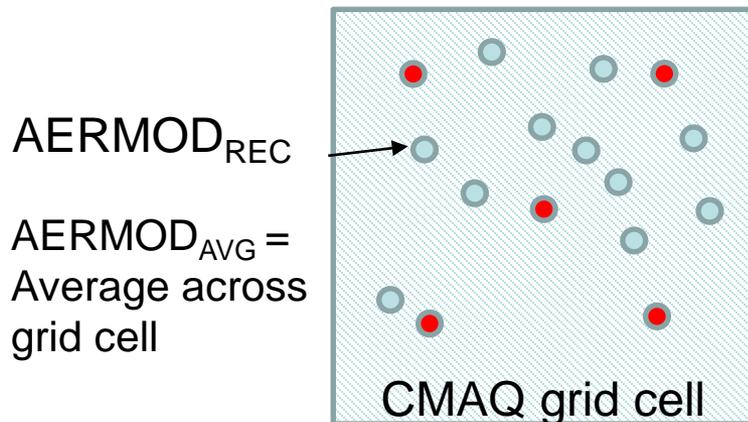
January 1, 2011 0:00:00  
Min= 0.000 at (1,1), Max= 605.077 at (361,163)

# Key Features of 2011 NATA: AQ Modeling

- Using a two-pronged approach
  - **AERMOD** is run for all air toxics pollutants to estimate pollutant concentrations at all US census tracts and blocks
  - **CMAQ** is run for the US (lower 48) at 12km grid resolution to capture chemistry and long-range transport and specific sources such as fires
- Using consistent gridded meteorological data in both CMAQ and AERMOD
- Final estimates of ambient pollutant concentrations will be based on a hybrid approach that combines data from AERMOD and CMAQ

# Hybrid Concept

- Use CMAQ for mass conservation, transport, chemistry. All sources including biogenic emissions and fires. Criteria & HAPs
- Use AERMOD receptor concentrations ( $AERMOD_{REC}$ ) to determine subgrid cell variability. Point, nonpoint, onroad, nonroad
- Approach allows source attribution (e.g., point, nonpoint, onroad, nonroad, secondary, fires)



- Census block centroid receptor
- Evenly placed receptor – ensures low or no population grid cells have at least 5 receptors

$$C_{\text{hybrid}, \text{REC}} = \text{AERMOD}_{\text{REC}} \times \frac{\text{CMAQ}_{\text{P}, \text{NFB}}}{\text{AERMOD}_{\text{AVG}}} + \text{CMAQ}_{\text{SEC}, \text{NFB}} + \text{CMAQ}_{\text{FIRE}} + \text{CMAQ}_{\text{BIOG}}$$

Adjusted AERMOD concentration from primary non-fire, non- biogenic sources		CMAQ secondary concentration from non-fire, non- biogenic sources		CMAQ concentration from fires		CMAQ concentration from biogenic emissions
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6.6 million receptors (census) block centroids + evenly placed receptors

- 56,500 12km x12km grid cells that cover the continental US

# Air Toxics in CMAQ

## Gas Phase – stationary & mobile

Pollutant	Inhalation Health Impacts
<b>BENZENE</b>	Cancer, Noncancer
<b>FORMALDEHDYE</b>	Cancer, Noncancer
<b>ACETALDEHYDE</b>	Cancer, Noncancer
<b>1,3 BUTADIENE</b>	Cancer, Noncancer
<b>NAPHTHALENE</b>	Cancer, Noncancer
<b>ACROLEIN</b>	Noncancer
<b>METHANOL</b>	Noncancer
<b>XYLENES (M, O, P)</b>	Noncancer
<b>TOLUENE</b>	Noncancer
<b>PAHs (9 Groups)</b>	Cancer

## Particle and multi-phase – stationary & mobile

Pollutant	Inhalation Health Impacts
<b>NICKEL</b>	Cancer, Noncancer
<b>HEX CHROMIUM</b>	Cancer, Noncancer
<b>ARSENIC</b>	Cancer, Noncancer
<b>CADMIUM</b>	Cancer, Noncancer
<b>BERYLLIUM</b>	Cancer, Noncancer
<b>MANGANESE</b>	Noncancer
<b>LEAD</b>	Noncancer
<b>DIESEL PM</b>	Noncancer
<b>MERCURY</b>	Noncancer

