



# Use of CMAQ for the 2011 National Air Toxics Assessment (NATA)

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## Introduction

On December 17, 2015, the U.S. Environmental Protection Agency (EPA) released the fifth version of the National Air Toxics Assessment (NATA), a state-of-the-science screening tool that provides information on the potential risks from breathing air toxics. This version of NATA is based on emissions for the 2011 calendar year, the most complete and up-to-date emissions data available at the time of the assessment.

For the 2011 NATA, EPA modeled 180 air toxics plus diesel particulate matter from emission sources including stationary sources, mobile sources, events (e.g., wildfires and prescribed burning), biogenics (e.g., naturally-occurring emissions from vegetation), secondary formed pollutants and background. Output from NATA includes both chronic cancer and noncancer inhalation risk estimates at a census tract resolution nationwide.

Forty of the 180 air toxics were modeled using a "hybrid approach" – a combination of CMAQ and AERMOD annual average concentrations.

## Model Specifications/Methods

- CMAQv5.02; CB05 chemical mechanism ~ 40 HAPs
- AERMOD12345 ~ 180 HAPs
- Source attribution of primary emissions other than fires and biogenic sources is based on AERMOD. Fires and biogenic contributions derived from CMAQ zero-out runs. Secondary contribution from CMAQ
- Combine to get census block-resolved hybrid concentrations "C<sub>REC</sub>" for the 40 HAPs in both CMAQ & AERMOD (see equation below)

Gas Phase – stationary & mobile		Gas Phase – stationary		Source Attribution Groups	
Pollutant	Inhalation Health Impacts	Pollutant	Inhalation Health Impacts	Onroad and Nonroad	Point
BENZENE	Cancer, Noncancer	ACRYLONITRILE	Cancer, Noncancer	Bulk gasoline terminals	Airports
FORMALDEHYDE	Cancer, Noncancer	CARBON TETRACHLORIDE	Cancer, Noncancer	Chemical manufacturing	Railyards
ACETALDEHYDE	Cancer, Noncancer	CHLORINE	Noncancer	Mining	Other point
1,3 BUTADIENE	Cancer, Noncancer	CHLOROPROPENE	Noncancer	Industrial not elsewhere classified	
NAPHTHALENE	Cancer, Noncancer	1,3-DICHLOROPROPENE	Cancer, Noncancer	Nonferrous metals	
ACROLEIN	Noncancer	ETHYLENE DIBROMIDE	Cancer, Noncancer	Oil and gas	
METHANOL	Noncancer	ETHYLENE DICHLORIDE	Cancer, Noncancer	Refineries	
XYLENES (m, o, p)	Noncancer	ETHYLENE OXIDE	Cancer, Noncancer	Storage and transfer	
TOLUENE	Noncancer	HEXAMETHYLENE-1,6-DIISOCYANATE	Noncancer	Gas stations (Stage 1)	Other (CMAQ only)
PAHs (9 Groups)	Cancer	HYDROCHLORIC ACID	Noncancer	Industrial, commercial/institutional fuel combustion	Fires
		HYDRAZINE	Cancer, Noncancer	Landfills	Biogenics
		MALEIC ANHYDRIDE	Noncancer	Surface coating and industrial solvent	Secondary formation
		METHYLENE CHLORIDE	Cancer, Noncancer	Waste disposal other	
		PROPYLENE DICHLORIDE	Noncancer	Commercial Cooking	
		QUINOLINE	Neither	Miscellaneous nonindustrial	
		TETRACHLOROETHANE	Neither	Residential wood combustion	
		2,4-TOLUENE DIISOCYANATE	Cancer, Noncancer	Residential fuel combustion except wood	
		TRICHLOROETHYLENE	Cancer, Noncancer	Consumer & commercial solvent	
		TRIETHYLAMINE	Noncancer	Solvent degreasing	
		VINYL CHLORIDE	Cancer, Noncancer	Solvent dry cleaning	
				Non-industrial surface coating	
				CMV-Ports	
				CMV-Underway	
				Locomotives	

