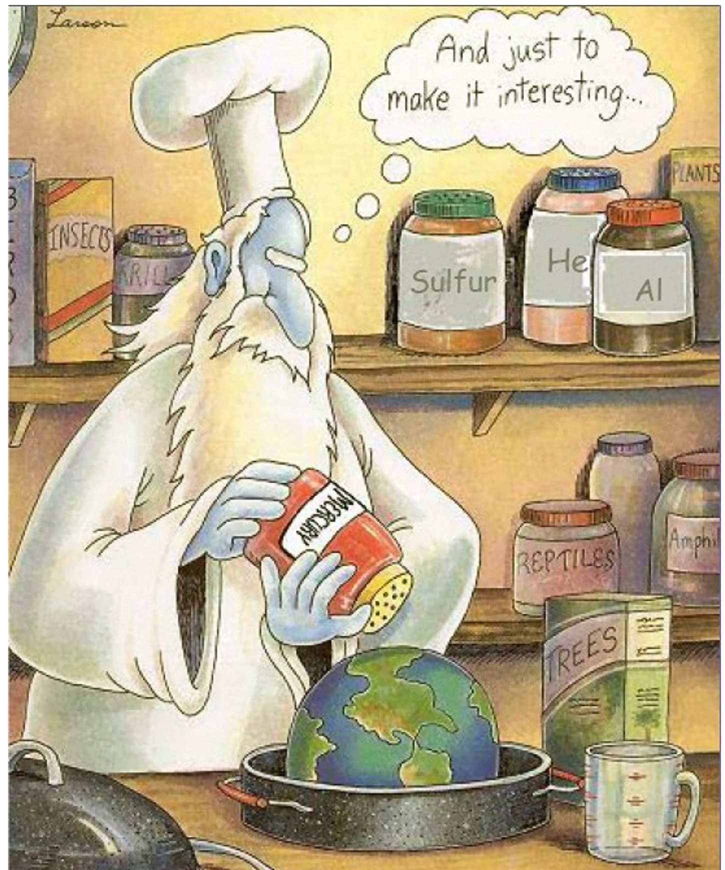
Emissions Inventory Preparation for Air Toxics and for Modeling Air Toxics Pollutants



Instructors

Anne Pope

- US EPA/EIG
- pope.anne@epa.gov

Madeleine Strum

- US EPA/AQMG
- Strum.madeleine@epa.gov

Our Goals

- Explain what air toxics are, the history behind air toxics regulatory and inventory programs, and why it is important to develop an air toxics emissions inventory periodically
- Provide information on how to develop an air toxics inventory using detailed examples
- Explain how air toxics inventories are used for air toxics modeling

Terminology

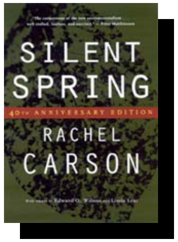
AERMOD	MACT	SMOKE
ASPEN	NEI	TEQ
CAA	NESHAP	TRI
CALPUFF	NIF	URE
CMAQ	NTI	VMT
CMAS	PAH	VOC
CMVs	PBTs	10/25
EMS-HAP	PM	
HAPs	POM	
ISCST3	RfC	

Overview

- Introduction
  - History of Air Toxics Program
  - Uses/ Reasons to Prepare Air Toxics Inventories
  - HAP Inventory Background
- Modeling Ambient Air Toxics Concentrations
  - Models
  - Modeling Preparation
- Pollutant Definitions, Pollutant grouping for modeling
- Source Category Definitions
- Point Sources
- Nonpoint Sources
- Mobile Sources
- 99 NATA
- Wrap Up!

Introduction

Air Toxics History



PHS Air Pollution Control Act
1955
Research Tech. Assistance for Air Pollution Control

1st CAA
1963
Prevention & Abatement of Air Pollution

65 CAAA
1965
Mobile Sources

67 CAAA
1967
SIPS

70 CAAA EPA
1970
Air Quality for CAPS & HAPS

77 CAAA
1977
PSD Mobile Sources

6 NESHAPS
(1977 thru 1989)

1989

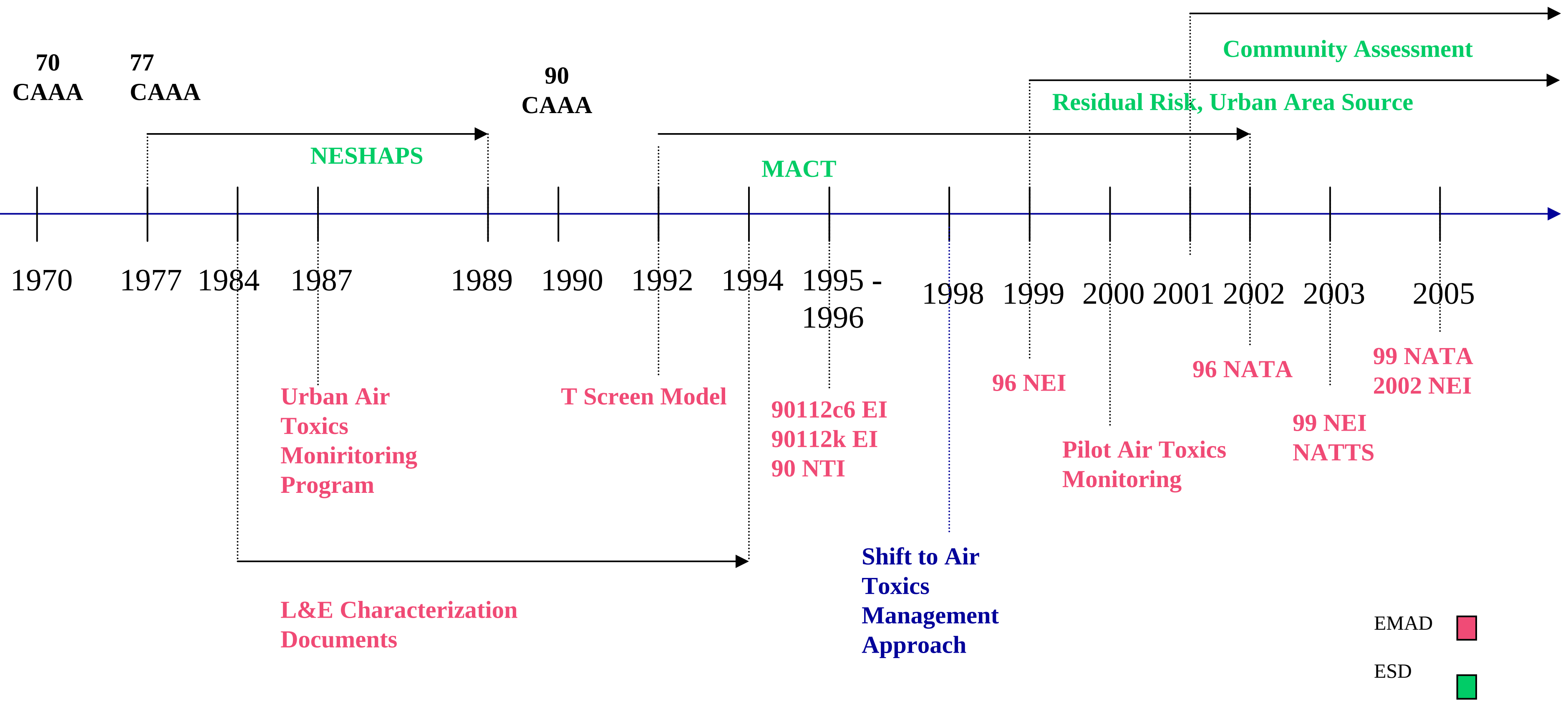
Benzene NESHAP
10-6 as Ample
Margin of Safety

90 CAAA
1990

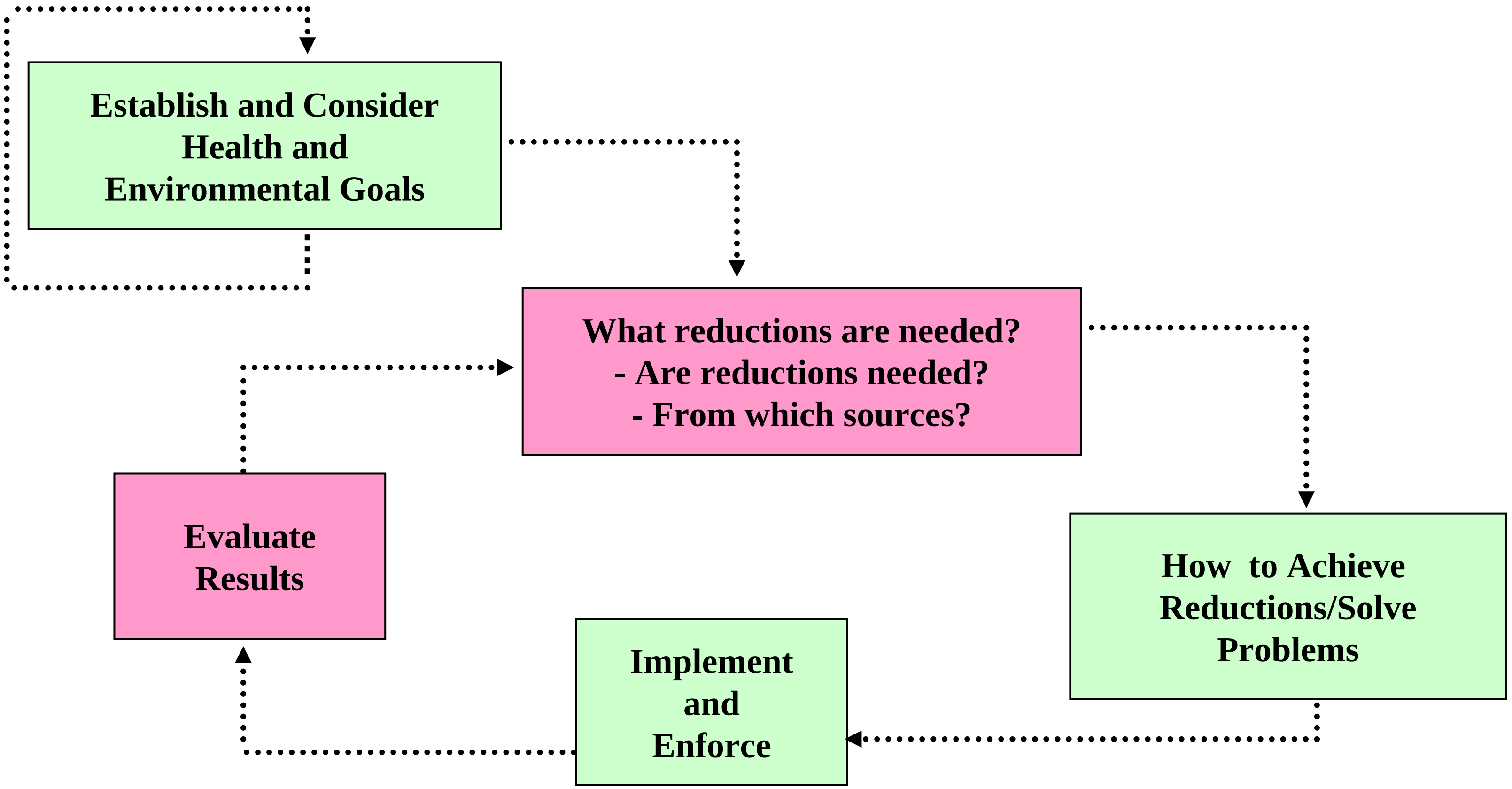
HAPS:
202–Mobile Air Toxics
129–Combustion – Sources
112b–List 189 HAPS
112d–MACT
112f– Residual Risk
112c6–7 PBTS
112c3/112k–Urban Area Source
112m–Great Waters
112n–Special Studies, Hg

FUTURE

OAQPS/EMAD Air Toxics History



Air Toxics Management Model



So Where are we now?

• **Ancient History: We came from a time where there was no law regarding air toxics, to…**

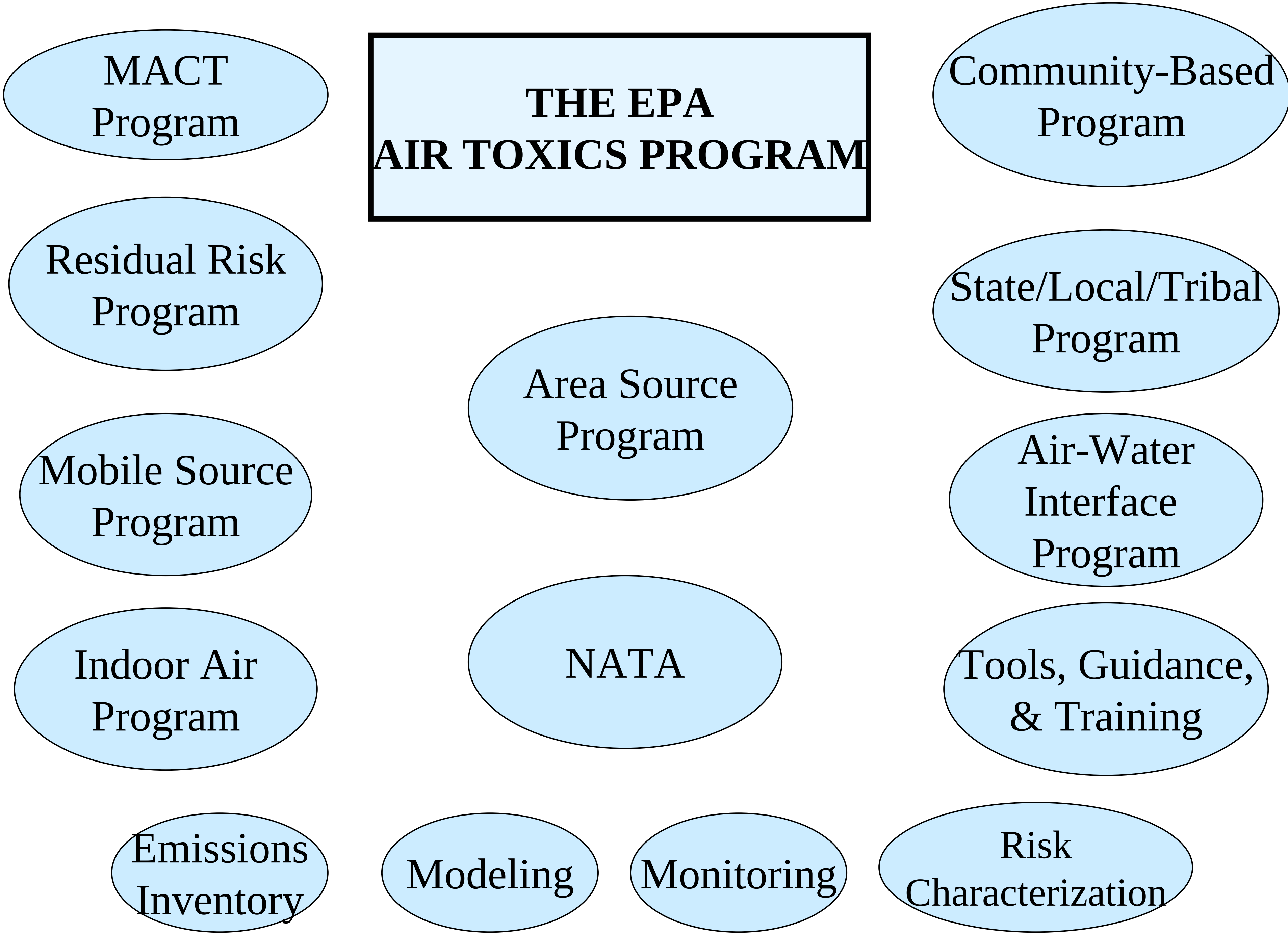
• **1970: An air toxics provision which was impossibly difficult to implement, to…**

• **1990: A new provision designed to give us time to hone our risk assessment methods, to…**

• **TODAY: Conducting/reviewing source-specific and community-level and national risk assessments**

Air Toxics Program

- Air Toxics is a Complex Program
- Air Toxics are a Public Health Concern
- Major Risk Reductions Have Been Achieved to Date but More Are Needed
- Challenges Ahead


THE EPA
AIR TOXICS PROGRAM
MACT Program
Residual Risk Program
Mobile Source Program
Indoor Air Program
Community-Based Program
State/Local/Tribal Program
Area Source Program
Air-Water Interface Program
NATA
Tools, Guidance, & Training
Emissions Inventory
Modeling
Monitoring
Risk Characterization

Air Toxics are a Public Health Concern

Air Toxics

- Pollutants capable of causing serious illnesses (e.g., cancer, birth defects) or even death
- Health effects are typically irreversible
- Health effects generally associated with years of exposure rather than hours or days
- Some persist in the environment, either remaining in the air or depositing on soil and in waterways
- Toxic in small amounts

Air Toxics

- We often think of air toxics and criteria pollutants as being separate (e.g., PM and VOCs)
- Air toxics comprise a significant percentage of criteria pollutants (e.g., volatiles and metals)
- Most urban toxic “hot spots” are in non-attainment areas
  - criteria pollutants and air toxics affect the same populations

Air Toxics

- Large uncertainties
  - Direct evidence linking affect with exposure is often missing or sparse
  - Health science for toxics is largely undeveloped
  - Have very limited human data
  - Unique assessment tools are required
- CAA includes 188 pollutants but there are thousands of new chemicals being introduced into our environment each year

Risks from Air Toxics Are Widely Perceived as Smaller Than They Really Are

- Reason: Assessments subdivide risk into small pieces
  - Example: One facility's cancer incidence estimated at 0.02 per year
  - BUT
    - The lifetime incidence is 0.02 x 70 years = 1.4
    - The incidence for 20 similar sources is 1.4 x 20 = 28
    - The incidence for all air toxics sources combined is about 10,000
    - The incidence for all sources of 188 air toxics = ??

Cancer Risks Exceed Action Levels Cited in Clean Air Act

- 1996 NSATA indicates U.S. residents have cancer risks for air toxics which exceed 50 in a million by inhalation from outside sources
  - This is 50 times the 1 in a million action level cited in CAA
  - Could be larger or smaller because risk estimate is surrounded by uncertainty

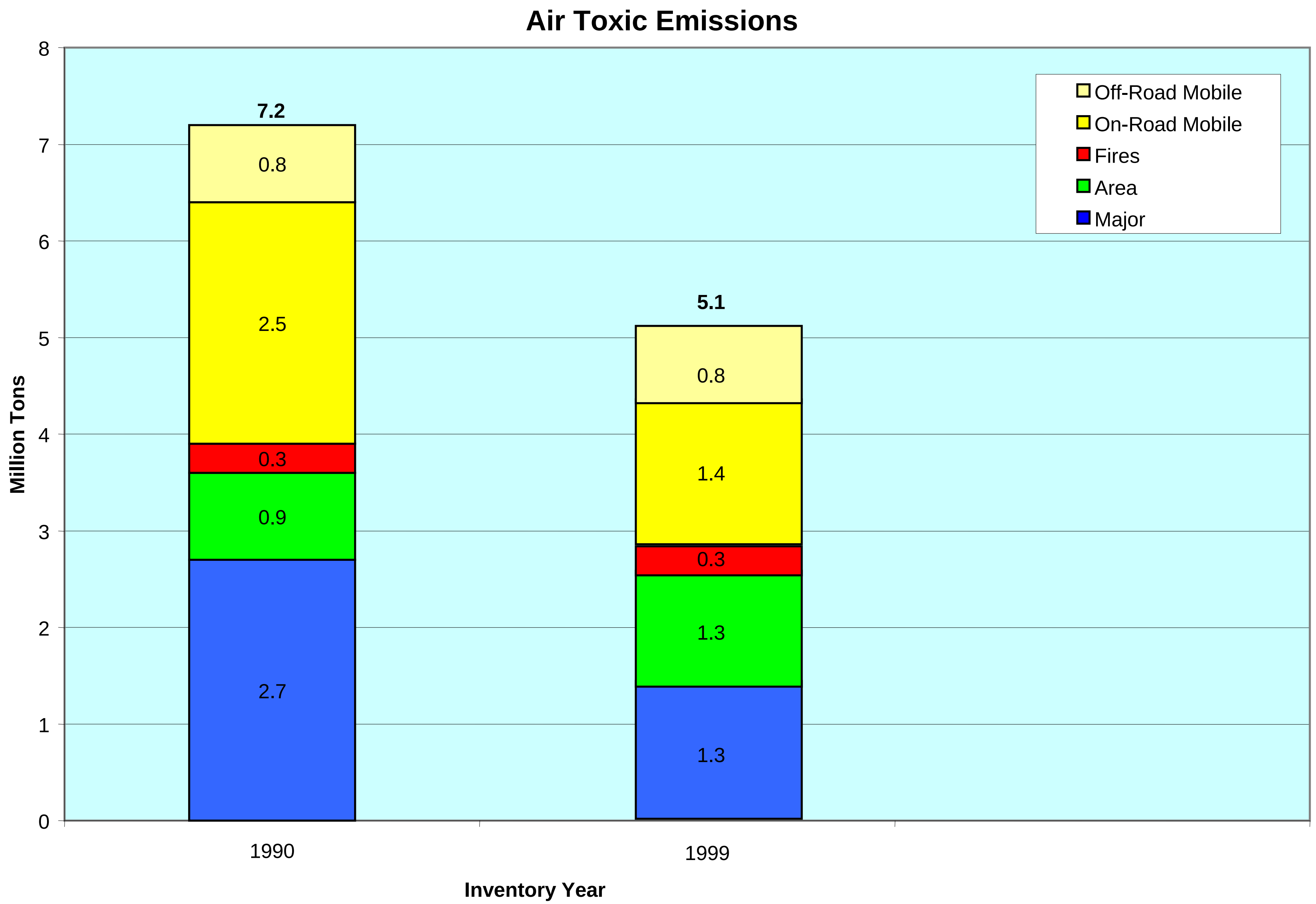
Major Risk Reductions Have Been Achieved to Date

Significant Reductions Achieved

- Emissions reduced by over 2 million tons or nearly a 30% reduction since 1990 due to MACT and mobile source programs
  - 25% reduction in carcinogens
  - 50% reduction in other pollutants causing serious illnesses

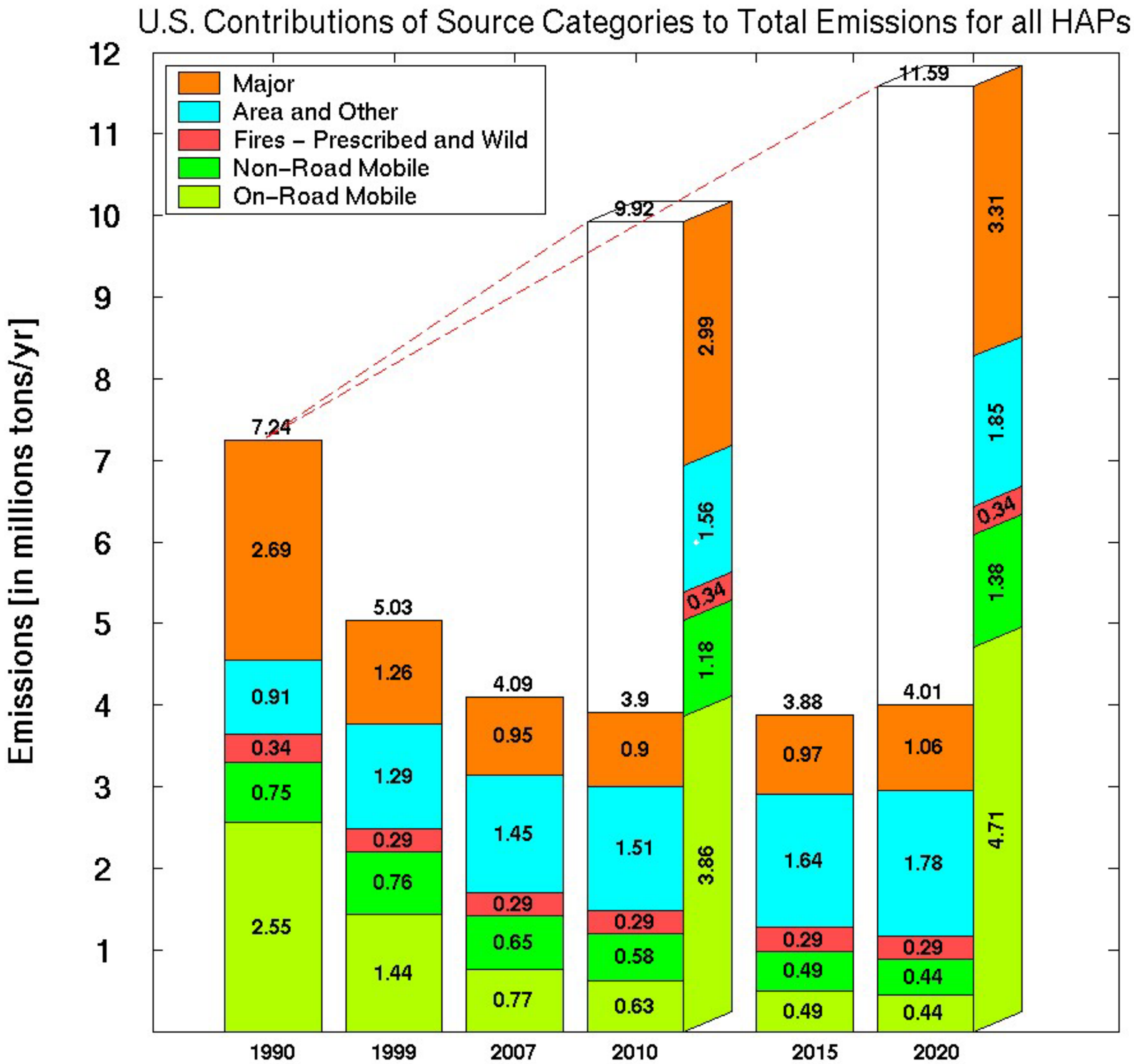
- Indoor air exposure has been reduced for 4.8 million children in over 9,200 schools through Tools for Schools program

...But More Reductions Are Needed


Air Toxic Emissions
Million Tons
Inventory Year
0
1
2
3
4
5
6
7
8
1990
1999
7.2
0.8
2.5
0.3
0.9
2.7
5.1
0.8
1.4
0.3
1.3
1.3
Off-Road Mobile
On-Road Mobile
Fires
Area
Major

Projections: Total HAP Emissions

US (All 50 States) Emissions of all HAPs* by Source Sector



Key Findings

• Without EPA's programs, 50% increase in emissions from 1990 to 2020; however, with them expect a 40% decrease

•Major source emissions decrease through 2010, reflecting reductions associated with MACT program. Stable past 2010 since resid risk not included in projection

•Area&other increase. Most of the standards resulting from the area program are not included.

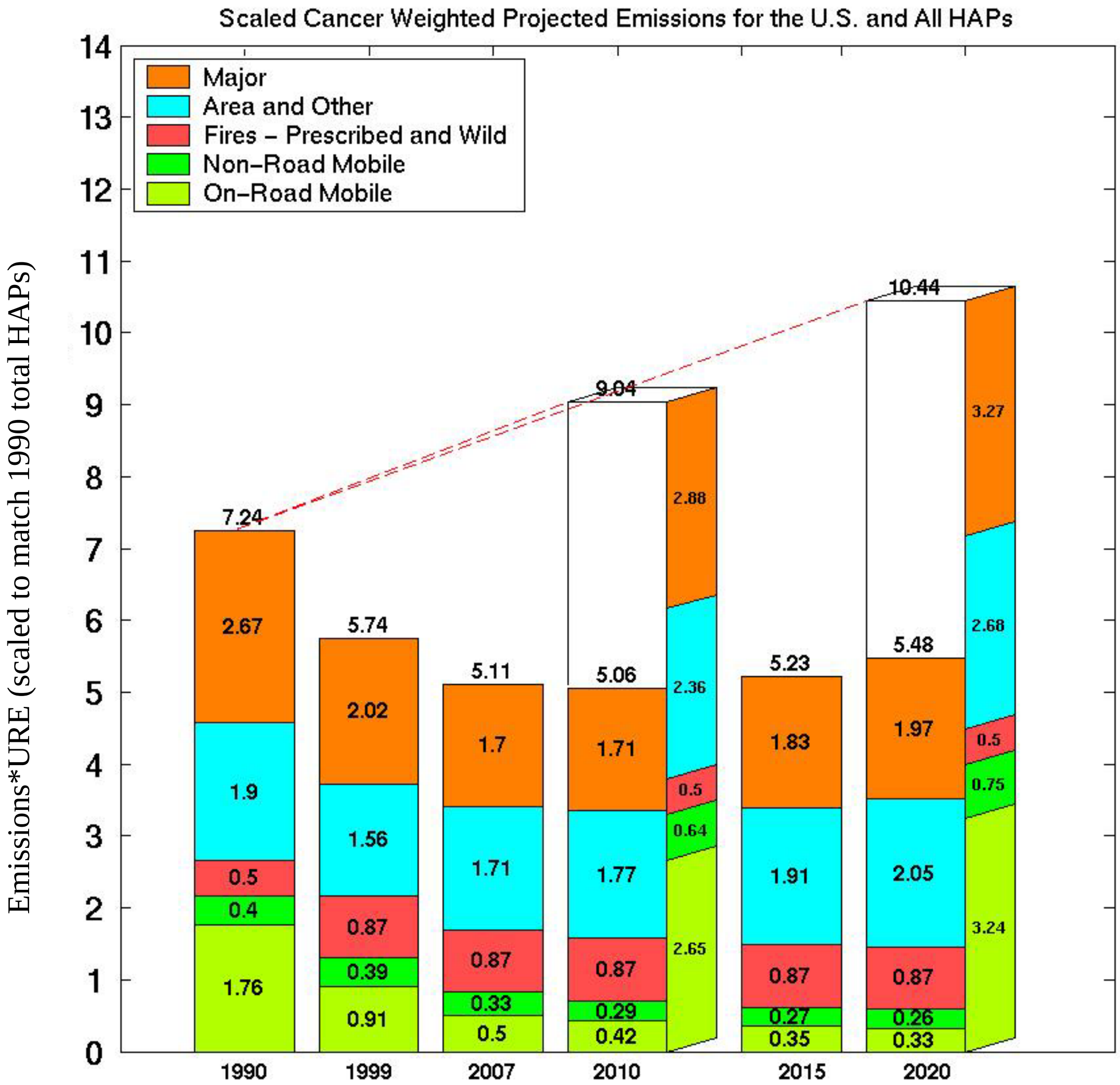
•Mobile source emissions decrease thru 2020 with additional decreases likely from future programs (e.g., MSAT2)

•Contribution of stationary source emissions to total HAP increases over time

*except mercury

Projections:

Toxicity-Weighted Emissions for Cancer

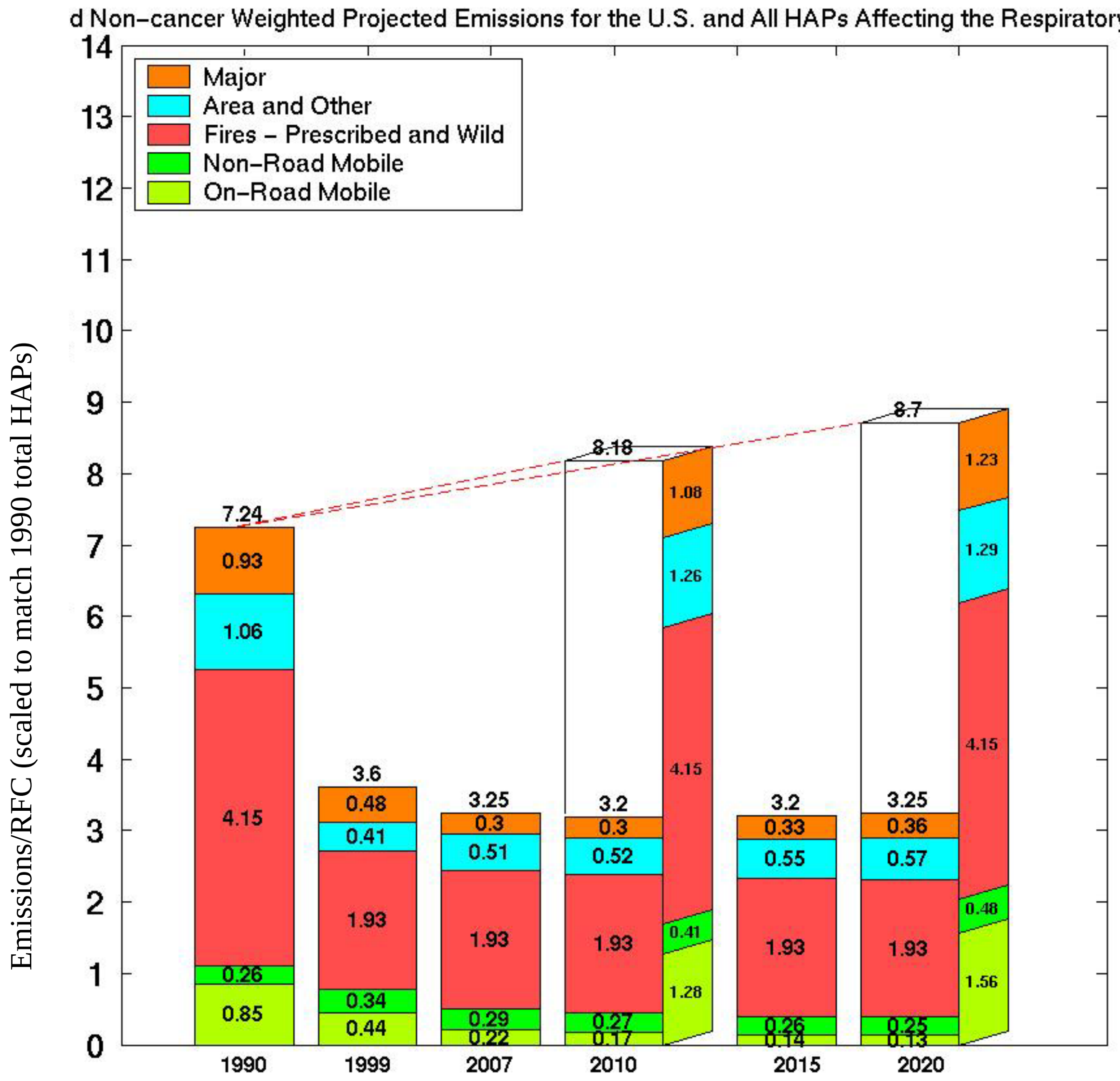


Key Findings

- •Total tox weighted emissions show similar trend as total emissions, but at lower magnitude
- •Major source programs, in particular, show larger reductions in total HAPs than cancer HAPs
- •Area&other shows markedly different 1990-to-1999 trend: large decreases rather than increases due to hex chrom & perc reductions
- •Mobile source tox weighted trends closely follow total HAP trends
- •Contribution of stationary source tox-weighted emissions larger than mobile source contribution, and increases in the future

Projections:

Toxicity-Weighted Emissions for NonCancer



Key Findings

- Large decrease from 1990 to other years is primarily due to wildfires&prescribed burning due in part to methodology inconsistency; however can gain insights by looking at source sector trends which also decrease
- Major source reductions larger for noncancer HAPs than total HAPs
- Area&other trend somewhat limited by methodology uncertainty
- Mobile source tox weighted trends closely follow total HAP trends
- Contribution of stationary source non-cancer weighted emissions to the total increases over time

National Rules Are Still Needed

- Residual Risk
- Area Sources
- Combustion Sources
- Mobile Sources

Local Approaches Are Also Needed

- Can more efficiently address many local air problems
- Can take a lot of actions not covered by Federal rules
- Can address cumulative exposure
- Can obtain results sooner

Challenges Ahead

Challenges Ahead

- How to increase efficiency across EPA programs – integration of CAP and HAP programs
- How to further reduce indoor air exposure
- How to address air-water interface needs
- How to determine whether to list additional pollutants (e.g., diesel, particulate matter, hydrogen sulfite, ammonia)
- How to have a multi-media strategy to address metals
- How to get speciated and real-time data on air toxics
- How to address upsets

What Is an Air Toxics Emission Inventory?

