ENVIRONMENTAL RESEARCH
LETTERS

PERSPECTIVE • OPEN ACCESS

Plant species selection and participatory community co-design are essential in balancing ecosystem services and disservices in urban areas

To cite this article: Ahram Cho *et al* 2025 *Environ. Res. Lett.* **20** 051003

IOP Publishing Environ. Res. Lett. 20 (2025) 051003 https://doi.org/10.1088/1748-9326/adc944

ENVIRONMENTAL RESEARCH
LETTERS

CrossMark

OPEN ACCESS

RECEIVED
30 September 2024

REVISED
1 April 2025

ACCEPTED FOR PUBLICATION
4 April 2025

PUBLISHED
15 April 2025

PERSPECTIVE

Plant species selection and participatory community co-design are essential in balancing ecosystem services and disservices in urban areas

Ahram Cho[1,*], **Natalie Love**[2], **Ralph Cintron**[3], **Jane Nicholson**[4], **Lu Xu**[5], **Gabriela C Nunez-Mir**[1], **Jangho Lee**[6], **Max Berkelhammer**[6] **and Miquel A Gonzalez-Meler**[1]

[1] Department of Biological Sciences, University of Illinois Chicago, Chicago, IL, United States of America
[2] Negaunee Institute for Plant Conservation Science and Action, Chicago Botanic Garden, Glencoe, IL, United States of America
[3] English, Latin American and Latino Studies, and Great Cities Institute, University of Illinois Chicago, Chicago, IL, United States of America
[4] The Puerto Rican Cultural Center, Chicago, IL, United States of America
[5] Department of Energy, Environmental and Chemical Engineering, Washington University in St. Louis, St. Louis, MO, United States of America
[6] Department of Earth and Environmental Sciences, University of Illinois Chicago, Chicago, IL, United States of America
[*] Author to whom any correspondence should be addressed.

E-mail: ahram@uic.edu

Keywords: air quality, allergenicity, asthma rate, biogenic volatile organic compounds, land surface temperature

Supplementary material for this article is available online

Abstract

Balancing the benefits and disservices of urban green infrastructure is critical for sustainable city planning. While urban vegetation provides ecosystem services such as air quality improvement and heat reduction, it can also contribute to air pollution through the emission of biogenic volatile organic compounds, and pollen can exacerbate respiratory health issues and allergies within communities. Chicago's environmental and health disparities make it a critical case for examining the complex interactions between urban vegetation and air quality. This paper evaluates how plant species selection and participatory community co-design can address these challenges, focusing on Humboldt Park, Chicago, IL, and Evanston, IL, as case studies. Community-driven initiatives, such as those led by the Puerto Rican Agenda in Humboldt Park, are essential in mitigating negative impacts on air quality through informed species selection. This approach ensures that urban greening strategies balance ecological benefits with improve air quality and prevents health disparities.

1. Introduction

Urban green infrastructure–such as parks, street trees, or community gardens–offers a potential solution to a deteriorating urban environment by improving air quality, promoting biodiversity, and enhancing the social and psychological well-being of city residents [1, 2]. However, while trees provide numerous public and ecosystem health benefits, there are potential drawbacks of urban greening, known as ecosystem disservices, which are rarely considered in urban greening projects [3–5]. Therefore, we need to consider positive and negative effects of nature-based solutions on air pollution and the buy-in from residents before shaping any environmental action and policy [6]. This is particularly important in lower-income urban areas that often have residents with a considerable risk of respiratory disease and other environmental risks related to human health [7].

Urban greening is common strategy to reduce the negative environmental effects of urban areas [1, 2, 8]. Trees cool urban environments through shading, reducing direct sunlight and lowerings surface temperatures, and through evapotranspiration, which releases water vapor, cooling the air [9]. However, trees release biogenic volatile organic compounds

(BVOCs), such as isoprene and monoterpenes, for communication, disease-resistance, and attracting pollinators [10–15]. BVOCs emissions also increase under both biotic and abiotic stress [10]. In urban environments, high levels of CO_2, ozone, sulfur oxide, and other pollutants often elicit the emissions of BVOCs [11, 14]. The oxidation of BVOCs in the presence of nitrogen oxides (NOx) and sunlight produces ground-level ozone and forms secondary organic aerosols that contribute to particulate matter (PM) [16]. Ground-level ozone is a criteria pollutant, and many metropolitan areas often exceed regulatory levels during summertime [17]. While cities aim to reduce pollution through vegetation, BVOC-emitting plants could potentially further increase ground ozone levels and PM, especially in high temperatures and stagnant air masses [11, 14].

