BROWARD COUNTY ENVIRONMENTAL PROTECTION DEPARTMENT /AIR QUALITY DIVISION COMMENTS REGARDING THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S 1999 NATIONAL AIR TOXICS ASSESSMENT (NATA)

EXECUTIVE SUMMARY

The 1999 National Air Toxics Assessment (NATA) is a U.S. EPA census tract level assessment of risk associated with inhalation exposure to air toxics in the environment for all 50 states plus Puerto Rico and the U.S. Virgin Islands. Cancer risk, non-cancer inhalation risk, and non-cancer neurological risk from air toxics were estimated using a four step process incorporating actual/estimated emissions data, air modeling, inhalation exposure modeling, and risk assessment data. A detailed description of the process is discussed below. NATA results can be viewed at the U.S. EPA website (www.epa.gov/ttn/atw/nata1999/).

In Broward County, overall cancer and non-cancer respiratory risks are comparable to other large urban areas throughout the United States. This is expected, as a large portion of both cancer and non-cancer risk is due to sources associated with urban areas, such as vehicle and industrial emissions. Non-cancer neurological risk is negligible for Broward County and most of the nation. The purpose of the NATA is to aid Federal, State, Local, and Tribal agencies in focusing attention on pollutants and areas of concern.

BACKGROUND

Air toxics, also known as hazardous air pollutants (HAPs) are those pollutants that are known or suspected to cause cancer or other serious health effects. The Clean Air Act (www.epa.gov/air/caa/) defined an initial list of air toxics. The U.S. EPA currently identifies 188 chemicals as air toxics (see www.epa.gov/ttn/atw/188polls.html). Each air toxic belongs to one of four chemical groups: volatile organic compounds (VOCs), aldehydes (carbonyl compounds), metals (inorganic compounds), and semi-volatile organic compounds (SVOCs) and others.

It is important to note that the two NATAs performed to date (1996 and 1999) have also included non-cancer risk assessments for diesel particulate matter (diesel PM) although it is not listed as one of the 188 air toxic pollutants in the Clean Air Act amendments. Diesel PM is included in the assessment because evidence suggests that these particles can pose serious health effects.

The NATA is a nationwide assessment prepared by the U.S. EPA that shows cancer and non-cancer risk from air toxics at census tract level. (Census tracts are land areas defined by the U.S. Bureau of the Census that vary in size but typically contain about 4,000 residents each. Census tracts are usually smaller than 2 square miles in cities, but can be much larger in rural areas.) The NATA was designed as a tool for Federal, State, Local, and Tribal agencies to prioritize pollutants, emission sources, and locations of interest. The NATA was not designed to determine cancer and non-cancer risk due to air toxics to small geographical areas. The first NATA (released in 2002) was based on 1996 emissions data, which was the most recent and complete data set available when the data was being compiled for the NATA. The current NATA is based on 1999 emissions data.

The NATA uses emissions data from the National Emissions Inventory (NEI) for all emissions sources: major (e.g., steel mills, power plants), area (e.g. gasoline stations, dry cleaners), on-road mobile (e.g., automobiles, trucks, motorcycles), non-road mobile (e.g., lawnmowers, construction equipment, planes, trains), and background (i.e., air toxics that were emitted in the past, but have long lifetimes in the atmosphere). Although actual emissions data are preferred, those data are generally only available for major sources. Estimated emission data based on emission factors are used in the NEI when actual data are not available. Emissions data, along with meteorological and terrain data are used to estimate ambient concentrations of air toxics using an air pollution dispersion model (ASPEN model). The modeled ambient concentration data are then used in an exposure model (HAPEM5). The HAPEM5 model estimates the inhalation exposure from outdoor air sources based on population and estimated activity pattern data. The exposure model along with risk assessment data are used to estimate cancer and non-cancer inhalation risk for each of the modeled pollutants throughout the United States based on chronic (long-term, 70 years) exposure (see Figure 1). The results of the 1999 NATA assessment can be viewed at www.epa.gov/ttn/atw/nata1999/.