## Hybrid Approach

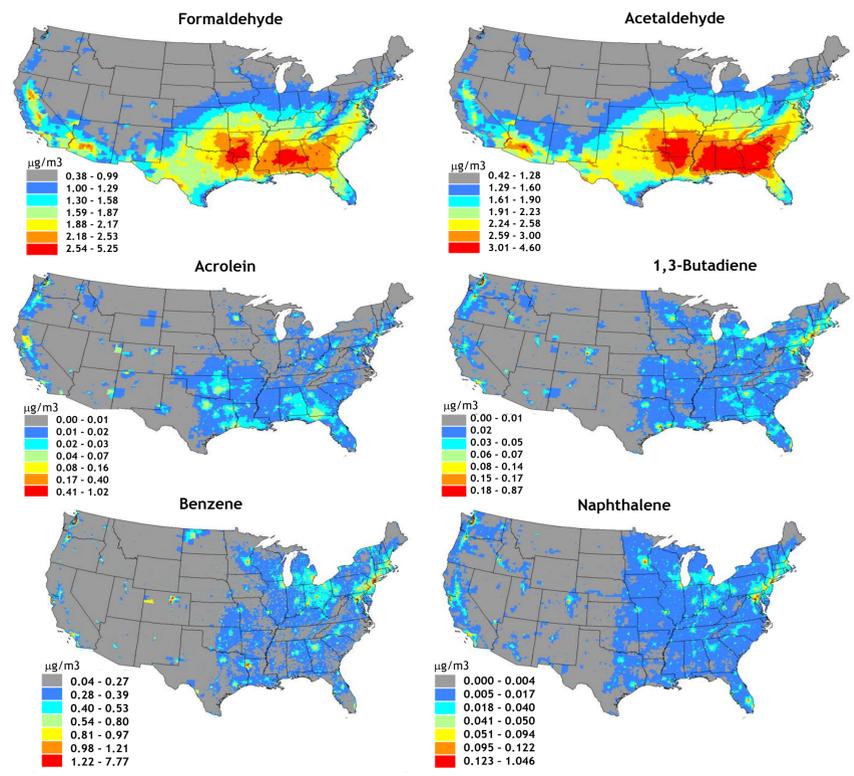


$$C_{REC} = AERMOD_{REC} \times \frac{CMAQ_{PNFB}}{AERMOD_{GRIDAVG}} + CMAQ_{SEC} + CMAQ_{PFIRE} + CMAQ_{PBIOTENICS}$$

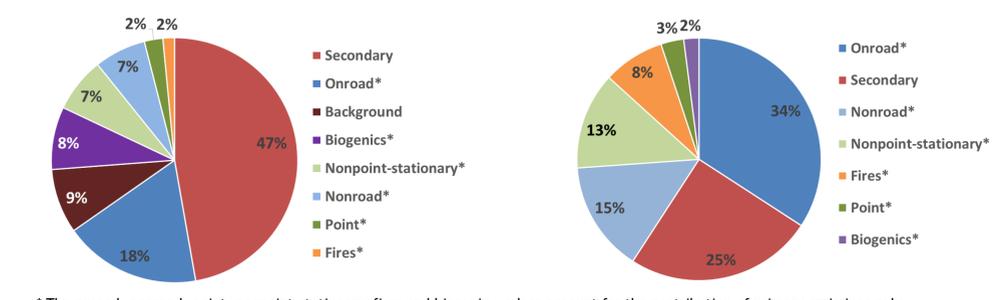
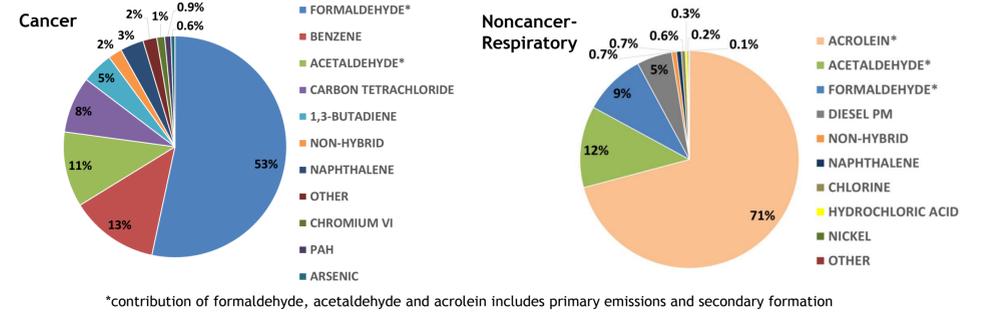
- Source attribution from non-fires and non-biogenic emission sector "J" based on AERMOD runs
- Source attribution of biogenics and fires (12 km resolution) from CMAQ zero-out runs
- Secondary formation for formaldehyde, acetaldehyde and acrolein