Inventory - current comprehensive listing by sources of air pollutant emissions in a geographic area during a specific time period

Why Do We Need Air Toxics Inventories?

- Public interest in clean air
- To identify sources and problem areas
- As a baseline for future planning
- Tracking trends/progress towards cleaner air
- Determining compliance with regulations
- Projecting control strategy impacts
- For use in air quality modeling and risk assessments
- To help site ambient monitors

1990 Clean Air Act Toxics Requirements

- www.epa.gov/ttn/atw/eparules.html
- MACT source category & HAP listing/delisting
- Section 112(k), Urban Area Source Program
- Section 112(c)(6)
- Section 112(f), Residual Risk Program
- Section 112(m), Great Waters Program
- Section 112(n), Special Studies, e.g., Hg

Your Agency's Air Toxics Rules, Standards, and Programs

Introduction
to Air Toxics Modeling

What is Air Quality Modeling?

Determination of ambient air concentrations and deposition of pollutants by mathematically simulating their “fate & transport” in the atmosphere

Why Model?

- Too costly to monitor for every pollutant everywhere
- To predict what will happen...
  - New source
  - New strategies
  - Future Growth
- Can tell you what sources are contributing to the ambient air concentrations
- Can help you decide where to put monitors

Basic types of models

- Eulerian

  (grid)

- Observer "watches the plume go by"

- Lagrangian

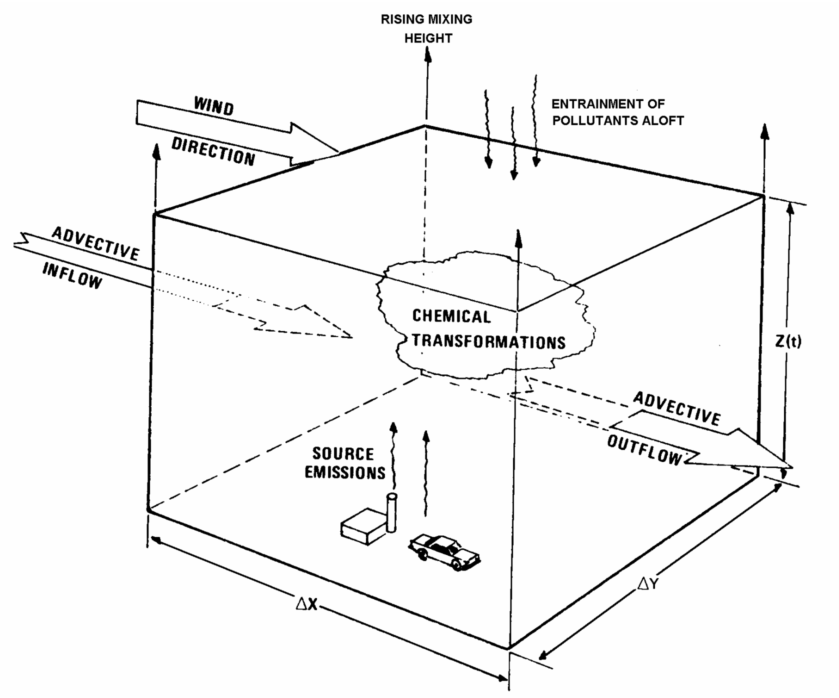
  (plume/puff)

- Observer "follows along with the plume"

Eulerian Model

Grid models (CMAQ, CAMX, etc.)

- Chemistry
- Emissions pass through a volume of air



Lagrangian Models

- Example is the gaussian plume model, e.g., ISCST3
- Local scale impacts
- Non-reactive pollutants

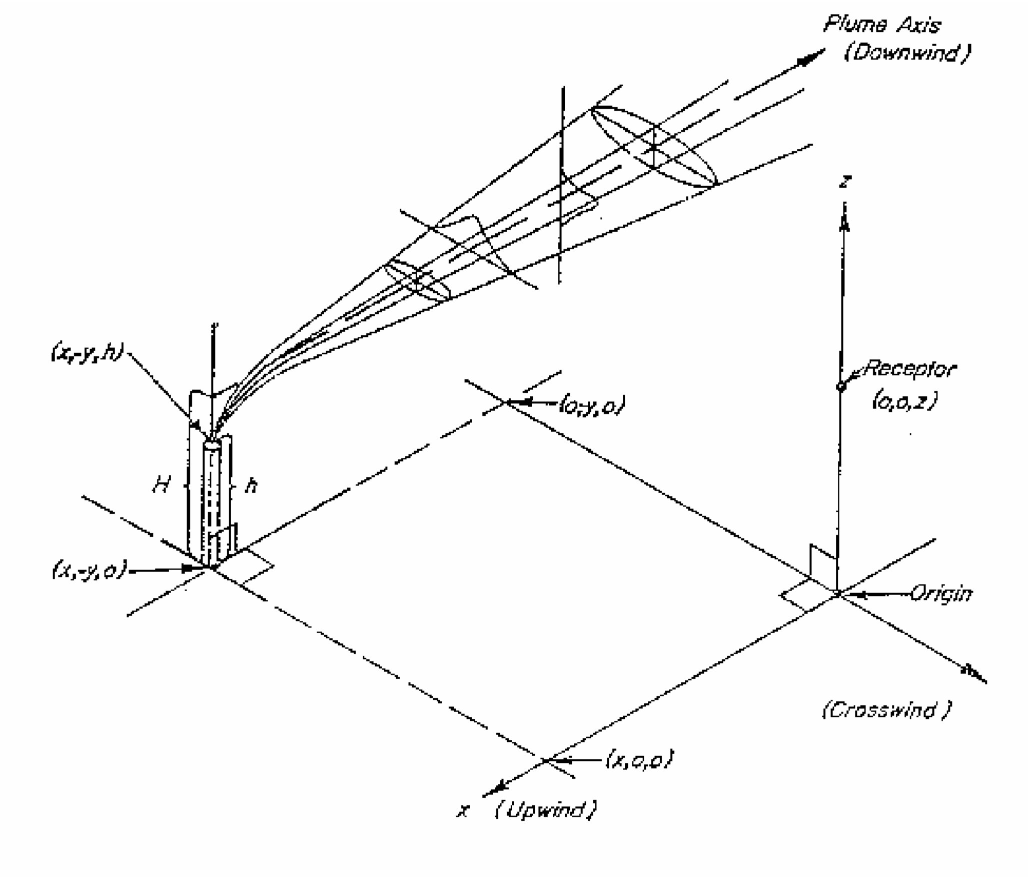


Figure from the CALPUFF training course manual,Earth Tech, Inc., 10/99; reproduced courtesy of Joseph Scire

Standard examples of Lagrangian models for use in risk assessments

- SCREEN3 – simple, easy, conservative screening level model
- ISCST3 – Refined gaussian plume model, commonly used
- CALPUFF – puff model used for complex winds and long range transport
- AERMOD – Proposed to replace ISCST3
- ASPEN – ISCLT2 with changes made to allow national scale modeling at reasonable run times

Which model should I select?

- Are the pollutants of interest primary or secondary? Are they reactive?
- Are the gases heavier than air (i.e., dense)?
- How large is the area of interest? How far away from the source(s) will I be predicting concentrations?
- Are there significant terrain features (i.e., mountains, hills, valleys)?

Which model should I select? (continued)

- Are there nearby buildings that can affect the plume?
- Is there important complex meteorology (i.e., stagnation, valley upslope/downslope flows, channeling)?
- Are multiple pathway exposures a concern (i.e., soil ingestion, fish consumption, etc.)?

Air Quality Modeling is One Step of an Air Toxics Modeling Application

Emissions preparation → Air Quality Model → Exposure Modeling and Risk Characterization

Other tools prior to the AQ model and after the AQ model are used

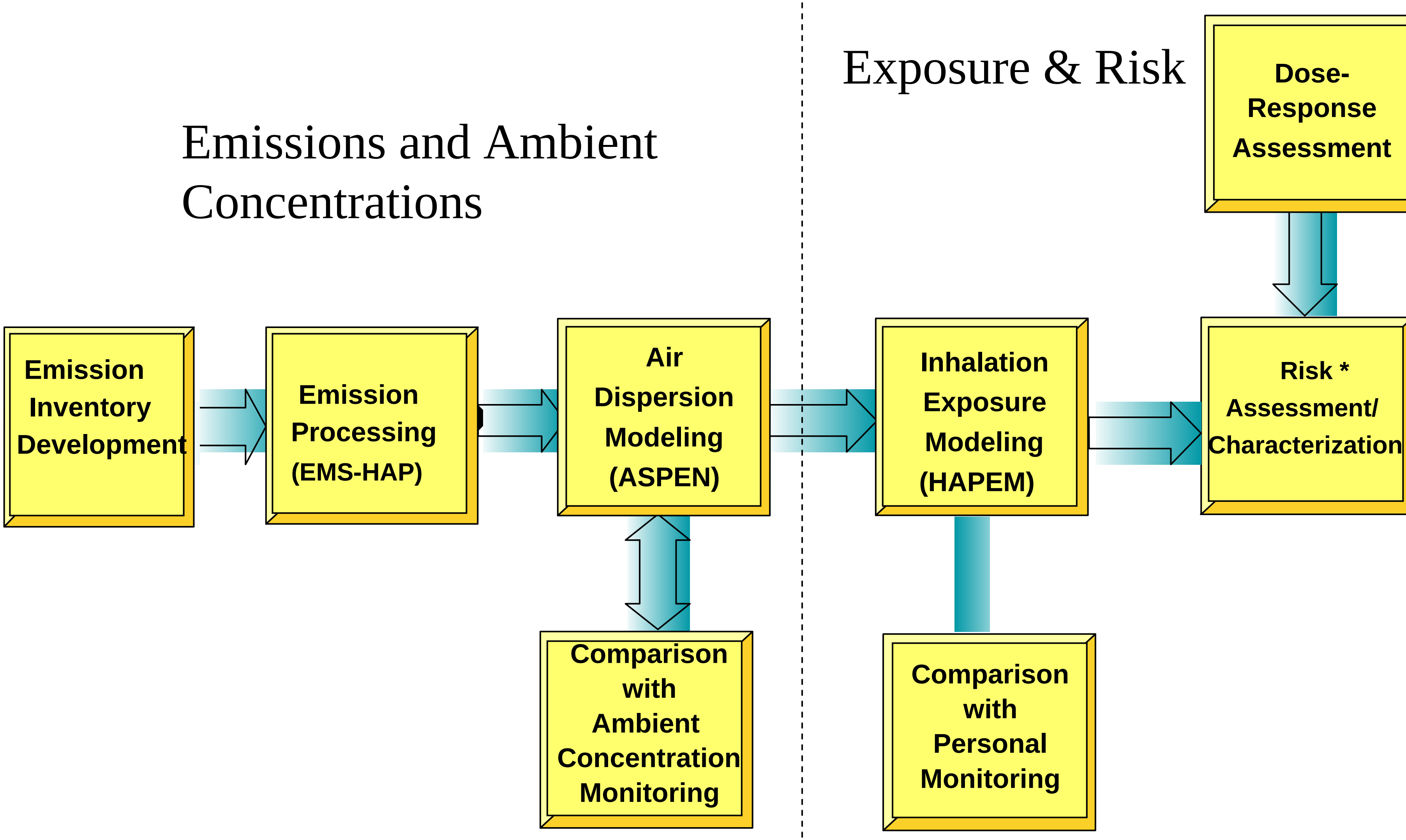
Example Air Toxics Modeling Applications

- National Scale Assessment

  NATA 1996- www.epa.gov/ttn/atw/nata

  NATA 1999 -
- Urban/local/community scale
  - Portland Air Toxics Assessment http://www.deq.state.or.us/aq/Factsheets/03-AQ-004-PATA.pdf
  - Philadelphia Air Toxics Assessment http://www.epa.gov/reg3artd/airquality/phila_toxics.htm
  - Houston Application "Example Application of Modeling Toxics Air Pollutants in Urban Areas" (EPA454-R-02-003, June 2002).

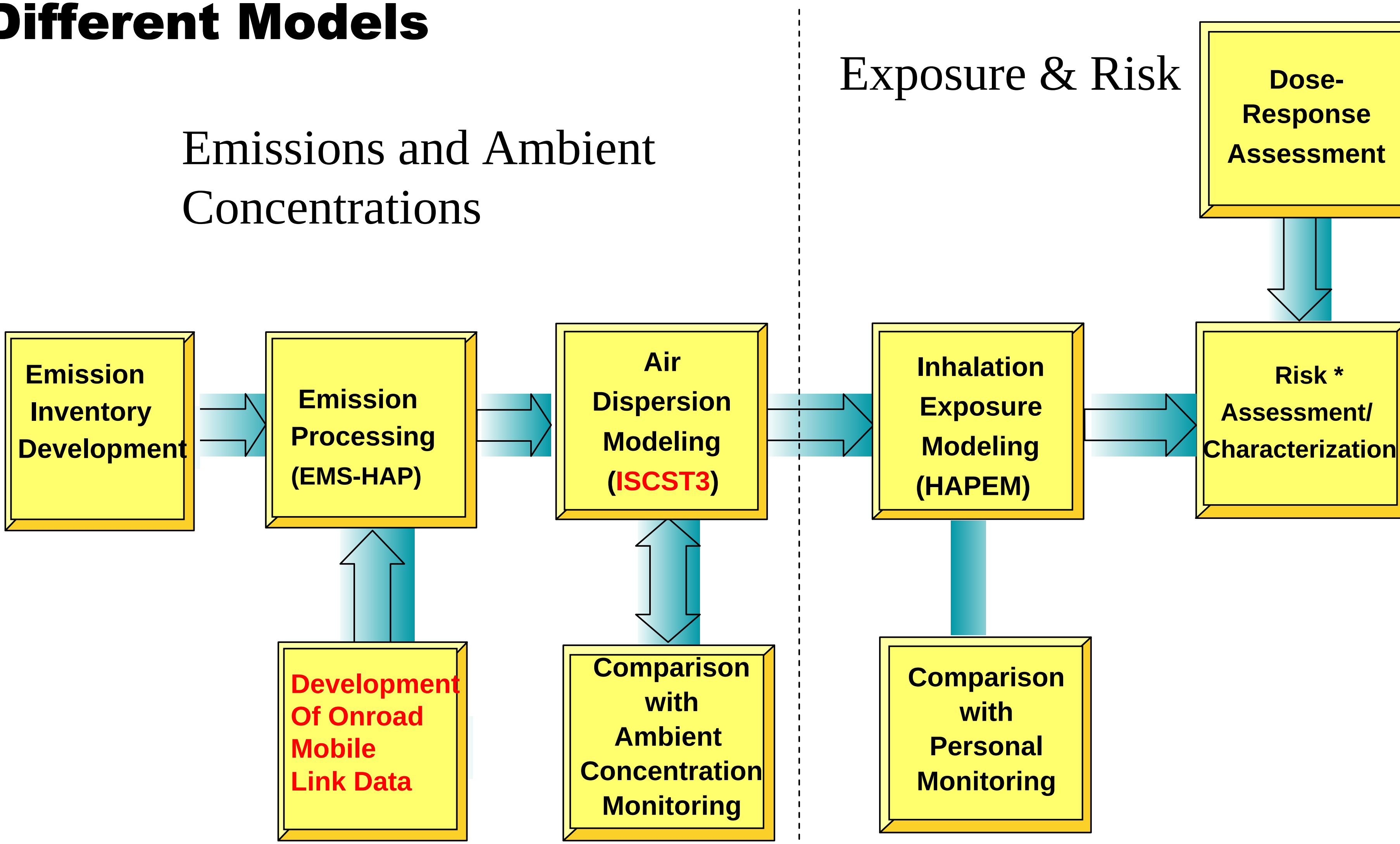
National-Scale Modeling Approach For Air Toxics for NATA



* Inhalation exposure **only**

Chronic exposures **only**

Community-Scale Modeling Approach For Air Toxics for Houston/Philly Utilize Different Models



* Inhalation exposure **only**
Chronic exposures **only**

Other options for community scale modeling

- CALPUFF, AERMOD, UAM-TOX, CMAQ
- Processing emissions for these models may be done manually or with EMS-HAP (ISCST3 or AERMOD), or SMOKE (CMAQ) if proper inputs are developed
- RAIMI (Regional Impact Air Modeling Initiative) has also been used as a modeling/risk tool (http://www.epa.gov/air/oaqps/eog/broadcast.html, see July 2004 broadcast)

Ambient Monitoring Helps to Inform Modeling

- Limited monitoring data already confirm that EPA's modeling results
  - Did not overestimate risks associated with gaseous pollutants
  - May have underestimated risks associated with particulate pollutants
- To be more comprehensive, EPA is expanding the air toxics inventory and monitoring programs, both locally and nationally

Preparing an Emission Inventory for Air Quality Modeling

Adapted from Presentation at
The 12/2003 Region 10 Air Toxics Summit

strum.madeleine@epa.gov

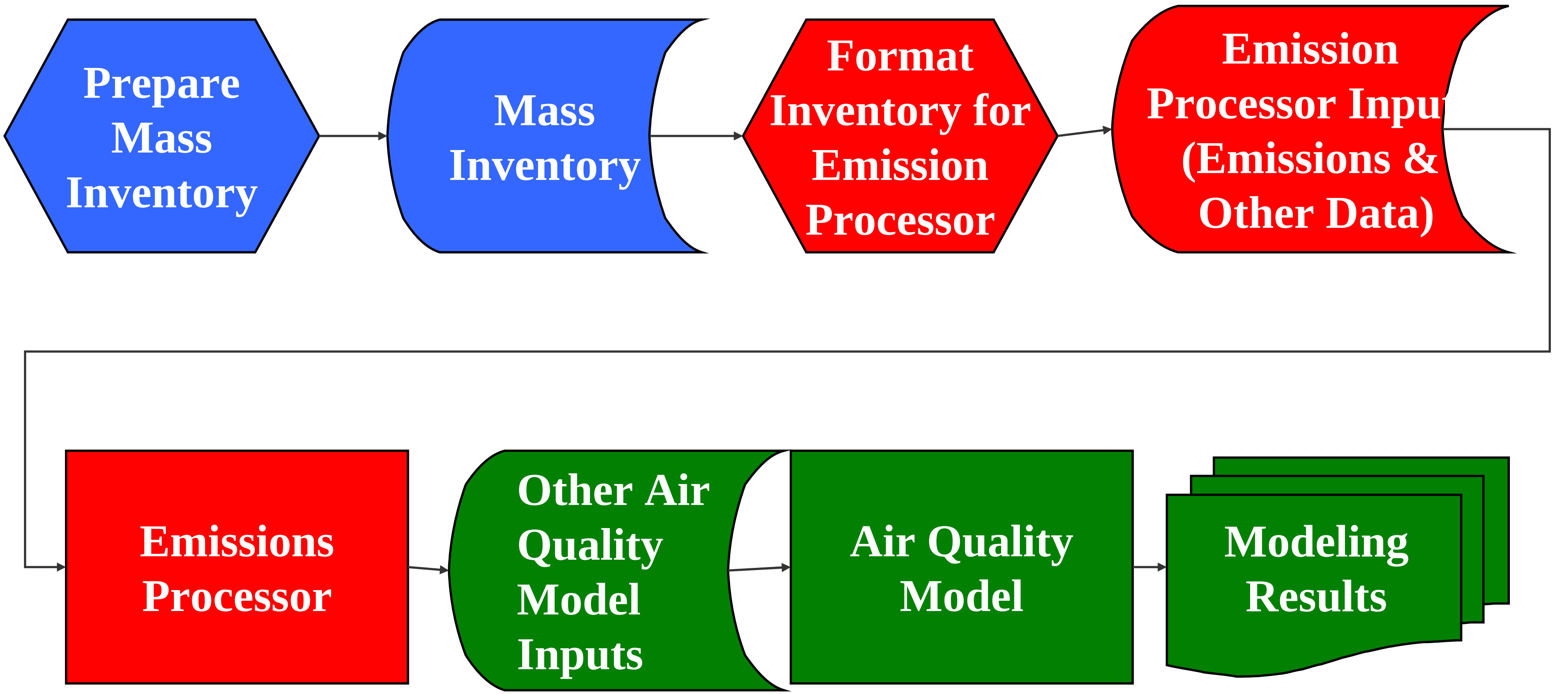
Objective of Presentation

Provide an overview of how to prepare an emission inventory for air quality modeling

- Background & terminology
- Emission processor functions
- Getting an inventory ready for the emission processor

strum.madeleine@epa.gov

The Big Picture



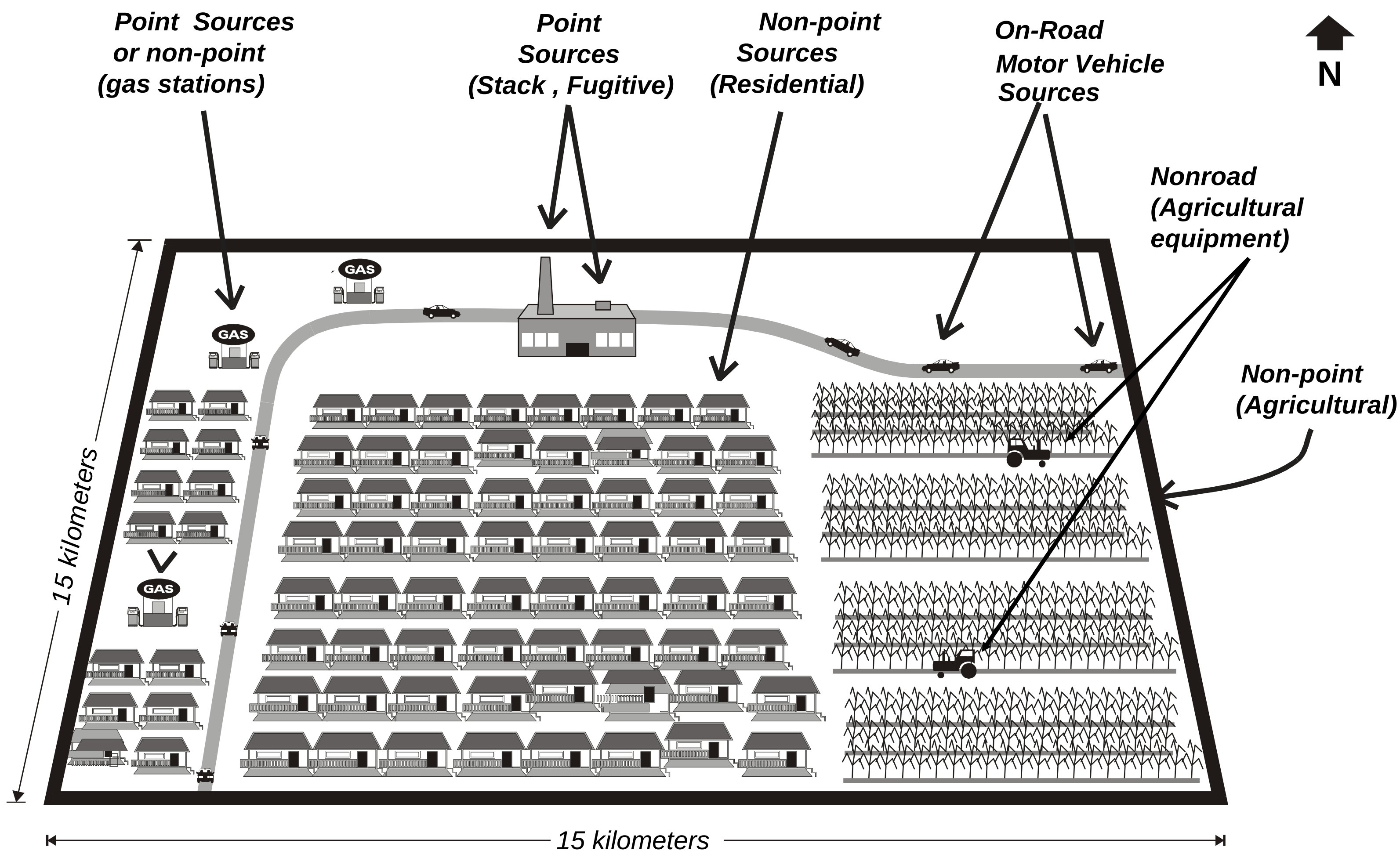
Challenges in Preparing an Inventory For Modeling

- Different air quality models have different emission needs
- Inventory information doesn't match those needs
- Inventory information evolves -- emission processors must keep up with the changes
- Terminology can be different from inventory to processor to air quality model

Inventory preparers should understand the inventory and its development and the AQ model

strum.madeleine@epa.gov

Example Modeling Domain



Point Sources

- Inventory Perspective: Emissions occur at a facility – at a known location
- Gaussian AQ Model Perspective: Point sources are vertical stacks
- Key inventory elements
  - Facility/Process/Stack-Level emissions, by pollutant
  - Geographic coordinates
  - Emission release point parameters
  - Operating schedule
  - Control Information (for projections)

strum.madeleine@epa.gov

Non-Point , Nonroad

- Non-point and Nonroad emissions treated similarly
- Inventory-perspective: county-level emissions
- AQ model perspective: non-stack
- Key inventory elements
  - Category-Level Emissions (process/industrial category), by pollutant
  - State/county
  - Operating Schedule
  - Control information (projections)

strum.madeleine@epa.gov

Onroad

- National Inventory-perspective: county-level emissions
- AQ model perspective: non-stack
- Key inventory elements
  - Category-Level Emissions (vehicle type/road class), by pollutant
  - State/county
- For local scale analysis, you can create a link-based inventory by running MOBILE6 model using link-specific activity

strum.madeleine@epa.gov

NEI Modeling files

- 3 Types
  - NEI HAP Annual
  - NEI CAP Annual
  - NEI CAP NonAnnual
- Sector formats
  - Point – Handout 1
  - NonPoint – Handout 2
  - Nonroad – Handout 2
  - Onroad – Handout 3

strum.madeleine@epa.gov

Emission Processor Functions

Air Quality Model Needs…

- Hourly time resolution
- Geographically resolved emissions (gridded or specific dimensions)
- Pollutant species (“model species”) to meet needs of AQ model chemical/physical algorithms
- *Risk assessors want modeled species to match health effects data
- All sources represented
    - Anthropogenic, Biogenic (grid models)

strum.madeleine@epa.gov

Developing of Emission Inventories for Modeling Requires

- Quality Assurance/Quality Control
- Temporal Allocation – hourly
- Spatial Allocation – proper resolution
- Pollutant Speciation – model species
- Emission Projections (optional)

Typically done in an Emission Processor

Using inventory codes (SCC, SIC, MACT)

strum.madeleine@epa.gov

Commonly Used Emission Models/Processors

For criteria pollutants

EMS95/2000, 2001

SMOKE

EPS2.5

For toxic pollutants

EMS-HAP (ISC/ASPEN): Version 3

http://www.epa.gov/ttn/scram/tt22.htm#aspen for User's Guide and code

SMOKE (grid models) Version 2.0

http://www.cep.unc.edu/empd/products/smoke/version2.1/ for User's Guide, www.cmas.org for code

strum.madeleine@epa.gov

Temporal Allocation

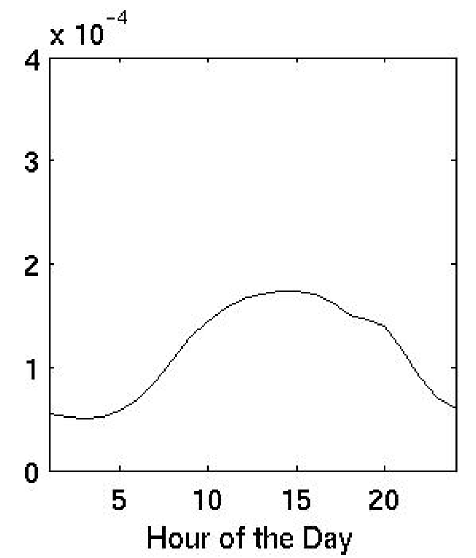
Typically from annual (inventory) to what model needs

EMS-HAP/ASPEN → **3-hour time blocks (every day is treated the same)**

EMS-HAP/ISCST3 → **24-hourly, 4 season, 3 day type factors**

EMS-HAP uses temporal profiles

Example: temporal profile for aircraft emissions, for summer weekday



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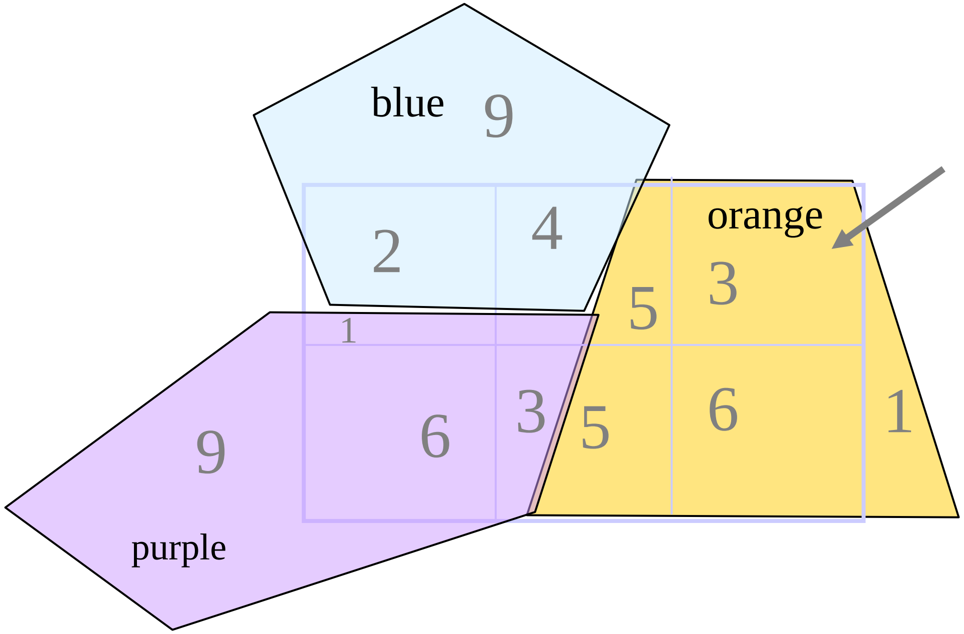
Spatial Allocation of County-level Emissions

Concept: use surrogates to allocate county level emissions for county-level sources

e.g., population data to allocate consumer product emissions



This Grid cell gets 3/20 of Orange county's consumer product emissions

strum.madeleine@epa.gov

Spatial Allocation of County-level Emissions: Where do the Underlying Data Come From?