Ozone and PM formation require elevated air temperature, often greater in cities than in surrounding vegetated areas because of the urban heat island (UHI) effect [18]. Health risks related to urban air quality and temperature have been reported in many cities [19–22]. Moreover, plant pollen and BVOC can further deteriorate air quality affecting respiratory health and increasing allergies [23, 24]. These negative interactions are likely to be further exacerbated by climate change. The environmental challenges pose a significant threat to public health, necessitating community-driven solutions and climate action.

Chicago is one of the most segregated cities in North America, where historically low-income communities face environmental and health disparities [25]. From 1970 to 2010, 84% of the city's natural hazard-related deaths were linked to extreme weather [26]. While NOx emissions declined steadily from 2005 to 2013 due to regulatory controls on anthropogenic sources, concentrations of reactive VOCs in Chicago more than doubled after 2009, possibly driven by biogenic sources and warmer conditions [17]. This shift underscores the need to evaluate how increasing urban vegetation could unintentionally impact the air quality and suggest some potential solutions, using Chicago as a case study.

This work builds on previous connections between urban vegetation, climate change, and air quality [5, 15, 27], while also recognizing the contributions of community-led initiatives, such as Chicago's Puerto Rican Agenda (PRA), in addressing environmental and social injustices. The PRA is a coalition of social service agencies, neighborhood organizations, professionals, and educators dedicated to improving the quality of life in Humboldt Park and Puerto Rico. By expanding green spaces, PRA aims to mitigate climate change impacts on their residents while strengthening Puerto Rican cultural heritage, fostering healthier, more resilient communities in the face of environmental and social challenges. Organizations like PRA are big promoters of urban vegetation but often lack agency on planting decisions. Therefore, this study examines how urban greening strategies must account for BVOC emissions and allergenic pollen (section 2), the role of community co-design (section 3), species selection impacts on air quality (sections 4 and 5), and sustainable, community-driven management (section 6).

2. Urban air quality and respiratory health

Chronic air pollution affects human respiratory system by increasing asthma and airway responsiveness, resulting in higher mortality risk [28]. In New York City, peaks in tree pollen have been strongly associated with increased sales of allergy medications [29]. While a higher concentration of trees can lower levels of $PM_{2.5}$, species with high allergenicity can increase levels of PM_{10} [30] and local asthma hospitalization rates, particularly in vulnerable populations [31]. Despite rising awareness of BVOC emissions and pollen by modeling work [32–35], many large tree planting strategies overlook these disservices [36].

BVOCs help plants cope with heat stress, exacerbated by the UHI effect [10], where built infrastructure absorbs and retains heat, reaching up to 60 °C [37]. Urban trees also emit BVOCs during drought. Ozone is then made according to the ratio of VOCs to NOx in the air [16]. Ozone synthesis in urban areas is often limited by the amount of VOCs (both biogenic or anthropogenic) [38]. High urbanized areas experiencing high temperatures are usually poorly vegetated, low income, and with high incidences of respiratory disease. In Chicago, vulnerability to UHI varies, with Hispanic/Latino communities facing the highest land surface temperatures (LST) [39]. Adding BVOC-emitting vegetation to elevated-temperature areas of cities can raise VOCs, further increasing ozone levels and health risks.

3. Participatory community co-design of greening projects

Developing urban greening strategies that minimize hazards while maximizing benefits is crucial. Community initiatives should address local environmental issues through equitable solutions. The PRA's climate committee tackles environmental and public health challenges using a community-driven approach, offering a new model for sustainable greening projects across housing, health, education, and economic development.

