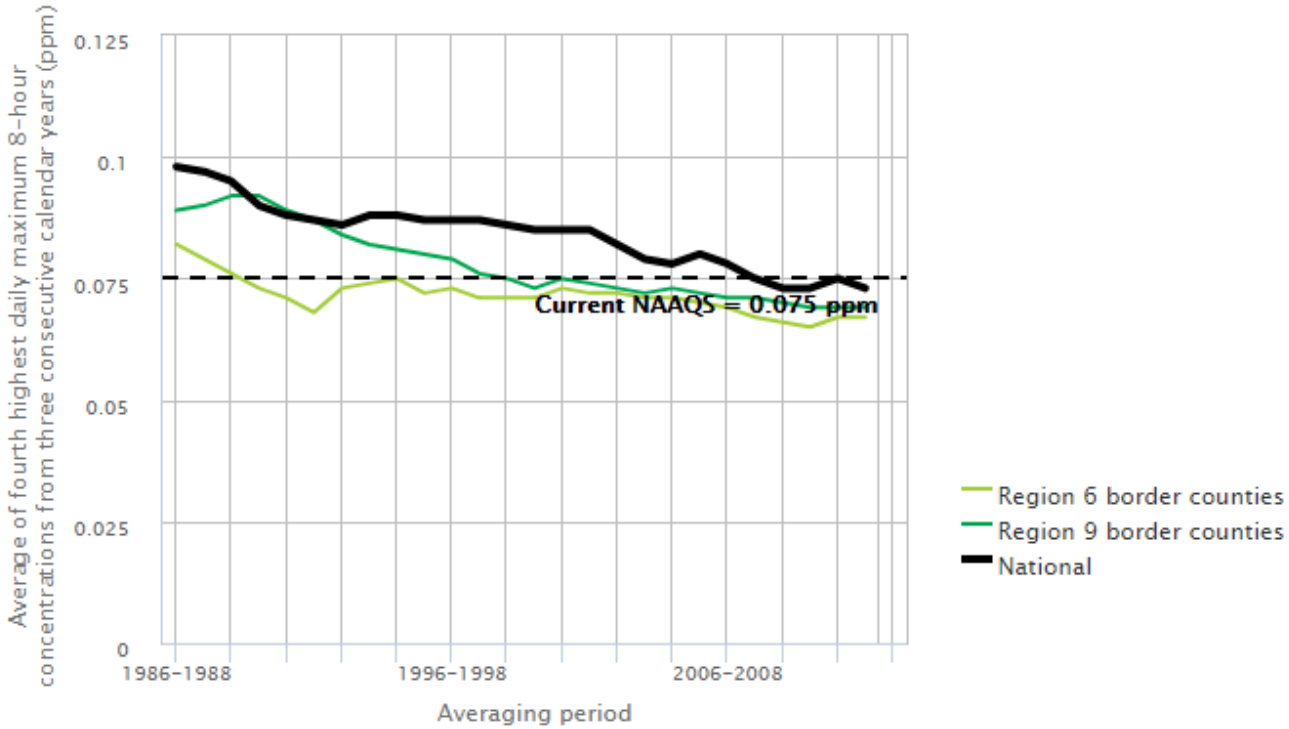
Ozone and Particulate Matter Concentrations for U.S. Counties in the U.S./Mexico Border Region

Exhibits

Exhibit 1. Ambient 8-hour ozone concentrations in U.S. counties in the U.S./Mexico border area, 1986–2013



