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National-Scale Air Toxics Assessments

U.S. Environmental Protection Agency
http://www.epa.gov/ttn/atw/natamain/

What is NATA?

The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing comprehensive evaluation of air toxics in the U.S. EPA developed the NATA as a state-of-the-science screening tool for State/Local/Tribal Agencies to prioritize pollutants, emission sources and locations of interest for further study in order to gain a better understanding of risks. NATA assessments do not incorporate refined information about emission sources, but rather, use general information about sources to develop estimates of risks which are more likely to overestimate impacts than underestimate them. NATA provides estimates of the risk of cancer and other serious health effects from breathing (inhaling) air toxics in order to inform both national and more localized efforts to identify and prioritize air toxics, emission source types and locations which are of greatest potential concern in terms of contributing to population risk. This in turn helps air pollution experts focus limited analytical resources on areas and or populations where the potential for health risks are highest. Assessments include estimates of cancer and non-cancer health effects based on chronic exposure from outdoor sources, including assessments of non-cancer health effects for Diesel Particulate Matter (PM). Assessments provide a snapshot of the outdoor air quality and the risks to human health that would result if air toxic emissions levels remained unchanged.

Why was NATA developed?

The NATA assessments were designed to help guide efforts to cut toxic air pollution and build upon the already significant emissions reductions achieved in the US since 1990.

NATA was developed as a tool to inform both national and more localized efforts to collect air toxics information, characterize emissions, and help prioritize pollutants/geographic areas of interest for more refined data collection and analyses.

The goal is to identify those air toxics which are of greatest potential concern in terms of contribution to population risk. Ambient and exposure concentrations, and estimates of risk and hazard for air toxics in each State are typically generated at the census tract level.

How are NATA assessments developed?

NATA assessments generally include a four step process including:

1. Compile a national emissions inventory from outdoor sources.
2. Estimate ambient concentrations of air toxics across the United States.
3. Estimate population exposures across the United States.
4. Characterize potential public health risks due to inhalation of air toxics.

The Pollutants

Hazardous air pollutants, also known as toxic air pollutants or air toxics, are those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. EPA is required to control 187 hazardous air pollutants. Examples of toxic air pollutants include benzene, which is found in gasoline; perchlorethlyene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries. Through appropriate rulemaking, the Clean Air Act list can be modified. A current list of modifications is available. Some clarification on certain pollutant aggregation is also available.

The Sources

Most air toxics originate from human-made sources, including mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., building materials and activities such as cleaning). There are two types of stationary sources that generate routine emissions of air toxics:

- "Major" sources are defined as sources that emit 10 tons per year of any of the listed toxic air pollutants, or 25 tons per year of a mixture of air toxics. These sources may release air toxics from equipment leaks, when materials are transferred from one location to another, or during discharge through emission stacks or vents
- "Area" sources consist of smaller-size facilities that release lesser quantities of toxic pollutants into the air. Area sources are defined as sources that emit less than 10 tons per year of a single air toxic, or less than 25 tons per year of a combination of air toxics. Though emissions from individual area sources are often relatively small, collectively their emissions can be of concern - particularly where large numbers of sources are located in heavily populated areas.

EPA published the initial list of "source categories" in 1992 (57FR31576 , July 16, 1992) and since that time has issued several revisions and updates to the list and promulgation schedule. For each listed source category, EPA indicates whether the sources are considered to be "major" sources or "area" sources. The 1990 Clean Air Act Amendments direct EPA to set standards for all major sources of air toxics (and some area sources that are of particular concern).

Descriptions of Selected NATA Chemicals

Acetaldehyde is mainly used as an intermediate in the synthesis of other chemicals. Acetaldehyde is formed as a product of incomplete wood combustion in fireplaces and woodstoves, forest and wildfires, pulp and paper production, stationary internal combustion engines and turbines, vehicle exhaust fumes, and wastewater processing.

Acrolein is primarily used as an intermediate in the manufacture of acrylic acid. It can be formed from the breakdown of certain pollutants in outdoor air or from forest and wildfires, as well as vehicle exhaust.

