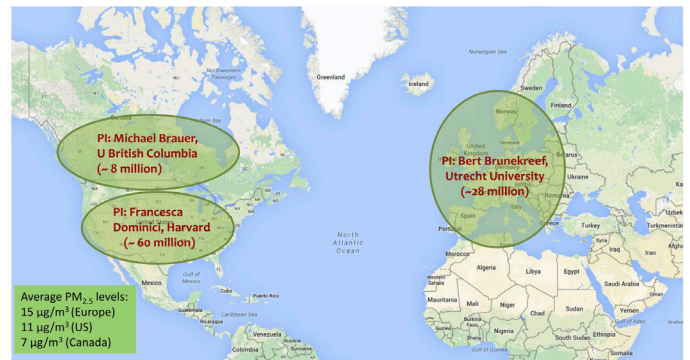# HEI update

HEALTH EFFECTS INSTITUTE

Major HEI Study Reports Health Effects at Low Levels of Air Pollution in the United States

HEI recently published a comprehensive study examining potential health risks from low levels of air pollution exposure in 68.5 million older Americans. The investigators found increased risks of mortality at low levels of exposure to fine particulate matter ($PM_{2.5}$), even at levels below the current U.S. National Ambient Air Quality Standards (NAAQS).

The results were released in time for an accelerated U.S. Environmental Protection Agency (EPA) review of the current NAAQS for particulate matter. Proposals for tightening of the standards are expected later this year.

In the four-year study, presented in Research Report 211, *Assessing Adverse Health Effects of Long-Term Exposure to Low Levels of Ambient Pollution: Implementation of Causal Inference Methods*, Francesca Dominici of the Harvard T.H. Chan School of Public Health and colleagues developed annual exposure models for $PM_{2.5}$, ozone (O_3), and nitrogen

PI: Michael Brauer, U British Columbia (~ 8 million)

PI: Francesca Dominici, Harvard (~ 60 million)

PI: Bert Brunekreef, Utrecht University (~28 million)

Average $PM_{2.5}$ levels:
15 µg/m³ (Europe)
11 µg/m³ (US)
7 µg/m³ (Canada)

Geographical areas and populations covered by HEI's Research Program to assess adverse effects of long-term exposure to low levels of ambient air pollution.

Urban and Regional Planning Expert Catherine Ross Joins HEI Board

At its most recent meeting, the HEI Board of Directors was pleased to welcome as its newest member Catherine Ross of the Georgia Institute of Technology, where she is Regents' Professor of City and Regional Planning and Civil and Environmental Engineering and director of the Center for Quality Growth and Regional Development.

Members of the HEI Board are drawn from distinguished leaders in science and policy whose principal responsibilities are to ensure the integrity and scientific quality of HEI's research and review.

Catherine Ross

Ross is one of the world's experts on megaregions and sustainability—the analysis of the synergistic opportunities for cities and regions that become possible when policies on transportation, energy, land development, health, and water are linked to create places that can compete in a global world. She is the author of several leading reference

Sign Up Now for HEI's Annual Conference 2022!

Join us on June 26–28 for the Health Effects Institute Annual Conference in Washington, D.C. Scientists, institute sponsors, and policymakers will again have the opportunity to meet in person at the Westin Washington, D.C. City Center Hotel to learn about the latest, most timely research findings on air pollution and health. For those who cannot attend, the conference will also be available for remote viewing via Zoom.

Sessions include the following:

- Setting Ambient Air Quality Standards: What's Science Got to Do with It?
- Getting from A to B: Emerging Trends in Mobility
- Acute Air Pollution and the Immune System
- Improving Global Public Health Through Actions on Energy, Air Quality, and Climate
- The "Climate Penalty": How Heat and Carbon Dioxide Influence Ozone Exposures and Health

Poster presenters will include winners of the 2022 Jane Warren Trainee Conference Awards (see page 4).

For complete program and registration information, see our Annual Conference web page.

Also in This Issue...

Research Committee Welcomes Expert in Exposure Assessment

The HEI Board of Directors has appointed Ana María Rule of Johns Hopkins Bloomberg School of Public Health to the HEI Research Committee. This important committee is responsible for defining, implementing, and overseeing HEI's research program, which provides high-quality, impartial, and relevant science on the health effects of air pollution. The committee is composed of leading independent scientists who typically serve two four-year terms.

Ana María Rule

Rule earned her master's degree in occupational health and her Ph.D. in environmental health sciences at Johns Hopkins. She is an expert in exposure assessment of airborne environmental and occupational hazards, including in agricultural, urban, and hospital environments. She has led projects to evaluate exposures to biological aerosols and electronic cigarettes, as well as other types of indoor and outdoor air pollution.

