

## Report on the Environment

<https://www.epa.gov/report-environment>

### Regional Haze

Visibility impairment occurs when air pollution, especially particles, scatter and absorb light. The resulting haze not only limits the distance one can see, but also degrades the color, clarity, and contrast of scenes. As the [Particulate Matter Concentrations indicator](#) describes further, the same pollutants that impair visibility are linked to serious health effects. Visibility impairment occurs throughout the country, including both urban and rural areas. Regional haze is visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area (U.S. EPA, 2004). Regional haze has been identified as an important issue in selected National Parks, Wilderness Areas, and international parks, such as the Grand Canyon, Great Smoky Mountains, Mount Rainier, Shenandoah, Yellowstone, and Yosemite National Parks (U.S. EPA, 2003).

The particles that impair visibility include both primary and secondary pollutants. The primary pollutants of concern are particles that are emitted directly into the atmosphere, such as dust from roads or soot (elemental carbon) from combustion sources (e.g., wood combustion). Secondary pollutants of concern are particles that form in the atmosphere from chemical reactions and physical processes, such as sulfates (formed from sulfur dioxide emissions from power plants and other industrial facilities) and nitrates (formed from nitrogen oxides emitted from power plants, automobiles, and other types of combustion sources).

Humidity can increase the effect of pollution on visibility, causing some particles to become more efficient at scattering light and impairing visibility (U.S. EPA, 2003). In the eastern U.S., where annual average relative humidity levels are between 70 and 80 percent, reduced visibility mainly results from secondarily formed sulfates and high humidity, along with a somewhat lower contribution from organic carbon and nitrates (U.S. EPA, 2004). The effect of humidity is particularly strong in summer. Humidity is less of a factor in the West, as average values are generally between 50 and 60 percent. In western states, primary emissions from sources like wood smoke and nitrates contribute a large percentage of the total particulate loading, though secondarily formed sulfates also contribute to visibility impairment. Without the effects of anthropogenic sources of pollution, the annual average natural visual range in the U.S. would vary with location, and is estimated to range from approximately 75 to 150 kilometers (45 to 90 miles) in the East and from approximately 200 to 300 kilometers (120 to 180 miles) in the West (U.S. EPA, 2003).

This indicator reports visibility estimates calculated from measurements of particulate matter constituents collected at 43 monitoring sites between 1992 and 2015 at National Parks, Wilderness Areas, and other protected sites under the Interagency Monitoring of Protected Visual Environments (IMPROVE) network. Values are presented for 11 Eastern (east of 100 degrees west longitude) sites and 32 Western (west of 100 degrees west longitude) sites. Visibility, expressed as visual range, is calculated from the measured levels of different components within airborne particles and these components' light extinction efficiencies. The IMPROVE algorithm (Debell et al., 2006) includes an adjustment for ammonium sulfate and ammonium nitrate to account for their adsorption of water vapor from the atmosphere under elevated relative humidity conditions. The IMPROVE particle data are generated by laboratory analysis of 24-hour duration filter samples collected at each site on a one-day-in-three schedule. This indicator tracks visibility in three categories: worst visibility

conditions (the average of the 20 percent worst visibility days); best visibility conditions (the average of the 20 percent best visibility days); and mid-range visibility conditions (the average of the remaining 60 percent of days).

## What the Data Show

As shown in Exhibits 1 and 2, the average visual range for the worst days in 2015 in the East was 57 kilometers (36 miles), compared to 177 kilometers (110 miles) for the best visibility days. In the West, the average visual range in 2015 extended from 117 kilometers (73 miles) on the worst days to 282 km (175 miles) on the best days. In both regions, the average visual range in selected National Parks and Wilderness Areas increased since 1992 for worst, mid-range, and best visibility days. The increased visual ranges between 1992 and 2015 for mid-range visibility days were 98 percent in the East and 32 percent in the West.

## Limitations

- These data represent visibility in a sampling of selected National Parks and Wilderness Areas and might not reflect conditions in other rural or urban areas.

## Data Sources

Summary data in this indicator were provided by the National Park Service Air Quality Division, based on ambient air monitoring data collected as part of the IMPROVE network and a computational algorithm last updated in November 2008 (IMPROVE, 2017). Visibility trends in this indicator are derived from the subset of IMPROVE monitoring stations outside urban areas that have sufficient data to assess trends between 1992 and 2015.

## References

Debell, L.J., K.A. Gebhart, W.C. Malm, M.L. Pitchford, B.A. Schichtel, and W.H. White. 2006. Spatial and seasonal patterns and temporal visibility of haze and its constituents in the United States: Report IV.