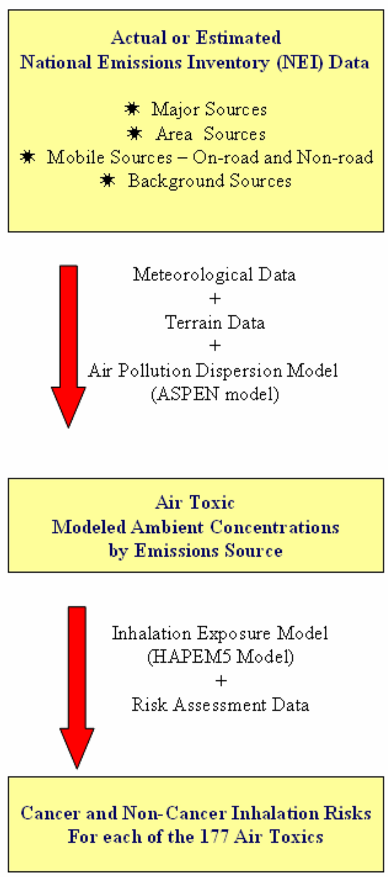

Figure 1. Flow Chart of 1999 National Ambient Air Toxics Assessment (NATA) process.

DIFFERENCES BETWEEN THE 1996 AND 1999 NATAS

While the 1996 NATA focused on 33 of the 188 air toxic pollutants listed in the Clean Air Act amendments, the 1999 assessment addresses 177 of these pollutants. Additionally, the 1999 assessment uses an improved emissions inventory with almost double the number of major sources as were used in the 1996 assessments, as well as, updated risk estimates. Because of the improvements made in the 1999 NATA methodology, it is not advisable to compare results from the 1996 and 1999 assessments since it is not evident whether differences are due to changes in the assessment method or actual changes in air toxics concentrations.

SUMMARY OF THE 1999 NATA

According to the U.S. EPA, the average nationwide cancer risk from inhalation of air toxics for 1999 was 42 in a million (1 in 23,800). This is an estimate of the average American's chance of contracting cancer from breathing the air toxics analyzed in the NATA, if they were exposed to 1999 emissions levels for 70 years. This assessment does not include risk from indoor air, diesel emissions, non-inhalation exposure pathways (i.e., dermal exposure, ingestion), or criteria pollutants (i.e., sulfur dioxide, ozone, nitrogen oxides, lead, particulate matter, and carbon monoxide). The air toxic which poses the greatest risk of causing cancer by chronic (long-term) inhalation is benzene. Benzene is a component of motor fuels, a solvent for many materials (i.e., fats, waxes, resins, oils, inks, paints, plastics, rubber), an extracting agent for oils from seeds and nuts, and an agent used in the manufacture of products (i.e., detergents, explosives, pharmaceuticals, and dyes). Benzene is also present in combustion emissions, particularly vehicle emissions (both on-road and non-road) and tobacco smoke.

The average nationwide non-cancer respiratory *hazard index (HI)* from inhalation of air toxics for 1999 was 6.4. The hazard index is the sum of hazard quotients for substances that affect the same target organ or organ system. To determine the hazard index for respiratory non-cancer health effects, the U.S. EPA summed the effects of different respiratory irritants. The HI for respiratory irritation is only an approximation of the combined effects on the respiratory system (i.e., lungs and air passages). An HI below 1.0 will likely not result in adverse non-cancer health effects over a lifetime of exposure. A respiratory HI greater than 1.0 can be best described as indicating that a potential may exist for adverse irritation to the respiratory system. The air toxic which poses the greatest risk of causing non-cancer respiratory health problems by chronic inhalation is acrolein. Acrolein is primarily used in the manufacture of acrylic acid. It can also be formed from the breakdown of pollutants from burning vegetation (prescribed burns and wildfires), gasoline emissions, and tobacco smoke. The inhalation non-cancer chronic effects of acrolein exposure generally consist of respiratory system congestion and irritation.

The average nationwide non-cancer neurological *hazard index (HI)* from inhalation of air toxics for 1999 was 0.10. As mentioned previously, an HI below 1.0 will likely not result in adverse non-cancer health effects over a lifetime of exposure.