## Gas Phase – stationary

Pollutant	Inhalation Health Impacts
<b>ACRYLONITRILE</b>	Cancer, Noncancer
<b>CARBON TETRACHLORIDE</b>	Cancer, Noncancer
<b>CHLORINE</b>	Noncancer
<b>CHLOROFORM</b>	Noncancer
<b>1,4-DICHLOROBENZENE</b>	Cancer, Noncancer
<b>1,3-DICHLOROPROPENE</b>	Cancer, Noncancer
<b>ETHYLENE DIBROMIDE</b>	Cancer, Noncancer
<b>ETHYLENE DICHLORIDE</b>	Cancer, Noncancer
<b>ETHYLENE OXIDE</b>	Cancer, Noncancer
<b>HEXAMETHYLENE-1,6-DIISOCYANATE</b>	Noncancer
<b>HYDROCHLORIC ACID</b>	Noncancer
<b>HYDRAZINE</b>	Cancer, Noncancer
<b>MALEIC ANHYDRIDE</b>	Noncancer
<b>METHYLENE CHLORIDE</b>	Cancer, Noncancer
<b>PROPYLENE DICHLORIDE</b>	Noncancer
<b>QUINOLINE</b>	Neither
<b>1,1,2,2-TETRACHLOROETHANE</b>	Neither
<b>2,4-TOLUENE DIISOCYANATE</b>	Cancer, Noncancer
<b>TRICHLOROETHYLENE</b>	Cancer, Noncancer
<b>TRIETHYLAMINE</b>	Noncancer
<b>VINYL CHLORIDE</b>	Cancer, Noncancer

# Key Features of 2011 NATA: Exposure/Risk

- Updated exposure factors using HAPEM7
  - Includes near roadway exposures
- Health benchmarks are consistent with those used in RTR rulemakings
  - Several benchmarks have been updated since 2005 NATA but none appear to be risks drivers
  - EPA does not quantify cancer risks from Diesel PM
- Results provided to the public at census tract level
- Risk apportionment information provided (i.e., information on sources and pollutants), allowing states to use NATA to focus their air toxics efforts
- Are developing new ways to present data in web-based map formats (e.g. GeoPlatform)

# Source Attribution – Concentrations/Risks by These Groups

## Onroad and Nonroad

Refueling
Light duty gas
Light duty diesel
Heavy duty gas
Heavy duty diesel
Nonroad construction
Nonroad pleasurecraft
Nonroad gas other
Nonroad diesel other

## Nonpoint nonroad

CMV-Ports
CMV-Underway
Locomotives

## Nonpoint stationary

Bulk gasoline terminals
Chemical manufacturing
Mining
Industrial not elsewhere classified
Nonferrous metals
Oil and gas
Refineries
Storage and transfer
Gas stations
Industrial, commercial institutional fuel combustion
Landfills
Surface coating and industrial solvent
Wastewater
Waste disposal other
Commercial Cooking
Miscellaneous nonindustrial
Residential wood combustion
Residential fuel combustion except wood
Consumer & commercial solvent
Solvent degreasing
Solvent dry cleaning
Non-industrial surface coating