Rule's main research goal is the development and evaluation of novel sampling and analysis strategies for the assessment of exposure to air pollutants. She is currently director of the Environmental Exposure Assessment Lab, where she develops and applies methods for the assessment of exposures to adult and pediatric populations. She has experience working in multidisciplinary projects that involve collaboration with researchers from other disciplines, and she is passionate about addressing the root causes of environmental injustice. [HEI]

Rosenblith New Investigator for 2021 Announced

HEI extends congratulations to Lucas Henneman, the 2021 recipient of the Institute's Walter A. Rosenblith New Investigator Award. Henneman is an assistant professor in the Department of Civil, Environmental, and Infrastructure Engineering at George Mason University in Fairfax, Virginia. He was selected by HEI's Research Committee from a highly qualified pool of candidates.

Henneman received this award for his proposal "Air pollution source impacts at fine scales for long-term regulatory accountability and environmental justice." His three-year study seeks to estimate the impacts of different sources on daily patterns and concentrations of ambient fine particulate matter followed over a decade, at a fine spatial resolution, for the continental United States. This study aims to identify differing toxicities of fine particulate matter originating from various sources. Additionally, Henneman plans to perform an environmental justice accountability analysis of source-related exposure reductions to determine how such reductions have been distributed across population groups. He plans to host the resulting datasets on a publicly accessible website.

Named for the first chair of the HEI Research Committee, the Rosenblith award supports the work of a promising early career scientist. In selecting award recipients, the Committee considers each applicant's potential for a productive research career in examining air pollution and its effects on health, the support provided by

books, including *Megaregions: Planning for Global Competitiveness* (2009) and *Health Impact Assessment in the United States* (2014).

Ross is a member of the National Academy of Public Administration and former president of the National Association of Collegiate Schools of Planning. Her expertise at the intersection of science and policy is widely sought, including in the establishment of the first White House Office of Urban Affairs. She earned a master's degree and a Ph.D. in city and regional planning from Cornell University. [HEI]
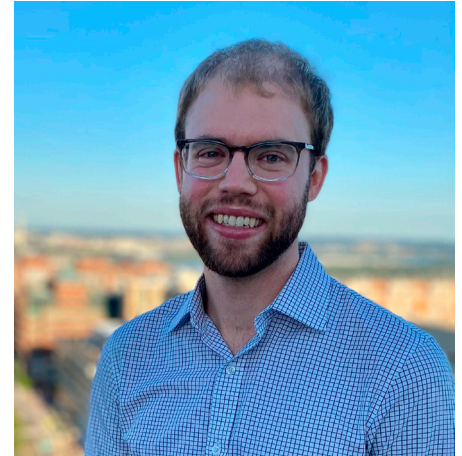
Lucas Henneman

the applicant's institution, and the scientific merit of the research project and its relevance to HEI's mission. Since inception of the program in 1999 HEI has supported 31 awardees, many of whom have continued to excel in their fields. [HEI]

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dioxide (NO$_2$) for the years 2000 to 2016 to estimate exposure for the 68.5 million study subjects, all of whom were Medicare recipients.

The research team compared three causal inference approaches (one newly developed) and two traditional regression approaches to estimate the risk of dying associated with long-term exposures to the three pollutants. Findings were consistent across all five analyses. The team reported a 6% to 8% increased risk of mortality per 10 micrograms per cubic meter (μg/m^3) increase in PM$_{2.5}$ exposure across the different analyses, effects that are similar in magnitude to those reported in several other recent, large cohort studies. Importantly, they observed stronger associations at exposure levels below the current annual national standard of 12 μg/m^3.

They also found evidence of a relationship between mortality and NO$_2$ exposures at higher concentrations, but at annual mean NO$_2$ concentrations below the NAAQS (53 ppb), associations were non-linear and statistically uncertain. Similarly, they found some evidence of increased risks of mortality with O$_3$ at exposures higher than 45 ppb, but the exposure–response function was almost flat at concentrations below that, showing no statistically significant effect.

"This study is the result of a multiyear effort by an incredibly talented team of graduate students and postdocs," Dominici said, adding, "Importantly, results of this study will be able to inform the EPA as to whether or not they should lower the National Ambient Air Quality Standards for PM$_{2.5}$ in the United States."