The sources which contributed the most to the national 1999 NATA cancer risk are background sources (41%) and on-road sources (24%). As is expected, cancer risk was assessed to be greater in the more urbanized areas of the country. South Florida which is highly urbanized and has a great deal of vehicular traffic had a cancer risk higher than most rural areas, but comparable to urban areas throughout the United States (see Figure 2). The cancer risk is predicted to be between 1 and 25 in a million throughout most of the country, greater than 25 in a million in urbanized areas, greater than 50 in a million for transportation corridors and highly urbanized/industrialized areas, and greater than 100 in a million in some areas. Broward County's estimated median risk level for cancer was 44 in a million which is comparable to most urban areas in the country, but much lower than counties with larger cities (i.e., Miami, New York, Chicago, Atlanta, Los Angeles, etc.). To put cancer risk from inhalation of air toxics into perspective, the U.S. EPA notes that it is estimated that one out of every 3 Americans will contract cancer during a lifetime, when all causes are taken into account (two-thirds of this risk is due to lifestyle factors, i.e., smoking). The sources which contributed the most to Broward County's cancer risk are background sources (57.7%), on-road sources (26.7%), and area sources (15.0%).

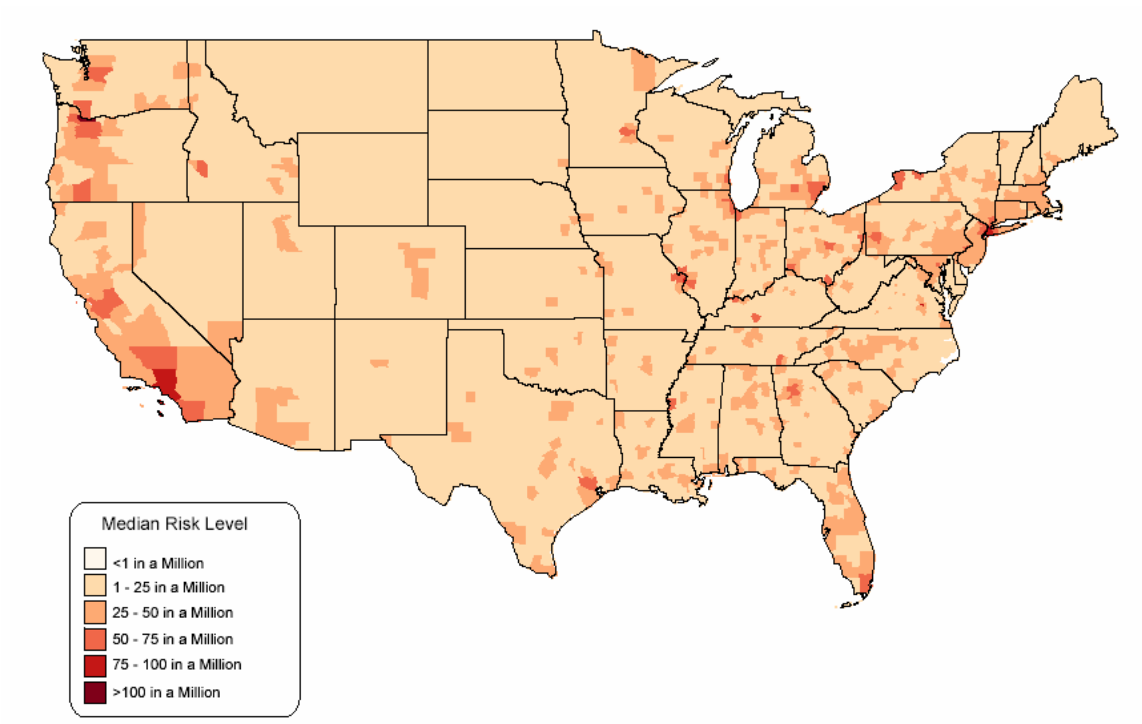

Figure 2. 1999 NATA Estimated County Level Cancer Risk (U.S. EPA)

The sources which contributed the most to the national 1999 NATA for non-cancer risk respiratory health effects are on-road sources (56%) and area sources (22%). While non-cancer respiratory risk was assessed to be greater in the more urbanized areas of the country, it was also high in more rural areas (see Figure 3). This is due to the fact that acrolein (the primary non-cancer respiratory risk air toxic) is produced during biomass burning which generally occurs more often in rural areas due to lightning strikes, uncontrolled burns, forest fires, open burning of leaves and other biological material, etc. Some rural areas had as high (or even higher) non-cancer respiratory health risks as those estimated for urban areas. High non-cancer respiratory risk values in Florida were attributed to wildfires. Broward County's estimated median hazard index was 11. The major sources for non-cancer risk respiratory health effects in Broward County are area sources (57.4%), on-road sources (29.7%), and non-road sources (10.8%).