About 60 surrogates prepared for SMOKE can be obtained from "emission modeling clearinghouse" website: www.epa.gov/ttn/chief/emch/spatial

Same "raw" data used for EMS-HAP surrogates for 1999 NATA. EMS-HAP-ready files can be downloaded from **http://www.epa.gov/ttn/scram/tt22.htm#aspen**

strum.madeleine@epa.gov

County – to – Point Processing

- Allows airport-related emissions to be modeled at specific locations rather than distributed to a grid
- Airport location data and allocation factors supplied with EMS-HAP/SMOKE
- Airport dimensions supplied by user (EMS-HAP/ISCST3)
- Code general enough to include other sources such as landfills and ports

strum.madeleine@epa.gov

Grouping/Partitioning Metal Compounds for Toxics Modeling

Example: Manganese Coarse and Fine Pollutant Groups

Inventory Species
Manganese nitrate
Manganese dioxide
Manganese tetroxide
Manganese napthenate
Manganese & compounds
Manganese
Manganese tallate
Manganese sulfate

- Remove non-manganese mass

→

- Partition into coarse and fine

Model Species
Manganese coarse
Manganese fine

EMS-HAP Version 3 and SMOKE allow speciation of inventory reported chromium into hexavalent chromium based on inventory codes (SCC, SIC, MACT)

strum.madeleine@epa.gov

Getting Ready for the Emission Processor

Steps to Prepare Inventory for Emissions Processor

National Emission Inventory (NEI) is starting point

- Develop “modeling files” containing the necessary variables for processing and QA
- Subset to modeling domain
- For all inventory categories: check inventory codes (SCC, SIC, MACT), pollutants, FIPs codes, and make sure cross references are available for emission processor ancillary files

strum.madeleine@epa.gov

Point Source Inventory Analysis

- Emissions – top 5 or top 10 lists for key pollutants
- Geographic coordinates
  - Check if any were defaulted – find actual values
  - Check that coordinates are consistent with county
- Stack parameters
  - Check if any were defaulted – find actual values
  - Check similar parameters for similar SCC/SIC
- Add modeling information likely not in inventory
  - Building parameters
  - Dimensions for sources you would like to model as “area”

strum.madeleine@epa.gov

Non-Point Source/Nonroad Inventory Analysis

- Determine if any source categories can be assigned to actual locations, e.g., landfills-placing emissions in the proper location will always improve the modeled estimate
- Find locations, area source dimensions, release parameters
- Develop surrogates for those categories that cannot be allocated to actual locations
- Compare surrogate data to emission data – e.g., do you have port emissions where you have no ports?

strum.madeleine@epa.gov

Mobile Source Inventory Analysis

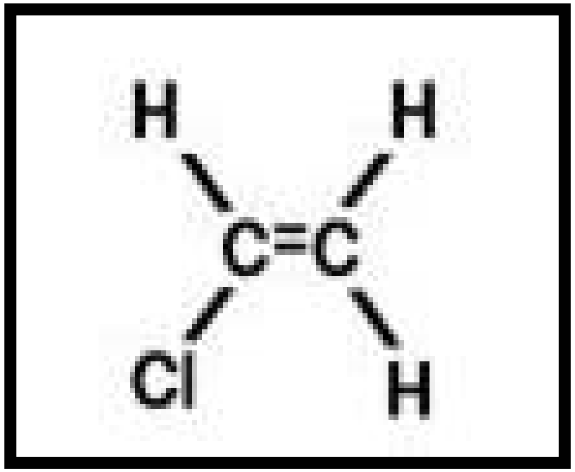
- Depends on whether you do link-based
- If you do grid emissions, check the surrogate data for completeness

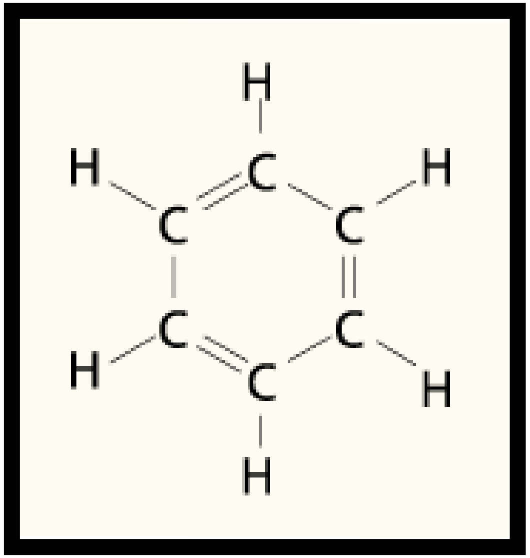
strum.madeleine@epa.gov

Conclusions

- Inventories used for modeling are more than just emissions – AQ models need more detailed inputs
- Take steps to insure the inventory can support temporal, spatial and speciation needs as required by the analysis
- Cooperative effort between inventory preparers and modelers to understand analysis goals and the limitations of the inventory

strum.madeleine@epa.gov





Pollutant Definitions

Pollutant Definitions – Identifying HAPs

- Clean Air Act list of 188 HAPs
- Clean Air Act Section 112(k) 33 Urban HAPs
- Persistent Bioaccumulative Toxics (PBTs)
- State and local agency lists

33 Urban HAPs

Acetaldehyde
Acrolein
Acrylonitrile
Arsenic compounds
Benzene
Beryllium compounds
1, 3-Butadiene
Cadmium compounds
Carbon tetrachloride
Chloroform
Chromium compounds
Coke oven emissions
1, 3-Dichloropropene
Diesel particulate matter*
Ethylene dibromide
Ethylene dichloride
Ethylene oxide
Formaldehyde
Hexachlorobenzene
Hydrazine
Lead compounds
Manganese compounds
Mercury compounds
Methylene chloride
Nickel compounds
Perchloroethylene
Polychlorinated biphenyls (PCBs)
Polycyclic organic matter (POM)*
Propylene dichloride
Quinoline
1, 1, 2, 2-Tetrachloroethane
Trichloroethylene
Vinyl chloride

Persistent Bioaccumulative Toxics (PBTs)

- Alkyl-lead
- Dioxins
- Furans
- Mercury and compounds
- Octachlorostyrene
- Polychlorinated biphenyls (PCBs)
- Aldrin/Dieldrin
- Chlordane
- DDT, DDD, DDE
- Hexachlorobenzene
- Mirex
- Toxaphene

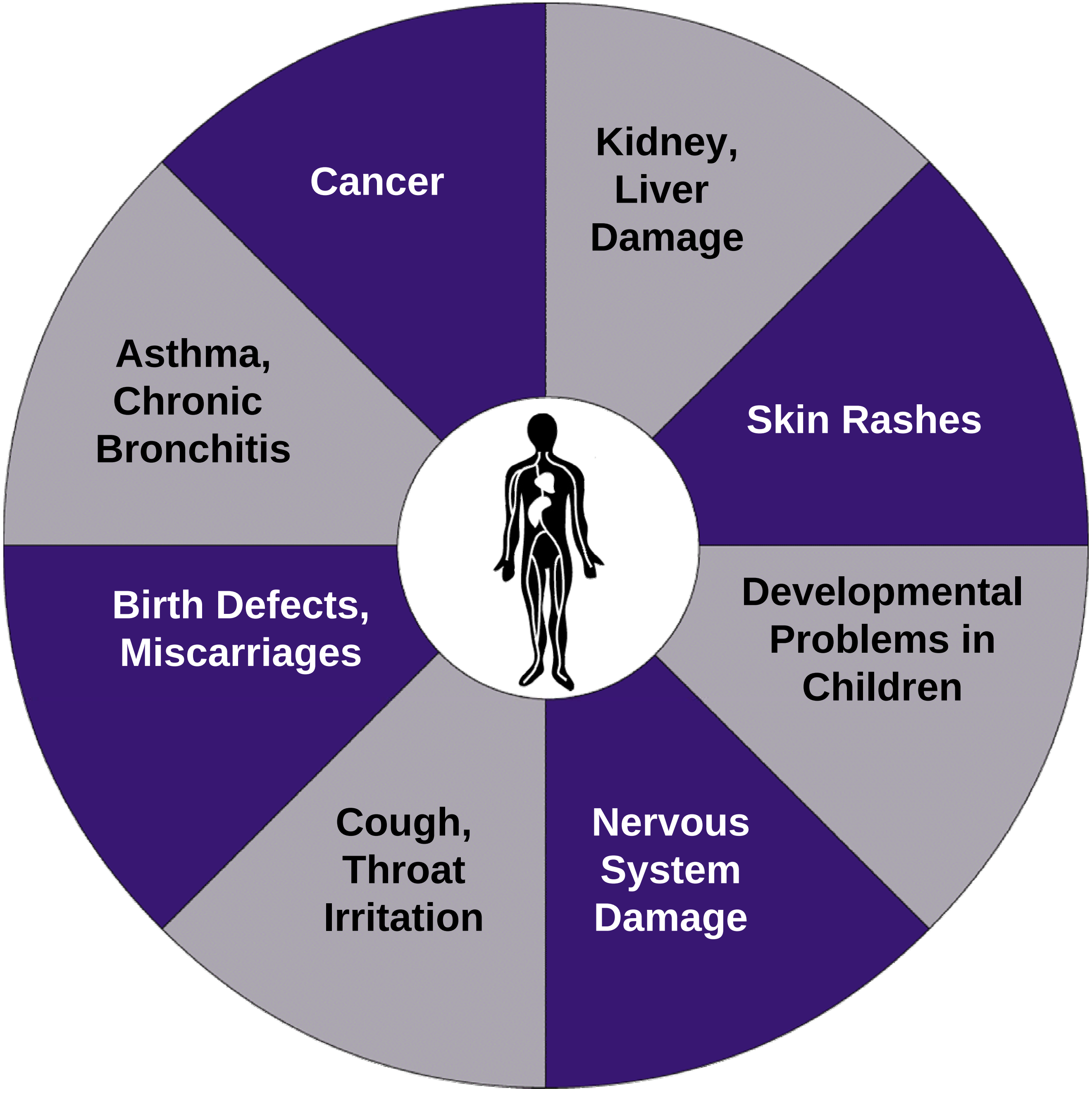
Your Agency's Air Toxics Definitions/List

Issues to Consider With HAPs

- Important to use CAS #s
- Keep in mind that toxicity varies by chemical
  - Carcinogens
  - Non-carcinogens
- HAP Groups in the CAA and Diesel PM

Chemical Abstracts Service (CAS) #s

- http://www.epa.gov/ttn/chief/nif/index.html#ver3
- EPA's Office of Environmental Information Substance Registry System www.epa.gov/srs/


Cancer
Kidney, Liver Damage
Skin Rashes
Developmental Problems in Children
Nervous System Damage
Cough, Throat Irritation
Birth Defects, Miscarriages
Asthma, Chronic Bronchitis

Toxicity Information

- http://www.epa.gov/ttn/fera/risk_atoxic.html
- NATA uses "Chronic Inhalation" to prioritize HAPs and quantify effects
  - URE: cancer
    - Higher URE means higher risk at same dose
  - RfC: noncancer
    - Lower RfC means response can be caused by smaller dose

Carcinogens

- Chemical or physical agents capable of causing cancer
- Risks are usually reported as lifetime chances that a certain number of people in 1 million will contract cancer after continuous lifetime exposure
- The Unit Risk Estimate is the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 µg/m3 in air

Non-carcinogens

- Capable of causing damage to immune system, neurological, reproductive, developmental, and respiratory health problems
- Risks can be reported relative to a Reference Concentration (RfC), where there is no appreciable risk of effects after continuous lifetime exposure

Benzene NESHAP Risk Ranges

Risk is acceptable with ample margin No further action needed	Risk may be Acceptable Look at Health Issues Then consider costs/ technical feasibility before deciding if emissions reductions are needed	Risk is unacceptable Take action to reduce risks Can only consider health

$1x10^{-6}$ $1x10^{-4}$

Risk →

1989

HAP Groups in the CAA

- Polycyclic organic matter (POM) & naphthalene
- Dioxins and furans
- Metals
- Cyanide compounds
- Glycol Ethers
- Xylenes
- Cresols

Modeling Considerations for HAPs that are part of groups

- Group multiple inventory species into a single pollutant category Example: group lead oxide, lead nitrate, lead sulfate, etc. into lead group)
- Partition inventory species into multiple pollutant categories with different particulate size classes,

  Example: apportion lead chromate to:
  1) lead compounds, fine particulate;
  2) lead compounds, coarse particulate;
  3) chromium compounds, fine particulate and
  4) chromium compounds, coarse particulate
- Adjust the emissions of an inventory species to partition it among multiple pollutant categories, account for a particular portion of it (e.g., the lead portion of lead sulfate), or adjust its potency to determine a toxics or reactivity equivalency
- Speciate compounds based on the type of source if exact compound is not given

  Example: speciate chromium into hexavalent and trivalent forms using assumptions about the process emitting the chromium

Pollutant Grouping/ Partitioning Done in Emission Processor

- "General HAP Table" is the ancillary file in EMS-HAP
- "INVTABLE" is the ancillary file in SMOKE
- These files must contain all pollutants in the input inventory to the emission processor
- Speciation based on source type is done using a separate file ("Specific HAP Table" in EMS-HAP)
- Exercise: Using the "General HAP Table" determine the two factors applied to manganese oxide, to get it to "manganese coarse" and manganese fine"
  - Factor to get from manganese oxide to manganese course
  - Factor to get from manganese oxide to manganese fine

Polycyclic Organic Matter

- "Includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100^0 C"
- Examples include polycyclic aromatic hydrocarbons (PAHs), chrysene, benzo(a)pyrene, and naphthalene
- Naphthalene is unique in that it is listed as a separate HAP on the 188 list

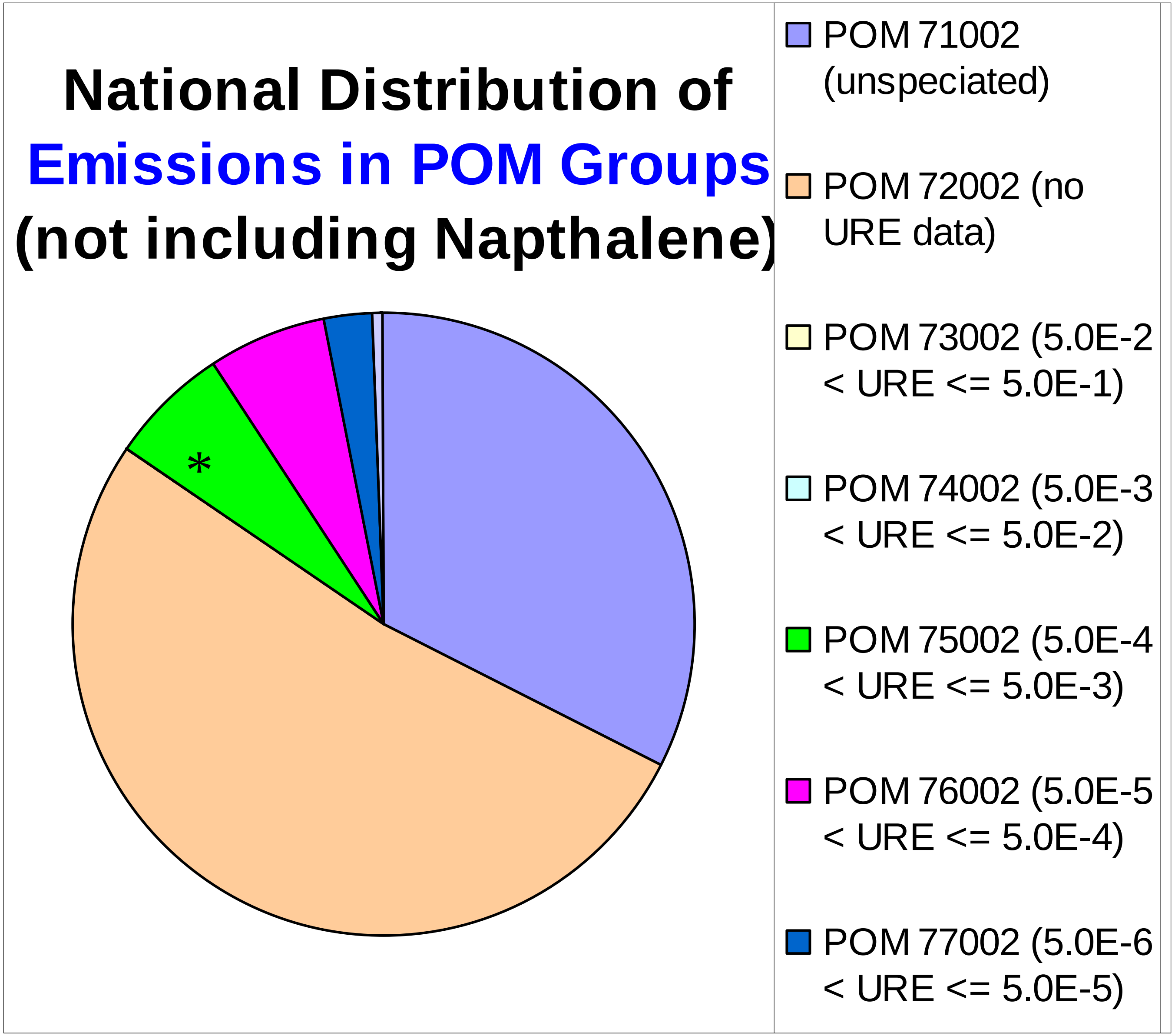
POM – NEI Groups

- POM as 7-PAH
- POM as 15-PAH – includes 7 PAH compounds
- POM as non-15PAH

Grouping of POM for 1999 NATA

POM GROUP (EMS-HAP name)	Names Used in NATA Website*	URE used in Risk Assessment	Basis
71002	POM, Group 1: Unspeciated POM_Group_1_unspec	5.5 * 10 -5	Same URE as was assumed for total POM group in NATA 1996: 5% of risk from Benzo(a)pyrene
72002	POM, Group 2: No URE data POM_Group_2_nodata	5.5 * 10 -5	Same as 71002
73002	POM, Group 3: 5e-2<URE<5e-1 POM_Group_3_vhigh1	1 * 10 -1	Midpoint of range
74002	POM, Group 4: 5e-3<URE<5e-2 POM_Group_4_high2	1 * 10 -2	Midpoint of range
75002	POM, Group 5: 5e-4<URE<5e-3 POM_Group_5_mhigh3	1 * 10 -3	Midpoint of range *this group contains benzo(a) pyrene
76002	POM, Group 6: 5e-5<URE<5e-4 POM_Group_6_med4	1 * 10 -4	Midpoint of range
77002	POM, Group 7: 5e-6<URE<5e-5 POM_Group_7_mlow5	1 * 10 -5	Midpoint of range
78002	POM, Group 8: Unspeciated 7-PAH POM_Group_8_Unspec_7	2 * 10 -4	Same as was used for 7-PAH from 1996 NATA: 18% of risk from Benzo(a)pyrene

* **first name used in maps, second used in HAP-specific raw data files**



*Group 5 overestimated due to Oregon Fire Emission Factor Issue

Dioxins and Furans

- Dibenzofurans and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) are listed on the 188 list
- EPA inventories all dioxins and furans
- Compounds can be grouped by 2,3,7,8 TCDD Toxic Equivalents (TEQs)
- TEQs are multipliers for some dioxin and furan congeners to get to a common basis of toxicity
- For some air quality models, dioxins will require more refined inventory (not sufficient to report TEQs)

Metals

- Antimony
- Arsenic
- Beryllium
- Cadmium
- Chromium
  - Hexavalent and trivalent
- Cobalt
- Lead
  - Organic and inorganic
- Manganese
- Mercury
  - Particulate, gaseous elemental, and gaseous divalent
- Nickel
  - Nickel subsulfide and other nickel compounds
- Selenium

Modeling Metal Compounds

- Specific metal HAPs should be reported in the inventory, if available
- Model mass of metal only
  - E.g. emission modelers compute the mass of manganese in manganese oxide
- Specific compound may be needed for risk assessment or chemistry considerations in model
  - E.g., to determine whether it is hexavalent chromium or trivalent chromium, is it nickel subsulfide?
- For mercury, if exact chemical compounds not known, provide amount of mass as “divalent particulate,” “divalent gas,” and “elemental”
  - These three are “model species” in numerous grid models (e.g., REMSAD, CMAQ)
  - Ideally, emissions should be broken out by specific chemical and by specific form (gas vs particulate)

Cyanide Compounds

- Includes: Hydrogen cyanide, Zinc cyanide, Potassium ferrocyanide, etc.

- NATA Methodology: "Convert" (mass adjustment) all cyanides to hydrogen cyanide equivalents and group as "cyanide compounds"

  E.g., To quantify how much hydrogen cyanide emissions would result from silver cyanide (CAgN):

  Molecular Weight of CAgN is 133.8857

  Molecular Weight of HCN is 27.0256

  Factor = 27.0256/133.8857= 0.2019

  Equivalent emissions of CAgN= CAgN Emissions * 0.2019

Glycol Ethers

- “Includes moni-and di-ethers of ethylene glycol, diethylene glycol, and triethylene glycol...Polymers are excluded from the glycol category.”
- Over 50 individual compounds in NEI pollutant code look up table
- http://daq.state.nc.us/toxics/glycol/

Xylenes and Cresols

- Xylenes: mixture of o-,m- and p- isomers
- Cresols: mixture of o-,m- and p- isomers, cresylic acid

Note: For NATA, we're not currently using the isomers.

Diesel PM

- Mixture of particles that is a component of diesel exhaust
- Cancer and noncancer health effects
- Noncancer health effects not aggregated with other HAPs in NATA
- Diesel PM is not in 1999 NEI for HAPs
- Diesel PM modeling inventory (coarse and fine diesel PM) is created from PM inventory from diesel engines (onroad and nonroad only)

HAP Toxicity Exercises

This link opens MS Explorer. Browse the CD for the two files under \exercises\hap toxicity exercises\
You will need MS Excel to complete the exercise.

Source Category Definitions

Point, Nonpoint, and Mobile Sources are Needed for a Complete Air Toxics Inventory

Point Sources

- <u>Major Sources:</u> Stationary sources that have the potential to release 10 tons per year (TPY) of any one HAP or 25 TPY of a combination of HAPs
- <u>Area Sources:</u> Stationary sources that have the potential to release less than 10/25 TPY
- Emissions may be released from equipment leaks, when materials are transferred from one location to another, or during discharge through emissions stacks or vents

Point Source Considerations

- Point source cutoffs/local thresholds
- Major vs Area definition
- MACT vs Non-MACT source categories
- Other federal regulations, state and local regs
- Detail needed:
  - Plant, unit, process, stack (emission release point)
  - Location, stack parameters, control device info, SCCS, NAICS

Nonpoint Sources

- Called “area” sources in a criteria pollutant inventory and in some emission processing tools (SMOKE)
- Include smaller point source facilities grouped by source category
  - ✓ Gasoline stations
  - ✓ Dry cleaners
  - ✓ Car painting shops
  - ✓ Small electroplaters

Other Nonpoint Sources

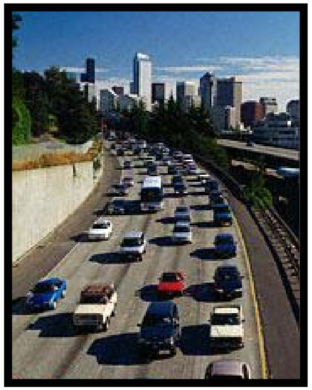
- Sources such as wildfires and prescribed burnings that may be more appropriately addressed by other programs rather than through regulations developed under certain air toxics provisions (section 112 or 129) in the Clean Air Act. For example, wildfires and prescribed burning are being addressed through the burning policy agreed to by the Interim Federal Wildland Policy.
- Other examples
  - Residential wood combustion
  - Residential combustion of household waste (backyard barrel burning)

Nonpoint Source Considerations

- Includes source categories that overlap with point source inventory
- HAP point source inventories often include small sources such as dry cleaners and gas stations (treated as area sources in a criteria inventory)
- MACT vs non-MACT source categories
- Other federal regulations, state and local regs
- Detail needed:
  - County level
  - SCCs, NAICS

Mobile Sources

- **Onroad** - Vehicles found on roads and highways (e.g., cars, trucks, buses)
  - 20 volatile organic compounds and metals
  - Diesel particulate matter and diesel exhaust organic gases
- **Nonroad** - Mobile sources not found on roads and highways
  - 2/4 stroke engines in lawn mowers, construction vehicles, farm machinery
  - Aircraft
  - Locomotives
  - Commercial marine vessels

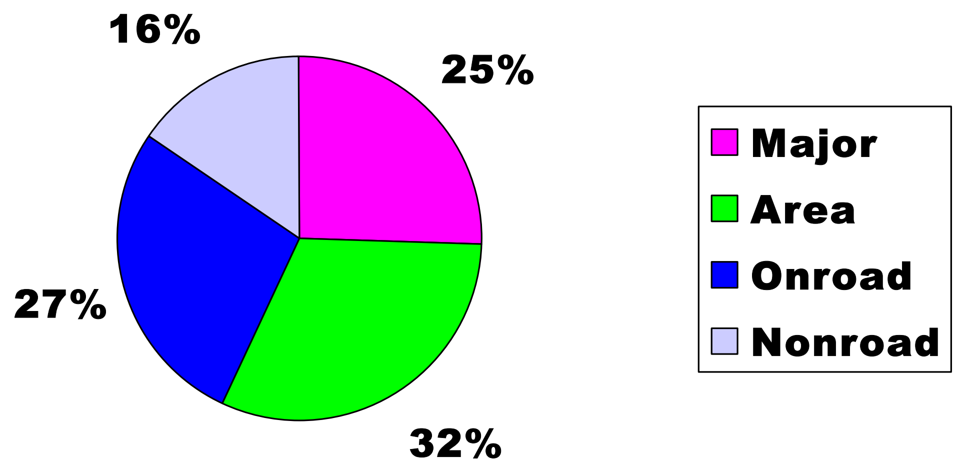


Mobile Source Considerations

- Contribution by source category varies geographically
- Federal, state, and local regulations
- Diesel PM

Developing a Mobile Source Inventory

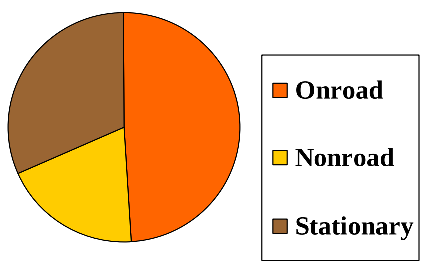
- 43% of toxic emissions in the 1999 NEI are attributable to mobile sources



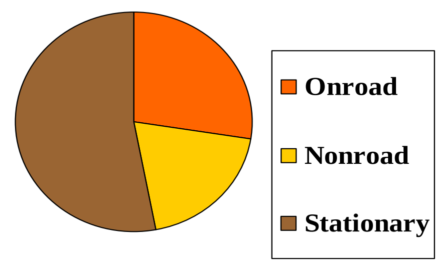
Mobile Source Contribution to 1999 Toxics Inventory

- Inventories of several major HAPs dominated by mobile sources

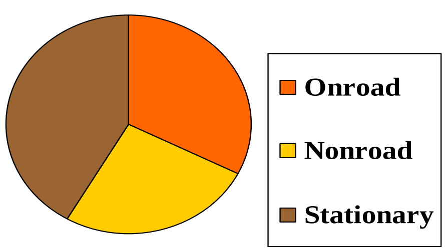
Benzene



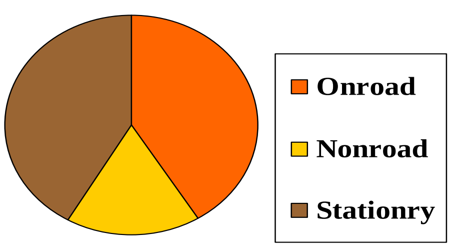
Formaldehyde



Acetaldehyde



1,3-Butadiene



Onroad Mobile Sources

- MOBILE 6.2 model
- Vehicle types
- Vehicle Miles Traveled (VMT)
- Fuels used

Nonroad Mobile Sources

- Nonroad Equipment
  - NONROAD model yields criteria pollutant estimates
  - Fuels used
  - Activity data
  - Emission factors
  - Speciation profiles

Aircraft

- Commercial air carriers, air taxis, general aviation, helicopters, and military aircraft
- FAA’s Emissions and Dispersion Modeling System (EDMS) for commercial carriers
- Activity data
- Emission factors
- Speciation profiles

Locomotives

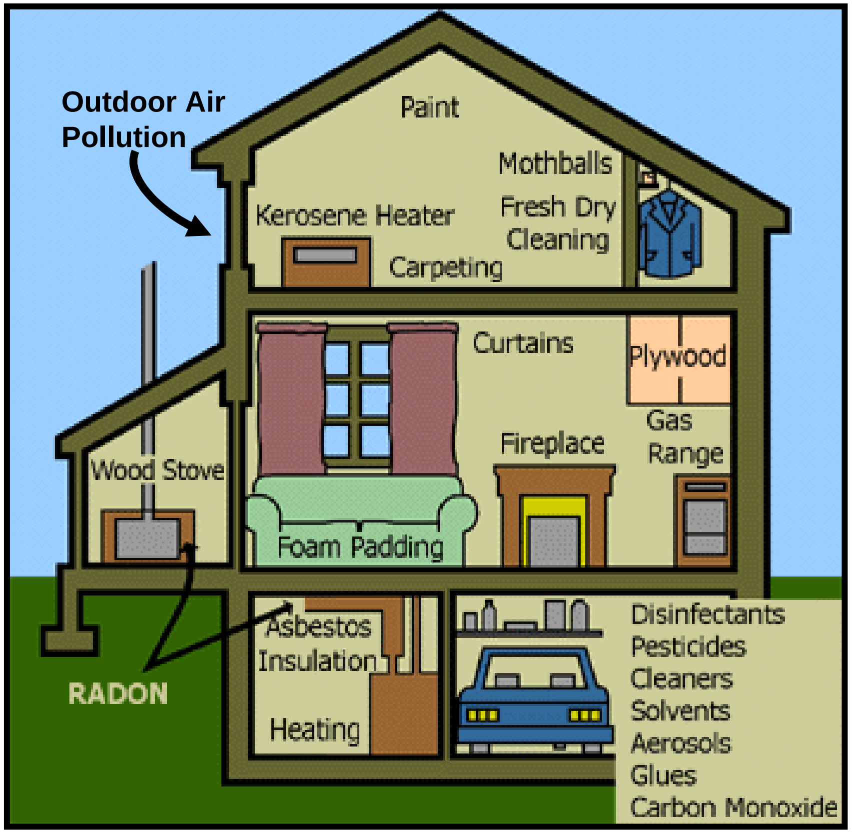
- Long haul, passenger, yard, and Commuter Class II/III trains
- GIS data available for long haul and passenger trains
- Need local data for yard and commuter trains
- Emission factors
- Speciation profiles

Commercial Marine Vessels

- Cruise ships
- Container ships
- Tankers
- Barges
- GIS data available for underway operations
- Need local data for ports
- Emission factors
- Speciation profiles

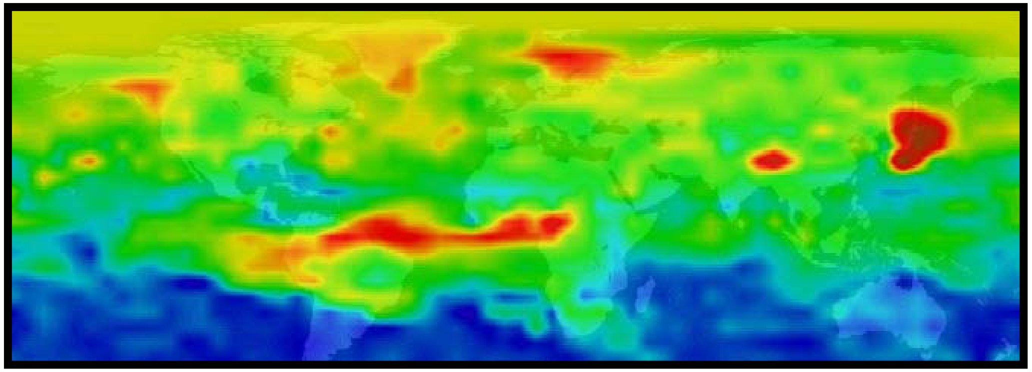
Indoor Sources

- Indoor air can become contaminated from numerous sources
- Indoor air can have significantly higher concentrations of air toxics than outdoor air
- EPA currently does not regulate indoor sources of air toxics



Other Types of Sources

- There are a number of other important sources of air toxics that aren't so easy to categorize or count
  - Accidents
  - Long-range transport of air pollutants
  - Historical background (CCl_4)



Developing A Point Source Inventory

- Planning
- Data Gathering
- Estimating Emissions
- QA/QC
- Data Augmentation
- Compiling the Database
- Case Studies, Examples

Why is Planning Important?

- Emission inventories are the foundation of many decisions
- Develop an Inventory Preparation/QA Plan
- Specify data needs, database format
- Consider user needs, level of detail needed
- Mistakes early in the process interject errors in downstream calculations
- Redoing work is costly and embarrassing

How Are Point Sources Typically Categorized?

- Fuel Combustion
- Waste disposal
- Food and agriculture industry
- Metallurgical industry
- Petroleum-related industries
- MACT/Residual Risk categories
- Mineral products industry
- Chemical process industry
- Wood products industry
- Storage tanks

How Do I Identify Source Categories?

- Usually dictated by the pollutants of interest
- Past inventory efforts and historical knowledge of the inventory area can help identify categories
- EPA has identified many source categories associated with HAPs
- Consider time and budget constraints
- Document your decisions for the benefit of future preparers

How do I Identify HAPs to Include?

- State/local/tribal requirements
- Inventory goals
  - Public interest in clean air
  - Identification of sources and problem areas
  - Determining compliance with regulations
  - Use in air quality modeling and risk assessments
- Existing data
  - Ambient monitoring data
  - Modeling results

How Should I Research Possible Sources of HAPs?

Identify sources of HAPS

- 1999 NEI
- MACT/Residual Risk data
- Other State/Local/Tribal inventories
- TRI data
- Permit files
- EPA documents/tools, e.g. EIIP, L&Es, AP-42
- Source test data, compliance data

Determine Point Source Threshold

- Report as many facilities as possible, both major and area, as point sources
- Report all major sources, both MACT and non-MACT as point sources
- Report all MACT facilities, both major and area, as point sources
- Document decisions on point source thresholds

At What Level of Detail Are Point Source Inventories Compiled?

- Plant = Secondary lead smelter
- Unit = Boiler
- Process = Surface coating operation, coal-fired boiler
- Stack (emission release point)

What Data Elements Are Needed in the Inventory?

- Source Identification
  - Facility Name and ID
- Source Location
  - Latitude, Longitude
  - Accuracy and Reliability of Latitude and Longitude Coordinates
  - Physical Address
  - State/County/Tribe

What Data Elements Are Needed in the Inventory?

- Source Description
  - Release Type- Stack or Fugitive
  - Stack Parameters, Capacity
  - Source Type – Major or Area
- Process Description
  - North America Industry Classification System (NAICS Code)
  - Standard Industrial Classification (SIC) Code – optional, replace with NAICS
  - Source Classification Code (SCC)
  - MACT Code
  - MACT Compliance Code

What Data Elements Are Required in the Inventory?

- Activity
  - Operating schedule
  - Throughput
  - Temporal Data
- Control Device
  - Equipment Type
  - Efficiency
- Emissions By Pollutant Species (CAS number)
  - Amount
  - Emission type – Entire period, average weekday, etc.
  - Estimation calculation methods
    - Include emission factor if this method is used
  - HAP Emissions Performance Level - Actual, allowable, potential, maximum
  - Control Status – controlled or uncontrolled
  - Emissions reliability indicator

What Methods Are Used to Collect Data for Point Sources

- Surveys and questionnaires
- Permit applications or compliance files
  - Title V permits and compliance reports
  - Inspection reports - major sources, fuel combustion, MSDS, etc.
- Existing Inventories
  - State and local EIs for HAPs and CAPs
  - NEI for HAPs and CAPs
  - TRI
  - MACT/Residual Risk databases
- Emission data
  - State and local industrial directories
  - State Departments of Commerce and Labor statistics
  - National and state directories of manufacturers
  - Data compiled by private research and development companies, e.g. SRI
  - Trade and professional associations

Electronic Data Collection

- Used by many states and local agencies
- Example DE, SC, and TX instructions

Compiling an Inventory from Available Data

- Compile composite facility list
  - Facility Name, Address
  - Facility IDS
  - Coordinates
  - Stack parameters
  - Emissions Units and Processes
- Note closed facilities—MWIs, dry cleaners
- Source Category Information
  - NAICS
  - SCCs
  - MACT Categories
- Activity data
  - Fuel usage
  - Material throughput
- Control device information
- Compliance and inspection reports—applicable regulations

Should I Consider Rule Effectiveness?

- What is the nature of the regulation?
- What are the compliance procedures?
- What is the historical performance of the source in maintaining compliance over time?
- How is compliance determined?

