



**ANNUAL
REPORT
2022-23**

AIR QUALITY MOBILE LAB



**Northeastern University
Civil and Environmental Engineering**



With over 230 tenured/tenure-track faculty and 18 multidisciplinary research centers and institutes with funding by eight federal agencies, the College of Engineering is a leader in experiential education and interdisciplinary research focused on discovering solutions to global challenges to benefit society. Northeastern's global university system—with engineering programs on campuses across the U.S. and in multiple countries—provides flexible academic offerings, innovative partnerships, and the ability to scale ideas, talent, and solutions.

About Northeastern

Founded in 1898, Northeastern is a global research university and the recognized leader in experiential lifelong learning. Our approach of integrating real-world experience with education, research, and innovation empowers our students, faculty, alumni, and partners to create worldwide impact.

Northeastern's personalized, experiential undergraduate and graduate programs lead to degrees through the doctorate in 10 colleges and schools across our 13 campuses worldwide. Learning emphasizes the intersection of data, technology, and human literacies, uniquely preparing graduates for careers of the future and lives of fulfillment and accomplishment.

Our research enterprise, with an R1 Carnegie classification, is solutions oriented and spans the world. Our faculty scholars and students work in teams that cross not just disciplines, but also sectors—aligned around solving today's highly interconnected global challenges and focused on transformative impact for humankind.

**We are a leader in experiential education
and interdisciplinary use-inspired research,
focused on Engineering for Society**

DEAR COLLEAGUES, FRIENDS, AND STUDENTS,

Our 2023 fall semester begins with exciting opportunities and the launch of our new MS in Climate Science and Engineering. This degree, combined with our premier cooperative education program, provides training in the fundamental science of climate systems, as well as the engineering strategies and technologies required for decarbonization and adaptation to climate change.

This year, we are pleased to welcome five new professors to our ranks. We are joined by four new tenured/tenure-track faculty. Serena Alexander joins us as an associate professor, jointly appointed with her home department in the School of Public Policy and Urban Affairs. Khaled Ghannam and Shang Liu enter the department as assistant professors and the first faculty hired as part of our multi-year iSUPER impact engine, expanding our capacity in atmospheric, urban pollution, and air quality. Eleonora Tronci joins as an assistant professor. Her research focuses on artificial intelligence, cross domain transfer and data analytics applied to structural health monitoring and infrastructure design. We also welcomed Nancy Varney as associate teaching professor, who brings many years of experience as a practicing structural engineer at top industry firms.

This annual report details the academic and professional accomplishments of our faculty and students for the 2022-2023 academic year. Our scholars are engineering a resilient and sustainable future through cutting-edge research, education, and national and international leadership. We look forward to partnering with you as we address key societal goals.

Sincerely,

Jerome Hajjar, PhD, PE, NAE, F.ASCE, F.SEI
CDM Smith Professor and Department Chair
Civil and Environmental Engineering
jf.hajjar@northeastern.edu

For more details, visit our website at [CEE.NORTHEASTERN.EDU](https://cee.northeastern.edu).



Quick Facts **CIVIL AND ENVIRONMENTAL ENGINEERING**

38 **TENURED/
TENURE-TRACK**
Faculty

14 **Young
Investigator
Awards**

12 **Professional
Society
Fellows**

606 Students enrolled,
49% are women
(Fall 2022)

21 **Distinguished
Research and
Service Awards**

\$34M **External
Research
Awards**
(2021-2023)

Promotion

Andrew Myers
Professor



Amy Mueller
Associate Professor



Samuel Muñoz
Associate Professor



3 **Research Centers
and Institutes**

PROTECT
Superfund
Research Center
funded
by NIEHS

**Global Resilience
Institute**
Northeastern University
interdisciplinary
research institute

ECHO
Environmental
Influences on Child
Health Outcomes,
funded by NIH



Member of National Academy of Engineering

Jerome Hajjar
CDM Smith Professor
and Department Chair

Quick Facts **COLLEGE OF ENGINEERING**

With **238** tenured/tenure-track faculty and **18** multidisciplinary research centers and institutes with funding by eight federal agencies, the College is a leader in experiential education and interdisciplinary research focused on discovering solutions to global challenges to benefit society.