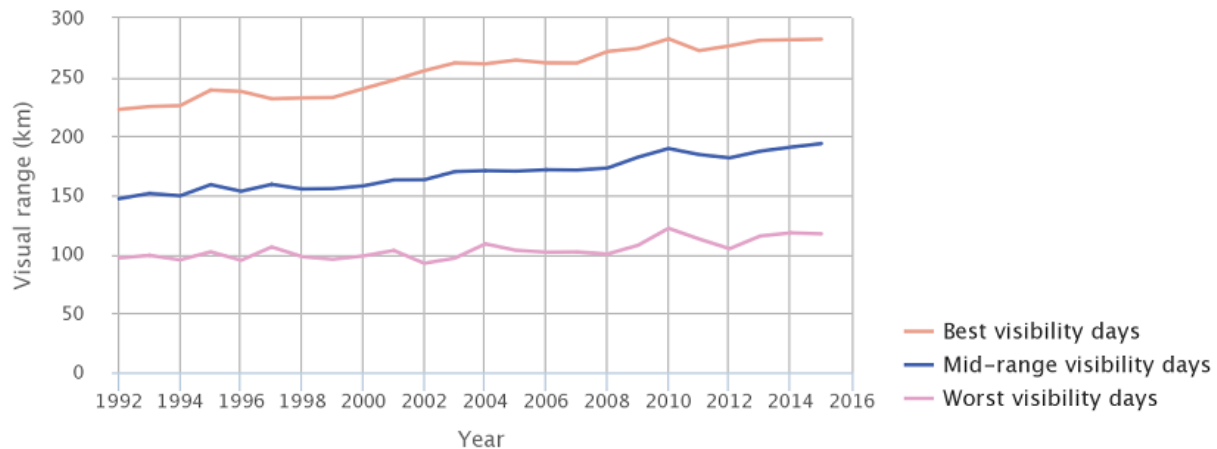
<http://vista.cira.colostate.edu/Improve/spatial-and-seasonal-patterns-and-temporal-variability-of-haze-and-its-constituents-in-the-united-states-report-iv-november-2006/>.

IMPROVE (Interagency Monitoring of Protected Visual Environments). 2017. 1992-2015 data from the IMPROVE network based on the “New IMPROVE algorithm” (updated December, 2016). Accessed 2017. <http://vista.cira.colostate.edu/Improve/rhr-summary-data/>.

U.S. EPA (United States Environmental Protection Agency). 2004. The particle pollution report: Current understanding of air quality and emissions through 2003. EPA/454/R-04/002. Research Triangle Park, NC. <https://nepis.epa.gov/Exe/ZyPDF.cgi/30005VASPDF?Dockey=30005VAS.PDF> (PDF) (32 pp, 4.7MB).

U.S. EPA. 2003. Latest findings on national air quality—2002 status and trends. EPA/454/K-03/001. Research Triangle Park, NC. <https://nepis.epa.gov/Exe/ZyPDF.cgi/P1003URM.PDF?Dockey=P1003URM.PDF> (PDF) (36 pp, 4.4MB).

## Exhibit 1. Visibility in selected National Parks and Wilderness Areas in the western U.S., 1992–2015



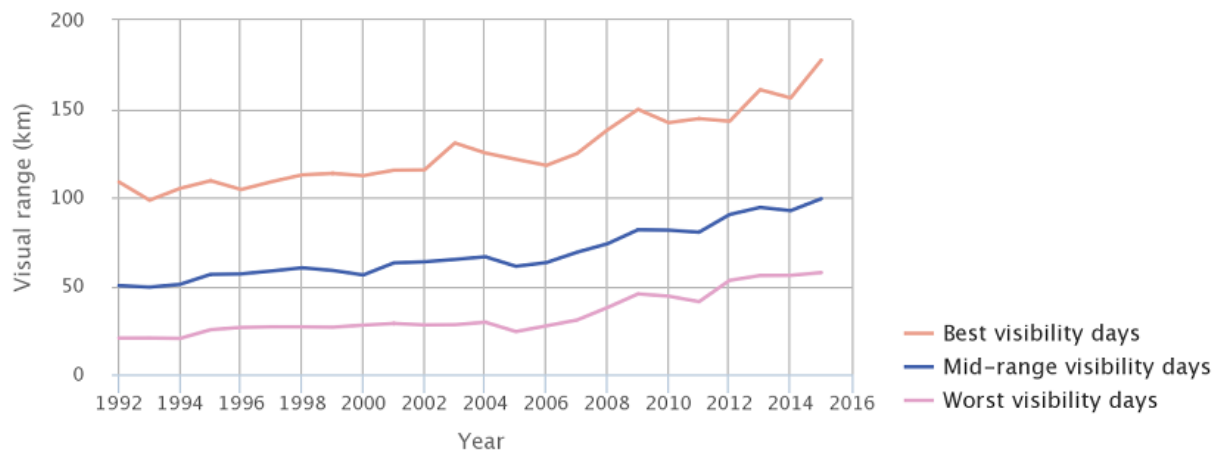
**Coverage:** 32 monitoring sites in the western U.S. with sufficient data to assess visibility trends from 1992 to 2015.

Visual ranges are calculated from the measured levels of different components within airborne particles and these components' light extinction efficiencies.

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:** IMPROVE, 2017

## Exhibit 2. Visibility in selected National Parks and Wilderness Areas in the eastern U.S., 1992–2015



**Coverage:** 11 monitoring sites in the eastern U.S. with sufficient data to assess visibility trends from 1992 to 2015.

Visual ranges are calculated from the measured levels of different components within airborne particles and these components' light extinction efficiencies.

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:** IMPROVE, 2017