What Is the Basic RE Equation?

$$E_C = A \times EF \times (1 - (CE \times RE))$$

where:

E_C	=	Emissions after control
A	=	Activity
EF	=	Emission Factor
CE	=	Estimated control efficiency (expressed as a fraction)
RE	=	Rule effectiveness (expressed as a fraction)

Data Augmentation

- CAS numbers

  http://www.epa.gov/ttn/chief/nif/index.html

  http://www.epa.gov/srs
- SCCs, SIC codes, NAICS codes

  http://www.epa.gov/ttn/chief/nif/index.html
- MACT codes

  www.epa.gov/ttn/atw/eparules.html
- Latitude/longitude coordinates
- Stack parameters
- 2002 NEI QA and Augmentation Report

  www.epa.gov/ttn/chief/emch/invent/

How Do I Augment Stack Parameters?

- Stack releases
  - Evaluate Emission Release Point Type and SCCs
  - Height>Diameter; if not default all parameters
  - Temp>250 F for boilers and incinerators
  - Calculate missing flow rate or velocity if only one of the 3 parameters is missing
  - NEI default lookup tables generated by SCC and SIC Codes - if multiple defaults available, use default record with lowest stack height
  - If no SCC or SIC code are available, use national default values
    - Height - 10 ft
    - Diameter - 1 ft
    - Temperature - 72 degrees F
    - Velocity - 15 ft/sec
    - Flow Rate - 12 cu ft/sec

How Do I Augment Stack Parameters?

- Fugitive releases
  - Evaluate Emission Release Point Type and SCCs

  - Retain height if in range, default other 4 parameters. If height not in range, default all 5 parameters.
    - Height - 10 ft
    - Diameter - 0.003 ft
    - Temperature - 72 degrees F
    - Velocity - 0.0003 ft/sec
    - Flow Rate - 0.0 cu ft/sec

How Do I Augment Location Coordinates

- Convert coordinates to correct units if necessary
- Verify all emission release points are within 3 km of one another
- Make sure coordinates are in correct county
- Replace bad/missing coordinates

NEI Input Format

NEI Input Format (NIF) –used to transfer data to EPA's National Emission Inventory (NEI) for HAPs and criteria air pollutants

For 2002, use NIF Version 3.0

www.epa.gov/ttn/chief/nif/

NEI Input Format, Version 3.0

- Point Source File – 8 Record Types
  - Transmittal (TR)
  - Site (SI)
  - Emission Unit (EU)
  - Emission Process (EP)
  - Emission Period (PE)
  - Emission Release Point (ER)
  - Control Equipment (CE)
  - Emission (EM)

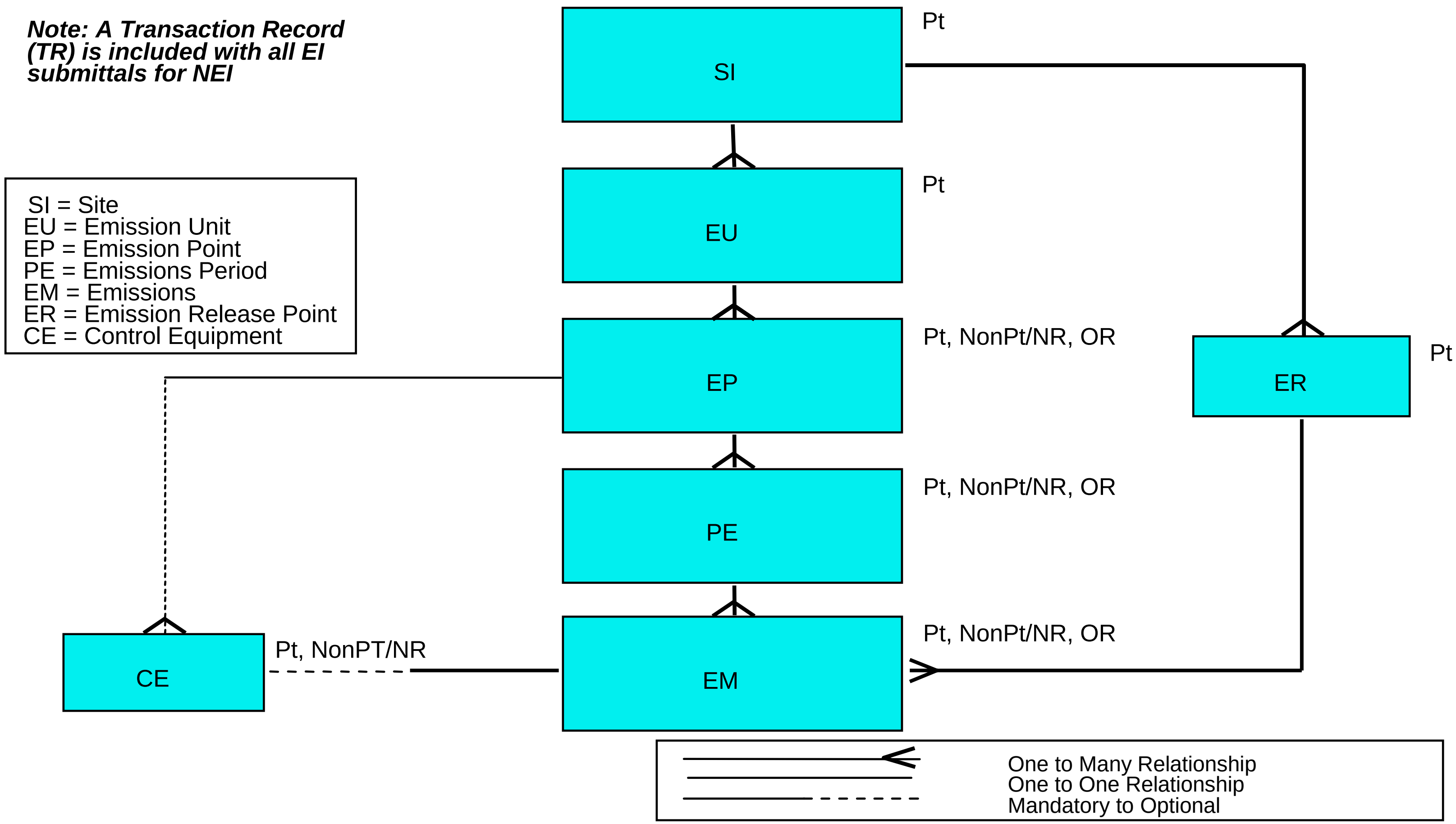
- More than 115 data fields in the 8 Tables

NEI Input Format, Version 3.0

Record Type Descriptions

- Transmittal (TR) – organization submitting to EPA, data year, source types
- Site (SI) – plant location and IDs
- Emission Unit (EU) – unit or device generating point emissions
- Emission Process (EP) – operational process generating emissions
- Emission Period (PE) – activity data and time period for releases
- Emission Release Point (ER) – mechanism releasing emission to the air including stack parameters and geographic coordinates
- Control Equipment (CE) – control equipment and efficiency
- Emission (EM) – amount of emissions

NEI Input Format, Version 3.0 – EI Relationships



NEI Input Format, Version 3.0

Format Notes

- Prescribed data types, lengths, and positions
- Data types – character, numeric, date
- Key fields – indicated by bold italics
- Mandatory fields – mandatory for inventory
- Necessary fields – needed to complete dataset used in air quality modeling
- Data definitions – description of expected data for fields
- Instructions and conventions for using NIF code tables
- User convention notes – information on where to find valid code values and how to implement and express values of fields

Point Sources: Data Integrity

tblPointSI

State and County FIPS	Site ID
01001	1
01153	23
05890	45
06560	23
06560	11
06120	900

tblPointEU

State and County FIPS	Site ID	Unit ID
01001	1	A
01001	1	B
01001	1	C
01153	23	V
05890	45	DF
05890	45	DG
06560	23	N
06560	11	M
06560	11	K
06120	900	P

tblPointEP

State and County FIPS	Site ID	Unit ID	Process ID
01001	1	A	001
01001	1	A	002
01001	1	B	002
01001	1	C	005
01153	23	V	001
01153	23	V	002
01153	23	V	003
05890	45	DF	007
05890	45	DF	101
05890	45	DF	008
05890	45	DF	009
05890	45	DF	010
05890	45	DF	016
05890	45	DG	005
06560	23	N	007
06560	11	M	001
06560	11	K	012
06120	900	P	014

Every record is Unique. No unrelated records.

Point Sources: Data Integrity Lost

tblPointSI

State and County FIPS	Site ID
01001	1
01153	23
07100	89
08230	2111
05890	45
06560	11
06120	900

tblPointEU

State and County FIPS	Site ID	Unit ID
01001	1	A
01001	1	B
01001	1	C
01153	23	V
05890	45	DG
06560	23	N
06560	11	M
06560	11	K
06560	520	AA
06120	900	P

tblPointEP

State and County FIPS	Site ID	Unit ID	Process ID
01001	1	B	002
01001	1	C	005
01153	23	V	001
01153	23	V	002
01153	23	V	003
05890	45	DF	007
05890	45	DF	101
05890	45	DF	008
05890	45	DF	009
05890	45	DF	010
05890	45	DF	016
05890	45	DG	005
06560	23	N	007
06560	11	M	001
06560	11	K	012
06120	900	P	014

Widows

Widows & Orphans

Orphans

Point Sources: Data Integrity Restored

tblPointSI

State and County FIPS	Site ID
01001	1
01153	23
07100	89
08230	2111
05890	45
06560	23
06560	11
06120	900
06560	520

tblPointEU

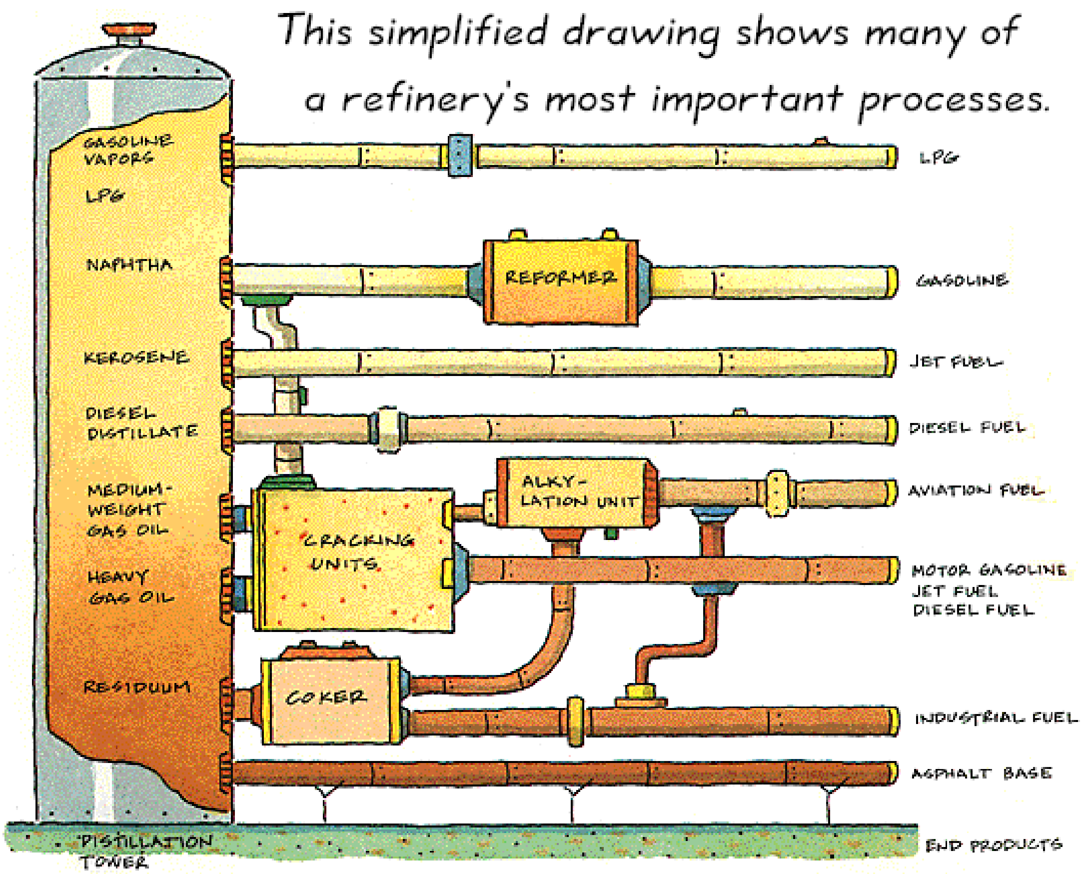
State and County FIPS	Site ID	Unit ID
01001	1	A
01001	1	B
01001	1	C
01153	23	V
05890	45	DF
05890	45	DG
06560	23	N
06560	11	M
06560	11	K
06560	520	AA
06120	900	P
07100	89	OC
08230	2111	LM

tblPointEP

State and County FIPS	Site ID	Unit ID	Process ID
01001	1	A	XX
01001	1	B	002
01001	1	C	005
01153	23	V	001
01153	23	V	002
01153	23	V	003
05890	45	DF	007
05890	45	DF	101
05890	45	DF	008
05890	45	DF	009
05890	45	DF	010
05890	45	DF	016
05890	45	DG	005
07100	89	OC	89
08230	2111	LM	90
06560	23	N	007
06560	11	M	001
06560	520	AA	HHJ
06560	11	K	012
06120	900	P	014

Point Source Case Studies and Exercises

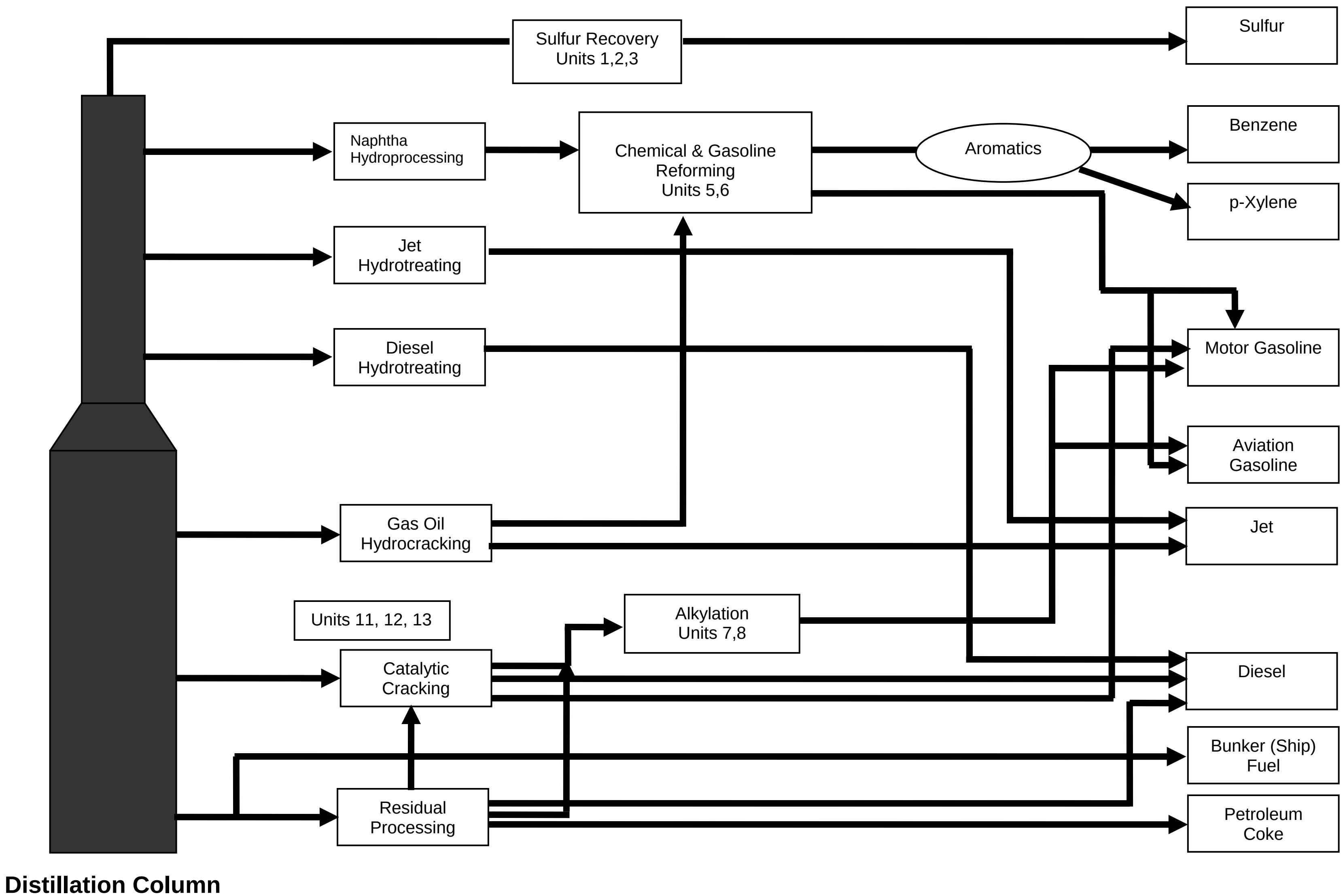
Refinery Example



Drawing from Chevron's Web Site

Emission Sources and Pollutants

- Boilers, Process Heaters, and Catalytic Cracking Unit
  - PM, NO_X, SO_X, CO_2
  - Ar, Cd, Cr, HCl, HFl, Pb, Mn, Hg, Ni
- Regeneration Vent on Catalytic Reforming Unit
  - NO_X, CO_2, PM
  - HCl, Cl_2
- Sulfur Recovery Unit
  - SO_X
  - Carbonyl Sulfide, Carbon Disulfide
- Catalyst Changeovers and Cokers
  - PM
- Equipment Leaks, Wastewater Collection and Treatment, Cooling Towers, Storage Tanks, Product Loading and Handling
  - VOC
  - Benzene, Toluene, Xylene, Hexane, 2,2,4 – Trimethylpentane, Cresols, Ethylbenzene, Methyl Ethyl Ketone, Methyl Tert Butyl Ether, Naphthalene, Phenol
- Flares
  - SO_X



Petroleum Refinery - Simplified Plant Diagram

This link opens MS Explorer. Browse the CD for the files under \exercises\

Petroleum Refinery --> NEI Format Version 3.0

- Putting Data into NIF 3.0 - Point Source
- Map fields in original data to NIF fields
  - Fill in plant ID, unit, process IDs where given; fill in with "dummy" IDs as necessary
  - Fill in required elements
    - Address; lat/long coordinates, SIC, SCC, ERP type, units
    - Use available information and additional references
  - Translate descriptive text into NIF codes
    - Important codes = Pollutant Codes, Units, SCCs, ERP Type
  - Parse data into NIF tables & run the *Basic Format & Content Checker**
- (See Handouts for example).

** Formerly known as the QA/QC Tool*

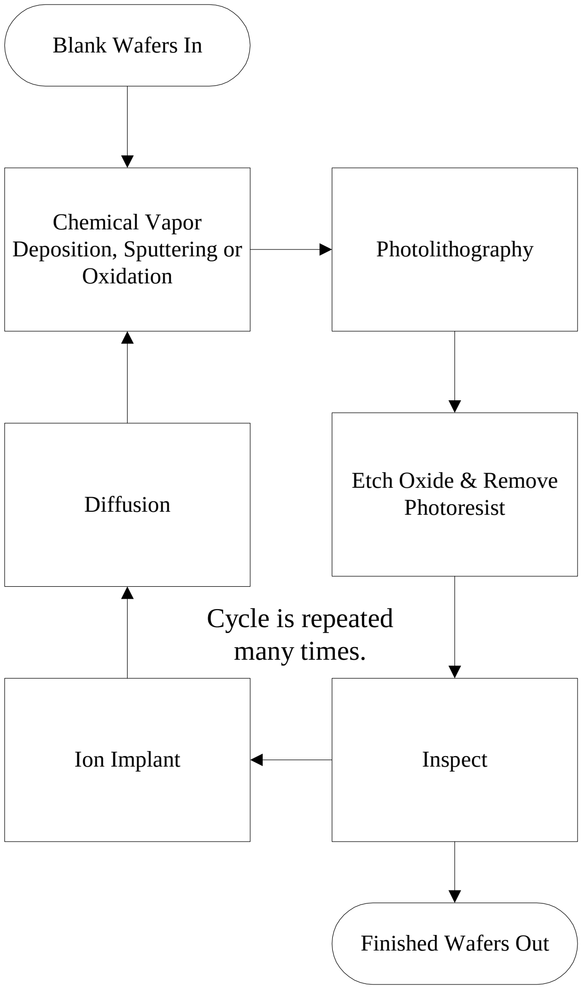
Wafer Tech Example

GOAL

Use information in the air permit (WaferTech, permit ID = 97-2040R8TSD.doc) to create a NIF 3.0 Emissions Inventory

Description of Facility

WaferTech, LLC (WaferTech) produces integrated circuits (ICs) on eight-inch wafers using advanced Complementary Metal Oxide Semiconductor (CMOS) technology with circuit widths ranging from initial production at 0.35 microns down to 0.15 microns and less.



Data Sources

1. Air emissions permit
2. NIF Lookup Tables
3. 1999 NEI
4. Internet

Data Sources – Air Emissions Permit

1. Facility-level emissions

2. Facility information

3. Additional Information
   - Emission Unit Information
   - Emission Factors
   - Fuel Characteristics

Data Sources – Facility-level Emissions (MS Excel File)

1. Emissions by unit type: boilers, emergency generators, oxidizer/concentrator, acid scrubber, wastewater treatment, and plant scrubber

2. Pollutant Name: criteria, HAPs, and ammonia

3. Control Device Information: device and control efficiency

4. Maximum Emissions

Data Sources – Facility Information

1. Plant ID
2. Location Address
3. SIC, NAICS, and SCC Codes

NIF 3.0 – Option 1

1. With facility-level emissions and facility information, a NIF 3.0 file can be created.

2. Look at
   - WaferTech-Option1.mdb
   - Wafer Tech Option 1 QA Problems
   - Wafer Tech Option 1 QA NIFTEMPDB3.mdb

The exercises are on the CD under \exercises\ You will need MS Access.

NIF 3.0 – Option 1- Limitations

However, just using these two pieces has limitations:

- No activity data, hours of operation
- No emission factor data
- No fuel characterization data
- Emissions lumped by grouped units
- No stack parameter data
- No emission calculation method

Data Sources – Additional Information

1. Fuel characterization data
2. Activity and hours of operation data
3. Detailed SCC processes
4. Stack parameter data
5. Emission factors per process
6. Emission calculation method code

Other Sources of Information

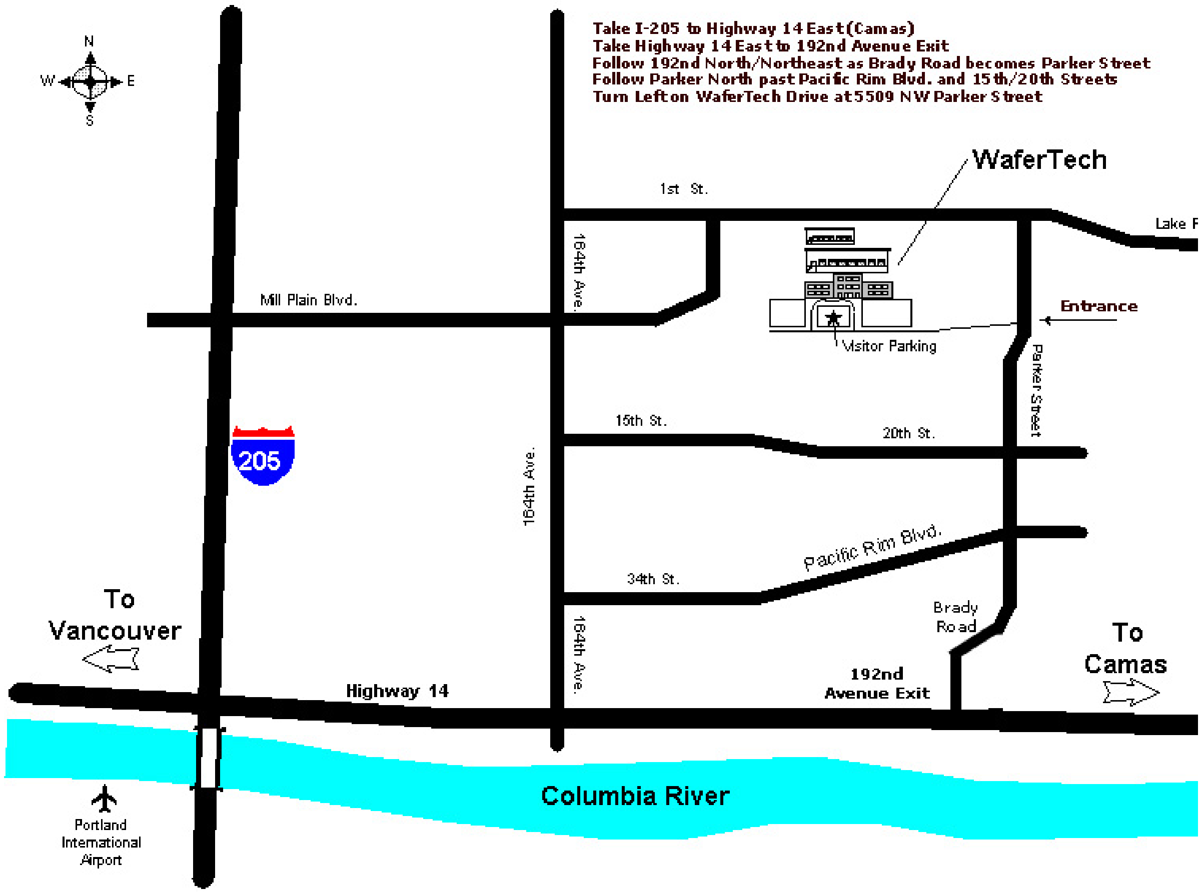
1. NIF lookup tables

2. 1999 NEI: NEI Site ID

3. Internet:
   - Transmittal Information
   - TRI ID
   - Facility lat/lon

Determining Facility Lat/Lon (1)

1. WaferTech Website (www.wafertech.com)



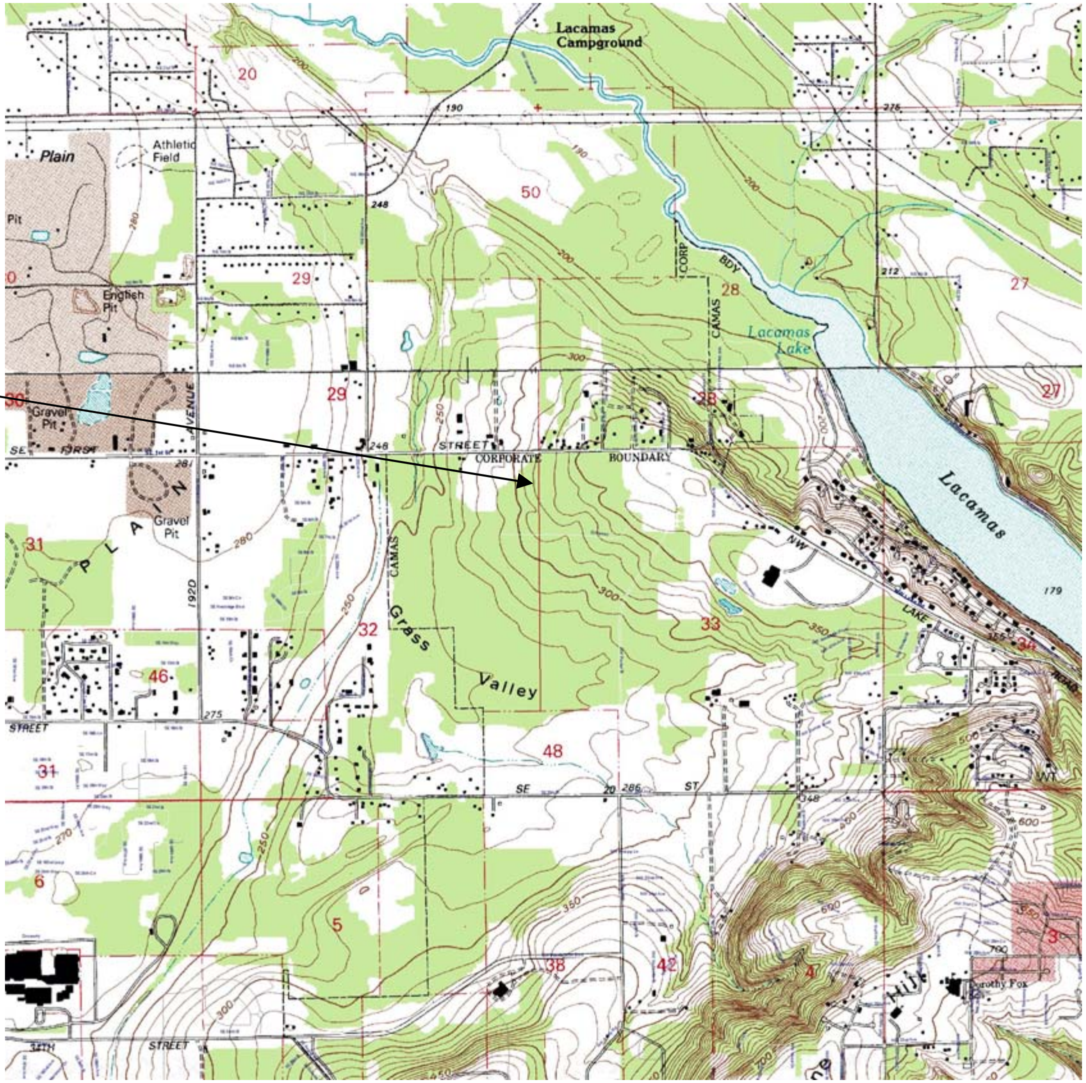
Determining Facility Lat/Lon (2)

2. Yahoo Maps (www.yahoo.com)

Determining Facility Lat/Lon (3)

3. Topozone Maps (www.topozone.com)

WaferTech Facility



Determining Facility Lat/Lon (4)

4. TRI (www.epa.gov/enviro/)

NIF 3.0 – Option 2

1. Boiler and generator-specific emissions can now be created.

2. Used the grouped unit emissions of acid scrubbers, wastewater treatment, oxidizer/concentrator, and plant scrubber and spread evenly across each unit.

3. Look at
   - WaferTech-Option2.mdb
   - Wafer Tech Option 2 QA Problems
   - Wafer Tech Option 2 QA NIFTEMPDB3.mdb

The exercises are on the CD under \exercises\ You will need MS Access.

NIF 3.0 – Option 2 - Limitations

1. However, emissions are still maximum. Need actual hours of operation.

2. Lat/lon only available for facility, not at individual emission release points

Wafer Tech Questions?

QA/QC

- Technical reviews
- Peer review
- Accuracy checks
- Reality checks
- Completeness checks
- Best implemented with standardized checklists, EPA's NIF *Basic Format & Content Checker*

What Types of Errors Are Typically Found?

- Missing facilities
- Duplicate facilities
- Closed facilities
- Improper facility locations
- Missing operating or technical data
- Erroneous technical data
- Inconsistent point and nonpoint source size designation
- Double counting
- Errors in calculations
- Data entry and transposition errors; data coding errors

Point Source *Basic Format Checker & Extended QC Tool Checker* Exercises

- If you need to install the software tools, they are located on the CD under:

\tools\basic format content\

and

\tools\qc tool\

The exercises for both tools are here:

\tools\exercises\

Point Source Questions, Discussion

Developing A NonPoint Source Inventory

- Planning
- Data Gathering
- Estimating Emissions
- QA/QC
- Compiling the Database
- Case Studies, Examples

What Planning is Needed for a Nonpoint Source Inventory?

- Decide which source categories to include
- Specify emission estimation methods, data needs, data availability
- Consider user needs, level of detail, priorities
- Identify possible point source overlap
- Temporal considerations

How Are Nonpoint Sources Typically Categorized?

- Residential Fuel Combustion
- Chemical and allied products manufacturing
- Metal processing
- Petroleum and related industries
- Other industrial processes
- Solvent utilization
- Storage and transport
- Waste disposal and transport
- Material storage/distribution
- Halogenated Solvents/ Degreasing
- Hospital sterilizers
- Gasoline service stations
- Dry cleaners
- MACT/NonMACT
- Fires - prescribed burning, forest fires, structural fires, ag burning

Preliminary Screening Study for Nonpoint Sources

Conduct Preliminary Screening Study to:

- Determine pollutants emitted by source categories within the geographic areas

- Determine which source categories to inventory as point vs. nonpoint sources in specific geographic areas

At What Level of Detail Are Nonpoint Source Inventories Compiled?

- State
- County
- Tribal jurisdiction
- Other jurisdictions for which activity surrogates are available, e.g. community scale assessments

What Data Elements Are Required in the Inventory?

- Source Identification
  - Source Category
- Source Location
  - State/County/Tribe
- Source Category Description
  - Source Type – Area
  - Source Classification Code (SCC)
  - MACT Code
  - North America Industry Classification System (NAICS Code)
  - Standard Industrial Classification (SIC) Code – optional, replace with NAICS

What Data Elements Are Required in the Inventory?

- Activity
  - Throughput
  - Temporal Data
- Control Device
  - Equipment Type
  - Efficiency
- Emissions By Pollutant Species (CAS #)
  - Amount
  - Estimation calculation methods
    - Include emission factor if this method is used
  - Emission Type - Actual, Allowable, Potential, Maximum
  - Emissions reliability indicator

How Do I Choose Emission Estimation Methods?

- Choice of methods depends on:
  - HAP and source category priorities
  - Intended use of the inventory
  - Resources
  - Availability of data
  - Compromise between method accuracy and cost to implement

What Emissions Estimation Methods Should I Use for Nonpoint Sources?

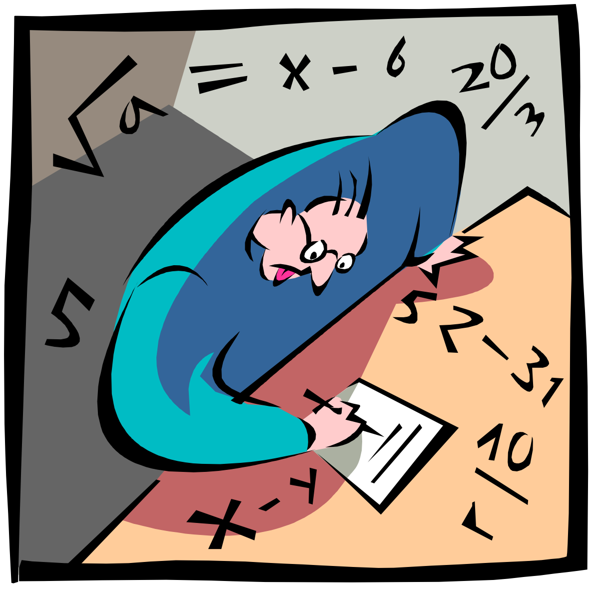
- Applying point source methods to nonpoint sources (bottom-up)
- Conducting local activity level surveys (bottom-up)
- Applying a top-down approach

What are the Characteristics of a Top-Down Approach?

