Asthma Exacerbation Avoided Due to SO_2 Removed

This EnviroAtlas community map illustrates the annual reduction in asthma exacerbation cases due to sulfur dioxide removed by trees, summarized by census block group. This dataset identifies one of the adverse health effects that can be reduced by trees in a community. These data are estimated using the U.S. EPA's Environmental Benefits Mapping and Analysis Program (BenMAP).

Why is avoiding asthma exacerbation important?

Asthma, a chronic lung disease, involves the inflammation and narrowing of airways that can lead to wheezing, coughing, chest tightness, and shortness of breath. While asthma most frequently begins in childhood, it can affect people of all ages.[1] It is estimated that 1 in 12 people in the U.S. have asthma and according to researchers, rates of asthma diagnosis have been rising for at least the last decade.[2] Asthma can frequently be managed through a number of behavioral and medical techniques. However, if symptoms are not treated, outcomes may be more severe and include activity limitations, hospitalizations, and death.[1]

Triggers for asthma attacks, or exacerbations, include mold, outdoor air pollution, tobacco smoke, and colds and flu.[2] Short-term exposure to sulfur dioxide (SO_2) has been shown to increase bronchial restriction (airway narrowing) and symptoms of asthma, especially during periods of increased respiration or exercise. Increased emergency room visits and hospital admissions for respiratory issues are additional risks for vulnerable populations.[3] SO_2 is formed in the combustion of sulfur-containing fossil fuels such as coal and diesel.[3] As SO_2 exposures can be elevated near busy roadways and industrial areas, people who spend time or live near these areas, particularly the elderly, children, and those with asthma, may be more at risk than other groups.[3]

Trees help reduce the potential adverse health and environmental effects of SO_2 by removing it from the air. Gaseous air pollutants, like SO_2, are taken in primarily through the leaf stomata (pores), though some gases are removed by the plant surface.[4] Absorbed gases are often converted within the leaf interior, making their removal more permanent than pollutants removed by plant surfaces. Healthy trees can remove significant amounts of air pollution in cities, where it is often concentrated.


Photo: U.S. National Institutes of Health

How can I use this information?

The map, Asthma Exacerbation Avoided Due to Sulfur Dioxide Removed by Tree Cover (cases/yr), is one of four EnviroAtlas maps that illustrate annual adverse health outcomes avoided that are attributable to pollutant removal by tree cover.

Used in conjunction with near-road and overall tree cover data available in EnviroAtlas, this map can highlight which areas are likely receiving the benefits of tree cover and which may lack natural buffers to common air pollutants. EnviroAtlas provides census demographic data that may be overlaid to visualize the distribution of sensitive populations relative to the health benefits of tree cover. This map can also be used with urban planning and local health data to aid in current and future decision-making processes, such as land development, public health program implementation, or policy changes, which could involve changes in tree cover.

How were the data for this map created?

This data layer was derived from a high resolution community land cover map. For each U.S. Census block group, the total amount of tree cover (m^2) was determined. The i-Tree pollution removal program was then run for each block group, assuming a leaf area index value of 4.9 and utilizing the closest hourly meteorological and pollution data. Percent of county tree cover that is evergreen was derived from the most current NLCD 30-m resolution land cover maps. Local leaf on and leaf off dates were used to vary canopy cover daily based on the amount of tree cover

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classified as evergreen. Hourly estimates of pollution removal by trees were combined with atmospheric data to estimate annual percent air quality improvement due to pollution removal for several pollutants.[6]

Selected adverse health effects avoided due to tree cover were calculated using BenMAP. The BenMAP model estimates health impacts and related costs or savings based on the local population and change in pollutant concentration. For EnviroAtlas, county-level multipliers of health impact per change in SO_2 were calculated, then downscaled to the block group. The final values incorporated the block-group changes in pollutant concentrations from i-Tree, and U.S. Census Bureau age distribution data reallocated from census tracts. For more information on these methods, see the layer's metadata or the publications below.

What are the limitations of these data?

Pollutant removal estimates are related to the use of leaf area index values that have been averaged from multiple study areas; specific values are unavailable for most communities. The relatively few existing weather stations and pollutant monitors are used to represent conditions across many block groups. Similarly, nearest atmospheric boundary layer height measurements and an assumption of a well-mixed boundary layer are used, but these may not reflect the local boundary layer. An additional limitation is the assumption that the age distribution for a census tract is mirrored in its block groups.

For more technical details about the limitations of these data, refer to the layer's metadata. EnviroAtlas data are estimates of the truth, founded on the best available science. These estimates reflect research on the relationships between tree canopy and SO2, and SO2 and asthma exacerbation. They do not consider potential asthma exacerbation from pollen or from other respiratory irritants generated by the trees themselves. Such effects vary widely with species and are not yet fully understood. It is advisable to consult with an arborist or urban forester on local tree planting decisions.

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?

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. There are numerous resources on the relationships among trees, ecosystem services, and human health and well-being; a selection of these resources is listed below. In-depth information on the relationships between trees and human health and well-being can be found in EPA's Eco-Health Relationship Browser. For additional information on the data creation process, access the corresponding metadata found in the drop-down menu for each community map layer listed in the EnviroAtlas 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

EnviroAtlas is a collaborative effort led by EPA. The data for this map were generated by Satoshi Hirabayashi and Allison Bodine, Davey Tree Expert Co., and David J. Nowak, USDA Forest Service. The fact sheet was written by David J. Nowak, USDA Forest Service; Pamela Barclay, EPA ORISE Fellow; Leah Yngve, EPA ASPPH Fellow; and Laura Jackson, EPA.

Selected Publications

1. National Institutes of Health. 2014. What is asthma? National Heart, Lung, and Blood Institute, accessed August, 2014.

2. Centers for Disease Control and Prevention. 2011. Asthma in the U.S., accessed August, 2014.

3. US EPA. 2016. Sulfur dioxide (SO2) Pollution. Accessed January 2018.

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