Air Toxics Concentrations

Air toxics, also known as hazardous air pollutants, are pollutants that EPA has identified as being known or suspected to cause cancers and other adverse health effects, including damage to the immune system, neurological problems, respiratory affects, and birth defects. The Clean Air Act identifies 187 air toxics associated with industrial sources, many of which are also associated with mobile sources (U.S. EPA, 2007). In addition, EPA identifies mobile source air toxics by evaluating the compounds emitted by mobile sources that have the potential to cause serious adverse health effects.

This indicator presents outdoor air quality trends for the subset of air toxics believed to account for the greatest nationwide excess lifetime cancer risk estimated to result from inhalation exposure to outdoor air pollution (U.S. EPA, 2011; McCarthy et al., 2009). Excess lifetime cancer risk refers to the additional or extra risk of developing cancer due to inhalation exposure to a toxic substance incurred over the lifetime of an individual. According to a recent EPA assessment, the 10 air toxics that contribute to more than 90 percent of the estimated incremental cancer risk associated with breathing outdoor air pollution are:

- Formaldehyde
- Benzene
- Acetaldehyde
- Carbon tetrachloride
- Naphthalene
- 1,3-Butadiene
- Polycyclic aromatic hydrocarbons (PAHs)
- Chromium compounds
- Arsenic compounds
- Tetrachloroethylene

Sufficient ambient air monitoring data are currently available to assess nationwide outdoor air quality trends for eight of these 10 pollutants. Monitoring data have not been collected at enough sites and for long enough to reliably assess outdoor air quality trends for either naphthalene or for other PAHs. Taken together, the eight remaining air toxics account for 84 percent of the estimated nationwide incremental cancer risks associated with breathing outdoor air pollution (U.S. EPA, 2011) and these include some of the most commonly measured air toxics. Information on emissions sources and health effects associated with the eight air toxics considered in this indicator are available from many sources (e.g., U.S. EPA, 2012a), including Toxicological Profiles published by the Agency for Toxic Substances and Disease Registry and Toxicological Reviews available from EPA's Integrated Risk Information System.

This indicator presents ambient concentration trends for eight air toxics in micrograms per cubic meter ($\mu g/m^3$). Trends are based on annual average concentrations, which were calculated from 24-hour measurements collected at monitoring stations nationwide, although some sub-daily duration sampling does occur. For the organic compounds considered in this indicator, trends are for 2003 to 2010. For arsenic and hexavalent chromium, monitoring data are available to establish trends only from 2005 to 2010. The numbers of monitoring sites with sufficient data to calculate concentration trends varied by pollutant: from 15 sites for hexavalent chromium to 154 sites for benzene. These include monitoring sites in the National Air Toxics Trends Sites (NATTS) network and all other air quality monitoring sites in the United States where the pollutants were measured using comparable methods. The trend sites for a given pollutant were based on those that had sufficient data for calculating annual average concentrations for at least 75 percent of the years covered in the indicator. A complete account of data processing steps—including the site selection

criteria and the approach used to consider non-detect observations—are explained in this indicator's technical documentation.

For the organic compounds considered in this indicator, monitors measure ambient air concentrations of gases. For arsenic and chromium, monitors measure the amounts of these metals within particulate matter, and the available air quality measurements for these two pollutants are based on multiple particle size fractions. The indicator presents data for the particle size fractions currently considered in the NATTS network: arsenic trends are based on measurements of particulate matter with aerodynamic diameters of 10 microns or smaller (PM_{10}), and hexavalent chromium trends are based on measurements of total suspended particulate (TSP).

What the Data Show

Exhibit 1 summarizes outdoor air quality trends for the eight air toxics considered in this indicator, and Exhibits 2 to 9 present the trends for the individual air toxics. For seven out of the eight air toxics, annual average concentrations decreased over the period of record considered in the indicator (2005-2010 for arsenic and hexavalent chromium and 2003-2010 for the remaining air toxics). The reductions ranged from 17 percent (formaldehyde) to 54 percent (tetrachloroethylene). These downward trends in air toxics concentrations are generally consistent with downward trends in air toxic emissions that have been observed since 1990 (the Air Toxics Emissions indicator).