5 **Engineering
Departments**

142 **YOUNG
INVESTIGATOR
Awards**

Including **72** NSF CAREER Awards, and **26** DOD Young Investigator Awards

102 **Professional
Society
Fellowships**

3,333 **Total Co-op Hires**
(AY2023)

3,057 **Co-op Employer
Partners** (AY2021-2023)

TOTAL ENROLLMENT (Fall 2022)
10,046 62% Graduate
38% Undergraduate

**Graduate
Enrollment
Growth**

up **68%**
vs. 2017

Our Newest Faculty



Serena Alexander

Associate Professor

Jointly Appointed: Public Policy and Urban Affairs

PhD: Cleveland State University, 2016

Previously: Associate Professor, San Jose State University

Scholarship Focus: Climate change, sustainable and resilient transportation systems, environmental policy



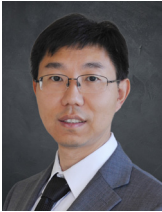
Khaled Ghannam

Assistant Professor

PhD: Duke University, 2017

Previously: Associate Research Scholar and Postdoc, Princeton University & NOAA

Scholarship Focus: Boundary-layer meteorology, land-atmosphere interactions, air quality modeling, hydroclimatology



Shang Liu

Assistant Professor

PhD: University of California, San Diego, 2012

Previously: Scientist, California Air Sciences Board, and Professor, University of Science and Technology China

Scholarship Focus: Field measurements of atmospheric aerosols and volatile organic compounds using advanced instrumentation



Eleonora Tronci

Assistant Professor

PhD: Columbia University, 2022; Sapienza University, 2019

Previously: Postdoc, Tufts University

Scholarship Focus: Applied machine learning for damage assessment in civil structures, multi-domain transfer learning, performance and structural assessment of offshore wind structures



Nancy Larson Varney

Associate Teaching Professor

PhD: The University of Texas, Austin, 2013

Previously: LeMessurier Consultants, and Simpson Gumpertz & Heger

Teaching Focus: Structural engineering, sustainable and resilient structures, architectural design

New Master's Program

MS in Climate Science and Engineering

Offered jointly by the Department of Civil and Environmental Engineering in the College of Engineering and the Department of Marine and Environmental Sciences in the College of Science, the MS in Climate Science and Engineering prepares students to tackle the inherently multidisciplinary challenges that climate change presents for both natural and engineered systems.

Faculty by Research Area

Civil Infrastructure Security

Serena Alexander
Dionisio P. Bernal
Luca Caracoglia
Qin Jim Chen
Stephen Flynn
Peter Furth
Auroop R. Ganguly
Fatemeh Ghoreishi
Jerome F. Hajjar
Michael Kane
Haris Koutsopoulos
Nancy Larson Varney
Jack Lesko
Yiannis Levendis
Sinan Müftü
Andrew Myers
Mark Patterson
Nathan Post
Mehrdad Sasani
Thomas Sheahan
Craig Shillaber
Michael B. Silevitch
Ali Touran
Eleonora Tronci
Sara Wadia-Fascetti
Ming L. Wang
Qi "Ryan" Wang
Mishac Yegian
Moira Zellner

Environmental Health

Akram Alshawabkeh
R. Edward Beighley
Qin Jim Chen
Peter "James" Dennedy-Frank
Matthew J. Eckelman
Loretta A. Fernandez
Auroop R. Ganguly
Khaled Ghannam
Tarik Gouhier
Jonathan Grabowski
Brian Helmuth
Julia Hopkins
Randall Hughes
Philip Larese-Casanova
Shang Liu
Yu Miao
Amy Mueller
Samuel Munoz
Annalisa Onnis-Hayden
Mark Patterson
Kelsey Pieper
Cristina Schultz
Thomas Sheahan
Aron Stubbins
Geoffrey C. Trussell
Julia Varshavsky
Yang Zhang