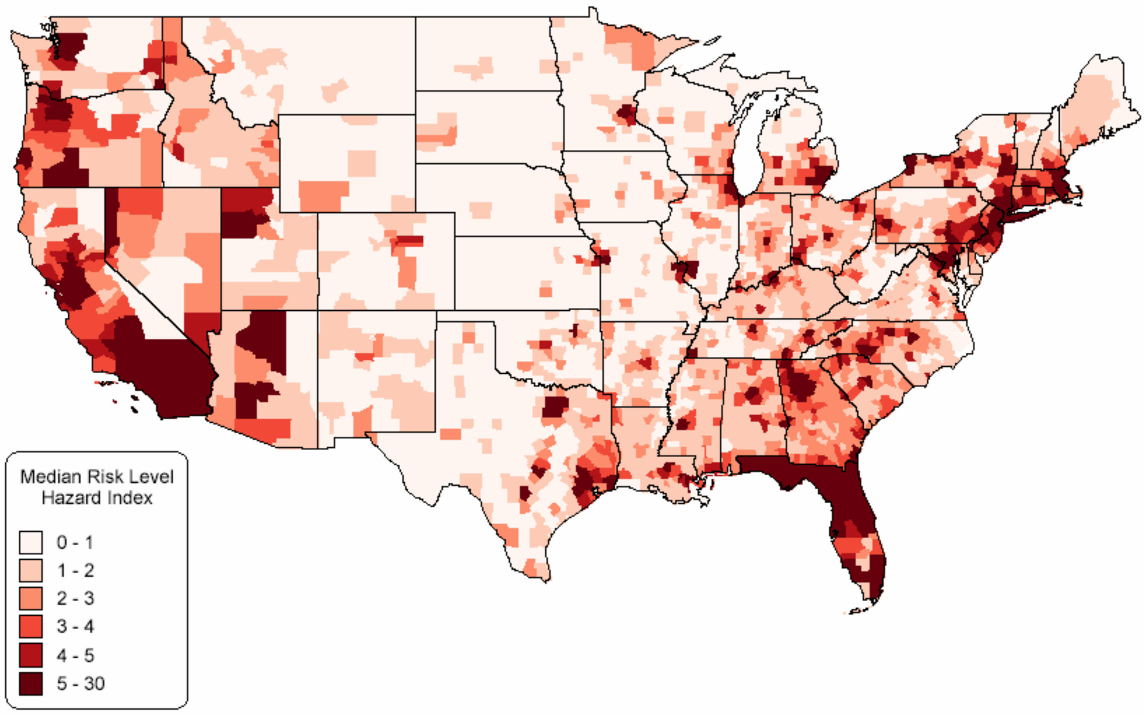

Figure 3. 1999 NATA Estimated County Level Non-cancer (Respiratory) Risk (U.S. EPA)

The major sources for non-cancer risk neurological health effects are area sources (43%) and background sources (22%). Non-cancer neurological risk was very low for most of the country (see Figure 4). Broward County's estimated median hazard index was 0.07 (well below the 1.0 attributed to a possible risk of health effects from a lifetime of exposure). The major sources for non-cancer risk respiratory health effects in Broward County are on-road sources (31.7%), background sources (31.1%), and area sources (28.9%).

The information gathered by the NATA will help State, Local, and Tribal agencies to analyze the risk in their communities, as well as, serve as a tool to help focus the efforts of agencies in improving air quality at the state, local, and tribal levels.