As the exception, the average carbon tetrachloride concentrations indicated by the trend sites increased by 9 percent from 2003 to 2010. Most industrial and consumer uses of carbon tetrachloride were phased out as a result of international treaties, but the pollutant remains in the atmosphere due primarily to its extremely long half-life in the troposphere (Mohamed et al., 2002).

Also shown in Exhibits 2 to 9 are the 90^{th} and 10^{th} percentiles based on the distribution of annual measurements at the monitoring sites. This provides additional graphical representation of the distribution of measured concentrations across the monitoring sites for a given year. Thus, the graphic displays the concentration range where 80 percent of measured values occurred for that year.

Limitations

- The data summarized in this indicator are based on the subset of monitoring sites with sufficient data over the period of record for the individual pollutants. These monitoring sites are primarily (but not exclusively) located in urban areas. The nationwide trends presented in this indicator therefore might not accurately reflect conditions outside the monitoring areas.
- The indicator presents trends for the eight air toxics estimated to account for most of the nationwide incremental cancer risk attributed to breathing outdoor air pollution and with data available to characterize trends. Many additional air toxics are commonly found in outdoor ambient air.
- To ensure that long-term trends are based on a consistent set of monitoring sites, selection criteria were applied to identify the subset of air toxics monitoring sites with sufficient data to assess trends over the period of record. Monitoring sites without sufficient data are not included in the trend analysis. The footnotes to the trend figures give some indication of the number of active monitoring sites that do not meet the site selection criteria. Uncertainty in trends is greatest for the pollutants with the fewest monitoring sites that meet the selection criteria (i.e., arsenic, hexavalent chromium).
- Uncertainty in trends is greatest for the pollutants with the greatest proportion of non-detects (i.e., 1,3-butadiene, tetrachloroethylene, and arsenic). The data processing approach for

non-detect observations can affect the concentration trends depicted.

Data Sources

This indicator was based on measurements of ambient air toxic concentrations from EPA's Air Quality System (U.S. EPA, 2012b). The technical documentation for this indicator describes the site selection criteria and data processing methodology that were applied to generate the trend charts for the individual air toxics. The trends are based on the subset of monitoring stations that have sufficient data to assess trends since 2003 or 2005, depending on the pollutant.

References

McCarthy, M.C., T.E. O'Brien, J.G. Charrier, and H.R. Hafner. 2009. Characterization of the chronic risk and hazard of hazardous air pollutants in the United States using ambient monitoring data. Env Health Pers 117(5):790-796.

Mohamed, M.F., D. Kang, and V.P. Aneja. 2002. Volatile organic compounds in some urban locations in United States. Chemosphere 47:863-882.

U.S. EPA (United States Environmental Protection Agency). 2012a. Health effects notebook for hazardous air pollutants. http://www.epa.gov/ttn/atw/hlthef/hapindex.html.

U.S. EPA. 2012b. Data from the Air Quality System. Accessed 2012. http://www.epa.gov/ttn/airs/airsaqs.

U.S. EPA. 2011. 2005 national-scale air toxics assessment. Last accessed April 25, 2012. http://www.epa.gov/ttn/atw/nata2005.

