How Incorporation of Urban Green Spaces Affects Air Quality: A Study on UC San Diego Campus

Cindy Tan | University of California Carbon Neutrality Initiative Fellowship | UC San Diego

Introduction

According to the State of Global Air Report, air pollution contributed to 6.67 million deaths globally in 2019. Extensive studies have shown that exposure to elevated levels of fine particle air pollutants is linked to serious health risks including cardiovascular, respiratory, and neurological disorders. Air pollutants and greenhouse gas emissions from anthropogenic activities pose serious public health concerns and exacerbate the effects of climate warming. Furthermore, air pollution is also associated with serious social implications as studies conducted in the U.S. have shown that people of color are at higher risks of exposure to air pollutants.

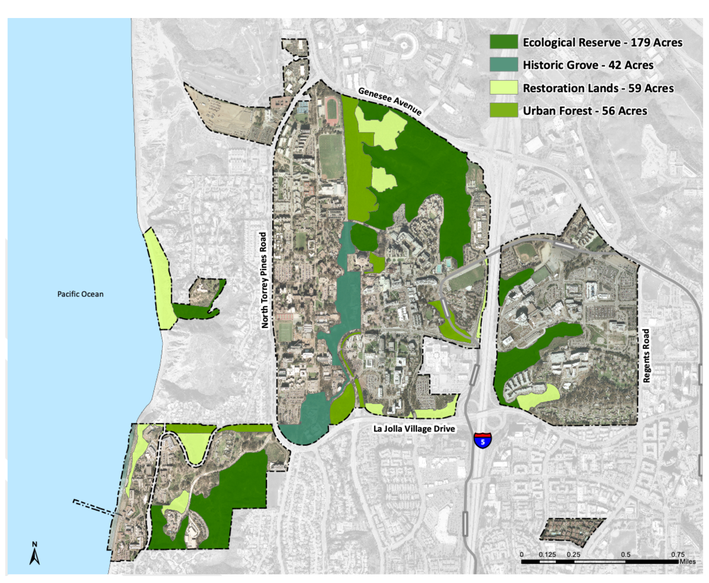
To combat the adverse social, climate, and health effects of air pollutants in metropolitan regions, urban greening demonstrates an effective mitigation strategy. The associated benefits include carbon dioxide sequestration, air pollutant removal, and cooling effects due to the increase in tree canopy. This project aims to explore the air quality effects of current tree canopy coverage at UC San Diego by estimating the area of tree canopy and projecting the corresponding amount of air pollutants removed using the USDA-developed software, iTree. The results may highlight the potential for further incorporation of urban green spaces for campus development, or even city-wide planning, to provide communities with an equitable and safe living environment.

Air pollution in Los Angles (Shutterstock/J Dennis)

Project Goals

The goals of this project are to utilize the iTree canopy software developed by USDA to:

- Estimate the total tree canopy coverage on UC San Diego main campus
- Project the amount of air pollutants (carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, PM 2.5 and PM 10) removed, carbon sequestered, and their corresponding monetary value due to the associated tree canopy



Map of UCSD Open Space Preserve (Source: UCSD 2018 Long Range Development Plan)

Materials and Methods

Using iTree Canopy,

- 1000 random points within the defined border were classified into either a tree or non-tree category
- Air pollutant removal and monetary value estimation were calculated based on county-specific multiplier values
- Multiplier values were derived from field studies specific to each county

Basic process of the i-Tree program (Source: Understanding iTree: Summary of Programs and Methods GTR-NRS-200-2021)

Results and Outcomes

With an estimated 29.7% of tree canopy coverage on UC San Diego main campus, there was an associated environmental benefit of 498 tons of carbon sequestered in trees annually, which is equivalent to 1,827 tons of CO_2.

- The estimated amount of air pollutants removed are shown in Figure 3
- An associated monetary value for the total amount of air pollutants removed was $14,904

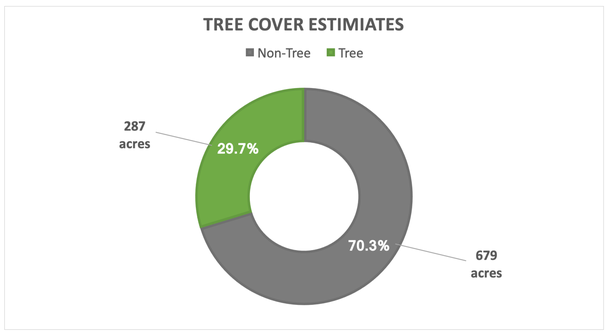


Figure 1. Percent tree canopy coverage on the UC San Diego main campus was estimated to be 29.7%, corresponding to 287 acres.

