Q&A: How 30,000 Detroit trees bloomed into a better way for researchers to predict airborne pollen

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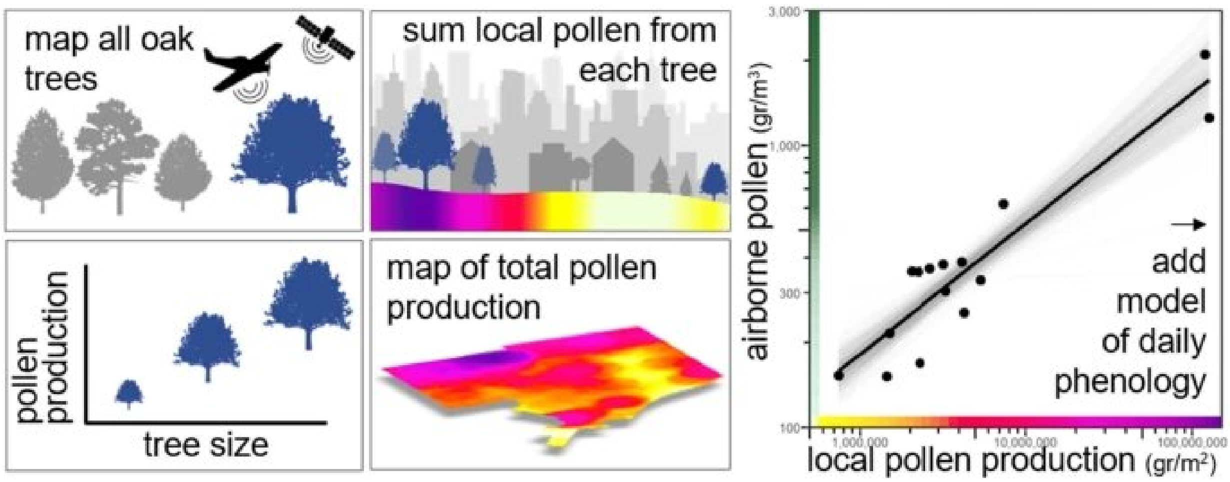

Credit: *Aerobiologia* (2023). DOI: 10.1007/s10453-023-09784-9

Working with aerial and satellite imagery and more than 30,000 trees in Detroit, researchers from the University of Michigan set out in 2017 to find a better way to measure pollen.

By the time they wrapped up their research two years later, the researchers believed they had tested and proved a more precise and meaningful way to know when and where pollen will most likely affect allergy sufferers.

Their research, most recently published in *Aerobiologia*, explains how measuring pollen levels in a city, neighborhood, or from an individual tree—rather than over a large geographic area—means better prediction of allergenic pollen. This in turn can provide the public with information that may help residents avoid asthma attacks, lost days from work and school, and the cost of drugs and treatment.

In Detroit in 2019, there were four times as many hospitalizations for asthma than the state of Michigan as a whole, and Detroit ranks among the 20 most challenging cities for people with asthma to live.

Daniel Katz led the research project as part of his postdoctoral research at U-M's School of Public Health. He worked with co-authors Stuart Batterman, a professor of environmental health sciences in the School of Public Health, and Alan Baptist, an internal medicine physician specializing in allergies and immunology and an associate professor in U-M's School of Medicine and School of Public Health.

Katz, now an assistant professor at Cornell University, sees the trio's research as having significant public health relevance, including preventing allergic reactions and asthma attacks that lead to emergency room visits.

Could you describe how pollen levels are currently measured and the difference in how your research in Detroit measured pollen output?

Most pollen measurements in the United States are taken by the National Allergy Bureau monitoring network. The data collected by these stations is invaluable, but with only 80 across the U.S., many cities and regions don't have local measurements. Even cities that are lucky enough to have a station must assume that concentrations recorded on a single rooftop are the same across the entire city or region.

This is problematic because pollen concentrations vary by orders of magnitude from one neighborhood to the next. Pollen measurements are also taken over a 24-hour period, so even the latest reports come from yesterday's air. While there are a variety of companies that create proprietary pollen forecasts, what data we have suggests their accuracy is quite low.

What we did differently was to quantify the underlying biological processes instead of only relying upon empirical measurements of airborne pollen. To do so, we identified trees in Detroit with aerial and satellite imagery, calculated how much pollen individual trees produced, and developed data-based estimates of the timing of pollen release. Our estimates of pollen release did a very good job of predicting the airborne pollen concentrations that we measured throughout Detroit.

How did you capture pollen output?

In this study, we estimated pollen production for about 30,000 oak trees in Detroit. To do so, we calculated the canopy area of each of those trees and then estimated pollen production; we had previously developed equations that quantified the strong relationships between tree size and pollen production. We created those equations by quantifying the number of flowers on trees, the number of anthers per flower and the number of pollen grains per anther.

How is your pollen modeling different and why is it significant?

What's new about our pollen model is that it's based on measurements from individual trees. Instead of having to assume that pollen concentrations measured on one rooftop are the same across all of Detroit, we can actually say how many trees are in a neighborhood, how big they are and how much pollen they're producing. This allows us to create predictions of pollen at a very fine spatial scale. Forecasts that capture that spatial variability will be much more accurate, giving people information about where and when they may encounter allergen hotspots. These improved forecasts would help people with pollen allergies reduce their exposures and better manage their medications.

Knowing how much airborne pollen is from nearby trees would also help us to understand how much it matters whether we plant low-allergen trees around our homes and neighborhoods. Afterall, even though some types of trees do release allergenic pollen, they also provide many benefits, such as shading, stormwater retention and removing air pollutants; all of these should be considered in our tree planting decisions.

How do you foresee this research being put to good use?

Millions of Americans are allergic to pollen. Imagine having a personally tailored alert system on your phone that could give you good suggestions about how to avoid pollen hotspots, reduce your exposure and when to take allergy medications so that they reach full efficacy before your symptoms start. Having an alert system based on granular spatiotemporal forecasts could improve quality of life for the millions of Americans with pollen allergies, but it would be especially beneficial for those with asthma or chronic obstructive pulmonary disorder. The more information we have about pollen, the more we can reduce exposures and the subsequent allergic reactions, allergy symptoms, asthma attacks and even hospital visits.

Is it feasible, practical to change the way pollen forecasts are made and reported?

This study demonstrates that we can create accurate biologically based models of airborne pollen concentrations at the neighborhood level. I'm now applying these same approaches to larger spatial scales and with more types of plants; eventually these pollen forecasts will be operationalized and provided to the general public.

Why did you choose Detroit for the research?

Asthma rates are very high in Detroit and allergenic pollen can trigger asthma attacks. We wanted to understand the role of pollen exposure and whether it could help explain some of the differences among neighborhoods. Detroit is also a great city to spend time in!

Is understanding pollen more important given the impacts of climate change?

Increases in carbon dioxide and temperature are linked to more pollen production, pollen that is more allergenic and a longer pollen season. This means that climate change is going to make pollen allergies worse. It also gives us even more incentive to find solutions to allergenic pollen.

More information: Daniel S. W. Katz et al, Modeling airborne pollen concentrations at an urban scale with pollen release from individual trees, *Aerobiologia* (2023). DOI: 10.1007/s10453-023-09784-9

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