Green gentrification is a major concern of city residents [5, 40]. For instance, Puerto Ricans began settling in Chicago's West Town and Humboldt Park in the 1970s [41], but demographic changes over recent decades have led to concerns about displacement and urban development pressures. As neighborhoods like Humboldt Park evolve, it is important to assess how urban greening intersects with these changes. Whether planting certain tree species may contribute to asthma rates and whether urban greening projects could drive further gentrification are key concerns for PRA and the communities it serves. This work seeks to balance the environmental and public health benefits of urban greening with the need to protect long-standing residents from unintended social and environmental impacts. As such, greening initiative partnerships should seek intentional agreements and commitments between researchers, practitioners, and the community [42, 43], ensuring that projects are co-designed with community members to align with their priorities and mitigate potential risks

4. Evaluating greening and health risks in two contrasting Chicago Metro Area Communities

We contrasted Humboldt Park, served by PRA, with Evanston, IL, a municipality with different sociodemographic characteristics and urban forestry practices (table S1). Humboldt Park's tree species composition includes high BVOC emitters, such as London Planetree, Black Locust, and Quaking Aspen, comprising 9% of the tree composition, despite having a much lower overall tree count compared to Evanston (figure 1(a)). London Planetree can emit up to 67.0 $\mu g \cdot g^{-1} \cdot h^{-1}$ and Quaking Aspen up to 76.0 $\mu g \cdot g^{-1} \cdot h^{-1}$ (table S2 and figure 1(a)). Comparatively, Evanston's tree species, such as Norway maple, American elm, Honeylocust, and Little-leaved Linden, are primarily non- or low BVOC emitters (figure 1(b)), not contributing to ozone formation. Consequently, the greening of Humboldt Park can increase ground-level ozone formation. In ozone chemistry, two distinct regimes determine how much ozone is formed: VOC-limited and NOx-limited [38]. In VOC-limited areas like Chicago, where NOx levels are high, ozone formation is controlled by the amount of VOCs present [17]. This means that increased in BVOCs from trees can lead to higher ozone production and potentially degrade air quality [12].

Humboldt Park experiences a higher average LST (16.1 °C) than Evanston (15.1 °C), which can intensify BVOC emissions from plants (figure 2(a)) and subsequent PM and ozone levels (see supplementary materials). Consistently higher NO_2 levels in Humboldt Park (figure 2(b)) suggest ozone formation is VOC-limited, where additional BVOCs could promote ozone formation [38]. The potential of higher $PM_{2.5}$ and ozone concentrations in Humboldt Park highlights the careful selection of tree species to avoid air pollution (figures 2(c) and (d)). PM_{10} levels were higher in Humboldt Park than in Evanston, emphasizing species selection's importance in balancing cooling benefits with air quality impacts (figure 2(e)).

Large-leafed species and stress-resistant species such as American Sycamore and London Planetree are frequently selected for urban green spaces for cooling effect [12]. However, this choice may inadvertently contribute to higher BVOC emissions, which may degrade air quality in the presence of high NOx. It is important that species selection is made in consortium with community organizations, such as PRA.

VOC measurements are available in the Photochemical Assessment Monitoring Stations (PAMS) network, which monitors ozone precursors and is operated by state and local agencies [44]. However, only one Air Quality System was available around Chicago, limiting spatial coverage. Among the 34 measurements taken using Gas Chromatography within the PAMS network, isoprene was detected in approximately 70% of the samples. Given the complexity of VOC reactivity in ozone formation, field campaigns provide a valuable opportunity to capture spatially explicit data to refine these interactions at the local level.

5. Neighborhoods asthma rates and the potential allergenicity of trees by census tract areas

Tree pollen, combined with urban air pollution, plays a key role in triggering respiratory allergies, particularly in densely populated cities where air quality is already compromised [15]. Synergistic effects of pollen and pollutants like NOx and PM exacerbate conditions such as asthma and allergic rhinitis [28]. Humboldt Park has a higher adult asthma prevalence, particularly in the southern parts marked in yellow, compared to Evanston, where 50% of tracts are colored navy (figure 3). Additionally, using data from the CARE-S database by Magyar *et al* [45], the proportion of trees classified as high or very high allergenicity in Humboldt Park ranges from 0.043 to 0.250, higher than in Evanston, where values are limited to 0.009–0.013. It is important to note that tree data for Humboldt Park is likely incomplete (figure S1) despite using two data sources, impeding an accurate assessment of the presence of tree pollen production by census tract areas. However, residents in the southern part of Humboldt Park may be particularly vulnerable to highly allergenic species like London Planetree and White Mulberry, which have a high allergenicity rating of 4 (figure S2) and have