- Typically used to inventory nonpoint sources
- Requires minimum resources
- Used when:
  - Local data are not available
  - The cost to gather local information is prohibitive
  - The end use of the data does not justify the cost
- Emission factors/national estimates used to estimate emissions in state or county based on surrogate parameter
- Loss of accuracy

Estimation Methods

- Surveys and questionnaires
- Material balance
- Emission factor x activity factors
- Emission models



Emission Inventory Improvement Program

- http://www.epa.gov/ttn/chief/eiip/index.html
  - Area Sources
    - Introduction to Area Source Emission Inventory Development
    - RWC, Arch Surface Coating, Dry Cleaning, Consumer and Commercial Solvent Use, etc.

What Methods Are Used to Collect Data for Nonpoint Sources?

- Surveys
- Examination of local, state and federal documents and databases
- Examination of trade association reports, journals, and databases

Applying The Top-Down Approach to Nonpoint Sources

- Applying source test or national (or regional) derived emission factor to the local level
- Allocating national, regional, or state level emission estimates to the local level

What is Spatial Allocation?

- The adjustment of activity levels or emission estimates to a smaller or larger geographic area than the area for which the activity levels or emission estimates were prepared

How Do I Make Spatial Adjustments for Nonpoint sources?

- Make adjustments based on:
  - Local activity level data
  - State or national data
  - Population data
  - Employment data

Allocating Nonpoint Source Emission Estimates

- Can use representative surrogate factors- uses surveys of representative subsets of the source category and then scales subset to entire inventory area

- Disadvantage - accuracy lost in the allocation process

Where Do I Find Applicable Activity Parameters (Nonpoint)?

- Sources of Area Source Activity Data
  - Regional planning commissions
  - Agency-sponsored surveys
  - State Depts. of Transportation and State Energy Offices
  - US DOE
    - State Energy Reports
    - Petroleum Marketing Annual
    - Natural Gas Annual

Where Do I Find Applicable Activity Parameters (Nonpoint)?

- Sources of Area Source Activity Data
  - US Dept of Commerce
    - County Business Patterns
    - Census of Population
    - Census of Manufacturers
    - Census of Agriculture
    - County and City Data Book
    - Current Industrial Reports
    - Census of Retail Trade

Where Do I Find Applicable Activity Parameters (Nonpoint)?

- Sources of Area Source Activity Data
  - State Departments Of Labor
  - State Agriculture Offices and USDA
  - State Solid Waste Management agencies
  - Fire marshals
  - Port Authority
  - State Health Departments
  - Miscellaneous statistical government & trade publications

How Do I Make Temporal Adjustments?

- Collect emission rate and activity data
  - Collect activity data for each specific time period represented by the inventory
  - Conduct a survey to collect nonpoint source information (include seasonal emission rate variations)
  - Collect information from indirect sources such as business and labor statistics

What Is Rule Penetration for Nonpoint Sources?

The percentage of an nonpoint source category that is covered by an applicable regulation

$$\text{Rule Penetration} = \left(\frac{\text{Uncontrolled emissions covered by the regulation}}{\text{Total uncontrolled emissions}} \right)$$

Example of RE/RP Calculation for Nonpoint Sources

- Assumption Operating Parameters Stage I Gasoline Marketing
  - Total county throughput: 500,000 gal/day
  - Tank filling method: splash filling
  - Filling method central efficiency: 95%
  - Stage I gasoline marketing emission factors: 11.5 lb/1,000 gallon throughput (from AP-42, Table 5.2-7)
  - RE is assumed to be 80%
  - RP is assumed to be 93% (fraction of throughput that will be subject to control)

Example of RE/RP Calculation

$$E = ACT \times EF \times (1 - (CE \times RE \times RP))$$

$$E = 500 \times 11.5 \times 1 - ((0.95)(0.8)(0.93))$$

$$= 1{,}685 \text{ lb of VOC/day}$$

Special Issues to Resolve in Preparing HAP Inventories

- Categories to include as point sources
- Double counting between point source data and emission estimates using nonpoint source methods
- Overlap between two nonpoint source categories

What Is Double Counting and How Do I Avoid It?

- Double counting occurs when the emissions from one source are included twice in the same inventory
- Causes
  - Overlap between point and nonpoint sources
  - Overlap between nonpoint source categories

How Do I Adjust Nonpoint Source Inventories for Point Source Contributions?

Nonpoint Source Activity =

Total Emissions of Source Category

- Sum of Point Source Emissions

QA/QC

- Technical reviews
- Peer review
- Accuracy checks
- Reality checks
- Completeness checks
- Best implemented with standardized checklists, EPA's NIF *Basic Format & Content Checker*

NEI Input Format, Version 3.0

- Nonpoint Source File – 5 Record Types
  - Transmittal (TR)
  - Emission Process (EP)
  - Emission Period (PE)
  - Control Equipment (CE)
  - Emission (EM)

NEI Input Format, Version 3.0

Primary Key Fields – Nonpoint Sources

- TR: State, County, Tribe
- EP: State, County, Tribe, SCC
- CE: State, County, Tribe, SCC, pollutant
- PE: State, County, Tribe, SCC, Start and End Dates
- EM: State, County, Tribe, SCC, Pollutant, Emission Type, Start and End Dates

Nonpoint Inventory Examples

- Perchloroethylene Dry Cleaners & Adjustment for Colorado Inventory
- Residential Heating : Wood Combustion

  Dade County Adjustment
- Houston Electroplating
- Texas Graphic Arts

Perchloroethylene Dry Cleaners

- National emissions estimated by using total PCE consumption in 1999 and subtracting % reduction for controls
  - MACT promulgated Sept. 1993; Compliance date Sept. 1996
- National emissions allocated to counties using business patterns
  - Estimates allocated based on employment of employees in SIC codes 7215, 7216, 7218

Perc Dry Cleaners: County Emissions Calculation

CE = County Emissions
PCE =Total Nationwide Consumption of PCE in 1999
R = % Reduction
CntyEmp = County SIC Employment
NatEmp = National SIC Employment

PCE = 31,500 Tons/year
R = 44%
CntyEmp = 1,433
NatEmp = 1,303,266

CE = [PCE -(R x PCE)] X [CntyEmp/NatEmp]

CE = [(31,500 - (31,500 X .44)] X [1433/1,303,266]
CE = 19.40 tons/year

Perc Dry Cleaners: County Emissions Calculation

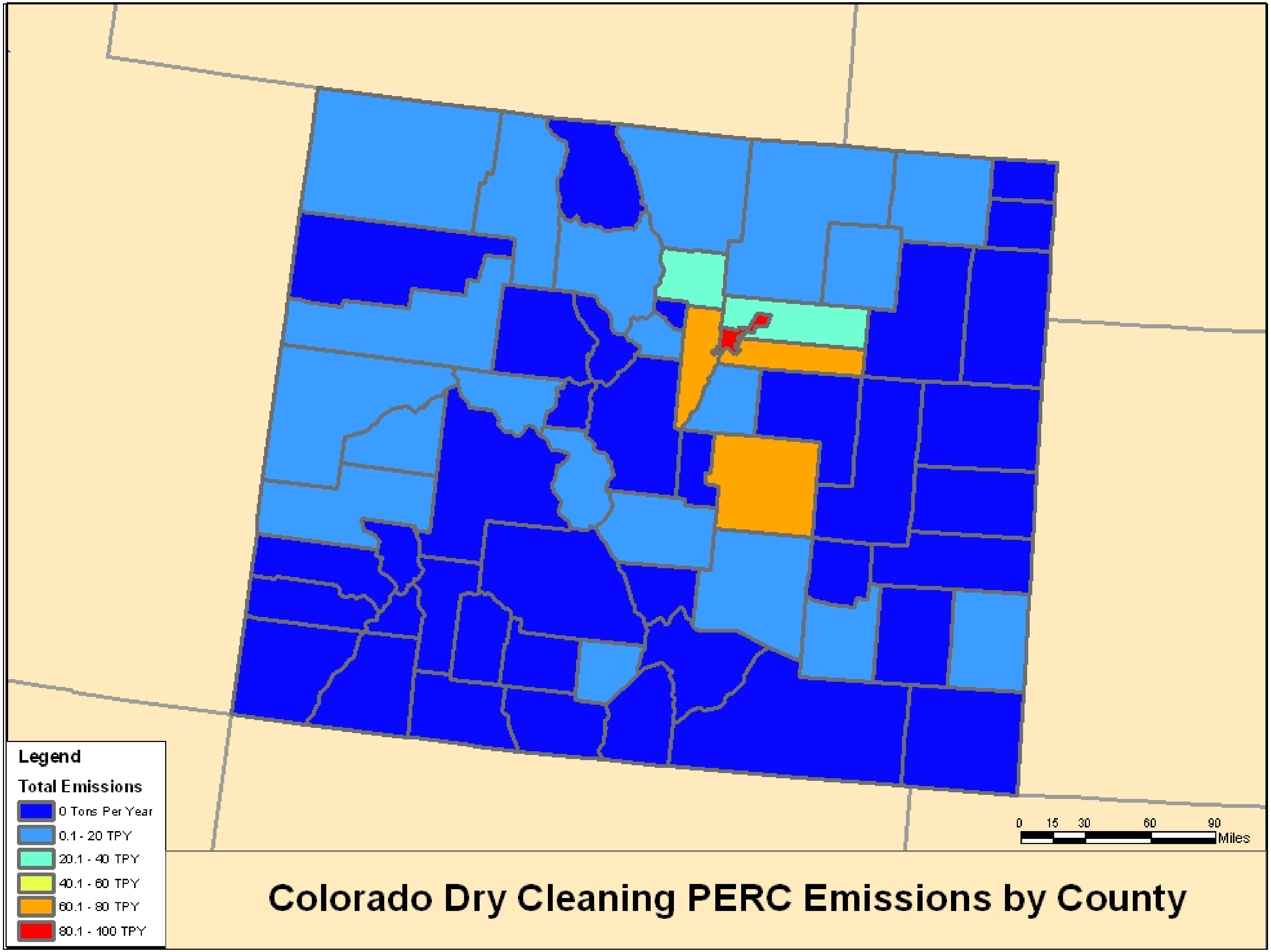
- Colorado surveyed dry cleaners and created a state-wide inventory of point sources
- Determine completeness of point source inventory
- Make sure that emissions are not included in the nonpoint database to avoid double-counting between point and nonpoint

Perc Dry Cleaners:
County Emissions Calculation

Revise Nonpoint Estimate:

Nonpoint Source County Estimate – Point Source Estimate

1) > 0, Adjust Nonpoint
2) <= 0, Remove Nonpoint


Legend
Total Emissions
0 Tons Per Year
0.1 - 20 TPY
20.1 - 40 TPY
40.1 - 60 TPY
60.1 - 80 TPY
80.1 - 100 TPY
0 15 30 60 90
Miles
Colorado Dry Cleaning PERC Emissions by County

Residential Heating: Wood

- 1997 National activity data used to extrapolate 1999 data (EIA, 2001)
  - Woodstoves & fireplaces with inserts - based on total annual wood consumption
  - Fireplaces - based on # of U.S. homes
- Counties grouped into 1 of 5 climatic zones and percentage of wood consumption assigned to zone
- Wood consumption allocated to county based on proportion of homes in county (compared with overall zone)

Residential Heating: Wood

- Counties designated as urban/rural
  - Combustion type differs by county type
    - 68% of fireplaces in urban
    - 69% of woodstoves in rural
    - 50-50 distribution of fireplaces with inserts
- Adjustments made if total wood consumption for zone didn’t match this split
- Dade County had NO woodstoves, but would have emissions assigned based on this method

Metal Plating Emissions & Houston Study

- City of Houston surveyed 58 metal plating facilities by phone, mail, visits
- SIC group = 3471
- Information gathered enabled calculation of chromium, HCl emissions using emission factors
- Adjusted estimates based on response rate to survey, etc.

Texas Graphic Arts Example

- Industry consists of many small facilities, with no emission controls
- Source category consists of many different printing technologies
- Hundreds of different inks, washes, and process solutions are used
- Surveyed facilities with support from industry trade associations
- Developed material consumption estimates for “model” plants
- Developed VOC and HAP estimates from MSDS

Nonpoint Modeling Example

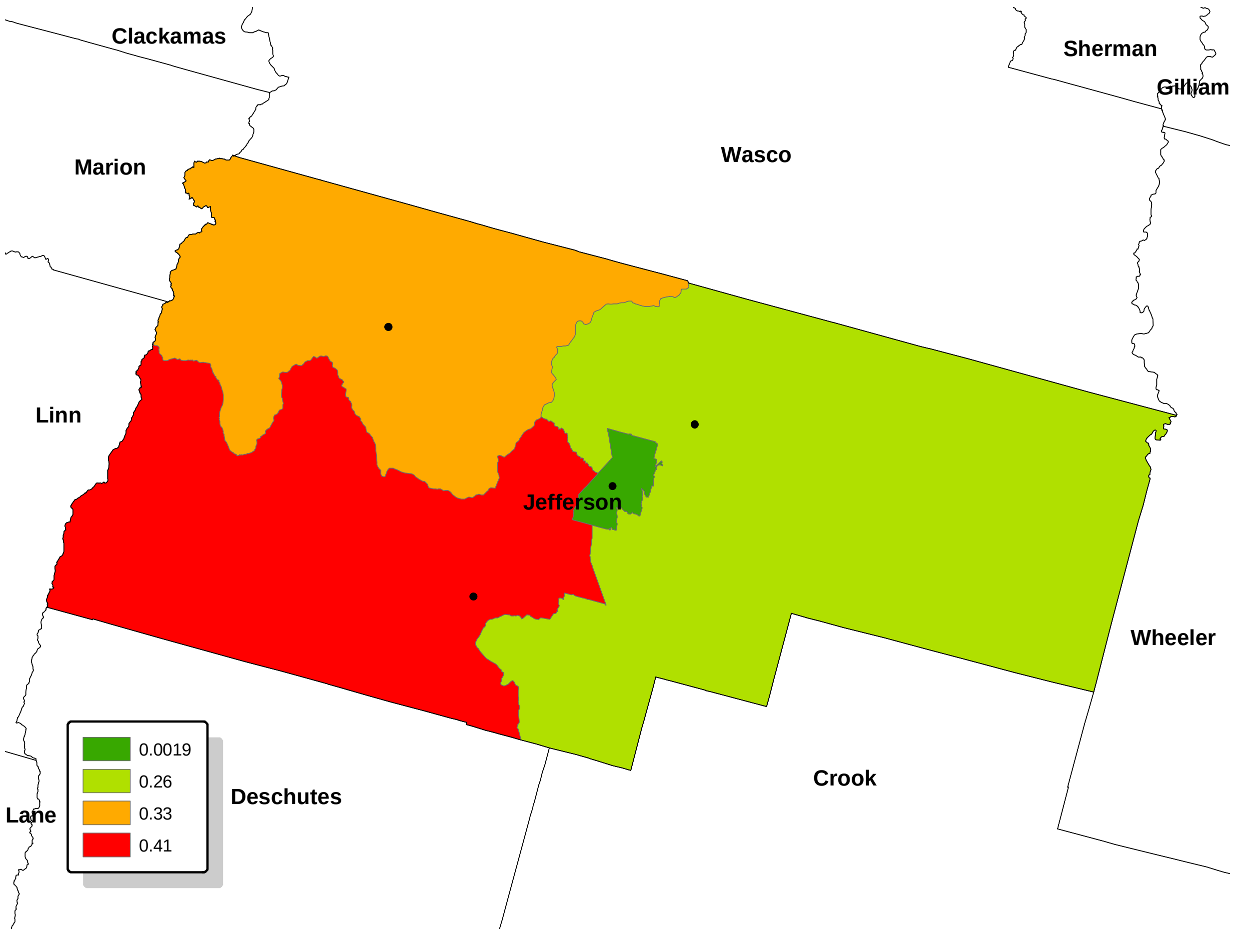
- Wildfires

Modeling Example: spatial allocation of wildfire emissions for national scale modeling (NATA)

Jefferson County, Oregon (FIPS=41031)

SCC=2810001000 (wildfires); Surrogate=forest land (code=320)

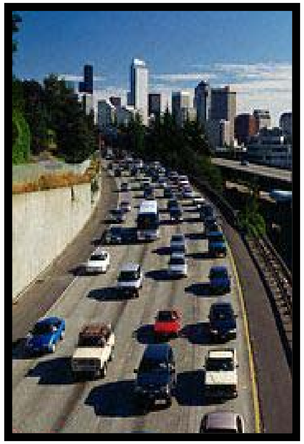
Acrolein annual emissions (1999 NEI) =36 tons (state reported)



4 Tracts in county, most emissions are in Southwestern most tract

Nonpoint Source Questions, Discussion

Mobile Sources



Goal of Presentation is Provide An Overview of:

- Mobile Source Categories in the NEI
- Emission Estimation Methods – Used in NEI
- Issues in Mobile Source Emission Estimations/Modeling

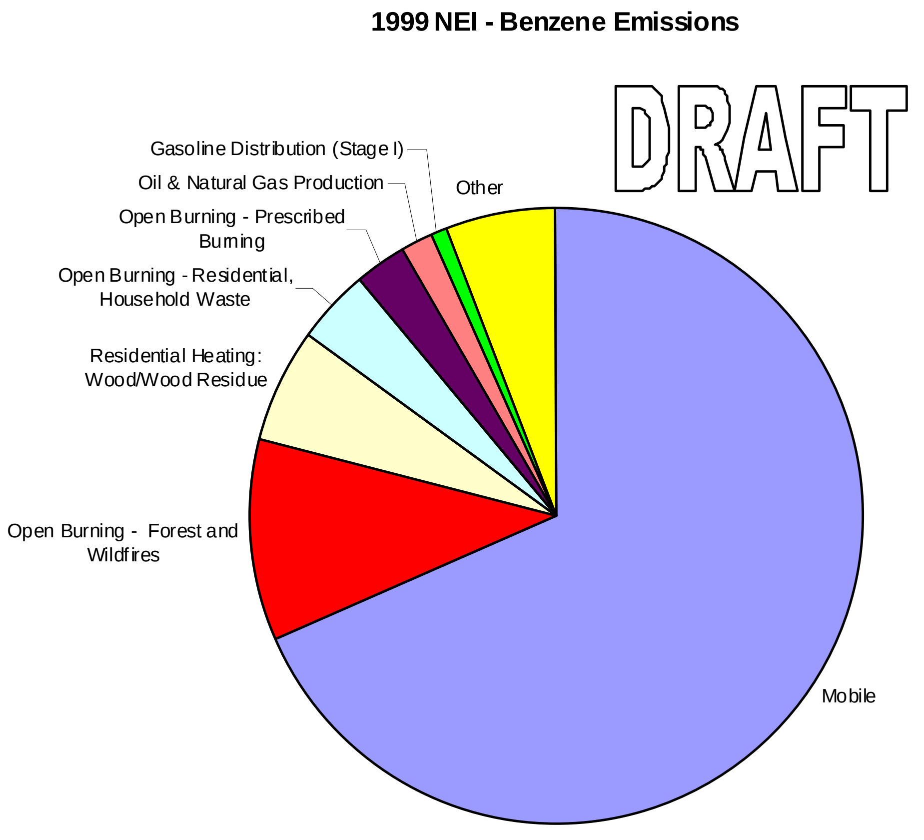
And to provide

- Website references to go to for more details

Outline

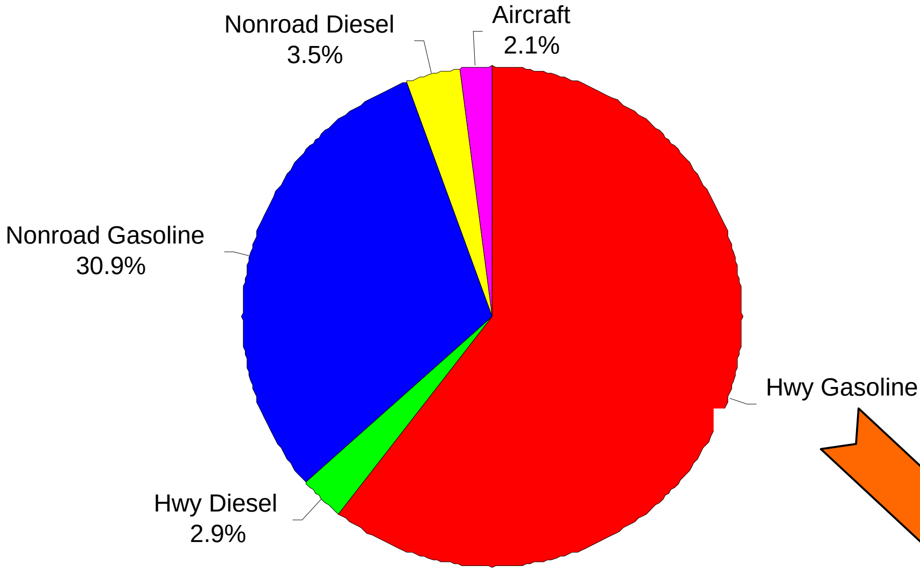
- Introduction/issues
- Onroad
- Nonroad (from NONROAD model)
- NMIM
- Nonroad: Planes
- Nonroad: Ships
- Nonroad: Trains

Mobile Sources Contribute Significantly to Air Toxics



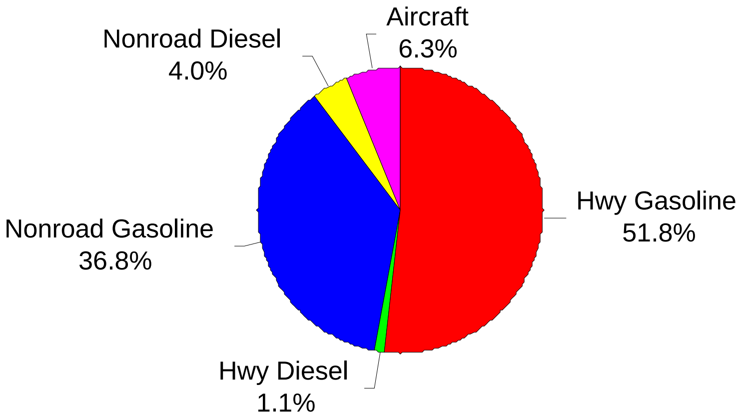
Emission reductions over time as rules are developed/phased in

8,339,000 Tons



Mobile Source VOC reduced 55% between 1996 - 2020

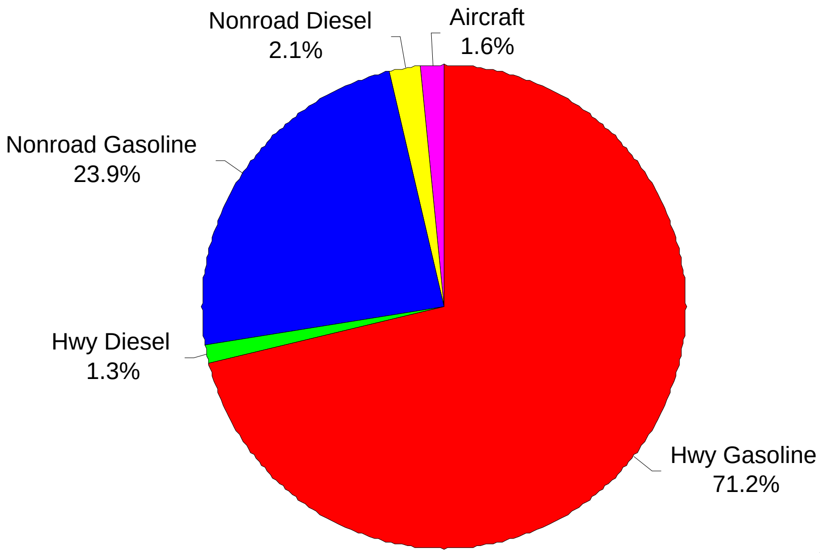
3,829,000 Tons



<u>Key programs</u>
NLEV and Tier 2 Light-duty vehicles
Small SI and Large SI nonroad engines
Nonroad recreational vehicles
Recreational marine engines
Heavy-duty gasoline vehicles

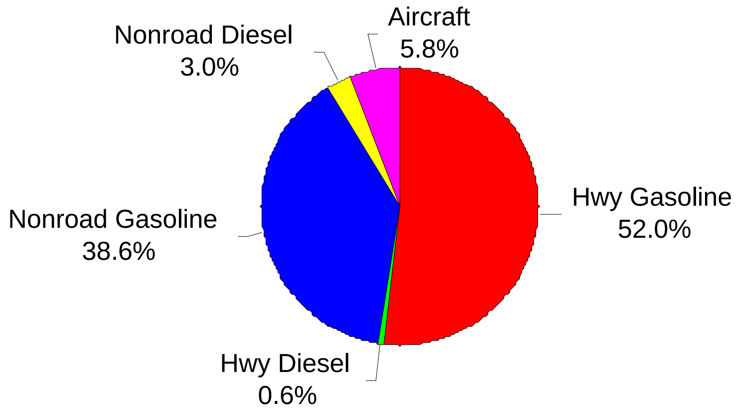
DRAFT

281,000 Tons



Mobile Source benzene reduced 63% between 1996 - 2020

103,000 Tons



<u>Key programs</u>

NLEV and Tier 2 Light-duty vehicles
MSAT1/Reformulated Gasoline
Small SI and Large SI nonroad engines
Nonroad recreational vehicles
Recreational marine engines
Heavy-duty gasoline vehicles

DRAFT

Need to keep up with changes to Mobile Source Emissions/Modeling

- Advances in emission estimation/modeling approaches
  - NONROAD
  - MOBILE6
  - NMIM
  - MOVES
  - Link-based modeling
  - Improved spatial allocation (both for county and sub-county emission allocation)
- Integration of toxics and criteria pollutants

For model development issues, join the EPA-MOBILENEWS Listserv:

http://www.epa.gov/otaq/mobile.htm

Improvements in Emission Estimation Needed in Many Areas

- Lots of needs remaining, for example
  - Inventory development for ports (commercial marine emissions)
  - Emission factors for mercury, arsenic and other metals
  - Improvements in other factors, activity data, particularly nonroad
  - Emissions for more advanced (modern) technology engines (both onroad and nonroad)

ONROAD SOURCES
(cars, trucks, motorcycles…)

Many Options for Developing Mobile Source Inventories for Subsequent Air Quality Modeling using MOBILE6 Model

- Spatial scale
  - Develop county-level (national/regional scale)
  - Link-based emissions (finer scale)
- Temporal scale (annual, seasonal, monthly, daily, hourly)
- Tools (NMIM, MOBILE6-in-SMOKE, MOBILE6)
- Decision based on resources, availability of data (inputs to MOBILE6, VMT) and goals of study
- Rest of this section focuses on how NEI is developed

How are Onroad Mobile Sources Categorized in the NEI?

- Broad Vehicle Types
  Light duty gas
  - Light duty diesel
  - Heavy duty gas
  - Heavy duty diesel
  - Motorcycles (gas)

Notes: NEI: 12 types, MOBILE5: 8 types, MOBILE6: 28 types, SMOKE/MOBILE6: 8 types

- Emission Types
  - Exhaust (X)
  - Evap (V)
  - Brake (B)
  - Tirewear (T)

- Broad Road Types
  - Urban interstates
  - Urban arterials/collectors
  - Urban local
  - Rural interstates, freeways, expressways
  - Rural arterials/collectors
  - Rural local

This produces a large number of emission records, e.g.; LDGV categories input to emission processor for NATA

Light Duty Gasoline Vehicles (LDGV)– Rural Interstate

Light Duty Gasoline Vehicles (LDGV)– Rural Other Principal Arterial, Total

Light Duty Gasoline Vehicles (LDGV)– Rural Minor Arterial, Total

Light Duty Gasoline Vehicles (LDGV)– Rural Major Collector, Total

Light Duty Gasoline Vehicles (LDGV)– Rural Minor Collector, Total

Light Duty Gasoline Vehicles (LDGV)– Rural Local, Total

Light Duty Gasoline Vehicles (LDGV)– Urban Interstate

Light Duty Gasoline Vehicles (LDGV)– Urban Other Freeways and Expressways

Light Duty Gasoline Vehicles (LDGV)– Urban Other Principal Arterial

Light Duty Gasoline Vehicles (LDGV)– Urban Minor Arterial

Light Duty Gasoline Vehicles (LDGV)– Urban Collector

Light Duty Gasoline Vehicles (LDGV)– Urban Local

Other 11 vehicle types:

Light Duty Gasoline Trucks 1 & 2

Light Duty Gasoline Trucks 3 & 4

Heavy Duty Gasoline Vehicles 2B thru 8B & Buses

Motorcycles (MC)

Light Duty Diesel Vehicles (LDDV)

Light Duty Diesel Trucks 1 thru 4

Heavy Duty Diesel Vehicles (HDDV) Class 2B

Heavy Duty Diesel Vehicles (HDDV) Class 3,4,and5

Heavy Duty Diesel Vehicles (HDDV) Class 6 and 7

Heavy Duty Diesel Vehicles (HDDV) Classes 8a and 8b

Heavy Duty Diesel Vehicles (HDDV) Buses (school&transit)

Emission Modelers May Also Want to Distinguish Among Mobile Source Emission Processes

- Evaporative Emissions:
  - VOC emissions from the gasoline tank and hoses
- Crankcase Emissions:
  - VOC emissions from the engine
- Tailpipe Emissions:
  - From the engine exhaust
- Others (starts, hotsoak, others)

Overview of Onroad Mobile Source Inventory for Preliminary 2002 NEI

- **Use MOBILE6.2 model for emission factors**
  - $PM_{2.5}$, SO_2, NO_x, NH_3, PM_{10}, VOC, and CO and HAPs
  - $PM_{2.5}$ and PM_{10} emission factors are for primary emissions (PM25-PRI and PM10-PRI)
- **Use vehicle miles traveled (VMT) data for activity**
  - State/local-provided VMT
  - FHWA HPMS data summaries
    - By roadway type and State
    - By roadway type and Urban Area
    - Nationally by Vehicle Type

Overview of Onroad Mobile Source Inventory for Preliminary 2002 NEI (continued)

- Map VMT data to corresponding MOBILE6.2 emission factors
- Emission calculations to produce monthly, county-level emissions
- Documentation for Preliminary 2002 NEI (January 2004) includes all previous inventories (1970 to 2002) as well: http://www.epa.gov/ttn/chief/net/2002inventory.html#onroad
- NMIM (National Mobile Inventory Model) will be used for the draft/final 2002 NEI

NONROAD SOURCES

Overview

- NONROAD Model Engines
- Aircraft
- Commercial Marine Vessels
- Locomotives

NONROAD Model

What Sources are Included?

SCCs (4-digit SCC denotes engine type)

2260xxxxxx	2-Stroke Gasoline
2265xxxxxx	4-Stroke Gasoline
2267xxxxxx	Liquefied Petroleum Gasoline (LPG)
2268xxxxxx	Compressed Natural Gas (CNG)
2270xxxxxx	Diesel

Two exceptions:

2282xxxxxx	Recreational Marine
2285xxxxxx	Railroad Maintenance

NONROAD Model

What Sources are Included?

Equipment Categories:

- Airport ground support
- Agricultural
- Construction
- Industrial
- Commercial
- Residential/commercial lawn and garden
- Logging
- Recreational marine vessels
- Recreational equipment
- Oil field
- Underground mining
- Railway maintenance

10-digit SCC generally denotes specific application within equipment category, e.g., SCC=2265004010 is Off-highway Vehicle Gasoline, 4-Stroke, Lawn Mowers (Residential)

NONROAD Model

What Sources are Included?

- Pollutants
  - PM10-PRI, PM2.5-PRI, CO, NO_x, VOC, SO_2, and CO_2
    - PM_{10} and $PM_{2.5}$ emission factors represent Primary PM
    - NH_3 not a direct output of NONROAD, can be estimated based on fuel consumption and EPA emission factors derived from light-duty onroad vehicle emission measurements
    - Model estimates exhaust and evaporative VOC components

Overview of Nonroad (NONROAD Engine) Inventory for Preliminary 2002 NEI

- Use NMIM (National Mobile Inventory Model)
- NMIM runs NONROAD model
  - Has both emission factors and activities built in
- VOC speciated to estimate organic HAP
- Metal HAPs estimated using fuel-based emission factors
- Documentation for the preliminary 2002 NEI for NONROAD engine sources can be found at:

http://www.epa.gov/ttn/chief/net/2002inventory.html#nonroad

NONROAD Model Concepts
Emission Equation

$$I_{exh} = E_{exh} * A * L * P * N$$

where:	I_{exh}	=	Exhaust emissions, (ton/year)
	E_{exh}	=	Exhaust emission factor, (ton/hp-hr)
	A	=	Equipment activity, (hours/year)
	L	=	Load factor, (proportion of rated power used on average basis)
	P	=	Average rated power for modeled engines, (hp)
	N	=	Equipment population (# of pieces of equipment)

--- Future year emission controls or standards reflected in emission factor value

--- Activity Variables obtained for majority of SCCs from Power Systems Research (PSR), an engine market research firm, by telephone survey of equipment owners and operators, with some exceptions

NONROAD Model Concepts
(Emission Equation Cont'd)

- SO_2, CO_2, and evaporative VOC emissions based on fuel consumption
- PM_{10} assumed to be equivalent to total PM
  - For gasoline and diesel-fueled engines, $PM_{2.5} = 0.92 * PM_{10}$
  - For LPG and CNG-fueled engines, $PM_{2.5} = PM_{10}$

NONROAD Model

Temporal Allocation

- NONROAD accounts for temporal variations in activity
  - Monthly activity profiles by equipment category according to 10 geographic regions

NONROAD Model Concepts
Geographic Allocation

- County-level allocation of equipment population
  - Allocates populations to counties using surrogate indicators that correlate with nonroad activity for specific equipment types
  - Not the same surrogate indicators as what we use for getting the emissions to sub-county for modeling
  - EPA encourages State to provide county-level activity data to replace NONROAD model defaults through submitting inputs to NMIM

Mobile Source Inventory Development with NMIM

- NMIM will be the method EPA uses for developing inventories for Onroad and NONROAD model engines
- The **N**ational **M**obile **I**nventory **M**odel is a consolidated emissions modeling system for EPA's MOBILE and NONROAD models.
- NMIM combines a Java framework with MOBILE, NONROAD, and a national county database.
- Generates monthly, county inventories for years from 1999 to 2050.
- Does not estimate emissions for aircraft, commercial marine vessels or locomotives

Why NMIM?

