Naomi Zimmerman, Ph.D.

CONTACT

University of British Columbia, Department of Mechanical Engineering
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RESEARCH EXPERIENCE

2018- **University of British Columbia, Department of Mechanical Engineering**
Assistant Professor

2015-17 **Carnegie Mellon University, Center for Atmospheric Particle Studies**
Postdoctoral Research Associate

2011-15 **University of Toronto, Southern Ontario Centre for Atmospheric Aerosol Research**
Graduate Research Associate

EDUCATION

2015 **University of Toronto, Toronto, Canada**
Ph.D., Chemical Engineering and Applied Chemistry

Thesis: "Linking laboratory engine studies to real-world observations: Assessing the air quality impacts of gasoline direct injection engines"
Advisors: Dr. Greg J. Evans, Dr. James S. Wallace

2011 **University of Waterloo, Waterloo, Canada**
B.A.Sc., Chemical Engineering, Co-operative Program, Water Resources Option

Degree Honors: With Distinction, Dean's Honors List
Thesis: "Carbon dioxide capture and sequestration using seawater"
Advisors: Dr. William A. Anderson, Dr. Dale Henneke

HONOURS & AWARDS

2016 Postdoctoral Fellowship, Natural Sciences and Engineering Research Council of Canada (NSERC)
2016 Graduate Student Life Catalyst Award, University of Toronto
2015 Student Discovery Award, University of Toronto
2015 Edward Jarvis Tyrrell Fellowship, University of Toronto
2014 Environment Canada Atmospheric and Meteorological Graduate Supplement
2014 First Place, Graduate Research Seminar Competition, University of Toronto
2013 School of Graduate Studies Conference Grant, University of Toronto
2012 Student Poster Award, American Association for Aerosol Research
2012 Student Travel Grant, American Association for Aerosol Research
2012 Postgraduate Scholarship, NSERC
2011 Alexander Graham Bell Canada Graduate Scholarship, NSERC
2011 Ontario Graduate Scholarship, Ontario Student Assistance Program, *declined*
2011 Mary H. Beatty Fellowship, University of Toronto
2011 Co-operative Education Proficiency Medal, Sandford Fleming Foundation, University of Waterloo
2011 Freeport-McMoRan Copper & Gold Innovation in Sustainability Award, 21st Annual International Environmental Design Competition, New Mexico State University
2010 S.C. Johnson & Son Limited Work Report Award, University of Waterloo

PEER-REVIEWED JOURNAL ARTICLES

2018 P.K. Saha, E.S. Robinson, R.U. Shah, **N. Zimmerman**, J.S. Apte, A.L. Robinson, A.A. Presto "Reduced Ultrafine Particle Concentration in Urban Air: Changes in Nucleation and Anthropogenic Emissions". *Environ. Sci. Technol.*, in press.

2018 J.M. Wang, C.H. Jeong, **N. Zimmerman**, R. M. Healy, G.J. Evans "Real World Vehicle Fleet Emission Factors: Seasonal and Diurnal Trends in Traffic Related Air Pollutants". *Atmos. Environ.*, 184, 77-86.

2018 C. L. Maikawa, **N. Zimmerman**, M. Ramos, M. Shah, J. S. Wallace, K. J. Godri Pollitt, "Comparison of airway responses induced in a mouse model by the gas and particulate fractions of gasoline direct injection engine exhaust". *Int. J. Environ. Res. Public Health*, 15 93), 429.

2018 **N. Zimmerman**, A.A. Presto, S.P.N. Kumar, J. Gu, A. Hauryliuk, E.S. Robinson, A.L. Robinson, R. Subramanian "A machine learning calibration model using random forests to improve sensor performance for lower-cost air quality monitoring". *Atmos. Meas. Tech.*, 11, 291-313.

2017 J.M. Wang, C.-H. Jeong, **N. Zimmerman**, R. Healy, N. Hilker, G.J. Evans, "Real-World Emission of Particles from Vehicles: Volatility and the Effects of Ambient Temperature". *Environ. Sci. Technol.*, 51 (7), 4081-4090.

2016 **N. Zimmerman**, J. M. Wang, C.-H. Jeong, J.S. Wallace, G.J. Evans, "Assessing the climate trade-offs of gasoline direct injection engines". *Environ. Sci. Technol.*, 50 (15) 8385-8392.

2016 C. L. Maikawa, **N. Zimmerman**, K. Rais, M. Shah, B. Hawley, P. Pant, C.-H. Jeong, J.M. Delgado-Saborit, J. Volkens, G.J. Evans, J.S. Wallace, K.J. Godri Pollitt, "Murine precision-cut lung slices exhibit acute responses following exposure to gasoline direct injection engine emissions". *Sci. Total Environ.*, 568, 1102-1109.

