Carbon Monoxide Removed Annually by Tree Cover

This EnviroAtlas community map estimates the total kilograms of ambient carbon monoxide removed annually by trees in each census block group.

Why is carbon monoxide removal important?

Carbon monoxide (CO) is a colorless, odorless gas that is emitted from combustion processes. CO is a common air pollutant, and it is one of the six criteria pollutants regulated by EPA under the National Ambient Air Quality Standards (NAAQS). Ambient levels of CO can contribute to health problems, especially for individuals with heart disease and other chronic cardiopulmonary conditions. Carbon monoxide also contributes to the formation of smog, carbon dioxide (CO_2), and ozone (O_3), which are associated with air quality and climate concerns. Trees can remove ambient CO from the atmosphere, thus contributing to air quality and a stable climate, as well as helping to avoid potential human health problems associated with CO exposure.

Ambient CO concentrations are often higher in urban areas relative to other places, because a majority of CO emissions come from mobile sources.[1] EPA estimates that exhaust from motor vehicles contributes roughly 60 percent of all nationwide carbon monoxide emissions, and up to 95 percent in urban areas.[2]

CO can harm people by reducing oxygen delivery to the body's tissues and organs, such as the heart and brain. Carbon monoxide poisoning, which is often associated with malfunctioning heating and cooling systems and indoor air quality, can be severely debilitating or even fatal. The health effects of outdoor exposure to carbon monoxide are usually less severe, but they can still be of significant concern for certain individuals. People with heart disease are at particular risk for problems resulting from CO exposure because it is already difficult for them to pump oxygenated blood to the heart.[3]

In addition to its potential health effects, CO has environmental impacts. Carbon monoxide contributes to the formation of CO_2 and ozone, two potent greenhouse gases (GHGs) that warm the atmosphere.[1] Thus, the removal of CO may also contribute to a more stable climate by helping to reduce the amount of greenhouse gases in the atmosphere.

Trees help reduce the potential adverse health and environmental effects of CO by removing it from the air.

Gaseous air pollutants are taken in primarily through the leaf stomata (pores), though some gases are removed by the plant surface. Once inside the leaf, gases diffuse into intercellular spaces and may be absorbed by water films to form acids or react with inner-leaf surfaces.[4] The removal of gaseous pollutants is more permanent than the removal of particulates because the gases are often absorbed and converted within the leaf interior. Healthy trees can remove significant amounts of air pollution in cities, where it is often concentrated.

How can I use this information?

The map, Carbon Monoxide Removed Annually by Tree Cover (kg/yr), estimates and illustrates the variation in the amount of carbon monoxide removed by trees. These data could be used to explore the patterns of carbon monoxide removal by trees in communities that do not meet the standards set by the EPA's NAAQS. For compliant areas, the map can identify neighborhoods that potentially have higher carbon monoxide concentrations compared to other neighborhoods. When used with EnviroAtlas data and maps that look at near-road environments, users can explore areas where high percentages of the block group population are in close proximity to roadways that have notably low volumes of carbon monoxide removed by trees. Additionally, communities and researchers that have access to health data may be able to use this map and its underlying data to continue to research the relationships among trees, carbon monoxide, and human health.

CONTINUED ON BACK ▶

How were the data for this map created?

The data for this map are based on the land cover derived for each EnviroAtlas community and the pollution removal models in i-Tree, a toolkit developed by the USDA Forest Service. The land cover data were created from aerial photography through remote sensing methods; tree cover was then summarized as the percentage of each census block group. The i-Tree pollution removal module uses the tree cover data by block group, the closest hourly meteorological monitoring data for the community, and the closest pollution monitoring data. Additionally, the 2001 National Land Cover Dataset was used to determine the percent of these trees that are deciduous or evergreen. Local leaf-on and leaf-off dates were used to vary canopy cover daily based on the amount of tree cover classified as deciduous. Assuming a leaf area index value of 4.9, hourly estimates of pollution removal by trees were combined with atmospheric data to estimate hourly percent air quality improvement due to pollution removal for each pollutant.[5]

What are the limitations of these data?

All of the EnviroAtlas community maps that are based on land cover use remotely-sensed data. Remotely-sensed data in EnviroAtlas have been derived from imagery that has not been verified. These data are estimates and are inherently imperfect. This map also uses estimation methods for pollution removal. To accomplish this, average leaf area index values from urban areas were used. These averages may not accurately reflect local conditions, but since local values are not available, these are the best usable estimates. This limitation is not particularly significant because index values do not vary substantially and have a relatively small impact on the estimate. Additionally, this map uses weather and pollutant monitoring data to represent local conditions, though a city's average weather and pollutant conditions do not depict potential variability of conditions within the community.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. To find the EnviroAtlas 1-meter land cover grids created for each community, enter *land cover community* in the interactive map search box.

Where can I get more information?

There are numerous resources where additional information on carbon monoxide as an air pollutant can be found; a selection of these resources is listed below. For information on EPA air pollution rules, regulations, and monitoring programs, please visit the Agency's website. To learn more about i-Tree tools and how they can be used to support research, planning, and policy efforts, visit the i-Tree website. For more information on how air pollution and its removal may affect human health, visit the Clean Air section of the Eco-Health Relationship Browser. For additional information on the data creation process, access the metadata found in the layer list drop-down menu for map layers in the EnviroAtlas interactive map. To ask specific questions about these data, please contact the EnviroAtlas Team.

Acknowledgments

EnviroAtlas is a collaborative effort by EPA, its contractors, and project partners. The data for Carbon Monoxide Removed were generated by Satoshi Hirabayashi and Allison Bodine, Davey Tree Expert Co. and David J. Nowak, USDA Forest Service. The fact sheet was created by David J. Nowak, USDA Forest Service, Jessica Daniel, EPA Student Services Contractor, and Laura Jackson, EPA.

Selected Publications

1. United States Environmental Protection Agency (EPA). 2017. Our nation's air: Status and trends through 2016. Accessed October 2020.

2. United States Environmental Protection Agency (EPA). 2018. Carbon monoxide (CO) pollution in outdoor air. Accessed October 2020.

3. United States Environmental Protection Agency (EPA). 2016. Basic information about carbon monoxide (CO). Accessed October 2020.

4. Smith, W.H. 1990. *Air pollution and forests*. Springer- Verlag, New York, 618 p.

5. Nowak, D.J., D.E. Crane, and J.C. Stevens. 2006. Air pollution removal by urban trees and shrubs in the United States. *Urban Forestry and Urban Greening* 4:115–123.

Centers for Disease Control and Prevention (CDC). 2012. Asthma in the U.S. Accessed October 2020.

Nowak, D.J., R.E. Hoehn, D.E. Crane, J.C. Stevens, J.T. Walton, and J. Bond. 2008. A ground-based method of assessing urban forest structure and ecosystem services. *Arboriculture and Urban Forestry* 34(6):347–358.