- Consistency
  - between NEI and OTAQ rulemaking
  - between criteria pollutants and HAPS
- Improved access
  - to inventory input information
  - to inventory building tools

County Specific Inputs

- Min, max, average temperatures
- Fuel characteristics
- Base year VMT, monthly allocation
- VMT growth
- Local emission control programs
- Many others

NMIM and the NEI

- Previously, EPA generated inventories based on default inputs and States could replace those *inventories* in the NEI.
- Now, States may supply *inputs* and documentation to NMIM database.
- Hence, rulemaking inventories, including projections, will be consistent with NEI.

Pollutants Currently in NMIM

- Criteria: CO, VOC, NH3, NOx, SO2, PM10, PM2.5
- HAPs:
  - Metals: chromium 3+, chromium 6+, manganese, nickel
  - VOC HAPS: acetaldehyde, acrolein, benzene, 1,3 butadiene, ethyl benzene, formaldehyde, hexane, MTBE, propionaldehyde, styrene, 2,2,4 trimethylpentane, toluene, xylene
  - POM: each of the 16 PAHs individually (e.g., naphthalene)
  - Dioxin/furan: 17 congeners individually (e.g., octachlorodibenzofuran)
- For more details (NONROAD), see Table 1 in Draft Documentation for 2002 NEI:
  ftp://ftp.epa.gov/pub/EmisInventory/prelim2002nei/mobile/nonroad/documentation/nr2002neijan04doc1.pdf (nonroad)
- For more details (ONROAD), see page 18 and Attachment B of Appendix C of
  ftp://ftp.epa.gov/pub/EmisInventory/prelim2002nei/mobile/onroad/documentation/nei_onroad_jan04.pdf
- 1999/2002 NEI contain more than the above HAPs due to State data (e.g., methanol from Ca.)

NMIM – a few process considerations for modeling

- Exhaust and evaporative emissions can be split out for VOC
- Brake and tirewear can be split out for PM10 and PM2.5
- Refueling can be included within on/nonroad categories, excluded or calculated separately

NMIM and the 2002 NEI Status

- Draft version of NMIM database used for the preliminary 2002 NEI (ftp://ftp.epa.gov/EmisInventory/prelim2002nei/mobile/nmim_related/)
- County-specific inputs to NMIM sought during data submittal period
  - Instructions posted: NMIMtechnical memorandum.pdf (ftp site above)
  - About a dozen NMIM data submittals received from S/L agencies
- Training on beta version held at 2004 EI conference (ftp://ftp.epa.gov/EmisInventory/nmimtraining/) but numerous changes are in the works
- February 2005 NEI will utilize the updated NMIM database/model changes (including updated NONROAD model version)
- NMIM contacts:
  - Model and Database: Dave Brzezinski and Harvey Michaels (OTAQ)
  - Use in 2002 NEI: Laurel Driver (OAQPS)

NMIM does not cover

- Aircraft
- Commercial Marine Vessels
- Locomotives

ftp://ftp.epa.gov/pub/EmisInventory/prelim2002nei/mobile/nonroad/documentation/airrailcmv/

Other volumes on same ftp site

AIRCRAFT

Overview

- SCCs
  - 2275020000 – Commercial Aircraft
  - 2275050000 – General Aviation
  - 2275060000 – Air Taxis
  - 2275001000 – Military Aircraft
- Activity Data – landing and take-off operations (LTOs)
- Emission Factors – aircraft/engine-specific or fleet average
- Activity/Emissions developed on a national basis and then allocated to counties

AIRCRAFT
Overview (Cont'd)

- Definitions of Aircraft Categories:
  - Commercial - Aircraft used for scheduled service to transport passengers, freight, or both.
  - Air taxis - Smaller aircraft operating on a more limited basis to transport passengers and freight.
  - General aviation - aircraft used on an unscheduled basis for recreational flying, personal transportation, and other activities, including business travel.
  - Military aircraft - aircraft used to support military operations.

COMMERCIAL AIRCRAFT
NEI Method

- Commercial Aircraft Emissions
  - Calculated using national-level FAA LTO data by aircraft type and emission rates from Emissions and Dispersion Modeling System (EDMS) Version 4.0.
  - Used default engines for each aircraft type and default time-in-mode values.
  - EDMS does not include PM,
  - Alternate approach will be used to estimate PM emissions for draft/final 2002 NEI, but still an area that needs improvement
  - Speciation of VOC/PM for HAPs

General Aviation, Air Taxi and Military Aircraft – *NEI Method*

- National Emissions for General Aviation, Air Taxi, and Military Aircraft calculated using equation:

$$National\ Emissions_{c,p} = National\ LTOs_c * EF_{c,p}$$

where:	*LTOs*	=	landing and take-off operations;
	EF	=	emission factor;
	c	=	aircraft category; and
	p	=	criteria pollutant.

General Aviation, Air Taxi Criteria Pollutants are speciated for HAPs, although Lead computed differently (through fuel)

Military aircraft emissions not computed for HAPs due to lack of speciation factors

AIRCRAFT
NEI Method- getting from National to County-level

- National Emissions Allocation for Each Aircraft Category

$$Airport\ Emissions_{c,p,x} = National\ Emissions_{c,p} * AF_{c,p,x}$$

where: AF = allocation factor; and
x = airport (e.g. La Guardia)
c = aircraft category; and
p = criteria pollutant.

$$AF_{c,x} = LTOs_{c,x}/National\ LTOs_{c}$$

- County-level emissions are sum of Airport Emissions for Airports within the County

AIRCRAFT: *getting from county-level to what is needed for modeling*

- County-level emissions can be allocated back to airports through algorithms, data using SMOKE area-to-point and EMS-HAP COPAX programs (see http://www.epa.gov/ttn/chief/conference/ei13/modeling/strum.pdf)

- Data on airport lat/lons and allocation factors used by EPA are available and are used in these programs (ftp://ftp.epa.gov/pub/EmisInventory/finalnei99ver3/haps/datafiles/nonroad/auxiliary/)

- You can/should look at this data and provide corrections if necessary

COMMERCIAL MARINE VESSELS (CMV) *Overview*

- CMV classifications:
  - Residual fuel-powered (Steamships)
  - Diesel-powered Vessels
    - Category 1: recreational cruisers, ancillary engines
    - Category 2: tug boats, barges
    - Category 3: tankers, large passenger lines
  - Turbine-powered vessels: very few, not calculated for in NEI
- Commercial Marine Vessel SCCs
  - 2280002100 – Diesel, In Port
  - 2280002200 – Diesel, Underway
  - 2280003100 – Residual, In Port
  - 2280003200 – Residual, Underway
- New emission estimation methods being developed by OTAQ as part of new rulemaking, http://www.epa.gov/otaq/marine.htm

See, for example:
http://www.epa.gov/otaq/regs/nonroad/issuesdocketmemo.pdf

COMMERCIAL MARINE VESSELS *NEI Method: Residual*

- Nationwide residual oil consumed (OTAQ)
- Emission factors (U.S. EPA, 1989. Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources. Office of Air Quality Planning and Standards. RTP, NC. 1989.) for criteria pollutants.
- Speciation factors for HAPs: acetaldehyde, benzene, formaldehyde, polycyclic organic matter as 16-PAH, polycyclic organic matter as 7-PAH, beryllium, cadmium, chromium, lead, manganese, nickel and selenium

COMMERCIAL MARINE VESSELS *NEI Method: Diesel*

- Nationwide Year 2000 criteria pollutant estimates from diesel-powered vessels obtained from regulatory background document (U.S. EPA, 1998. Draft Regulatory Impact Analysis: Control of Emissions from Compression Ignition Marine Engines. EPA-420-R-98-017. Office of Mobile Sources, Engine Programs, and Compliance Division. Ann Arbor, MI. 1998.), and were adjusted to year 1999 estimates based on a growth factor (also in the background document).
- National-level SO2 and lead emissions were developed using a per gallon emission factor and the nationwide total of diesel gallons consumed from DOE's Distillate Fuel Oil Vessel Bunkering Adjusted Sales data for 1999.
- Speciation factors for HAPs for VOC and PM are from HDDV HAP speciation factors.
  - VOC HAPS: 2,2,4-trimethylpentane;, acetaldehyde, acrolein, benzene, ethylbenzene, formaldehyde, n-hexane, polycyclic organic matter (individual aromatic hydrocarbon species), propionaldehyde, styrene, and toluene
  - PM HAPs: chromium, manganese, and nickel

COMMERCIAL MARINE VESSELS *NEI Method – allocation to counties*

- National Diesel and Residual Emissions split into port and underway components
- Port and underway activity allocated separately, assigned to counties
- Port emissions allocated to counties using the proportion of the total amount of freight handled for the largest 150 ports (each port associated with single county)
- Underway emissions assigned to counties using county-level proportions of GIS shipping lanes and estimated activity in terms of ton miles

COMMERCIAL MARINE VESSELS

Improvements to NEI

- Key ones:

- Allocate port emissions to ports other than 150 largest

- Allocate port emissions to appropriate counties, since port emissions assigned to a single county in port area

COMMERCIAL MARINE VESSELS

Improvements to NEI (Cont'd)

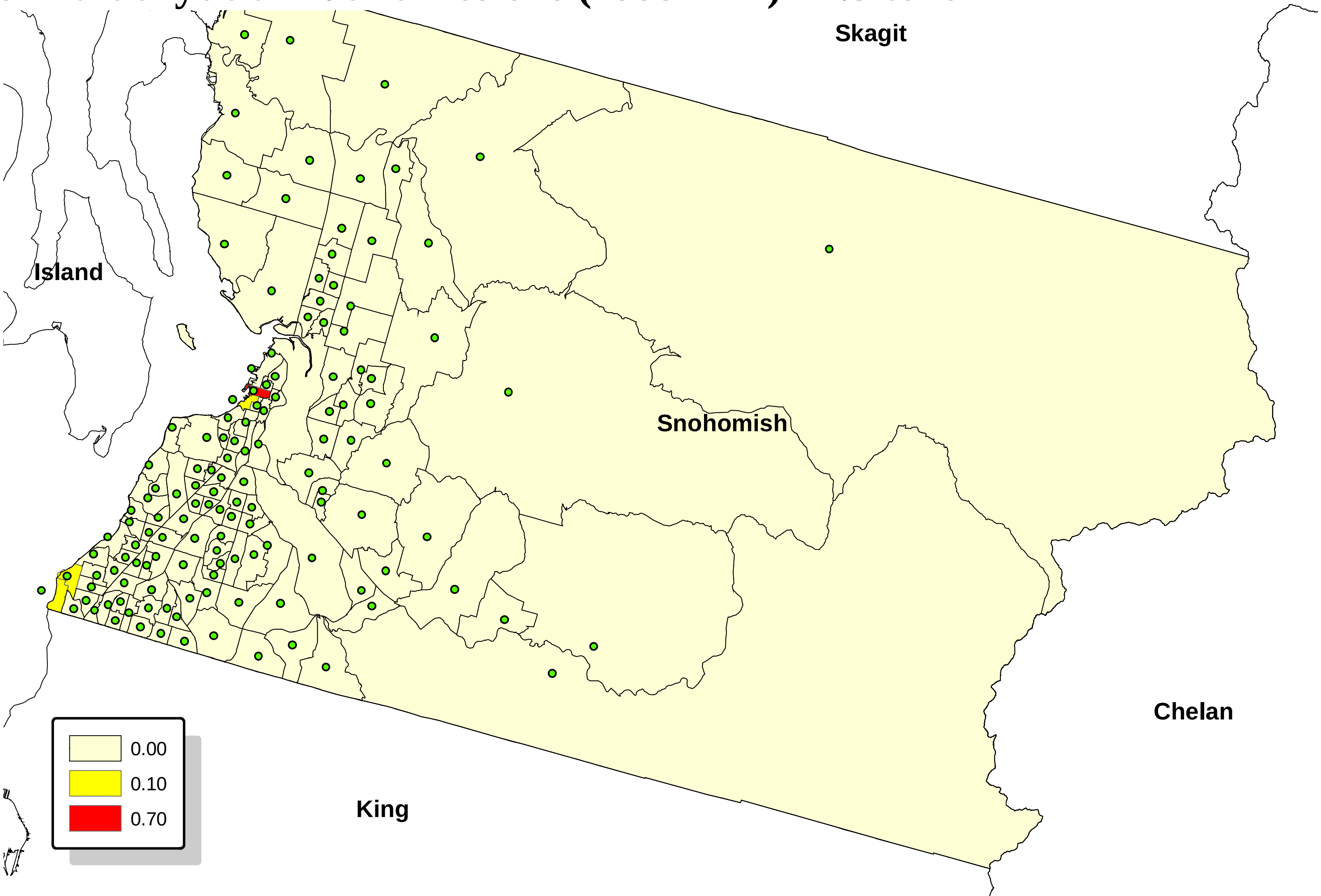
- Collect local activity data (e.g., hours of operation, gallons of fuel used)
- Collect vessel characteristics (e.g., total propulsion horsepower, vessel sizes, engine sizes)
- Use the equations from the EPA marine diesel regulatory background document to recalculate local criteria pollutant emissions from diesel-powered vessels. Apply HAP emission speciation profiles.
- Explore methods data for Los Angeles and Houston Ports (submitted by Port Authorities in these areas)

CMV at ports – Sub-county spatial allocation for air quality modeling for NATA

- Done in EMS-HAP to prepare emissions for ASPEN
- Two examples for CMV at ports, Snohomish and Grays Harbor Counties, Washington State
- Spatial surrogate code: 800 (ports)
- CMV diesel port emissions (SCC=2280002100)

Example: Snohomish County, WA (FIPS=53061)

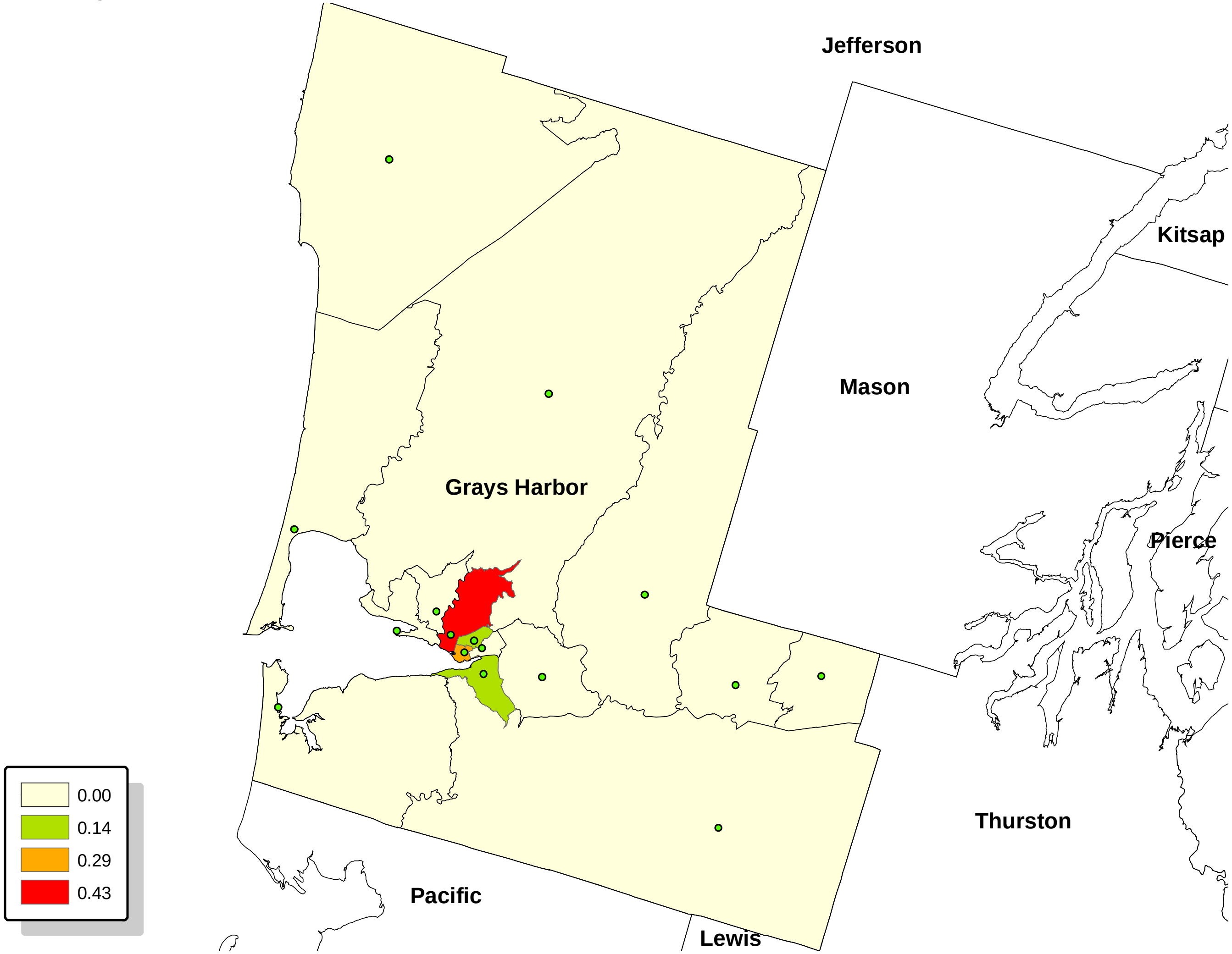
SCC=2280002100 (CMV diesel, port);
Formaldehyde annual emissions (1999 NEI) =4.3 tons



Out of about 130 tracts, only 4 tracts have ports: 1 tract gets 70% of emissions (2.8 tons), the remaining 3 get 10% of the emissions (.43 tons)

Example 2: Gray Harbor County, WA (FIPS=53027)

SCC=2280002100 (CMV diesel, port);
Formaldehyde annual emissions (1999 NEI) =1.6 tons



Out of 16 tracts, only 4 tracts have ports and get emissions allocated to them

LOCOMOTIVES

Overview

SCCs:

- 2285002006 – Diesel Class I Line Haul
- 2285002007 – Diesel Class II/III Line Haul
- 2285002008 – Diesel Passenger (Amtrak)
- 2285002009 – Diesel Commuter
- 2285002010 – Diesel Switchyard Locomotives

LOCOMOTIVES
NEI Methods

- National emissions computed from
  - Activity Data --- Gallons of distillate fuel oil consumed by railroads by type
  - Emission factors --references provided in NEI documentation

LOCOMOTIVES
NEI Methods (Cont'd)

- County-level emissions allocation
  - National emissions allocated to counties based on ratio of county to national rail activity.
  - Rail activity measured as product of density (gross ton miles per mile) on each rail line and mileage for the associated rail line in county determined through GIS analysis.

(Reference: *National Transportation Atlas Databases - National Rail Network 1:2,000,000,* GIS data from Bureau of Transportation Statistics, 2001. Available from http://www.bts.gov/gis/ntatlas/networks.html.)

Conclusions

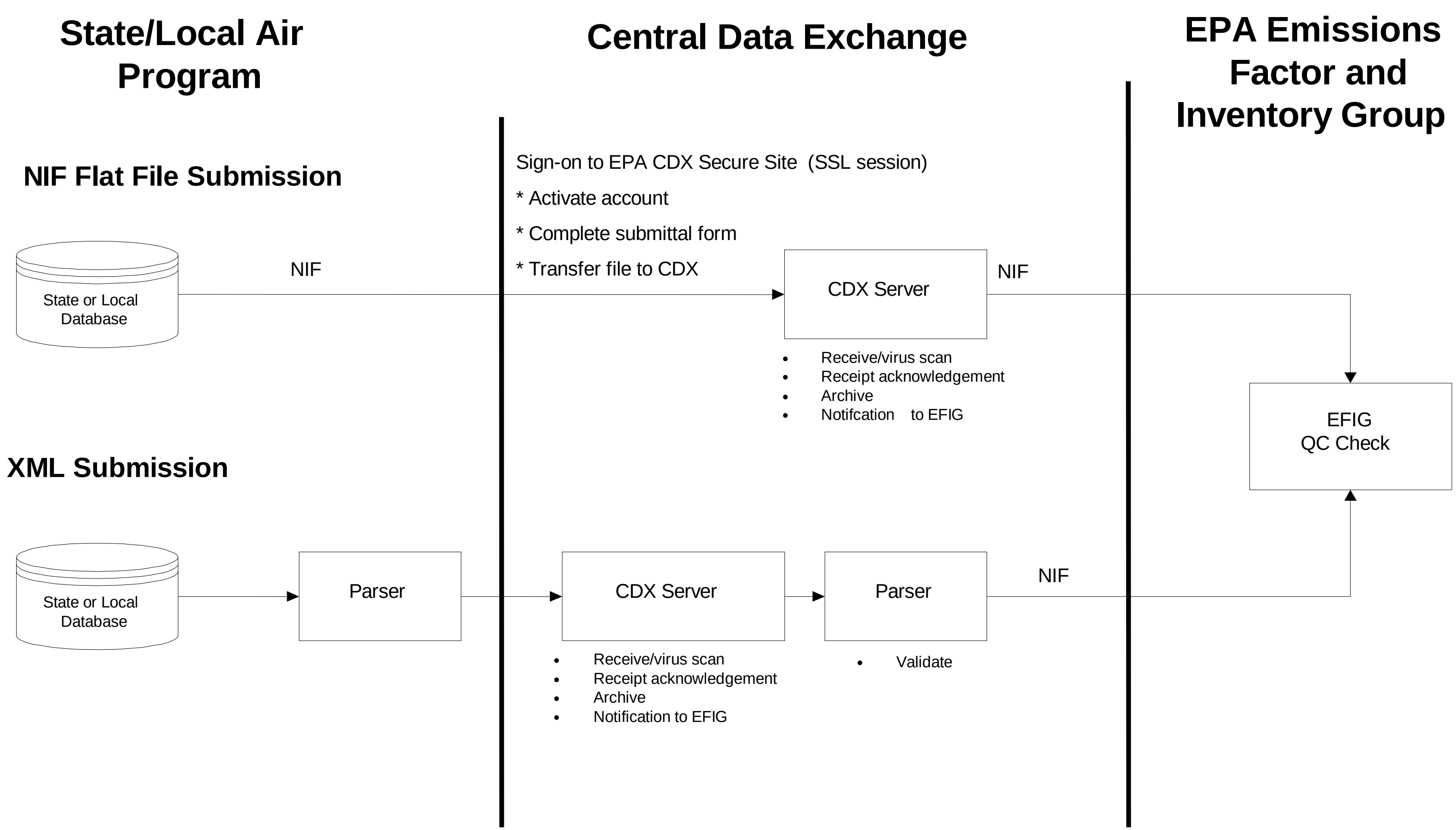
- Recent advances in mobile source emission estimation methods; more are coming
- You can keep up with 2002 NEI mobile inventory development at http://www.epa.gov/ttn/chief/net/2002inventory.html
- Join NEI Usergroup listserv at http://www.epa.gov/ttn/chief/listserv.html#nei
- Many areas for improvement
- States can submit local inputs (through NMIM database for onroad and NONROAD model engines)

CDX and NEI Data Access

Electronic Data Transfer to EPA

- CDX Role in NEI Development
  - Provide Single Point of Entry to EPA
    - Move Data to EPA Programs
  - Support Variety of Formats
    - User-Defined Flat Files
    - Extensible Markup Language (XML)
    - Web Forms
  - Automate and Secure Data Transfer With All Trading Partners
- Submission Procedures
  - State /Local/Tribal Air Program or Industry Prepares Emissions Data in NEI Input Format (NIF), Version 3.0 or XML
  - Submitters Access EPA CDX Secure Web Site
    - Complete (on-line) NEI Submittal Form
    - Upload NIF Version 3.0 File
  - Data Files Accessed by OAQPS

CDX Process


State/Local Air Program
Central Data Exchange
EPA Emissions Factor and Inventory Group
NIF Flat File Submission
Sign-on to EPA CDX Secure Site (SSL session)
* Activate account
* Complete submittal form
* Transfer file to CDX
State or Local Database
NIF
CDX Server
NIF
Receive/virus scan
Receipt acknowledgement
Archive
Notifcation to EFIG
EFIG
QC Check
XML Submission
State or Local Database
Parser
CDX Server
Parser
NIF
Receive/virus scan
Receipt acknowledgement
Archive
Notification to EFIG
Validate

NEI Data Access

Summaries — Level of Detail — Most Detail

Air Data Web Site	NEON	EPA FTP Site
Plant Level Summaries County Level Summaries MACT Code Summaries **www.epa.gov/air/data**	Intranet Query Tool Available to EPA Design Your Own Queries and Data Extracts Emission Process Detail Summaries (SCC, SIC, MACT)	1999 NEI site Process/SCC Level for Points County/SCC Level for Area/Mobile **ftp.epa.gov/EmisInventory/**

Easiest — Accessibility — Most Difficult

Relevant Web Sites

– **Resources List of Relevant Web Sites**

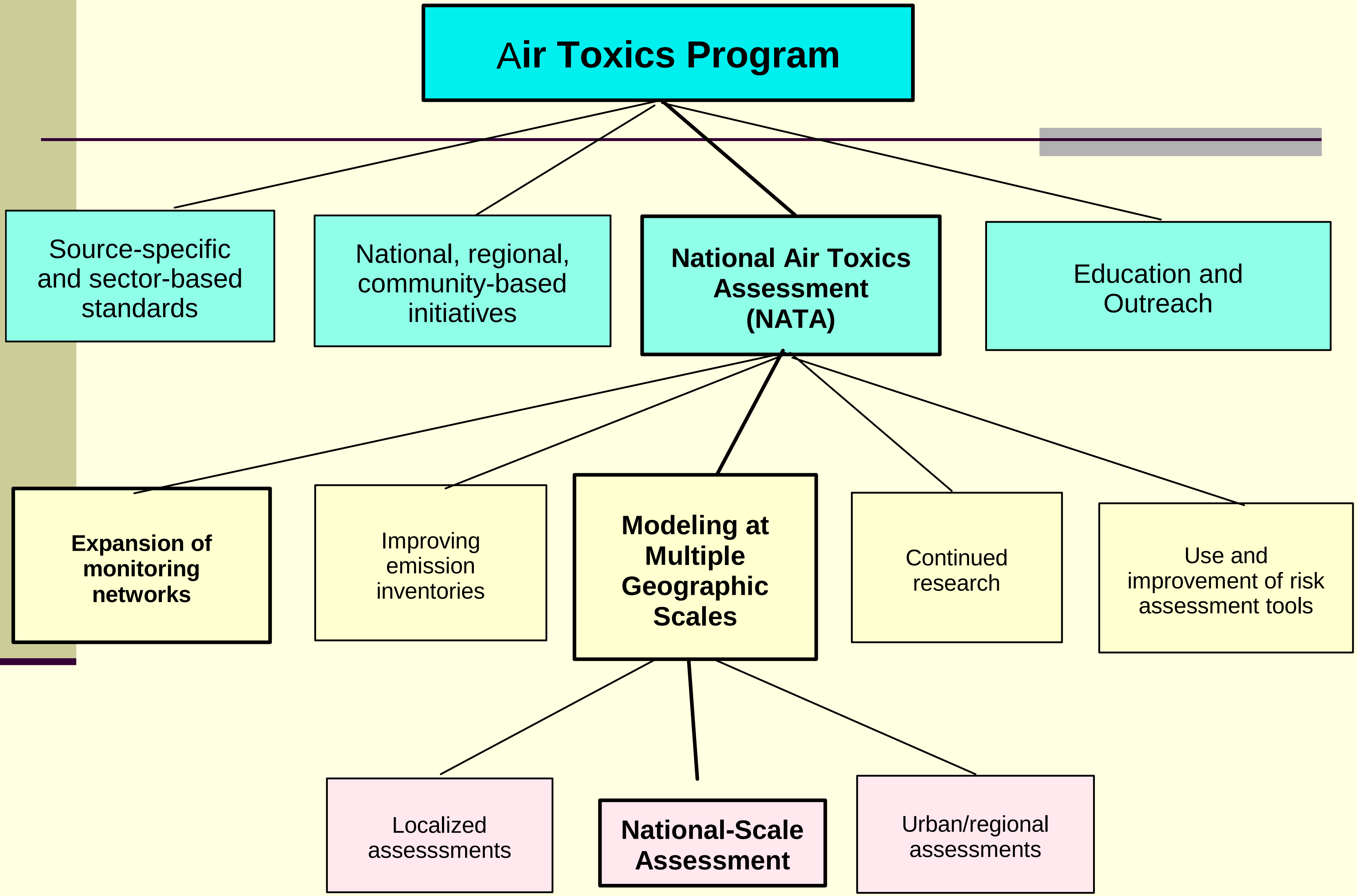
1999 National Air Toxics Assessment (NATA) National Scale Assessment

For the Air Toxics Implementation Workshop
March 30, 2005

Ted Palma and Madeleine Strum
EPA, Office of Air Quality Planning and Standards

Outline

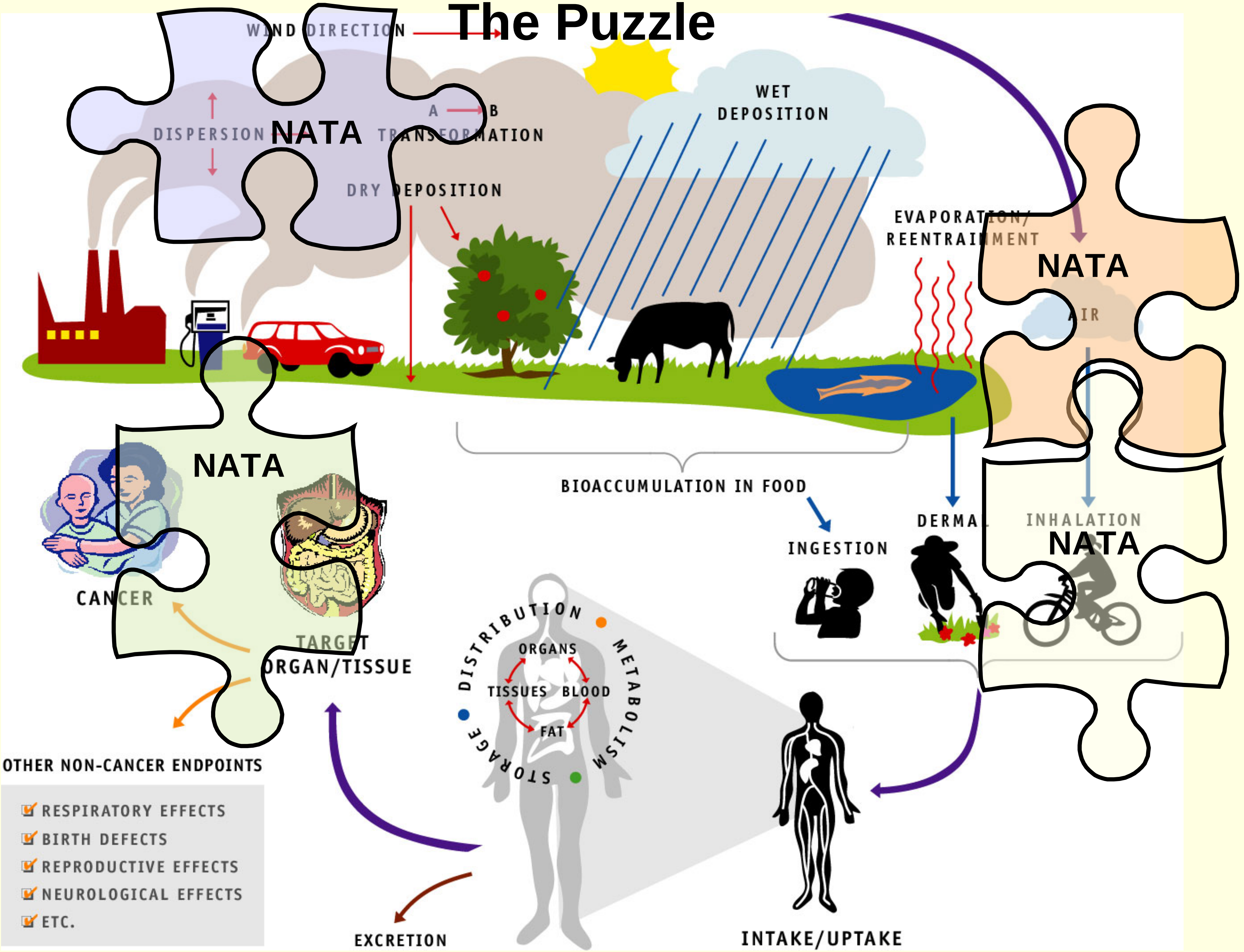
- **Background on NATA**
- **Summary of results**
  - Which air toxics are most important & what are the key source categories?
  - Where are the areas of concern?
- **Communications**
- **NATA's impact on the air toxics program**


Air Toxics Program
Source-specific and sector-based standards
National, regional, community-based initiatives
National Air Toxics Assessment (NATA)
Education and Outreach
Expansion of monitoring networks
Improving emission inventories
Modeling at Multiple Geographic Scales
Continued research
Use and improvement of risk assessment tools
Localized assesssments
National-Scale Assessment
Urban/regional assessments

What is NATA?