Sustainable Resource Engineering

Serena Alexander
Luca Caracoglia
Peter "James" Dennedy-Frank
Matthew J. Eckelman
David Fannon
Peter Furth
Auroop R. Ganguly
Khaled Ghannam
Tarik Gouhier
Jonathan Grabowski
Jerome F. Hajjar
Brian Helmuth
Julia Hopkins
Randall Hughes
Michael Kane
Haris Koutsopoulos
Michelle Laboy
Nancy Larson Varney
Yu Miao
Andrew Myers
Mark Patterson
Nathan Post
Cristina Schultz
Craig Shillaber
Jennie C. Stephens
Ali Touran
Eleonora Tronci
Geoffrey C. Trussell
Ming L. Wang
Qi "Ryan" Wang
Moira Zellner
Yang Zhang

Faculty Honors and Research

SELECTED HIGHLIGHTS

Leading Universitywide Research iSUPER Impact Engine



Yang Zhang, professor and distinguished fellow and associate chair for research, civil and environmental engineering, is leading Northeastern's multidisciplinary research Impact Engine, "Healthier Air and People: Intelligent Solutions to Urban Pollution for Equity and Resilience (iSUPER)." It will pair low-cost, adaptable sensing technologies with novel pollution prediction models to accurately identify hyperlocal pollution hot spots in real time. The research team will install more than 100 stationary pollution sensors in Brookline and Chelsea, Massachusetts, and also explore Greater Boston streets in a van outfitted with monitoring equipment to detect greater variety of pollutants on a sub-neighborhood level.

Northeastern University
Solutions to Urban Pollution
AIR QUALITY MOBILE LAB

Photo by Alyssa Stone

Lynn S. Beedle Lifetime Achievement Award from SSRC and Elected SEI President



Jerome F. Hajjar, CDM Smith Professor and Chair of Civil and Environmental Engineering, received the 2024 Lynn S. Beedle Award, a lifetime achievement award from the Structural Stability Research Council (SSRC). Award recipients must be long-time SSRC members and be recognized as follows: a worldwide, leading stability researcher or designer of structures with significant stability issues; a leader in fostering

cooperation between professionals worldwide; and a significant contributor to national and international design code development. Hajjar was also elected the FY2024 president of the Structural Engineering Institute; his term began October 2023.

Climate-Mediated Shifts in Temperature Fluctuations Promote Extinction Risk



Affiliated Faculty **Tarik Gouhier** and College of Engineering Distinguished Professor **Auroop Ganguly**, both of civil and environmental engineering, published research on "Climate-mediated Shifts in Temperature Fluctuations Promote Extinction Risk" in *Nature Climate Change*. The research shows that the effects of climate change may be more extensive than previously predicted, on the basis of the statistical relationship between biological performance and average temperature.

NSF CAREER Award to Improve Flood Hazard Assessments



Samuel Muñoz, associate professor, marine and environmental sciences and civil and environmental engineering, has been awarded a \$718,000 National Science Foundation CAREER grant to study floodplain sedimentation through observation and simulation to improve flood hazard assessments.

Flood hazard assessments are crucial tools for developers, municipalities, and insurers in deciding where to site new buildings or infrastructure near rivers. Used to determine the likelihood of flooding in a particular area, these assessments rely chiefly on historical data—measures of a river’s high and low points over the years, or the volume of water that has flowed through it. Muñoz points out a problem with this common approach, however.

“We tend to underestimate how much water can flow through a river,” he says, because relevant historical records in the United States only go back so far, in many cases only a few decades. Describing a mere fraction of the geologic time scales in which rivers exist, these records provide a very limited view of their behavior.

“It leads to some pretty poor decisions about where we build things in floodplains,” Muñoz explains. “The economic losses associated with flooding over the last 30 or 40 years keep increasing.”