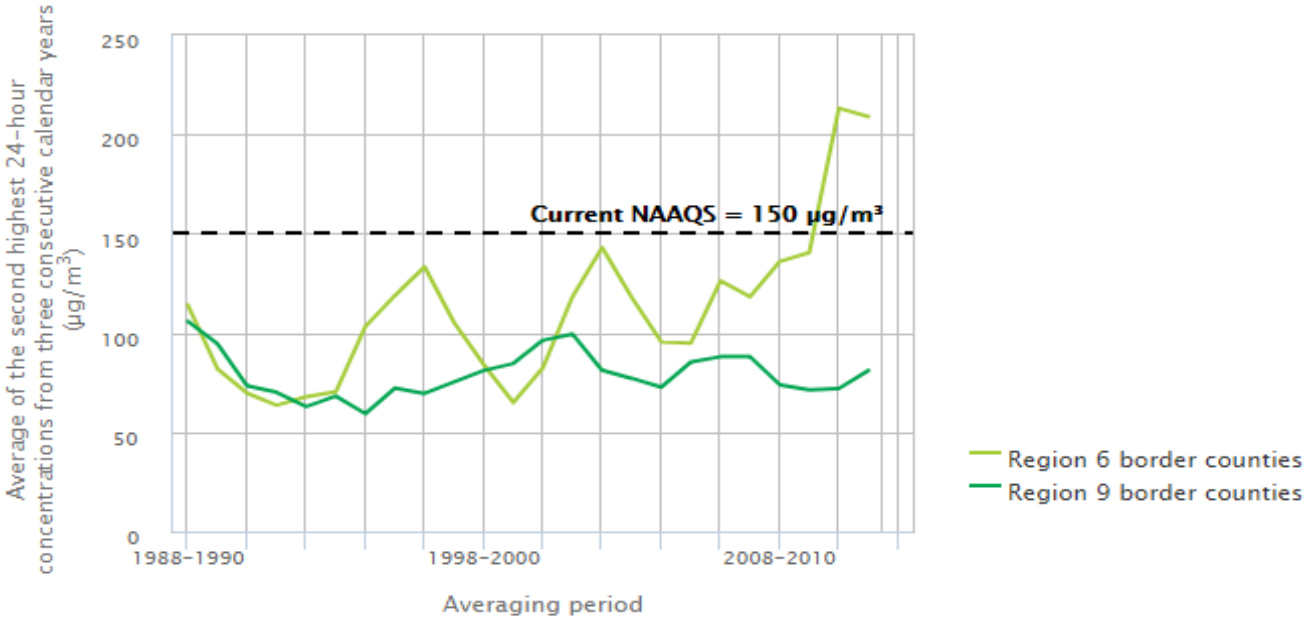
The current NAAQS was established in 2008 and is shown to provide context for the magnitude of pollutant concentrations. It is more stringent than all previous NAAQS (e.g., the concentration levels for the previous NAAQS are higher) (U.S. EPA, 2014b).

Coverage: 40 combined ozone monitoring sites located in U.S. counties along the U.S./Mexico border that have sufficient data to assess trends from 1986 to 2013. Not all sites meet criteria used to calculate indicator for each three year average.

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, 2014a

Exhibit 2. Ambient 24-hour PM_{10} concentrations in U.S. counties in the U.S./Mexico border area, 1988–2013



The current 24-hour NAAQS was established in 1987 and has not been revised since (U.S. EPA, 2014c).

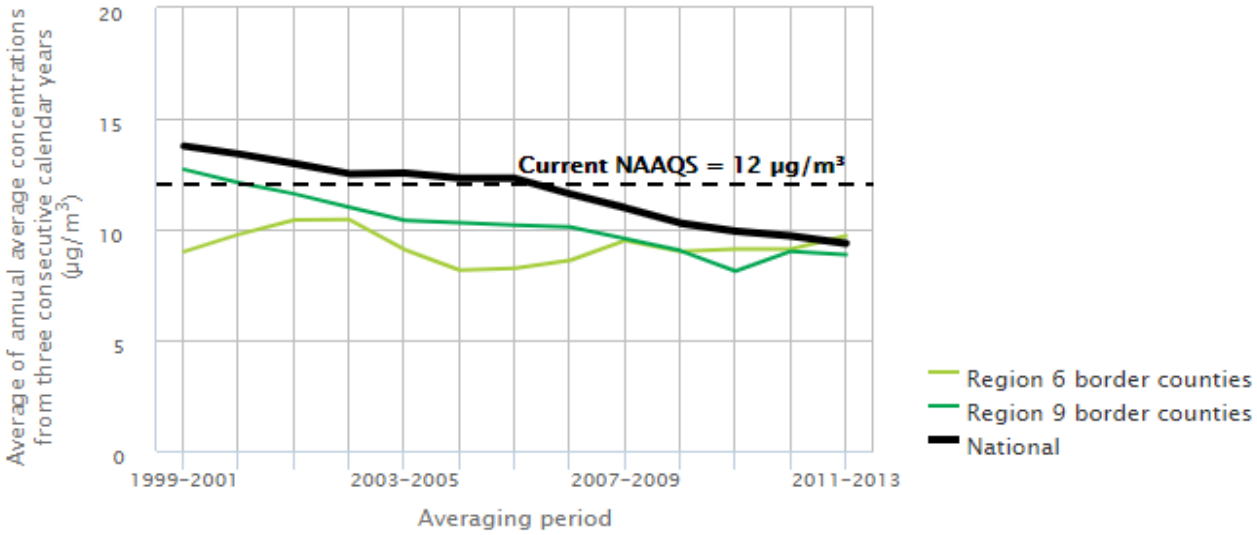
Coverage: 33 combined PM_{10} monitoring sites located in U.S. counties along the U.S./Mexico border that have sufficient data to assess trends from 1988 to 2013. Not all sites meet criteria used to calculate indicator for each three year average.