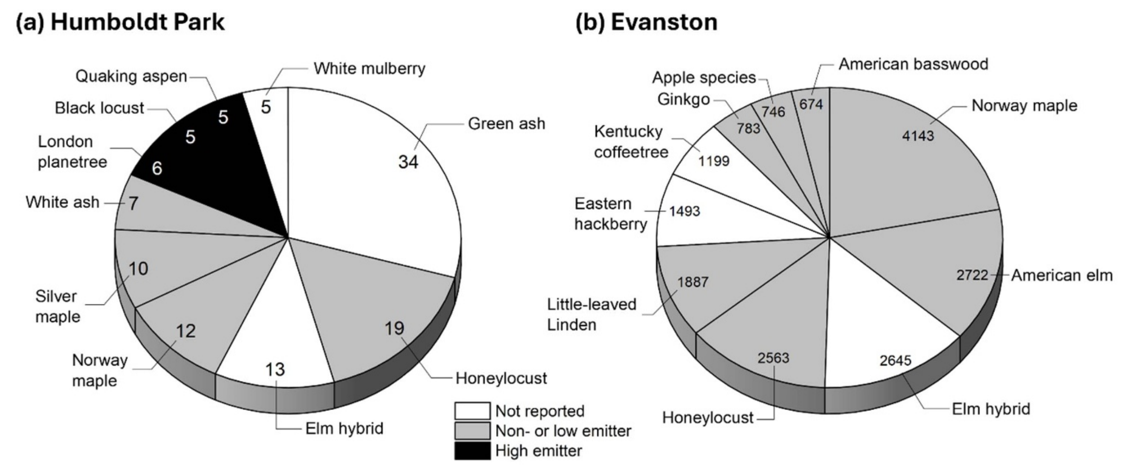

Figure 1. Tree species composition of the top 10 most abundant species in (a) Humboldt Park, Chicago, IL, and (b) Evanston, sourced from datasets provided by The Morton Arboretum and the iNaturalist platform. The pie charts display the number of trees of each species of the top 10 trees, with a total of 134 trees in Humboldt Park and 30 679 trees in Evanston. Tree species are categorized based on their isoprene and monoterpene emission levels on published paper (table S2): species with none or low emissions (<10 $\mu g \cdot g^{-1} \cdot h^{-1}$) are shown in grey; species with high emissions (>10 $\mu g \cdot g^{-1} \cdot h^{-1}$) are shown in black; and species with no reported emission data are indicated in white.