2016 **N. Zimmerman**, J.M. Wang, C.-H. Jeong, N. Hilker, R.M. Healy, K. Sabaliauskas, J.S. Wallace, G.J. Evans, "Field measurement of gasoline direct injection emission factors: spatial and seasonal variability". *Environ. Sci. Technol.*, 50 (4), 2035-2043.

2015 R.M. Healy, J.M. Wang, C.-H. Jeong, A.K.Y. Lee, M.D. Willis, E. Jaroudi, **N. Zimmerman**, N. Hilker, M. Murphy, S. Eckhardt, A. Stohl, J.P.D. Abbatt, J.C. Wenger, G.J. Evans, "Light-absorbing properties of ambient black carbon and brown carbon from fossil fuel and biomass burning sources", *J. Geophys. Res. Atmos.* 120, 6619-6633.

2015 J.M. Wang, C.-H. Jeong, **N. Zimmerman**, R. Healy, D.K. Wang, F. Ku, G.J. Evans, "Plume-based analysis of vehicle fleet air pollutant emissions and the contribution of high emitters", *Atmos. Meas. Tech.*, 8, 3263-3275.

2015 **N. Zimmerman**, C.-H. Jeong, J.M. Wang, M. Ramos, J.S. Wallace, G.J. Evans, "A source-independent empirical correction procedure for the fast mobility and engine exhaust particle sizers", *Atmos. Environ.*, 100, 178-184.

2014 **N. Zimmerman**, K.J. Godri Pollitt, C.-H. Jeong, J.M. Wang, T. Jung, J.M. Cooper, J.S. Wallace, G.J. Evans, "Comparison of three nanoparticle sizing instruments: the influence of particle morphology", *Atmos. Environ.*, 86, 140-147.

2010 W.S. Epling, A. Yezerets, N. Currier, H.S. Hess, H.-Y. Chen, A. Russell, M. Venkov, **N. Zimmerman**, "Spatially-Resolved Thermal Degradation Induced Temperature Pattern Changes along a Commercial Lean NO_x Trap Catalyst", *SAE Int. J. Fuels Lubr.*, 3, 723-732.

IN PREPARATION

N. Zimmerman, P. Pant, C.-H. Jeong, J.M. Delgado-Saborit, J.S. Wallace, G.J. Evans, J.R. Brook, K. J. Pollitt, "Carbonaceous aerosol sampling of gasoline direct injection engine exhaust with an integrated organic gas and particle sampler". In preparation for Science of the Total Environment.

N. Zimmerman, M. Omara, X. Li, A.A. Ellis, M. Sullivan, R. Subramanian, A.A. Presto, A.L. Robinson "Drive-by analysis as an effective surveying tool for quantifying fugitive methane from natural gas production". In preparation for Atmospheric Measurement Techniques

N. Zimmerman, H.Z. Li, A.A. Ellis, A. Hauryliuk, E.S. Robinson, P. Gu, R. Shah, Q. Ye, L. Snell, R. Subramanian, A.L. Robinson, J.S. Apte, A.A. Presto "Integrating Spatiotemporal Variability and Modifiable Factors into Air Pollution Estimates: The Center for Air, Climate, and Energy Solutions Air Quality Observatory". In preparation for Atmospheric Environment.

H.Z. Li, P. Gu, Q. Ye, **N. Zimmerman**, E.S. Robinson, R. Subramanian, J.S. Apte, A.L. Robinson, A. A Presto, "Comparison of spatial and temporal variation of airborne pollutants using mobile and distributed sampling". In preparation for Atmospheric Environment.

M. Omara, **N. Zimmerman**, M. R. Sullivan, X. Li, A.A. Ellis, R. Cesa, R. Subramanian, A.A. Presto, A.L. Robinson, "Marginally economic wells dominate methane emissions from U.S. natural gas production". In preparation for Nature Communications.

C. Malings, R. Tanzer, A. Hauryliuk, S.P.N. Kumar, **N. Zimmerman**, L.B. Kara, A.A. Presto, R. Subramanian, "Development of a General Calibration Model and Long-Term Performance Evaluation of Low-Cost Sensors for Gas Monitoring with RAMPs". In preparation for Atmospheric Measurement Techniques.

A.A. Presto, **N. Zimmerman**, A. L. Robinson, R. Subramanian. "Applicability of low-cost sensors for compliance monitoring". In preparation for Environmental Science & Technology.

SELECT CONFERENCE PLATFORM PRESENTATIONS

2017 **N. Zimmerman**, H. Z. Li, E.S. Robinson, A.E. Ellis, R. Subramanian, A.L. Robinson, J.S. Apte, A.A. Presto, "Characterizing Intra-Urban Air Pollution Gradients with a Spatially-Distributed Network of Lower Cost Sensors". American Association for Aerosol Research 36th Annual Conference, Raleigh, NC.