National PM_{10} data are not depicted because the approach used to track PM_{10} concentrations in the U.S./Mexico border region differs from that used on the national scale.

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, 2014a

Exhibit 3. Ambient annual $PM_{2.5}$ concentrations in U.S. counties in the U.S./Mexico border area, 1999–2013



The current NAAQS was established in 2012 and is shown to provide context for the magnitude of pollutant concentrations. It is more stringent than all previous NAAQS (e.g., the concentration levels for the previous NAAQS are higher) (U.S. EPA, 2014c).

Coverage: 18 combined $PM_{2.5}$ monitoring sites located in U.S. counties along the U.S./Mexico border that have sufficient data to assess trends from 1999 to 2013. Not all sites meet criteria used to calculate indicator for each three year average.

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, 2014a

Introduction

The border between the U.S. and Mexico spans approximately 2,000 miles, from the Pacific Ocean to the Gulf of Mexico. The area is subjected to a unique blend of increased industrial development (especially on the Mexican side of the border), intense pressures because of the shifting and growing population related to this development, and an arid climate that can exacerbate many air quality problems. Ozone and particulate matter are air pollutants of particular concern (U.S. EPA, 2003).

Ground-level ozone is harmful to both human health and the environment (the Ozone Concentrations indicator). Although some industrial sources release ozone directly into the environment, most ground-level ozone forms from chemical reactions involving nitrogen oxides, volatile organic compounds, and sunlight. Ozone levels are typically highest during the afternoon hours of the summer months, when the influence of direct sunlight is the greatest (U.S. EPA, 2013).

"Particulate matter" (PM) is the general term used for a mixture of solid particles and liquid droplets found in the air. Primary PM is released directly from emissions sources into the atmosphere, while secondary PM is formed in the air from reactions involving precursor chemicals (e.g., ammonia, nitrogen oxides, sulfur dioxide, particle-producing organic gases). Ambient air monitoring stations measure air concentrations of two size ranges of particles: $PM_{2.5}$ (fine particles with aerodynamic diameter less than or equal to 2.5 micrometers [µm]) and PM_{10} (particles with aerodynamic diameters less

than or equal to 10 µm, including $PM_{2.5}$). Exposure to coarse particles (i.e., particles with aerodynamic diameters between 2.5 and 10 µm) can aggravate respiratory conditions such as asthma, and exposure to fine particles is associated with various additional human health effects (the PM Concentrations indicator) (U.S. EPA, 2009).

This Ozone and Particulate Matter Concentrations along U.S./Mexico Border indicator shows trends in ambient air concentrations of ozone and particulate matter in the U.S. counties at the U.S./Mexico border area in comparison to U.S. national trends, where appropriate. These trends are shown for the longest duration of time supported by the underlying monitoring data. For ozone, this indicator reports the average of the fourth highest daily maximum 8-hour concentrations for three consecutive calendar years. For PM_{10}, this indicator reports the 3-year average of the second highest 24-hour concentrations. For $PM_{2.5}$, this indicator reports the 3-year average of the seasonally weighted annual average concentration. For ozone and $PM_{2.5}$, national trend lines are also depicted because the statistics used to report data in this indicator are similar to those used in the corresponding national indicators. For PM_{10}, national data are not presented, because the approach used to track PM_{10}concentrations in the U.S./Mexico border region differs from that used on the national scale. This indicator is based on all monitoring stations that operated within 100 kilometers of the border on the U.S. side during this time period.