The report was subjected to comprehensive independent peer review by the HEI Low-Exposure Epidemiology Studies Review Panel, whose members had no role in conducting or overseeing the study. The panel concluded that this report presents a high-quality and thorough investigation into associations between risk of mortality and exposures to ambient air pollution in the United States, applying advanced statistical techniques to test rigorously whether the air pollution exposure actually caused direct impacts on health.

"Dominici and colleagues report analyses of the highest rigor that contribute important knowledge about health effects associated with long-term exposures to very low con-

HEI Study Aims to Better Understand Air Pollutant Concentrations Near Roads

Exposure to traffic-related air pollution, especially at the higher levels occurring in cities, has been associated with adverse health effects such as childhood asthma, impaired lung function, and cardiovascular disease. However, assessing levels of air pollution where people spend their time is challenging, because traffic-related air pollution is a complex mixture of many particulate and gaseous pollutants and varies depending on the location, weather, and time.

A new HEI study led by Christopher Frey of North Carolina State University examines models of traffic-related air pollution to better understand traffic activity and air flow at small spatial scales within cities and seeks to improve their use in exposure assessment for epidemiological studies.

For the study, presented in Research Report 207, *Characterizing Determinants of Near-Road Ambient Air Quality for an Urban Intersection and a Freeway Site,* Frey and his team measured six air pollutants (nitrogen oxides, ultrafine particles, black carbon, fine particles, nitrogen dioxide, and ozone) near a freeway and in an urban area. They collected detailed data on real-world motor vehicle traffic intensity, vehicle behavior (e.g., acceleration, breaking, and turning), and the resultant emissions.

The investigators used two methods to collect air quality data within several hundred meters of roadways: monitors placed near an intersection and portable monitors that were moved along sidewalks (see aerial view). They then developed statistical models of the air pollutant concentrations that integrated various data sources, including other factors, such as locale-specific traffic and meteorology.

In its independent evaluation, the HEI Research Committee said the study contributes a rich set of results on six air
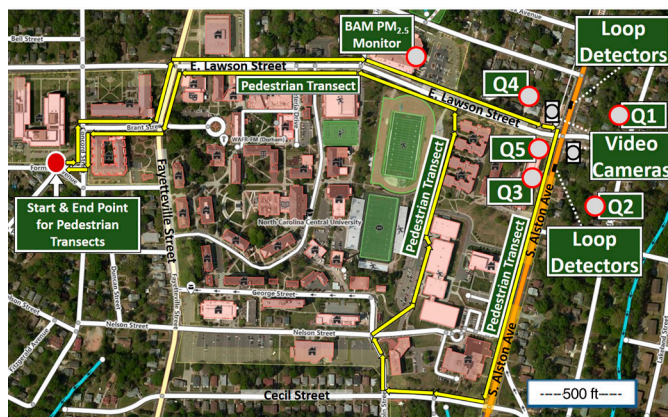
Urban sampling sites located in Durham, North Carolina. Q1–Q5 denote air quality monitors in five near-road locations.
(From Research Report 207; map and aerial image attributed to OpenStreetMap contributors under Open Database License with cartography licensed as CC BY-SA; https://www.openstreetmap.org/copyright.)

pollutants and shows that more detailed measurements can help with development of enhanced near-road air quality models in certain situations. HEI

Research Report 207 will soon be available for downloading at www.healtheffects.org/publications. *For more information contact* Allison Patton.

centrations of ambient air pollution," said HEI President Dan Greenbaum.

The report is the second in a set of three studies funded by HEI to explore health effects from air pollution exposure at levels below government-recommended standards. The other two studies were conducted in Europe, released in September 2021, and in Canada, with initial results published in 2019 and final results expected this year. All three studies were

funded through HEI's program to investigate the health effects of long-term exposures to low levels of air pollution in very large populations. HEI

HEI Research Report 211 is available for downloading at www.healtheffects.org/publications. *For more information, contact* Dan Crouse.

Communicating the Science ———

HEI Holds Four-Part Workshop on Satellite-Derived Air Quality Data

More than ever, scientists rely on remote-sensing tools carried by satellites to help evaluate and understand air pollution and its effects on human health.

As the practice of deriving air quality datasets from satellite remote sensing has become more widespread, the range of their applications to epidemiology and assessing disease burden associated with air pollution has grown. Additionally, new satellite instruments are being launched to monitor air quality at higher spatial and temporal resolution, and for wider ranges of pollutants, than have been previously available.