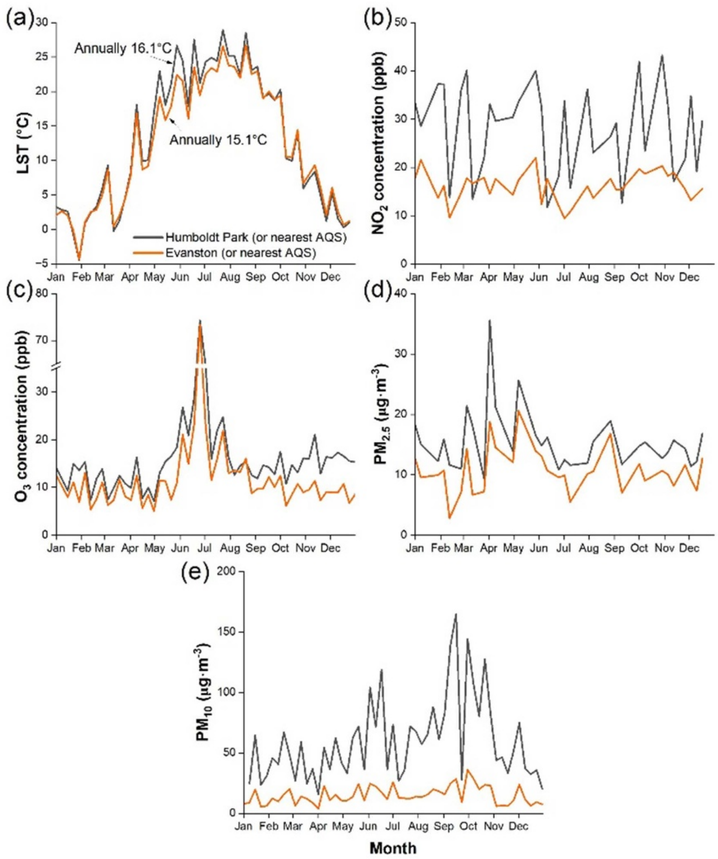

Figure 2. Comparison of land surface temperature (LST) (a), nitrogen dioxide (NO_2) (b), ozone (O_3) concentrations (c), particulate matter ($PM_{2.5}$ and PM_{10}) (d, e) between Humboldt Park, Chicago, IL and Evanston, IL. The data for LST, NO_2, O_3, and $PM_{2.5}$ are from 2023, while PM_{10} data is from 2024 due to unavailability in 2023. LST was obtained from the GOES satellite constellations that can provide hourly LST across the North American region with a 2 km spatial resolution. NO_2, O_3, $PM_{2.5}$, and PM_{10} were retrieved from the U.S. Environmental Protection Agency (EPA)'s Air Quality System.

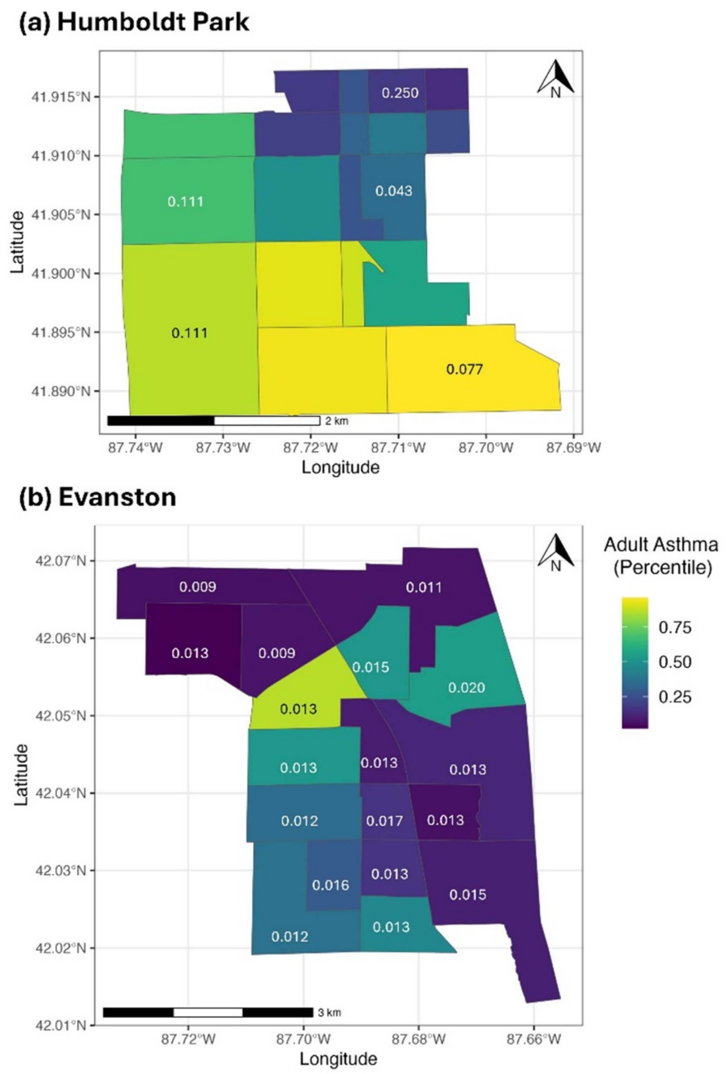

Figure 3. Percentile of asthma rates among adults aged 18 and older in Humboldt Park, Chicago, IL (a) and Evanston, IL (b). The numbers inside each tract represent the average proportion of trees classified as high or very high allergenicity (ranked 3 or 4), based on data from the CARE-S database (Magyar et al., 2022). The CARE-S database categorizes potential allergenicity into five levels (0–4) based on immunogenicity, morphological factors, and pollen production: 0 = non-allergenic, 1 = low allergenicity, 2 = moderate allergenicity, 3 = high allergenicity, and 4 = very high allergenicity. The allergenicity levels of the top 10 most abundant species in Humboldt Park and Evanston are shown in figure S2. Allergenicity data were excluded for tracts with fewer than five trees.

been included in the planting list for the greening of the area by city authorities.