2017 **N. Zimmerman**, A.A. Presto, S. Kumar, J. Gu, E.S. Robinson, A.L. Robinson, R. Subramanian, "Improved Community Air Quality Monitoring Networks: Achieving Sensitivity to Pollutant Gradients Using Lower-Cost Sensors and Machine Learning". International Society of Exposure Science 27th Annual Meeting, Research Triangle Park, NC.

2017 **N. Zimmerman,** E.S. Robinson, H.Z. Li, A.E. Ellis, R. Subramanian, A.L. Robinson, J.S. Apte, A.A. Presto, "Characterizing intra-urban air quality gradients with a spatially-distributed network". Air & Waste Management Association's 110th Annual Conference and Exhibition, Pittsburgh, PA.

2016 **N. Zimmerman**, P. Pant, C.-H. Jeong, J.M. Delgado-Saborit, J.S. Wallace, G.J. Evans, J.R. Brook, K. J. Pollitt, "Phase-partitioned PAHs in Gasoline Direct Injection Engine Exhaust Sampled with an Integrated Organic Gas and Particle Sampler." American Association for Aerosol Research 35th Annual Conference, Portland, OR.

2014 **N. Zimmerman**, J.M. Wang, C.-H. Jeong, N. Hilker, K. Sabaliauskas, R.M. Healy, G.J. Evans, "Assessing the impact of driving pattern on real-world emission factor variability using a gasoline direct injection light-duty passenger vehicle". American Association for Aerosol Research 33rd Annual Conference, Orlando, FL.

2014 **N. Zimmerman**, J.M. Wang, C.-H. Jeong, N. Hilker, K. Sabaliauskas, R.M. Healy, G.J. Evans, "Measuring real-world emission factor variability in urban and remote environments

using a gasoline direct injection light-duty passenger vehicle". North Country Aerosol Summer Conference, Clarkson University.

2013 **N. Zimmerman**, K.J. Godri Pollitt, C.-H. Jeong, T. Jung, J.M. Cooper, J.S. Wallace, G.J. Evans, "Accurate measurement of particle size and number concentration for meeting regulatory Limits on vehicle emissions: Inter-comparison of three particle sizing instruments". American Association for Aerosol Research 32nd Annual Conference, Portland, OR.

Select Conference Poster Presentations

2016 **N. Zimmerman**, A. Ellis, M. Schurman, R. Subramanian, A.L. Robinson, J.S. Apte, A.A. Presto, "Characterizing intra-urban air quality gradients with a spatially-distributed network in Pittsburgh, Pennsylvania." American Geophysical Union Fall Meeting, San Francisco, CA.

2016 **N. Zimmerman**, E. Lipsky, R. Subramanian, A.L. Robinson, A.A. Presto, "Assessment of Compact, Real-time PM2.5 and Ultrafine Particle Counting Instrumentation with a Spatially-distributed Network in Pittsburgh, Pennsylvania." American Association for Aerosol Research 35th Annual Conference, Portland, OR.

2015 **N. Zimmerman**, J.M. Wang, C.-H. Jeong, N. Hilker, K. Sabaliauskas, R.M. Healy, G.J. Evans, "Field measurement of gasoline direct injection particle number emission factors: spatial and temporal variability in particle size and concentration". 11th International Conference on Carbonaceous Particles in the Atmosphere, Berkeley, CA.

2014 **N. Zimmerman**, M. Ramos, C.-H. Jeong, K.J. Godri Pollitt, J.S. Wallace, G.J. Evans, "Physicochemical assessment of conventional and ethanol blended exhaust emissions from a light-duty gasoline direct injection (GDI) engine". American Association for Aerosol Research 33rd Annual Conference, Orlando, FL.

2012 **N. Zimmerman**, K.J. Godri, C.-H. Jeong, T. Jung, J.M. Cooper, J.S. Wallace, G.J. Evans, "Physicochemical assessment of biodiesel vehicle fuel exhaust emissions and the effect of new emission control devices: The EMITTED study". American Association for Aerosol Research 31st Annual Conference, Minneapolis, MN.

