Forrest G. Lacey, PhD

CONTACT INFORMATION

National Center for Atmospheric Research
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RESEARCH INTERESTS

Use of computational models to advance the understanding of how aerosols and other short-lived species impact climate and human health

EDUCATION

University of Colorado, Boulder, Colorado USA
Ph.D., Mechanical Engineering, August 2016
Advisor: Dr. Daven Henze

- Dissertation Topic: "Constraining climate and health impacts of atmospheric aerosols using adjoint modeling."

Kettering University, Flint, Michigan USA
B.S., Mechanical Engineering, December 2006

- Undergraduate Thesis: "Design and development of a hydraulically damped torsional coupler for small engine transmission applications."

PROFESSIONAL EXPERIENCE

National Center for Atmospheric Research (NCAR), Boulder, Colorado USA

ASP Postdoctoral Fellow **August, 2018 - Present**

Use of both the NCAR CESM (CAM-chem) and the GEOS-Chem adjoint model to explore changes in ambient air quality at exposure relevant scales ($\approx$ 12 km) due to shifts in anthropogenic activity. Primary roles include model development of both a regionally refined model and coupling GEOS-Chem into the CESM framework.

University of Colorado / NCAR, Boulder, Colorado USA

Postdoctoral Researcher **August, 2016 - August, 2018**

Lead modeler for NCAR CESM simulations in support of NASA ATom flight campaign. Also developed and ran simulations in a framework to estimate future changes in emissions and the resulting ambient air quality in Africa that utilizes statistical trends in socioeconomic indicators.

University of Colorado, Boulder, Colorado USA

Adjunct Professor **Fall 2017 and Fall 2018**

Instructor of record for Engineering Statics (MCEN-2023); this is a three credit-hour course and I was responsible for lecturing, office hours, homework and exams for this sophomore level class of $\approx$80 students. Quantitive metrics from student submitted Faculty Course Questionnaire are available at the following website:

`https://public.tableau.com/profile/fcq.office#!/vizhome/FCQ/Boulder`

BorgWarner Morse TEC, Ithaca, New York USA

Product Application Engineer **January, 2007 - July, 2011**

Design and bid responsible for multiple Variable Camshaft Timing system applications for OEMs. Developed and performed DVP&R, DFMEA and PFMEA steps for production programs. Product responsibility for Asian OEM with peak volumes 1.2 mln units per year, including but not limited to pre-production simulation, patent defense, test data analysis, customer interactions, and mfg. engineering assistance. Autonomous role with customer and supplier visits with multiple trips to Japan, China, and Korea.

PUBLICATIONS

(8) Diao, M., Holloway, T., Choi, S., O'Neill, S., Al-Hamdan, M., van Donkelaar, A., Martin, R., Jin, X., Fiore, A., Henze, D., **Lacey**, **F**., Kinney, P., Freedman, F., Larkin, N., Zou, Y., Vaidyanathan, A. Methods, availability, and applications of $PM_{2.5}$ exposure estimates derived from ground measurements, satellite, and atmospheric models. (*in prep*). 2018

(7) Pfotenhauer, D., Coffey, E., Piedrahita, R., Agao, D., Alirigia, R., Muvandimwe, D., **Lacey, F.**, Wiedinmyer, C., Dickinson, K., Dalaba, M., Kanyomse, E., Oduro, A., Hannigan, M. Updated emission factors from diffuse combustion sources in sub-Saharan Africa and their effect on regional emission estimates. Envir. Sci. and Tech (*under review*). 2018

(7) Diao, M., Holloway, T., Choi, S., O'Neill, S., Al-Hamdan, M., van Donkelaar, A., Martin, R., Jin, X., Fiore, A., Henze, D., **Lacey, F.**, Kinney, P., Freedman, F., Larkin, N., Zou, Y., Vaidyanathan, A. Methods, availability, and applications of $PM_{2.5}$ exposure estimates derived from ground measurements, satellite, and atmospheric models. (*in prep*). 2018

(6) Archer-Nicholls, S., Lowe, D., **Lacey, F.**, Kumar, R., Xiao, Q., Liu, Y., Carter, E., Baumgartner, J., and C. Wiedinmyer. (2019) Radiative Effects of Residential Sector Emissions in China: Sensitivity to Uncertainty in Black Carbon Emissions. J. Geophys. Res. Atmos (*accepted*).

(5) **Lacey, F.**, Henze, D. K., Lee, C., van Donkelaar, A., and Martin, R. (2017) Transient climate and ambient health impacts due to national solid fuel cookstove emissions. Proc. Nat. Acad. Sci. 114, 1269-1274, doi:10.1073/pnas.1612430114

(4) Anenberg, S. C., J. Miller, R. Minjares, Li Du, D. K. Henze, **F.Lacey**, C. S. Malley, et al. (2017) Impacts and Mitigation of Excess Diesel-Related NO_X Emissions in 11 Major Vehicle Markets. Nature 545, 467-471. doi-10.1038/nature22086.