To help scientists make best use of this increasingly sophisticated technology, this spring HEI presented the four-part Virtual Workshop on Health Applications for Satellite-Derived Air Quality: Opportunities and Potential Pitfalls. The workshop, a webinar series open to the general public, identified opportunities for applying new and expected satellite remote sensing data to health research, as well as potential pitfalls to avoid in those applications.
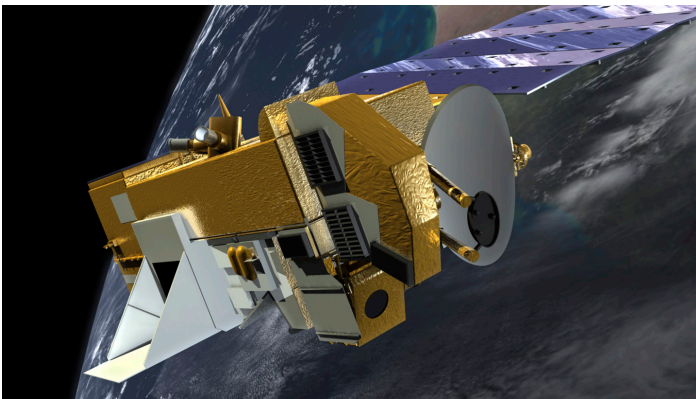
NASA's Aura satellite is equipped with instruments that monitor pollutant concentrations in cities and regions.

Satellite Workshop Sessions:

April 20: Setting the Stage for Trusted, High-Quality Satellite Remote Sensing Data of Air Quality in Health Applications

April 29: Global Applications of Satellite-Derived Air Quality Data

May 5: Pushing the Methodological Limits on Satellite Use in Health Applications

May 18: Roundtable Discussion on the Future of Satellite Remote Sensing of Air Quality in Health Applications

Jeff Brook and Heather Holmes of the HEI Research Committee chaired the series. HEI

Session recordings will be posted here as they become available. For more information, contact Allison Patton.

Jane Warren Trainee Conference Award Recipients Announced

HEI is excited to showcase the work of the 2022 Jane Warren Trainee Conference Award winners at the Annual Conference, which will take place June 26–28 in Washington, D.C.

Each year, HEI invites abstract submissions from graduate students and postdocs, and sponsors travel for several award winners to attend the conference. This year's competition had two tracks—one for applicants from institutions in the greater District of Columbia (U.S.) area and one for applicants from any institution in North America or Europe.

The award is presented in remembrance of Jane Warren, who joined HEI in the 1980s and served as the director of science from 1999 until her retirement in 2008.

PHOTO BY JAY MALLIN

The conference brings together stakeholders and scientists to discuss the latest research on air pollution and health.

Congratulations to the following winners of the Jane Warren Trainee Conference Award 2022:

LOCAL AWARDEES

Joyce J.Y. Lin, Johns Hopkins University: Characterizing spatiotemporal variability in airborne heavy metal concentration: Changes after 18 years in Baltimore, MD | Abstract

Joshua Rivera, American University: Distributed in-situ measurements of $PM_{2.5}$ in the Buzzard Point, Washington, D.C. neighborhood | Abstract

GENERAL AWARDEES

Garima Raheja, Columbia University: $PM_{2.5}$ sensor intercomparisons and regional trend assessments from low-cost sensor networks in Accra, Ghana, and Lomé, Togo | Abstract

Ajit Singh, University of Birmingham: Health and economic benefits attributed to changes in air quality and traffic emissions induced by COVID-19 emergency measures in Oxford City, UK | Abstract

Yifan Wang, Emory University: Disparities in ambient nitrogen dioxide pollution in the United States | Abstract

Wenlu Ye, University of California, Berkeley: Effects of a liquefied petroleum gas stove intervention on gestational blood pressure: Intention-to-treat and exposure-response findings from the Household Air Pollution Intervention Network (HAPIN) trial | Abstract HEI

The Jane Warren awardees will be presenting posters on Sunday, June 26. For more information, contact Martha Ondras.

A Year of Impact for HEI's Global Health Program

Two Major Analyses Released in March; State of Global Air and Southeast Europe Reports Underway

HEI's Global Health program has been hard at work on a variety of projects and reports over the last few months.