In EPA Region 6, ozone monitoring data from border locations were collected in Dona Ana, Grant, and Luna Counties in New Mexico and El Paso, Brewster, Webb, Hidalgo, and Cameron Counties in Texas. In EPA Region 9, ozone monitoring data from border locations were collected in the counties of Cochise, Pima, and Yuma in Arizona and Imperial and San Diego in California. PM_{10} sampling data for EPA Region 6 are from Cameron, Hidalgo, Webb and El Paso Counties in Texas and Dona Ana, Luna, and Grant Counties in New Mexico. $PM_{2.5}$ data were available for all of the above counties except for Luna County, New Mexico. For EPA Region 9, PM_{10} monitoring data were collected in the counties of Cochise, Pima, Santa Cruz, and Yuma in Arizona and Imperial and San Diego in California. For EPA Region 9, $PM_{2.5}$ monitoring data were collected in the counties of Cochise, Pima, and Santa Cruz in Arizona and Imperial and San Diego in California.

What The Data Show

Trends for 8-Hour Ozone Concentrations

In EPA Region 6, average border ozone concentrations decreased by 11 percent between the 1986–1988 and 1992–1994 time periods (a smaller decrease than the national average, which was 12 percent) and by 9 percent between the 1993–1995 and 2011–2013 periods (again, smaller than the national average decrease of 17 percent) (Exhibit 1). In EPA Region 9, border ozone concentrations decreased by 6 percent between the 1986–1988 and 1992–1994 time periods and then decreased by 16 percent between the 1993–1995 and 2011–2013 periods.

Trends for 24-Hour PM_{10} Concentrations

In EPA Region 6, the second highest 24-hour PM_{10} concentrations at border monitoring sites varied considerably over the period of record, with an increase in PM_{10} concentrations in the two most recent 3-year periods (Exhibit 2). The highly variable PM_{10}concentrations most likely result from variation in meteorological conditions (e.g., drought, rainfall, wind speed) and soil erosion, and no clear long-term trend is apparent from the Region 6 data. In EPA Region 9, corresponding PM_{10} concentrations at border monitoring sites did not exhibit such strong temporal variations, and the average second highest 24-hour concentrations do not show an obvious trend from 1988 to present.

Trends for Annual Average $PM_{2.5}$ Concentrations

Between 1999–2001 and 2011–2013, average annual ambient $PM_{2.5}$ concentrations in the border counties of EPA Region 6 varied from year to year, with no clear long-term trends (Exhibit 3). Over the same time frame, average annual ambient

$PM_{2.5}$concentrations at the Region 9 border trend sites decreased by 30 percent. Average annual ambient $PM_{2.5}$ concentrations decreased 32 percent nationwide over the same period.

Limitations

- Many counties along the U.S./Mexico border do not have ambient air quality monitors; these counties are not characterized by this indicator.
- This indicator does not include data from the Mexican side of the border. When a technical review concludes the quality of these data is appropriate for the intended use, the indicator will be updated with those data.
- Short-term trends in PM10 concentrations are often highly dependent on meteorological conditions. The maximum concentration for a given site can be influenced by wind-blown dust and will exhibit considerable variations from day to day. Trends over the longer term are far less likely to be influenced by unusual meteorological conditions.
- The long-term ozone trends are derived from an increasing number of monitors over the course of time from 1986 to 2013, but an analysis of the limited number of border sites that have full periods of record show that the slopes of the trends are similar to those in this indicator.
- The trend lines present composite averages of the particular trend statistic over all monitoring sites that met the selection criteria; all monitoring sites were weighted equally in calculating the composite average trend statistic.
- Because most of the monitoring sites are located in urban areas, the trends might not accurately reflect conditions outside the immediate urban monitoring areas.

Data Sources

Summary data in this indicator were provided by EPA's Office of Air Quality Planning and Standards, Region 6, and Region 9. These summaries were based on ozone and PM ambient air monitoring data in EPA's Air Quality System (U.S. EPA, 2014a) (https://www.epa.gov/aqs). Trends in this indicator are based on the subset of ozone and PM monitoring stations located in counties along the U.S./Mexico border that have sufficient data to assess trends over the period of record.