(3) **Lacey, F.**, Marais, E. A., Henze, D. K., Lee, C. J., van Donkelaar, A., Martin, R V., Hannigan, M. P., and Wiedinmyer, C. (2017) Improving present day and future estimates of anthropogenic sectoral emissions and the resulting air quality impacts in Africa. Faraday Discuss. 2017, 200, 397, doi:10.1039/C7FD00011A

(2) Anenberg S., Henze D. K., **Lacey, F.**, Irfan, A., Kinney, P., Kleiman, G., and Pillarisetti, P. (2017) Air pollution-related health and climate benefits of clean cookstove programs in Mozambique. Environ. Res. Lettt. (12) 020056, doi:10.1088/1748-9326/aa5557

(1) **Lacey, F.**, and Henze, D. K.. 2015. Global climate impacts of country-level primary carbonaceous aerosol from solid-fuel cookstove emissions. Environ. Res. Lett. 10 (11): 114003. doi:10.1088/1748-9326/10/11/114003.

Conference Oral Presentations

Lacey, F., Schwantes, R., Tilmes, S., Zarzyki, C., Emmons, L., Marsh, D., Walters, S., Pfister, G., Lauritzen, P. (2018) Reaching Exposure-Relevant Scales: The Implementation of Full Chemistry into Regionally Refined CAM-chem. CESM Chemistry-Climate Working Group Meeting, Boulder, Colorado, February, 2019.

(Invited Keynote) **Lacey, F.**, Tilmes, S., Marais, E. A., Wiedinmyer, C., Coffey, E., Mesenbring, E.,Pfotenhauer, D., Henze, D. K., Hannigan, M. P. (2018) Ambient air quality modeling in Africa: Present day and future mitigation strategies. 1st National Workshop on Air Quality, Centre for Atmospheric Research, National Space Research and Development Agency, Federal Ministry of Science and Technology, Anyigba, Nigeria. March, 2018.

Lacey, F., Tilmes, S., Lamarque, J-F., Hornbrook, R., Apel, E., Wiedinmyer, C. (2018) Impacts of anthropogenic and biomass burning emissions on CAM-Chem model bias. CESM Chemistry-Climate Working Group Meeting, Boulder, Colorado, February, 2018.

Lacey, F., Marais, E. A., Wiedinmyer, C., Coffey, E., Mesenbring, E.,Pfotenhauer, D., Hannigan, M. P., Henze, D. K., Evans, M., Davila, Y., Morris, E. (2017) Future shifts in African air quality and the resulting impacts on human health and climate: Design of efficient mitigation strategies. American Geophysical Union, Fall Meeting 2017, New Orleans, Louisiana, December, 2017.

Lacey, F., Marais, E. A., Henze, D. K., Lee, C. J., van Donkelaar, A., Martin, R V., Hannigan, M. P., and Wiedinmyer, C. (2017) Improving present day and future estimates of anthropogenic

sectoral emissions and the resulting air quality impacts in Africa. Faraday Discuss. May, 2017, 200, 397, doi:10.1039/C7FD00011A

Lacey, F., Henze, D. K., Martin, R., Lee, C., van Donkelaar, A., and Reed, L. (2015) Climate and health impacts of the shift from traditional solid cookstove fuels to modern energy sources. American Geophysical Union, Fall Meeting 2015, San Francisco, California, December, 2015.

Lacey, F., and Henze, D. K. (2015) Evaluation the health and climate impacts of cookstove emissions using the GEOS-Chem adjoint model. The 7th International GEOS-Chem Meeting, Harvard University, Cambridge, Massachusetts, May, 2015.

Lacey, F., and Henze, D. K.. (2014). Balancing health and climate impacts of aerosols in a changing world using GEOS-Chem adjoint sensitivities. 33rd Annual Conference: American Association for Aerosol Research, Orlando, Florida, October, 2014.

Poster Presentations

Lacey, F., et al. (2018) How well do model emissions represent the remote atmosphere? Using ATom observations to compare biomass burning in CAM-Chem. ATom Science Team Meeting, Boulder, Colorado, 2018.

Lacey, F., et al. (2017) Projecting ambient air quality in Africa: Anthropogenic-driven shifts in ozone and aerosol formation. Gordon Research Conference: Atmospheric Chemistry, Newry, Maine, 2017.

Lacey, F., et al. (2017) Arctic temperature impacts from regional and national home heating emissions. Stoves Summit: Addressing Black Carbon and Other Emissions from Stoves Globally, Warsaw, Poland, 2017.