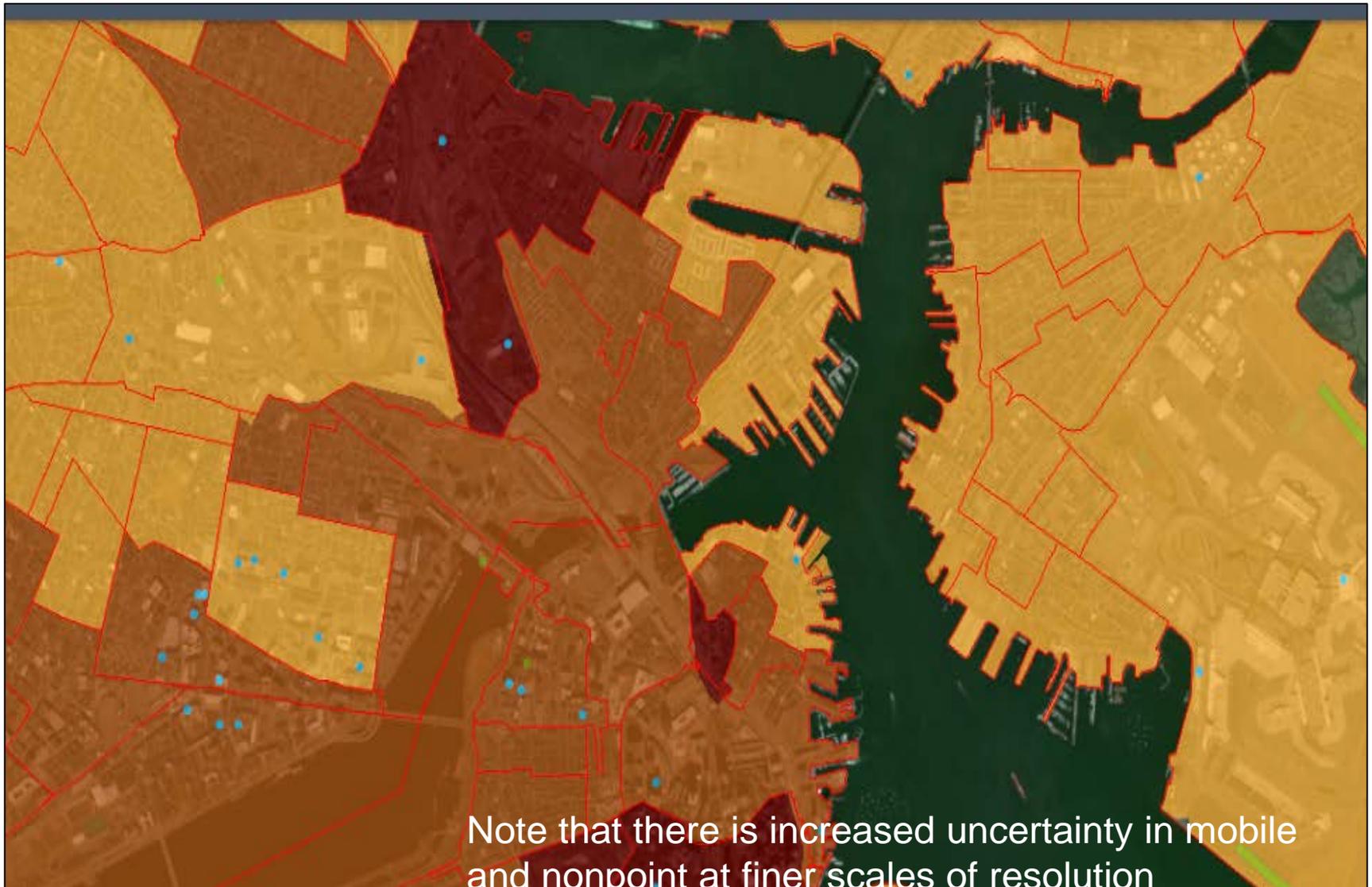
## Point

Airports
Railyards
Other point

## Other (CMAQ only)

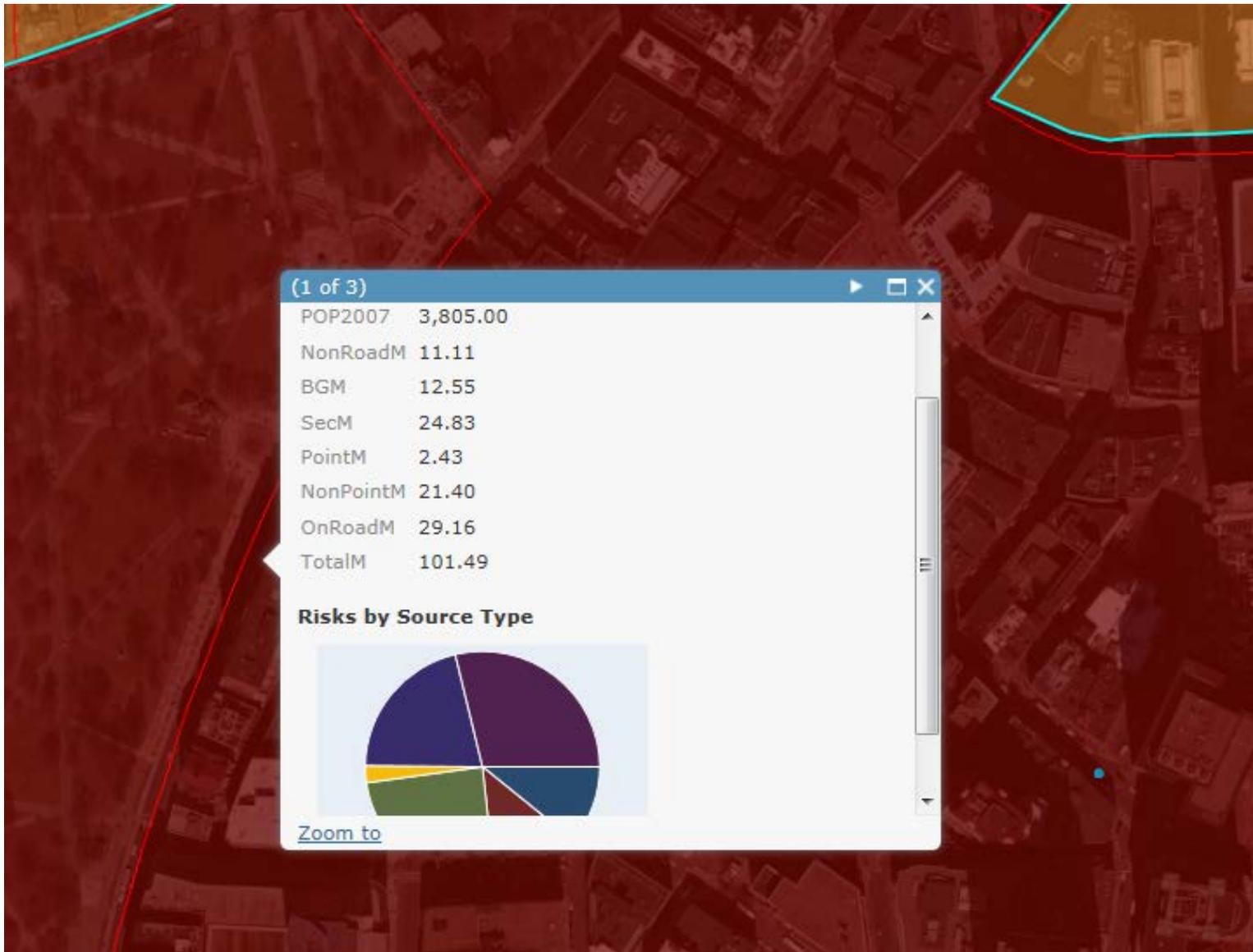
Fires
Biogenics
Secondary formation

# NATA Data in EPA's GeoPlatform - Overview

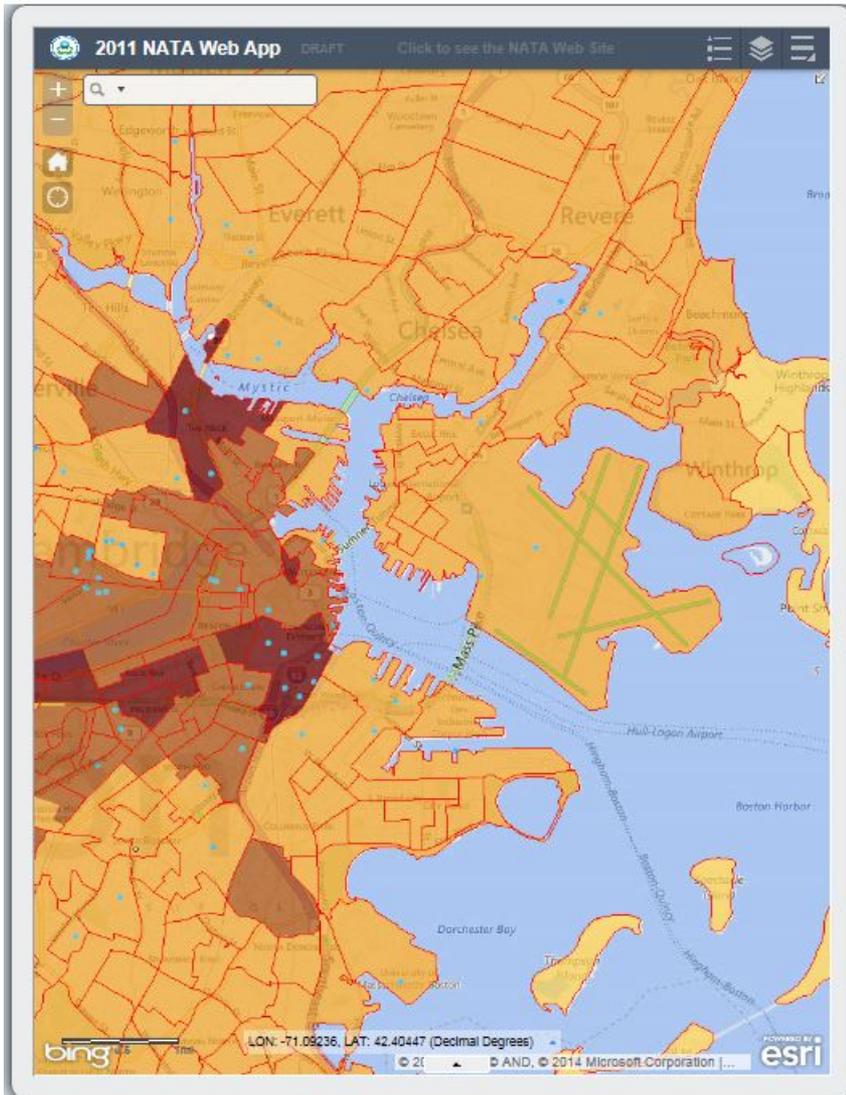


Note that there is increased uncertainty in mobile and nonpoint at finer scales of resolution