$$C_{REC,J} = AERMOD_{REC,J} \times \frac{CMAQ_{PNFB}}{AERMOD_{GRIDAVG}}$$

## Results: Concentration Patterns of Selected HAPs

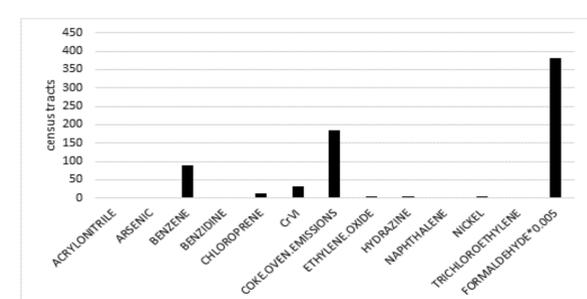


## Pollutants and Source Contributions to Risk

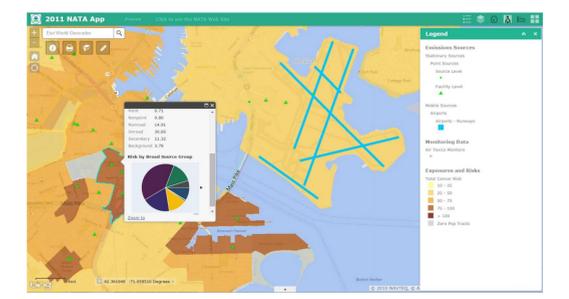


\* The onroad, nonroad, point, nonpoint-stationary, fires and biogenic wedges account for the contribution of primary emissions only

## Risk Drivers at Census Tract Level

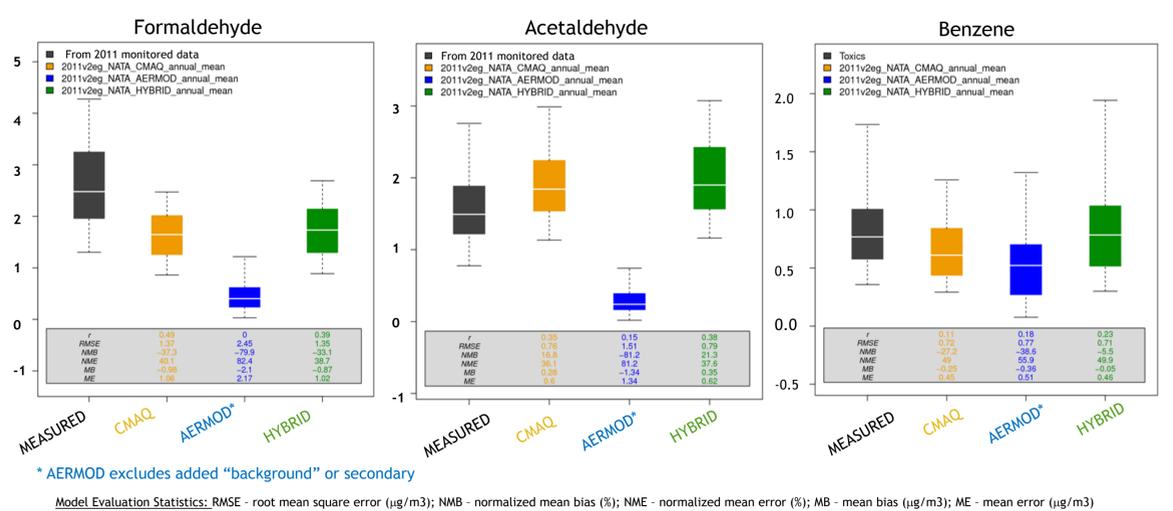


Formaldehyde is the largest contributor to cancer risk in over 99% of all census tracts nationwide.



Query data to look at drivers for specific tracts using the NATA Web App.

## Model Evaluation



\* AERMOD excludes added "background" or secondary  
Model Evaluation Statistics: RMSE - root mean square error (µg/m³); NMB - normalized mean bias (%); NME - normalized mean error (%); MB - mean bias (µg/m³); ME - mean error (µg/m³)

## Summary

- NATA summarizes risks at national, state, county and census tract level nationwide in spreadsheet and database formats
  - Chronic cancer and noncancer risks provided for 140 pollutants (those with health benchmarks)
  - Ambient concentrations provided for the 180 pollutants that were modeled
- The NATA data and Web App allow users to quickly examine the potential risks in a local community
  - See risks by pollutant and source category
  - Get detailed facility emissions data
  - Compare the results to available monitoring data
  - NATA Web App map layers can also be downloaded from EPA's Environmental Dataset Gateway at: [www.epa.gov/edg](http://www.epa.gov/edg)

<http://www.epa.gov/national-air-toxics-assessment>

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