Arsenic, a naturally occurring element, is found throughout the environment; for most people, food is the major source of exposure. The air emissions are predominantly a result of the burning of coal or fuel oil, from metal smelters, iron foundries, and burning of wastes.

Benzene is found in the air from emissions from oil and natural gas production, petroleum refining, burning coal and oil, gasoline service stations, pulp and paper production, coke ovens, and motor vehicle exhaust. Benzene is used as a constituent in motor fuels; as a solvent for fats,

waxes, resins, oils, inks, paints, plastics, and rubber; in the extraction of oils from seeds and nuts; and in photogravure printing. It is also used as a chemical intermediate. Benzene is also used in the manufacture of detergents, explosives, pharmaceuticals, and dyestuffs.

1,3-Butadiene is found in ambient air from motor vehicle exhaust as well as manufacturing and processing facilities, gasoline distribution, production of synthetic plastics and rubber, wastewater processing, forest and wildfires, or other combustion

Cadmium emissions are mainly from the burning of fossil fuels such as coal or oil, and the incineration of municipal waste. Cadmium may also be emitted into the air from zinc, lead, or copper smelters. For nonsmokers, food is generally the largest source of cadmium exposure. Cadmium levels in some foods can be increased by the application of phosphate fertilizers or sewage sludge to farm fields.

Carbon tetrachloride *was* produced in large quantities to make refrigerants and propellants for aerosol cans, as a solvent for oils, fats, lacquers, varnishes, rubber waxes, and resins, and as a grain fumigant and a dry cleaning agent. Consumer and fumigant uses have been discontinued and only industrial uses remain. Individuals may be exposed to carbon tetrachloride in the air from accidental releases from production and uses, its disposal in landfills, and wastewater processing.

Chloroform may be released to the air from a large number of sources related to its manufacture and use, as well as its formation in the chlorination of drinking water, wastewater, and swimming pools. Pulp and paper mills, hazardous waste sites, and sanitary landfills are also sources of air emissions. Chloroform was used in the past as an extraction solvent for fats, oils, greases, and other products; as a dry cleaning spot remover; in fire extinguishers; as a fumigant; and as an anesthetic. However, chloroform is no longer used in these products.

Chromium sources of emissions include the combustion of coal and oil, electroplating, vehicles, iron and steel plants, and metal smelters. The emissions reflected in this assessment are based on state and local agency reporting of chromium as "chromium and compounds," individual chromium compounds and chromium ions. Because of the inconsistent reporting, all of the chromium was lumped together and modeled as "chromium compounds." In assessing the risk, the Agency conservatively assumed that 34 percent of the chromium is hexavalent (which is the most toxic form).

Diesel Particulate Matter (PM) is a mixture of particles and gases that is a component of diesel exhaust. Diesel exhaust is listed as a mobile source air toxic due to the cancer and noncancer health effects associated with exposure to whole diesel exhaust. EPA believes that exposure to whole diesel exhaust is best described, as many researchers have done over the years, by diesel particulate concentrations.

Ethylene dibromide was used in the past as an additive to leaded gasoline and as a fumigant. Ethylene dibromide is currently used in the treatment of felled logs for bark beetles and termites, and control of wax moths in beehives. Ethylene dibromide is also used as an intermediate for dyes, resins, waxes, and gums.

Ethylene oxide is used mainly as a chemical intermediate in the manufacture of textiles, detergents, polyurethane foam, antifreeze, solvents, medicinals, adhesives, and other products. The major sources of emissions are commercial and hospital sterilizers.

Formaldehyde is used mainly to produce resins used in particleboard products and as an intermediate in the synthesis of other chemicals. The major sources of emissions to the air are

forest and wildfires, stationary internal combustion engines and turbines, pulp and paper plants, petroleum refineries, power plants, manufacturing facilities, incinerators, and automobile exhaust emissions.

Hydrazine is used in agricultural chemicals (pesticides), chemical blowing agents, pharmaceutical intermediates, photography chemicals, boiler water treatment for corrosion protection, textile dyes, and as fuel for rockets and spacecraft.