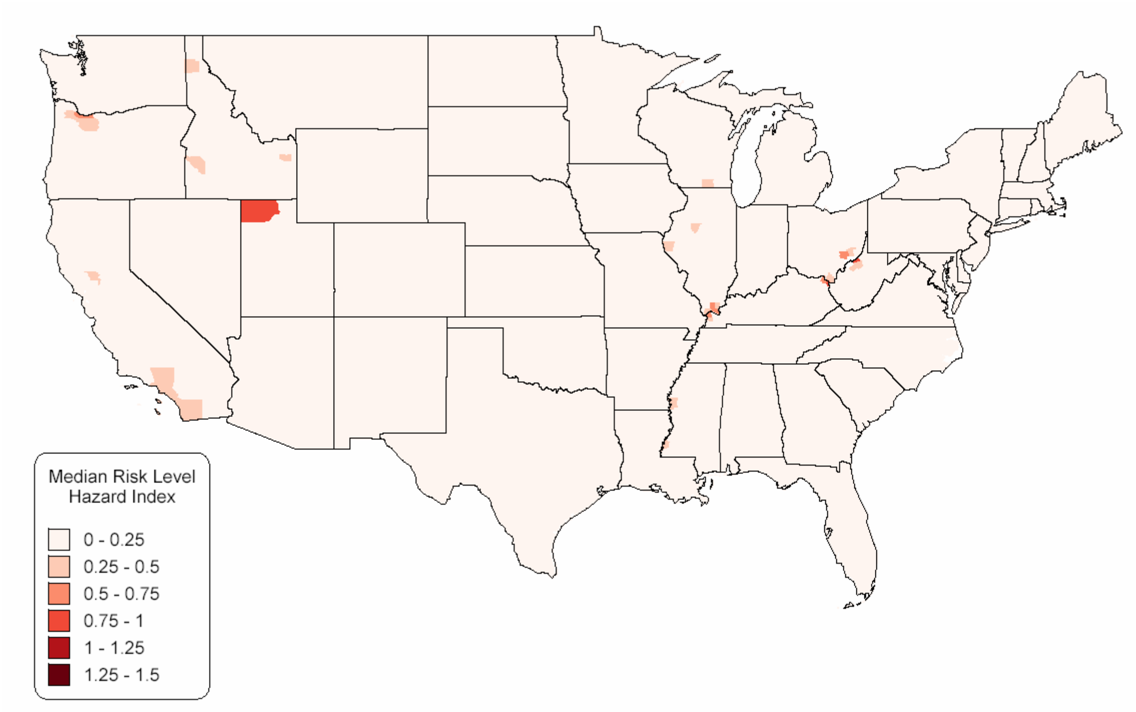

Figure 4. 1999 NATA Estimated County Level Non-cancer (Neurological) Risk (U.S. EPA)

COMMENTS

While the NATA results are based on computer models which require the use of simplifying assumptions and can introduce significant uncertainties, models are needed to conduct a large-scale assessment such as the NATA. Direct measurements of ambient air toxics are limited and direct measurements of personal exposures studies are rare. Such measurements are generally available for only a small subset of air toxics in a few locations or for a small study population. While Federal, State, and Tribal agencies are working to increase the number and locations of air toxics monitors and the study of personal exposures, the direct measurement of all air toxics at ambient and personal levels across the country is not currently feasible. Whether it will be feasible in the future remains to be seen. For now, in order to assess the risk posed by air toxics throughout the country, computer models despite all their limitations are needed.

Broward County has been analyzing ambient air samples collected within the Air Toxics Monitoring Network since 1993 for volatile organic compound (VOC) air toxics. Daily (24-hour) samples are collected every sixth day using programmable / automatic air collection systems. The samples are analyzed using a U.S. EPA approved analysis method by the Broward County Environmental Monitoring Laboratory. In 1999, collected air toxics samples were analyzed using U.S. EPA method TO-14 for 35 VOCs, 27 of which are air toxics which were modeled in the 1999 NATA. All sampling techniques and analytical methodologies used by the county are consistent with U.S. EPA guidance - EPA/625/R-96-010b (*Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air – Second Edition*, January 1997).