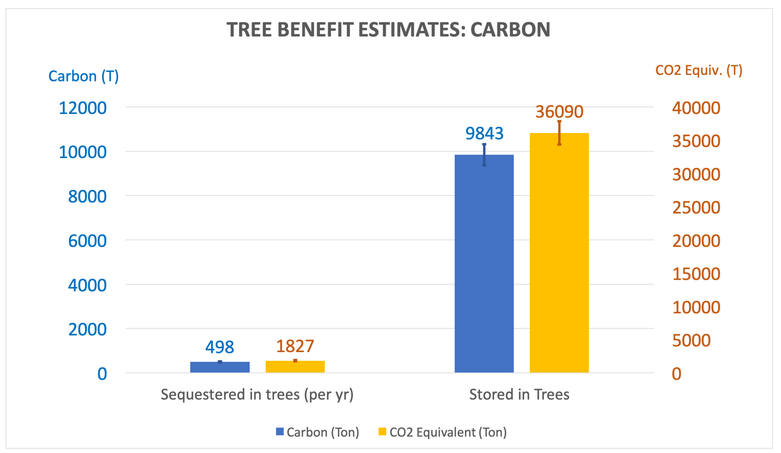


Figure 2. Amount of carbon sequestered in trees annually and CO_2 equivalent were calculated by the iTree software with the following multiplier values: 1.735 tons of carbon or 6.363 tons of CO_2 per acre per year.

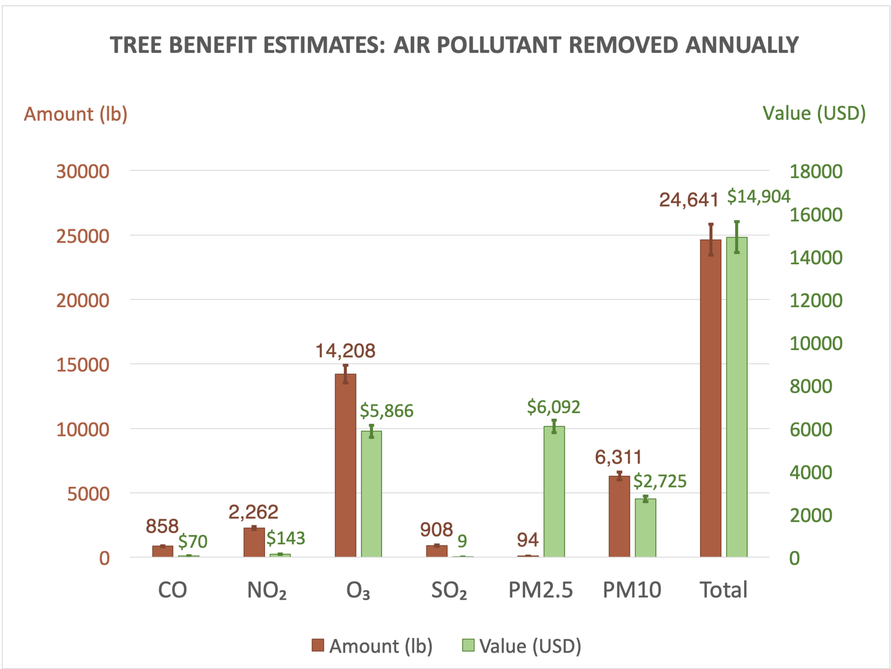


Figure 3. Amount of air pollutants removed was calculated by the iTree software with multiplier values that are specific to the County of San Diego (values in figures were plotted from iTree report generated for the 1000 random points classified).

Conclusion

Using the iTree Canopy software, an estimated tree canopy coverage of 29.7% on the UCSD main campus was correlated to a projected 24,641 pounds of air pollutants removed and 498 tons of carbon sequestered annually.

In addition to percent tree coverage, tree selection in urban greening projects should also be considered. Eucalyptus trees are the dominant tree species in the 335 acres of the Open Space Preserve designated by UCSD. Eucalyptus trees provide tree canopy that contributes to air pollutant removal and carbon sequestration, but they are classified as large emitters of biogenic volatile organic compounds (BVOC), specifically isoprene[2,4]. These gaseous compounds generated in nature can react with other anthropogenic air pollutants, such as nitrogen oxides to produce ozone and other secondary pollutants[3]. To maximize air pollutant removal and carbon sequestration, not only should tree canopy be increased in future development projects, tree species selection should also be carefully considered.

Urban Forest next to Geisel Library (Source: UCSD 2018 Long Range Development Plan)

Future Goals

To further assess the climate effects of urban greening projects, similar methods of analysis can be employed for the entire county of San Diego and potentially other counties as well. Real-time air quality data can also be incorporated to highlight vulnerable areas with high air pollution and address social equity considerations of green infrastructure placement in cities to mitigate the climate and health effects of air pollution.

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