Lead is used in the manufacture of batteries. The largest source of lead in the atmosphere has been from leaded gasoline combustion, but with the phase down of lead in gasoline, air lead levels have decreased considerably. Other sources of air emissions include combustion of solid waste, coal, and oils, emissions from iron and steel production and lead smelters. Exposure to lead can also occur from food and soil. Children are at particular risk to lead exposure since they commonly put hands, toys, and other items in their mouths, which may come in contact with lead-containing dust and dirt. Lead-based paints were commonly used for many years and flaking paint, paint chips, and weathered paint powder may be a major source of lead exposure, particularly for children.

Mercury is predominantly emitted to the air by the combustion of fossil fuels (mostly coal) and waste. Included in the "combustion" category are medical waste incinerators, which burn medical waste and municipal waste combustors which burn municipal waste. Once mercury enters waters, either directly or through air deposition, it can "bioaccumulate" in fish and animal tissue in its most toxic form, methylmercury. Bioaccumulation means that the concentration of mercury in predators at the top of the food web (for example, predatory fish and fish-eating birds and mammals) can be thousands or even millions of times greater than the concentrations of mercury found in the water.

Methylene chloride is predominantly used as a solvent in paint strippers and removers; as a process solvent in the manufacture of drugs, pharmaceuticals, and film coatings; as a metal cleaning and finishing solvent in electronics manufacturing; and as an agent in urethane foam blowing. Other sources of emissions are landfills and wastewater processing.

Nickel is found in the outside air as a result of releases from utility oil and coal combustion, residential heating, nickel metal refining, lead smelting, sewage sludge incineration, manufacturing facilities, mobile sources, and other sources.

Perchloroethylene is widely used for dry-cleaning fabrics and metal degreasing operations.

Polycyclic organic matter (POM) defines a broad class of compounds that includes the polycyclic aromatic hydrocarbon compounds (PAHs). POM compounds are formed primarily from combustion and are present in the atmosphere in particulate form. Sources of air emissions are diverse and include, vehicle exhausts, forest and wildfires, asphalt roads, coal, coal tar, coke ovens, agricultural burning, residential wood burning, and hazardous waste sites.

Trichloroethylene used in the United States is mainly associated with industrial degreasing operations and is also emitted from landfills.

Vinyl chloride is used to make polyvinyl chloride (PVC) plastic and vinyl products. Sources of emissions include the discharge of exhaust gases from factories that manufacture or process vinyl chloride, landfills, or evaporation from areas where chemical wastes are stored.

National-Scale Air Toxics Assessment for 2002 - Fact Sheet

http://www.epa.gov/ttn/atw/nata2002/factsheet.html

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- The Environmental Protection Agency (EPA) has released the 2002 national-scale air toxics assessment (NATA). The assessment is a state-of-the-science national-scale tool which provides broad estimates of health risks from breathing air toxics.
- NATA helps air agencies take an important step toward reducing risks from air toxics by identifying exposures that should be evaluated further to gain a better understanding of risks and to determine steps to reduce those exposures where necessary.
- Air toxics are pollutants known or suspected of causing cancer or other serious health problems, such as birth defects. The 2002 NATA assessed 181 air toxics, such as benzene, methylene chloride, acrolein, and diesel particulate matter (diesel PM). NATA estimates risks from exposure to emissions from large industries, smaller industries and from mobile sources such as cars and trucks.
- EPA collaborated with state, local and tribal agencies to develop the information that is contained in the NATA.
- EPA also used results from the 2002 NATA assessment as one of the tools to determine which schools to include in the Agency's initiative to monitor the air outside a subset of schools.
- Much progress has been made in reducing air toxics emissions. Since the passage of the 1990 Clean Air Act Amendments, emissions of air toxics have declined 40 percent from all sources. The NATA 2002 can be used to help target further necessary reductions in air toxics emissions.

RESULTS

- NATA 2002 estimated chronic cancer risks and non-cancer hazards for the 285 million people in the U.S. based on the 2000 census.
- NATA provides broad estimates of risk over geographic areas of the country and not definitive risks to specific individuals. The results are best used to prioritize pollutants and areas for further study, not as the sole basis for regulation or risk reduction activities.
- To determine cancer risk, EPA assumes that people would be exposed to the specific concentration over 70 years (an assumed lifetime). This would be an excess cancer risk that is in addition to those cancer cases that would normally occur in an unexposed population.