The average concentrations of these compounds observed in Broward County are shown in Figure 5, along with the estimated ambient concentrations determined by the NATA assessment. Estimated ambient concentrations are shown by source category contribution: major source, area source, on-road mobile source, non-road mobile source, and background source. It is important to note that the majority of the compounds in the assessment (23 of 27) had average measured concentrations below the detection limit for method TO-14. In other words, ambient concentrations were lower than the minimum amount detectable by the analysis method for these compounds. In 2002, Broward County began using method TO-15 for the air toxics VOC analysis. This method has much lower detection limits for some compounds, thus enabling detection of actual concentration levels of more air toxics.

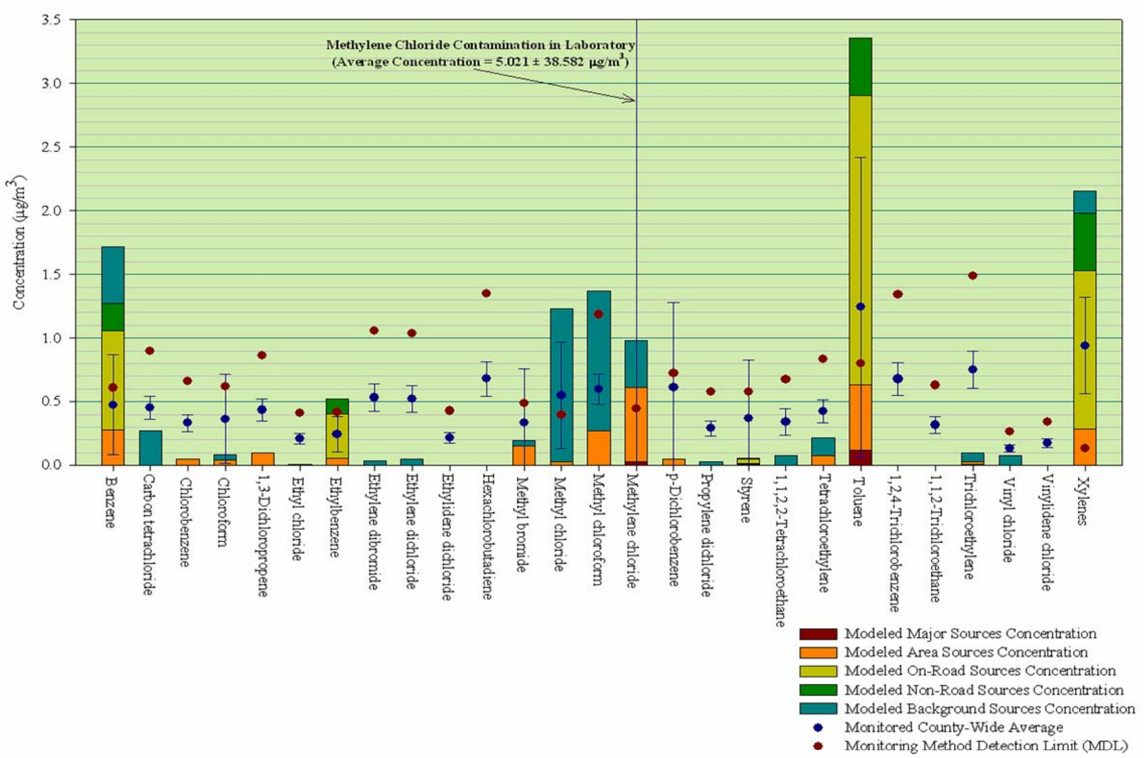

Figure 5. 1999 Broward County ambient monitored concentrations (± standard deviation) are plotted along with the NATA concentration estimates for Major, Area, On-Road, Non-Road, and Background sources. (Monitoring method detection limits are also shown.)

An important means of verifying modeled ambient concentration data is to compare it to monitored data. The comparison of estimated (modeled) concentrations to actual (measured) concentrations helps to determine how well the model and the assumptions made in running the model worked. The U.S. EPA comparison of model to monitor comparison data showed that many air toxics (with the exception of metals) throughout the country compared quite well. Benzene compared extremely well (within a factor of two) nation-wide. One may find more information on the model to monitor comparisons by visiting the U.S. EPA at www.epa.gov/ttn/atw/nata1999/99compare.html.