References

U.S. EPA (United States Environmental Protection Agency). 2014a. Data from the Air Quality System. Accessed 2014. https://www.epa.gov/aqs.

U.S. EPA. 2014b. History of the national ambient air quality standards for ozone. http://www3.epa.gov/ttn/naaqs/standards/ozone/s_o3_history.html.

U.S. EPA. 2014c. History of the national ambient air quality standards for particulate matter. http://www3.epa.gov/ttn/naaqs/standards/pm/s_pm_history.html.

U.S. EPA. 2013. Integrated science assessment for ozone and related photochemical oxidants. EPA 600R/R-10/076F. Research Triangle Park, NC. http://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492.

U.S. EPA. 2009. Integrated science assessment for particulate matter. EPA/600/R-08/139F. Washington, DC. http://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=216546.

U.S. EPA. 2003. Border 2012: U.S.-Mexico environmental program. EPA/160/R-03/001. Washington, DC.

Technical Documentation

Identification

1. Indicator Title

   Ozone and Particulate Matter Concentrations for U.S. Counties in the U.S./Mexico Border Region

2. ROE Question(s) This Indicator Helps to Answer

   What are the trends in outdoor air quality and their effects on human health and the environment?

3. Indicator Abstract

   This indicator presents ambient PM_{10}, $PM_{2.5}$, and ozone levels for U.S. counties along the U.S./Mexico border from 1986 to 2013. This information characterizes how these air pollutants are responding to the region's unique industrial, demographic, and climatic pressures in recent decades.

4. Most Recent Update

   July 2015

Data Sources

5. Data Sources

   This indicator is based on ozone and particulate matter (PM) ambient air monitoring data collected by states and tribes from 1986 to 2013.

6. Data Availability

   Summary data in this indicator were provided by EPA's Office of Air Quality Planning and Standards, Region 6, and Region 9. These summaries are based on ozone and PM ambient air monitoring data downloaded from EPA's Air Quality System (AQS) (http://www.epa.gov/aqs). Trends in this indicator are based on the subset of ozone and PM monitoring stations located in counties along the U.S./Mexico border that have sufficient data to assess trends over the period of record. There are no confidentiality issues that limit accessibility to the complete data set.

Methodology

7. Data Collection

   The ambient air quality data are based on data retrieved from AQS in 2014. These are direct measurements of pollutant concentrations at monitoring stations operated by state, local, and tribal governments throughout the U.S./Mexico border region. All ozone and PM measurements used in this indicator were made with EPA reference or equivalent methods, which have been extensively studied and verified as being capable of generating highly accurate and precise measures of outdoor air quality. For a list of the current methods, see the "Designated EPA

Reference and Equivalent Methods," which are updated periodically and available online at http://www.epa.gov/ttn/amtic/criteria.html.

Particulate matter (PM), specifically $PM_{2.5}$ (fine particles with aerodynamic diameter less than or equal to 2.5 micrometers [µm]) and PM_{10} (particles with aerodynamic diameters less than or equal to 10 µm, including $PM_{2.5}$) concentration data are collected via EPA designated methods. Daily measurements are primarily obtained from monitoring instruments that produce one measurement per 24-hour period and typically operate on a systematic sampling schedule of once every 6 days (which usually amounts to 61 samples per year). EPA has determined that an every sixth day sampling schedule for PM is sufficient to accurately characterize air quality for comparison to the NAAQS. Ozone concentration data are collected via EPA designated methods from monitoring instruments that operate continuously.

The measurements collected were from monitors following all requirements of the State and Local Air Monitoring Stations (SLAMS) network. SLAMS allow state or local governments to develop networks tailored for their immediate monitoring needs. The monitoring objectives for the SLAMS network are found in: 40 CFR 58, Appendix D (http://www.epa.gov/ttn/amtic/), 40 CFR 58.2(c); and EPA 454/R-98-004, Part I, Section 3.2 (U.S. EPA, 2008). The monitoring network conforms to uniform criteria for monitor siting, instrumentation, and quality assurance.