To better understand the dynamics of rivers, including their potential for flooding, Muñoz has focused for much of his career on the field of paleoflood hydrology. By examining the shape and size of channels that rivers carve in a landscape, as well as nearby sedimentary deposits, scientists can piece together a record of how that river rose, fell, flooded, and changed its course in the distant past. While combining such observations with recorded historical measurements can yield a

fuller picture of a river’s history, it can still create inaccuracies when applied to flood frequency analysis, according to Muñoz, due to uncertainties inherent in prehistoric geological study.

Muñoz’s project, “Sedimentary Signatures of Large Riverine Floods to Constrain Risk and Build Resiliency,” aims to mitigate such uncertainty by combining systematic, long-term observations with hydraulic model simulations to create more accurate flood hazard assessments. Key to his research project is the creation of a floodplain observatory, a collection of data-gathering instrumentation including sediment traps, water level and temperature sensors, and accelerometers, situated on a stretch of the Merrimack River in Concord, New Hampshire. Muñoz chose the location in part due to its “oxbow” lakes, features characteristic of low-lying rivers that represent paths taken by the river in the past. Muñoz will collect sediment from these lakes, and from nearby surface areas and subsurface core samples, to establish when and how the floodplain was inundated in the past.

Data from the observatory will be used to calibrate and validate a computer model of flooding in the study area—a model that can then be used to generate simulations of flooding events under different circumstances. The insights developed through observations and simulations will help generate high-quality paleoflood estimates—the first for the Merrimack River, according to Muñoz.

The workflow and toolsets that will result from his project could transform our ability to reconstruct prehistoric floods on lowland river systems. “Going forward,” he says, “anyone could do this on an area of interest and vastly decrease the uncertainty in our flood hazard assessments.”

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DoE Award to Train Next-Generation of Grid-Interactive Efficient Building Operators



Michael Kane, assistant professor of civil and environmental engineering, received a \$750,000 award from the U.S. Department of Energy to develop a training program for vocational technology high schools and community colleges that improves entry-level building operators' literacy in grid-interactive efficient buildings. Kane is joined on the project by partners from the Northwest Energy Efficiency Council (NEEC), the Washington State University (WSU) Integrated Design+Construction Lab (ID+CL), and Boston Public Schools.



ASCE Thomas A. Lenox ExCEED Leadership Award

The American Society of Civil Engineers (ASCE) has awarded W. Samuel Easterling, James L. and Katherine S. Melsa Dean of Engineering at Iowa State University, and **Jerome F. Hajjar**, CDM Smith Professor and Chair in the Department of Civil and Environmental Engineering at Northeastern University, the 2023 Thomas A. Lenox Excellence in Civil Engineering Education (ExCEED) Leadership Award for extraordinary leadership in civil engineering education.

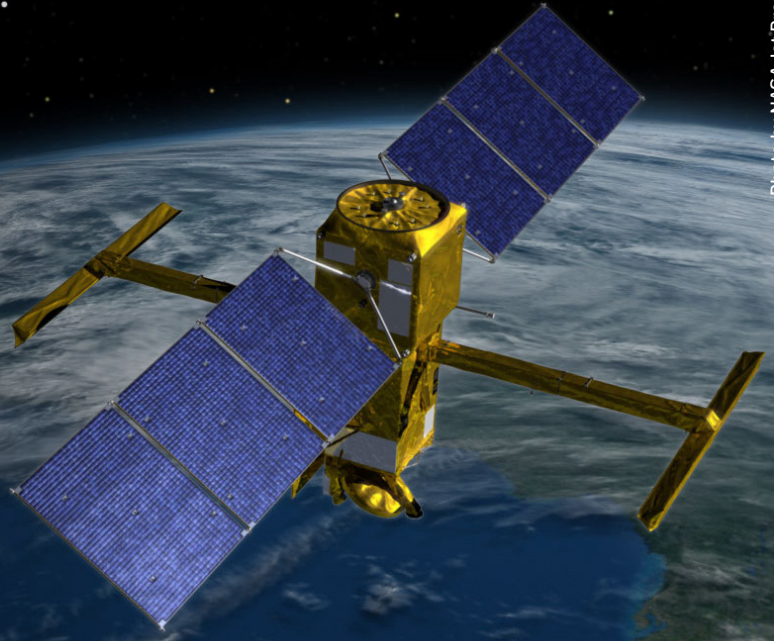
\$3M DOE Award to Build a Carbon Negative Future with Steel and Cross Laminated Timber