Cancer Risk

- NATA estimates that nearly all of the 285 million people in the U.S. have an increased cancer risk of greater than 10 in one million. The average cancer risk for 2002 is 36 in a million. This means that, on average, approximately 1 in every 28,000 people could contract cancer as a result of breathing air toxics from outdoor sources, if they were exposed to 2002 emission levels over the course of their lifetime.
- Two million (less than 1 percent of the total U.S. population based on the 2000 census) have an increased cancer risk of greater than 100 in one million.
- There are several contributors to these cancer risks:
    - Pollutants that are emitted locally by industrial sources and therefore have local or "hotspot" effects. Examples of these include tetrachloroethylene which is emitted from dry cleaning operations and methylene chloride which is used as an industrial solvent in many operations
        - NATA results show that local industry emissions account for about 25 percent of the average overall cancer risk.
- Pollutants that are emitted from mobile sources and are widespread, for example benzene.
    - NATA results show mobile emissions account for about 30 percent of the overall average cancer risk. The majority of this risk is from benzene.

- Pollutants that are considered to be “background” pollutants. These are pollutants for which there are currently no known emission sources, but because these pollutants persist in the environment, they still may be detected in the ambient air by monitors.
    - NATA results show that pollutants in this group account for about 45 percent of overall cancer risk, with carbon tetrachloride contributing nearly half of this risk.

Non-cancer Hazard

- Previous NATAs showed that respiratory and neurological health effects are the key chronic non-cancer effects of concern from air toxic exposures. For this reason, the 2002 NATA is only reporting non-cancer results for those two health effects.
- Of the 23 air toxics showing the potential for neurological effects, 5 are responsible for approximately 95% of the national average neurological hazard with manganese being the most significant contributor at 28%.
- Of the 43 air toxics showing the potential for respiratory effects, acrolein is the most significant, contributing about 90 percent of the nationwide average non-cancer hazard.

Diesel PM

- In this assessment, the potential cancer risk from diesel PM exhaust emissions is not addressed. This is because data are not sufficient to develop a quantitative estimate of the carcinogenic potency for this pollutant. However, EPA has concluded that diesel exhaust is among the substances that may pose the greatest risk.
- In the 2002 NATA, diesel PM is assessed for non-cancer hazard and is shown to contribute approximately 3 percent to the national average respiratory hazard.

ABOUT THE ASSESSMENT

- This iteration of NATA is based on air toxics emissions information from the year 2002. Emissions information from that year were the most complete and up-to-date available at the time EPA conducted the analysis. Working with industries and states, EPA updates information about air toxics emissions every three years. Once an inventory is complete, EPA conducts the analysis which is then reviewed by the states. Once the review is complete and the results are evaluated for accuracy, EPA releases the NATA.
- NATA is a screening-level assessment. A screening-level assessment is performed with a limited amount of technical information and with several health-protective assumptions to identify exposures that should be evaluated more carefully with more technical information to gain a better understanding of risks. Also, given that NATA is a screening-level assessment, it is not designed to be used as the sole basis for regulatory action.
- NATA results are used to target those geographical areas where more refined local-scale assessments or monitoring are needed to identify hotspots.
- The risks estimated in the assessment are associated with breathing the pollutants -- it does not address other methods of exposure such as eating or drinking. For the majority of air toxics, most exposure comes from breathing. For some air toxics, a separate assessment of other exposure routes is important.
- Because of improvements in EPA's NATA methodology, it is not meaningful to directly compare results across the national-scale assessments. Any change in emissions, ambient concentrations, or risks may be due to either improvements in the methodology or to real changes in emission levels.
- EPA plans to develop new national-scale assessments as inventory data from subsequent years become available. The next such analysis will focus on 2005 emissions inventory data. Work on this analysis has begun.
- The Agency has published two previous national-scale air toxics assessments for the years 1996 (published in 2002) and 1999 (published in 2006).
- The National-Scale Air Toxics Assessment website is available at http://www.epa.gov/nata2002.