Value of School Days Not Lost to Illness Due to Ozone Removed by Tree Cover

This EnviroAtlas community map estimates the economic value ($/yr) of the school days per year not lost to illness due to ozone removed by trees, summarized by census block group. This dataset identifies one of the adverse economic 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 school days lost to illness important?

In 2012, roughly two thirds of school-aged children missed one or more days of school due to illness or injury.[1] Respiratory illnesses result in an average rate of school days missed of 1 to 2 days per student per year depending on geographic region.[2] Missing even one day of school has been linked to lower academic performance, particularly in math.[3] Additionally, if a child cannot attend school due to an illness, the parent or guardian may need to stay home as well, miss work, and lose wages.

Several studies have found an association between elevated ozone levels and school days missed. Young adults and children are especially sensitive to high levels of ozone, which can decrease lung function and exacerbate existing lung conditions such as asthma.[4] Exposure to elevated levels of ozone can cause cough, throat irritation, and discomfort or difficulty breathing.[4] An absence from school indicates the relative severity of the effects of ozone on children. However, students are generally not in school during the hot summer months when ozone levels are higher, so the full impact of ozone on youth may not be reflected by this metric.

Trees help reduce the potential adverse health 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.[5] The removal of gaseous pollutants is more permanent than the removal of air particles 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.

Photo: US EPA, Montgomery County, Maryland.

How can I use this information?

The map, Value of School Days Not Lost to Illness Due to Ozone Removed by Tree Cover ($/year), is one of two EnviroAtlas maps that illustrate annual productivity losses avoided 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 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. The total amount of tree cover (m^2) was determined for each census block group. 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 evergreen tree cover 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 classified as evergreen. Hourly

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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 person per change in O_3 were calculated and then applied 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 to each block group. The value of lost school days is based on the estimated loss in wages due to a parent missing work to care for his or her child. 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 ozone, and ozone and school days lost due to respiratory illness. They do not consider school days lost due to pollen or other respiratory irritants generated by the trees themselves. Such effects vary widely with tree 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 the BenMAP program and how they can be used to support research, planning, and policy efforts, visit their respective websites. 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 wellbeing can be found in EPA's 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

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Selected Publications

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2. Adams, P.F., G.E. Hendershot, and M.A. Marano. 1999. Current estimates from the National Health Interview Survey, 1996. National Center for Health Statistics, Vital Health Stat 10(200), Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. Accessed October 2020.

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