A recent State of Global Air special analysis asked the question "How Does Your Air Measure Up Against the WHO Air Quality Guidelines?" following the release of the updated World Health Organization's (WHO) Air Quality Guidelines in September 2021. This analysis indicates that more than 50% of the world lives with air pollution that exceeds even the least stringent WHO air quality target for $PM_{2.5}$.
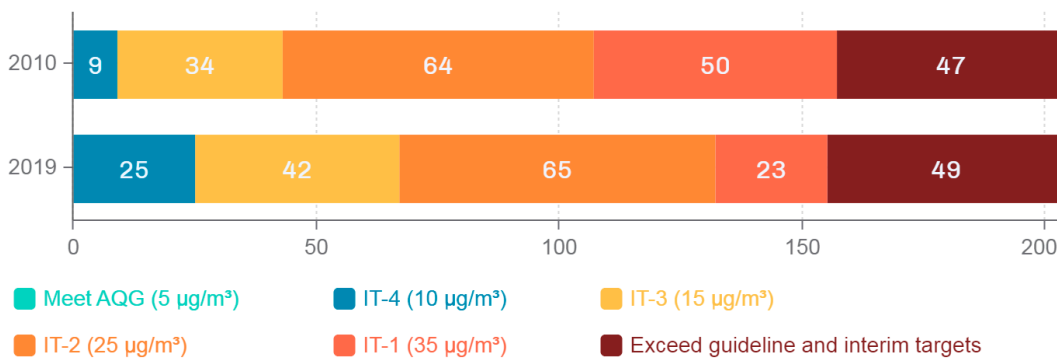
A second State of Global Air special analysis, in collaboration with the Institute for Health Metrics and Evaluation and Joshua Apte of the University of California, Berkeley, focused on the impacts of air pollution on life expectancy in countries around the world. It found that air pollution can reduce global life expectancy by an average of 1.8 years, with the greatest losses reported in Oceania, South Asia, and sub-Saharan Africa.

The Global Health team is working on a new *State of Global Air Cities* report, targeted for release this summer, on air pollution and health-impact trends in cities around the world. (For the moment, due to the rapidly changing data on COVID-19–related health outcomes and the need for ongoing dataset adjustments for the coronavirus, the release of HEI's flagship report, *State of Global Air 2022*, is planned for later in the year.)

Also in March, HEI released an interactive literature database featuring studies and reports on air quality and health in Southeast Europe. This launch follows the success of a webinar series that explored available data and the role of scientific evidence in informing regional and national air quality legislation in the region. The series attracted audiences from across Europe and beyond.

Number of countries in each WHO guideline category for annual ambient PM$_{2.5}$

Legend:
- Meet AQG (5 µg/m³)
- IT-4 (10 µg/m³)
- IT-3 (15 µg/m³)
- IT-2 (25 µg/m³)
- IT-1 (35 µg/m³)
- Exceed guideline and interim targets

New Southeast Europe Report

HEI recently released *Trends in Air Quality and Health in Southeast Europe* and will soon publish two country-specific reports for Bulgaria and Serbia. The reports draw on the latest data from the Global Burden of Disease (GBD) 2019 study and HEI Research Report 210 to outline the state of air quality and associated health impacts. The reports will summarize available evidence on health effects of air pollution and provide detailed data on major sources of $PM_{2.5}$ pollution across various countries in Southeast Europe. ⊞HEI
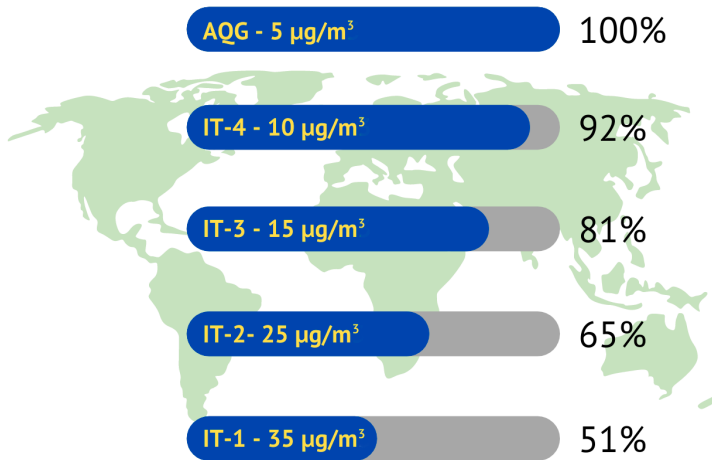
Percentage of the world's population living in areas where $PM_{2.5}$ levels exceed WHO recommendations. (AQG = air quality guideline; IT = interim target)

New HEI Annual Report: Trusted Science for a Changing World

In 2021 HEI made significant progress on ambitious goals from a stronger focus on the air quality–climate connection, to Global Health research, to a deeper understanding of accountability and the improvements in health outcomes that result from air quality actions. Read about our successes and progress last year in the latest HEI Annual Report. ⊞HEI