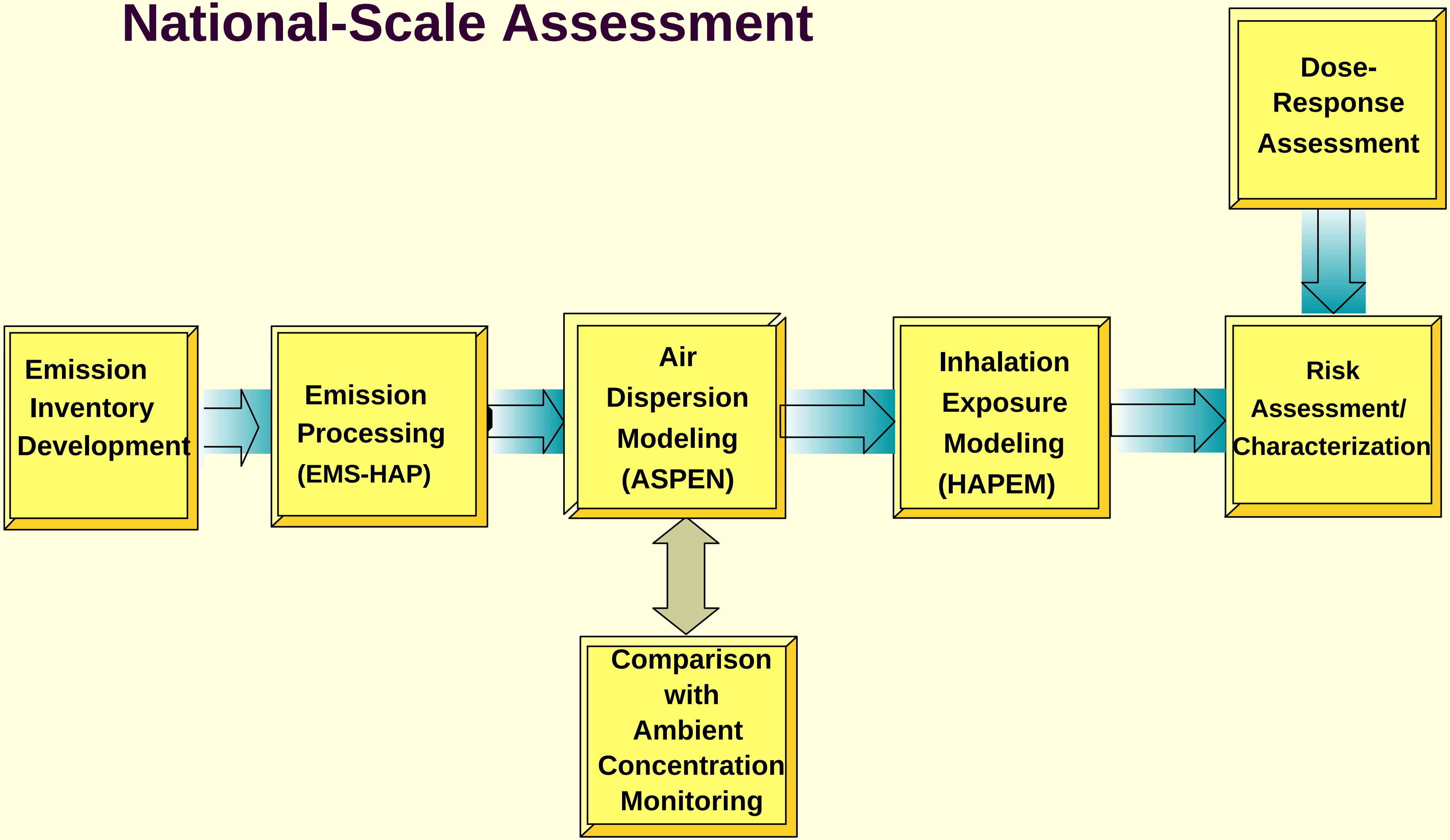
- **Characterization of air toxics across the nation**
  - Nationwide assessment with *census tract* resolution for 177 HAPs plus diesel PM
  - Emissions, modeled ambient concentrations and estimated *inhalation exposures* from *outdoor sources*
  - *Cancer and noncancer* risk estimates for the 133 HAPs with health data based on *chronic exposures*
- **Tools for State/Local/Tribal Agencies (and EPA) to prioritize pollutants, emission sources and locations of interest**
  - Provides a starting point for local-scale assessments
  - Focuses community efforts
  - Informs monitoring programs
- **A few pieces of the air toxic puzzle**

The Puzzle



NATA
NATA
NATA
NATA
WIND DIRECTION
A B
TRANSFORMATION
DISPERSION
DRY DEPOSITION
WET DEPOSITION
EVAPORATION/
REENTRAINMENT
AIR
BIOACCUMULATION IN FOOD
INGESTION
DERMAL
INHALATION
CANCER
TARGET
ORGAN/TISSUE
DISTRIBUTION
METABOLISM
STORAGE
ORGANS
TISSUES
BLOOD
FAT
INTAKE/UPTAKE
EXCRETION
OTHER NON-CANCER ENDPOINTS
RESPIRATORY EFFECTS
BIRTH DEFECTS
REPRODUCTIVE EFFECTS
NEUROLOGICAL EFFECTS
ETC.

Components of the NATA National-Scale Assessment



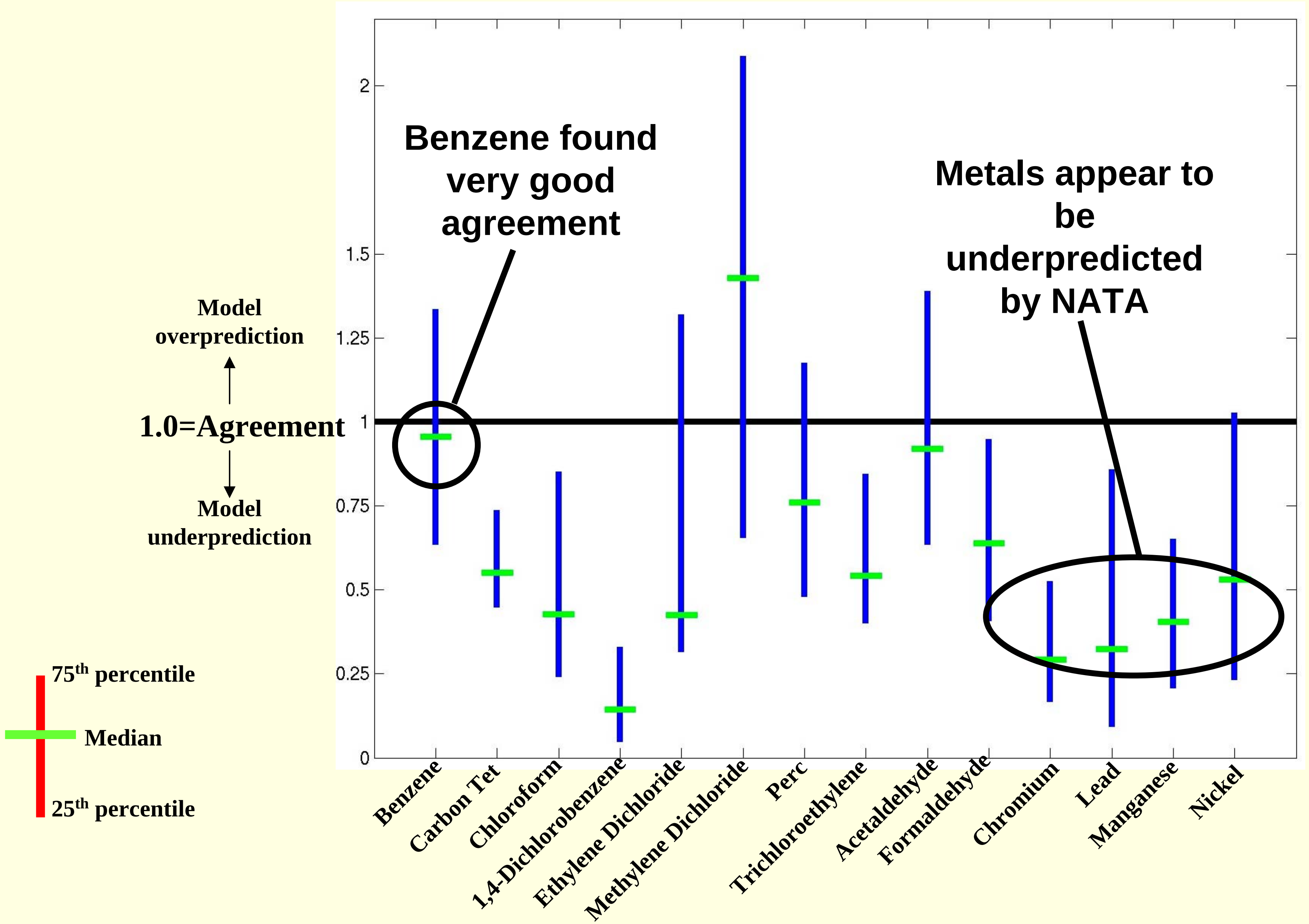
Improvement from the 1996 NATA

- Improved quality of inventory
- Expanded coverage to include nearly all HAPs
- Improved technical quality of modeling analyses
  - Responded to many of SAB comments
- Used latest health risk information
- Improved presentation of results
  - More transparent and accessible website data
  - Local scale mapping tools

Room for Future Improvements

- Misses some local impacts (i.e. hot spots, next to major sources, near roadways)
- Modeling science
- Tends to underestimate metals

NATA Model to Monitor Comparisons



Pollutant Issues

- **Diesel PM**:
  - **Did not** calculate <u>cancer</u> risks
  - **Did** calculate <u>noncancer</u> risks
- **Formaldehyde:**
  - We are working with ORD to appropriately represent latest scientific issues
- **Naphthalene:**
  - Included in assessment as carcinogen
- **Dioxin:**
  - not included because of issues with inventories (was not in 1996 either)

Summary of 1999 NATA Results

Overall Summary of 1999 NATA Results

- The **average cancer risk** for 1999 is **48 in a million**
  - **Benzene** is most significant carcinogen
  - Comparable to 1996 NATA of 55 in a million
- The **average noncancer risk** for 1999 is **6.4** (hazard index for respiratory)
  - **Acrolein** a majority of this risk
  - Comparable to 1996 NATA of 5.2
- Some new HAPs added to list of significant pollutants
- Confirmed list of 33 urban air toxics as primary risk drivers

Which air toxics are most important & what are the key source categories?

1999 National-Scale Assessment Risk Characterization - Significant Pollutants

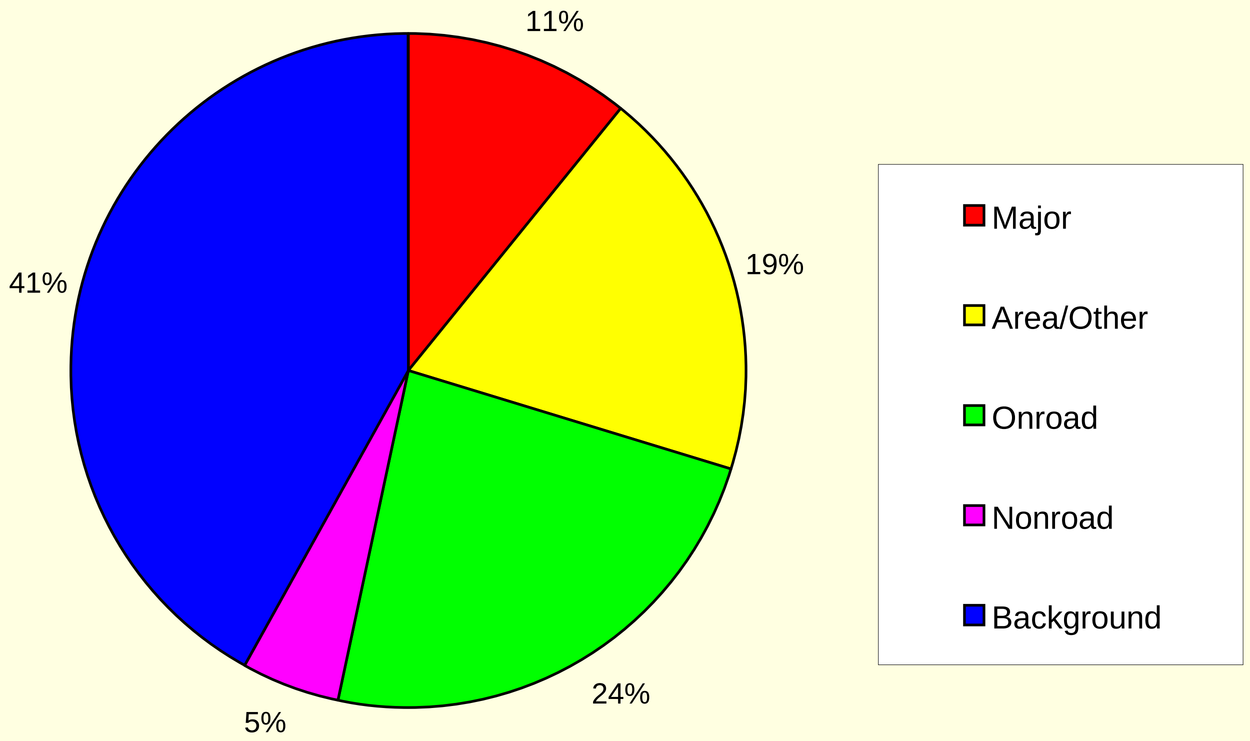
- Cancer
  - **National drivers** [1]
    - Benzene
  - **Regional drivers** [2]
    - Arsenic compounds
    - Benzidine
    - 1,3-Butadiene
    - Cadmium compounds
    - Carbon Tetrachloride
    - Chromium 6
    - Coke oven
    - Ethylene oxide
    - Hydrazine
    - Naphthalene
    - Perchloroethylene
    - POM

[1] At least 25 million people exposed to risk > 10 in 1 million
[2] At least 1 million people exposed to risk > 10 in 1 million OR At least 10,000 people exposed to risk > 100 in 1 million

- Non-Cancer
  - **National drivers**[3]
    - Acrolein
  - **Regional drivers**[4]
    - Antimony
    - Arsenic Compounds
    - 1,3-Butadiene
    - Cadmium compounds
    - Chlorine
    - Chromium 6
    - Diesel PM
    - Formaldehyde
    - Hexamethylene 1-6-diisocyanate
    - Hydrazine
    - Hydrochloric acid
    - Maleic anhydride
    - Manganese compounds
    - Nickel compounds
    - 2,4-Toluene Diisocyanate
    - Triethylamine

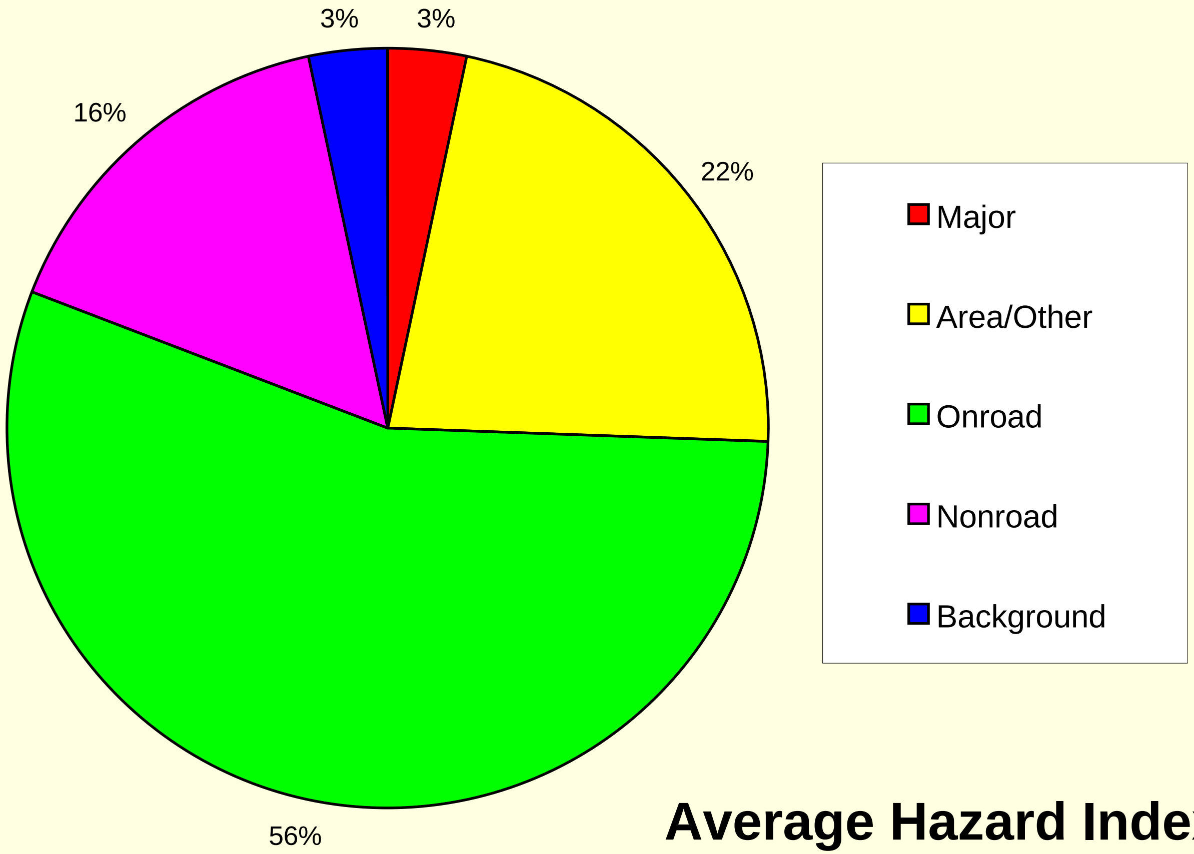
[3] At least 25 million people exposed to a hazard quotient (HQ) > 1.0
[4] At least 10,000 people exposed to HQ >1
Blue indicates new drivers since 1996

1999 NATA Cancer Risk
Source Sector Contributions



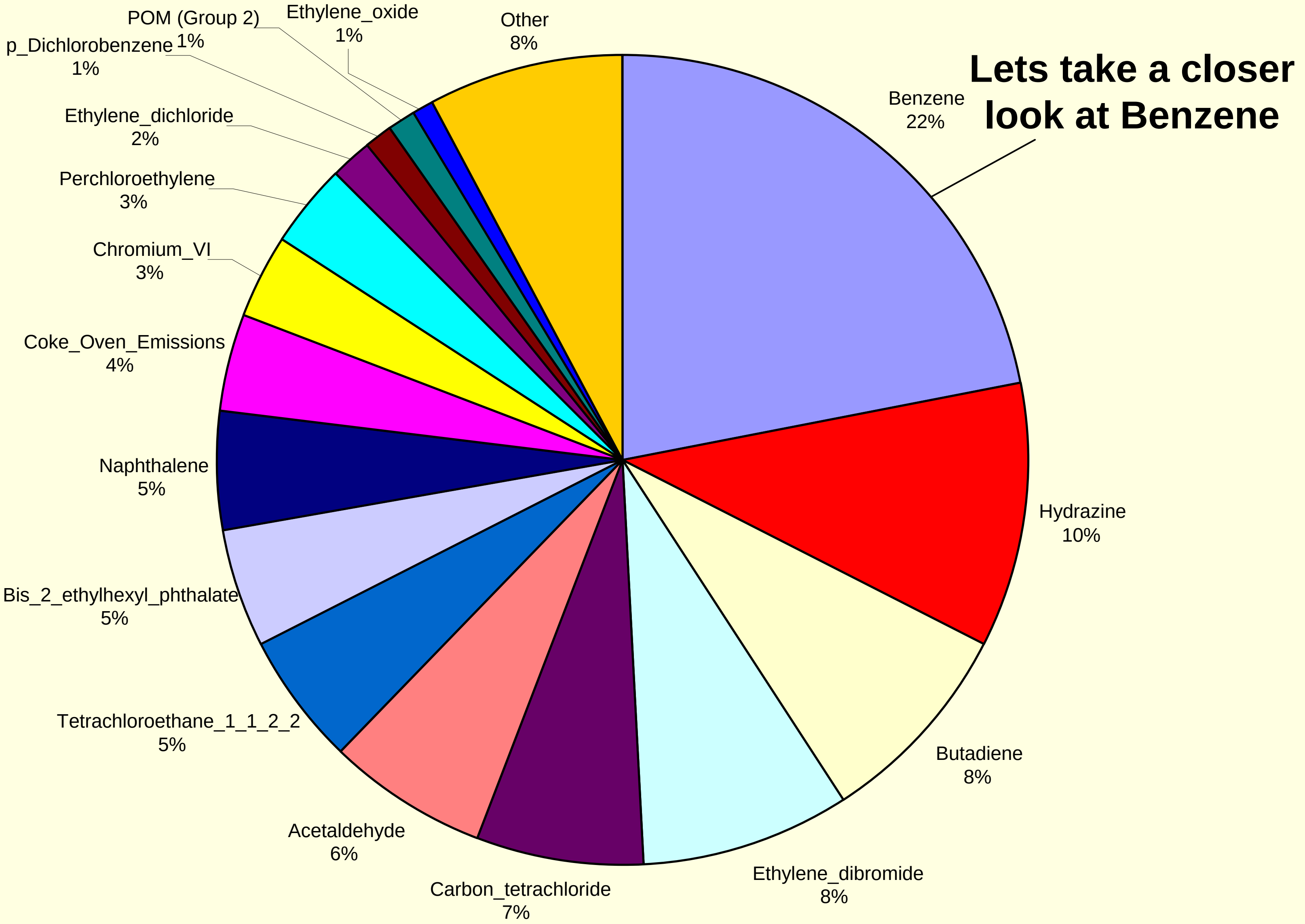
Average Risk: 48 in a Million

1999 NATA Noncancer (Respiratory) Risk Source Sector Contributions



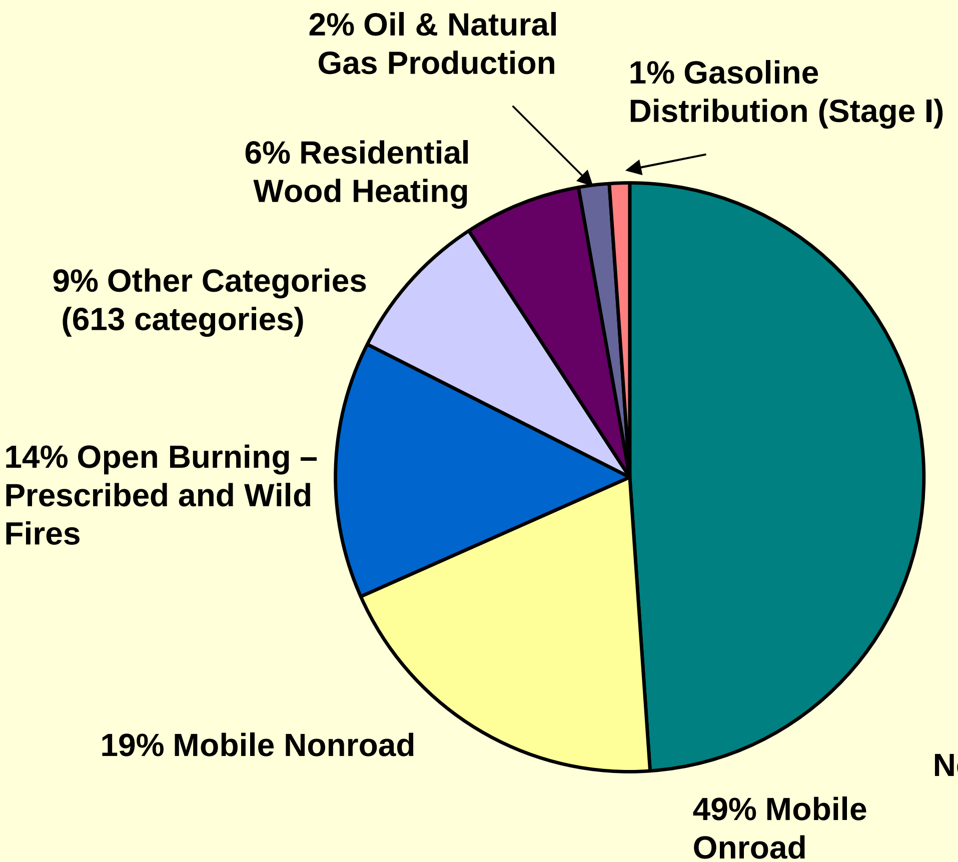
Average Hazard Index = 6.4

1999 NATA - Pollutant Contribution to Average Cancer Risk (48 in a million)

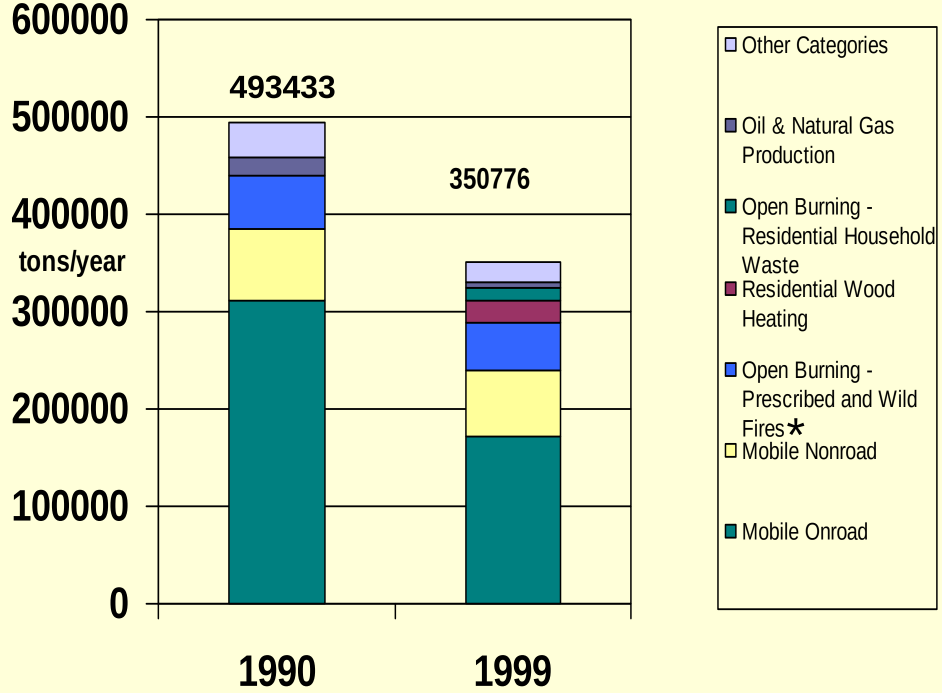


We Can Analyze Emissions Further to Identify Key Source Categories: Benzene

1999 Emissions



Emissions Trends in the 1990s

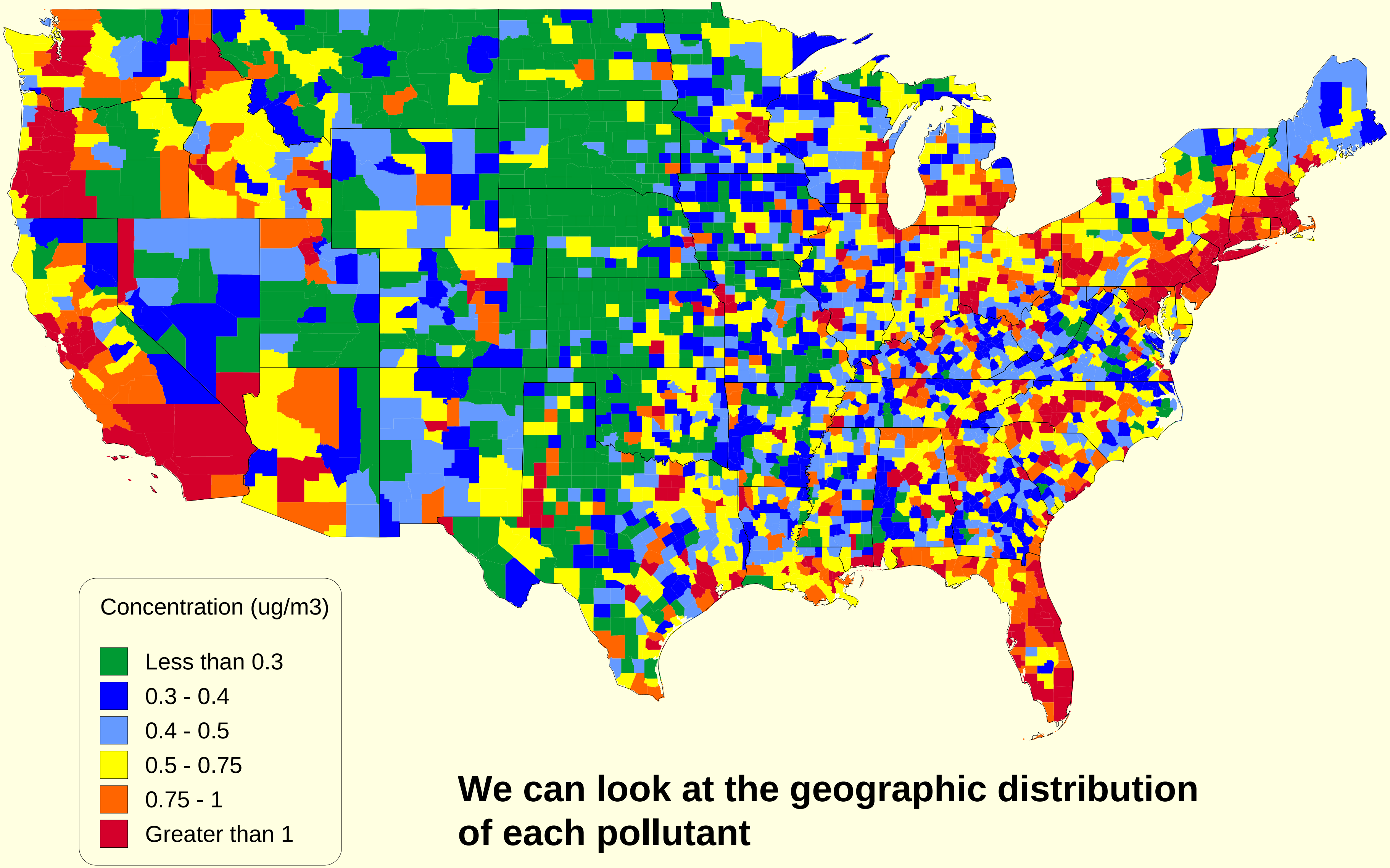


Net emissions reductions ('90 to '99) = 142,657 tons

Mobile Onroad:	140,343 tons
Oil & Natural Gas:	11,892 tons
Petroleum Refineries:	5,654 tons
Mobile Nonroad:	4,591 tons

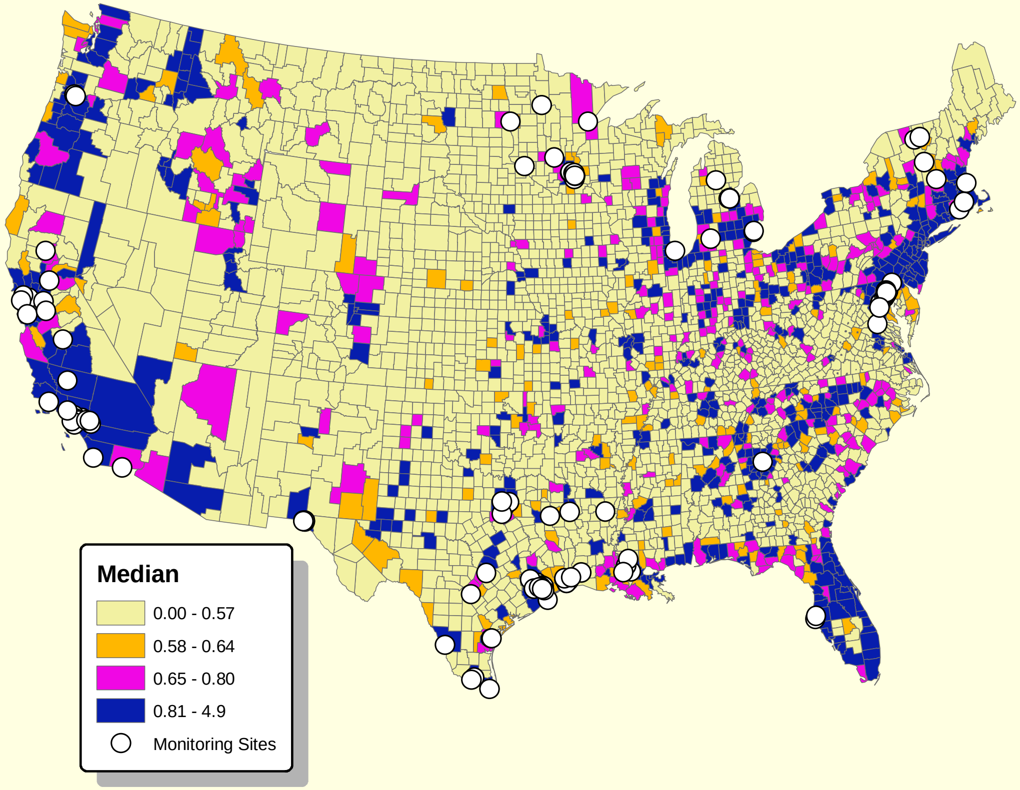
* 1990 estimates do not reflect latest methodology used in 1999 estimates for prescribed and wildfires