This indicator reflects data from 40 ozone monitoring sites, 33 PM_{10} monitoring sites, and 18 $PM_{2.5}$monitoring sites located in U.S. counties along the U.S./Mexico border that have sufficient data to assess trends over the corresponding time frames that these pollutants were monitored (see "Indicator Derivation"). The primary rationale for siting the existing PM_{10}, $PM_{2.5}$, and ozone monitors in the border zone was to determine air pollution concentrations in populated areas. A secondary rationale was to supply trends information for sensitive ecosystems. Additional rural monitoring in the border zone may help scientists assess transport and ecological effects, which are increasingly important with recent findings of significant long-range transport of $PM_{2.5}$ in North America (see Big Bend Regional Aerosol and Visibility Observational Study Final Report, September 2004, http://vista.cira.colostate.edu/Improve/wp-content/uploads/2016/05/Cover.pdf (PDF) (31 pp, 421K)).

In EPA Region 6, ozone monitoring data from border locations were collected in Dona Ana, Grant, and Luna Counties in New Mexico and El Paso, Brewster, Webb, Hidalgo, and Cameron Counties in Texas. In EPA Region 9, ozone monitoring data from border locations were collected in the counties of Cochise, Pima, and Yuma in Arizona and Imperial and San Diego in California. PM_{10} monitoring data for EPA Region 6 are from Cameron, Hidalgo, Webb and El Paso Counties in Texas and Dona Ana, Luna, and Grant Counties in New Mexico. $PM_{2.5}$ data were available for all of the above counties except for Luna County, New Mexico. For EPA Region 9, PM_{10} monitoring data were collected in the counties of Cochise, Pima, Santa Cruz, and Yuma in Arizona and Imperial and San Diego in California. For EPA Region 9, $PM_{2.5}$ monitoring data were collected in the counties of Cochise, Pima, and Santa Cruz in Arizona and Imperial and San Diego in California.

The Ambient Monitoring Technology Information Center (AMTIC) contains information and files on ambient air quality monitoring programs (this includes information on ozone and particulate monitoring), details on monitoring methods, relevant documents and articles, information on air quality trends and nonattainment areas, and federal regulations related to ambient air quality monitoring. This information can be found

at http://www.epa.gov/ttn/amtic/. The $PM_{2.5}$, PM_{10}, and ozone monitoring network design for the U.S./Mexico border used methods and approaches consistent with those used nationwide.

8. Indicator Derivation

For PM_{10} and $PM_{2.5}$, a 75 percent minimal data completeness is required for trends purposes. The statistics presented in the indicators cover the 3-year time horizons for both PM_{10} and $PM_{2.5}$. For PM_{10}, the 24-hour statistic presented in the indicator is the average of the second highest 24-hour concentrations from three consecutive calendar years. For $PM_{2.5}$, the statistic used in the indicator is the average of annual average concentrations from three consecutive calendar years. These statistics were selected to be consistent with reporting conventions used for tracking trends in the U.S./Mexico border zone.

Ozone sites meet the annual trends data completeness requirement if they have at least 50 percent of the daily data available for the ozone season, which varies by state, but typically runs from May through September. The ozone statistic used for this indicator is the 3-year average of the fourth highest daily maximum 8-hour concentrations at a given site. This statistic is a scientifically acceptable selection for presenting ozone trends, because it reduces variability in year-to-year changes in the ozone ambient concentrations, thus enabling a more confident estimate of how ozone levels are changing. Eight-hour ozone concentrations are presented as running averages.

The air quality statistics presented relate to the pollutant-specific NAAQS and comply with the recommendations of the Intra-Agency Task Force on Air Quality Indicators. For all three pollutants considered in this indicator, the trend lines present composite averages of the particular trend statistic over all monitoring sites that met the selection criteria; all monitoring sites were weighted equally in calculating the composite average trend statistic. Only sites with complete data for a given year are used in the calculation of indicator values. The resulting data sets are statistically balanced, allowing simple statistical procedures and graphics to be easily applied.

Spatial statistics and interpolation were not employed to determine concentrations in areas not covered by the monitoring network, and the indicator does not present data for times when monitoring did not occur.

9. Quality Assurance and Quality Control

The national air monitoring program follows a comprehensive Quality Assurance (QA)/Quality Control (QC) protocol which is documented online at http://www.epa.gov/ttn/amtic/qaqcrein.html and in EPA's Quality Assurance Handbook (EPA-454/R-98-004 Section 15).