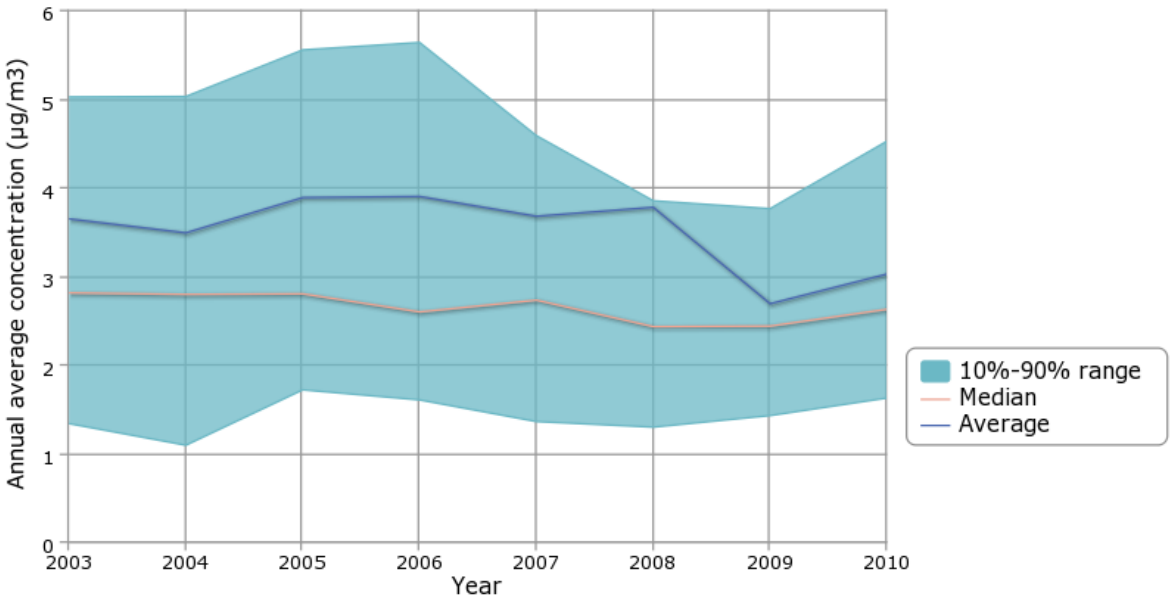
Exhibit 1. Summary data for selected air toxics

Pollutant	Trend Period	Number of Trend Sites	Percent Change in Average Concentrations over Trend Record	Exhibit Depicting Trend
Formaldehyde	2003-2010	80	17% decrease	2
Benzene	2003-2010	154	33% decrease	3
Acetaldehyde	2003-2010	78	19% decrease	4
Carbon tetrachloride	2003-2010	116	9% increase	5
1,3-Butadiene	2003-2010	137	45% decrease	6
Hexavalent chromium (in TSP)	2005-2010	15	33% decrease	7
Arsenic (in PM_{10})	2005-2010	27	26% decrease	8
Tetrachloroethylene	2003-2010	131	54% decrease	9

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b

Exhibit 2. Ambient formaldehyde concentrations in the U.S., 2003-2010

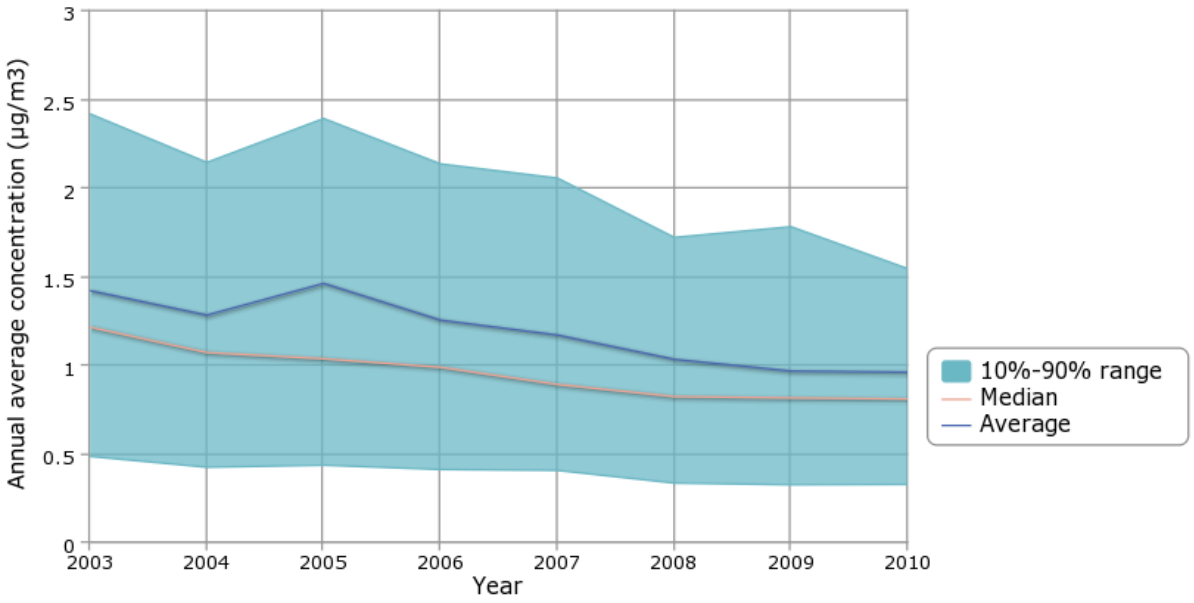


Coverage: 80 monitoring sites nationwide (out of a total of 143 sites measuring formaldehyde in 2010) that have sufficient data to assess trends since 2003.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b