1999 NATA - National Scale Assessment
Predicted County Level
Ambient Benzene Concentrations

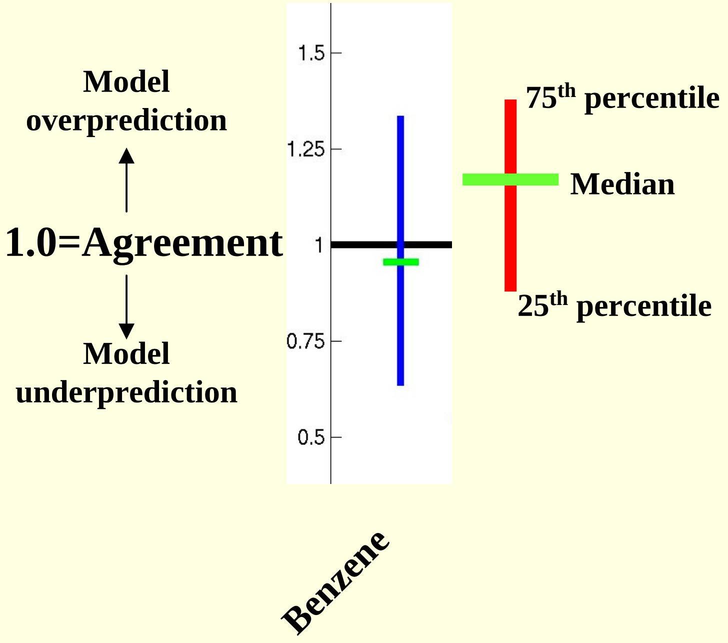


We can look at the geographic distribution of each pollutant

Model-to-Monitor Comparison for Benzene

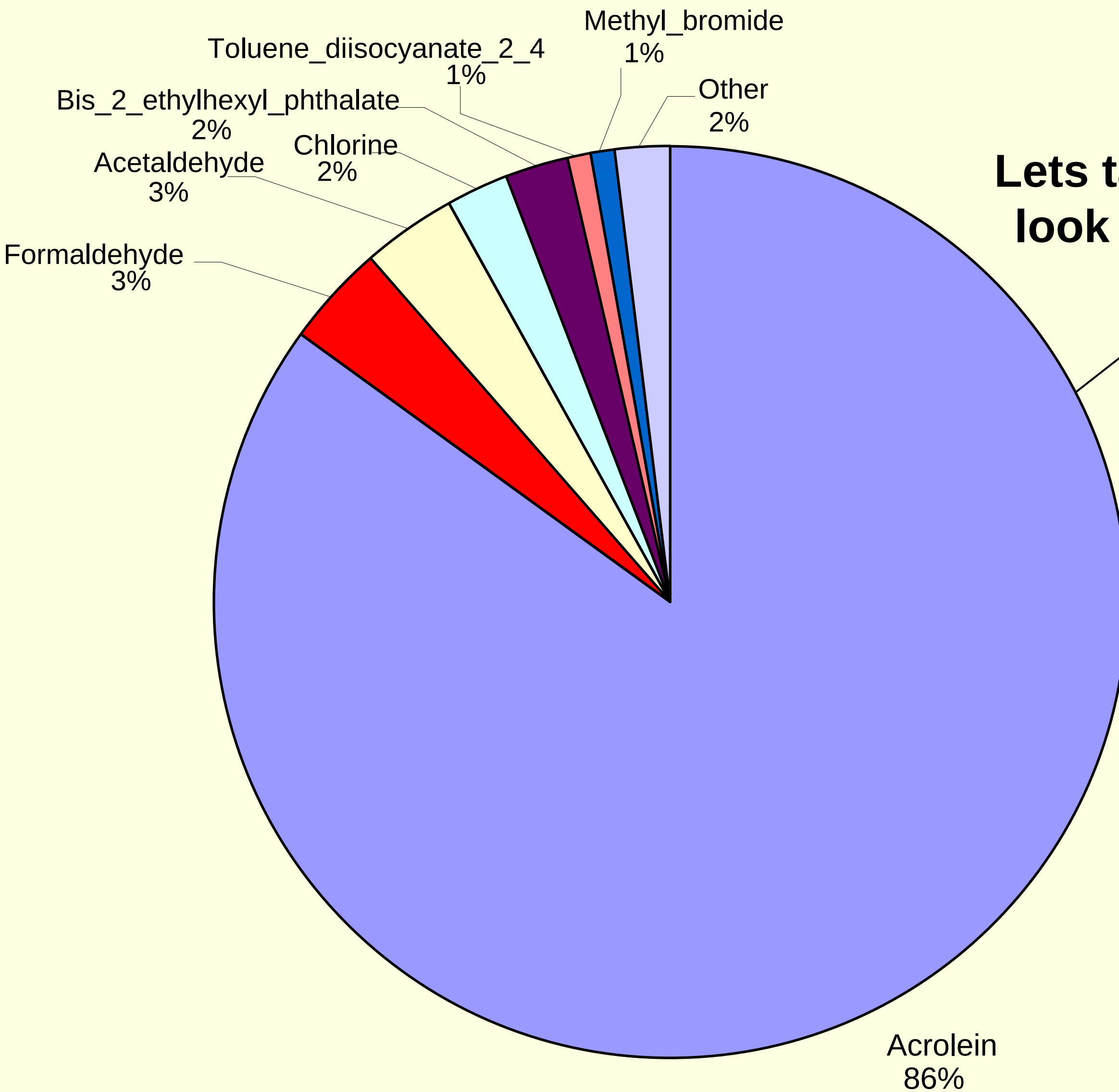


- Compared 115 monitored values from 1999



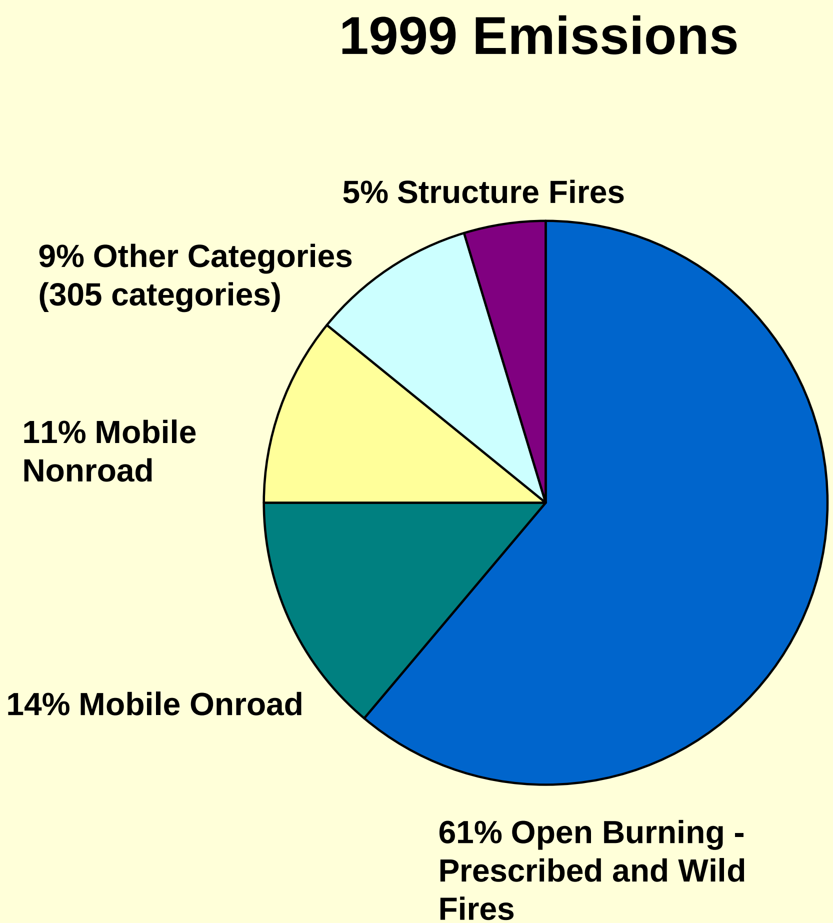
- Found very good agreement with NATA 1999 ambient concentrations

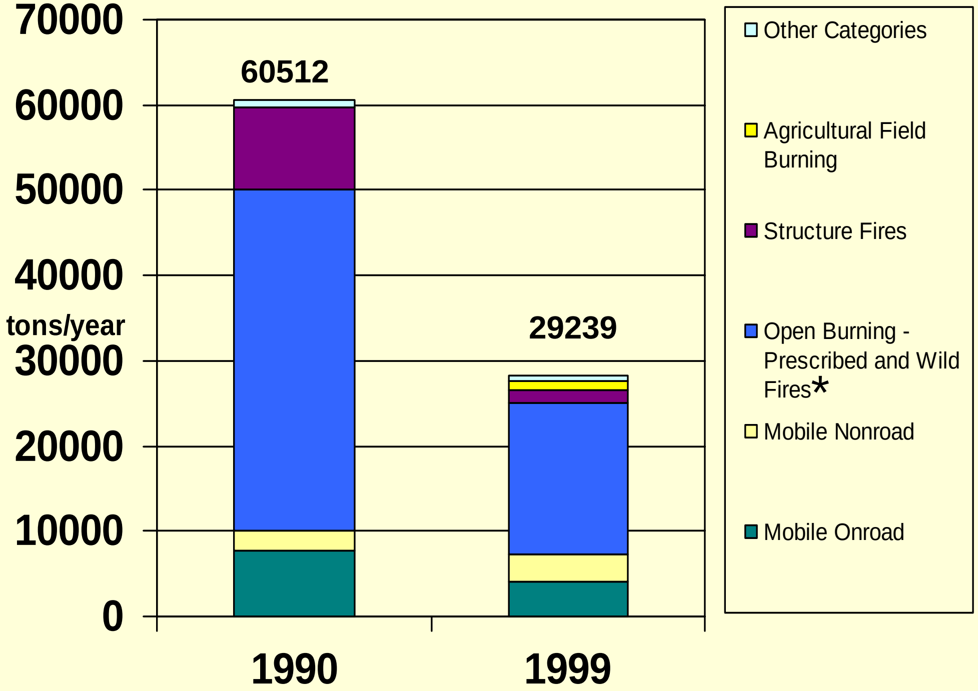
1999 NATA - Pollutant Contribution to Average Noncancer Risk (HI=6.4)



Lets take a closer look at Acrolein

We Can Analyze Emissions Further to Identify Key Source Categories: Acrolein



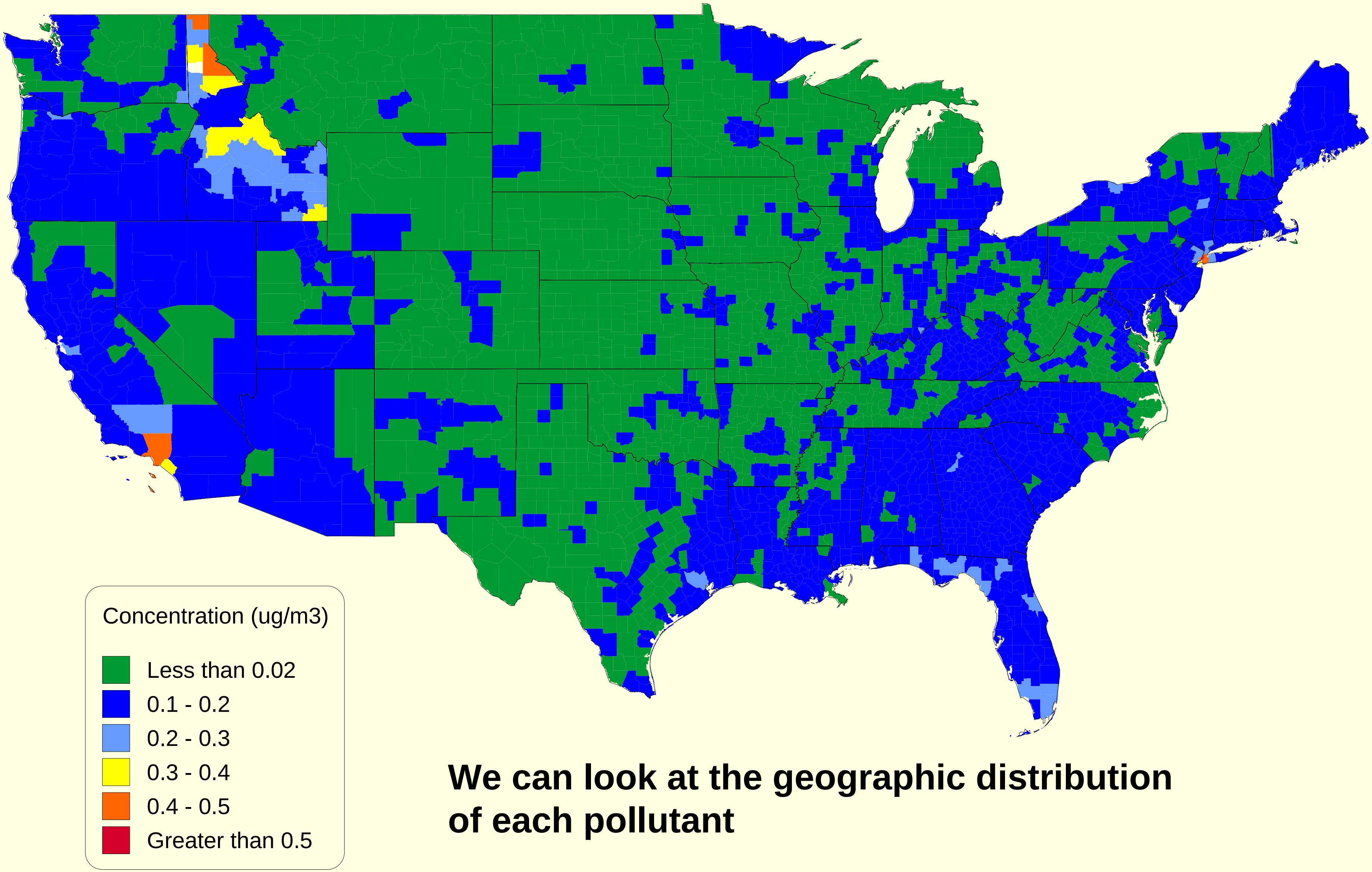


Emissions reductions from 1990 to 1999

Mobile Onroad:	3,730 tons
All Categories	31,273 tons

* 1990 estimates do not reflect latest methodology used in 1999 estimates for prescribed and wildfires

1999 NATA - National Scale Assessment
Predicted County Level
Ambient Acrolein Concentrations



We can look at the geographic distribution of each pollutant

Acrolein Monitoring Status

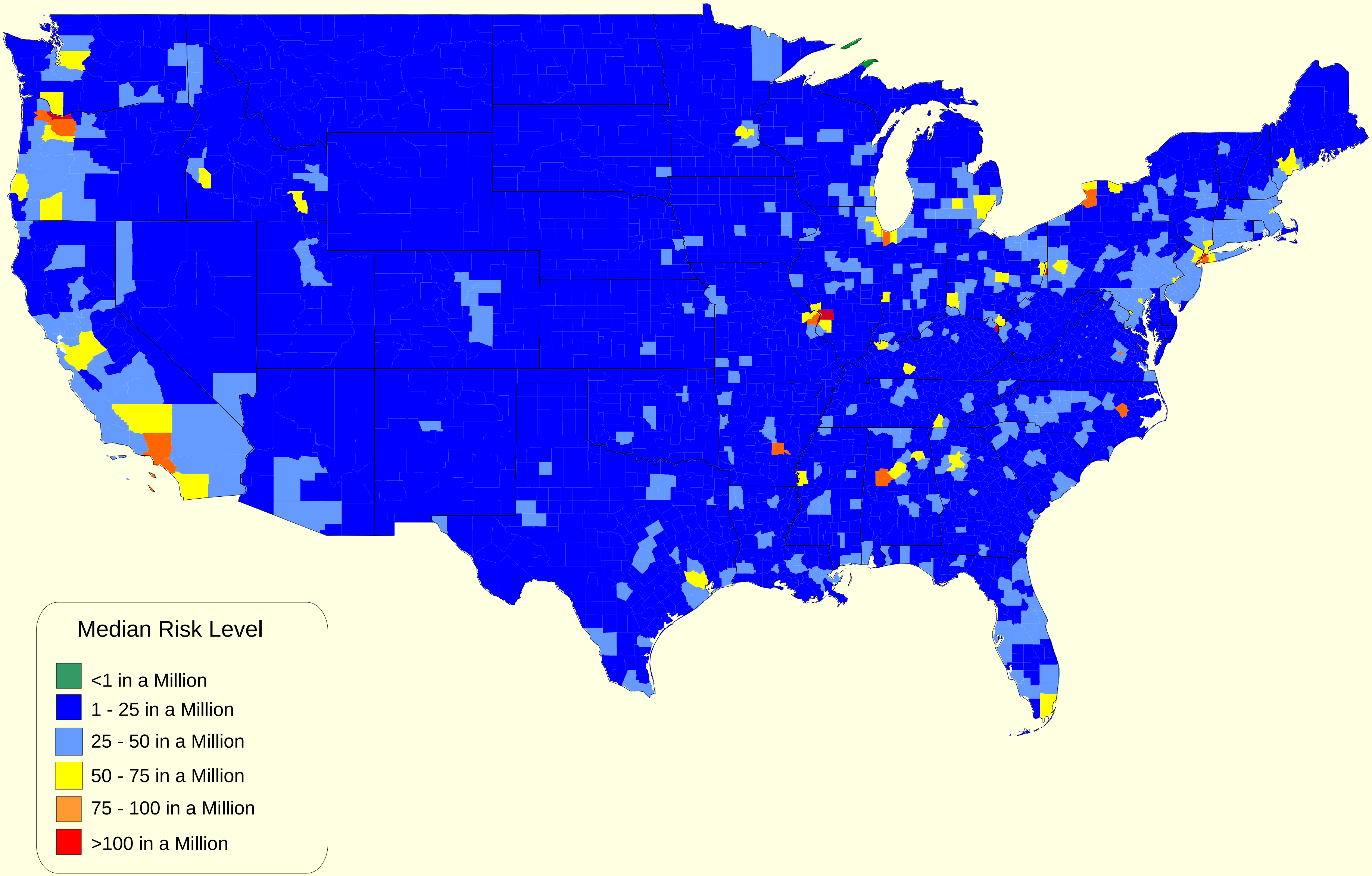
- Model to monitoring comparison not done for acrolein
- Limited monitoring data available
- Issue with method sample stability; resolution pending within the year
- ORD is working on a new monitoring method that may improve reliability

Where are the locations of greatest air toxic risk of concern?

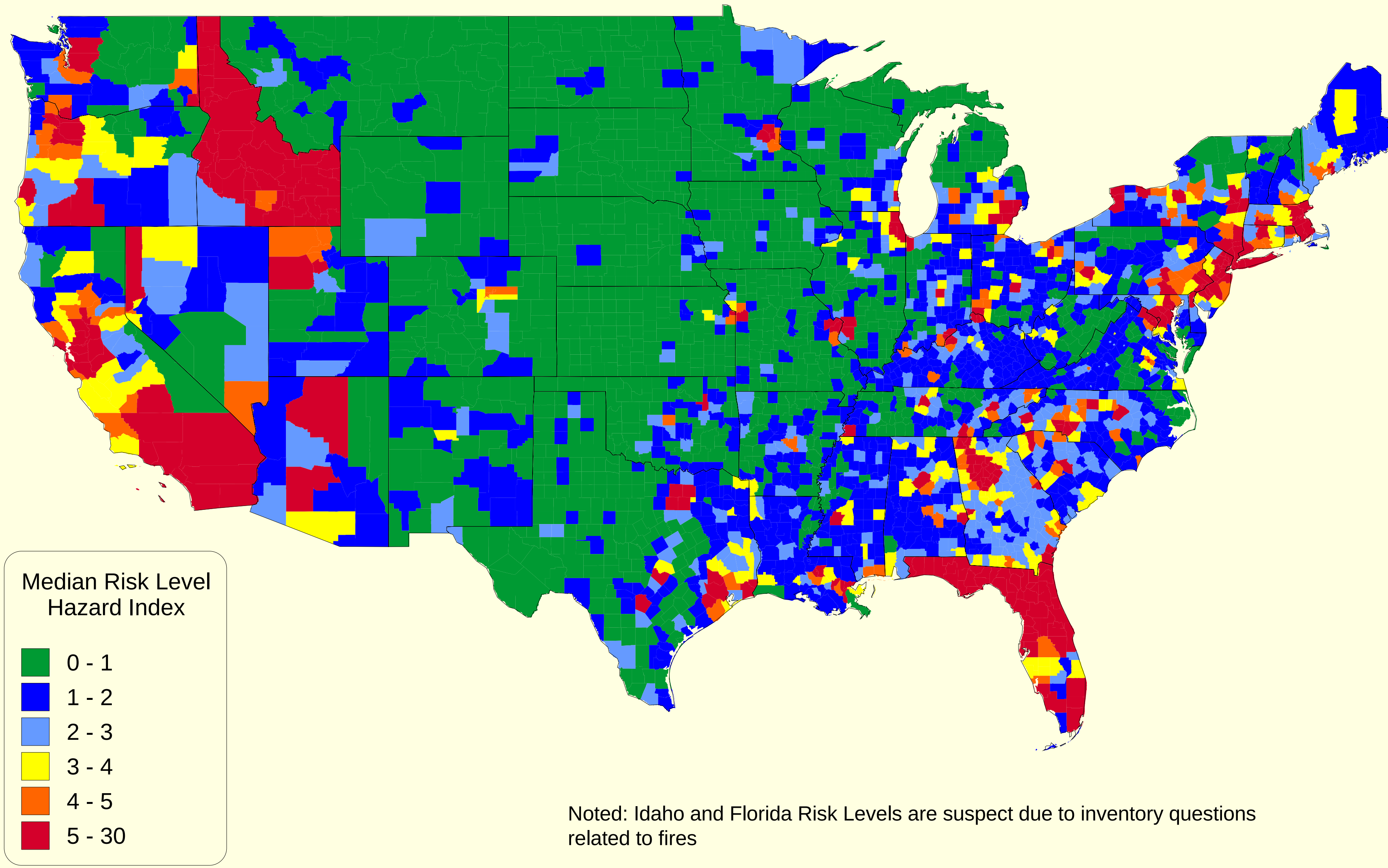
Geographic Risk Distribution

- **Cancer Risk**
  - Spatially, majority of country predicted to have risk between 1 and 25 in a million
  - Most urban locations greater than 25 in a million
  - Transportation corridors and some locations greater than 50 in a million risk
  - Several counties greater than 100 in a million risk
- **Noncancer**
  - Over 40% of counties hazard index greater than 1
  - Several counties hazard index greater than greater than 10
  - High values in Florida and Idaho from forest fires
- **Highest risk counties coincide with locations where criteria pollutant issues are significant**

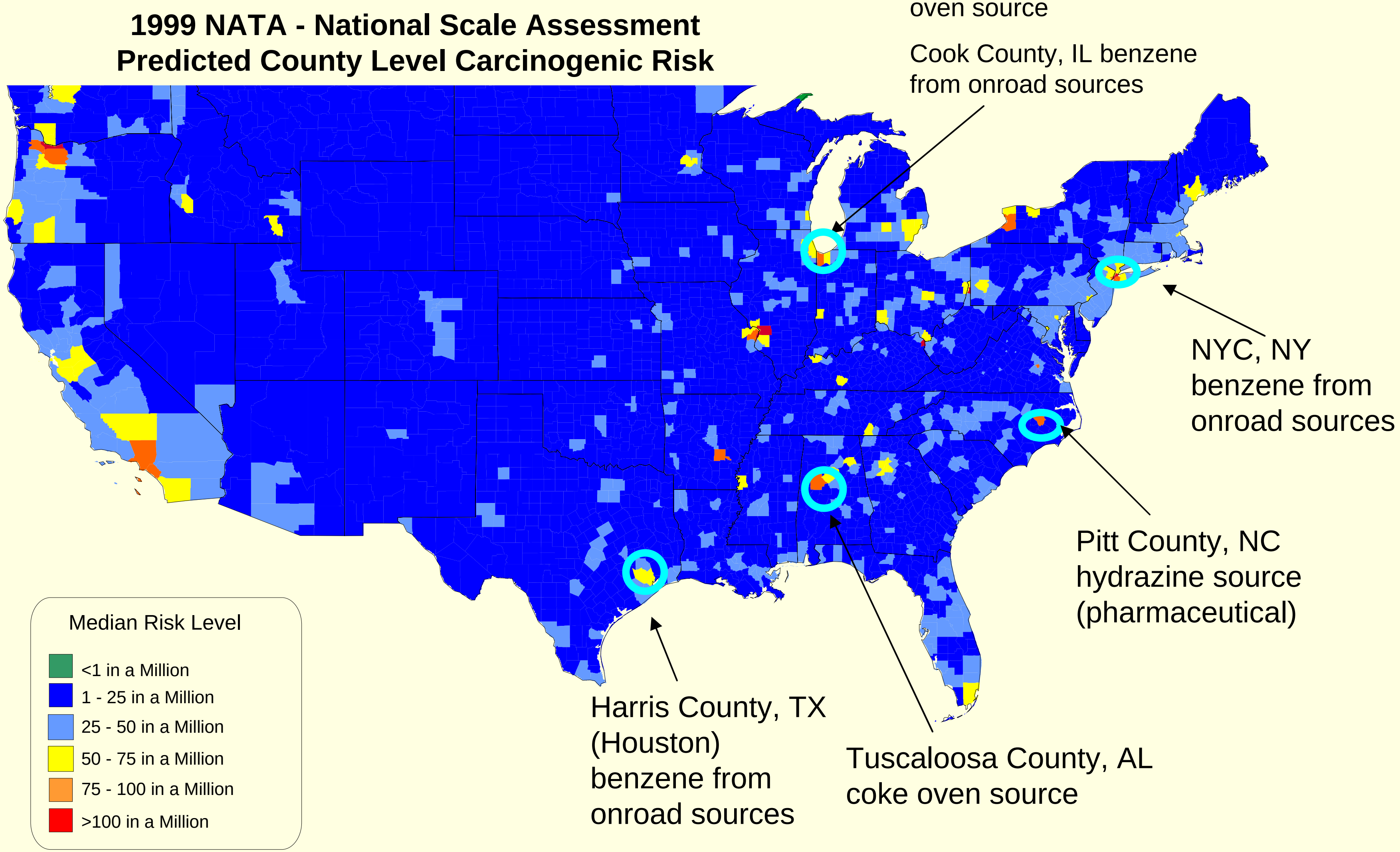
1999 NATA - National Scale Assessment
Predicted County Level Carcinogenic Risk



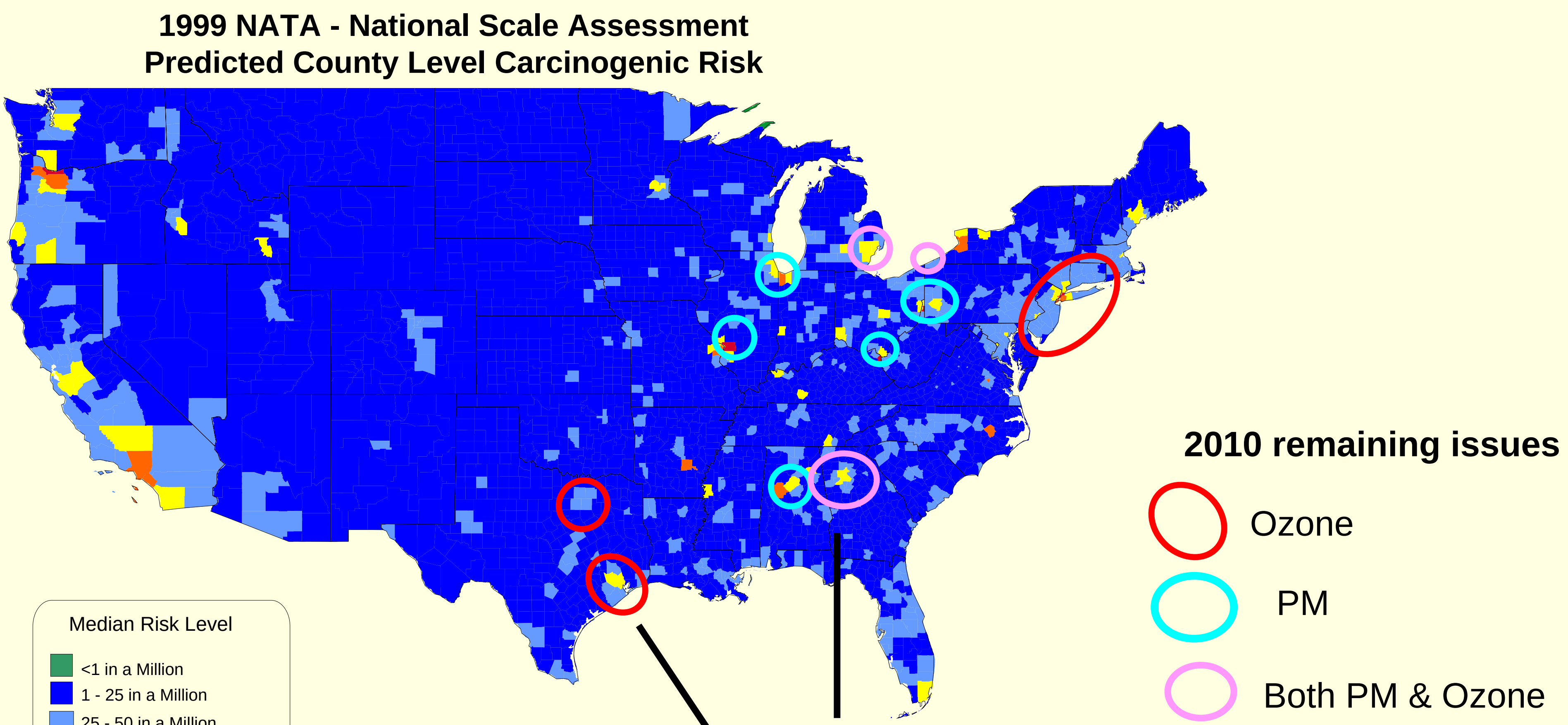
1999 NATA - National Scale Assessment
Predicted County Level Noncancer (Respiratory) Risk



NATA can be used as a tool for states/locals/tribes to begin to analyze their risks



Using NATA we can begin to conduct multi-pollutant assessments



Some areas of predicted high air toxic risk are expected to have O3 and PM problems in the future (2010)

Communication of NATA Results

- Improved presentation of results on NATA website
  - More transparent and accessible website data
    - Raw Data; Data Summaries
    - Updating Q & A s
    - Technical Support Information
  - Facilitates ability to conduct local analysis
    - Local Scale Mapping Tool – census tract level
- Working towards a new dynamic visualization tool with use of the data warehouse

1999 NATA: Arizona Cancer Risk & Non-Cancer Hazard - Microsoft Internet Explorer

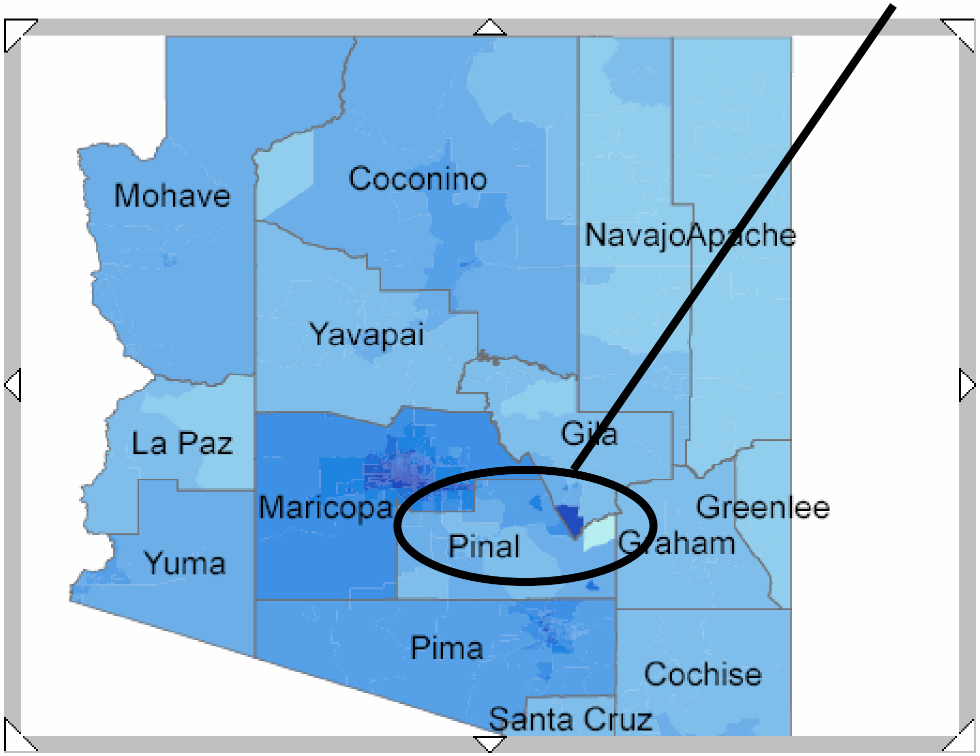
File Edit View Favorites Tools Help

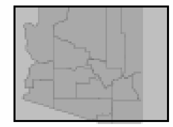
Address http://hill.nccr.epa.gov/ttn/atw/nata1999/arizona/mapview/index.html

1999 NATA: Arizona Cancer Risk & Non-Cancer Hazard

Zoom 100%

Can zoom in to area of concern





Zoom to ...

- 15 to 20
- 20 to 25
- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 50
- 50 to 100
- 100 to 250
- 250 to 500
- 500 to 1000
- 1000 to 1500

Author: 1999 NATA Team
Company: USEPA/OAQPS
E-Mail: fann.neal@epa.gov
Date: 13. August 2004
Projection: GCS North American 1983
Comment: [disclaimer & link]

Adobe Download SVG Viewer

Internet

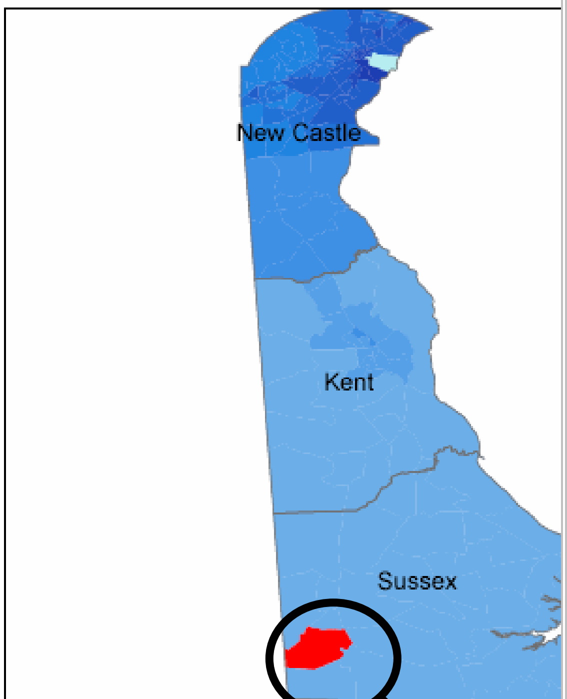
1999 NATA: Delaware Cancer Risk & Non-Cancer Hazard - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://hill.nccr.epa.gov/ttn/atw/nata1999/delaware/mapview/index.html

1999 NATA: Delaware Cancer Risk & Non-Cancer Hazard

Zoom 100%



Attribute Table - Microsoft Internet Explorer

light the object on the map. Press the Ctrl-key at the same

	Major Source Risk	Area Source Risk	On-Road Risk	Non-Road Risk
	0.09	0.63	1.74	0.47
	0.07	0.52	1.64	0.3
	0.13	0.81	3.03	0.4
	0.1	0.86	2.27	0.4
	0.09	1.92	3	0.75
	0.09	1.2	2.93	0.47
	0.07	0.9	1.74	0.46
	0.09	1.34	2.6	0.57
	0.11	1.03	2.09	0.49
	0.17	1.89	4.22	0.62
	0.23	1.25	2.98	0.46

Author: 1999 NATA Team
Company: USEPA/OAQPS
E-Mail: fann.neal@epa.gov
Date: 11. August 2004
Projection: GCS North American 1983
Comment: [Disclaimer & Link]

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Can highlight tract and get details information in exportable tables

Done Internet

What is NATA's impact on the air toxics program?

- A few pieces of the puzzle to help us track progress of program
- Starting point for local-scale assessment (prioritize pollutants of interest and locations of interest)
- Improving emissions inventories - inspiring greater participation and enhanced quality control
- Impacting the new air toxics monitoring network
- Facilitates future multipollutant assessments
- All of this will enable the Air Toxic Program to more effectively target risk reduction efforts

NATA Exercises

- State NATA exercise.
  - Close your training CD and insert the *Interactive Session on 1999 NATA CD* with your state data file. The NATA data CD must be returned to your instructor at the conclusion of the training session.
  - 1999 NATA class exercise.