6. Implications for sustainable urban greening and community participation

With the Bureau of Forestry's budget increase from $19,001,447 in 2020 to $21,660,736 in 2022 [46], strategic allocation is essential, including partnerships with community groups like PRA. Chicago residents can request tree planting in their neighborhoods with a simple phone call, after which the city plants trees along public right-of-ways. Many chosen species are high BVOC and pollen emitters (table S2 and figure S2), posing challenges for community buy-in and long-term tree stewardship.

PRA secures funding to address heat, air quality, and flooding through community-driven tree advocacy. However, limited authority over species selection highlights the need for a scientifically informed, collaborative approach, integrating planners, scientists, and residents in data-driven urban greening initiatives. Without such collaboration, active environmental organizations are forced to seek their funding to expand public education and to empower the community to influence tree species selection and program design.

Scientific methodologies should be central to urban forestry planning. Model simulations incorporating various tree species' physiological traits, emissions profiles, and air quality impacts can provide data-driven insights to guide species selection. Additionally, systematic tree census programs and long-term environmental and air quality monitoring are essential to evaluate urban greening strategies' effectiveness. Prioritizing these efforts in under-resourced communities can ensure both environmental and public health objectives, tailoring actions to the unique needs of each community.

Reducing BVOC and PM emissions, along with mitigating pollen allergies, requires strategies tailored to local conditions. Management should consider regional climate, urban infrastructure, existing tree species composition and their aesthetic, psychosocial, and ecosystem roles. It must also account for emission potential and population health risks, such as respiratory diseases. However, accurately measuring BVOCs remains challenging due to their high reactivity and limited spatial coverage in existing monitoring networks, making it difficult to assess their role in ozone formation. Additional strategies include enhancing biodiversity, managing invasive species, and selecting female dioecious and low-allergenicity trees to minimize pollen loads. Local authorities should support these efforts to ensure thoughtful greenspace design that balances ecological benefits with public health and prevents displacement.

Data availability statement

All data that support the findings of this study are included within the article (and any supplementary files).

Acknowledgments

This work was supported by the U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research, through the Urban Integrated Field Laboratories CROCUS (Collaborative Research on Complex Urban Systems) project under Award Numbers DE-SC0023226 and DE-SC0023253. We appreciate Lindsay Darling from The Morton Arboretum for sharing tree census data used in our analysis of tree composition. We also acknowledge Bilal Kaludi and Gunashree Channakeshava for their contributions to understanding the biogenic volatile emissions model. We are grateful to Samira Umar for her helpful feedback on the participatory community co-design approach.

ORCID iDs

Ahram Cho https://orcid.org/0000-0002-4434-6308
Natalie Love https://orcid.org/0000-0002-5013-5478
Gabriela C Nunez-Mir https://orcid.org/0000-0003-2426-3393
Jangho Lee https://orcid.org/0000-0002-8942-1092
Max Berkelhammer https://orcid.org/0000-0002-8924-716X
Miquel A Gonzalez-Meler https://orcid.org/0000-0001-5388-7969