Despite the high detection limits of the TO-14 analysis method, several of the county-wide average measured concentrations in Broward County compared well with the modeled concentrations. When comparing modeling results to actual results, the lower the ratio of the modeling results to the monitoring results, the better the modeled and monitored data compare to each other. In general, data with a ratio of two (i.e., data two times less or two times more of each other) are considered to be almost an exact match. A comparison of the ratio of modeled to monitored Broward County-wide averages is shown in Figure 6 and Table 1. The county-wide average modeled and monitored concentrations were within a factor of three for 10 of the 27 compounds, including benzene, ethylbenzene, toluene, vinyl chloride, and xylenes. Seven of the compounds were within factors of three to eight. A few of the compounds did not compare well at all. As you can see in Table 1, five compounds were under predicted by factors of hundred to thousands.

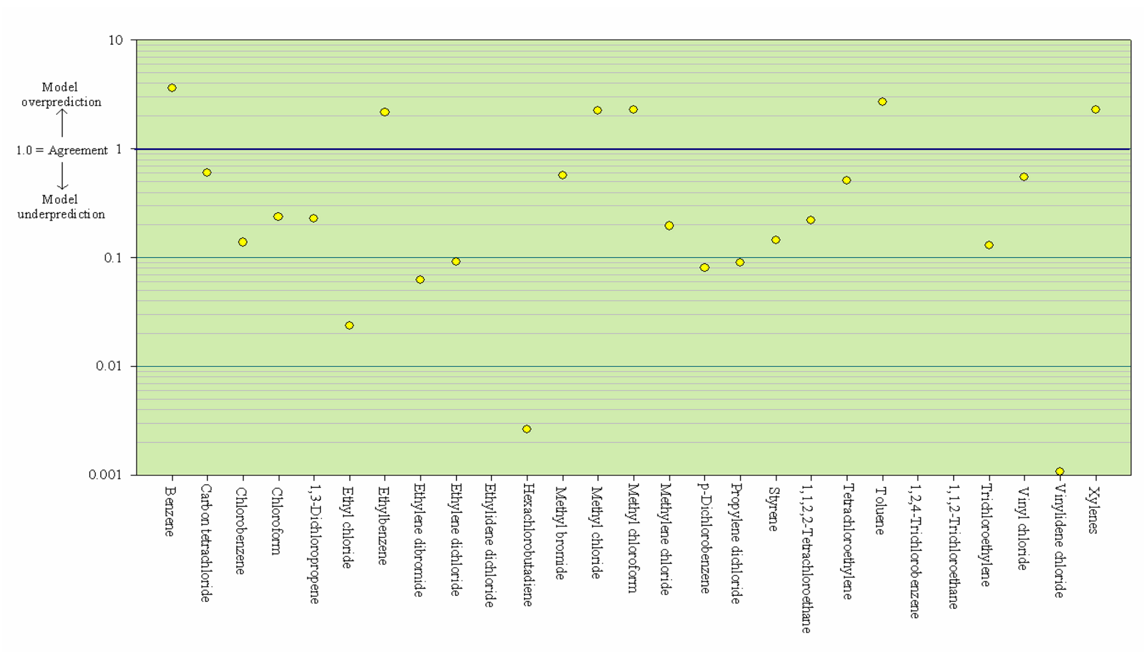

Figure 6. Comparison between modeled average concentration and measured average concentration of air toxics in the 1999 NATA.

There are several reasons for the differences between the county-wide average model and monitor concentrations. One is the fact the modeled concentrations take into account a vast number of virtual sampling sites throughout the county, while only five physical sites were present in Broward Count in 1999. Therefore, the modeled results are more extensive than monitored results. However, the modeled results include several assumptions, while the monitored data was “real”. Perhaps most importantly, the limitations of the analysis method for the monitored data prevented actual concentration values from being determined because the concentrations were below the detection limit of the instrumentation/analysis method. For these reasons, it is not surprising that some compounds did not compare well. However, the cancer risk driver benzene and several of the compounds linked to gasoline emissions did compare well (i.e., ethylbenzene, toluene, tetrachloroethylene).