With a \$3.1 million award from the Department of Energy's Advanced Research Projects Agency - Energy, **Jerome Hajjar**, CDM Smith Professor and Chair of civil and environmental engineering, will lead a multi-institution team of researchers developing a new carbon sequestration technique using cross-laminated timber composite floor systems in bolted steel construction for building structures. The new method aims to achieve net-zero embodied carbon of buildings constructed using the innovative steel and timber combination system.

First-Ever Global Survey of Earth's Surface Water



Professor **Ed Beighley**, civil and environmental engineering, served as a principal investigator on the Surface Water and Ocean Topography (SWOT) satellite science team and was one of two U.S. SWOT applications scientists. The satellite launched in December 2022, and for the first time simultaneously measures elevations and extents of the Earth's surface waters at high resolution. Beighley is currently a member of the SWOT applications team and is funded by NASA's Jet Propulsion Laboratory and the Consortium of Universities for the Advancement of Hydrologic Science, Inc., working on new methods for integrating SWOT measurements into flood hazard applications for the global insurance industry and developing visualizations of the SWOT mission data.



Northeastern Hosts AEEP Conference in Boston

Phil Larese-Casanova, associate professor, civil and environmental engineering (CEE), and **Amy Mueller**, associate professor of CEE and marine and environmental sciences, were planning committee co-chairs of the AEEP 2023 conference hosted on Northeastern's Boston campus. The conference, with a theme of "Responding Together to Global Challenges," had over 800 attendees.



The Dependencies Between El Niño and River Flow

Research conducted by Professor **Jennifer Dy**, electrical and computer engineering, and College of Engineering Distinguished Professor **Auroop Ganguly**, civil and environmental engineering, on "Explainable Deep Learning for Insights in El Niño and River Flows" was published in *Nature Communications*.



Published Book on Industrial Ecology and Sustainability



Associate Professor **Matthew Eckelman**, civil and environmental engineering, published a book on "Industrial Ecology and Sustainability." It covers the broad spectrum of topics in sustainability science and is designed to fill the gaps at a time of rapid changes in technology and the global environment to develop sustainability situations.

CEE Hosts Funwave-TVD Training Workshop with Attendees from around the World

The Department of Civil and Environmental Engineering (CEE) hosted the FUNWAVE-TVD Training Workshop at Northeastern, alongside partners from The Center for Applied Coastal Research, University of Delaware, and the U.S. Army Engineer and Development Center, bringing attendees to campus from around the globe. FUNWAVE is an open-source community model used as a tool to predict tsunamis, hurricane waves, and more for coastal resilience and sustainability initiatives and programs. **Q. Jim Chen**, professor of CEE and marine and environmental sciences, gave a seminar on predicting hazardous rip currents using FUNWAVE-TVD. Other CEE researchers and students were also actively involved.



Co-Director of Global Resilience Institute

College of Engineering Distinguished Professor **Auroop Ganguly**, civil and environmental engineering, has been selected as co-director of Northeastern's Global Resilience Institute, which is committed to developing and deploying practical and innovative tools, applications, and skills that strengthen the resilience of individuals, communities, infrastructure, systems, networks, and societies.



Photo by Matthew Modono

Elected Member of the National Academy of Engineering



Christine Keville, master's alumna in civil engineering, and founder, president, and chief executive officer of Keville Enterprises, and chair of Northeastern's civil and environmental engineering Industrial Advisory Board, has been elected to the National Academy of Engineering. She was inducted for promoting diversity in the engineering profession through business success, mentoring students and businesses, and leadership of national professional societies.