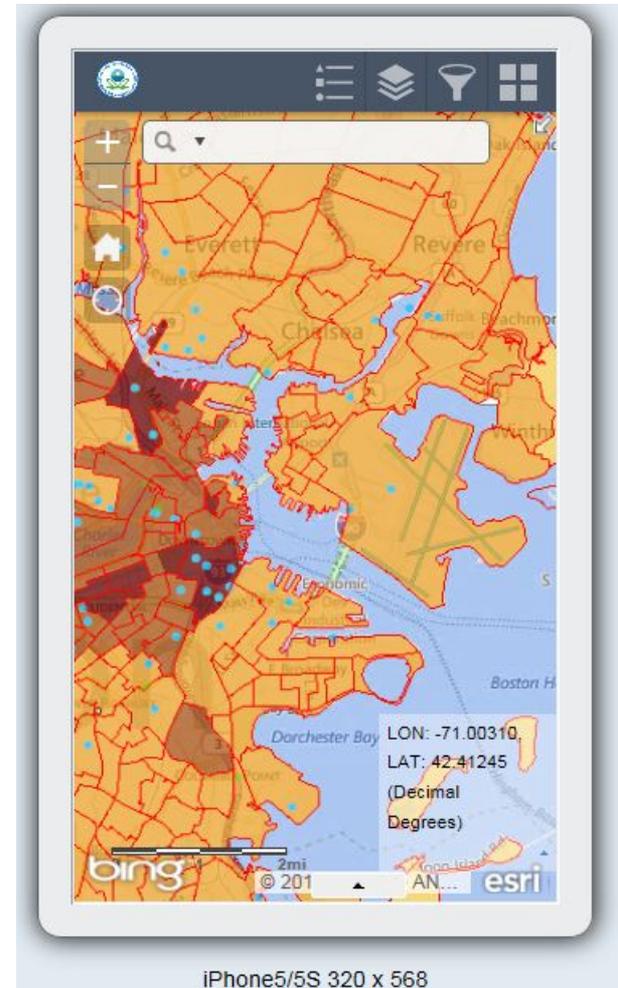
# NATA Data in EPA's GeoPlatform - Detailed Tract Data



# NATA Data in EPA's GeoPlatform – Data may be available on mobile devices



iPad & iPad2 768 x 1024



iPhone5/5S 320 x 568

## 2011 Current Schedule

- AERMOD/CMAQ Modeling- complete
- Post Model Adjustments - complete
- Hybrid Calculations/Exposures/Risk - ongoing
- State Preview and NATA Release – 2015

# 2011 NATA – EPA TEAM

- Madeleine Strum
- Ted Palma
- Rich Scheffe
- Bryan Hubbell
- Rich Cook
- James Thurman
- Mark Morris
- Sharon Phillips
- Alison Eyth
- Alexis Zubrow
- Rich Mason
- Laurel Driver