Exhibit 3. Ambient benzene concentrations in the U.S., 2003–2010

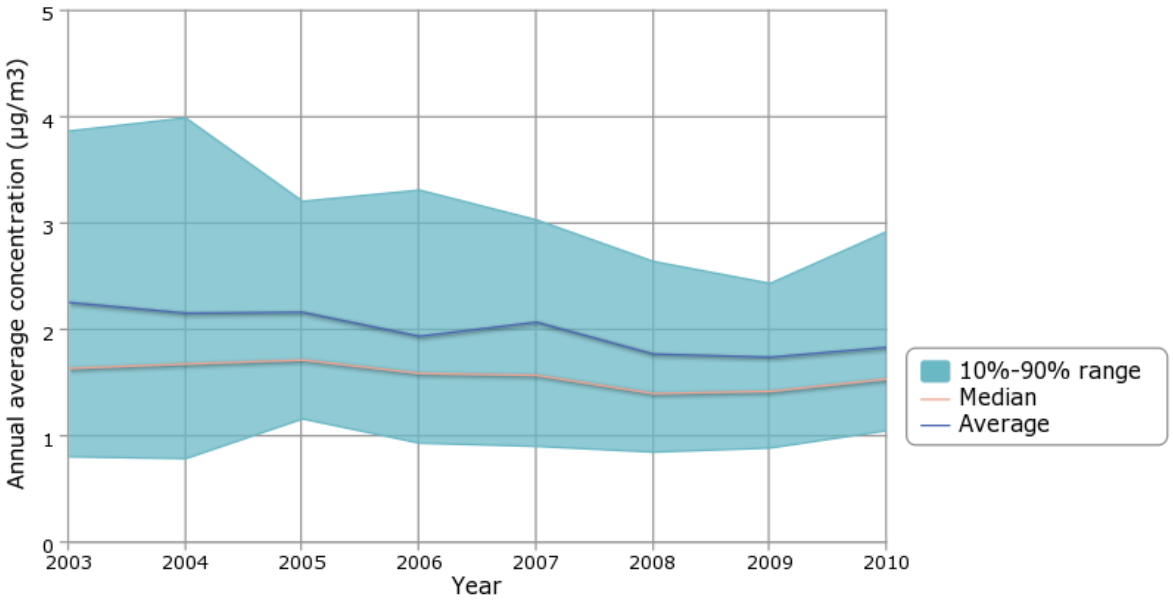


Coverage: 154 monitoring sites nationwide (out of a total of 310 sites measuring benzene in 2010) that have sufficient data to assess trends since 2003.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b