References

[1] Wolch J R, Byrne J and Newell J P 2014 Urban green space, public health, and environmental justice: the challenge of making cities 'just green enough' *Landsc. Urban Plan.* **125** 234–44
[2] Chiesura A 2004 The role of urban parks for the sustainable city *Landsc. Urban Plan.* **68** 129–38
[3] Pataki D E, Alberti M, Cadenasso M L, Felson A J, McDonnell M J, Pincetl S, Pouyat R V, Setälä H and Whitlow T H 2021 The benefits and limits of urban tree planting for environmental and human health *Front. Ecol. Evol.* **9** 603757
[4] Conway T M and Yip V 2016 Assessing residents' reactions to urban forest disservices: a case study of a major storm event *Landsc. Urban Plan.* **153** 1–10
[5] Marshall K A and Gonzalez-Meler M A 2016 Can ecosystem services be part of the solution to environmental justice? *Ecosyst. Serv.* **22** 202–3
[6] Villa C, Ahmad N, Bratspies R, Lin R, Rechtschaffen C, Gauna E and O'Neill C 2020 *Environmental Justice: Law, Policy & Regulation* (Carolina Academic Press)
[7] Rauh V A, Landrigan P J and Claudio L 2008 Housing and health: intersection of poverty and environmental exposures *Ann. New York Acad. Sci.* **1136** 276–88
[8] Cho A, Dziedzic N, Davis A, Hanson C, Lee J, Nunez-Mir G C and Gonzalez-Meler M A 2024 Leaf functional traits highlight phenotypic variation of two tree species in the urban environment *Front. Plant Sci.* **15** 1450723
[9] Rahman M A, Stratopoulos L M F, Moser-Reischl A, Zölch T, Häberle K-H, Rötzer T, Pretzsch H and Pauleit S 2020 Traits of trees for cooling urban heat islands: a meta-analysis *Build. Environ.* **170** 106606
[10] Brunetti C, Moura B B and Velikova V 2023 Editorial: Biogenic volatiles in natural and urban forest *Front. Plant Sci.* **14** 1233612
[11] Wei D, Cao C, Karambelas A, Mak J, Reinmann A and Commane R 2024 High-resolution modeling of summertime biogenic isoprene emissions in New York City *Environ. Sci. Technol.* **58** 13783–94
[12] Yuan Y, Sun Z, Kännaste A, Guo M, Zhou G and Niinemets Ü 2020 Isoprenoid and aromatic compound emissions in relation to leaf structure, plant growth form and species ecology in 45 East-Asian urban subtropical woody species *Urban For. Urban Green.* **53** 126705
[13] He C, Murray F and Lyons T 2000 Monoterpene and isoprene emissions from 15 Eucalyptus species in Australia *Atmos. Environ.* **34** 645–55
[14] Karlik J F and Pittenger D R 2012 Urban trees and ozone formation: a consideration for large-scale plantings *Agric. Nat. Resour.* **8484** 1–9
[15] Eisenman T S, Churkina G, Jariwala S P, Kumar P, Lovasi G S, Pataki D E, Weinberger K R and Whitlow T H 2019 Urban trees, air quality, and asthma: an interdisciplinary review *Landsc. Urban Plan.* **187** 47–59
[16] Heald C L and Kroll J 2020 The fuel of atmospheric chemistry: toward a complete description of reactive organic carbon *Sci. Adv.* **6** eaay8967
[17] Jing P, Lu Z, Xing J, Streets D G, Tan Q, O'Brien T and Kamberos J 2014 Response of the summertime ground-level ozone trend in the Chicago area to emission controls