Teaching Experience

The University of British Columbia

2018 Instructor, Engineering Economics (MECH 431)

- Discounted cash flows. Sources of funds, cost of capital. Effects of depreciation, taxes, inflation. Evaluation and comparison of economic models for engineering projects. Replacement decisions. Public project analysis. Risk analysis. Project control, inventory analysis, simulation.
- Lectures to class of 80-120 students

Carnegie Mellon University

2016 Undergraduate student supervisor

- Supervisor of four undergraduate students in Mechanical Engineering and Environmental Science
- Provided supporting letters and materials for a successful Summer Undergraduate Research Fellowship application

University of Toronto

2015 Co-Instructor, Environmental Chemistry (CHE 230)

- Prepared and delivered four weeks of lectures to a class of approximately 150.
- Lectured on the topics of heavy metal speciation in water and atmospheric kinetics.
- Instruction of leadership and team skills within a design project.
- Evaluation: Overall: 3.8/5.0, Creating an environment conducive to learning: 4.0/5.0

2015	Prospective Professors in Training (PPIT) Certificate Program ▪ Participated in a seminar series on being an effective academic. ▪ Coursework: Engineering Teaching and Learning (APS1203).
2014-15	Teaching Assistant, Scientific Writing for Graduate Students
2013-15	Teaching Assistant, Assessing Global Change: Science and the Environment (ENV200)
2012-14	Teaching Assistant, Environmental Chemistry (CHE230)
2012-14	Teaching Assistant, Process Design (CHE324)
2012	Summer internship supervisor
2012	Teaching Assistant, Applied Chemistry Laboratory (CHE204)

Industry Experience

2010	**Blackberry Inc., Materials Interconnect Laboratory, Waterloo, ON** Research Associate (Co-op Student)
2009	**University of Waterloo, Air Pollution Laboratory, Waterloo, ON** NSERC Undergraduate Research Assistant to Prof. Bill Epling (Co-op student)
2008-09	**Newterra Ltd., Toronto, ON** Research Analyst (Co-op Student)
2007	**Xerox Research Centre of Canada, Scale-up Engineering, Mississauga, ON** Composite Materials and Process Engineering (Co-op Student)
2007	**Nemak Canada, Windsor Aluminum Plant, Windsor, ON** Environmental Engineering (Co-op Student)

Invited Seminars and Conference Talks

2017	**Diverse Voices in Climate Change Innovation**, Panelist: "Climate Change at Work: Perspectives from leaders in their field", The Consulate General of Canada & Perkins Coie, Seattle, WA.
2017	**100th Canadian Chemistry Conference and Exhibition**, Special Symposia: "Atmospheric Chemistry in a Changing Climate", Canadian Society for Chemistry, "Regional differences in methane emissions from oil and gas production sites in three US basins"
2017	**The University of British Columbia**, Department of Mechanical Engineering, "In search of fresh air: Characterizing the sources and impacts of urban air pollution"
2016	**Carleton University**, Department of Civil & Environmental Engineering, "In search of fresh air: Characterizing the sources and impacts of urban air pollution"
2015	**University of Toronto**, Sigma Xi Distinguished Lecture Series, University of Toronto Chapter, "Vehicle emissions regulations: are we chasing our own tailpipes?"
2015	**Carnegie Mellon University**, Center for Atmospheric Particle Studies (CAPS) "From Cylinder to City: Linking controlled engine studies to real-world measurements of exhaust pollutants"

MEDIA INTERVIEWS & PRESS COVERAGE

2017 **90.5 WESA**, Web and Radio Story: "Why the EPA Wants Data from Pittsburgh Rooftops", Interview with Liz Reid, February 6th, 2017

2016 **Scientific American**, 60-Second Science Podcast: "Fuel-Efficient Engines Have A Sooty Flaw", Interview with Christopher Intagliata, July 16th, 2016

2016 **NPR Science Friday**, Segment: "A Climate Tradeoff for Fuel-Efficient Engines?", Interview with Ira Flatow, July 15th, 2016

2016 **Chemical & Engineering News (C&EN)**, Story: "Fuel efficiency alone does not bring climate benefits for eco-engines" Interview with Melissae Fellet, July 15th, 2016

2016 **University of Toronto News**, Story: "Think a more fuel-efficient engine is the green choice? Not so fast, U of T engineers say" Interview with Marit Mitchell, July 13th, 2016

2016 **The Daily Mail**, Story "Not so green after all! Fuel efficient cars may be churning out MORE pollutants than previously thought", July 13th, 2016

2016 **American Chemical Society Press Release**, "Could more fuel-efficient engines lead to more global warming?" July 13th, 2016

2016 **The Allegheny Front**, Web and Radio Story: "The Hunt for Methane Leaks Goes High-Tech", Interview with Reid Frazier, July 8th, 2016

SERVICE

Reviewer for: Aerosol Science and Technology, Environmental Science & Technology, Environmental Science & Technology Letters, Atmospheric Environment, Process Safety and Environmental Protection, Atmospheric Measurement Techniques

Combustion working group Vice Chair, American Association for Aerosol Research

PROFESSIONAL AFFILIATIONS

American Association for Aerosol Research

Society of Automotive Engineers

American Geophysical Union