Exhibit 4. Ambient acetaldehyde concentrations in the U.S., 2003-2010

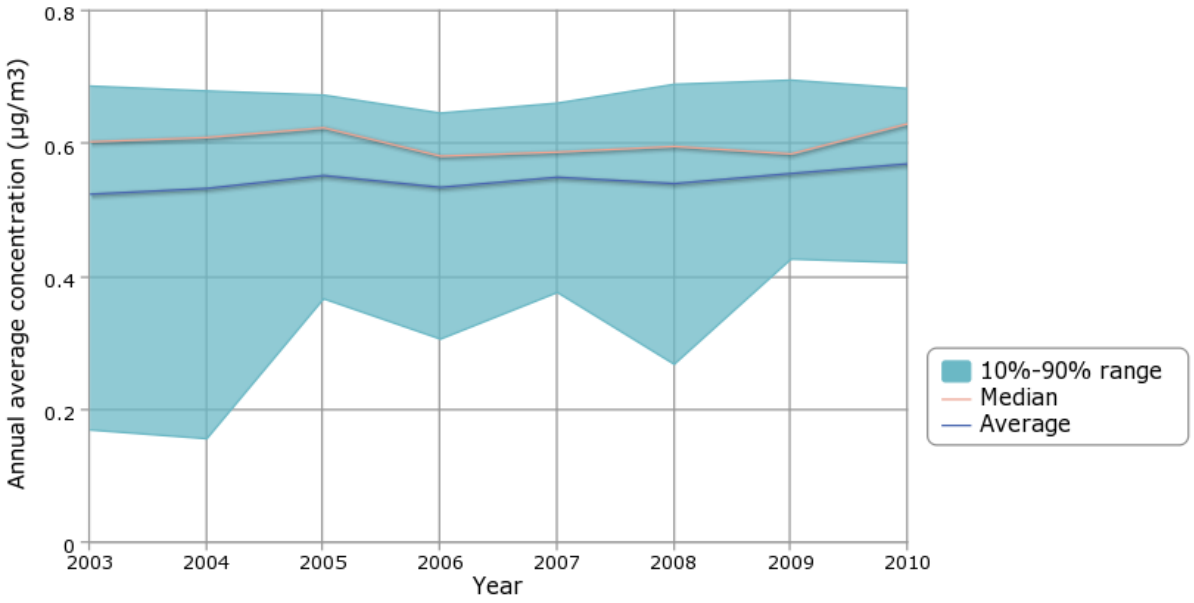


Coverage: 78 monitoring sites nationwide (out of a total of 148 sites measuring acetaldehyde in 2010) that have sufficient data to assess trends since 2003.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b

Exhibit 5. Ambient carbon tetrachloride concentrations in the U.S., 2003-2010

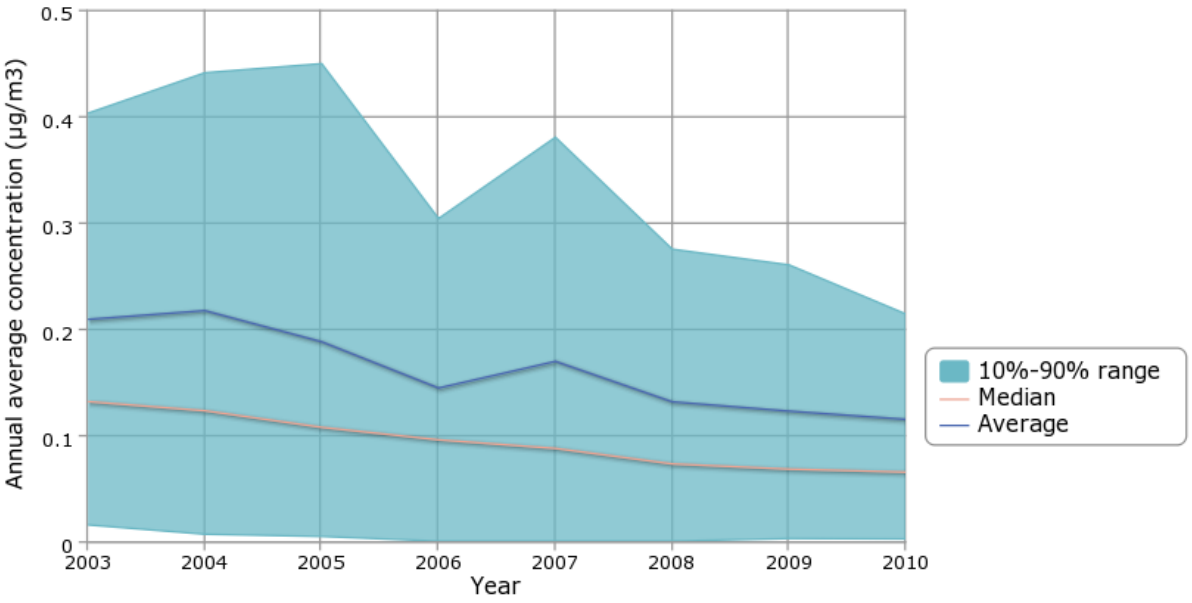


Coverage: 116 monitoring sites nationwide (out of a total of 256 sites measuring carbon tetrachloride in 2010) that have sufficient data to assess trends since 2003.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b