Lacey, F., et al. (2017) Adjoint analysis of present and future ECLIPSE emissions climate and health impacts for provinces in China. The 8th International GEOS-Chem Meeting, Harvard University, Cambridge, Massachusetts, 2017.

Lacey, F., et al. (2016) Health and climate impacts in and from G-20 countries using realistic diesel emissions under present and future standards. International Global Atmospheric Chemistry (IGAC) Project Science Conference, Breckenridge, Colorado, 2016.

Lacey, F., et al. (2013) Investigation into future radiative forcing sensitivities using GEOS-Chem and its adjoint based on RCPs. The 6th International GEOS-Chem Meeting, Harvard University, Cambridge, Massachusetts, 2013 and Chemistry-Climate Modeling Initiative Science Workshop, Boulder, Colorado, 2013.

Invited Seminars

Linking science and policy: Using models to understand ambient air quality impacts on climate and human health. Atmospheric and Oceanic Sciences, University of Wisconsin-Madison, Madison, Wisconsin, October 25, 2018.

Future shifts in African air quality and the resulting impacts on human health and climate: Design of efficient mitigation strategies. Energy and Environment Seminar, Colorado State University, Fort Collins, Colorado, February 15, 2018.

Policy-based approach of using of adjoint models to understand the impacts of anthropogenic activity on climate and human health. Earth and Atmospheric Sciences Seminar, Cornell University, Ithaca, New York, February 16, 2017.

Policy-based approach of using of adjoint models to understand the impacts of anthropogenic activity on climate and human health. School of Mathematical Sciences, Rochester Institute of Technology, Ithaca, New York, January 31, 2017.

Constraining climate and health impacts of atmospheric aerosols using adjoint modeling. Chemical Sciences and Global Systems Seminar, National Oceanic and Atmospheric Administration, Boulder, Colorado, November 6, 2015.

Academic Experience

University of Colorado, Boulder, Colorado USA

Adjunct Professor **Fall 2017 and Fall 2018**

Instructor of record for Engineering Statics (MCEN-2023); this is a three credit-hour course and I was responsible for lecturing, office hours, homework and exams for this sophomore level class of ≈80 students. Quantitive metrics from student submitted Faculty Course Questionnaire are available at the following website:

`https://public.tableau.com/profile/fcq.office#!/vizhome/FCQ/Boulder`

Graduate Research Assistant **August, 2011 - August 2016**

Developed and used the GEOS-Chem adjoint model to estimate climate and health impacts from sector specific anthropogenic emissions. Developed models to estimate the surface temperature impacts of spatially variable global emissions. Responsibilities included fully understanding the parameterizations used in chemical transport models and developing methods to quantify or limit the uncertainties which they have on various model outputs representing climate and health impacts.

Teaching Assistant **Fall 2011 and Fall 2013**

Taught recitation, held office hours, and taught selected lectures for various classes. Shared responsibility for grading and evaluating exams and homework assignments.

- MCEN 2023-3: Statics & Structures, Fall 2013.
- MCEN 4026-3: Manufacturing Processes & Systems, Fall 2011.

Service Experience

National Center for Atmospheric Research *2019* Lead organizer for the Frontiers of Atmospheric Science and Chemistry: Integration of Novel Applications and Technological Endeavors (FASCINATE) conference

National Center for Atmospheric Research *2019* Thompson Lecture Series committee member and invitee host

National Center for Atmospheric Research *2018* Chemistry Modeling Workshop organizer and student mentor

National Center for Atmospheric Research *2018* Employee search early career liason

University of Colorado Boulder *2015* Faculty search committee graduate student liason

Awards and Honors

National Center for Atmospheric Research Advanced Study Program Postdoctoral Fellowship

National Center for Atmospheric Research Strategic Capability Program 2018 Project Awardee (11.3 mln CPU hours)

Technical Skills

- ◇ **Proposals and bidding:** Have worked on and developed a number of different proposals for governmental and non-governmental organizations. NCAR Strategic Capability awardee for 2018.
- ◇ **Peer-reviewed research:** Have acted as a reviewer for multiple journals, including, but not limited to; Environmental Research Letters, Environmental Science and Technology, Atmospheric Environment, and others.
- ◇ **Testing and data analysis:** Competent in a number of statistical methods used to both collect and filter data and identify trends and performance anomalies. Also familiar with multiple levels of satellite data products and the methods used for their analysis.
- ◇ **Disseminating results:** Proficient at leading meetings and presenting to a variety of audiences; from international conferences, to stakeholder meetings, to internal multidisciplinary discussions.
- ◇ **Product design and validation:** Well-versed in GD&T requirements and notation for machined components meant to perform with clearances in the micron scale. Comfortable working machinists, suppliers, and production to meet required specifications.
- ◇ **Software:** Matlab, IDL, NCL, R, Python, UNIX, Unigraphics NX, ANSYS, high-performance computing interfaces