In addition, for criteria pollutants, each state or local agency operating a SLAMS monitor is required to have Quality Assurance Project Plans that meet the EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. The quality assurance plans for specific sites are publicly available via request to the reporting agency or to the corresponding EPA Regional Office.

Analysis

10. Reference Points

The statistics used to portray data in this indicator are compared to the NAAQS, national ambient air quality standards which are set to protect public health and public welfare. For purposes of this indicator, the relevant NAAQS for PM_{10} is 150 µg/m^3 (24-hour averaging period); for $PM_{2.5}$ the standard is 12 µg/m^3(annual averaging period); and for ozone the standard is 0.075 ppm (8-hour averaging period). If the values are below that of the NAAQS, the area is considered in attainment for a given NAAQS. (Note, however, that the ROE indicators should not be considered an evaluation of any area's attainment status. Current maps of attainment status can be generated at the following EPA AQS Web site: http://www.epa.gov/airquality/greenbook/.)

Refer to http://www.epa.gov/ttn/naaqs/standards/ozone/s_o3_history.html for more information on the history of the ozone NAAQS and to http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_history.html for more information on the history of the PM_{10} and $PM_{2.5}$ NAAQS.

11. Comparability Over Time and Space

The data presented in this indicator are viewed as highly comparable over both time and space because every monitor used in this indicator is either a federal reference or equivalent method, monitoring locations were selected according to strict siting criteria, and extensive quality assurance protocols must be followed.

12. Sources of Uncertainty

Sources of uncertainty in this indicator's air quality trends include measurement uncertainty associated with the air sampling equipment and uncertainties associated with characterizing regional air quality trends using data from a limited number of monitoring sites. Measurement uncertainty is believed to be limited because the indicator is derived entirely from Federal Reference Method or equivalent method monitoring devices, methods that have been shown to be capable of measuring criteria pollutant air concentrations to a high degree of precision and accuracy. Further, the monitoring sites considered are required to meet strict quality assurance and quality control criteria to ensure the comparability from monitor to monitor. This is necessary, since a primary objective for most of these monitors is to measure against the same National Ambient Air Quality Standard (NAAQS). A greater source of uncertainty arises from the spatial coverage of monitors. The statistics in this indicator are a composite of monitoring data collected from a discrete number of fixed monitoring sites, mostly found in higher populated areas as required by federal monitoring regulations. The depicted trends reflect air quality across those locations, and might not reflect conditions along the border outside of these more populated areas.

13. Sources of Variability

The indicator data for PM_{10}, $PM_{2.5}$, and ozone are valuable measures of air quality trends in the border zone. Presentation of data averaged over 3-year time frames helps minimize temporal variability in concentrations that could otherwise be influenced by short-term fluctuations in meteorological conditions.

Short-term trends in PM_{10} concentrations are often highly dependent on meteorological conditions. The maximum concentration for a given site can be influenced by wind-blown dust and will exhibit considerable variations from day to day. Trends over the longer term are far less likely to be influenced by unusual meteorological conditions.

14. Statistical/Trend Analysis

The indicator presents a time series of concentrations averaged across the border monitoring stations. No special statistical techniques or analyses were used to characterize the long-term trends and their statistical significance.

Limitations

15. Data Limitations

Limitations to this indicator include the following:

1. Many counties along the U.S./Mexico border do not have ambient air quality monitors; these counties are not characterized by this indicator.
2. This indicator does not include data from the Mexican side of the border. When a technical review concludes the quality of this data is appropriate for the intended use, the indicator will be updated with those data.
3. Short-term trends in PM10 concentrations are often highly dependent on meteorological conditions. The maximum concentration for a given site can be influenced by wind-blown dust and will exhibit considerable variations from day to day. Trends over the longer term are far less likely to be influenced by unusual meteorological conditions.
4. The long-term ozone trends are derived from an increasing number of monitors over the course of time from 1986 to 2013, but an analysis of the limited number of border sites that have full periods of record show that the slopes of the trends are similar to those in this indicator.
5. The trend lines present composite averages of the particular trend statistic over all monitoring sites that met the selection criteria; all monitoring sites were weighted equally in calculating the composite average trend statistic.
6. Because most of the monitoring sites are located in urban areas, the trends might not accurately reflect conditions outside the immediate urban monitoring areas.

References

No additional references for the Technical Documentation.