Exhibit 6. Ambient 1,3-butadiene concentrations in the U.S., 2003-2010

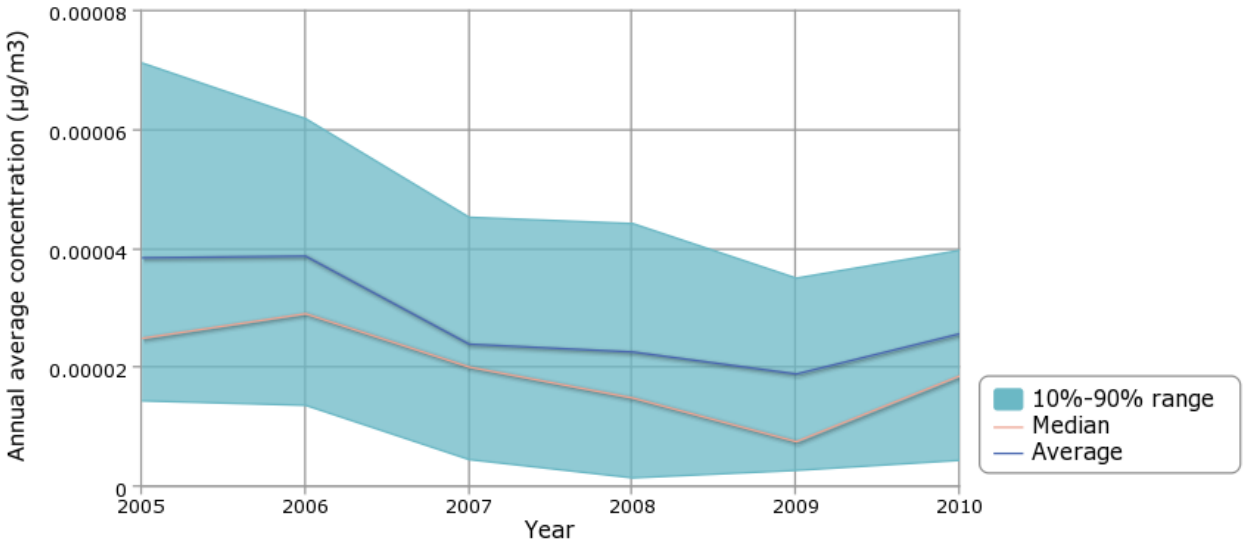


Coverage: 137 monitoring sites nationwide (out of a total of 272 sites measuring 1,3-butadiene in 2010) that have sufficient data to assess trends since 2003.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b

Exhibit 7. Ambient hexavalent chromium concentrations in the U.S., 2005–2010



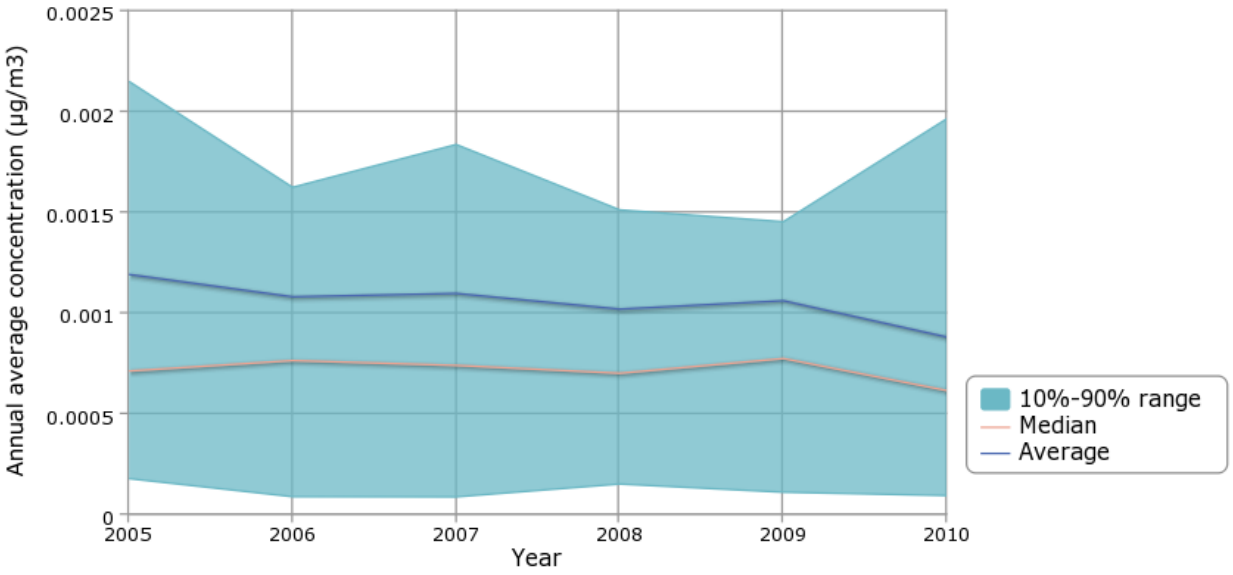
Coverage: 15 monitoring sites nationwide (out of a total of 29 sites measuring hexavalent chromium in TSP in 2010) that have sufficient data to assess trends since 2005.