Learn more about our accomplished faculty



Student Successes

SELECTED HIGHLIGHTS

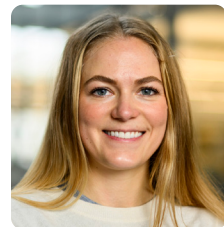


Photo by Matthew Modona

Alumni AI Startup Receives NASA SBIR Phase II Funding

Interdisciplinary engineering alumni **Kate Duffy**, PhD'21, and **Thomas Vandal**, PhD'18, both worked with Civil and Environmental Engineering Professor **Auroop Ganguly** in his Sustainability and Data Sciences Lab while students and then as NASA scientists before creating their new startup, Zeus AI. The company, which received Small Business Innovation Research phase II funding from NASA, uses AI and machine learning to analyze data from satellites to improve weather forecasting.

PhD Student's Research on Impact of Insect Decline Published in *Nature Climate Change*



A paper led by **Kate Duffy**, PhD '21, civil and environmental engineering, and published in *Nature Climate Change*, uses data science to show that, in addition to rising temperatures, fluctuations in temperature will increase the risk of insect extinction in the decades ahead. Insect population collapse could devastate the food chain and sanitation, which depends on insects for cross-pollination and waste disposal.



Udall Undergraduate Scholarship Honorable Mention

Benjamin Lanava, E'24, environmental engineering, received a Udall Undergraduate Scholarship Honorable Mention. Lanava hopes to find sustainable and affordable solutions for

carbon sequestration and provide communities around the world with access to safe, clean drinking water. The Udall Foundation recognizes aspiring sophomores and juniors who advance environmental issues, native health care, and tribal public policy.



Structural Engineers Association of Mass. Scholarship

Baiyu Chen, PhD, civil and environmental engineering, was awarded the Structural Engineers Association of Massachusetts (SEAMASS) scholarship. Chen, who is advised

by Professor and Department Chair Jerome Hajjar, demonstrated exceptional passion and commitment to the field. Chen is developing innovative connection and design equations for steel-CLT hybrid structures. Additionally, she is working on conducting a Life Cycle Analysis of framing plan options, aiming to contribute to sustainable practices in the construction industry.

Student Spotlights

Sarah Sanchez, PhD'23

CIVIL AND ENVIRONMENTAL ENGINEERING

Advised by Matthew Eckelman, Associate Professor of Civil and Environmental Engineering

Sarah Sanchez earned her bachelor's, master's, and doctoral degrees from Northeastern's Department of Civil and Environmental Engineering. As an undergraduate, she studied sustainable cities and systems, designing the environmental infrastructure for a brand-new city of 200,000 in China as a capstone project. As a member of the inaugural class of Northeastern's MS in Engineering and Public Policy program, she focused her research on sustainability in healthcare, leading a study evaluating reusable versus disposable medical supplies and devices that was published in the peer-reviewed journal *Resources Conservation and Recycling*.

Sanchez was awarded the Strategic Advancement of Rising Scholars (STARS) Fellowship funded by the National Science Foundation to continue her research and graduate training through a PhD in civil and environmental engineering. Her main dissertation work lay in building methods and models for lifecycle environmental assessment in direct collaboration with communities of "care professionals," from medical doctors to art conservators. Sanchez's work led to numerous published case studies, exhibits, databases, and a website visited and used by tens of thousands of art conservators around the world. Many of the environmental concerns among care professionals involve chemicals and pollution, and Sanchez also conducted research at community scales on the sources and distribution of hazardous air pollutants in Massachusetts.

In addition to her academic work, Sanchez served on and eventually led the CEE department's Graduate Student Council that advises the department and organizes trainings and events. She has dedicated her academic career to understanding the environmental and health impacts that care communities cause, not from a distance, but deeply embedded within those communities of practice. Sanchez embodies Northeastern's mission of impact-driven research, working to put knowledge into the hands of care professionals and create tools to help "green" their practices.





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