and temperature changes, 2005–2013 *Atmos. Environ.* **99** 630–40
[18] Yao R, Wang L, Huang X, Gong W and Xia X 2019 Greening in rural areas increases the surface urban heat island intensity *Geophys. Res. Lett.* **46** 2204–12
[19] Mar T F and Koenig J Q 2009 Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington *Ann. Allergy Asthma Immunol.* **103** 474–9
[20] Ostro B, Lipsett M, Mann J, Braxton-Owens H and White M 2001 Air pollution and exacerbation of asthma in African-American children in Los Angeles *Epidemiology* **12** 200–8
[21] Paoletti E, De Marco A, Beddows D C S, Harrison R M and Manning W J 2014 Ozone levels in European and USA cities are increasing more than at rural sites, while peak values are decreasing *Environ. Pollut.* **192** 295–9
[22] Sbihi H, Tamburic L, Koehoorn M and Brauer M 2015 Greenness and incident childhood asthma: a 10-year follow-up in a population-based birth cohort *Am. J. Respir. Crit. Care Med.* **192** 1131–3
[23] Berger M, Bastl M, Bouchal J, Dirr L and Berger U 2021 The influence of air pollution on pollen allergy sufferers *Allergol. Sel.* **5** 345
[24] Capone P, Lancia A and D'Ovidio M C 2023 Interaction between air pollutants and pollen grains: effects on public and occupational health *Atmosphere* **14** 1544
[25] Sampson R J 2012 *Great American City: Chicago and the Enduring Neighborhood Effect* (University of Chicago press)
[26] Houghton A and Castillo-Salgado C 2020 Analysis of correlations between neighborhood-level vulnerability to climate change and protective green building design strategies: a spatial and ecological analysis *Build. Environ.* **168** 106523
[27] D'Amato G and D'Amato M 2023 Climate change, air pollution, pollen allergy and extreme atmospheric events *Curr. Opin. Pediatr.* **35** 356–61
[28] D'Amato G 2011 Effects of climatic changes and urban air pollution on the rising trends of respiratory allergy and asthma *Multidiscip. Respir. Med.* **28** 28–37
[29] Sheffield P E, Weinberger K R, Ito K, Matte T D, Mathes R W, Robinson G S and Kinney P L 2011 The association of tree pollen concentration peaks and allergy medication sales in New York City: 2003–2008 *Int. Sch. Res. Notices* **2011** 537194
[30] Sousa S, Martins F, Pereira M, Alvim-Ferraz M, Ribeiro H, Oliveira M and Abreu I 2008 Influence of atmospheric ozone, PM_{10} and meteorological factors on the concentration of airborne pollen and fungal spores *Atmos. Environ.* **42** 7452–64
[31] Lai Y and Kontokosta C E 2019 The impact of urban street tree species on air quality and respiratory illness: a spatial analysis of large-scale, high-resolution urban data *Health Pl* **56** 80–87
[32] Calfapietra C, Fares S, Manes F, Morani A, Sgrigna G and Loreto F 2013 Role of Biogenic Volatile Organic Compounds (BVOC) emitted by urban trees on ozone concentration in cities: a review *Environ. Pollut.* **183** 71–80
[33] Steinbrecher R, Smiatek G, Köble R, Seufert G, Theloke J, Hauff K, Ciccioli P, Vautard R and Curci G 2009 Intra-and inter-annual variability of VOC emissions from natural and semi-natural vegetation in Europe and neighbouring countries *Atmos. Environ.* **43** 1380–91
[34] Shah A M, Liu G, Huo Z, Yang Q, Zhang W, Meng F, Yao L and Ulgiati S 2022 Assessing environmental services and disservices of urban street trees. an application of the emergy accounting *Resour. Conserv. Recycl.* **186** 106563
[35] Baghi R, Helmig D, Guenther A, Duhl T and Daly R 2012 Contribution of flowering trees to urban atmospheric biogenic volatile organic compound emissions *Biogeosci* **9** 3777–85
[36] Diener A and Mudu P 2021 How can vegetation protect us from air pollution? A critical review on green spaces' mitigation abilities for air-borne particles from a public health perspective-with implications for urban planning *Sci. Total Environ.* **796** 148605
[37] Zölch T, Maderspacher J, Wamsler C and Pauleit S 2016 Using green infrastructure for urban climate-proofing: an evaluation of heat mitigation measures at the micro-scale *Urban For. Urban Green.* **20** 305–16
[38] Zhao Y, Li Y, Kumar A, Ying Q, Vandenberghe F and Kleeman M J 2022 Separately resolving NOx and VOC contributions to ozone formation *Atmos. Environ.* **285** 119224
[39] Lee J, Berkelhammer M, Wilson M D, Love N and Cintron R 2024 Urban land surface temperature downscaling in chicago: addressing ethnic inequality and gentrification *Remote Sens.* **16** 1639
[40] Sax D L, Nesbitt L and Quinton J 2022 Improvement, not displacement: a framework for urban green gentrification research and practice *Environ. Sci. Policy* **137** 373–83
[41] Flores C 2001 Capturing the images of Chicago's Puerto Rican Community *Cent. J.* **13** 134–65
[42] Pearson A L, Pfeiffer K A, Gardiner J, Horton T, Buxton R T, Hunter R F, Breeze V and McDade T 2020 Study of active neighborhoods in Detroit (StAND): study protocol for a natural experiment evaluating the health benefits of ecological restoration of parks *BMC Public Health* **20** 1–14
[43] Yan J, Huang X, Wang S, He Y, Li X, Hohl A, Li X, Aly M and Lin B 2023 Toward a comprehensive understanding of eye-level urban greenness: a systematic review *Int. J. Digit. Earth* **16** 4769–89
[44] EPA 2024 Photochemical Assessment Monitoring Stations (PAMS) (available at: www.epa.gov/amtic/photochemical-assessment-monitoring-stations-pams) (Accessed 28 Feburary 2025)
[45] Magyar D, Páldy A, Szigeti T and Orlóci L 2022 A regulation-oriented approach for allergenicity categorization of plants *Urban For. Urban Green.* **70** 127530
[46] City of Chicago BoF 2023 Chicago urban forest management plan (available at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/www.chicago.gov/content/dam/city/depts/streets/general/Chicago%20UF%20Management%20Plan_FINAL_January%202023.pdf) (Accessed 21 August 2024)