Percent Ozone Removed Annually by Tree Cover

This EnviroAtlas community map estimates the mean percent of ozone removed annually by tree cover in each census block group.

Why is ozone removal important?

Ground level ozone (O_3) is a greenhouse gas (GHG) that is formed by chemical reactions between nitrogen oxides and volatile organic compounds; it is the main component of smog. Ozone 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). Breathing in ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and congestion.[1] Trees are capable of removing ozone from the atmosphere, thus contributing to air quality, a more stable climate, and public health.

Ozone, along with other air pollutants, can have significant effects on human health. Some of the human health problems that result from air pollution include aggravation of respiratory and cardiovascular diseases, decreased lung function, increased frequency and severity of respiratory symptoms (e.g., difficulty breathing and coughing), increased susceptibility to respiratory infections, effects on the nervous system (e.g., impacts on learning, memory, and behavior), cancer, and premature death.[2] People with pre-existing conditions such as heart disease, asthma and emphysema, as well as older adults and children, are at greater risk for air pollution-related health effects. Despite improvements in air quality, approximately 127 million people live in areas that exceeded the NAAQS in 2008.[2] Additionally, the number of people with asthma is growing, with about 1 in 12 people (25 million, 8% of U.S. population) having asthma in 2009, compared with 1 in 14 (about 20 million, or 7%) in 2001.[3]

In addition to its potential health effects, ozone also has environmental impacts. Ozone can damage trees and other plants, especially sensitive vegetation, affecting the appearance of leaves and interfering with photosynthesis.[1] Ozone, a potent greenhouse gas, contributes to atmospheric warming. The removal of ozone may contribute to healthier ecosystems and a more stable climate.

Trees help reduce the potential adverse health and environmental effects of ozone 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, Percent Ozone Removed Annually by Tree Cover, estimates and illustrates the variation in the amount of air pollution removed by trees. These data could be used to explore the patterns of ozone 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 ozone 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 with low volumes of ozone removed by trees. When overlaid with demographic data such as the percent of elderly individuals, this map could be used to identify areas where ozone reduction would most benefit highly vulnerable populations. 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, ozone, and human health.

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How were the data for this map created?

The data for this map are based on land cover derived for each EnviroAtlas community and 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 summarized as the percentage in 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 (NLCD) was used to determine the percentage of trees that were 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 and have 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 leaf area 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 ground level ozone 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 for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about these data, please contact the EnviroAtlas Team.

Acknowledgments

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Selected Publications

1. United States Environmental Protection Agency (EPA). 2012. Ozone pollution. Accessed May 2016.

2. United States Environmental Protection Agency (EPA). 2017. Our nation's air: Status and trends through 2016. Accessed January 2018.

3. Centers for Disease Control and Prevention (CDC). 2012. Asthma in the U.S: Growing every year. Accessed March 2013.

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

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