The trend is based on hexavalent chromium concentrations measured in TSP, which is the measurement currently used in the NATTS network. The indicator does not consider measurements in other particle size fractions.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b

Exhibit 8. Ambient arsenic concentrations in the U.S., 2005–2010



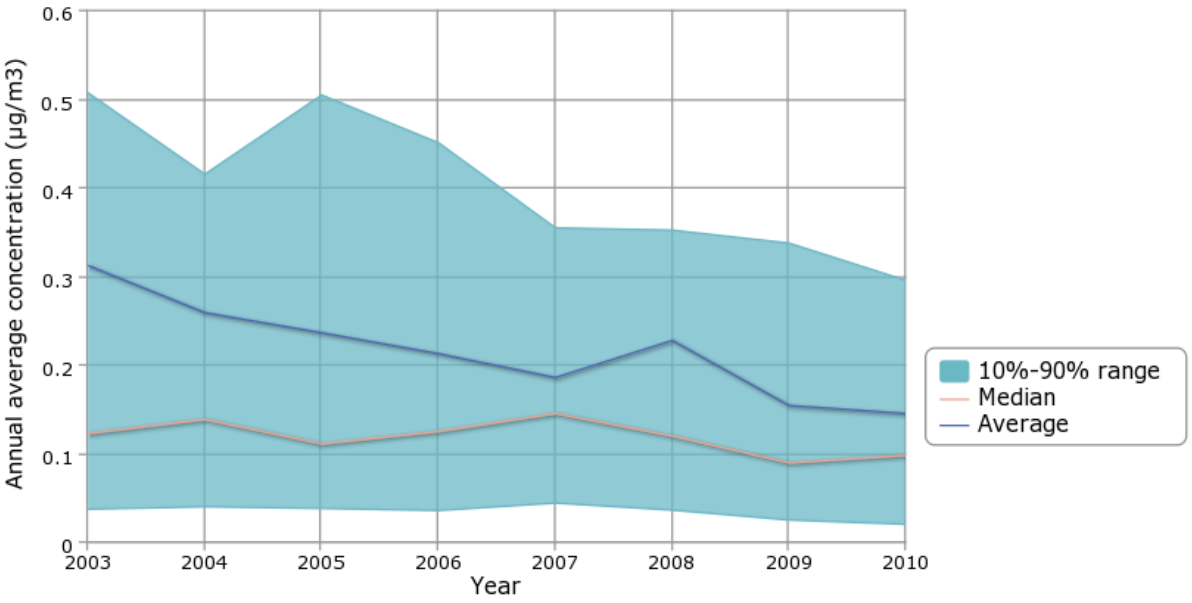
Coverage: 27 monitoring sites nationwide (out of a total of 47 sites measuring arsenic in PM10 in 2010) that have sufficient data to assess trends since 2005.

The trend is based on arsenic concentrations measured in PM10, which is the measurement currently used in the NATTS network. The indicator does not consider measurements in other particle size fractions.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b

Exhibit 9. Ambient tetrachloroethylene concentrations in the U.S., 2003-2010



Coverage: 131 monitoring sites nationwide (out of a total of 256 sites measuring tetrachloroethylene in 2010) that have sufficient data to assess trends since 2003.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2012b