Table 1. Comparison of County-Wide Average Air Toxics Concentrations as Predicted by the 1999 NATA Modeling Process for Broward County to the Actual Average Monitored Ambient Air Toxics Concentrations for Broward County in the 1999

Compound	Model Over Predicted by:	Model Under Predicted by:	Compound	Model Over Predicted by:	Model Under Predicted by:
Benzene	**3.6**		Methylene chloride		5.1
Carbon tetrachloride		**1.7**	p-Dichlorobenzene		12
Chlorobenzene		7.2	Propylene dichloride		11
Chloroform		4.3	Styrene		6.9
1,3-Dichloropropene		4.4	1,1,2,2-Tetrachloroethane		4.6
Ethyl chloride		42			
Ethylbenzene	**2.2**		**Tetrachloroethylene**		**2.0**
Ethylene dibromide		16	**Toluene**	**2.7**	
Ethylene dichloride		11	1,2,4-Trichlorobenzene		18709
Ethylidene dichloride		1481	1,1,2-Trichloroethane		259923
Hexachlorobutadiene		378	Trichloroethylene		7.7
Methyl bromide		**1.7**	**Vinyl chloride**		**1.8**
Methyl chloride	**2.2**		Vinylidene chloride		933
Methyl chloroform	**2.3**		**Xylenes**	**2.3**	

The air toxic which posed the greatest risk of causing non-cancer respiratory health problems by chronic inhalation in the 1999 NATA was acrolein. Acrolein is a carbonyl compound. Carbonyl compounds were not measured in Broward County in 1999. While carbonyl compound concentrations have been measured in Broward County in recent years, there is an issue with acrolein sample stability in the method currently used for carbonyl monitoring (U.S. Compendium Method TO-11; www.epa.gov/ttn/amtic/files/ambient/airtox/to-11ar.pdf). The U.S. EPA is working on developing a new monitoring method that should improve sample reliability and thus allow the actual determination of acrolein concentrations in ambient air.

LIMITATIONS OF THE NATA ASSESSMENT

The U.S. EPA developed this assessment tool (NATA) to inform national and more localized efforts to collect information and characterize/reduce air toxics emissions. The U.S. EPA cautions that the overall quality and uncertainties of the assessment will vary between locations and pollutants. In many cases, more localized assessments (modeling and monitoring) may be needed to better characterize the local-level risk. The limitations of the NATA can be found at www.epa.gov/ttn/atw/nata1999/limitations.html. According to the U.S. EPA, general limitations include the following: gaps in data, limitations in computer models used, default assumptions used routinely in any risk assessment, and limitations in the overall design of the assessment (assessment intended to address some questions, but not others). Additionally, it is also important to note that the risk assessment is based on 70 years of exposures at the levels observed in 1999. The NATA does not account for changes in air toxics emissions over the years due to population changes and emissions standards implemented by the Federal government.

CONCLUSIONS

The U.S. EPA's 1999 NATA is a far more comprehensive assessment than the 1996 NATA. Several assumptions were made in the assessment. These assumptions and the limitations of the NATA assessment must be taken into account when reviewing the results. The NATA estimates air toxics risk throughout the country, as comprehensive local and personal scale monitoring is not possible at this point in time. The purpose of the NATA is to aid Federal, State, Local, and Tribal agencies in focusing attention on pollutants and areas of concern. Although there are differences between the NATA modeled and actual monitored data, the reasons for these are accounted for by the modeling assumptions and shortcomings of the monitoring/analysis method.

In Broward County, overall the cancer and non-cancer risks are comparable to other large urban areas throughout the United States. This is expected, as a large portion of both cancer and non-cancer risk is due to sources associated with urban areas.

The assessment does quite well in accomplishing its primary goal. However, there is room for improvement in both the modeling and monitoring aspects of this assessment. Therefore, the U.S. EPA is currently focusing on refining the assessment methodology and monitoring techniques. In the future, the U.S. EPA hopes further improve the assessment process by decreasing the time between the assessment year and release date. This should make the released assessments more comparable to the current situation in many areas, thereby helping to better protect the public from the dangers of air toxics.